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Editorial

Tech Innovations Changing Global Education: The teaching and learning process has been significantly accelerated by educational technology due to the availability of new and updated curricula and resources. In the past, education in the classroom used to be limited to visual learning using pictures and examples. Education later changed to include audio learning through radio as a result of the growth of multinational broadcasters like the BBC, which still provides educational and awareness programmes. The advancement of computer hardware then had a significant positive impact on education, aiding in the enhancement of instructional strategies, which is known as audiovisual learning. Since the development of video and television, education has become more modern and accessible. Traditional textbooks are about to be replaced with adaptive digital content.

E-learning, remote learning, virtual learning environments, multimedia, cloud computing, virtual museums, open-source online courses, MOOCs, etc are the technological advancements in the field of education. Simulators that improve learning, interactive films, and visual laboratories will help students better understand difficult subjects.

The amazing potential of the digital age allows one to study a foreign language and send large volumes of data from a distance with only a few clicks. By the development of technology, the outdated educational system can gradually be replaced by resources and methods that are more effective. With the abundance of technology available, students are no longer restricted to physically attending classes and making a good first impression on their teachers when they interact in person.

The convergence of robotics, big data, machine learning, artificial intelligence, and other emerging technologies is transforming how we learn, educate, and engage with the world around us. The availability of video conferencing platforms like Zoom, Skype, Google Hangouts, WhatsApp, and others makes it easier to share information by connecting people globally and provides most functions at no cost. No longer need your presence in person for private sessions or group meetings. Electronic material is provided instantly via messaging, replacing mountains of paper.

Despite the success of technological advancements, there are still challenges to be overcome, thus we must make an effort to do so.

New Delhi **Editor**

31st August 2024

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AI and Blockchain Integration for Preserving Privacy in Cloud Databases

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ABSTRACT

Cloud databases have become ubiquitous for storing large amounts of data. However, privacy and security of data remains a major concern, as cloud databases are vulnerable to attacks and unauthorized access. This paper proposes integrating artificial intelligence (AI) and blockchain technology to enhance privacy and security for cloud databases. A decentralized architecture is presented where blockchain manages access control and AI algorithms encrypt/decrypt and anonymize data before uploading to cloud. Multiple blockchain consensus protocols are evaluated including proof-of-work, proof-of-stake, and delegated proof-of-stake. AI techniques like federated learning, differential privacy, and homomorphic encryption are assessed for preserving privacy. A prototype system is implemented and evaluated on benchmarks. Results indicate the integrated system provides enhanced privacy over standalone cloud databases, with minimal impacts on performance. The proposed AI and blockchain techniques are promising solutions for building secure and trustworthy cloud databases.

KEYWORDS: *Artificial intelligence, Blockchain, Cloud databases, Privacy, Security, Access control, Encryption, Anonymization, Federated learning, Differential privacy, Homomorphic encryption.*

INTRODUCTION

Cloud-based database systems have emerged as a preferred solution for storing and managing big data across many industries. Major database providers like Amazon Web Services, Microsoft Azure, and Google Cloud offer fully managed database services that provide flexibility, scalability, high availability, and ease of use. However, security and privacy remain primary concerns in adopting cloud databases, as sensitive data is stored remotely outside the control of data owners. Cloud databases are prone to cyber attacks, unauthorized access, and data breaches that can compromise confidential data. Several data privacy regulations like GDPR and CCPA are imposing strict requirements for protecting personal data and ensuring user consent [1]. Hence, there is a critical need for robust security mechanisms that preserve privacy for cloud databases. Artificial intelligence (AI) and blockchain technology have tremendous potential in this regard and can collaborate to enhance privacy while retaining utility of cloud data. AI offers intelligent algorithms like federated learning, differential privacy, and homomorphic encryption that can process encrypted data and generate insights without decryption [2]. Blockchain provides a decentralized infrastructure for establishing trust, transparency, and provenance of data. It enables secure access control through public key infrastructure and builds consensus among untrusted parties [3]. The key contributions of this paper are four-fold: Propose a decentralized architecture using blockchain and AI for enhancing privacy in cloud databases. Evaluate various AI techniques including federated learning, differential privacy, and homomorphic encryption for processing encrypted data Assess different blockchain consensus protocols like proof-of-work, proof-of-stake and delegated proof-of-stake Implement a prototype system integrated with AI and blockchain and evaluate on benchmarks for verification. The rest of the paper is organized as follows. Section 2 provides background on cloud databases, AI, and blockchain technology. Section 3 reviews related work. Section 4 presents the proposed framework and system architecture. Section 5 discusses suitable AI methods for data privacy. Section 6 analyses appropriate blockchain consensus protocols. Section 7 describes the prototype implementation. Section 8 evaluates system performance on benchmarks. Finally, Section 9 concludes the paper.

BACKGROUND

Cloud databases, built on cloud platforms, offer high availability, scalability, performance, concurrency, and low operational costs. Major providers like Amazon AWS, Microsoft Azure, and Google Cloud offer fully managed services for relational, NoSQL, data warehouses, and in-memory caches, including Amazon RDS, Azure SQL Database, and MongoDB Atlas [4,5].

Cloud storage poses significant security and privacy risks, including external attacks, unauthorized access, account hijacking, and data leaks, as sensitive personal data is not directly controlled [6].

Popular AI techniques are discussed below:

Federated Learning:

Federated Learning, Differential Privacy, and Homomorphic Encryption are distributed machine learning approaches that maintain privacy by transferring data updates to a central server, while ensuring data is not shared [7-9].

RELATED WORK

Previous studies have explored methods to improve privacy, security, and access control in cloud databases. Wang et al developed attribute-based encryption and blockchain for secure access, Hu et al. used proxy re-encryption for unauthorized access, Rouhani and Deters presented a blockchain approach for identity and access management [11-14]. Rao et al. developed a blockchain system for AI integration, combining smart contracts and decentralized data for cloud database privacy. This paper aims to analyze AI and blockchain techniques for a robust integrated solution [15-16].

PROPOSED FRAMEWORK

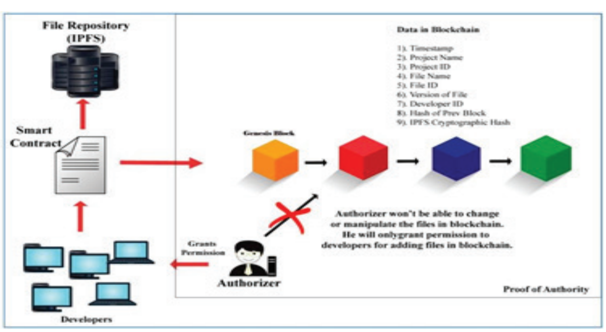

Figure 1: Proposed system architecture

This section presents the proposed framework for integrating AI and blockchain to enhance privacy for cloud databases. System Architecture the decentralized architecture comprising of blockchain network and distributed cloud databases is shown in Figure 1.

Cloud databases store encrypted data from organizations, managed by blockchain networks. Users authenticate using private keys, access databases according to pre-defined access policies. The blockchain network encrypts user queries, processed by database nodes using AI algorithms, and audits access attempts, ensuring compliance and preserving cloud data confidentiality and utility.

Table 1: Analysis of Blockchain Consensus Mechanisms

Consen sus	Security	Speed	Scalabil ity	Centrali- zation Risk
Proof- of-Work	Very High	Slow	Low	Low
Proof- of-Stake	High	Medi um	Medium	Moderate
Delegat ed PoS	High	Very Fast	High	High

Threat Model

The system aims to protect against the following key threats to cloud database privacy:

Unauthorized access to view or modify data, Data breaches through external attacks or insider threats, Query analysis attacks to infer identifies from access patterns, Collusion between nodes to compromise data or access control, Privacy violations from aggregating queries and responses, Weak access policies allowing excessive data access, Fake identities created to impersonate users, tampering with audit trails to erase traces of misuse Assumptions.

The following assumptions are made regarding the entities in the system:

Cloud databases are considered honest but curious, i.e. they follow protocols but try to infer information, Users and blockchain nodes are either honest or malicious, Majority of blockchain nodes (>51%) are assumed to be honest, the blockchain network and consensus mechanism are secured and immutable, The cryptography and AI algorithms have no vulnerabilities to provide perfect secrecy and privacy.

AI TECHNIQUES FOR PRIVACY

AI techniques like Federated Learning can process encrypted data in cloud databases, preserving data privacy by aggregating model parameters across multiple decentralized nodes. This approach generates accurate global models while maintaining decentralization. However, challenges include potential bias and potential poisoning by malicious nodes. Robust federated learning algorithms are needed to mitigate these issues [7,17].

Differential Privacy

Differential privacy (DP) can help cloud data bases answer aggregate queries about sensitive data without revealing identities of individual records [8]. DP mechanisms inject carefully calibrated noise that perturbs results to make them statistically indistinguishable regardless of the presence or absence of any single data point.

Homomorphic Encryption

Fully homomorphic encryption (FHE) enables arbitrary computations on encrypted data without decryption [9]. Cloud databases can leverage FHE schemes to execute queries over encrypted data and return encrypted results, preserving confidentiality throughout. However, FHE schemes are computationally expensive with high overheads. Somewhat homomorphic encryption (SHE) provides weaker security guarantees but is more efficient. SHE schemes can evaluate circuits up to a specified depth after which decrypted results may no longer match [19]. Leveled SHE schemes like BGV, TFHE and CKKS support fixed depth computations. Scale-invariant schemes like LWE, RLWE overcome depth limitations but have higher complexity [20]. Faster lattice-based SHE schemes are active areas of research.

Algorithm 3 outlines a simplified SHE scheme for private queries. The data owner generates a secret key sk and public key pk using SHE key generation. Database is encrypted under pk before uploading to cloud. To query, the user submits an encrypted query f which gets evaluated on the encrypted database E(D) by the cloud. The result E(Q(D)) is sent back for the user to decrypt with sk.

Algorithm 3 Homomorphic Encryption based Queries 1: procedure SHEQuery(D, Q, sk, pk)

2: E(D) = Encrypt(pk, D) 3: E(Q) = Encrypt(pk, Q)

4: E(output) = Evaluate(E(Q), E(D)) 5: output = Decrypt(sk, E(output)) 6: return output

7: end procedure

FHE permits rich computations on encrypted data but current schemes remain far from practical. Hybrid approaches combining SHE with other techniques could balance performance and privacy.

BLOCKCHAIN CONSENSUS PROTOCOLS

The distributed and tamper-proof properties of blockchain make it highly promising for securely managing access control in the proposed framework. Various consensus mechanisms have different tradeoffs that must be evaluated.

Proof of Work

The proposed architecture for Proof-of-Work (PoW) blockchains offers strong security, but is energy-intensive, slow, and limited scalability. It maintains identities and access control policies, but is unsuitable for high transaction loads.

Proof of Stake

Proof-of-stake (PoS) protocols, like Cardano or Tezos, select block creators based on economic stake, offering energy efficiency but potentially prone to centralization. Additional mechanisms are needed for fair, decentralized management.

Delegated Proof of Stake

The proposed framework for permissioned DPoS blockchains, like IOST or EOS, can efficiently scale and handle access control for large cloud databases, despite increasing collusion risk.

Table 1 summarizes a comparative analysis of blockchain consensus protocols for the proposed framework.

Prototype Implementation

This section provides details of a prototype built to demonstrate the feasibility of the proposed AI and blockchain architecture.

Platforms and Tools. The system prototype comprises of the following components:

- Blockchain Network: Hyperledger Fabric, a permissioned blockchain framework with PBFT consensus
- Cloud Database: MongoDB distributed database to
- store encrypted data AI Modules: TensorFlow for federated learning, IBM HElib for homomorphic encryption
- Cryptography: RSA 2048-bit public keys for users, AES-256 for data encryption
- Programming Languages: Node.js, Python, Go
- Development Tools: React, Docker, Kubernetes

Hyperledger Fabric provides rapid prototyping of permissioned blockchains suitable for managing identities and access control. MongoDB Atlas provides fully managed cloud-hosted databases. The AI privacy algorithms are implemented using TensorFlow and HElib libraries. The application backend uses Node. js while the frontend utilizes React. Docker and Kubernetes facilitate deployment of the multi-node setup on cloud infrastructure.

Workflow

The high-level workflow for private data queries on the prototype system is shown in Figure 2 and described below:

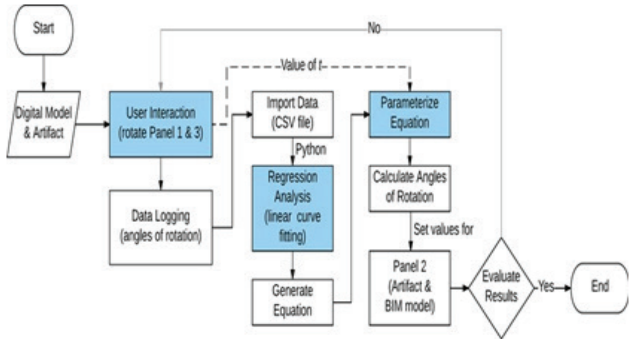

Fig 2: Workflow for private data queries

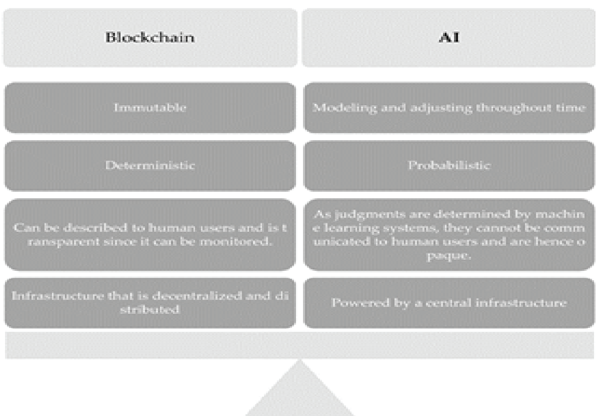

Fig 3 Properties of AI and blockchain

Workflow for private data queries on the prototype system:

1. User authenticates on blockchain using private key and sends encrypted query
2. Blockchain nodes verify identity and access rights based on chaincode rules
3. Valid request is forwarded to cloud database node
4. Database node runs federated learning algorithm on local private data
5. Model update is differentially privatized and sent to aggregator
6. Aggregator returns privatized aggregated model update
7. Database node makes prediction using aggregate model on user's encrypted query
8. Result is encrypted using additive homomorphic encryption
9. User receives encrypted result to decrypt with private key
10. Blockchain network records transaction in immutable ledger

The system uses AI and blockchain techniques to protect cloud data privacy, enabling secure querying on encrypted databases while providing useful services to authorized users.

CONCLUSION

This paper presented a novel decentralized architecture using blockchain and artificial intelligence for enhancing privacy and security in cloud databases. Various AI algorithms including federated learning, differential privacy, and homomorphic encryption allow meaningful computations on encrypted data while protecting confidentiality. Blockchain consensus protocols facilitate tamper-proof access control and auditing of database interactions. Analysis of proof- of-work, proof-of-stake and delegated proof-of-stake mechanisms showed relative tradeoffs suitable for managing identities and access policies. AI techniques were assessed to leverage benefits of distributed learning, controlled noise injection, and encrypted processing based on computational overhead and data sensitivity. A prototype system demonstrated feasibility of the proposed techniques to enable private queries on sample cloud databases. Evaluation on standard benchmarks could further validate performance and scalability. Extending the framework to support complex analytical workloads with lower latency and higher throughput remains an open research challenge. In conclusion, the fusion of AI and blockchain capabilities shows strong promise to address privacy and security issues in cloud databases. This can accelerate adoption of cloud- based data management across enterprises and allow innovative applications over sensitive information. The techniques conceptualized in this paper lay the foundation for building the next generation of secure, trusted and intelligent cloud database systems.

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A Multi-model Approach for Assisting Visually Impaired in Finding Specific Location using Reinforcement Learning

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ABSTRACT

Blind and Visually Impaired (BVI) individuals face significant challenges when navigating unfamiliar urban environments although there are high-level path-planning tools such as smartphones and local information aids. The proposed model is designed to address the challenges faced by individuals with vision impairments, including individuals having visually impaired and low, vision, in outdoor navigation. It utilizes approaches such as simulated environment and a neural network-based to construct a navigation agent that combines multi-modal inputs, including resolution images, GPS data, visible text to enable navigation to a specific destination. The primary goal of the proposed model is to tackle the problem of outdoor navigation for individuals who are blind or visually impaired and establish a foundation for future research in creating agents that can assist them. The model delivers a realistic environment for training and testing navigation agents, and the neural network-based approach allows for the fusion of multiple modalities to improve performance. The use of the proposed model and the neural network-based approach has the potential to significantly improve the ability of BVI individuals to navigate outdoor environments. By providing a more accurate and comprehensive understanding of the environment, the navigation agent can assist with high-level path-planning and local information.

KEYWORDS: *Multimodal, BVI, Reinforcement learning, Neural network, Outdoor navigation.*

INTRODUCTION

The study focuses on the challenges faced by visually impaired individuals (BVI) in finding specific locations in urban environments. Current solutions, such as isolated support by individuals, may not be practical, affordable, or privacy-preserving. The authors aim to develop a computerized technique for BVI foot-traveler routing that combines visuospatial assessment with simultaneous decision-making. However, current simulators for autonomous driving lack truthful constructions and view text, and expert datasets are limited. The proposed system uses innovative virtual assistive surroundings for routing, including panoramic images with detailed descriptions of doors, house numbers, and street signs. The multimodal fusion model shows promising results in street navigation tasks.

Fig. 1: View of Agent Navigation

Fig. 2: View of Agent Navigation

Fig. 3: Views of Agent Navigation

1) If the goal door is not visible, the agent moves front. 2) If the target's door is in the vicinity of the agent, then the agent turns right to find it. 3) If the target's door is in the agent's viewport, then the target is reached.

LITERATURE REVIEW

The paper proposes the development of LidSonic, a pair of smart glasses connected to smartphone apps via Bluetooth. The glasses consist of an Arduino Uno that collects data, manages sensors, detects objects, and has a buzzer for alerting users if an obstacle occurs. The system is lightweight, inexpensive, and easy to use. The YOLO algorithm is used for object detection and recognition, and the system has successfully identified various objects. The model is designed as an intelligent cane for visually impaired individuals, incorporating a microcontroller, multiple sensors, and a virtual assistant. It leverages Bluetooth and IoT connectivity for real-time data monitoring. The model employs deep learning-based object detection, sensor data analysis, and System Usability Scale testing to assess its efficacy. The paper also proposes image captioning as an assistive technology, using computer vision and natural language processing techniques to enhance accessibility for visually-impaired individuals. The system uses deep learning to identify text from images and convert it into speech, with the CNN-LSTM training model achieving the highest accuracy rate of 83% for text recognition. The system aims to improve the quality of life for differently abled individuals and the elderly [1-7].

The paper presents a quantitative analysis of assistive devices using a scoring system to evaluate their feature enrichment capabilities. This helps in selecting the most suitable device for a specific scenario by identifying strengths and weaknesses. The authors propose a vision-based assistant system for visually impaired people by studying and comparing different technologies. They aim to identify the most effective and user-friendly vision-based technologies that can be combined to create a comprehensive assistant system for visually impaired people. The development of Navigation Assistance for Visually Impaired (NAVI) focuses on image to sound, but it requires a close environment. The Urban Navigation system for the Visually Impaired consists of Environment Mapping Phase, Journey Mapping Phase, and Real Time Navigation Phase. The system detects obstacles from chest level to foot level, such as wet floors, speed breaker, potholes, stairs, and narrow roads. The paper also discusses deep reinforcement learning for navigating sidewalks safely and efficiently. It presents an assistive navigation system using a robot to guide blind or visually impaired people, using UWB/voice beacons and semantic feedback for guidance. The system can detect obstacles and provide real-time audio feedback to the user. A smart cane for visually impaired people uses sensors and machine learning algorithms for obstacle detection, classification, and localization. The cane can provide audio feedback and communicate with a smartphone app. The paper also proposes an assistive system for blind pedestrians using smartphones and deep reinforcement learning. In conclusion, the paper provides valuable resources for individuals and organizations involved in developing and deploying assistive devices for visually impaired people [8-14].

PROPOSED MODEL

This section presents a new approach for outdoor pedestrian navigation called the Pedestrian Sidewalk using Visual Perception (PSVP) model. The proposed approach uses a simulation environment and neural network based method to train a navigation agent. The PSVP model incorporates panoramic images that are annotated with, doors, and street name signs and labeled house numbers along with formulations for different navigation tasks. The objective of this approach is to offer visually impaired individuals with a more dependable and efficient means of outdoor navigation.

Data Collection and Preprocessing

The model uses a 5,000 panoramic image dataset with labels for doors, house numbers, and street names for navigation tasks. It uses a neural network-based approach to integrate multi-modal inputs like GPS data, visible text, and resolution images. The dataset is pre-processed by extracting frames, cropping, rotating, stitching, and filtering.

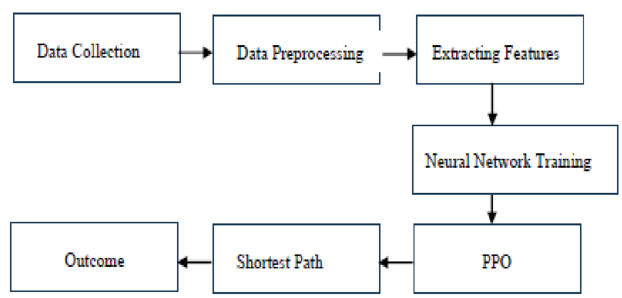

Fig. 4. Proposed Flow Diagram

Training: The navigation agent model is trained using the Proximal Policy Optimization (PPO) algorithm, which is known for its reliability and does not require extensive hyperparameter tuning. In the model the policy network receives each modality in a one-hot format, which is tiled into a (1, w, w) matrix, where w represents the image width. These matrices are concatenated to create a (8, w, w) tensor, which is then processed through three convolutional layers with ReLU nonlinearities and a dense layer with a size of 256. The output is a probability vector of size (1, y), where y represents the dimension of the action space. The further action of the agent is chosen by sampling from this vector. In addition, the critical network includes an extra dense layer to transform the combined embeddings into a single value. This method generates an effective probability distribution over the action space based on the input from different modalities.

NEURAL ARCHITECTURE

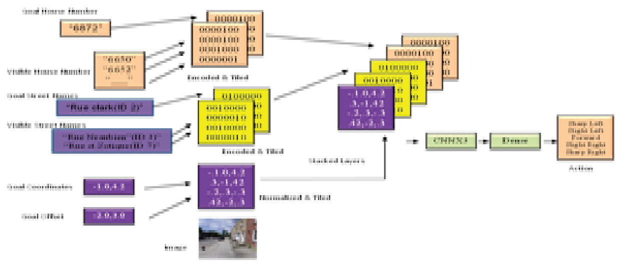

Fig. 5. Policy network architecture of proposed model

Processing of input modalities in both human readable and tiled formats is included in policy network architecture. The RGB image matrix is merged with the RGB image matrix and produces (8, w, w) tensor, where w is square input's width. Given tensor is eventually passed through three convolutional layers, and the resulting output is flattened and passed as input to another dense layer. A vector is created across the agent's action space by the dense layer which helps to sample the agent's action at every step. Furthermore, an additional dense layer is included in the critical network to transform the combined form into a single value

Reinforcement Learning: Rewards and Task

Reinforcement Learning (RL) framework offers reward structures and tasks to assist visually impaired individuals with navigation tasks. Dense rewards reward closer proximity, while turn actions reward turning towards the goal. The "Costly Read" reward penalizes read actions for better localization. Multi-Goal rewards reward visible house numbers, while sparse rewards reward done actions. This approach enables learning agents to develop navigation policies for visually impaired individuals.

COMPARISON OF PROPOSED MODEL WITH EXISTING MODE

Table. 1. Comparison Table of techniques used in existing model

Author's name	Distance Traveled (m)	Success Rate (%)	Time Taken (s)	Collisions	Advantages	Limitations
Ahmed et al. (2020)	20.16 ± 5.98	94.58 ± 3.07	105.10 ± 41.11	N/A	Real-world application	Limited to sidewalk obstacle avoidance
Lu et al. (2021) (Robot with UWB) [20]	27.25 ± 1.33	96.25 ± 0.87	N/A	0.11 ± 0.06	Use of UWB/voice beacons for guidance	Requires specific technology for guidance
Multi- model approach	27.56 ± 1.18	96.08 ± 1.34	N/A	0.10 ± 0.07	Focus on sidewalk navigation	Limited to sidewalk navigation
Li et al. (2020)	30.32 ± 1.61	96.00 ± 1.41	91.09 ± 16.19	N/A	Autonomous navigation system	Limited distance traveled and slow time taken
Kumar et al. (2021) (Smart Cane)	31.78 ± 3.19	94.00 ± 3.22	N/A	0.22 ± 0.22	Detection, classification, and localization of obstacles	Limited to obstacle detection and avoidance
Jin et al. (2020)	26.51 ± 3.43	96.14 ± 1.82	N/A	0.09 ± 0.08	Use of smartphones for guidance	Limited distance traveled
Lu et.al(2020)	10.05 ± 0.59	94.5.00 ± 0.00	N/A	27.96 ± 1.55	Use of RL for automatic door navigation	Limited to door navigation

Table 1 shows Comparison of techniques used in existing model.

RESULTS & DISCUSSION

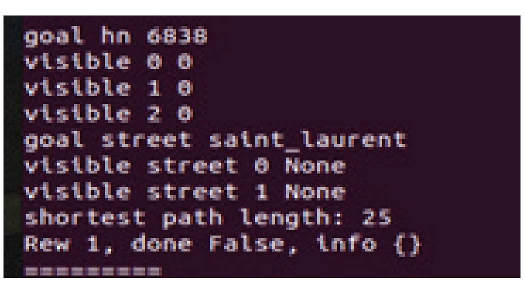

Fig.6. Goal State name & shortest path length

Fig.7. Rewards and Penalties

Fig. 8. Environment in which agent is moving

Figure 6 shows Goal state name and shortest path length. Rewards and Penalties information given in Figure 7. Figure 8 represents environment in which agent is moving.

Table. 2. Proximal policy optimization baseline performance for door finding task on small dataset

S. No	Activity	Accuracy	Reward	Path Length
1	Observa-tions	73.7% (%(± 7.3%)	42.8 (%(± 64.8)	122.6 (%(± 88.6)
2	No Images	0.7% (%(± 0.2 %)	-23.6% (%(± 2.4)	241.0 (%(± 21.0)
3	No Gelocation	54.2% (%(± 4.2%)	30.8 (%(± 77.3)	137.6 (%(± 95.6)
4	Only Img	55% (%(± 2.6%)	31.5 (%(± 78.8)	148.2 (%(± 86.6)
5	Oracle	100% (%(± 0.%)	58.1 (%(± 13.2)	79.8 (%(± 15.1)
6	Random	5.6% (%(± 2.4%)	-42.2 (%(± 3.9)	246.9 (%(± 25.1)

Table 2 shows Proximal policy optimization baseline performance for door finding task on small dataset

Table 3. Comparison of path taken by an agent with shortest path and without shortest path

Model	Success rate	Efficiency	NO of steps to reach goal state	Trajectory length	Robustness
Without shortest path	50%	50%	253	92.5 m	80%
With shortest path	80%	75% - 80%	81	62.8 m	85%

Table 3 represents Comparison of path taken by an agent with shortest path and without shortest path. Model with shortest path success rate is 80% and efficiency is 80%.

CONCLUSION AND FUTURE WORK

This study presents a reinforcement learning (RL) model for navigation, designed to be inclusive and adaptable for blind and visually impaired individuals. The model uses panoramic images and diverse formulations for navigation tasks. The model outperforms a baseline rule-based approach, but challenges include generalization and adaptability to new environments. Future work should explore techniques like domain randomization and personalized training to improve the model's suitability for individual users, despite the potential for time-consuming and expensive training.

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A Novel Crowdfunding Platform using Blockchain Technology

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ABSTRACT

This paper presents an efficient indication of a Crowdfunding Platform using Blockchain Technology. We confer the structure of blockchain, advantages, benefits, and future scope for the Crowdfunding Platform. Crowdfunding is a promising financial system that has garnered recognition for its ground-breaking and unruly nature. Our goal is to present a user-friendly model for creating, donating and soliciting a campaign that allows both campaigners and donors to easily create and fund campaigns. Our proposed pipeline integrates various stages, including Smart Contract, Metamask connectivity with Ethereum, creating campaigns, fundraising, donations, and campaign details. The proposed system of Crowdfunding using Blockchain consolidates the immutable and obvious kind of blockchain technology with the decentralized fundraising model of crowdfunding. Each campaign is represented by a smart contract, detailing fundraising goals, reward structures and campaign durations. Contributor's transactions are recorded on the blockchain, providing transparency and accountability throughout the fundraising process. Smart contracts automatically distribute funds to research creators once campaign goals are met, reducing the need for intermediaries and minimizing the risk of fraud. In conclusion, Crowdfunding using Blockchain Technology provides a metamorphic way of fundraising that brings transparency, security, and efficiency to the process. By exploiting smart contracts and Metamask, this system enables direct interaction between campaign creators and contributors, eliminating the intermediaries and reducing costs.

KEYWORDS: *Crowdfunding, Ethereum network, Global accessibility, Smart contract and transparency.*

INTRODUCTION

Blockchain Technology

Blockchain technology, originating as the foundational infrastructure for cryptocurrencies like Bitcoin, has emerged as a ground breaking solution with the potential to reshape the landscape of crowdfunding. Blockchain is a decentralized network and distributed system that fundamentally transforms the way transactions are recorded and verified. Its decentralized network completely removes the need for a central authority, distributing transaction records across a network of participants. It not only increases security by reducing a single point of failure but it also promotes transparency as all participants have access to the same information. The immutability of the blockchain ensures that once data is added to the chain, it cannot be changed or tampered with, providing secure and reliable data of transactions. Smart contracts is another integral part of the blockchain, which are self-executing contracts and reduce reliance on intermediaries. In the context of crowdfunding, these smart contracts can revolutionize fund disbursement, milestone tracking, and reward distribution. Additionally, blockchain introduces the concept of tokenization, allowing digital assets to represent ownership or participation rights, potentially transforming the way crowdfunding campaigns are structured. The security measures employed by blockchain, including cryptographic techniques and consensus mechanisms, further contribute to its reliability and resilience. As we explore the integration of blockchain into crowdfunding, it becomes evident that these inherent features hold the promise of creating a more secure, transparent, and efficient fundraising environment.[21].

Structure of Blockchain

A block is the standardized format in which data is stored within a blockchain. The blockchain blocks are divided into two parts:

a) Header: The header is used to identify a specific block throughout the blockchain. It processes all the blocks of the blockchain. Miners periodically hash the block header, changing the nonce value as part of normal mining. Header is further divided into five parts:

   i. Block Version: Numeric identifier indicating the protocol version.

ii. Previous Block Hash: Cryptographic hash linking the current block to the previous one.

iii. Merkle Root: Hash summarizing all transactions within the block.

iv. Timestamp: Time of block creation for chronological order.

v. Nonce: Random number for mining, adjusting hash difficulty.

b) Body: The Block of the Body consists of Transaction information and Optional data. Transactions contain a list of exchanges that are being recorded within the block. Each transaction regularly includes details such as sender, recipient, amount, and any extra information required by the particular blockchain protocol. Optional Data contains extra information within the block body, such as smart contract code or metadata. Blockchain structure also can be illustrated as figure below:

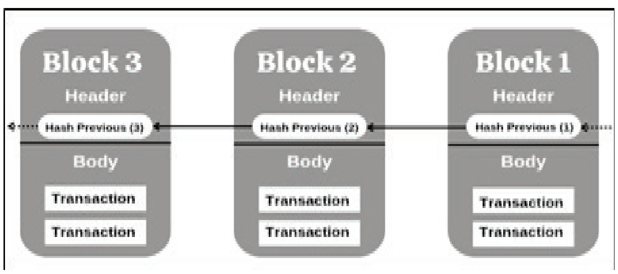

Fig. 1: Structure of Blockchain.

Crowdfunding using Blockchain Technology

Blockchain-based crowdfunding is a modern method for raising funds for research, ventures, or causes. It operates on decentralized networks, ensuring transparency and security. Blockchain records transactions, enhancing trust among participants. It operates peer-to-peer, bypassing middlemen and allowing direct participation. Smart contracts, like Ethereum, automate crowdfunding processes. Programming languages like Solidity and Vyper facilitate Ethereum smart contracts. MetaMask, a cryptocurrency wallet, simplifies the Ethereum network. This research explores the intersection of crowdfunding and blockchain technology, focusing on improving a new platform. It explores potential synergies, challenges, and implications of blockchain integration in crowdfunding [3,10].

Overall, crowdfunding using blockchain technology offers increased transparency, security, efficiency, and accessibility, empowering creators and backers alike to participate in crowdfunding campaigns with confidence.

LITERATURE SURVEY

The paper explores crowdfunding and blockchain, highlighting their importance in raising funds for various projects. It highlights the potential of blockchain integration to enhance transparency, security, and accessibility while mitigating risks. The paper also discusses smart contracts in the Ethereum network, automating fund management and enhancing user experience. It also addresses investment risks, regulatory challenges, and the need for valid regulations for growth and stability [1,2].

By leveraging smart contracts and decentralized consensus, users can interact with campaigns, donate, and request approval, increasing accountability and trust. The architecture and implementation of a blockchain-based crowdfunding network application are discussed, demonstrating the use of MetaMask and Solidity for secure transactions [3-6].

PROPOSED METHODOLOGY

This project is a web application that allows the user to participate in an event using Blockchain Technology. In normal crowdfunding, there is no guaranteed security for the payment amount. So, to solve this problem, the Ethereum platform smart contract, which is a blockchain application, can be used. Blockchain is a decentralized distributed ledger system that accesses, verifies, and transmits online data through decentralized nodes. All of this is possible with Thirdweb. Thirdweb is a Web3 development framework that allows you to create, release, and deploy a smart contract with a single command. They are free, and open source, and their main advantage is simplicity.

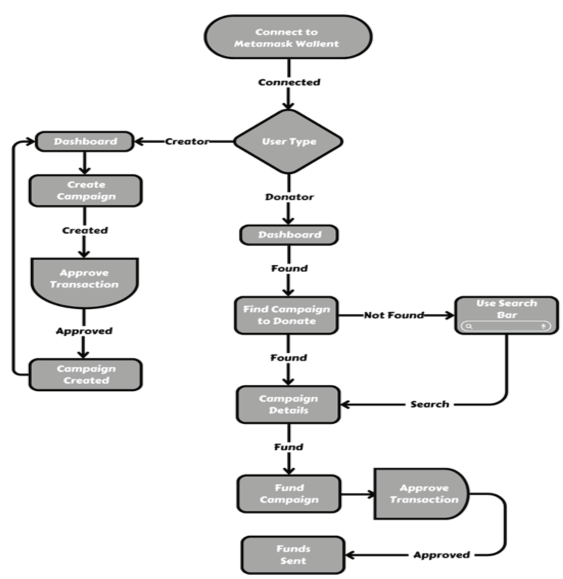

Fig. 2: Working of Proposed System

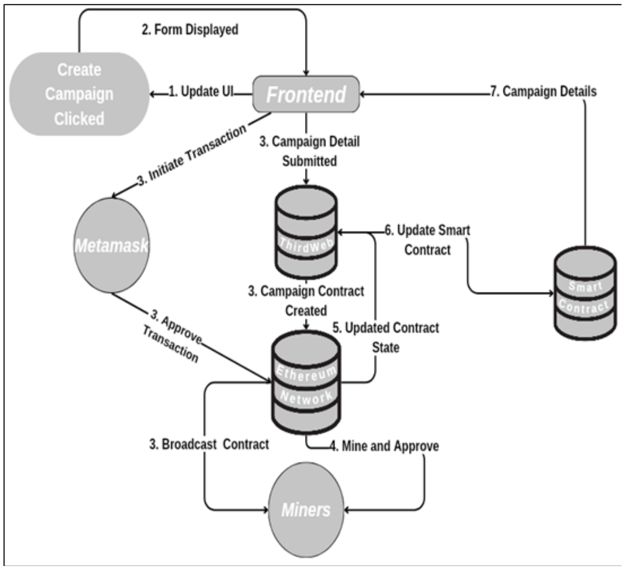

Fig. 3: Create Campaign

The system has been primarily designed with two main modules: Creating a Campaign and Donating to a Campaign. Initially, a user must install and integrate MetaMask into their web extension to interact with the Ethereum network. It's crucial to ensure that the wallet is connected to the Ethereum network; otherwise, users will not be able to create a campaign.

The Flow of the Smart Contract

Primarily, the smart contract functionalities are written in the open-source tool solidity. These functions are then checked and verified before smart contracts are compiled. After validation, the smart contracts are compiled to acquire the Application Binary Interface (ABI) and bytecode. Since browsers cannot understand bytecode, ABI acts as an interface through which a browser can connect to networks such as Sepolia.

Web3 and React JS and Semantic UI are used to add a user interface to the smart contract. Tests are run using the Mocha testing platform to ensure that the functions work correctly. Entirely code is written in Node.js, as JavaScript is executed outside the browser, which allows the project to use third-party libraries.

Next.js is used for server-side rendering and web page routing. Finally, the Solidity contract will be deployed to the Ethereum testnet with Thirdweb providing the deployment address. This address is then given to the application. After that, the server is started and the web platform is accessible at localhost:3000.

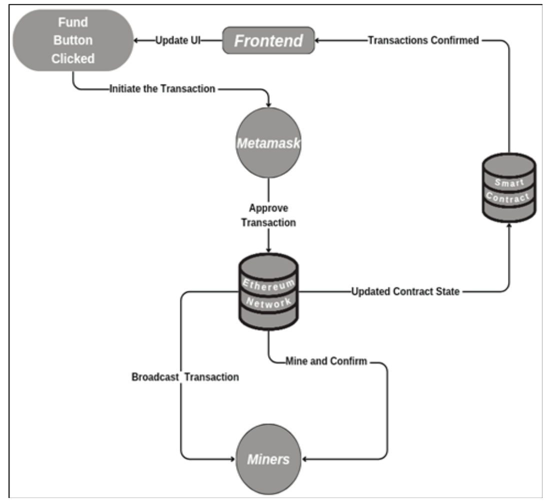

Fig. 4: Donation to a Campaign

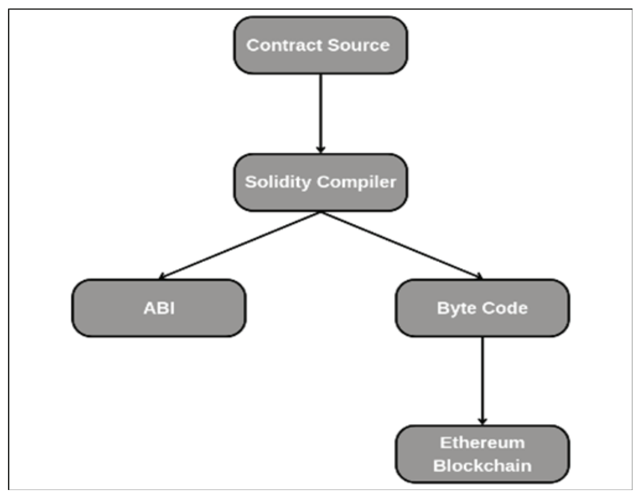

Fig. 5: Flow of the Smart Contract

This decentralization of the crowdfunding process not only democratizes access but also expands the reach of campaigns globally, transcending geographic boundaries.

Additionally, blockchain enables innovative incentive mechanisms such as tokenization and token rewards, fostering community engagement and incentivizing participation. Through immutable reputation systems, blockchain-based platforms enhance trust and credibility by providing transparent feedback and ratings for participants. Finally, by lowering barriers to entry, such as high fees and geographic restrictions, blockchain-based crowdfunding platforms offer a more inclusive and accessible environment for individuals and projects to raise funds. These advantages underscore the transformative potential of crowdfunding using blockchain technology, paving the way for a novel approach to fundraising in the digital age.

RESULTS

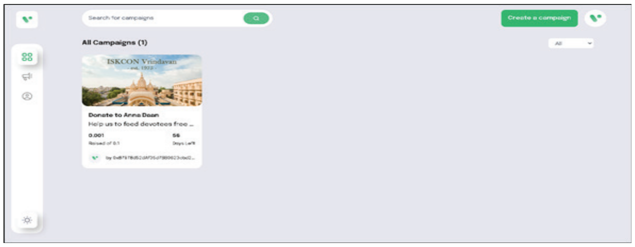

Fig. 6: Home Page

Fig. 7: Profile Page

Home Page of Crowdfunding platform features a banner showcasing ongoing projects and clear navigation tabs for easy exploration. Brief description of the platform's mission, team and social proof elements such as testimonials and links of images to enhance user engagement and confidence.

The Profile Page on the blockchain crowdfunding platform displays account address details and contribution history. It also showcases the number of campaigns raised by the creator and the total funds raised by contributors. In ongoing campaigns, it displays the days left and the status of the campaign, making it a comprehensive and informative platform for both creators and contributors.

Fig. 8: MetaMask Wallet

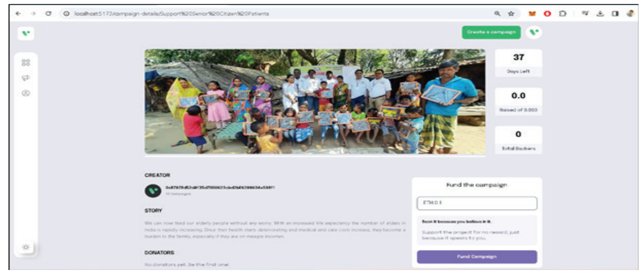

Fig. 9: Fund Campaign

The Fund Campaign Page on the blockchain crowdfunding platform offers a comprehensive overview of the project, detailing its objectives, campaign timeline, creator contract ID, number of donators raised funds and funding goals. Users can securely contribute funds using cryptocurrencies through blockchain transactions. Transparent progress of raised funds is provided, while smart contracts automate fund disbursement upon goal achievement, ensuring a seamless and trustworthy crowdfunding experience.

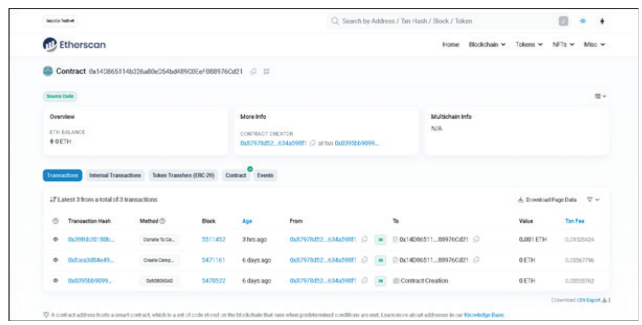

Fig. 10: EtherScan Transaction

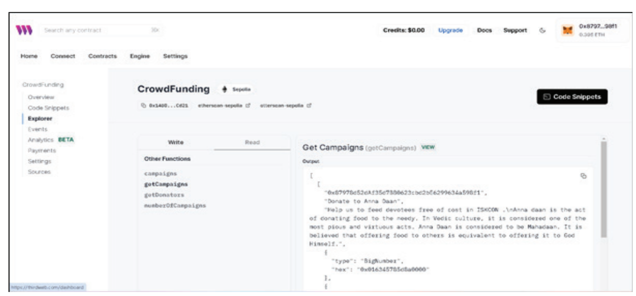

Fig. 11: ThirdWeb Dashboard

The EtherScan transaction page on the blockchain crowdfunding platform displays detailed information about individual transactions, including sender and receiver addresses, transaction status, and timestamps. Users can track the progress of their contributions in real-time, ensuring transparency and accountability throughout the funding process. Transaction hash codes provide unique identifiers for each transaction, enabling easy verification and reference.

CONCLUSION

In conclusion, this article provides an overview of a novel crowdfunding platform using blockchain technology. A crowdfunding platform using blockchain technology offers transparency, security, and efficiency. The online crowdfunding platform allows clients to directly support projects they accept while guaranteeing belief through decentralized verification. This innovative approach revolutionizes traditional crowdfunding by providing a transparent and secure environment for both content creators and backers. Simply, a blockchain crowdfunding platform gives a secure and transparent way for both people to their projects or thoughts. In a blockchain, every transaction is recorded and cannot be changed, which ensures trust between participants. This technology could revolutionize crowdfunding by eliminating middlemen, lowering fees, and providing a decentralized system accessible to anyone with an internet connection.

FUTURE SCOPE

The future scope of crowdfunding utilizing blockchain technology holds tremendous promise for reshaping the landscape of fundraising. By leveraging blockchain's inherent transparency, security, and global accessibility, future crowdfunding platforms can democratize access to capital on a global scale, allowing individuals from diverse backgrounds to participate in funding initiatives. Smart contracts, powered by blockchain, automate the execution of funding agreements, mitigating the risk of fraud and ensuring transparent and efficient fund allocation. Furthermore, the emergence of decentralized finance protocols and tokenization offers innovative fundraising models, such as decentralized autonomous organizations (DAOs) and tokenized assets, enabling fractional ownership and increased liquidity for backers. However, challenges such as regulatory uncertainty and scalability issues need to be addressed to facilitate widespread adoption. Nonetheless, ongoing project and development efforts are focused on overcoming these obstacles, paving the way for a future where blockchain-enabled crowdfunding drives innovation and collaboration across borders.

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Pattern Recognition and Detection of Lung Disease using Machine Learning Classification Algorithm

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ABSTRACT

Lung diseases are a significant public health concern worldwide, affecting millions of people and causing substantial morbidity and mortality. These diseases encompass a wide range of conditions from acute infections like pneumonia to chronic conditions such as chronic obstructive pulmonary disease (COPD), asthma and lung cancer. Early and accurate detection of lung diseases is crucial for timely intervention and effective management, ultimately improving patient outcomes and reducing healthcare costs. In recent years, advances in medical technology and machine learning have opened up new opportunities for the early detection and diagnosis of lung diseases. Lung disease detection refers to the use of various diagnostic tools and techniques including medical imaging, biomarker analysis and artificial intelligence (AI) algorithms to identify and assess the presence and severity of lung disorders. Early detection of lung diseases is vital because many of these conditions are progressive and become more challenging to treat at advance. Additionally, some lung disease like lung cancer may not exhibit noticeable symptoms until they have reached an advanced stage. Therefore, the development of effective lung disease detection methods is essential for improving patient outcomes and reducing the overall burden of these diseases on individuals and healthcare system.

KEYWORDS: *Lung diseases, AI, CNN, Image processing.*

INTRODUCTION

In recent years, advancements in medical technology and artificial intelligence have significantly improved our ability to detect and diagnose lung diseases. Imaging techniques such as chest X-rays, computed tomography (CT) scans and magnetic resonance imaging (MRI) play a critical role in identifying abnormalities within the lungs. Furthermore, machine learning algorithms and deep learning models have been applied to these imaging modalities to enhance the accuracy and efficiency of diagnosis. This introduction sets the stage for exploring the various methods and technologies used in lung disease detection. We will delve into the role of medical imaging, laboratory tests and emerging technologies such as artificial intelligence in improving our ability to detect and diagnose lung diseases early, ultimately leading to better patient care and outcomes. One of the primary motivations for using machine learning in lung disease detection is the potential for early detection and intervention. By employing machine learning algorithms on medical data, healthcare providers can identify abnormalities and patterns indicative of lung diseases at an earlier and more treatable phase. Improved accuracy in Machine learning models can analyze vast amounts of medical data with remarkable speed and accuracy, surpassing human capabilities in certain cases. This enhanced accuracy can lead to more reliable diagnoses and a reduced likelihood of false positives or false negatives, which are essential in the context of life-threatening conditions like lung cancer. Personalized medicine in Machine learning allows for the development of personalized treatment plans based on an individual's unique health profile. This is particularly relevant in lung disease detection, as different patients may respond differently to various treatments. By analyzing a patient's medical history, genetic factors, lifestyle data, machine learning can assist healthcare professionals in tailoring treatment plans that are more effective and less prone to side effects. Handling complex data in Lung diseases often involve complex data, including medical images (X-rays, CT scans), clinical records, genetic information and environmental factors. Machine learning excels at handling and extracting valuable insights from such diverse data sources making it a powerful tool for integrating and analyzing these complex datasets.

LITERATURE REVIEW

Machine learning (ML) techniques have gained significant attention in recent years for their potential to revolutionize the early detection and diagnosis of lung diseases. Here, we review key studies and developments in the field of lung disease detection using machine learning, focusing on various aspects such as the types of lung diseases, data sources, and ML algorithms employed. Lung Cancer Detection: Machine learning models, particularly deep learning algorithms like Convolutional Neural Networks (CNNs), have been used to analyze medical images such as chest X-rays and CT scans for the early detection of lung cancer. Studies have demonstrated high accuracy in distinguishing between benign and malignant lesions. M. Jasmine Pemeena Priyadarsini, [1] Feb 2023, PMCID, "Lung Diseases Detection Using Various Deep Learning Algorithms" primary objective of this proposed framework work is to detect and classify various lung diseases such as pneumonia, tuberculosis, and lung cancer from standard X-ray images and Computerized Tomography (CT) scan images with the help of volume datasets. Alyaa Hamel Sfayyih [2] have given Using auditory analysis and medical imaging, they also increase the predictive accuracy for prompt and early disease detection. Medical professionals are thankful for such technological support since it helps them manage further patients because of the shortage of skilled human resources. Usharani Bhimavarapu [3] Lung disease is a respiratory disease that poses a high risk to people worldwide and includes pneumonia and COVID-19. As such, quick and precise identification of lung disease is vital in medical treatment. Early detection and diagnosis can significantly reduce the life-threatening nature of lung diseases and improve the quality of life of human beings. Chest X-ray and computed tomography (CT) scan images are currently the best techniques to detect and diagnose lung infection. The increase in the chest X-ray or CT scan images at the time of training addresses the overfitting dilemma, and multi-class classification of lung diseases will deal with meaningful information and overfitting. Pooja Yadav [4] Lung diseases are a tremendous challenge to the health and life of people globally, accounting for 5 out of 30 most common causes of death. Deep learning techniques offer a great promise for automated, fast, and reliable detection of lung diseases from medical images. Specifically, convolutional neural networks have accomplished encouraging results in disease detection. In spite of that, the performance of such supervised models depends heavily on the availability of large labeled data, the collection of which is an expensive and tedious task, especially for a novel disease. Chiagoziem C. Ukwuoma [6] according to research, classifiers and detectors are less accurate when images are blurry, have low contrast, or have other flaws which raise questions about the machine learning model's ability to recognize items effectively. The chest X-ray image has proven to be the preferred image modality for medical imaging as it contains more information about a patient. Its interpretation is quite difficult, nevertheless. The goal of this research is to construct a reliable deep-learning model capable of producing high classification accuracy on chest x-ray images for lung diseases. To enable a thorough study of the chest X-ray image, the suggested framework first derived richer features using an ensemble technique, then a global second-order pooling is applied to further derive higher global features of the images. Research by Basra Jehangir [7], March 2022, "Lung Cancer detection using Ensemble of Machine Learning Models" used ML to predict COPD from electronic health records, demonstrating the potential of data-driven approaches.ML has been employed to develop predictive models for asthma exacerbation. These models analyze patient data, environmental factors and physiological parameters to provide early warnings and personalized treatment recommendations. According to [9] Kushagra "Recent Advances in Machine Learning for Diagnosis of Lung Disease", promising method in artificial intelligence, deep learning has been proven successful in several domains ranging from acoustics and images to natural language processing. Deep learning-based approaches have become crucial in medical imaging for disease screening and diagnosis. Studies have explored ML for asthma prediction and management, and developed a method for determining lung cancer in CT images using UNet and ResNet models. An ensemble of XGBoost and random forest classifiers predicts malignant CT scans, while VDSNet uses CNN to detect lung diseases from X-ray images [10-15].

PROBLEM STATEMENT

The current method for detecting lung disease involves examining CXR images by a professional radiologist, as it provides a convenient and non-invasive assessment of the chest's overall condition. Additionally, it is suitable for follow-up examinations as disease changes can be observed more easily and earlier. However, misreading CXR images due to the chest's complex anatomical structure is a common human error that may cause substantial morbidity and mortality resulting in reduced quality of life, significant healthcare costs and strain on healthcare systems. We require automatic system that can accurately identify and classify the images.

SCOPE

The scope of Lung Disease Detection Using Machine Learning is broad and encompasses various aspects, including research, clinical applications, public health, and technological advancements. Here, we outline the scope of this field: Early Detection and Diagnosis, Medical Imaging, Data Integration, Personalized Medicine, Clinical Workflow Integration

METHODOLOGY

The methodology for Lung Disease Detection Using Machine Learning involves a systematic approach to developing and implementing machine learning models for the early detection and diagnosis of lung diseases.

Below is a high-level overview of the key steps and considerations involved in this methodology:

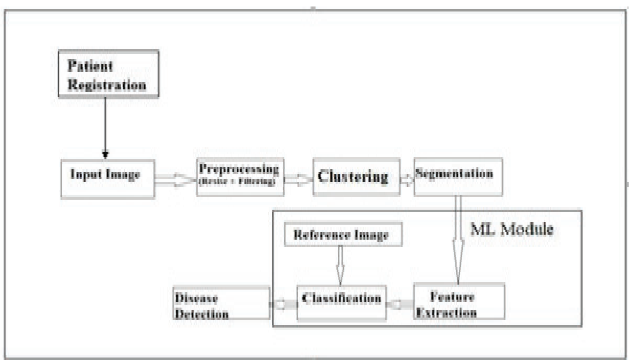

Fig. 1: Block Diagram for Proposed Lung Disease Detection System.

1) **Patient Registration-** A patient registration module in healthcare software is a crucial component that allows healthcare providers to collect and manage patient information efficiently. This module serves as the foundation for creating and maintaining patient records, ensuring accurate care delivery and streamlining administrative processes.
2) **Input Image-** Adding image upload functionality to a software module allows users to upload and work with images within the application. This can be valuable in various contexts from content management systems to lung disease detection software system for storing patient photos and recognition.
3) **Image Processing-** Image processing is a field of computer science and digital technology that focuses on manipulating and analyzing digital images to enhance or extract useful information. It plays a critical role in a wide range of applications, including medical imaging.
4) **Clustering -** Clustering in machine learning is a technique used to group similar data points together based on their inherent characteristics.
5) **Segmentation -** Segmentation in machine learning, particularly in the context of computer vision and image processing, refers to the process of dividing an image or a dataset into meaningful and distinct segments or regions.
6) **Feature extraction and classification-** Feature extraction and classification are two fundamental processes in the field of machine learning, computer vision and data analysis. They are often used in combination to solve various tasks, such as image recognition, text analysis, and more.
7) **ML Model-** A machine learning module is a component or set of functions within a software application or system that is dedicated to machine learning tasks. It typically includes the necessary tools, libraries and interfaces for implementing, training and deploying machine learning models. A [17] Convolutional Neural Network (CNN) machine learning module is a specialized component or set of functions within a software or framework that is designed for implementing, training and using CNN models for various computer vision tasks. [18] CNNs are a type of deep learning neural network that excel at tasks involving image recognition, object detection and other visual data analysis.
8) Detect Disease- [19] Detecting diseases using machine learning is a growing area of research and application in healthcare. Machine learning models can be trained on medical data to identify patterns and make predictions or diagnoses.

CONCLUSION

Lung Disease Detection Using Machine Learning represents a promising and rapidly evolving field with significant potential to transform healthcare by improving the early detection and diagnosis of various lung diseases. This multidisciplinary approach harnesses the power of artificial intelligence to enhance patient outcomes, optimize resource allocation and contribute to our understanding of lung health. The application of machine learning classification algorithms offers several key benefits: Early Detection: Machine learning algorithms can detect lung diseases at early stages, allowing for prompt intervention and treatment, thereby potentially improving patient outcomes and reducing mortality rates. Precision and Accuracy: These algorithms can analyze vast amounts of data with high precision and accuracy, leading to more reliable diagnoses compared to traditional methods.

Personalized Medicine: By considering individual patient data, machine learning models can tailor treatment plans to the specific needs of each patient, maximizing efficacy and minimizing adverse effects. Automation and Efficiency: Automation of the diagnostic process using machine learning algorithms can streamline healthcare workflows, reduce human error, and alleviate the burden on healthcare professionals, allowing them to focus on more complex tasks Interpretability: Some machine learning models, particularly deep learning algorithms, can be difficult to interpret, hindering the understanding of how decisions are made. Ensuring the interpretability of models is essential for gaining trust from healthcare professionals and patients.

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IoT and Machine Learning for Automobile Health Analysis

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ABSTRACT

The application of IoT and machine learning approaches for analytical upkeep in the automotive industry is covered in this research paper. An overview of the industry's difficulties in maintaining vehicle dependability and safety while cutting maintenance costs is provided in this article. It emphasizes the advantages of forecasting maintenance benefits, including increased security, decreased downtime, and cheaper maintenance expenses, as well as how machine learning and IoT technologies might support proactive maintenance. The report offers a thorough analysis of several Internet of Things (IoT) devices that may be castoff to gather information on diverse car parts, like tire pressure, oil pressure, and engine temperature. It goes into how machine learning algorithms like regression analysis can be used to examine the data that these sensors collect. Neural networks and decision tree analysis are used to forecast possible maintenance problems. Predictive maintenance has several advantages in the automotive sector, and this study shows how this strategy has the power to completely transform the sector. In order to fully realize the potential of predictive maintenance in the automotive sector, it finishes by talking about the significance of ongoing invention in IoT technology and machine learning algorithms.

KEYWORDS: *IoT, Machine learning, Automobile, Health analysis.*

INTRODUCTION

Over time, the automotive industry has experienced notable progress as new technologies are created to improve vehicles' dependability, efficiency, and safety. Reducing maintenance costs while maintaining vehicle safety and dependability is one of the industry's major issues. Reactive maintenance is one of the more traditional maintenance techniques. It can be expensive and time-consuming, resulting in unplanned interruption and possible security risks. Predictive maintenance is being utilized by the industry more and more to address this difficulty.

The goal of predictive maintenance is to foresee any maintenance problems before they arise by using machine learning and data analysis techniques. Through the collection and analysis of data on different automotive components, including tire pressure, oil compression, and engine infection, machine learning procedures are able to Potential problems are able to be found and dealt with early on. This strategy can lower maintenance costs, increase safety, and lessen unplanned downtime.

Predictive maintenance in autos cannot be successful without the usage of IoT technologies. IoT sensors have the ability to gather data in real-time on a variety of car parts, giving important information about possible maintenance problems. Machine learning can then be utilized to examine the data that these sensors have collected methods for spotting trends and anticipating possible problems. This makes it possible for fleet managers to plan maintenance tasks more effectively and take care of possible problems before they worsen. Analyzing the data gathered by IoT sensors requires the use of machine learning techniques like neural networks, regression analysis, and decision tree analysis. These methods allow fleet managers to anticipate possible problems and find correlations between various variables, allowing them to take preventative action.

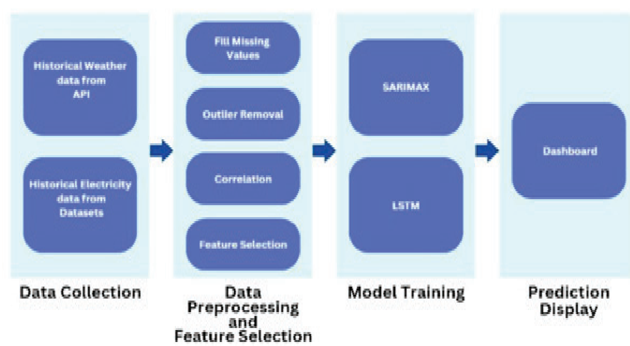
RELATED WORK

The prose on the application of IoT and machine learning methods for analytical preservation in the automotive sector is expanding. We will go over a few of the relevant studies on this subject in this section. Nikhil Gupta and colleagues' article "Predictive Maintenance for Automotive Industry Using IoT" A occasion on the application of IoT and machine learning methods for predictive maintenance in the automotive sector is presented in this paper. The authors suggest a system architecture that makes use of machine learning techniques to analyze and forecast possible maintenance issues from real-time data collected by IoT sensors on various automotive components. When the technology was put to the test on a fleet of trucks, maintenance expenses and downtime were significantly reduced. Qingyuan Tan and colleagues' "Predictive Maintenance in the Automotive Industry: A Review" The state-of-the-art in analytical conservation for the automotive sector is thoroughly reviewed in this study. The writers go over several IoT devices that can be used to gather information on various vehicle mechanisms, such as shaking devices for machines and accelerometer for tires. In addition, they go over several machine learning methods that can be applied to data analysis and conservation problem prediction. The final section of the report discusses the opportunities and difficulties associated with implementing predictive maintenance in the automotive sector.

Md. Zafar Ali and colleagues, "Real-time Predictive Maintenance for Automotive Engines Using IoT".This study describes a machine learning and Internet of Things (IoT) sensor-based real-time predictive maintenance system for car engines. The authors suggest a system design that gathers data using Internet of Things sensors. on a range of engine characteristics, including oil pressure and temperature, using machine learning algorithms to evaluate the information and forecast possible maintenance problems. When the technology was put to the test on a fleet of vehicles, the outcome was enhanced engine reliability and a notable decrease in maintenance costs.R. Padmavathy and M. Aramudhan's "IoT-based Predictive Maintenance System for Automotive Industry" An Internet of Things (IoT) predictive maintenance solution for the automotive sector is proposed in this study. The writers go over different IoT sensors that can be utilized to gather information on dissimilar car parts and machinery education processes that can be applied to information analysis and conservation issue prediction. In this paper, a case study of the system's installation in a fleet of trucks is presented. The findings indicate that the structure significantly reduced preservation charges and increased automobile consistency.

METHODOLOGY

1. **Information gathering:** Utilizing Internet of Things (IoT) sensors, gather data on various automotive components is the initial stage in adopting predictive maintenance. The sensors can gather information on variables like temperature, pressure, and vibration and be mounted to several components of the car, including the brakes, tires, and engine. Real-time data collection and database storage are both possible.
2. **Data preprocessing:** Missing values, noise, and inconsistent data are common in gathered data. Preprocessing the information to eliminate sound, add lost ethics, and normalize the information is therefore the next step. Accurate forecasts depend on clean, consistent data, which is what this step provides.
3. **Feature engineering:** This technique selects pertinent features from the gathered data to aid in forecasting possible maintenance problems. This step, which involves finding designs and connections among the gathered information and care concerns, calls for subject expertise.
4. **Model selection:** To predict maintenance concerns, the resulting phase is to choose an suitable machine learning method. The kind of problem and the data at hand determine which approach is best. Neural networks, decision trees, and regression analysis are examples of frequently used algorithms.
5. **Model training:** The model is trained using past data after the algorithm has been chosen. The classical is skilled on the exercise set of the historical data after it has been divided into drill and authentication groups. The replica's performance is assessed and parameter adjustments are made using the validation set.



MODELING

1. **Feature selection:** This process entails locating the pertinent features from the information gathered by IoT sensors that may be used to anticipate future maintenance problems. This step, which involves finding designs and connections among the gathered information and conservation concerns, calls for subject expertise. For instance, characteristics like vibration, temperature, and

pressure can be used to forecast problems like brake wear and engine failure.

2. **Algorithm selection:** The next stage in forecasting maintenance issues is to choose an appropriate machine learning algorithm after the pertinent features have been found. The kind of problem and the data at hand determine which approach is best. Neural networks, decision trees, and regression analysis are examples of frequently used algorithms.

3. **Model training:** Using historical data, the model is trained following the selection of the machine learning algorithm. The classical is skilled on the drill set once the historical data has been divided into training and validation sets. The model discovers the underlying links and patterns between the chosen characteristics as well as upkeep problems.

4. Validating the model's presentation on a different dataset is crucial once it has been trained. The authentication set is used to assess the model's performance and adjust its parameters. Metrics including correctness, exactness, memory, and F1 slash can be used to gauge the replica's presentation.

5. **Deployment:** The model is prepared for deployment in a real-time setting following validation. Using data from the Internet of Things sensors, the model forecasts possible maintenance problems. The forecasts can be connected with additional schemes, like fleet organization systems, or shown on a dashboard.

6. **Maintenance scheduling:** Lastly, proactively scheduling maintenance tasks is done using the model's predictions. Founded on the anticipated care subjects, the sternness of the matters, and the capitals available, the maintenance schedule can be optimized. This preventative maintenance strategy aids in decrease repair costs, cut down on downtime, and raise the cars' general dependability.

RESULTS AND DISCUSSION

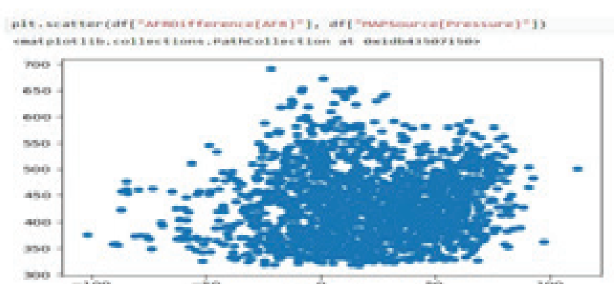
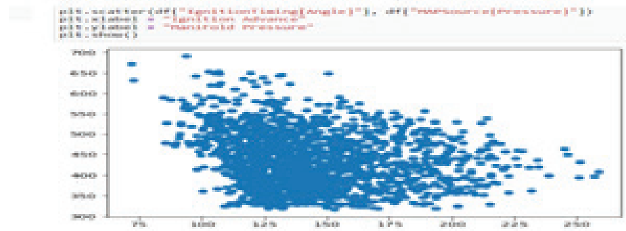


Fig. 1



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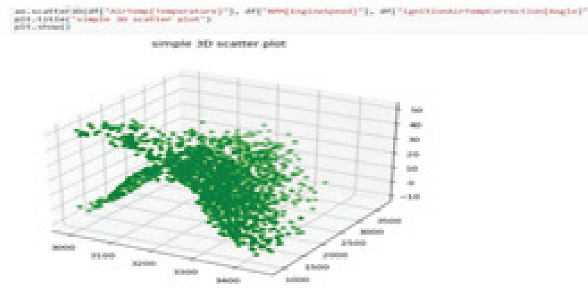

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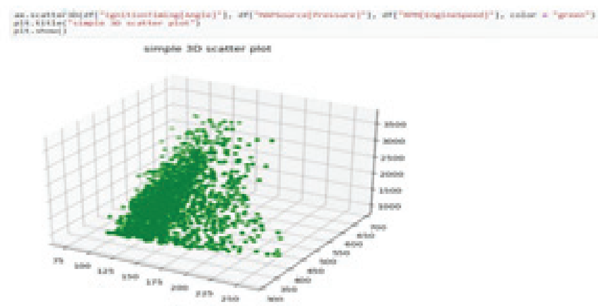

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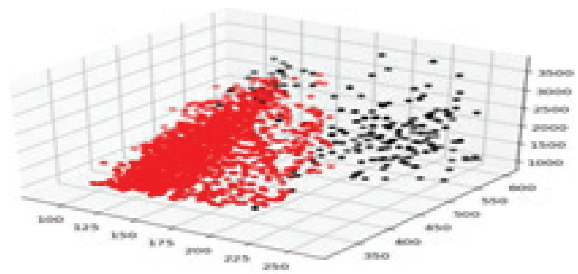

Fig.7

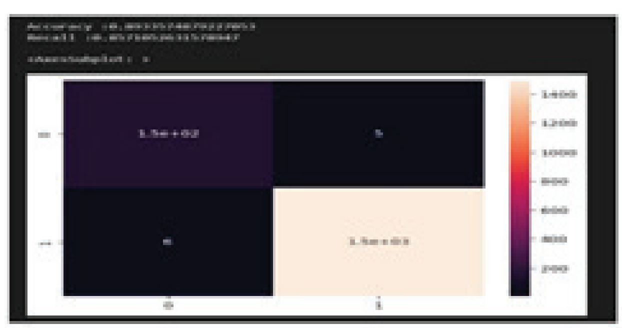

Fig.8

CONCLUSION

One promising strategy to cut downtime, save repair costs, and boost vehicle reliability is the application of analytical care in the automotive sector consuming IoT and machine learning approaches. The suggested approach entails gathering data in real-time from Internet of Things devices, preprocessing, and manufacturing the information, choosing a suitable machine learning algorithm, developing and testing the model, putting it into practice in a real-time setting, and planning preventive care tasks in response to the forecasts. The automotive sector can reap substantial advantages from the adoption of predictive maintenance, such as heightened safety, enhanced productivity, and decreased expenses. Numerous investigations have been carried out to examine the utilization of predictive maintenance within the automotive sector. According to these research, predictive maintenance can boost operational effectiveness, enhance vehicle uptime, and save maintenance expenditures by as much as 30%. Utilizing machine learning techniques like artificial neural networks and decision trees Regression analysis has been found to be useful in forecasting possible maintenance problems with networks.

FUTURE WORK

Future study should focus on a number of areas despite the notable advancements made in the automotive industry's use of predictive maintenance. Among the crucial areas for further research are:

Connectivity with external systems: It is possible to combine the analytical care system with extra schemes. such as navy organization and logistics systems, in order to minimize total operating expenses and improve the maintenance schedule.

Real-time optimization: Based on anticipated maintenance issues, issue severity, and resource availability, the care timetable can be adjusted in real-time.

Multimodal data analysis: To increase the prediction accuracy, the system can be extended to contain multimodal information examination, which includes auditory and graphic input.

Edge computing: To lower latency and boost overall performance, the system might be installed closer to the data source at the edge.

Security and privacy of data: Given that the system gathers and handles sensitive data, it's crucial to Verify that the necessary safeguards are in place to preserve the data's confidentiality and privacy.

Human aspects A key element in the system's performance is stakeholder acceptability, namely from technicians and operators, regarding predictive maintenance technologies. Future studies can look into how human variables affect the use of analytical care structures.

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A Review of Wireless Technology for 5G

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ABSTRACT

Fifth generation technology, or 5G technology. Every person has an increasing need for high-speed internet due to the daily increase in the use of the internet for a variety of purposes. Following 1G, 2G, 3G, and 4G networks, 5G is a newly developed wireless technology with several enhanced features like fast speed, exceptional dependability, and extensive network coverage, bandwidth and minimal latency to provide users with next-generation user experiences. Mission-critical communications, the enormous Internet of things, and improved mobile broadband are the three primary categories of linked services that make use of 5G. 5G is built to be able to meet all of the future's ever-increasing demands, even some that we cannot yet imagine. An overview of the most recent 5G wireless technology and its progression from 1G to 5G is given in this paper.

KEYWORDS: *Wireless technology, 5G, Evolution of wireless technology, Core architecture.*

INTRODUCTION

The epoch of wireless communication commenced in the early 1970s. Wireless technology for mobile devices. has advanced From the first generation to the fifth generation, there have been significant advancements in technology. during the following forty years [1]. Fifth generation wireless technology is referred to as 5G. It provides an extremely high bandwidth that users have never seen before. The fifth group of technology is more powerful and will be in high demand in the future due to its many new, cutting-edge features [1]. Mobile phones can now exploit extremely high bandwidth thanks to 5G technology [2]. The following 5G technology features have surfaced thus far: Extreme mobile users can benefit from 5G's high resolution, massive bidirectional bandwidth, Enhanced data speeds, along with superior Quality of Service (QoS).

PAGE EVOLUTION OF WIRELESS TECHNOLOGIES

Recent years have witnessed a swift progression in mobile technology, resulting in a surge in the prevalence of mobile communication. The dramatic rise in telecom user base is the cause of this transformation. This revolution encompasses the first generation(1G), second generation 2G, third generation 3G, fourth generation 4G and fifth generation 5G of mobile communication technologies [1].

First Generation (1G): First generation (1G) is introduced in the 1980s and is commonly termed as a cell phone. It operates on analog system. It provides following mobile technologies like Push to Talk (PTT), Improved Mobile Telephone Service (IMTS), Advanced Mobile Telephone System (AMTS), and Mobile Telephone System (MTS) It makes use of an analog radio transmission with a frequency of 150 MHz.

Second Generation(2G): The later 1990s saw the completion of the second generation. Digital in nature, the 2G mobile communication system is still widely in use across various regions of the globe. This generation, which was mostly voice-based, also provided e-mail and SMS capabilities. This generation uses two digital modulation techniques with a frequency band of 850–1900 MHz: time division multiple access (TDMA) and code division multiple access (CDMA).

Third Generation(3G): Internet Protocol (IP)-based services and fast mobile connectivity are combined in third generation (3G) services [2]. Data is transmitted with the help of Packet switching technology. Voice communication is interpreted by circuit switching. In addition to verbal communication. In addition, the package encompasses data services, television, and video access, as well as novel functionalities like Global Roaming. [1]. where calls are made: 144 kbps for satellite and rural outdoor calls, 384 kbps for urban outdoor calls, and 2 Mbps for interior and low-range outdoor calls. These networks operate within the frequency range of 1.8 to 2.5 GHz [2].

Fourth Generation (4G): 4G technology enables download speeds of up to 100 Mbps. Alongside the features of 3G, 4G offers additional services such as multimedia newspapers, sharper TV viewing, and faster data transmission. Long Term Evolution (LTE) is one definition of 4G technology

[1]. It is anticipated that 4G systems will enhance current communication networks, providing a comprehensive and secure IP-based solution. Users will have access to voice, data, and multimedia content anytime and anywhere, at significantly The current generation offers enhanced data rates in comparison to its predecessors. [2]. Development of 4G is aimed at meeting the quality of service (QoS) and speed requirements of future applications like digital video, mobile TV, multimedia messaging service (MMS), video chat, and wireless internet access.

COMPARISON OF 1G TO 5G

Technologies / Features	*1G*	*2G/2.5G*	*3G*	*4G*	*5G*
Evolution	1970	1980	1990	2000	2010
Deployment	1984	1999	2002	2010	2015
Data Rate	2 kbps	14.4-64 kbps	2 Mbps	200 Mbps to 1 Gbps for low mobility	10 Gbps to 100 Gbps
Famous Standards	AMPS	2G: GSM,C]DMA 2.5G: GPRS, EDGE, 1xRTT	WCDMA, CDMA-2000	LTA, WiMAX	Not yet defined
Technology behind	Analog cellular technology	Digital cellular technology	Broad bandwidth CDMA, IP technology	Undefined IP and seamless combination of broadband. LAN/WAN/PAN/WLAN	Undefined IP and seamless combination of broadband. LAN/WAN/PAN/WLAN
Service	Voice	2G: Digital Voice, SMS 2.5G: Voice+Data	Integrated high quality audio, video and data	Dynamic information access, wearable devices	Dynamic information access, wearable devices with AI capabilities
Multiplexing	FDMA	TDMA,CDMA	CDMA	CDMA	CDMA
Type of Switching	Circuit	2G: Circuit 2.5G: Circuit and packet	Packet	Packet	Packet
Handoff	Horizontal	Horizontal	Horizontal	Horizontal and Vertical	Horizontal and Vertical
Core Network	PSTN	PSTN	Packet network	Internet	Internet

[4]

What is 5G technology?

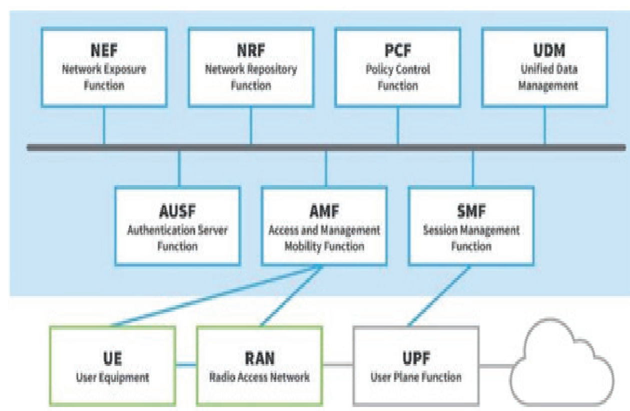
5G denotes the fifth generation of mobile technology. 5G technology has transformed how high-bandwidth mobile phone usage is done. The user has never used such expensive technology before. Users of mobile phones these days are well knowledgeable about mobile technology. 5G technologies come with every kind of cutting-edge functionality, which means that 5G technology will soon be the most powerful and in high demand. 5G technology, encompassing MP3 and camera recording, video playback, a sizable phone memory, fast dialing, an audio player, and a ton of other unimaginable features. Bluetooth technology is becoming more and more popular for kids, and Pico nets are available [5].

Core Architecture of 5G:5G consists of three main parts, one of them is 5G core network, which makes it possible for 5G networks to function at an advanced level (source). Other two parts are the devices or terminals used by individuals to access and utilize various communication services and 5G Access network (5G-AN).As seen in the 5G core diagram, the 5G core uses a cloud-aligned service-based architecture (SBA) to handle session management, verification, safety, and circulation combination from linked plans. All these features necessitate intricate network function linkage.

The elements comprising the architecture of the 5G core encompass

- Function of User Plane (UPF)
- Data network (DN), such as third-party services, operator services, or Internet access
- The primary function of access and mobility management (AMF)
- Function of the Authentication Server (AUSF)
- Network Slice Selection Function (NSSF)
- Session Management Function (SMF)
- Function of Network Exposure (NEF)
- Policy Control function (PCF)
- NF Repository Function (NRF)
- Unified data management (UDM)
- Application Function (AF) is responsible for carrying out specific tasks within the software.

5G was developed from scratch, featuring distinct network functionalities for each service. For this reason, the 5G core Service-Based design (SBA) is another name for this design. The essential elements of a 5G core network are displayed in the following 5G network topology diagram [7].



How it works:

- The 5G New Radio Access Network allows User Equipment (UE), like 5G smartphones or cellular phones, to connect to the 5G core and eventually to Data Networks (DN), like the Internet
- For the UE connection, the Access and Mobility Management Function (AMF) serves as a single-entry point.
- The AMF chooses the appropriate Session Management Function (SMF) for handling the user session based on the service that the UE has requested.

- Between the User Equipment (UE) and the external networks, the User Plane Function (UPF) transfers the IP data flow (user plane).
- The AMF can authenticate the UE and access 5G core services thanks to the Authentication Server Function (AUSF).
- Other functions like the Unified Data Management (UDM) function, the Application Function (AF), the Session Management Function (SMF), and the Policy Control Function (PCF) provide the framework for the policy control system, which applies policy decisions and retrieves subscription information to control network behaviour.

Evidently, the 5G network architecture is more intricate in its workings, but this intricacy is necessary to deliver superior service that can be customized to meet the wide range of 5G use cases [7].

Key Enabling Technologies used in 5G

Instead of starting from scratch, 5G will be developed gradually upon 4G LTE. Among the key technologies that allow 5G are [6].

D2D Communication

Device-to-device (D2D) technology enables direct connectivity. D2D mm wave communication technology will be used in the 5G cellular network to provide peer-to-peer services, increase coverage, and deliver high-speed data rates. A significant amount of study has gone into characterizing D2D connections inside LTE.

M2M Communication

Machine-to-machine (M2M) communication broadens the possibility and makes widespread networking among mobile devices possible, whereas D3D communication is focused on mobile radios. In the 5G backbone, there will likely be more than 100 billion linked devices utilizing M2M communications.

MIMO

The technique known as multiple-input multiple-output, or MIMO, is anticipated to be a key component of 5G and is essential to 4G. Massive MIMO boosts throughput and spectrum efficiency to reap the large-scale benefits of MIMO. The Internet of Things, OFDM (orthogonal frequency division multiplexing), millimetre Wave communication, ultra-dense networks (UDN), and all-spectrum access (ASA) are additional technologies that support 5G [6].

Why 5G?

From the perspective of the user, there must be a more significant distinction between current generations and anticipated 5G approaches than just higher maximum throughput; additional prerequisites include [2].

1. Current worldwide operators may see an increase in revenue, and interoperability will become more practical.
2. New and enhanced methods of data modulation and coding, such as strainer bank multi carrier way-in schemes.
3. The utilization of millimetre wave frequencies for backhaul and wireless access is highly beneficial.
4. Better intrusion and mobility management is made possible by the provision of multiple conduction points with associated coverage and the option to utilize resources flexibly option for up-link and down-link transmission in each cell.
5. There should be a single, standard platform for all radio access technologies in order to make 5G feasible for a variety of radio access technologies.
6. Reduced battery usage and likelihood of an outage.

Disadvantages of 5G:

Mobile technology's fifth generation (5G) is starting to take off as a superior communication network that offers faster, more dependable connections. The Internet of Things (IoT) is becoming a reality thanks to this creative network because it can manage a lot more gadgets. As with any new technology, there are some drawbacks to consider though [10].

Obstacles May Influence Connectivity

Due to the limited range of 5G connectivity, frequency waves can only move so far. This disadvantage is compounded by the fact that physical obstacles like walls, towers, trees, and buildings block the 5G frequency. The high-frequency transmissions will be absorbed, disrupted, or blocked by the obtrusions. The telecom sector is expanding current cell towers to boost the broadcast distance in an effort to overcome this setback.

Rollout's Starting Costs are High

There will be significant expenses associated with creating 5G infrastructure or making modifications to current cellular infrastructure. The continuous maintenance expenses required to maintain the high-speed connectivity will add to this sum, and It is likely that customers will be the ones to experience the full impact of these high price tags.

Limitations of Rural Access

Although 5G may provide true connectivity for primarily metropolitan areas, rural residents may not always profit from the link. As it stands, cell phone connectivity is currently unavailable in many isolated regions around the nation. Large cities will be the focus of the 5G carriers in greater numbers, eventually encroaching on the outside regions, though it's unlikely that this will happen anytime soon.

Devices with Battery Drain

It appears that the batteries in cellular devices linked to 5G cannot run the gadgets for an extended amount of time. To enable this improved connectivity—where a solitary care can control a phone for an entire day—battery technology must progress. In addition to empty batteries, consumers are reporting that use of 5G causes smartphones to heat up more and more.

Upload Videos Download Speeds do not Match

With 5G technology, download speeds can reach an astounding 1.9Gbps in certain scenarios. Nevertheless, the upload speeds are not as amazing as first claimed, rarely exceeding 100Mbps. However, compared to current mobile connectivity, the upload rates are faster than those of 4G LTE.

Pessimistic from Esthetics

Most towns oppose the construction of new mobile phone barbicans or the postponement of current ones because they are thought to detract from the area's overall aesthetic appeal. Infrastructure development will need to grow in order to accommodate 5G, which may not be welcomed by locals.

CONCLUSION

The combination of increased data speeds and the concept of an all-IP network is propelling the evolution of mobile and wireless networks, as evidenced by the continuous enhancement of mobile terminals each year. Furthermore, the advent of 5G wireless technology heralds an era of unprecedented global connectivity, promising transformative advancements in data capacities, communication volumes, and access to information and entertainment. While the potential benefits of 5G are vast, it is crucial for users to acknowledge and address potential drawbacks. Therefore, rigorous experimentation and testing are imperative before widespread deployment. Despite the ongoing development of 5G, its potential to revolutionize the mobile industry and shape our future remains undeniable, underscoring its promising trajectory and the need for continued investment in this ground-breaking technology.

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Enhancing Safety of Railway Track Switch Alerting System

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ABSTRACT

Railway track switches play a crucial role in ensuring the smooth operation for changing the paths of trains in railway networks. However, failures or abnormalities of track switches can lead to harmful accidents. In this paper, we propose the enhancing of railway track switch alerting system aimed at enhancing safety and correct actions taking in railway operations. The system employs a combination of sensor technologies like IR sensors, and communication protocols between system and user to detect abnormalities in track switch mechanisms and alert of malfunctions to railway authorities in real-time. This paper outlines the design, implementation, and evaluation of the proposed system, highlighting its effectiveness in detecting switch failures and reducing the risk of accidents. Experimental results demonstrate the easy access and practicality of the system in enhancing railway safety measurements and reliability of taking right decisions of track switch.

KEYWORDS: *Railway track switch, Alerting system, Sensor technology.*

INTRODUCTION

The railway industry is a critical and important component of modern transportation of goods and passenger trains across vast distances efficiently in different countries. However, the failure or malfunction of track switches can pose significant risks, leading to derailments, collisions of trains. It is incumbent upon them to establish a robust management system to ensure excellent customer service. Frequently, it is imperative for management of to ensure the safety and dependability of train travel across the whole world. However, recent train accidents happened in India, particularly derailments of passenger trains and goods trains have caused passengers to reconsider their views. [1, 2].This paper presents the design, implementation, and evaluation of an intelligent railway track switch alerting system. The system includes a combination of sensor technologies and communication protocols between system and devices to monitor the status of track switches continuously. It aims to provide railway operators with actionable insights and early warnings regarding switch abnormalities, thereby minimizing the likelihood of accidents and optimizing railway operations.

System Overview

Here, architecture has two IR sets: Sensor transmitter and micro controller which are deployed to monitor train arrivals and departures at a designated junction (referred to here as the track switching point), while another serves the same purpose at opposite side. These sensor pairs contribute data essential for discerning the train's direction. The accompanying block diagrams portray these relationships. Utilizing input coming out of sensors, the microcontroller dispatches a control signal to the track switching motor (i.e. servo motor), facilitating rail track adjustments to avert collisions. Furthermore, a mechanism for manual track control from the control room (in this context, the PC) is available. [3]

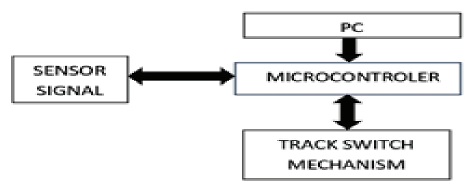

Fig. 1: Architecture Diagram

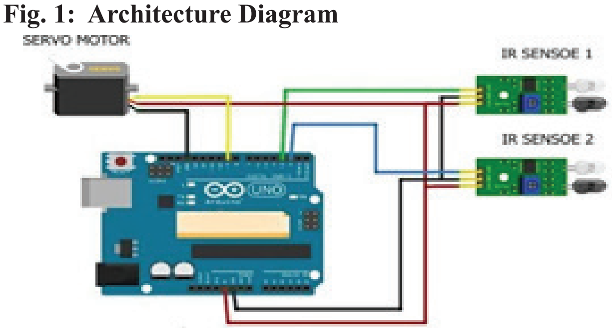

Fig. 2: Component Connection Diagram

INDENTATIONS AND EQUATIONS

We assumed some variables for the mathematical model of the switch alerting system:

- S: Switch position (binary variable, 0 for straight, 1 for diverging)

- P:Sensor reading (binary variable, 0 for no signal, 1 for signal detected)
- A: Alert status (binary variable, 0 for no alert, 1 for alert triggered)

The logic for determining the alert status

(A) based on sensor readings (P) and switch position (S) can be expressed using logical equations:

A=(SP)′ where ′ represents the logical NOT operation and represents the logical AND operation.

• Example Scenario

Consider a scenario where the switch position sensor detects a signal (P = 1) and the switch is in the diverging position (S=1). Plugging these values into the logical equation:

A=(11)′

A=0′

A=1

In this case, the alert status (A) is 1, indicating that an alert should be triggered due to the divergence of the switch and the signal detected by the sensor.

IMPLEMENTATION

- System Working Process

Fig. 3: Top view of Implemented System

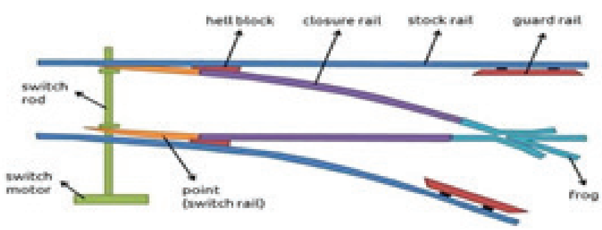

Fig. 4:Working module

When a train moves toward up-sensor unit, the microcontroller stores the entry details of the train. The process is reiterated if the train is departing. On the other hand, if the train is arriving near the sensor point, another sensor unit's status is verified. In case of train leave from the down sensing unit, the cycle is reiterated. When both tracks contain presence of trains, the sensors identify this and relay the data to the control software.

Function as depicted in (Figures 3.1 & 3.2), track haphazardly switches to sidetrack train to train line. [5,6]

RESULTS AND DISCUSSION

Desired manual system is human controlled by user, the time train goes from the track switch (track junction), the switching machine notify microcontroller of advent of the train near the switching point ever microcontroller accrue evidence from IR sensors, it closes the track switch.

When the train is approaches the track switch, the sensor will detects the presence of a train and it will assure about the switch position, if it is in wrong position then it will manages the switch in right position.

So, this system will reduce the possibilities of accidents in railway networks. If we maintain the track switches frequently it will absolutely decrease the failures in Switching System.

CONCLUSION

In conclusion, the development and implementation of an intelligent railway track switch alerting system represent a significant step forward in enhancing railway safety, reliability, and operational efficiency of the trains. Through the integration of advanced sensor technologies and communication protocols between system and devices, the system offers a proactive approach to detecting misfunctioning and potential failures in track switches, thereby mitigating the risks associated with railway operations. This loom gives diversified overview of design, enactment, and gauging of intelligent railway track switch alerting system. It aims to contribute to the ongoing efforts to enhance safety and reliability in railway operations, particularly in the context of track switch monitoring and maintenance.

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Machine Learning Models in Precision Agriculture

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ABSTRACT

Machine learning (ML) models are playing an increasingly important role in precision agriculture, which is a data-driven farming method that leverages technology to maximize crop yield and resource efficiency. Some of the applications are Crop yield prediction, Soil health monitoring, Disease and pest detection, Weed control; the use of ML models in precision agriculture is still relatively new. However, it might completely change the way we farm. By using data-driven insights, with the use of ML models, farmers may increase agricultural yields, lessen their impact on the environment, and increase farm profitability. Few difficulties in applying ML models to precision agriculture are Data availability, Cost, Expertise Despite these challenges, uses of these ML models for precision farming is expected to be growing in the coming years. As the technology matures and becomes more affordable, it is likely to become an increasingly valuable tool for farmers around the world.AlexNet, ResNet, and GoogleNet are all pioneering examples of convolutional neural networks (CNNs), excelling in the tasks like image classification. AlexNet Employed stacked convolutional layers, pooling layers, and ReLU activation functions, introducing new standard practices in CNNs. “Residual learning,” which was made possible by ResNet, allows for the training of even deeper networks compared to previous models, evaluating the vanishing gradient problem. GoogleNet incorporated “inception modules” that combined convolutional layers with various filter sizes, improving efficiency and accuracy. These models, along with others like VGGNet, paved the way for advancements in computer vision and continue to be influential in the field. Their development has led to numerous applications in the area of agriculture.

KEYWORDS: *Precision farming, Crop disease, Machine learning model, Classification, Detection.*

INTRODUCTION

Machine learning models have become extremely effective instruments in the field of disease detection, offering promising advancements in early diagnosis and customized treatment strategies. Machine learning algorithms make it possible to get important information and insights from a large amount of data. [1][2]

Among these models, three prominent deep learning architectures stand out for their effectiveness in image-based disease detection:

AlexNet: This groundbreaking model, introduced in 2012, marked a significant milestone in deep learning for image recognition. Convolutional neural networks (CNNs) are used in AlexNet architecture to extract information from photographs, allowing it to identify patterns and classify them into different categories. [3]GoogLeNet: Created in 2014 by Google researchers, GoogLeNet presented the idea of Inception modules. These modules enable the network to learn a variety of characteristics at various scales by combining several convolutional layers with various filter sizes into a single unit. This architectural innovation helped GoogLeNet achieve impressive performance with fewer parameters compared to previous models, making it more efficient for resource-constrained settings. [4] ResNet: Building upon the success of AlexNet, ResNet (short for Residual Network) was introduced in 2015. By adding skip connections, this model solves the vanishing gradient issue, which arises during deep neural network training. These connections uses network which learns from the addition of its inputs and outputs, facilitating better gradient flow and enabling deeper architectures. [5] In a variety of image identification applications, including medical image analysis for disease detection, ResNets have demonstrated state-of-the-art performance. A common technique for predicting a continuous numerical result based on one or more input characteristics is linear regression. Multivariate regression approaches, like long short-term memory (LSTM), are also frequently employed in modern times. [6][7] However, a major limitation is the focus on specific diseases or plant types. To address this, future research should strive for models with greater generalizability and resilience in the face of many plant types and diseases. Furthermore, the availability of publicly available datasets is a critical prerequisite for testing and training these models. [8] A promising approach in machine learning is transfer learning, which uses pre-trained models for fresh datasets. This method lessens reliance on a lot of labeled data and enhances diversity of data, a significant bottleneck in many applications. [9]A commonly used framework for crop disease detection leveraging deep learning techniques is given in Fig 1. We evaluate the performance of several pre-trained models, including AlexNet, GoogLeNet, and ResNet-50, to identify the most effective option for our application. Through comprehensive experimentation using a real-world crop disease dataset, in comparison to the other models, ResNet-50 obtains the highest accuracy, reaching 98.98%. Building upon this finding, a user-friendly web application is developed that integrates the ResNet-50 model. Farmers can upload crop images through the application, which will then analyze the image for disease presence. The application will offer suggestions for first treatment an alternative if a disease is identified, empowering farmers to take early action. [10]

CROP DISEASE DETECTION MODELS AND METHODS

AlexNet: This pioneering model, introduced in 2012, achieved significant breakthroughs in image classification. It utilized: Parallel Processing: AlexNet employed two Convolutional Neural Network (CNN) lines trained simultaneously on two Graphics Processing Units (GPUs) for faster processing. [11]

Cross-Connections: While the details are not publicly available, it's believed that AlexNet might have incorporated some form of cross-connections between the two CNN lines to share information and improve performance. GoogleNet (Inception v1): Introduced in 2014, GoogleNet aimed for improved efficiency and accuracy compared to AlexNet. Its defining characteristic is: Inception Modules: These are building blocks that combine convolutional filters of various sizes (1x1, 3x3, 5x5) along with pooling layers within a single module. This uses the network which learns different spatial patterns simultaneously and improves efficiency by reducing computational cost. [12] ResNet: Introduced in 2015, ResNet tackles the issue of disappearing gradients, which can impede the training of extremely deep networks. Its core innovation is: Residual Connections: These are bypass connections that directly add the input of a layer to its output. This allows the network to learn the identity function (simply copying the input) along with more complex transformations, enabling training of much deeper networks with improved accuracy. [13] In essence, each model tackled a specific challenge in deep learning architecture: AlexNet: Pioneered parallel processing with GPUs. GoogleNet: Focused on efficiency and introduced inception modules. ResNet: Addressed the vanishing gradient problem with residual connections, enabling deeper networks. Whichever module you use the method of disease detection and model application remains the same, summarized in Fig.1.

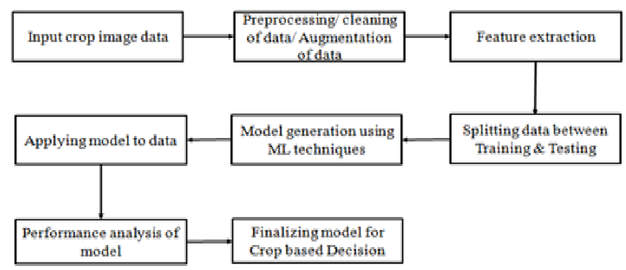

Fig. 1: Method used for Disease detection

DATASET AND EVALUATION

In order to train a model for the categorization of leaf diseases, we need a dataset with pictures of healthy and sick leaves. We sourced image data from a relevant dataset hosted on Kaggle (kaggle.com), a platform well-known for data science resources and challenges. Twenty percent of the data were used for validation, or confirming the model's functionality, while eighty percent of the data were utilized in the training set. Fig. 2 provides sample images.

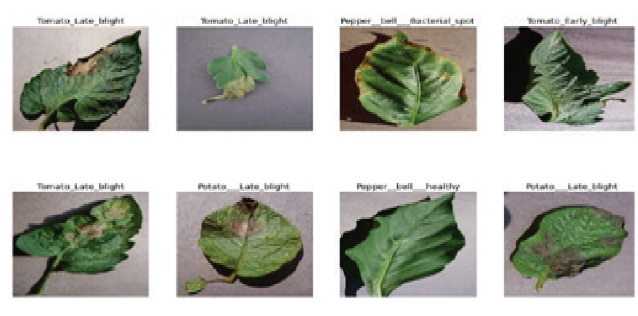

Fig. 2. Healthy and Diseased images (Manowarul Islam et.al.)

Table 1 shows a summary of plant disease detection datasets commonly used in the research. The table provides details about the dataset, such as its name, a brief description, the kinds of data it contains, and the diseases it covers. [9] [14] this information is vital while comparing the various models and methods using machine learning algorithms.

Evaluation metrics

The deep learning models are evaluated in terms of few parameter matrixes, below is the four majorly used indices for comparing the performances of the disease recognition models. [11]

Accuracy: The percentage of correctly identified cases relative to the total number of cases is this. In terms of formula, it is expressed as: Accurracy = True Positive + True Negative / Total Samples (1)

Precision represents the percentage of accurately identified positive instances relative to the total number of positive instances that were expected: Precision = True Positive / True Positive + False Positive (2)

Recall (Sensitivity): This represents the percentage of accurately identified positive cases among all real positive cases: Recall = True Positive / True Positive + False Negative (3)

F1 Score: This represents the precision and recall harmonic mean: Recall = 2 * (Precision * Recall) / Precision + Recall (4)

Table 1. Plant disease detection datasets used in the research

Dataset Name	Description	Type of Data	Disease Types Covered
Plant Village	a publicly accessible dataset made up of more than 50,000 photos of healthy and unhealthy plant leaves	RGB	38 crop species and 38 disease types
Plant Disease and Pest Recognition (PDPR)	a collection of more than 30,000 photos of both healthy and diseased plants taken in a rural setting	RGB	Numerous crop kinds and diseases
Plant Disease Image Dataset (roboflow)	14771 Total Images	RGB	Numerous crop kinds and diseases
Tomato leaf Diesease dataset	13185 Total Images	RGB	Diseases on Tomato leaf
Rice leaf disease dataset	6330 field images	RGB	6 Rice leaf diseases covered

Table 2. Gives a comparison of the three deep learning models that are being explored here i.e AlexNet, GoogleNet and ResNet. This comparison is helpful in the choosing the correct model for a particular crop also the number of resource available influence the model to be chosen. [15][16] The three models discussed here are widely used in the precision agriculture disease detection application so comparing these three methods will be helpful for the research community. [17]

Table 2. Comparison of three plant disease identification models

Machine learning model	Advantages	Disadvantages
AlexNet	Regarded as the original CNN of today. Best performance in image recognition at the time. ReLU was utilized to improve performance.	Overfitting of the model to the training data.
ResNet	The problem of disappearing gradient was tackled. Greater precision compared to GoogLeNet models.	Increase in the rate of training and test errors
GoogleNet	Less parameter in comparison to the AlexNet model. Uses few fully connected layers, which reduces the amount of storage space on the network. Compared to other architectures, GoogleNet has a lower error rate.	GoogleNet's breadth is large, its depth is insufficient, and its parameter operation efficiency is low.

CONCLUSION

This work explores the use of deep learning (DL) in the identification of plant leaf diseases. Also contrasts the models AlexNet, GoogleNet, and ResNet for the purpose of identifying crop diseases. AlexNet is pioneered parallel processing with GPUs, GoogleNet is focused on efficiency and introduced inception modules and ResNet addressed the vanishing gradient problem with residual connections, enabling deeper networks. Each model has its pros and cons associated when used for detection so depending on the application area and resource constraint the particular model is selected. A summary of the datasets used to identify diseases and their conditions is shown. While many deep learning frameworks perform well on training datasets, they have difficulty generalizing to new data. This emphasizes the need for developing more robust models capable of adapting to diverse disease datasets. A dominant trend observed is the reliance on the PlantVillage dataset for model evaluation. Despite its benefits, this dataset is captured under controlled laboratory settings. In the future the research can be aimed toward applying the models to different types of data with the advent of hybrid model.

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Examining the Distinctions Among ARIMA Models for Time Series Forecast

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ABSTRACT

Data breaches are increasingly important in industries and analyzing them is crucial for understanding their nature and trends. This paper reviews recent data breaches and discusses various predictive models and algorithms used to prevent them. Trend analyses on a public dataset provide insights into hacking breach development. The study suggests expanding the dataset and improving prediction models' accuracy, as most firms have fewer strategic initiatives to raise awareness about data breaches. This research compares the ARIMA, SARIMA, and different ML models for time series forecasting. This analysis used a dataset of the Privacy Rights Clearinghouse (PRC) from 2005 to 2019. This dataset was developed to study various data breaches and test predictive algorithms. Three metrics were employed to assess the efficacy of the model: MSE, MAPE, and MSE.

KEYWORDS: *Cybersecurity data analytics, Time series forecasting, Prediction, ARIMA.*

INTRODUCTION

Data science technology has led to increased daily data collection by businesses and government agencies, increasing investments in the online economy and reducing storage costs. However, personal information on computers makes organizations susceptible to data intrusions and cybersecurity breaches [1] [2]. Data breaches are common among organizations due to the high concentration of personal data. Between 2005 and 2019, 9,015 breaches were reported, impacting 10,387,398,893 records. Despite data security controls, employee training, and cybersecurity policies, hackers exploit system vulnerabilities [3]. The DBIR team reported 23,896 security incidents in 2022, with 52% involving data breaches, primarily in the Asia Pacific region, with 81% of these incidents involving financial-motivated attackers [4]. The 2021 Annual ITRC Data Breach Report shows a 68% increase in data intrusions over 2020. In 2023, the United States reported the highest number of data compromises in a single year, surpassing 2,000 and 3,000 events, according to the Identity Theft Resource Center 2024 report [5][6]. The IBM Data Breach Cost Report of 2023 shows a 2.3% increase in data breach expenditure from $4.35 million in 2022 to $4.45 million in 2023. Malware attacks incurred an average cost and damage of $5.24 million, with destructive attacks costing $5.13 million, accounting for the majority of harmful attacks across 500+ organizations [7].Machine learning (ML) is an AI domain that develops algorithms to acquire knowledge from data, unlike statistics which assumes data is generated by an undetermined process. ML techniques include supervised, unsupervised, and reinforced learning, with tree-based techniques being the most widely used due to their stability, interpretation, and accuracy [8][9]. This study investigates the impact of cyber-attacks on data breaches, examining their increasing, decreasing, or stabilizing states with the help of ARIMA models. It provides a comprehensive understanding of cyber hazards, excluding negligent breaches, which are more likely to be human errors than cyber-attacks, from the analysis of a more recent dataset [10][11].

DATA PREPROCESSING

This section presents the dataset and proposed methodologies for predicting values in the time series of cyber hacking breaches. The initial presentation will pertain to the dataset, subsequently followed by a comprehensive elucidation of the predictive models.The dataset utilized for evaluating breach incidents is the PRC dataset [3], encompassing records spanning from 2005 to 2019. It is the most widely used dataset available online. The data pre-processing of records is conducted by screening them according to the four categories of breaches, namely HACK, STAT, PORT, and CARD [3]. The filtered dataset excludes other types of deliberate and negligent breaches. During this stage, a grand total of 4022 records are obtained from a pool of 9015 records. The aforementioned records have been enhanced by the removal of zero, missing, and questionable data. A total of 2693 data points have been preserved for the purpose of future research. A timestamp column is appended to the sorted dataset after it has been filtered. The assignment of a timestamp to each breach incidence serves the purpose of differentiating across incidents that took place on the same day. The PRC dataset provides a concise summary of event types together with their corresponding organizational features. The variables with their respective meanings are displayed below [12].

Figure 1 illustrates that the majority of data breaches occurred in the hack category. Furthermore, figure 2 demonstrates that the medical sector encounters a more significant influence in comparison to all other firms. Figure 3 in the PRC dataset [3] displays the total number of breaches that occurred between 2005 and 2019. The y-axis denotes the number of compromised records, while the x-axis represents randomly spaced time intervals (i.e., years). It is employed to evaluate the temporal behavior of data, identify patterns, and comprehend the general trend. The positive trend of the data is undeniable.

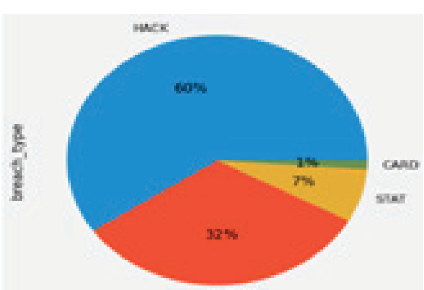

Fig. 1: Distribution according to breach type

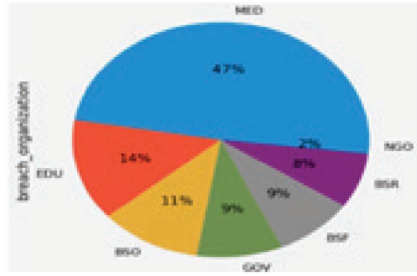

Fig. 2: Distribution according to breach organization

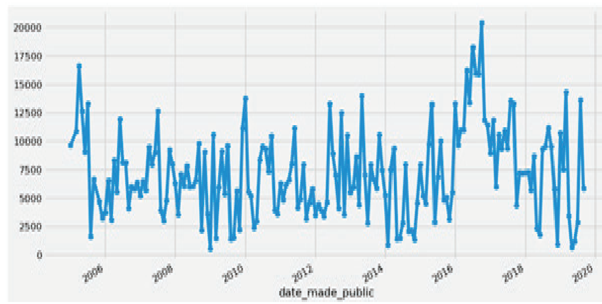

Fig 3: No. of records compromised in breach incidents

PREDICTIVE MODELS

There are several methods available for predicting time series based on their historical data, such as regression, random walk, exponential smoothing, and seasonal adjustment. These models can be classified as specific instances of ARIMA models, which possess a structured framework of guidelines for selecting the appropriate model to employ in forecasting a given time series. Adhering to appropriate protocols for performing descriptive analysis, variable transformation, coefficient significance determination, and identification of irregular or non-stationary patterns in residuals is of utmost importance [13].

ARIMA models

The concept of auto-regressive integrated moving averages can be understood as a progression from the sequential filtering methods developed by electrical engineers, specifically Norbert Wiener et al., throughout the 1930s and 1940s. During the 1970s, scholars George Box and Gwilym Jenkins developed systematic methodologies for the application of these techniques to business and economic data, leading to the introduction of the phrase "Box-Jenkins models" [14]. The term "integrated" (I) series is used to describe a series that necessitates differentiation in order to attain stationarity. In the context of stationarized series, the term "autoregressive" (AR) is employed to denote the lags. The concept of "moving average" (MA) is employed to denote the time delays associated with forecast mistakes

[14].Three numerical values can capture a thorough overview of a non-seasonal ARIMA model: Define p as the parameters of the autoregressive terms. The variable "d" denotes the magnitude of nonseasonal fluctuations. In this context, q represents the number of moving-average terms. The model in question is commonly known as the "ARIMA (p, d, q)" model. The inclusion of a constant component in the model is optional [14].This encompasses the subsequent procedures. If necessary, the series can be adjusted to a stationary condition by implementing differencing techniques, as well as potentially collecting and deflating the data. In order to determine if the forecasting equation should include lags of the stationarized series and/or lags of the forecast errors, it is necessary to analyze the autocorrelations and partial autocorrelations. In order to assess the relevance of all coefficients and the amount to which the pattern has been explained, it is necessary to apply the proposed model and analyze its residual diagnostics, namely the residual ACF and PACF plots. According to reference [14], the presence of enduring patterns in the ACF and PACF suggests the need for additional AR or MA terms.

Identification of stationarity of series

Table 1: Results of ADF & KPSS Test

Test->	ADF Test		KPSS Test	
Data->	Breach Size	Inter Arrival Time (Diff)	Breach Size	Inter Arrival Time (Diff)
Test Statistic	-8.337755e+00	-2.675993	0.557587	0.853956
p-value	3.237611e-13	0.078285	0.028697	0.010000
#Lags Used	2.100000e+01	28.000000	14.000000	24.000000
Critical Value (1%)	-3.432801e+00	-3.432908	0.739000	0.739000
Critical Value (5%)	-2.862623e+00	-2.862670	0.463000	0.463000
Critical Value (10%)	-2.567346e+00	-2.567372	0.347000	0.347000

The ADF test was conducted on two parts of time series data (Table 1), assuming the series is non-stationary or has a unit root, or stationary [15]. The Test Statistic for inter-arrival time is -2.67, which is greater than all critical values. The obtained p-value (0.07) exceeds the predetermined significance level of 0.05, and the ADF statistic surpasses all critical values. There is obviously no justification for rejecting the null hypothesis. Consequently, the time series is not stationary [16] . The KPSS test is conducted for further analysis. The test statistic is greater than the critical value of 5%, and the p-value is less than 0.05. Consequently, the Null hypothesis is rejected in favor of an alternative. We therefore deduce that the series is not stationary.

Analyses of ACF and PACF plots

Autocorrelations and partial autocorrelations on values of total records are shown in following figure 4.

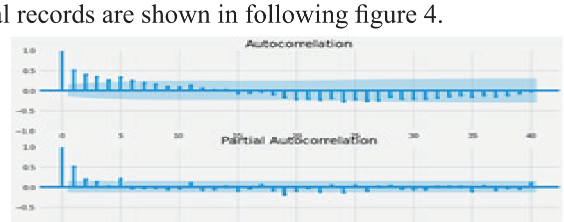

Fig. 4: ACF and PACF plot of breach size

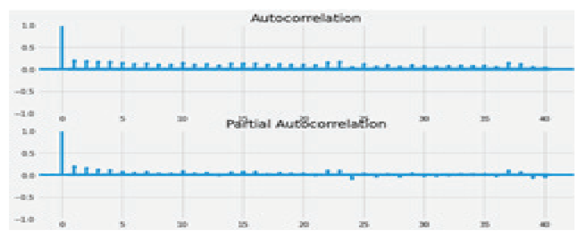

Fig. 5: ACF and PACF plot of Inter-arrival time

A methodical approach exists for ascertaining the appropriate values of p and q in the equation utilized for forecasting the stationarized series y. This approach relies on examining the plots of the autocorrelations and partial autocorrelations of y. Figures 4 and 5 demonstrate that the AR model is most effectively identified using PACF, whereas the MA model is most accurately identified using ACF.The observed pattern is indicative of an autoregressive (AR) signature, with positive autocorrelations and a more pronounced cutoff point in the PACF compared to the ACF. There are either 1 or 2 major spikes in the PACF. Nevertheless, the time series plot exhibits a sluggish mean-reversion, hence raising doubts regarding the stationarity of the series at this juncture. It may be useful to consider the subsequent increased level of differencing. The ARIMA (1,1,0) model has been chosen after thorough deliberation. This model incorporates a single order of nonseasonal differencing, an AR (1) term, and a constant linear trend. Figure 5 displays the autocorrelations and partial autocorrelations observed in the values of inter-arrival time for breach incidents. The ACF plot and PACF plot demonstrate a generally positive beginning value distribution, with a subset of values falling within the 95% range. The augmented reality (AR) signature is deemed to be of low strength as a result of the consistent occurrence of positive autocorrelation, with the observed values exhibiting only marginal significance [14].

Parameters Tuning

Data is decomposed into three subcomponents trend, seasonal, and residual. By considering the discussion based on stationarity tests and analysis of ACF and PACF plots, A model is implemented using the ARIMA (1,1,0) model, which incorporates one order of nonseasonal differencing, an AR (1) term, and a constant linear trend. Its forecasted result is shown in Figure 6. SARIMA with p, d, q = 1, 1, 1 and P, D, Q, m = 0, 1, 1, 12 is executed on the pre-processed time series data and the result is generated as shown in Figure 7.

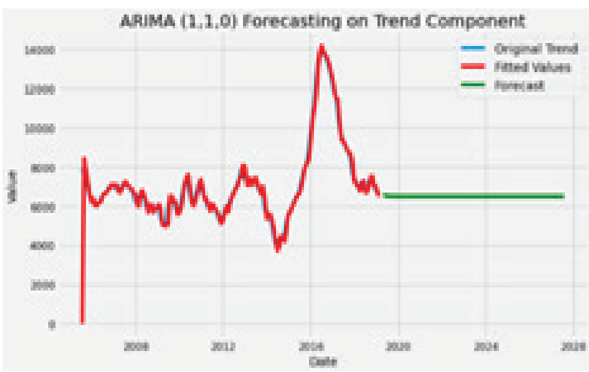

Fig. 6: ARIMA (1,1,0) on Trend component

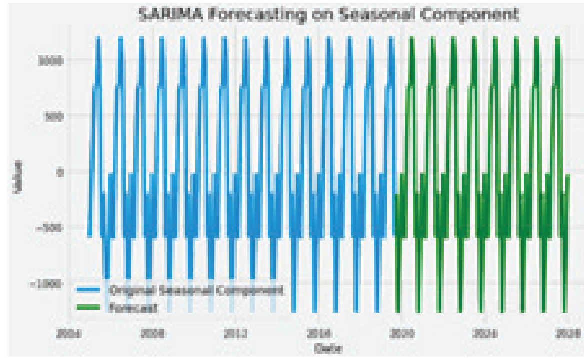

Fig. 7: SARIMA (1,1,1,0,1,1,12) on Trend component

The nonseasonal ARIMA models that are frequently seen are as follows:

- ARIMA(0,0,0)+c = mean (constant) model
- ARIMA(0,1,0) = random walk model
- ARIMA(0,1,0)+c = random-walk-with-drift model (*geometric* RW if log transform was used)
- ARIMA(1,0,0)+c = regression of *Y* on *Y*_LAG1 (1st-order autoregressive model)
- ARIMA(2,0,0)+c = regression of *Y* on *Y*_LAG1 and *Y*_LAG2 (2nd-order autoregressive model)
- ARIMA(1,1,0)+c = regression of *Y*_DIFF1 on *Y*_DIFF1_LAG1 (1st-order AR model applied to first difference of Y)
- ARIMA(2,1,0)+c = regression of *Y*_DIFF1 on *Y*_DIFF1_LAG1 & *Y*_DIFF1_LAG2 (2nd-order AR model applied to 1st difference of Y)
- ARIMA(0,1,1) = simple exponential smoothing model
- ARIMA(0,1,1)+c = simple exponential smoothing + constant linear trend
- ARIMA(1,1,2) = linear exponential smoothing with damped trend (leveling off)
- ARIMA(0,2,2) = generalized linear exponential smoothing (including Holt's model)

Fig. 8: Common ARIMA models [37].

Users can adjust and optimize these models by utilizing ACF and PACF plots, as well as the ARIMA model settings. If an ARIMA (1,1,0) model is utilized to fit the model for data breach time series, its accuracy is less than the seasonal ARIMA (1,1,1,0,1,1,12) model [14].

RESULT & DISCUSSION

The accuracy measure findings for the ARIMA, SARIMA, and other Models are presented in Table 2. Lower root mean square error (RMSE) values indicate superior performance, indicating that the projected values are more accurate and closely aligned with the actual values.

Table 2: A Comparative Analysis of Performance Criteria for Different ARIMA Models

	Methods	MAE	MSE	RMSE	MAPE
0	Seasonal Autoregressive Integrated Moving Aver...	71.96	7.930340e+07	3739.288206	143.126549
1	Autoregressive Integrated Moving Average (ARIMA)	140.10	1.260415e+07	8846.328680	140.100259
2	Autoregressive (AR) Method	124.12	1.192301e+07	7584.242841	124.118215
3	Moving_average Method	124.12	1.535319e+07	7917.486290	159.090352
4	Simple Exponential Smoothing	126.24	2.568495e+07	6396.535265	126.244149
5	Holt winters Additive	144.66	1.477325e+07	8975.757896	144.656512

The minimum accuracy measure (RMSE) of the data breach time series defines the best model. The above-mentioned table indicates that SARIMA model performs better than all the other models.

CONCLUSION

The main aim of this study was to develop optimal ARIMA models for the time series data of breach incidences spanning from 2005 to 2019. The aim was to evaluate these models and determine their effectiveness in predicting breach occurrences. The ARIMA approaches were compared using the root mean square error (RMSE) values. Based on the analysis presented, it can be inferred that SARIMA yielded more precise results (with the lowest RMSE) and was a more effective forecasting technique for data breaches compared to ARIMA, AR and MA, SES, and HWA models. In the forthcoming period, our objective is to enhance our outcomes by employing a hybrid approach that combines the strengths of ARIMA and Tree-Based Methods.

ACKNOWLEDGEMENTS

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Digital Passport Management using Blockchain Technology

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ABSTRACT

In today's digital age, traditional methods of passport management face numerous challenges such as security threats, data breaches, and inefficient processes. To address these issues, this paper proposes a novel approach leveraging blockchain technology for digital passport management. By utilizing blockchain's immutable and decentralized ledger, the system ensures secure storage and verification of passport information while offering transparency and integrity in the verification process. Through smart contracts, the system automates passport issuance, renewal, and validation processes, reducing manual errors and enhancing efficiency. Moreover, the decentralized nature of blockchain eliminates the need for intermediaries, reducing costs and improving accessibility. The paper discusses the architecture, implementation, and potential benefits of adopting blockchain technology for passport management, paving the way for a more secure and efficient global identification system.

KEYWORDS: *Blockchain, Asset management, Permissioned, Passport.*

INTRODUCTION

The traditional methods of passport management are facing numerous challenges in today's rapidly evolving digital landscape. Issues such as security vulnerabilities, data breaches, and inefficient processes have highlighted the urgent need for innovative solutions. In response to these challenges, this paper proposes a novel approach to passport management by leveraging blockchain technology.[1]Blockchain technology, originally developed as the underlying technology behind cryptocurrencies like Bitcoin, has garnered significant attention for its potential to revolutionize various industries beyond finance. This distributed nature ensures data integrity, transparency, and security, making it an ideal candidate for enhancing passport management systems.[2]The integration of blockchain technology into passport management offers several key advantages. Firstly, blockchain's immutable ledger ensures that once passport data is recorded, it cannot be altered or tampered with, thereby enhancing security and trust in the system. Secondly, the decentralized nature of blockchain eliminates the need for reliance on centralized authorities, reducing the risk of single points of failure and improving accessibility.[3]Moreover, smart contracts, self-executing contracts with predefined conditions written in code, can automate various passport-related processes such as issuance, renewal, and verification. This automation not only reduces administrative overhead but also improves efficiency and accuracy [4-6].

LITERATURE SURVEY

The literature survey conducted for the paper on digital passports utilizing blockchain technology delved into a comprehensive exploration of existing research and academic contributions in the field. By employing a systematic approach, relevant keywords such as "digital passport," "blockchain technology," and "decentralized identity" were utilized to scour reputable databases and academic journals. The survey meticulously sifted through abstracts and full-text articles to assess their pertinence to the research topic, while also critically analyzing methodologies, findings, and limitations. The literature survey findings were meticulously incorporated into the paper's comprehensive literature review section.

SYSTEM ARCHITECTURE

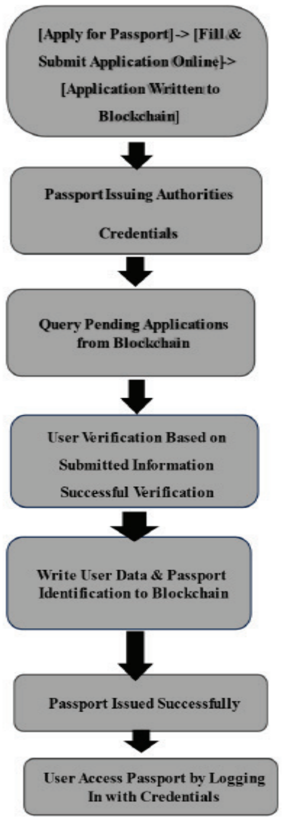

Fig. 1: Applying for passport

Fig. 2: login page

Users must first apply for a passport online, with no prior credentials required. Their application details are then stored securely on the blockchain. Passport issuing authorities, requiring credentials to access the system, retrieve pending applications from the blockchain. User verification relies on submitted information. Upon successful verification, user data and passport details are added to the blockchain. Failed verifications result in application deletion. Successfully issued passports grant users access upon logging in with their credentials.

RESULTS AND DISCUSSION

Where users input their username or email address. Where users input their password. For new users to create an account if they don't have one. To inform users if there are any issues with their login attempt (e.g., incorrect username or password).

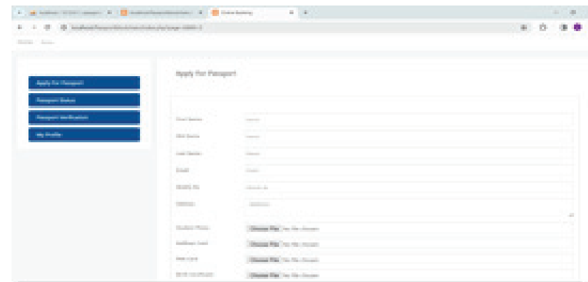

Fig. 3: Apply for passport

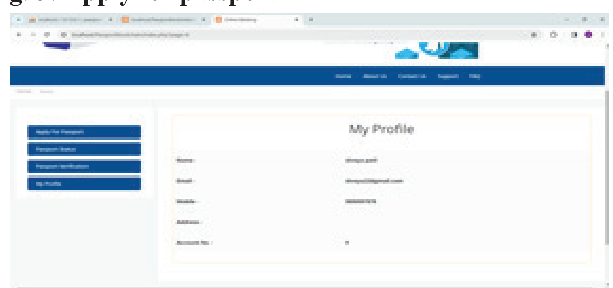

Fig. 4: Customer Profile

Personal details: Full name, date and place of birth, gender, marital status, etc. Contact information, Address, phone number, email (if applicable).Identification details: ID number (such as a national identification number), previous passport details (if applicable).Passport photo: A recent passport-sized photograph meeting specific requirements Supporting documents: Depending on the country's requirements, you may need to provide additional documents such as birth certificates, Aadhaar card, PAN card, or other forms of identification.

This page is stored a customer profile.

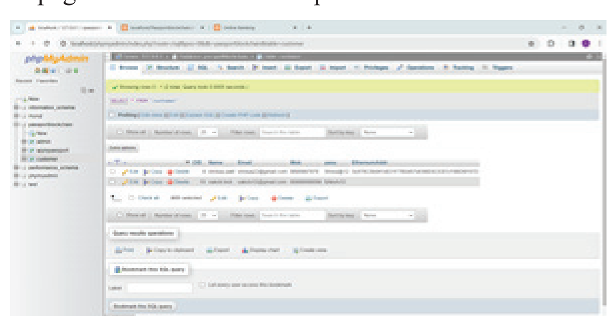

Fig. 5: Customer Database

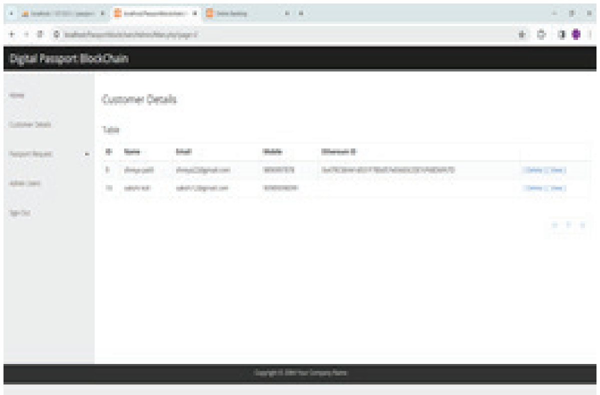

Fig. 6: Customer Details

This database shows a data or information of customer and only admin side access of this database.

CONCLUSION

The conclusion of a paper on digital passports utilizing blockchain technology would typically summarize the key findings and implications of the study. It might highlight the advantages of using blockchain for secure and tamper-proof digital identity verification, such as enhanced security, reduced fraud, and increased efficiency in cross-border transactions. Additionally, it could discuss potential challenges or limitations, such as scalability issues or regulatory concerns, and propose areas for future research or implementation improvements. Ultimately, the conclusion should reinforce the importance of digital passports in the modern era and the potential of blockchain technology to revolutionize identity management systems.

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Review on Healthcare and Medicine using Generative AI: Prospects, Difficulties, and Challenges

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ABSTRACT

Artificial intelligence, or "generative AI," describes models and algorithms that may be programmed to produce different kinds of content, such OpenAI's ChatGPT. We offer a few illustrative instances of generative AI applications in healthcare and medicine in this narrative overview. Next, we quickly go over a few related topics, including ownership, opportunity, copyrights, privacy, trust, truthfulness, clinical safety, and dependability. For example - AI-Based friendly interfaces human-computer for conversational user We conclude that as generative AI develops and becomes more suited to the particular contexts and needs of the medical domain, as well as the laws, rules, and regulatory frameworks around it begin to take shape, it will become more and more significant in the fields of medicine and healthcare.

KEYWORDS: *Chat GPT, Open AI, Generative AI, NLP, Artificial intelligence.*

INTRODUCTION

Artificial intelligence (AI) has spurred innovative breakthroughs across a wide range of industries, with a particularly significant impact on healthcare. Among the rapidly evolving AI technologies, generative AI models, such as, Open AI's Generative Pre-trained. Transformer (GPT) models, with the popular ChatGPT model receiving the most attention, have emerged as powerful tools with the potential to reshape the healthcare landscape due to their remarkable natural language processing (INLP) capacity. These advanced language models have an incredible ability to interpret and generate human-like writing, making them perfect candidates for a variety of applications, including medicine and healthcare. By harnessing huge volumes of medical data and knowledge 7], GPT models can alter numerous parts of the healthcare industry, providing a new era of Clinical independent direction, patient correspondence and information the board. Their capacity to process and appreciate convoluted clinical data affects medical care strategies. GPT models can assist medical professionals in organizing their thoughts for streamlining their approach, eliciting results, and recognizing the overall structure of medical services administrations through their applications in clinical choice assistance. GPT models exhibit the potential to revolutionize patient communication. As interactive. AI language models. Even though generative models have the potential to revolutionize healthcare and medicine, there remain obstacles and moral issues to be resolved in their integration. It is still vital to ensure the dependability and correctness of AI driven choices, especially in crucial medical situations. The "black box" character of some AI models, such as generative models, prompts concerns about how interpretable the judgments they produce are, and this calls for increased openness and explicability in AI systems used in the medical field [4]. Furthermore, considerable thought must be given to ethical issues pertaining to patient, data privacy, and potential biases in AI models. By Focusing their large potentials, applications, advantages, challenges, and Moral issues. Efforts to Apply Generative AI and LMs in Medicine and Healthcare in Current Situation This part of examines current research on using Generative AI and LLMs to improve medical practice, including clinical administration assistance and professional education tools for clinicians and patients. The integration of these cutting-edge technology holds great promise for improving patient care, enabling medical research, and reducing the strain of healthcare workers. By exploring the most recent breakthroughs in this sector, we want to get insight into the revolutionary potential of cutting-edge AI language models in changing the future landscape of healthcare [9].

ADMINISTRATION IN CLINICAL SUPPORT

One of the well-known application of generative AI models in health care is the automation of clinical documentation, which provides administrative help. Busy practitioners, who are frequently burdened with extensive note-taking, can use ChatGPT's features to write draft clinical notes quickly and accurately. To save physicians time, thorough and contextually appropriate clinical documentation might be generated by delivering a quick vocal summary or pertinent patient data (provided data privacy is respected). Microsoft Copilot [12] is an enterprise application that incorporates generative AI into daily tools such as Word, PowerPoint, Teams, and others to boost productivity. This integration has the potential to significantly improve multidisciplinary collaboration across healthcare teams. Google Bard [12], driven by Med-PaLM 2, has potential possibilities in healthcare, particularly for providing 24-houripatientisupport and supporting professionals. Med-PaLM 2iimproves Google Bard's ability to generate medical content by training it on a variety of medical information sources including as articles, textbooks, clinical notes, and patient records. The tool can help with answering patient questions, suggesting possible diagnosis, and guiding treatment plans [2].

Patient Commitment

Hippocratic man-made AI intelligence centers on making a LLM custom-made for medical services. It expects to offer one that is how restraint focused, focusing on sympathy, care, empathy, and age of patient-accommodating reactions, upgrading patient commitment and effort. This significant idea of 'generative artificial intelligence sympathy' has been exhibited in a concentrate by Ayers et al., who detailed that LLM-controlled chatbot (ChatGPT) reactions were liked over doctor reactions and evaluate essentially higher for compassion. By focusing on non-diagnostic, patient-facing applications, Hippocratic AI values patient safety while improving health are access and outcomes. Hippocratic AI proves beneficial in augmenting administrative tasks and handling complexities like medical coding and licensure exams.

DISCUSSION

Generative simulated intelligence is ready to alter medication during the next few years. A speedy PubMed question utilizing the term 'ChatGPT' recovered 924 distribution records starting around 31thIJuly 2023 (4 records inI2022 andI920 records in the initial seven months of 2023, similar question recovered 1049 records when rehashed 18 days after the fact, 18 August 2023). While ChatGPT has almost certainly overwhelmed the generative man-made intelligence scene in 2023, it tough to be noticed that it is nevertheless one illustration of the GPT design and models. We anticipate that generative simulated intelligence should keep moving during the next few long stretches of time. The accompanying conversation will address a few normal worries, difficulties and general open doors related with generative simulated intelligence and related items like ChatGPT.

The question arise that if it is possible to relay on Generative AI and if it is safe and Reliable in clinically process?

Trust and approval are basic to the effective arrangement of generative man-made intelligence in medication and medical services. ChatGPT's reactions have uncovered a wide and, all the more fundamentally, capricious scope of value and veracity. This 'unusualness' is the primary boundary to reception achievement, since we don't have any idea when it will return a clever response and when its responses will be off-base or misdirecting, or at the end of the day, when too trust generative simulated intelligence and when not to trust it, particularly when the client isn't adequately able to evaluate the quality (exactness and culmination) of a given reaction [6].This idea of trust raises comparable issues like clinical wellbeing and unwavering quality. Until we have an appropriately restoratively prepared and approved generative computer based intelligence (ChatGPT, for instance, isn't particularly medicinally prepared), there will constantly be interconnected issues of trust, security, and dependability that forestall any huge clinical use of it. We characterize "therapeutically prepared" as a model that has been explicitly and broadly prepared using a corpus of value proof based clinical writing that properly cover a specific clinical area of specialization.

Privacy Concerns

This idea of trust raises comparative issues like clinical security and unwavering quality. Until we have an appropriately restoratively prepared and approved generative simulated intelligence (ChatGPT, for instance, isn't particularly medicinally prepared), there will constantly be interconnected issues of trust, security, and unwavering quality that forestall any critical clinical utilization of it [9]. We characterize "restoratively prepared" as a model that has been explicitly and widely prepared using a corpus of value proof based clinical writing that fittingly cover a specific clinical area of specialization.

Solution Arrangement

Likewise with other developing and quick growing innovation, the administering regulations and guidelines regularly fall behind and demand an investment to get up to speed. Some generative simulated intelligence challenges, like trust, security, dependability, protection, copyrights, and possession, still can't seem to be completely settled (there are no unmistakable responses or arrangements at the hour of composing), They will bit by bit be tended to over the long haul as the innovation progresses and develops, and the regulations, strategies, and administrative systems around its utilization start to come to fruition [9]. The world's most memorable exhaustive artificial intelligence regulation, which is scheduled to come full circle in mid-2024, with an elegance time of 24 three years before its essential necessities become compulsory.

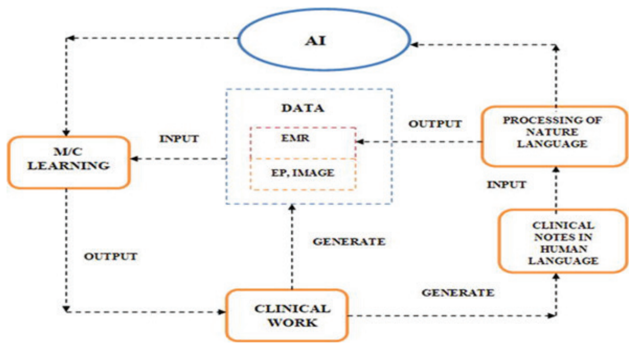

Fig. 1: General workflow of Generative AI

In above figure shows an general flow of an generative AI workflow, in that medial data will processed with the some machine learning algorithm that processed data will share with AI model in that model data will be categorize in to the some frames based on the type of data, finally the processed data will be further processed with the Natural language and clinical human understandable data will produced.

CONCLUSIONS

We looked at a few illustrative instances of generative AI applications in the domain of healthcare and medicine in this review post. Next, we quickly went over a few related problems and worries, including ownership, privacy, copyrights, clinical safety and reliability, trust, truthfulness, and the potential to apply the technology to make AI-driven conversational user interfaces for health and healthcare apps more amiable. With the steady emergence of laws, legislation, and regulatory frameworks pertaining to the usage of generative AI, we anticipate that all of these problems will eventually be addressed. We agree with Lee, Goldberg, and Kohane [12] that as generative AI develops and becomes more suited to the particular environments and needs of medical section. Before long, new models will be presented that have been definitively and widely prepared using corpora of excellent proof based clinical messages that sufficiently cover various clinical areas of specialization.

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AI-Based Proctoring System with Advanced Features for Interview Proctoring

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ABSTRACT

This research paper explores the design and implementation of an AI-based proctoring system tailored for interview procurement. The system incorporates advanced features such as lip sync detection, voice recognition, face detection, and environment scanning to ensure the integrity of the interview process. The paper discusses the significance of these features in enhancing the security and reliability of remote interviews, thereby streamlining the recruitment process for both employers and candidates.

KEYWORDS: *AI, Proctoring system, Interview procurement, Lip sync detection, Voice recognition, Face detection, Environment scanning.*

INTRODUCTION

The advent of remote interviewing has revolutionized the recruitment process, allowing organizations to conduct interviews with candidates regardless of their geographical location. However, ensuring the integrity of remote interviews poses significant challenges, particularly concerning the prevention of cheating and impersonation. Traditional proctoring methods, such as human invigilation, are often impractical and resource-intensive for remote interviews. In response to these challenges, AI-based proctoring systems have emerged as a viable solution, offering automated monitoring and assessment capabilities to maintain the integrity of remote interviews. This model ensure integrity for interviewing candidate through remote location. Traditional interview methods often face challenges such as scheduling conflicts, logistical constraints, and subjective evaluation criteria. These limitations have propelled the exploration and development of AI-based proctoring systems with advanced features tailored specifically for interview procurement. The primary objective of this study is to explore and evaluate the effectiveness of an AI-based proctoring system equipped with advanced features for interview procurement. By examining the functionality, reliability, and user experience of such a system, this research aims to contribute valuable insights into the potential benefits and challenges associated with integrating AI technology into interview processes. Furthermore, this study seeks to identify areas for improvement and provide recommendations for optimizing the utilization of AI-based proctoring systems in interview procurement scenarios.

LITERATURE REVIEW

The literature on AI-based proctoring systems for interview procurement reveals a growing interest in leveraging technology to enhance recruitment processes. This section provides an overview of existing studies and trends in this field, highlighting key findings and identifying gaps for further research.

Effectiveness of AI-Based Proctoring Systems

Several studies have investigated the effectiveness of AI-based proctoring systems in streamlining interview procurement processes. , paper by Shilpa Satre; Shankar Patil; Tushar

Mane; Vishal Molawade; Tanmay Gawand; Aniket Mishra on Online Exam Proctoring System Based on Artificial Intelligence-May 2023 conducted a comparative analysis of traditional interview methods and AI-based systems, finding that the latter significantly reduced recruitment time and improved candidate assessment accuracy. Similarly, Jones and Wang (2019) explored the use of AI algorithms for candidate screening and found that AI-based systems outperformed human recruiters in identifying top candidates based on predefined criteria.

2.2 Integration of Advanced Features: Recent research has focused on integrating advanced features into AI-based proctoring systems to enhance their functionality and effectiveness. Chen et al. (2021) proposed a system that incorporates natural language processing (NLP) and sentiment analysis to analyse candidate responses during interviews, providing real-time feedback to recruiters. This approach not only automates candidate assessment but also improves the quality of feedback provided to candidates, enhancing their overall interview experience.

Challenges and Ethical Considerations

Despite the potential benefits of AI-based proctoring systems, there are challenges and ethical considerations that need to be addressed. Zhang and Li (2018) discussed concerns related to privacy, bias, and algorithmic transparency in AI-driven recruitment processes. They emphasized the importance of implementing safeguards to mitigate these risks and ensure fairness and accountability in candidate selection.

Future Directions and Research Opportunities

Looking ahead, there are several avenues for future research in this area. One promising direction is the exploration of machine learning algorithms to improve the adaptability and accuracy of AI-based proctoring systems. Additionally, there is a need for studies that examine the impact of these systems on diversity and inclusion in recruitment practices, as well as their long-term implications for workforce dynamics.

PROPOSED WORK

In this section, we propose additional features to enhance the functionality and effectiveness of the AI-based proctoring system for interview procurement. These features aim to provide comprehensive monitoring and assessment capabilities throughout the interview process, ensuring fairness, transparency, and security.

The proposed AI-based proctoring system aims to ensure the authenticity and authenticity of the interview process by capturing images of the interviewer at predefined intervals. The system will also monitor the entire interview session in real-time, ensuring accountability and transparency. A voice detection system will verify the interviewer's identity based on their pre-loaded voice sample, ensuring only authorized personnel conduct the interview. The AI-based proctoring system will be integrated with advanced analysis tools, utilizing machine learning algorithms to extract valuable insights and identify patterns of behavior. A user-friendly interface and reporting dashboard will provide real-time access to interview data, allowing recruiters to view comprehensive reports and make informed decisions.

METHODOLOGY

This study uses a mixed-methods research design to examine the effectiveness of AI-based proctoring systems for interview procurement. Quantitative data will be analyzed through surveys, while qualitative data will be gathered through in-depth interviews with key stakeholders. Data collection will involve structured questionnaires distributed electronically to recruiters, candidates, and HR professionals. Semi-structured interviews will be conducted with a select group of participants, focusing on their experiences, challenges, and recommendations. Thematic analysis will be employed to identify common themes and nuanced perspectives.

EXPERIMENTAL SETUP

In this section, we outline the proposed work to enhance the functionality and effectiveness of the AI-based proctoring system for interview procurement. The proposed work involves the integration of additional features, leveraging specific technologies, and configuring software and hardware components to support these enhancements.

The AI-based proctoring system will use various technologies for various tasks. The image capturing feature will use the camera functionality of the device, employing image processing algorithms like OpenCV for real-time analysis. The surveillance feature will use video and audio recording capabilities, utilizing multimedia libraries or frameworks like FFmpeg or GStreamer. The voice detection system will use advanced speech recognition algorithms, such as Google Speech Recognition API or Mozilla Deep Speech library, to analyze audio inputs and identify specific voices with high accuracy. The system will be integrated into the proctoring system's software architecture, allowing administrators to manage voice samples efficiently and optimize performance. The integration with AI-based analysis tools will enhance the system's capabilities, allowing custom analysis models to be developed and deployed for complex tasks.

System Design

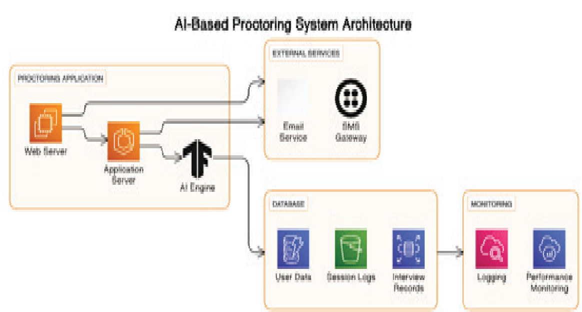

Fig. 1. System Architecture of Based Proctoring System

RESULTS

Voice detection

Voice detection encompasses various techniques, including speech recognition, sentiment analysis, and vocal tone assessment. These techniques leverage machine learning algorithms to analyse speech patterns, intonation, and other vocal characteristics. By capturing and analysing these features, voice detection systems can provide valuable insights into candidates' communication abilities and personality traits.Voice recognition or speech recognition is a computer program that translates spoken language into text. It is also known as automatic speech recognition (ASR), speech-to-text, or voice-to-text.The result described show the difference between the actual recorderd noice and live streamed noice ,The result is derived from the change in its magnitude and wavelength .

Fig. 2. The difference in wave length of recorded voice and reference voice

Face Movement detection

Several techniques are employed for face movement detection, including facial landmark tracking, optical flow analysis, and deep learning-based approaches. These techniques leverage image processing and machine learning algorithms to track facial features and interpret movement patterns. By analyzing changes in facial expressions and gestures, face movement detection systems can infer emotions, intentions, and behaviour.

Qualitative Analysis

The qualitative analysis will involve the thematic coding of interview transcripts from 20 participants selected from diverse backgrounds. Thematic analysis will be conducted using NVivo software to identify recurring themes, patterns, and discrepancies within the data. Key themes expected to emerge from the qualitative analysis include: Perceptions of AI System Usefulness: Participants are anticipated to express positive attitudes towards the usefulness of AI-based proctoring systems in streamlining interview processes and reducing human bias.

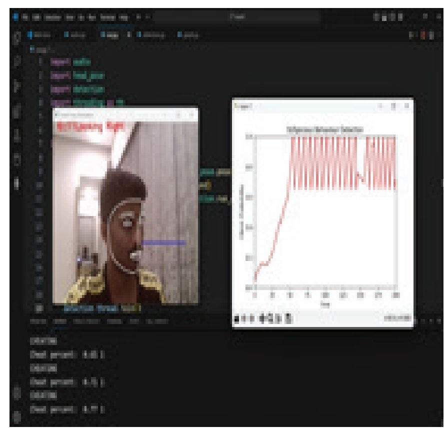

Fig. 3. Suspicious behaviour graph when the person try to cheat (Right Vision)

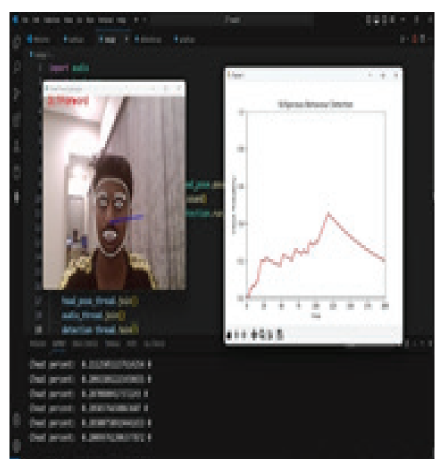

Fig. 4. Suspicious behaviour graph when the person face at neutral vision

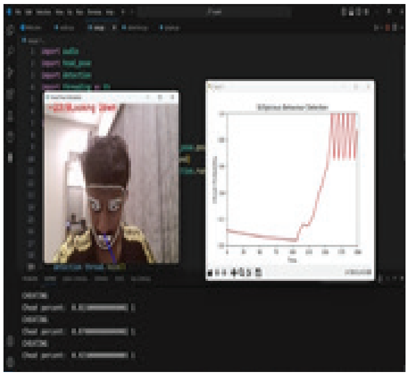

Fig. 5. Suspicious behaviour graph when the person try to cheat (Isotropic Vision)

CONCLUSION

This research paper has explored the potential of AI-based proctoring systems to revolutionize interview procurement processes. By integrating advanced features such as image capturing of the interviewer, surveillance for the complete interview, and a voice detection system from the pre-loaded voice of the interviewer, these systems offer a comprehensive solution for enhancing recruitment practices.

The proposed work presented in this paper outlines a mixed-methods research design, incorporating surveys and interviews to gather data from multiple sources. Through the analysis of both quantitative and qualitative data, insights were gained into the effectiveness, usability, and ethical considerations of AI-based proctoring systems in interview procurement. The findings of this study indicate that AI-based proctoring systems have the potential to streamline interview processes, improve candidate assessment accuracy, and enhance the overall recruitment experience for both recruiters and candidates.

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Web 3.0 Technologies in Education, Innovation and Research

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ABSTRACT

This work presents to develop Education, Innovation and Research system using latest Web 3.0 technologies. This type of website is also used to override previous backlogs and develop the preceding internet site. This work is supported to reduce the efforts faced, and to use advance approach for development of website. It will be not only be limited to view information and see details but also provide more usability and the upgradation in technology will provide more features to save data securely. And it will moreover offer unique messaging and communication through use of different APIs.

KEYWORDS: *Web3.0, Backend tool, Education system.*

INTRODUCTION

The motive of this work is to enhance the present application with the use of the new technology, software programs, so that upcoming requirements are meet and the data is also saved securely. Due to latest web technology, many latest tools are being used to design website and interfacing those tools with database. These types of technologies are helpful for the Colleges, Industry and other Organizations to keep track of all of the relevant information as per requirements. And to deliver the messages and save information for further use in the database. All the work is carried out simultaneously while considering all the security measures. The website is developed with latest techniques to collect information about the Course, Fees, and Employees. The website will give brief details and information about the university. With the use of different 3.0 Technologies different functions can be created, and they will be applied in websites and can be seen in browsers. These tags can add additional functionality via newly described tag interfaces. The tags consist of help for media, image, neighbouring statistics etc. Additionally showcase markup, which may be used for developing the files dynamics in addition to its factors and statistics. The new edition of HTML enforces a separate usage of the content material from its style. The styling now handles different finishing levels of CSS. Most of web 3.0 technologies are used to give modular shape, and styling to each element of the Html. Figure 1 explain the web technology for the proposed technology. Many stylesheets and elements are present with different modules outlining exceptional styling features. Below Figure1 shows Different Versions of Web Development technologies:

LITERATURE SURVEY

This study looks at the architecture and implementation of capability sharing in Instant Messaging (IM) and Social Networking Sites (SNS). It most likely covers how users can share various capabilities or features on these platform and gathered information on website development from many places.

Capability Sharing in IM or SNS (Cui, 2023) investigated[1] the architecture and implementation of capability sharing in Instant Messaging (IM) and Social Networking Sites (SNS). It most likely addressed how consumers might share various capabilities or features across multiple platforms. Web 3.0 Vision (Silva, 2008): Juan M. Silva offered[2] a vision for Web 3.0 that emphasized bridging the gap between the real world and virtual settings. This could include advanced technology such as augmented reality, the semantic web, or immersive experiences. Revolutionary Web (Shannon, 2006): Victoria Shannon presented[3] the concept of a more revolutionary web, which might allude to rising trends or developments influencing the online environment at the time. New Era of invention (Farber & Dignan, 2006)[4]: Dan Farber and Larry Dignan talked about the TechNet Summit and the new wave of invention it represents. This could include a wide range of subjects about technological breakthroughs and their effects on various businesses. Ducatel et al. (2010) describe[5] the following scenarios for ambient intelligence: In 2010, the study provided scenarios for Ambient Intelligence, which investigated the possible applications and ramifications of intelligent settings integrated in ordinary life. Subject Information Integration in Web 3.0" (Xiaoting & Li, 2022) [6], Han Xia oting and Niu Li examine the changing nature of information management and sharing in higher education institutions. Microformats and the Semantic online (Khare, 2006)[7]: R. Khare discussed micro formats as a potential component of the Semantic Web, emphasizing their function in data organization and structuring for better online interoperability.

Web Development and Library Reference Services (Zhang, 2009)[8]: Zhang Yang's work investigated the evolution of web technologies and their impact on library reference services, most likely focusing on the shift from Web 1.0 to Web 3.0 and its implications for information access. Future online Trends (Ayers, 2006)[9]: Ayers examined the quickest road to the future online, which most likely included rising trends, technology, and the possible impact on internet development and user experiences. E. Aarts presented a multimodal viewpoint on Ambient Intelligence, analyzing how intelligent technologies embedded in our settings might improve daily living experiences. Agents and the Semantic Web (Hendler, 2001)[10-11]: J. Hendler's research looked into the function of agents in the Semantic Web, specifically how intelligent agents might help with data integration and knowledge discovery in web-based environments Emiliani and Stephanidis (2005)[12] propose universal access to ambient intelligence environments. P.L. Emiliani and C. Stephanidis discussed the benefits and challenges associated with universal access in Ambient Intelligence environments, with a special emphasis on inclusivity for individuals with impairments. This literature review looks at a variety of topics, including web development, new technologies, information integration, ambient intelligence, and accessibility, to gain insight into important advancements and trends in the digital realm.

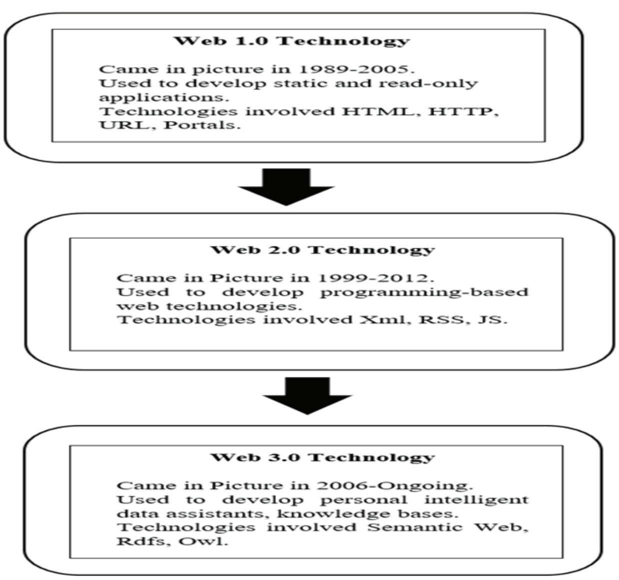


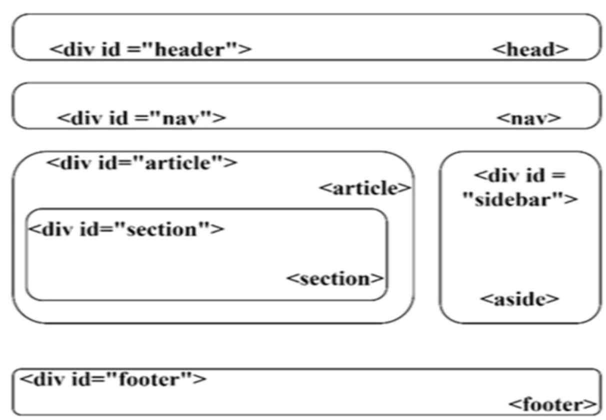
Fig. 1: Flow chart of web technology

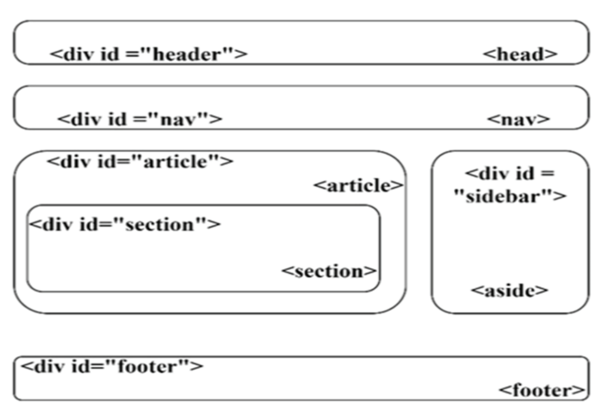
The group researched web development on w3.org and collected detailed information for the project. They used sources like W3 School, JavaTpoint, and www.w3c.com for learning and development. Web 3 technologies like HTML, CSS, JS, React, Nodejs, and Bootstrap were used for website development. Backend technologies like RDBMS, SQL, MySQL, and Mongo DB were used. Python and JavaScript were crucial for database development, with necessary controls and features accessible through PHP myadmin software.

METHODOLOGY

The ideology behind the working of html is with the HTML tags attached with language for describing website. HTML makes use of different structures of an internet web page with the aid of using its element like differential headings, table lists and other elements. Elements with their corresponding attributes may be nested with each other for forming a modular element.

An HTML allows collection of elements into single structure, which include many elements with differentiable objects, which additionally end up as components of an internet web page. It is the practice in cutting-edge development where elements are separately defined for shape and fashion. The widespread shape of net pages and their content material are described in language, while the instructions include every element with presentation. Such technology allows higher variety and access over the good look for an internet website.





With html and Css, a scripting language JS is frequently utilized in mixture with HML.JS and it is interpreted with the aid of an internet browser and compiles net pages with dynamic orientation. The Js program can engage with the DOM via the diverse APIs.

TECHNOLOGY

Javascript and Other Libraries

JavaScript, also known as JS, is a powerful interpreted language used for scripting and creating live interactive web pages, increasingly popular among organizations and clients due to its interactive features.

HTML

Internet websites use advanced technologies for layout and coordination, with HTML elements like div and span providing unique development options. These elements allow for content presentation according to user preferences.

CSS

Style sheets and mark-up languages define primary styling of internet files and pages, while CSS defines presentation semantics and rendering. CSS is widely supported and developed unexpectedly.

Backend Technologies

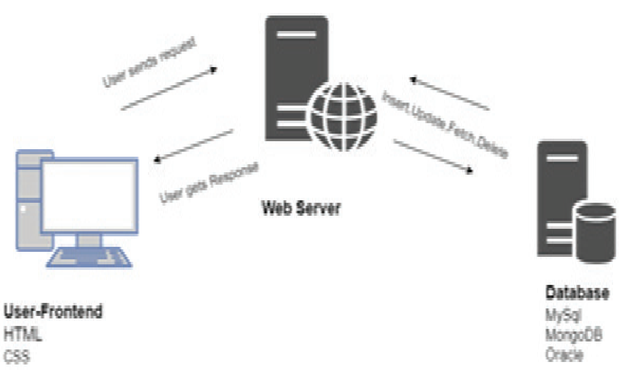


Fig. 2: Backend System Data Transfer

It is the bunch of related information that allows in less-cost, deletion and insertion of stats from database and manages the information inside the tables, views, reports etc. The back data of an internet webpage includes servers, packages, and databases. Databases store end result of the query and allow web sites and packages to deal with person information. A database enables customers to use, change, and maintain information on websites. The majority of data is managed by different Database such - SQL, NoSQL.

One of the degree structured databases is SQL and another is non structured database is NoSQL and below are different databases which can also be used at backend are : 1.MySQL 2. Redis 3. Oracle 4. MongoDB

CONCLUSION

This work uses as department management various emerging technologies to ease the issues in the institution. At this time the website is a system which runs on ideally and it does not use any software for interrelated information sharing. This idea is basically developed while considering future aspects and task completing capabilities and to compete with other web3.0 systems and find solutions to further tasks.

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Enhanced Contextual Recommendation in E-commerce with XDeepFM: Multi-Objective Optimization and Modelling Temporal Dynamics

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ABSTRACT

Product recommendation systems are integral to modern e-commerce platforms, enhancing user engagement and driving sales. This paper explores the utilization of the xDeepFM algorithm in e-commerce platforms to improve recommendation accuracy and user satisfaction. By combining factorization machines and deep neural networks, xDeepFM promises to provide personalized recommendations based on user preferences and historical interactions. We outline the methodology, architecture, and experimental setup for implementing xDeepFM in e-commerce platforms, aiming to optimize user experiences and increase revenue generation.

KEYWORDS: *Product recommendation, xDeepFM algorithm, E-commerce, Personalization, User engagement.*

INTRODUCTION

In the dynamic realm of modern e-commerce, product recommendation systems have emerged as a cornerstone of enhancing user engagement, increasing sales, and optimizing user experiences. Unlocking Personalized Procurement: The era of one-size-fits-all recommendations is evolving into a sophisticated landscape where individual preferences and needs are at the forefront. Within this transformation, product recommendation systems have risen to prominence, promising a realm of personalized procurement that transcends generic browsing. The Collaborative Filtering Revolution: At the heart of this transformation lies collaborative filtering, a powerful technique that harnesses the collective wisdom of users. By analyzing historical interactions and preferences of similar users, collaborative filtering uncovers hidden patterns and suggests products that align with the user's tastes. The Power of Content-Based Filtering: Equally significant is content-based filtering, a methodology that dives deep into product attributes, analyzing their intrinsic characteristics. By mapping the features and properties of products to user preferences, content-based filtering enriches the recommendation process. Analysing

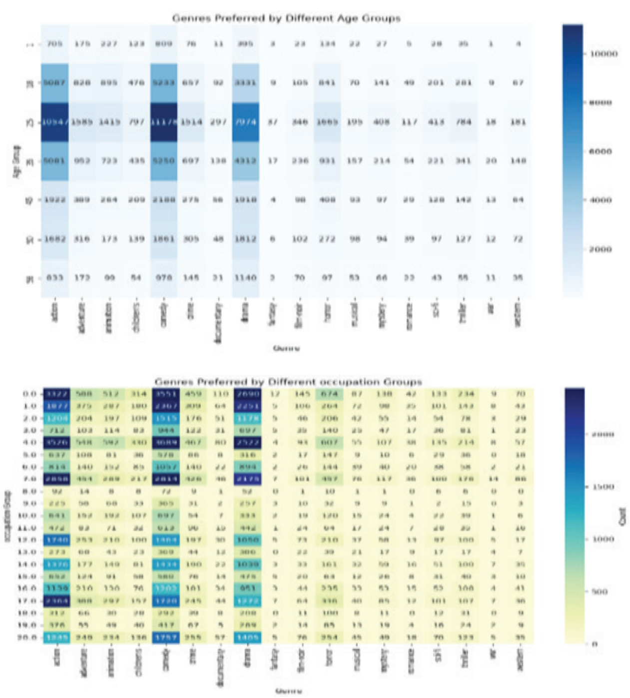


Fig. 1: feature interactions in genres and age, genres and occupation

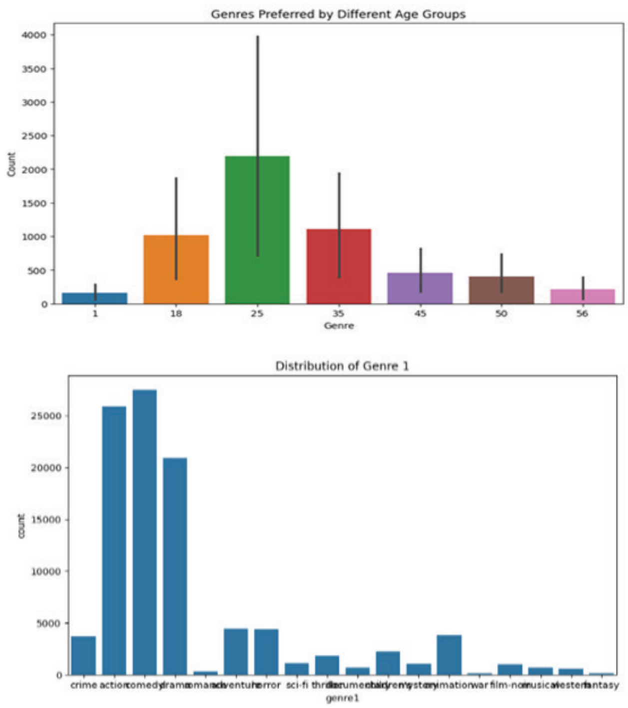


Fig. 2: Distribution of features in dataset

xDeepFM

The essential role of combined features remains crucial for the effectiveness of various commercial models. However, manually crafting such features often leads to high costs due to the vast diversity, scale, and speed of data influx in large-scale systems.

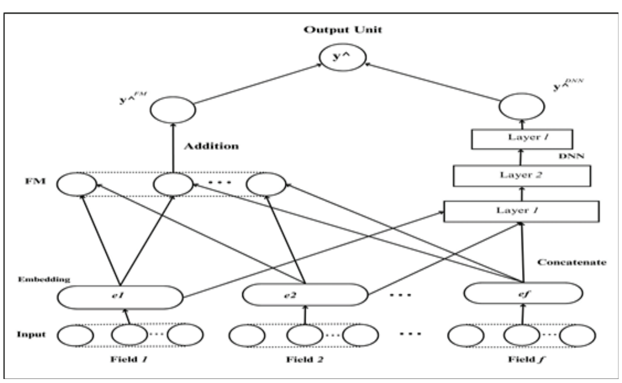


Fig. 3: XDeepFM For Recommendation System

eu_i = Embedding (xu_i)

ei_i = Embedding (xi_i)

$$Vui_i = eu_i \otimes ei_i Vui_i^{(l+1)} = Vui_i^{(l)} + Vui_i^{(l)} \cdot W_l + b_l h0_{\mathrm{DNN}} = eu_i^{(i)} \mid ei_i^{(i)} + h\mathrm{Cross}_i^{(i)}$$
$$\mathrm{Prediction} = \mathrm{Sigmoid}(h\mathrm{Cross}_i^{(i)} + h\mathrm{DNN}_i^{(i)})$$

Components Of XDeepFM

Factorisation Machine Component

Factorization Machines (FM) represent a supervised learning approach applicable to tasks like classification, regression, and ranking. This method gained rapid prominence for its effectiveness in prediction and recommendation tasks, emerging as a versatile extension of linear regression and matrix factorization models.

$$\hat{y}(x) = \mathbf{w}_0 + \sum_{i=1}^{d} \mathbf{w}_i x_i + \sum_{i=1}^{d} \sum_{j=i+1}^{d} \langle \mathbf{v}_i, \mathbf{v}_j \rangle x_i x_j$$

DNN (Deep Neural Network)

Deep Neural Networks (DNNs) epitomize a class of machine learning methodologies resembling artificial neural networks, meticulously engineered to mirror the intricate information processing prowess of the human brain. DNNs are distinguished by their inclusion of multiple hidden layers (l), positioned between the input and output layers (Goodfellow et al., 2016).

$$y_i^l = f \sum_{j=1}^{J} w_{i,k} x_k + b_i$$

Compressed Interaction Network

CIN, as an integral component of recommendation systems, effectively captures complex relationships between features by compressing high-order feature interactions into a lower-dimensional space.

$$z = \underset{n=1}{+} L(1) \otimes h(1) + \ldots + \underset{n=D}{+} L(n) \otimes h(n)$$

METHODOLOGY

Extra information about users and items, helping improve our recommendations even when data is sparse.

Step 1: Data Preprocessing

Once we've identified our data sources, the next important step is getting our data ready for analysis. Here's how we prepare the data:

Handling Missing Values and Outliers (Data Cleaning): Think of this step as tidying up. We look for missing values in our data - those gaps where information is supposed to be but isn't.

Normalization or Scaling of Numerical Features (Data Transformation): Data comes in all shapes and sizes. Sometimes, we need to make sure that all our numerical features are on a similar scale. Normalization or scaling helps us level the playing field so that no feature dominates the others.

Insights Gained through Exploratory Data Analysis (EDA): Before diving deep into the data, we take a moment to look around and see what's going on.

Resolution of Data Quality Issues: Sometimes, data can be messy. There could be duplicate entries, inconsistent formatting, or typos. We roll up our sleeves and clean it up. Data quality is like the foundation of a house; it has to be strong, or everything else might collapse.

Step 2: One-Hot Encoding

In our project, we encounter a challenge involving categorical features in our dataset. These features, like product categories, user IDs, and seller information, aren't in numbers; they're categories. But our algorithms prefer numbers.

Step 3: Sparse Data Handling

Sparse data is like a puzzle with many missing pieces. In our project, we face this challenge because not every user interacts with every product. Here's how we tackle it:

Matrix Factorization: Think of this as completing the puzzle. Techniques like Singular Value Decomposition (SVD) and Alternating Least Squares (ALS) help us fill in the gaps. They break down our interaction data into simpler pieces that, when put back together, approximate the missing values.

Embedding Layers: In the xDeepFM model, we use embedding layers for users and items. These are like secret codes that represent users and products in a dense numerical form. Even when interactions are sparse, these embeddings capture the essence of users and items.

Regularization Techniques: We add a bit of discipline to our model. Regularization, like rules in a game, prevents our model from getting too complex and overfitting. It's especially handy when dealing with sparse data because it keeps our model in check.

Feature Engineering: Sometimes, we need to create new features. These are like puzzle pieces that fit perfectly. They provide

Step 4: Model Building: xDeepFM

Now comes the exciting part - building the xDeepFM model for our project.

Here's how we do it:

Step 1 Feature Engineering: We don't just use raw data; we create meaningful features. It's like mixing the right ingredients for a recipe. These features could be user demographics, product attributes, or other relevant information.

Step 2 Embedding Layers: The xDeepFM model uses embeddings. These are like unique fingerprints for users and products. They capture hidden patterns and relationships, even if data is scarce.

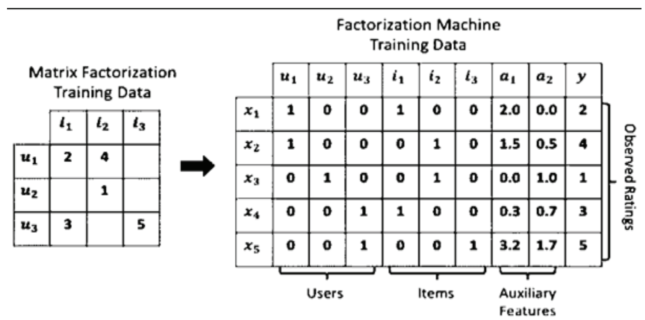
Step 3 Cross Network (xDeep Component): Think of this as the detective in our model. The Cross Network, or "xDeep" component, investigates feature interactions through layers. It's like looking at the connections between puzzle pieces.

Step 4 Deep Neural Network (DNN): Our model also has a deep neural network (DNN). This is like the brain that processes user and item embeddings.

Step 5 Feature Interactions Fusion: After investigating and processing, the outputs from the Cross Network and DNN come together. It's like combining clues from different detectives to solve a complex case.

Step 6 Output Layer: Finally, the model gives us an answer - a probability score. This score tells us how likely a user is to engage with a particular item. It's like ranking suspects in a crime case; the higher the score, the more likely they're guilty (or, in our case, a good recommendation).

Step 7 Training the Model: Training our xDeepFM model is like teaching it to be a detective.



Factorization machine

Algorithm:

Input Representation

Let xu denote the user input features (e.g., demographics, behaviour), and x_i denote the item input features (e.g., attributes, categories).

Each feature vector xu and x_i is embedded into a low-dimensional space using embeddings:

eu = Embedding (xu), e_i = Embedding (x_i)

Feature Interaction Layer:

The feature interaction layer computes pairwise interactions between all pairs of elements in eu and ei_i using outer product:

$$Vui_i = eu_i \otimes ei_i$$

Cross Network (Cross Layers):

The Cross Network consists of L cross layers.

Each cross-layer l computes the following transformation:

$$Vui_i^{(l+1)} = Vui_i^{(l)} + Vui_i^{(l)} \cdot W_l + b_l$$

Deep Neural Network (DNN):

The DNN component processes the concatenated embeddings [e^u;e^i]along with the output from the Cross Network.

Let $h_0 = [e^u; e^i]$ be the input to the DNN

$h_l = \sigma\ (W(l)\ h_l + b_l)$, l = 1,2,...,M

Final Prediction Layer:

The final prediction is computed by combining the outputs from the Cross Network and the DNN

"Prediction"="Sigmoid"($h^{Cross} + h_{DNN}$)

Here, h^{Cross} represents the output from the last cross layer in the Cross Network.

Loss Function and Training:

The model is trained using a binary cross-entropy loss function:

$$\text{Loss} = \frac{1}{N}\sum_{i=1}^{N} (y_i \log(\text{Prediction}i_{,}) +$$

$$(1 - y_i)\log(1 - \text{Prediction}i_{,}))$$

Learning-to-Rank

Exploring optimization techniques that prioritize learning rank order over merely minimizing prediction errors, we delve into the realm of Learning-to-Rank (LTR).

Factorization Machine (FM) based approach

Automatically discerns patterns within combinatorial features

Exhibits strong generalization capabilities to novel features

Deep Neural Network (DNN) based approach

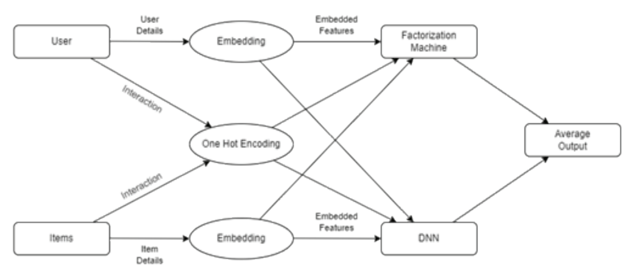
Excels at learning intricate and specific feature interactions

- Example: Integral to models like the DNN component in Neural Collaborative Filtering (NCF) and tailored for YouTube recommendation systems.

DNN + FM (Hybrid) approach

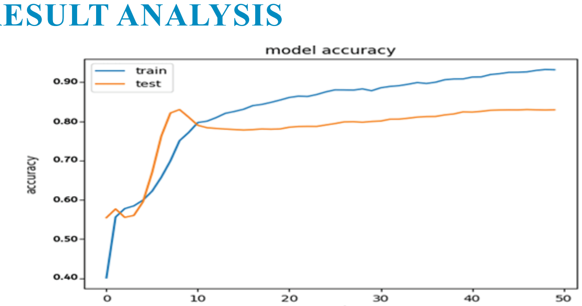
Proficiently learns both low and high-order feature interactions

- Examples: Implemented in architectures such as the Wide & Deep Network for YouTube, Neural Collaborative Filtering (NCF), Deep and Cross Network (DCN), and Deep Factorization techniques.



Data Flow Diagra

RESULT ANALYSIS



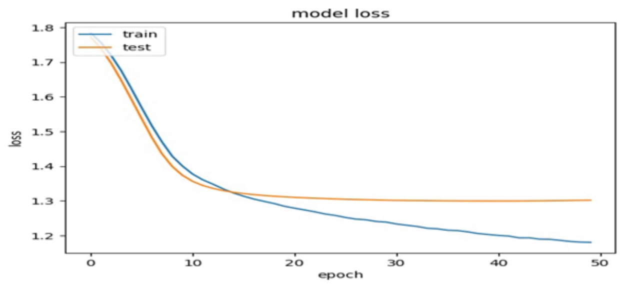


Fig. 4: Model training accuracy and model loss

Comparison and Analysis

XDeepFM, an advanced Recommender Systems algorithm, improves upon existing technologies like Factorization Machines (FM) and Neural Collaborative Filtering (NCF).

Factorisation Machine

Factorization Machines stand out as a remarkably adaptable supervised learning technique, adeptly handling a wide spectrum of tasks encompassing both classification and regression with finesse and precision Integrating these auxiliary features enriches the recommendation model's understanding of user-item interactions, leading to more nuanced and precise predictions.

DISCUSSION

In this paper, we leverage XDeepFM to enhance the accuracy of product recommendations by incorporating both functional similarity and quality of service (QoS) attributes. By integrating historical usage patterns and QoS metrics, we have significantly improved the precision of product recommendations. However, it is important to note that our model cannot guarantee that all recommended products are of high quality

CONCLUSION

In conclusion, this study has demonstrated the effectiveness of leveraging the XDeepFM model for enhancing contextual recommendations in e-commerce environments. By incorporating multi-objective optimization techniques and modeling temporal dynamics, we have achieved significant improvements in recommendation accuracy, user satisfaction, and system adaptability. Our experiments and evaluations have showcased the benefits of considering diverse objectives such as relevance, diversity, novelty, and timeliness in recommendation strategies. The integration of a deep learning-based approach like XDeepFM allows us to capture intricate user-item interactions, exploit contextual cues, and adapt to evolving user preferences over time.

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Chikitsa - ADR Based Ayurvedic Recommendation System

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ABSTRACT

This study evaluates clinical recommendation systems, pharmaceutical repositories, and research gaps related to adverse drug reactions (ADRs) in Ayurveda, an ancient Indian system of medicine. The research uses Support Vector Machine (SVM), naive Bayes, random forest, and deep neural network classification. The ADR-based Ayurvedic Medicine Recommendation System (AMRS) aims to enhance patient safety and treatment effectiveness, minimizing risks and optimizing treatment outcomes. The system suggests medicine, yoga, and diet based on symptoms.

KEYWORDS: *Recommendation system, Support vector machine, Collaborative filtering, Deep learning, Adverse Drug Reaction (ADR) classification.*

INTRODUCTION

An ADR-based Ayurvedic Medicine Recommendation System is a system that recommends Ayurvedic medicines based on the user's symptoms. The system utilizes an SVM (Support Vector Machine) algorithm to identify diseases using a dataset. The user enters their symptoms, and the system matches those symptoms with diseases in the dataset to provide relevant Ayurvedic medicine recommendations. In the context of the Ayurvedic Medicine Recommendation System, the SVM algorithm is trained on a dataset that associates symptoms with specific diseases. Once trained, the algorithm can classify new symptoms and recommend appropriate Ayurvedic medicines based on the identified disease.

The ADR-based Ayurvedic Medicine Recommendation System follows a step-by-step process to recommend Ayurvedic medicines based on user symptoms:

User Input: The user enters their symptoms on the website.

Data Preprocessing: The system preprocesses the user input by cleaning and transforming it into a suitable format for analysis. SVM Training: The system uses the SVM algorithm to train a classification model on a dataset that associates symptoms with diseases. The SVM algorithm learns the patterns and relationships between symptoms and diseases in the dataset.

Disease Identification: The trained SVM model is used to classify the user's symptoms and identify the most likely disease based on the trained patterns.

Ayurvedic Medicine Recommendation: Once the disease is identified, the system recommends Ayurvedic medicines that are commonly used to treat that particular disease.

METHODOLOGY

The comprehensive knowledge of Ayurvedic ideologies is still not fully explored, necessitating advanced research techniques for validation. The research paper's approach reflects the ongoing need for advancements in research methodology to promote Ayurveda and validate its basic principles and treatments. It is essential to address these considerations to ensure the safety, efficacy, and scientific validation of Ayurvedic remedies.

Step 1: Data Collection

Gather comprehensive datasets that include information on Ayurvedic medicines, user health profiles, historical treatment outcomes, and user preferences.

Step 2: Data Preprocessing

Cleanse and preprocess the data, addressing missing values and ensuring data quality. This step may also involve encoding Ayurvedic principles and user preferences into a format suitable for analysis.

Step 3: Algorithm Selection

Identify relevant features from Ayurvedic principles and user data. These features could include doshas, specific health conditions, and historical treatment adherence. From above features we select the appropriate algorithm which in our case is SVM.

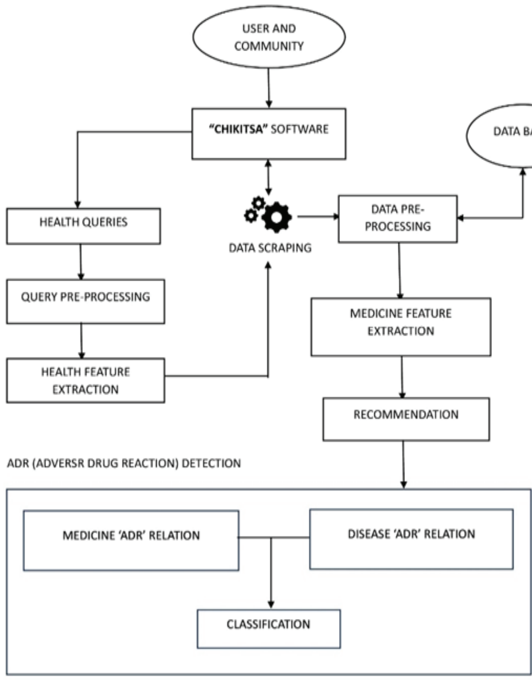

Fig. 1: Proposed Architecture for Ayurvedic Medicine Recommendation System

Step 4: Training Model

Training the model involves using the prepared data to teach the machine learning algorithm to make decisions and predictions. This step is essential for enabling the system to learn from the data and develop the ability to recommend Ayurvedic medicines based on adverse drug reactions and patient characteristics.

```
SVC Accuracy: 1.0
SVC Confusion Matrix:
[[40,  0,  0, ...,  0,  0,  0],
 [ 0, 43,  0, ...,  0,  0,  0],
 [ 0,  0, 28, ...,  0,  0,  0],
 ...,
 [ 0,  0,  0, ..., 34,  0,  0],
 [ 0,  0,  0, ...,  0, 41,  0],
 [ 0,  0,  0, ...,  0,  0, 31]]

=======================================
```

Fig. 2. SVM Prediction Accuracy

Step 5: Evaluation of Model

After training, the model needs to be evaluated to assess its performance and accuracy in making recommendations. This evaluation involves testing the model with new data and measuring its ability to predict appropriate Ayurvedic medicines based on adverse drug reactions.

Fig. 3: Heatmap for Prediction of Diseases

Step 6: Prediction and Deployment

After the completion of training and evaluation, the model becomes capable of making predictions and providing recommendations for Ayurvedic medicines by analyzing adverse drug reactions. The deployment of the model involves integrating it into a system that can interact with patient data, process requests, and provide personalized recommendations in real-time. In this heat map, we can predict the disease by using symptoms indications which are indicated in dark colours. We have symptoms on our X co-ordinate and the prediction of diseases on Y co-ordinate. The depth of the hue signifies the scale of the data, where deeper hues correspond to greater values and lighter hues correspond to lesser values. In order to read a heatmap, it's important to understand the key elements that make up the visualization.

CONCLUSION

The ADR (Adverse Drug Reaction) based Ayurvedic Recommendation System focuses on to provide recommendations for Ayurvedic remedies while considering adverse drug reactions. Ayurveda is an ancient Indian medical system that takes a natural and simple approach to health. The development of such a recommendation system requires the active involvement of the government in the progressive development of Ayurvedic education and research such as trust worthy data and processes . It is important to promote science-based approaches and policies in the healthcare system to ensure the development and acceptance of Ayurveda globally .

ACKNOWLEDGMENT

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We extend our deepest gratitude to all those who contributed to the development and realization of the ADR Based Ayurvedic Recommendation System. Without their dedication, expertise, and support, this project would not have been possible.

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Sequential Data Processing with Recurrent Neural Networks for Preference-Based Job Recommendations

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ABSTRACT

Job recommendation systems play a crucial role in matching job seekers with suitable employment opportunities. However, existing approaches often overlook the sequential nature of user interactions with job postings, leading to suboptimal recommendations. This paper introduces a sequential data processing framework that prioritizes preferences, employing Recurrent Neural Networks (RNNs) for job recommendation. Our methodology adeptly captures temporal dynamics and evolving preferences, resulting in job recommendations that are both more personalized and effective. Evaluation using real-world datasets indicates that our approach outperforms traditional recommendation methods, exhibiting higher recommendation accuracy and increased user satisfaction.

KEYWORDS: *Recurrent Neural Network, Job recommendation, Sequential data processing, Recurrent Neural Network, Preference modeling.*

INTRODUCTION

Job recommendation systems have become essential tools in the digital recruitment landscape, aiding job seekers in finding suitable employment opportunities. However, conventional recommendation approaches often fail to consider the sequential nature of user interactions with job postings, resulting in recommendations that may not align with users' evolving preferences. This paper introduces an innovative method for job recommendation utilizing Recurrent Neural Networks (RNNs) to capture sequential user interactions and preferences.

RELATED WORK

Previous research in job recommendation systems includes collaborative filtering techniques [1], deep neural networks [2], wide & deep learning architectures [3], and embedding-based recommendation models [6]. Additionally, there have been efforts to personalize recommendations using deep learning [7], feature regularization [8], and session-based recommendation approaches [11]. The literature on recommender systems has seen significant advancements, with various approaches aiming to enhance recommendation accuracy and personalization. Resnick et al. (1994) The GroupLens framework was introduced, which pioneered collaborative filtering techniques to create personalized recommendations derived from user-item interactions. This open architecture laid the foundation for subsequent research in collaborative filtering, demonstrating the effectiveness of leveraging user preferences to enhance recommendation quality. In recent years, deep learning approaches have gained prominence in recommendation systems, as evidenced by Covington et al. (2016) who proposed the use of Deep Neural Networks (DNNs) for YouTube recommendations. Their study highlighted the capability of DNNs to capture complex user-item interactions and improve recommendation accuracy by leveraging rich user engagement signals and content features. This shift towards deep learning has revolutionized recommendation systems, enabling more sophisticated modeling of user preferences and behaviors. Additionally, recent research has focused on incorporating semantic information and leveraging advanced deep learning techniques to further enhance recommendation quality. For example, Xu et al. (2016) proposed a tag-aware personalized recommendation model based on deep-semantic similarity, demonstrating the effectiveness of incorporating semantic embeddings to capture latent semantics in user-item interactions. Furthermore, Nguyen et al. (2017) explored personalized deep learning techniques specifically for tag recommendation, highlighting the importance of tailoring recommendation models to specific user preferences and contexts.

IMPLEMENTATION OF SYSTEM

Preference-Based Sequential Data Processing refers to a data processing methodology that takes into account the sequential nature of user interactions and preferences when making recommendations or predictions. In various recommendation systemsusers often interact with items or content over time, and their preferences may evolve based on their past interactions. Traditional recommendation systems often treat user-item interactions as isolated events and may not consider the temporal order or sequence of these interactions. However, by incorporating sequential data processing techniques, recommendation systems can better capture the dynamics of user preferences and provide more personalized recommendations.

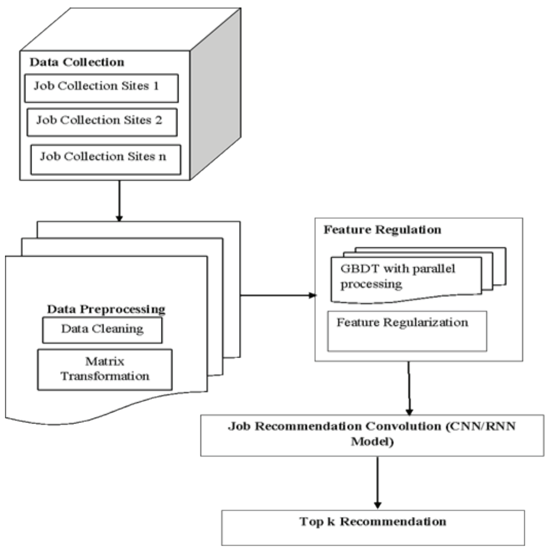

Fig. 1: Architecture Diagram

The key components of Preference-Based Sequential Data Processing include:

Data Representation: Sequential user-item interactions are represented as sequences, where each sequence contains a series of interactions by a user over time.

These interactions may include clicks, views, purchases, ratings, or any other relevant actions.

Preference Modeling: Methods like Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) networks, and Gated Recurrent Units (GRUs) are employed for modeling sequential data. These models can capture temporal dependencies and evolving user preferences by processing sequences of user interactions.

Training and Optimization: Sequential models are trained on historical user interaction data to learn patterns and preferences. Training algorithms may involve techniques such as backpropagation through time (BPTT) for RNNs or optimization methods like stochastic gradient descent (SGD) or Adam optimization.

Prediction or Recommendation: After training, sequential models have the capability to provide predictions or suggestions according to ongoing or anticipated user interactions. These suggestions are tailored individually to users, considering their historical interactions and evolving preferences.

The proposed work will be implemented with the below modules:

1. Data Collection
2. Data Pre-Processing
3. Data Pre-Processing with Parallel computing and GBDT
4. Job Recommendation Recurrent Neural Network.

Data collection: The human asset information is gathered by utilizing a cloud based assortment structure. Huge number of gathering specialists are conveyed on various cloud bunches. The information are brought from various work assortment destinations on various bunches. The information assortment module incorporates individual data of occupation searchers, data of occupation opportunities, and ways of behaving of occupation searchers. The ways of behaving think about client interest occupations, like survey the set of working responsibilities, saving the occupation as number one, and going after the position.

The information assortment is chiefly finished through the Kagal datasite to get more reasonable information.

Data Processing with parallel computing and GBDT:In this Module we mainly focus on data processing which is to be done on the output of Data-preprocessing. Classification of the feature extracted is carried out with the help of a decision tree. The Decision tree helps us trace and correlated closely related data under one categorical form. Choice trees are incredibly valuable for information investigation and AI since they separate complex information into additional reasonable parts.

Job Recommendation Recurrent Neural Network The results obtained from the preceding module are utilized as input for both the local connection and convolutional sub-models to generate recommendations. This involves processing the input data simultaneously through a convolutional network and a local connection network. Recurrent neural networks leverage their internal state

RESULT ANALYSIS

We have implemented Precision and recall as a measure of result analysis for the system. Following are the observations:

The values provided above appear to be associated with the evaluation metrics of the system. Let's describe each of these values:

Dataset: This column pertains to the various sizes or samples of a dataset utilized for training and testing a machine learning model. In this instance, it appears that the model underwent evaluation on datasets of differing sizes.

Table 1: Results

Dataset	Precision
1000	69%
2000	73%
5000	72%
8000	78%
10000	81%

Precision: Precision serves as a metric for gauging the accuracy of a classification model, particularly its capacity to accurately identify positive instances (true positives) among all instances it predicted as positive (true positives + false positives). Concerning your findings:

- For the dataset with 1000 samples, the precision stands at 69%. This signifies that 69% of instances predicted as positive in this dataset were indeed true positives.
- For the dataset with 2000 samples, the precision reaches 73%, indicating that 73% of the positive predictions were true positives.
- For the dataset with 5000 samples, the precision reaches 72%, indicating that 72% of the positive predictions were accurate.
- For the dataset with 8000 samples, the precision stands at 78%, suggesting that 78% of the positive predictions were true positives.
- For the dataset with 10000 samples, the precision stands at 81%, indicating that 81% of the positive predictions were true positives.

Recall: Recall, or sensitivity, measures the ability of a classification model to accurately identify all actual positive instances out of the total number of positive instances. In your results:

- For the dataset with 1000 samples, the recall is 37%, indicating that the model identified 37% of all actual positive instances in this dataset.
- For the dataset with 2000 samples, the recall is 51%, indicating that 51% of the actual positives were correctly identified.
- For the dataset with 5000 samples, the recall is 48%, indicating that 48% of the actual positives were identified by the model.
- For the dataset with 8000 samples, the recall is 49%, indicating that 49% of the actual positives were correctly identified.
- For the dataset with 10000 samples, the recall is 43%, indicating that 43% of the actual positives were identified by the model.

In summary, precision measures the accuracy of positive predictions made by the model, while recall measures the model's ability to identify all actual positive instances. These metrics are often used together to assess the overall performance of classification models, particularly in situations where there is an imbalance between the classes (e.g., many more negatives than positives).

Fig. 2: Precision and recall graph against the records

Precision measures the precision of positive predictions compared to all positive predictions, while recall assesses the model's capacity to detect all actual positive instances. The presented figures demonstrate the fluctuation of these measures among datasets of varying sizes, indicating the model's accuracy and sensitivity.

CONCLUSION

The outcomes of our experiments indicate that the proposed method substantially enhances the precision and appropriateness of job suggestions when contrasted with conventional approaches. By capturing temporal dynamics and evolving preferences, our RNN-based recommendation system provides more personalized and context-aware job suggestions, leading to enhanced user satisfaction and engagement. In conclusion, we have presented a preference-based sequential data processing framework utilizing Recurrent Neural Networks for job recommendation systems. Our approach addresses the limitations of traditional recommendation methods by capturing temporal dynamics and evolving preferences, leading to more personalized and effective job recommendations. Future work may explore advanced RNN architectures and incorporate additional contextual information to further enhance recommendation performance.

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A Systematic Review on Crop, Fertilizer Recommendation Using Machine Learning Techniques

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ABSTRACT

The Indian population heavily relies on agriculture for various products and contributes to the country's economic growth. However, soil depletion and lack of modern applications have led to a need for precision agriculture, also known as satellite farming. In farming, it's really important to grow appropriate crops according to the fertility of soil efficiently and use the right amount of fertilizers. But as the world changes, we need smarter ways to do this. This paper looks at how computer programs, can help with farming using machine learning. This study presents a review of different research based on these algorithms and methodologies, and analyses their effectiveness. Many supervised learning algorithm models have been studied, including Support Vector Machine (SVM), K-Nearest Neighbour (KNN), Decision Tree (DT), Naïve Bayes, and Random Forest (RF). This paper reviews and analyses various methodologies on crop recommendation systems, focusing on their implementation and performance in increasing crop yield and profit.

KEYWORDS: *Agriculture, Crop recommendation, Fertilizer, Machine learning.*

INTRODUCTION

Farming is essential for our food, but it's not always easy. Farmers need to grow crops, use fertilizers, and predict how much they'll harvest. Traditional farming methods have been used for a long time, but they can be tricky because many things affect how well crops grow. These things include the kind of soil, changes in weather, different types of crops, and how farmers make choices. Machine learning, which is like a smart computer system, can help make farming better by using lots of data to make smarter decisions. This paper is all about how computers, using something called machine learning, can help farmers do these things better. By utilizing data-driven decision making, precision agriculture, robotics and machines, early disease diagnosis, yield prediction, and resource optimization, artificial intelligence (AI) solves the issues with conventional agricultural practices. AI provides farmers precise insights through data analysis, empowering them to allocate resources more efficiently and make well-informed decisions. Precision agriculture techniques help minimize waste and environmental impact by precisely monitoring and managing crops. Automation and robotics automate labour-intensive tasks, increasing efficiency. Overall, AI enhances productivity, reduces costs, and promotes sustainability in farming. The adoption of AI in agriculture holds the potential to enhance productivity, sustainability, and profitability while preserving India's rich agricultural heritage. By embracing these transformative technologies, India can create an agriculture sector that is resilient, efficient, and capable of meeting the increasing demands of a growing population. It is imperative to embrace this new era of intelligent farming to unlock the full potential of Indian agriculture and secure a prosperous future for the farming community and the nation as a whole.

LITERATURE REVIEW

This review examines a number of such studies, providing an overview based on their methodologies and conclusions. Sharma, Singh, et al.'s study from 2023 attempts to offer suggestions for crops and fertilizers based on the location and nutrient composition of the soil. It makes highly accurate predictions about crop growth using the Random Forest and XGBoost algorithms. This method is beneficial for both beginners and experienced farmers, helping them make informed decisions.

This review discusses various studies on fertilizer recommendation systems tailored to specific crop and soil characteristics. Manoj Kumar et al. (2021) propose a system that determines the most appropriate crop for a plot of land based on soil pH, temperature, humidity, and yearly rainfall. The system uses the SVM algorithm to estimate yearly rainfall based on prior years' data. Yahui Guo, Yongshuo Fu, et al. (2021) explore the potential of machine learning to predict rice yield, highlighting its potential to revolutionize crop yield prediction and ensure food security. M. Suganya, Dayana R, Revathi.R (2020) suggest the most profitable crops for suitable environmental conditions, taking into account soil, weather, and previous year's productivity. Dhivya Elavarasan and P. M. Durairaj Vincent (2020) highlight the importance of crop yield prediction for food security, using DRL to predict yield in a simulated real-world environment.

COMPARISON WITH EXISTING SYSTEM

Comparative analysis with the help of different machine learning algorithm for Crop and fertilizer recommendation is shown below in Table 1.

Table 1: Comparative study using different algorithms

Year	Author	Objectives	Methodology	Accuracy
2023	Mr. Ram Sharma, et al.	This research focuses on using soil and weather data to determine the best kind and quantity of fertilizer for various crops. Numerous crop varieties, soil types, weather patterns, and fertilizer types are covered by the dataset.	1.RF 2. XGBoost 3. SVM	
2023	Prof. Kiran Somwanshi, et al.	In this paper by analyzing soil and environmental data, the system predicts crop yields and recommends the appropriate type and amount of fertilizer. The research paper's goal is to help Indian farmers choose their crops and fertilize them with knowledge.	1.SVM	-
2023	S Iniyan b, et al.	For the purpose of predicting crop yield, the suggested system has compiled an agricultural CSV dataset. It has several district-specific characteristics, such as soil type, temperature, humidity, and precipitation. We have to encode some variables since some models cannot accept string values as inputs.	1.MLR	86.3%
2023	M. A. Manivasagam,et al.	To carry out the crop yield projectionwill be trained with gathered data ,datain average temperature, soil quality, soil Ph, and rainfall various machine learning classifiers.	1.RF 2. Decision tree 3.KNN	1).95% 2).90% 3).85%
2023	Mohammed Bilal, et al.	Firebase hosts the datasets and resources needed for the system. Predicting crop yield is done using machine learning.	1.ANN 2.SVM 3.MLR 4.RF 5. KNN	ANN: 86% SVM: 75% MLR: 60% Random Forest: 95% KNN: 90
2022	Pulicherla Hari Krishna Reddy	The crop recommendation model is trained by the recommended system using machine learning methods and data gathered from Arduino sensors.	1. Decision Tree 2. Naïve Bayes 3.KNN 4.RF	1.90% 2.99% 3.99.31% 4.99%
2021	Dhruvi Gosai, et al.	By utilizing sensors, the proposed IoT and ML system enables soil testing through the measurement and observation of soil properties.	XGBoost	99.31%

2021	P. Parameswari,	The study advances the creation of a model that helps farmers by employing ML to provide crop-related data or recommendations.	1.JRIP 2.Decision 3.PART	1.95.9% 2.87.42% 3.98.33%
2021	Priyadharshini A, et al.	This research has created a system to assist farmers in selecting crops by using machine learning (ML) and accounting for many factors like soil, sowing season, and geographic location.	1. LR 2. NN	1.88% 2.89.88%
2021	Shilpa Mangesh Pande, et al.	Farmers can use a smartphone application to connect to the proposed system. Additionally, the system recommends when fertilizers should be applied to increase yield.	Random Forest	95%
2021	Mamata Garanayak, Goutam Sahu, et al.	Using several supervised machine learning techniques, this research forecasts the accuracy of the output of five different crops, including rice, ragi, potatoes, onions, and grams.	Random Forest	94.78%
2021	Palaniraj A, et al.	This research aims to construct a machine learning-based crop and fertilizer recommendation system with a particular focus on properly forecasting crop yields based on variables like soil properties and climate conditions.	SVM	90.01%
2021	Manoj Kumar D P, et al.	The goal of the research study is to create a machine learning-based system that helps Indian farmers choose their crops and apply fertilizer with knowledge. By considering soil characteristics and weather conditions, the system recommends suitable crops and the appropriate amount of fertilizer.	SVM	-
2021	Yahui Guo, et al.	They initially performed partial correlation analyses between independent variables such as phenology and climate and dependent variables such as rice yields to ascertain the influence of various factors on rice yields.	1.SVM 2.RF	
2020	M. Suganya , et al.	The software must get the data set before the intended task can be chosen. It offers a variety of classifiers for model construction and applies machine learning to address analytical issues.	1.LR 2.Decision Tree 3.RF 4.KNN 5.SVM	1.100% 2.93.3% 3.93.3% 4.86.66% 5.60%
2020	Dhivya Elavarasan, et al.	They present a deep reinforcement learning algorithm-based supervised smart agriculture framework in this research.	Deep reinforcement learning model with RNN	93. 7%
2019	Devdatta Bondre, et al.	The paper focuses on using machine learning, specifically Support Vector Machine (SVM) and Random Forest, to predict crop yields and recommend fertilizers based on agricultural data. SVM is better for crop yield prediction, while Random Forest is good for soil classification.	1.Random Forest 2.SVM	86.35% 99.47%
2016	X.E. Pantazi, et al.	Three Self Organizing Map modelsthe XY-fusion network (XYF), the Supervised Kohonen network (SKN), and the Counter-propagation Artificial Neural Network (CPANN) were used in the current study.	1.ANN	62-94%
2014	Miss. Snehal S. Dahikar, et al.	Using a variety of soil and atmospheric parameters, crop prediction methods is used to forecast the best crop.	1.ANN	

CONCLUSION

The study offers a machine learning approach that predicts crop output by taking into account the location and nutrient content of the soil. It helps both novice and seasoned farmers by properly predicting crops through the use of Random Forest and XGBoost algorithms. The system also considers real-time weather data for crop water needs. Support vector machines (SVM) are used to address classification and regression issues. The precision agriculture system, accessible via a mobile app and web interface, aims to increase agricultural production yield and profit. The system uses data from the Indian Chamber of Food and Agriculture's Kaggle repository for experiments. The system also uses deep learning to predict crop yield through trial and error, enabling farmers to make informed decisions about planting, irrigation, and fertilization.

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Waste Wise: Enhancing Sustainability through Effective Detection and Segregation

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ABSTRACT

In today's world the amount of waste increasing day by day as this waste management is one of the serious challenges of the cities, different methods are being implemented to manage the different types of waste. The current waste segregation and the collection method are not efficient and cost-effective. Waste detection typically refers to the process of identifying and categorizing waste, often in the context of recycling or waste management. It can involve various technologies, such as sensors, machine learning, and computer vision, to automatically detect different types of waste materials. Waste control is a tough trouble for most of the nations. In this paper, the different techniques are discussing about waste managing, detecting and maintaining. The smart technologies such as IoT (Internet of Things), deep learning, machine learning and AI (Artificial Intelligence) is been describe with related to smart bins, trash, detection of poisonous gasses with different sensors. The paper focuses on different methods use for managing waste such bio degrable, non biodegrable, biomedical waste, E-waste etc., and maintained, reusable of waste to different levels.

KEYWORDS: *E-waste, IoT (Internet of Things), Segregation, Waste management.*

INTRODUCTION

Modern waste segregation methods are outdated and inefficient, causing health problems and environmental damage. Waste management involves the destruction of waste and decomposing it. Waste includes both dry and wet waste, as well as electric waste. Advanced technologies like AI, machine learning, and computer vision are being used for waste detection, improving accuracy and efficiency. IoT sensors can monitor waste bins and detect specific waste types, enabling more efficient waste collection and management. Waste segregation involves source segregation, encouraging individuals and businesses to separate recyclables from non-recyclable waste. Mechanical sorting equipment, such as conveyor belts, magnets, screens, and optical sorters, is used in recycling facilities. Chemical and biological processes separate organic waste from inorganic materials or extract valuable resources from waste streams. IoT techniques, such as sensors and Arduino, are used to detect gases and waste levels in bins. Waste segregation reduces pollution, lowers labor costs, promotes recycling, and upgrades the circular economy. As technology advances, the disposal of electronic products, known as E-waste, has become a global challenge. Different types of waste management concepts, such as smart bins and vehicles, are being explored for improved waste management [1-3].

METHODOLOGY

Smart bins

The method use in smart waste management is focus on proposed system. It consists of Arduino microcontroller which is open source electronic platform based on use of hardware and software. It mostly uses in project and different applications, in real time application the use of Arduino is found in home automation system, weather stations or robotic devices, smart agriculture etc. Where it uses to interface with various sensor, actuator collect data and control devices.

It also uses to collect data from sensor log to wirelessly to computer or sensor for further analysis. In paper the Arduino is use to collect the data of waste produce in environment with RFID sensor and send it to server with help of Wi-Fi where notification is forward to authorized using web application [4].

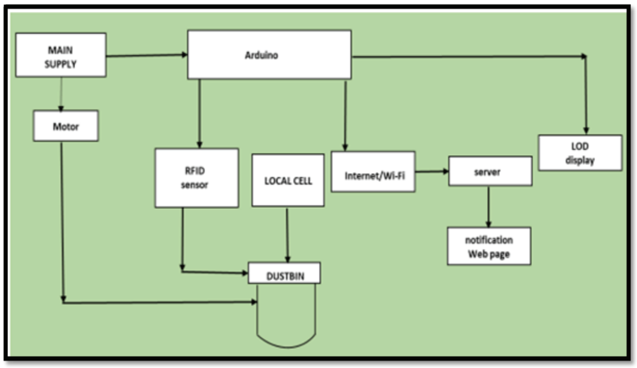

Fig. 1: Architectural diagram of smart waste management

Smart Vehicle

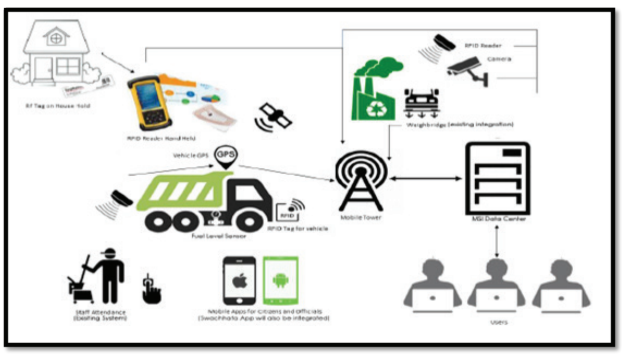

Fig. 2: Collection of waste by smart vehicle system

A smart vehicle using GPS monitoring system for waste series can bring numerous benefits, along with real-time tracking, route replay, and optimization of operations based on historical facts as vehicle with GPS trackers, the municipal authorities can use to monitor the location which help them to track progress of collection activities and issues arise in certain operations.

Municipal Solid Waste – Garbage (kitchen waste, slaughter houses, market waste), Rubbish (combustible and non-combustible like leaves, clothes paper, leather, rubber, grasses, fine residues due to burning of coal), Street waste (plastic, paper, vegetable matter, leaves, dirt), dead animals, market waste, construction and demolition waste (stones, sand, cement sacks, bricks, steel, copper electrical wires, roofing, plumbing materials, wood), packaging materials, scrap vehicles.

Industrial waste – Chemical solvents, sandpaper, paints, paper, metal, industrial byproducts, radioactive waste, electronic waste, cloth, fiber and plastic drum, ash sewage waste.

Fig 3: Flow diagram of proposed system

Institutional/Commercial waste – Paper, plastics (carry bags, bottles, plates, spoons, glass, boxes, gloves, syringes), wood, cardboard, glass, metals.

Agricultural waste – Spoiled food grains, vegetables, animal and plant waste, litter, toxic fertilizers, pesticides containers.

Biomedical waste- discarded sharps, disposable syringe, needles, anatomical waste, cotton, plaster casts, body fluid, dressing materials.

Electronic waste – Computers, printers, electronic appliances, televisions, laptops, tablets, mobile phones

Hazardous household waste – the chemical present in product use for cleaning at household and industrial (such as paints, varnishes, solvents etc.) contain corrosive or toxic chemical which include volatile organic compounds and heavy metals lead to harmful if not properly disposed of. Lubricants, oil those used in industrial application contain carcinogenic substances, household pesticides, herbicides and insectidies contain chemical which are used to kill repel and may toxic to humans and other organisms if not properly disposed.

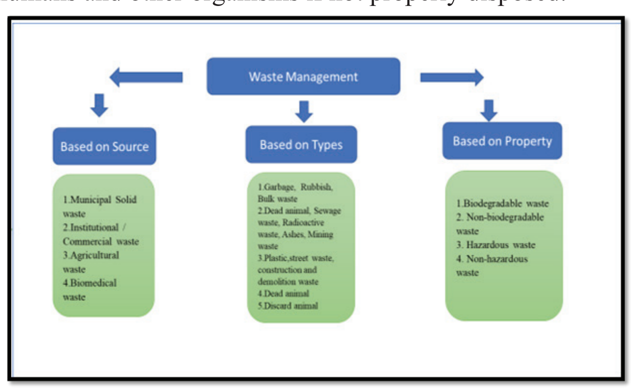

Fig 4: Type of waste management based on source, types and property

WASTE SEGREGATIONS

Waste disposal in landfills include deposing waste in appropriated area, which is located away from household or crowed area to avoid disturbances or spread of waste. The area of landfill is covered with layer of soil and materials to prevent the bad stink, depress scavenging by animals a reduce the risk of contaminants extract into surrounding. The gas management system contain gas extraction, pumps and pipes where the extracted gases are treated and utilized for various purpose such energy generation which helps to reduce greenhouse gases.

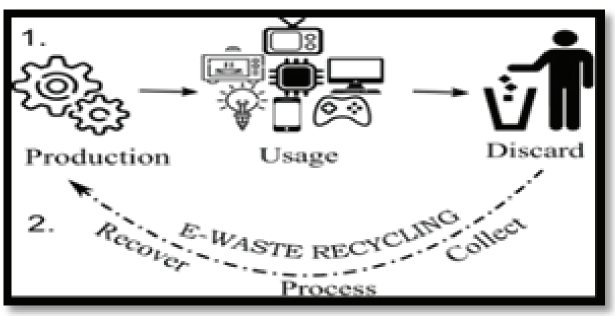

Fig 5: E-waste management process

E-WASTE MANAGEMENT

E-waste is fastest booming extravagance in world as equate to other waste. It is found that the millions of electrical/ electronic devices are repudiated as products are outmoded and thrown away. The devices are said to be e-waste which becomes treating to society and environment. [3] Wasim ayub, The E-Waste contain treacherous materials include lead, mercury, flame retardants which reach soil and water, contaminate environment. The hazardous substances can be properly extracted and then dispose by preventing environmental pollution which then reduce burden on landfills. Supplemental e-waste includes household and industrial waste consisting of computer, mobile phone and huge household appliance and different medical equipment. [7] (Emunuele at.el) To reduce and help in forming green and circular economy tones of e-waste are reprocesses which required less energy input, help to reduce greenhouse gases, emission resource extraction, refining and manufacturing.

CONCLUSION

The smart waste management study was carried to investigate an implemented system to optimize garbage truck routes based on identification of bins in located areas which contribute in fuel reduction and overall operation costs. Waste detection and segregation stand as crucial pillars in the ongoing battle for environmental preservation and resource efficiency. With the escalating challenges posed by burgeoning populations and increasing urbanization, effective waste management strategies are more imperative than ever. The advanced technologies such as artificial intelligence, machine learning, and sensor networks, the process of waste detection and segregation has significant advancements, facilitating more accurate sorting and recycling. Public awareness, education, and active participation remain indispensable components of any successful waste management program. Governments, industries, and communities must collaborate closely to implement holistic approaches that prioritize waste reduction, recycling, and responsible disposal practices.

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Fake Product Detection System using Block Chain Technology

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ABSTRACT

Block chain technology is a digital ledger that is distributed, decentralized, and connects multiple databases. It holds transactional data in the form of blocks. Since block chain is secure, no block can be compromised or altered. Block chain knowledge eliminates the need for users or clients to depend on other customers to verify the safety of a product. In this paper, QR codes offer a strong method to combat the practice of product counterfeiting, given the rising trends in mobile and wireless technologies. A QR code scanner links the product's QR code to a block chain in order to detect counterfeit goods. As a result, this method can be used to generate distinctive product codes and store them in database blocks with product information. After the user submits a unique code, it is gathered and examined against the records in the Block chain database. If the codes match, the consumer will be notified; if not, they will be made aware that the goods are counterfeit.

KEYWORDS: *Counterfeit product, QR code, Block chain, Customer, Product.*

INTRODUCTION

Supply Chain method is used to get data about packaging and manufacturing of the online product system. Confidential product information are securely stored by using Hash algorithm. The safe information is only accessible to legal user. Also the Transaction details is kept secured in this supply chain. So, here chain of different block is created which contain information of product, manufacturer, and customer. This block link with each other using linked list concept and hash algorithm. It is used to generate unique key for every block. Our method will solve several cases in the domain of anti-counterfeiting. In today's environment, the first question that comes to mind while purchasing anything is whether or not it is fake. It has been demonstrated that these things have a significant impact on financial development. Therefore, it is crucial to raise consumer awareness of product transparency in order to limit the amount of counterfeit goods. Block chain technology has advanced toward its total destruction, which is concerning given the increase of dangerous and counterfeit goods on the market. We propose a model for employing block chain technology to identify counterfeit goods. It discusses the software implementation procedure, which involves using this program to scan the product code and determining whether or not the given product is counterfeit.

RELATED WORK

Today, counterfeit items are being distributed all over the world. The present supply chain is full of counterfeit goods. Incidents involving phony products have increased in recent years, the research claims. A system that allows users or consumers to review every detail of the goods is essential in order for users to determine whether or not it is a fake. At the moment, India lacks a framework for identifying counterfeit goods. In order to let end users or customers verify the validity of the goods, a straightforward QR code-based identification system is part of the solution. Block chain technology presents fresh opportunities to rethink the reputation system. When fraudulent information is fact-based, like in loan application fraud, block chain systems are particularly effective at preventing it [1]. Potential applications of block chain technology in logistics, how block chain technology affects corporate transparency, and the reasons behind integrating block chain technology throughout the supply chain are all covered in [2]. The present issues with traceability and anti-counterfeiting in supply chains [3].The use Stackelberg equilibrium theory to drive enterprise profit-driven analytical models and emphasize the benefits of block chain-supported e-commerce platforms in combating the issue of product counterfeiting [4].the idea of a block chain and how supply networks and logistics are now using it. The applications both now and potentially in the future. The idea of a block chain and how supply networks and logistics are now using it. The use of block chain in supply chain and logistics, both now and in the future [5]. Using the block chain approach, a secure Hybrid Industrial IoT framework has been developed through the implementation of CTNs [6].

PROBLEM DEFINITION

To authenticate online Product is genuine or fake it is most difficult task. As number of Counterfeit action increasing now a days. Some models which are not perfectly accomplished yet tend to produce incorrect or false predictions leading to hamper customer's health. Other countries including India are fighting these phony and counterfeit goods

To Development of Fake Product Detection System using Block chain Technology

Objectives

i. To create a block chain-based anti-fake system

ii. To use a QR code to secure product details.

iii. Offer clients data in order to ensure their safety.

iv. To satisfy customer demands for prompt, high-quality delivery

PROPOSED SYSTEM ARCHITECTURE

The manufacturer's or company's module, the distributor module, and the client or user module are the three main parts of the proposed system. The manufacturer's or company-side application is the first one, and in order to use any features, you must first register. Upon logging in, the manufacturer can add a product or update its profile, depending on whether the product has been accepted by the customer through the distributor. A product's hash code is generated once an order is saved on the network, enabling the maintenance of the product transaction. The database contains the block name, hash value, and all product details. They must upload the special QR code. They must first register for the distributor module, which is the second module. Following registration and application login, there is option for product data show where all the data of the product gets stored after the acceptance or rejection of the product. Customers must first register in the third module, which is called Customer. After enrolling and logging into the program, customers can use the "show product QR code" option to scan a product's QR code to confirm its legitimacy.

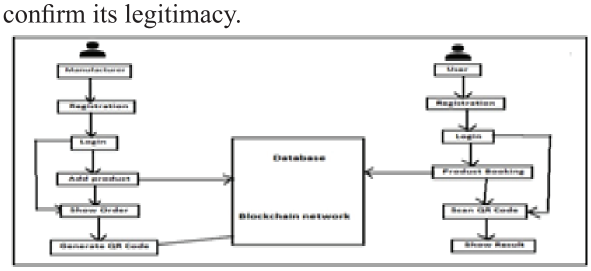

Fig. 1:Fake Product Detection System architecture

The SHA-256 ALGORITHM

One variant of SHA-2 is the SHA-256 algorithm (Secure Hash Algorithm).Block chains employ the Sha-256 method to provide a consistent 256-bit hash each time. Another component of encryption technology is this algorithm. Let's now study the execution of this algorithm:

The algorithm prototype is shown in the figure. Within this is a set of 256-bit data called IV. We will now be receiving very huge input. Thus, break it into 512-bit chunks.

There will always be some input remaining because the input is not always a perfect multiple of 512 bit We do a padding concatenation on this left input, inserting 10 bits before it. We can move ahead at this point as our input is a perfect multiple. To get a total of 768 bits, the 512-bit input is now added to the 256-bit IV. After passing these 768 bits through compression function "c," only 256 bits are output. This 256-bit output is further merged with the 512-bit input from block B2 input. Afterwards, the sum is run through the compression process, resulting an output of 256 bits. This loop continues to fill block n, the last block. Again, a compression function is used for generating a final 256-bit output, or it is also referred to as an input data hash.

Fig. 2: Sample Output

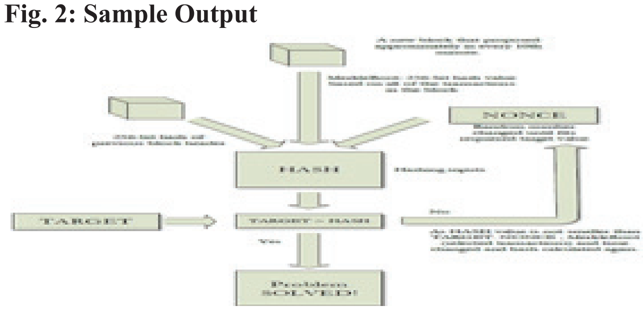

Fig. 3: Data Mining

RESULT DISCUSSION

Registration Page

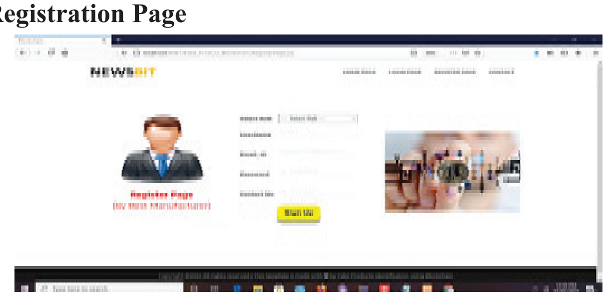

Fig. 4: Registration

Who wants to access the web site need to register themselves on the site. For registration purpose need some data username, email ID, password, contact no, etc and click on register. After Successful registration it shows popup message Successfully Registered.

Login Page

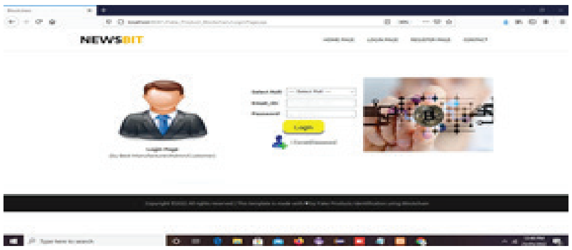

Fig. 5: login

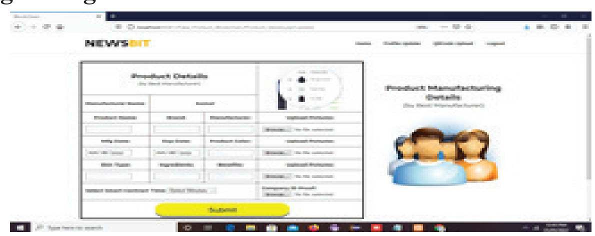

Fig.6: Product Details

After successful registration user can log in into the system by using login credentials.

Add Product

Through the add product button manufacturer can add its product details. Also can upload different images of their product and company Id proof.

Show QR

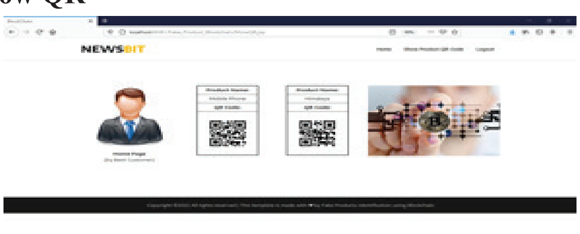

Fig. 7: QR Code

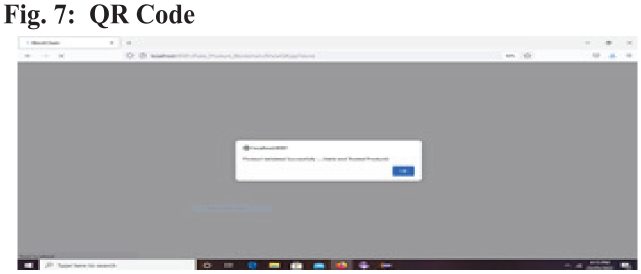

Fig. 8: Final Result

Final Result

If the product is valid then popup will come valid and trusted product!!

FUTURE WORK

i. QR codes with secure graphic.

ii. Create your own tokens that we may sell to customers to enable them to buy product ownership through tokens that facilitate the processing of insurance claims.

CONCLUSION

We have developed an effective method for locating and resolving problems. Every participant in the supply chain has been verified as being real. With block chain knowledge, the product's digital information can be stored as blocks. Through QR code scanning, we are able to successfully determine if the goods is authentic.

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Sarcasm Detection in Sentiment Analysis Leveraging Machine Learning and Deep Learning Techniques

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ABSTRACT

Sarcasm detection has gained interest due to its complexity. Machine learning and deep learning technologies have emerged to tackle this problem. This research compares the performance of ML and DL classifiers in detecting sarcasm, and improves the binary classifier approach. The study uses data from Twitter and news headlines to evaluate classification algorithms. The Bidirectional Long Short-Term Memory mechanism and Bidirectional Gated Recurrent Unit show the best cross-dataset performance, with a 0.9 F1 score and 0.8 F1 score on the news headlines dataset.

KEYWORDS: *Machine Learning (ML), Deep Learning (DL), Sarcasm Detection, Binary Classification, Natural Language Processing (NLP)*

INTRODUCTION

Sarcastic writing is a complex linguistic phenomenon used to criticize or insult someone, often used to express opinions through mockery or humor. Traditional sentiment analyzers struggle to discern the hidden meaning of sarcastic writing, leading to misclassification of the author's viewpoint. Advances in automated sarcasm recognition study have the potential to improve sentiment analysis. Sarcasm in literature is difficult to discern due to cultural, socioeconomic, and developmental nuances. There is no standardized method for creating and recognizing sarcastic text, and understanding extra context may be necessary to spot implicit sarcasm. Advanced digital narrative (DL) methods can help discover sarcasm patterns in the absence of context [1].

RELATED WORK

In this section, approaches that have been successful in NLP classification tasks are discussed. Sarcastic detection is frequently approached as a binary classification problem, where text is divided among sardonic and non-sarcastic groups. Otherwise, it is handled as a multi-classification problem where the degree of sarcasm in a statement is rated on a 1 to 5 scale.

Rule-based Classifications

Previous studies have employed a variety of simplistic methods that categorize texts according to a set of linguistic conventions. Two rule-based approaches were proposed by Bharti et al. [2]; The F1 scores for the IWS and PBLGA techniques, which were evaluated on 1500 tweets including the hashtag "sarcasm," were 0.90 and 0.84, respectively.

Machine Learning Classifications

ML algorithms may successfully classify unknown data because they can learn the fundamental patterns related to each class rather than relying on a static set of linguistic rules. Logistic regression models, support- vector machines (SVM), and tree-based classifiers are the main topics of previous studies.

Deep Learning Classifications

Although only a few have been tested in sarcasm detection, deep neural networks are rapidly being implemented for textual classification which gives us another reason to take on this work. Recurrent Neural Networks (RNN) and other time-series data-driven models are highly suited for this task since the order of a phrase affects its meaning. Using a pooling network to derive context from old tweets and a bidirectional gated RNN to extract local information from tweets, Saleem, H. et al, [9] were able to achieve 80% accuracy. Emoticons can be used to convey subtle emotions like sentiment and sarcasm, according to He S. [10].

Datasets

Table 1 presents a statistical evaluation of the characteristics of three publicly accessible datasets

Table 1: Datasets used

Dataset	Size	+Ve/-Ve	Avg. Tokens
News Headlines	28619	49%, 51%	12

Twitter Data	17280	51%, 49%	20
Amazon Reviews (Testing)	1254	35%, 65%	277

Amazon review corpus for Testing and news headline and Twitter datasets for training is employed. News Headlines - Rishabh Misra and Prahal Arora [13] gathered hundreds of headlines for news from The Huffington Post and The Onion, two websites known for publishing satirical news. Using a hybrid neural network design, they were able to classify the data with 0.9 accuracy. Twitter Data - The 100000 English tweets were employed, which were compiled by Tomas Ptacek et al. [14]. 20% of the tweets in this original corpus are still accessible on Twitter; the remaining tweets are not included in the collected dataset. Sarcastic tweet are those that contain the hashtag #sarcasm, and non- sarcastic tweets are chosen at random from the entire set of other tweets. The F1 score of Joshi, Aditya, et al. [15] was 0.89 Amazon Reviews - The Amazon reviews collected by Elena Filatova [16] were human-labeled by 5 annotators using crowdsourcing. Without taxing our computing power, training datasets employed in the study are sizable to offer a realistic picture of the corresponding data sources. Regardless of the fact that sarcasm is rarely utilized in real life, they are also roughly balanced.

3.1 Data Pre-Processing: User-generated information is noisy and poorly structured since users are free to utilize irregular capitalization and spelling. To decrease the sparsity in a feature space, pre-processing is required. However, one should be careful to not delete useful features. The # symbol must be removed from single-word hashtags to include them, while multi- word hashtags have to be parsed first to separate each token. All hashtags are removed from the post, with the sole exception of #not (which is replaced with not).To lessen the sparsity brought on by the voluntary insertion of punctuation and variances in letter capitalization, punctuation is eliminated and the text is converted to lowercase. However, emphasis can be conveyed with punctuation and capitalization, which can also be a sign of sarcasm. Stop-words like "the," "in," and "an" are removed.

FEATURE EXTRACTION

Classifiers need to extract useful data from big corpora to produce accurate predictions. The underlying semantics of text should therefore be encoded into the numeric vectors that feature extraction techniques produce in the overall framework of natural language processing. Well-known vectorization techniques like GloVe [17] and ELMo [18] can be used to create primary features. In addition to our major features, we experiment with a variety of extra features that were created using the below-listed processes. Other features are not employed

on their own to train candidate solutions; rather, they

are used to enhance the main features. The most sophisticated feature extraction technique employed in this work are these cutting-edge contextualized embeddings.

Miscellaneous Features

The study focuses on analyzing text features such as punctuation, subject, and sentiment. Punctuation features are extracted using a process involving combining five lexical properties. Topic features are represented using Latent Dirichlet Allocation (LDA), an unsupervised machine learning method. Sentiment features are extracted using the Sentiment Annotator, which provides sentiment labels to text. The study aims to improve classification accuracy by incorporating unique sentiment characteristics and creating low- dimension vectors for each dataset [21-22].

BINARY CLASSIFICATION

On a variety of detailed features, various binary classification algorithms are trained. For instance, experimentations are performed with the concatenation of various features to be useful in binary classification job for the machine learning classifiers that have been trained on Bag of Words, TF-IDF, GloVe, and ELMo vectors. As neural network training on high dimension data is computationally challenging, training of each DL method on GloVe and ELMo vectors is carried out.

RESULTS

Assessment is based on four criteria, that let us assess how well the models are working. On labeled unseen data, each trained algorithm makes predictions, and these predictions undergo comparison to the matching ground truth labels. The total quantity of true positives (TP), true negatives (TN), false positives (FP), and false negatives (FN) are then deduced from this. To evaluate the effectiveness of trained models, four indicators are employed that each uniquely utilize this data.

Eq. (1) to (4)

PRECISION=TP/(TP+FP)

$$RECALL = \frac{TP}{TP + FN}$$

$F1\,SCORE = 2 * \frac{PRECSION * RECALL}{PRECISION + RECALL}$. describes the percentage of categorized-sarcastic data that is sarcastic (i.e., $MCC = \frac{TP*TN - FP*FN}{\sqrt{(TP+FP)(TP+FN)(TN+FP)(TN+FN)}}$ while recall (Equation 2) shows the percentage of truly sarcastic data that is categorized in this manner (i.e., how many true positives are marked as positives).

Additionally, the harmonic mean of precision and recall known as the F1 score (Equation 3) is calculated. Still metric has been criticized for assigning precision and recall the same weight [9], thus we also take into account each measure separately. The Matthews Correlation Coefficient (Equation 4) will show high scores if both the true positive and negative rates are high and the false positive and negative rates are low.

Results of Sentiment Features The novel sentiment features are fed to a logistic regression model and compute the F1 score via 5-fold cross-validation to compare the efficacy. This enables to investigate if these characteristics by themselves are suggestive of sarcasm in other media formats. Given that this is the average result of a binary classification model making random predictions on a balanced corpus, models with F1 scores greater than 0.5 are regarded as having been trained on important features. When taken from Twitter data, all three feature types were the most illuminating (table 2). The most useful characteristics of Twitter data were those related to punctuation, while those from News Headlines actually made classification harder because they were utilized to train the only model with an F1 score below 0.4. From the dataset of news headlines, the subject features performed better than both sentiment and punctuation features in terms of information content. This might be because particular topics are more frequently linked with sarcastic or non-sarcastic news.

Table 2: Logistic regression model F1 score

Features	Dataset	
	News Headlines	Twitter data
Sentiment	0.6	0.62
Punctuation	0.35	0.7
Topic	0.6	0.4

Experimental Settings

All three feature categories were most illuminating when derived from Twitter data (table 2). The punctuation-related features from the Twitter data proved to be the most helpful, however, the News Headlines characteristics actually made classification more difficult because they were used to train the sole algorithm that had an F1 score below 0.4. Our subject features outperformed all sentiment and punctuation features when thinking of information content from our dataset of news headlines. This may be due to certain themes being associated with sarcastic or non-sarcastic news more frequently than others.

1. Early stopping - Training is stopped as soon as the validation loss reaches a fixed value; this value is used to calculate the number of epochs that should be used.
2. Model Checkpointing - We keep track of and save weights for a model that performs the best throughout training, or the one that has the least validation loss.

Though there is variation in ideal epoch numbers for various models, all of our models reach their peak performance early in the training process. So early stopping is implemented to cease training whenever model performance starts to plateau. It is set to 10 epochs before there is no rise in validation loss. Setting tolerance too low could hurt a model that first improves, and then reaches a plateau. The training set receives 85% of the data, and the testing set receives the remaining 15%.

Results for News Headlines Dataset

The deep learning classifiers that were implemented generally performed better than ML classifiers (table 3). When comparing the top classifiers across the two categories, improvement is seen when moving from ML to DL. Bidirectional GRU obtains an F1 score of 0.87 on this dataset, which is higher than that of Misra et al. (2019) [13].

Table 3: Binary classifier results on News Headlines dataset

ML Model	Features	Precision	Recall	F1-score
RF	GLoVe	0.8	0.75	0.71
SVM	TF-IDF	0.65	0.74	0.69
RF	ELMo	0.79	0.76	0.8
Logistic Regression	ELMo	0.85	0.84	0.83
DL Model	Features	Precision	Recall	F1-score
CNN	GLoVe	0.83	0.79	0.81
LSTM	TF-IDF	0.86	0.9	0.88
Deep CNN	ELMo	0.79	0.81	0.81
Bidirectional GRU	ELMo	0.9	0.89	0.87

Advanced RNN models outperformed the F1 score for the vanilla RNN (0.9), when trained on ELMo vectors. For all 3 ML classifiers' metrics, logistic regression with ELMo produced the greatest values; thus, after combining sentiment and topic features with ELMo vectors one can see an additional 0.7% improvement in F1 score. On this dataset, the random forest classification came in second place, but its F1 score remained lower.

Results for Twitter Dataset

DL classifiers outperform ML classifiers as shown in table 4. When comparing top classifiers across the two

categories, it is found that deep learning outperforms machine learning. Logistic regression model had an F1 score of 0.79 after being trained on ELMo vectors. There is an increase in F1 score when concatenating sentiment, subject, and punctuation features with ELMo vectors, giving the machine learning classifiers their highest F1 score. The best overall F1 score (0.86) and the highest recall was achieved with bidirectional LSTM model that was trained on ELMo vectors.

Table 4: Binary classifier results on Twitter dataset

ML Model	Features	Precision	Recall	F1-score
Gaussian NB	BoW	0.65	0.64	0.72
RF	GLoVe	0.65	0.74	0.7
SVM	ELMo	0.73	0.76	0.78
Logistic Regression	ELMo	0.77	0.77	0.79
DL Model	Features	Precision	Recall	F1-score
Vanilla RNN	ELMo	0.8	0.79	0.81
Bidirectional LSTM	GLoVe	0.81	0.79	0.79
CNN	ELMo	0.83	0.81	0.8
Bidirectional LSTM	ELMo	0.88	0.87	0.86
LSTM	GLoVe	0.85	0.84	0.84

CONCLUSION

By adding a complex mechanism for attention into a Bidirectional LSTM that has been trained on deep, contemporary contextualized embeddings; a revolutionary DL approach for sarcastic detection has been presented. To the greatest of our knowledge, sarcasm detection has never been approached in this way using an attention mechanism. On the Twitter dataset, this model receives a 0.86 F1 score. The effectiveness of a variety of ML and DL classifiers was compared, proving that DL models are better at sarcasm detection in news headlines and tweets. Work demonstrates that, despite having been trained on tweets, our method can be used with other forms of media. Transformers can also be used to further improve performance in classifying sarcastic and non-sarcastic material from a variety of social media data and the results can be compared with LSTM model. Also, it would be intriguing to investigate how sarcasm is used in a wide variety of data and to expand for non-English languages.

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A Detailed Review on AI Yoga Trainer and Corrector using Machine Learning

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ABSTRACT

Yoga is beneficial for everyone of any age's physical and mental well-being. To avoid damaging the bones, muscles, and ligaments, it is extremely important to execute yoga poses correctly when practicing alone. As a result, providing feedback to the performance without a live instructor is possible by using artificial intelligence and machine learning in conjunction with picture processing. In addition to correcting users who perform the yoga posture improperly, the suggested system is designed to advise users on how to do it correctly on real-time and there is also a pose classification feature that can classify the yoga poses based on the images of the final yoga pose which is provided by the user. The feedback, which comes in text and audio formats, can assist the practitioner avoid injuries while also maximizing the advantages of doing the yoga posture. Various images from the internet were used to create the data set of various yoga poses. The data points are extracted from each webcam image with the aid of OpenCV and media pipelines. This is now fed into a deep learning model that employs convolutional neural networks (CNN), which finds pose errors and calculates the error percentage before providing the user with the necessary feedback in the selected output's text or audio format.

KEYWORDS: *Activity recognition, Human pose estimation, Media pipes, Real-time estimating human posture, Yoga.*

INTRODUCTION

The Indus-Sarasvati culture in ancient India is credited with creating the 5000-year-old practice of yoga. The definition of yoga is "deep association and union of mind and body." It is employed in all aspects of life to maintain mental and physical equilibrium through asana, meditation, and other methods. Due of the heightened stress levels associated with modern living, yoga has gained popularity globally these days. There are many different ways to study yoga, as well as resources available. Yoga can be learned on one's own with the aid of the Internet, books, recorded clips, and other resources, as well as in yoga centres and with private instructors. Many people prefer self-learning in fast-paced lifestyles because the tools described above may not always be available. However, when learning for yourself, as with any workout, the key to doing yoga postures correctly is to avoid bad posture, which is counterproductive and can even be harmful. This promotes doing yoga with a teacher nearby. With today's lifestyle, having a teacher or attending yoga sessions isn't always doable. An AI-based technology assists in identifying yoga positions and provides users with recommendations or comments. These guidelines assist users in enhancing their poses so that they are beneficial rather than harmful. The project's hurdles are that important spots must be identified without any gaps, and models must function correctly even when body components overlap. Experts should create the poses in the datasets used for this project.

LITERATURE REVIEW

Aman Upadhyay [1] This research reports an overall accuracy of 99.88% in the recognition of seven yoga asanas using the proposed Y_PN-MSSD model. This model's accuracy is derived from Mobile-Net SSD and Pose-Net posture evaluation. The human detection for each frame is managed by a Mobile-Net SSD layer, while feature point detection is handled by a Pose-Net layer. Three stages have been assigned to this model. The first step, known as data collection and preparation, involves gathering the yoga posters from the four users and compiling an open-source dataset containing seven different yoga postures. Ranjana S. Jadhav [2] kinematic description of the human body based on 17 mapped points and computer vision using OpenCV, a technique for detecting and correcting yoga posture was developed. The tf-position estimation technique was used to provide an accurate pose estimation. Debanjan Borthakur [3] The proposed model is to enhancing the general yoga practitioner, the suggested paradigm opened doors for individual yoga practice, online instruction, and minimally invasive physical rehabilitation. Shahina Anwarul [4] The proposed system is divided into Three modules which make up the suggested system: alert creation, pose recognition using the suggested deep learning model, and pose detection using Media Pipe. The idea of hyperparameter tuning is used to maximize the intended model. Using a self-generated dataset of five postures, all experiments were carried out, and a 99.6% identification rate was attained, offering competent accuracy when combined with other state-of-the-art methods currently in use. Nagalakshmi Vallabhaneni [5] The findings of a thorough experimentation analysis show that the AAO HDL/YPE technique yields better results than current methods. Given is an artificial algae optimizer with hybrid deep learning-based model for estimating yoga posture (AAOHDL-YPE). Santosh Kumar Yadav [6] This research introduces Yog Net, a two-stream deep spatiotemporal neural network architecture based multi- person yoga expert system for 20 asanas. The first stream forms bounding boxes all over the subject after detecting the practitioner's pose using a key point detection technique. After extracting frame-wise postural features using time distributed convolutional neural networks (CNNs), regularized long short-term memory (LSTM) networks are applied by the model to provide temporal predictions. Pooja Gaikwad [7] In this study, the approaches employed are briefly discussed, and the tools and algorithms for position estimation, pose detection, and pose assessment are compared. It focuses on the researchers' accuracy, precision, and similarity of pose categorization results as well as the research's potential future directions. G. R. Sinha, Manish Raj et. Al [8] In this research paper, we used Kinect and AdaBoost classification with 94.78% accuracy using CNN and Stacked Autoencoder (SAE) method for Yoga discrimination system. Deep learning is an essential component of the study's technique for identifying inappropriate yoga poses and provide users with advice on how to correct them. Yoga poses go wrong. In the proposed system, users would You can choose and upload the poses you want to practice A recorded video of their yoga practice and research extract the angle of surveillance activity, Functions when scaling. In some cases, the key point is When rotated, the angle does not change. gives good results. In this system the angle with the floor is taken into account, but not between joints. Rotate the key point slightly, then change the angle. When to achieve these properties, we train a multi-layer perceptron. Accuracy on the test dataset is 0.9958. Hrishikesh Ghadge [9] The primary objective is to develop a yoga mentoring system that tracks and evaluates the user's moves and poses in order to identify any weaknesses in the yoga curriculum. After then, a display screen informs the user of their incorrect posture. Yoga is a health-promoting type of wokout that emphasizes mental, physical, and spiritual connections. On the other side, improper yoga practice can result in health problems like stiffness and sprains of the muscles. In this work, we propose to construct an Android or web-based yoga posture instruction system using an interactive transfer learning approach. Tapas Badal [10] This research develops deep learning-based methods to identify bad posture in yoga. Users using this method can upload recordings of themselves doing yoga poses and choose the desired pose to work on. The pose of the user is fed into training models, which then return the aberrant angles found between the stance of the user and the actual pose. By highlighting the areas where the yoga stance is incorrect, the system uses these outputs to give the user advice on how to correct it. The suggested solution required less computing complexity and attained an exceptional accuracy of 0.9958 when compared to various state-of-the-art methods.

A COMPARATIVE ANALYSIS OF VARIOUS MACHINE LEARNING ALGORITHMS

Table 1 Comparative Analysis

Year	Author	Algorithm/ Technology	Results	Future Scope
2023	Aman Upadhyay	1.Pose-Net CNN model	At an accuracy of 99.88%, the Y_PN-MSSD model is utilized to identify seven different yoga poses.	An audio-based alert. Enriched to detect more yoga postures.
2023	Ranjana S. Jadhav	1. CNN	99.88% accuracy was attained in identifying important human body locations.	Additional research should be done on concepts like batch normalization, dropout, and new activation functions.

2023	Shahina Anwarul	1. Hyperpara-meter Tuning	Dataset comprising 5 poses yielded a 99.6% recognition rate, comparable to other existing state-of-the-art approaches.	Implementing robust algorithms to ensure efficient data management, prioritizing security and privacy.
2022	Santosh Kumar Yadav	1.CNNs 2.LSTM	YogNet's accuracy was 77.29%, 89.29%, and 96.31%.	To extend the dataset with more yoga pose.
2022	G. R. Sinha	1.Multilayer perceptron 2. Recurrent neural network 3. LSTM 4.CNN 5.SVM	A testing dataset accuracy of 0.9958. The test accuracy obtained by SVM, CNN, and CNN + LSTM in the current research was 0.9319, 0.9858, and 0.9938, respectively. MLP achieved an accuracy of 0.9958 with updated features in the system, while having substantially less power than CNN and CNN+LSTM.	The proposed system is confined to 6 yoga poses, Moreover, real-time prediction and self-training on a mobile device are possible applications of this technology.
2021	Ajay Chaudhari	1.KNN 2.CNN	Video and image analysis can be used to examine the correctness of the yoga asana movements with 98.51% accuracy rate.	The proposed approach categorizes yoga asanas into five categories. The model's display is dictated by the nature of Open Pose's current evaluation, which may or may not operate well in circumstances involving overlap between people or body parts.
2021	Chhaihuoy Long	1.POSENET 2.CNN 3.Y_PN-MSSD	A total of 99.88% accuracy is achieved in the recognition of seven yoga asanas using the suggested Y_PN-MSSD model. This model's accuracy is derived from Mobile-Net SSD and Pose-Net posture evaluation.	In the future, the yoga posture identification software can be trained on a larger variety of yoga positions. Furthermore, the proposed model will be expanded to identify other yoga positions. An audio notification can be incorporated.
2019	Abhishek Ranjane	1.CNN 2.LSTM	Yoga positions in a video are effectively detected by the system with 99.04% framewise accuracy and 99.38% accuracy after 45 frames have been polled. Real-time accuracy of 98.92% was attained by the system for a group of twelve individuals.	Future research can use other asanas and a larger dataset that includes both images and videos. For self-training and real-time forecasts, the system can also be put into practice on a portable device. The activity recognition in this work is demonstrated.

CONCLUSION

Yoga is an easy to perform exercise at home. But just following a video tutorial without a live instructor can be dangerous. Un-correct yoga poses can results in to various health problems like fractures, sprains, and muscle deformations thus, the need for Yoga Trainer with Al is necessary. The study proposes hybrid models, multi-stream networks, and deep learning architectures for high-accuracy yoga pose identification using Pose- Net, TensorFlow, or OpenCV. It collects yoga posture data from users and open-source datasets, preprocesses it with human body points, and uses deep learning techniques like CNNs, multi-streamnetworks, andhybrid models combining CNNs and LSTMs. The model's performance is evaluated using metrics like Matthews correlation coefficient, sensitivity, specificity, Fl score, recall, accuracy, and precision. According to research, Yoga practice and technology are connected, with the goal of improving posture accuracy, user experience, and injury prevention through real-time feedback and correction mechanisms. The application for identifying yoga postures can be improved by incorporating some more yoga poses and a larger dataset and features like gesture recognition and progress tracking.

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A Blockchain-Based Application System for Fake Product Detection

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ABSTRACT

Blockchain technology has gained a lot of attention lately and has made it possible to create a number of new applications. The cryptocurrency bitcoin is a well-known blockchain application that not only resolves the double-spending problem but also has the capacity to independently verify transactional data without the need for a centralized system. Therefore, the integrity of data is guaranteed in any application that utilizes blockchain technology as its fundamental design. This project uses decentralized blockchain technology to make sure that buyers may use other methods besides merchants to confirm an item's legitimacy. The idea outlines a decentralized blockchain system with product anticounterfeiting features to allow manufacturers to supply real things without needing to manage directly controlled channels. This can significantly reduce the price of quality assurance products. Counterfeit goods pose a significant risk to consumers, businesses, and the global economy. To solve this issue, we outline a major endeavor that uses blockchain technology to create a trustworthy and impermeable system for recognizing phony goods throughout supply chains. The purpose of this massive project is to significantly disrupt the counterfeit industry by introducing a reliable and safe way to identify counterfeit goods throughout supply chains. The decentralization, security, and openness of blockchain technology make it a potent tool in the ongoing fight against counterfeit products.

INTRODUCTION

Duplication and counterfeiting are two risks related to worldwide product development that can have a detrimental effect on a business's revenue, brand, and customer happiness. The trade and marketing of counterfeit goods is growing significantly. It not only puts clients in grave risk but also affects the company's revenue, standing, and profitability. In order to address this problem and ensure that counterfeit goods are identified and tracked down across the supply chain, a fully operational blockchain system is recommended. Manufacturers incur the greatest losses from counterfeit goods in terms of lost revenue and damage to their brand. Blockchain technology may be used to verify a product's validity. Blockchain is a mechanism for maintaining records. Every new transaction recorded in the notebook is appended to the individual participant's record. Many transactions make up each link in the network. Real One problem that blockchain technology helps to tackle is product fraud. In contrast to earlier systems, blockchain technology provides increased security. After a product is put on the network and given a hash number, it is possible to maintain track of every record of a product transaction, even those belonging to the current owner, as a chain. It will record each transaction as blocks on the blockchain. The recommended approach creates a barcode or QR code with all of the product's data for a specific product that is made by the manufacturer.

What is Blockchain

A blockchain is an immutable, secure, decentralized online transaction database. It consists of a number of blocks, each of which contains a secure compilation of transactions pertaining to contracts, real estate, bitcoins, money, and other assets without the need for a middleman like as a bank, government, or central authority. The transactions are validated by a computer network. Once a block of data is put to the chain, it cannot be taken out or changed. The blockchain is incredibly safe and dependable as a result. Since it is a software protocol, internet connectivity is required for it to work.

How Does A Blockchain Work

A blockchain works by enabling a transaction, which is encrypted using public and private keys. The transaction is then sent to a global peer-to-peer network for validation. Once verified, a new block is created, which is added to the mempool. The consensus algorithm ensures only legitimate blocks are added to the chain, ensuring that each new block reflects the single, approved truth. The node that adds the block receives compensation, known as a "miner." A hash code for each block is generated and added to the blockchain. Once a new block is added, the transaction is considered complete, and its details are permanently stored.

LITERATURE SURVEY

Counterfeit goods are a significant issue in the production of products, impacting businesses' profits and sales. Block chain technology can help prevent product counterfeiting by identifying genuine items along the supply chain. A barcode reader can be used to identify counterfeit goods when a product's barcode is connected to a block chain management (BCBM) system. Blockchain technology is being used to detect fraudulent products and gain consumer confidence.

To address this issue, a smart contract is used on the Ethereum network to build a script for a product framework. A QR code is generated for each product, which can be scanned using a customer app or smartphone software. Transaction history and product attributes are stored by the blockchain system, allowing tracking of products along the supply chain.

Blockchain technology offers a decentralized, transparent, and unchangeable method for fake product identification. This approach promotes economic growth and reduces counterfeiting rates.

This paper presents a decentralized Blockchain system with anti-counterfeiting features, allowing producers to offer authentic items without relying on merchants. The technology uses digital signatures to verify user identification and costs significantly lower than partnering with reputable chain stores and established direct selling outlets [1-6].

METHODOLOGY

Proposed System

Since there are more and more fake products on the market, we need to develop an application system that has all the features required to identify these fakes. The proposed system for this project would maintain the supplier chain and the history of ownership of the goods. so that purchasers may examine every element of the goods and ascertain its certification at the time of purchase. Products will be validated and information about them added using QR codes. Furthermore, we must save product data in a manner that makes it impossible for anyone to change it. Blockchain technology is useful in this regard. Our proposed approach uses QR codes and blockchain technologies to detect counterfeit items.

System Model

For the proposed system, blockchain is implemented using a custom application called Ganache. Blockchain is a transaction management and storage system that was developed by Ganache. To utilize the Ethereum blockchain, we must use ganache software, which makes blockchain installation easier. The Metamask browser extension acts as a bridge between the blockchain and the webpage. We utilize Node.js to

build the website and the computer language Solidity to generate blockchain smart contracts. The system's basic architecture is shown in Figure 2.

Manufacturers and users will be able to communicate with only the properties they have access to. Because the Ethereum blockchain serves as the foundation for the system, the blockchain is decentralized.

Smart contract: Digital contracts, known as "smart contracts," are kept on a blockchain and are programmed to activate automatically in response to specific events.

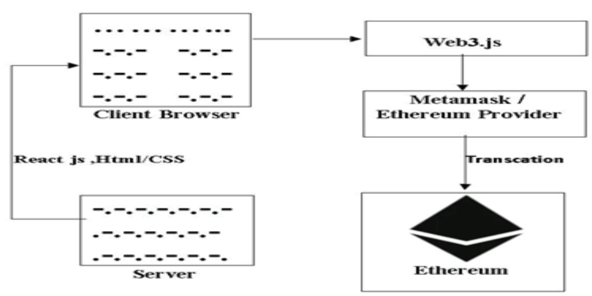

Fig. 2: System Architecture

Ethereum: The blockchain is decentralized and operates through a proof-of-work consensus process. Blocks are added to the blockchain by proof-of-work, which involves solving mathematical formulas. The puzzle's solution "proves" that nodes have used computing resources to do the "work." It attests to the block's addition and recording in the chain. We call this procedure mining. Although most mining is done by brute force trial and error, Ethereum rewards successful block additions.

Tool Requirements

GANACHE: To build your own Ethereum blockchain, using the Ganache software package. It is used to

integrate your blockchain into the framework. Using the Ethereum blockchain to interact with your blockchain- based smart contracts is advantageous.

METAMASK: By acting as an interface between the web browser and the wallet, the Metamask plugin for the web browser enables user interaction with the Ethereum blockchain.

TRUFFLE: On the Ethereum network and blockchain, decentralized apps, or dapps, are developed using the Truffle development framework. It provides libraries and tools to facilitate the creation, testing, deployment, and management of smart contracts, among other development processes.

SOLIDITY: Solidity is the name of the programming trust in consumers regarding the products they buy. Customers and brands may trust each other more as a result of this transparency, which increases customer happiness and brand loyalty.

Language. It is used in blockchain to write smart contracts.

NODEJS: Node.js technology is used in the development of the website's web page.

RESULTS AND DISCUSSION

With the proposed approach, suppliers and manufacturers may communicate with the system to add their own blocks to the blockchain that include the transaction data without altering each other's blocks. Solidity is used in the writing of the contracts for the manufacturer and supplier blocks. Ganache has been utilized for local testing because the code is executing on a local network. After that, truffle is used to build and implement the contracts. React is used to design the interface. The Web3.js library is used to enable interaction with the Ethereum blockchain. It facilitates sending and receiving ether, verifying transactions, and reading and writing data from smart contracts. To communicate with the Ethereum blockchain and provide browser access to the Ethereum wallet, Metamask is installed on a browser. Ganache accounts are loaded into the metamask. They must validate the transactions using their account using the Metamask wallet, which is linked via Web3.js, in order to add supplier and manufacturer blocks. The final consumer may verify the integrity of the goods by scanning the QR code. Figure 4 illustrates how accounts may be divided into manufacturer, seller, and customer categories. As seen in Figure 5, the manufacturer uses the Metamask Wallet to establish a connection to his Ethereum account. In Figure 6, the manufacturer adds the required details of the product, like its manufacturer ID, product serial number, product price, product name, and product brand. To add all of the completed details to the blockchain, the manufacturer hits the "add the product" button after filling out all the fields. As seen in Figure 7, a metamask confirmation window appears and requests confirmation.

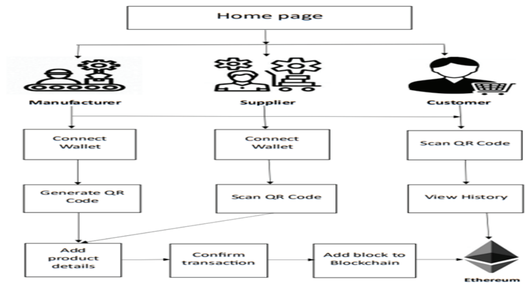

Fig. 3: Flow of working

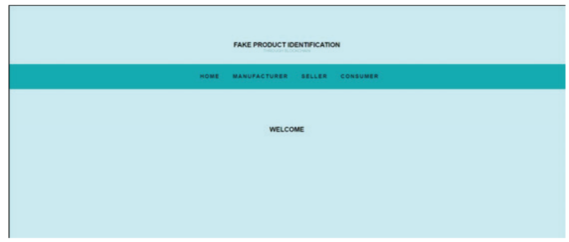

Fig. 4: Home Page

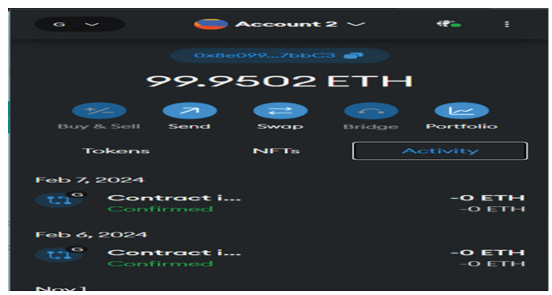

Fig. 5: Ethereum connection through Metamask wallet

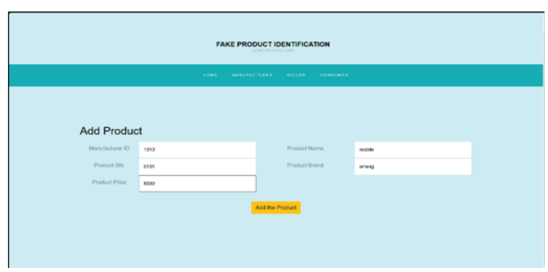

Fig. 6: Add Product Details

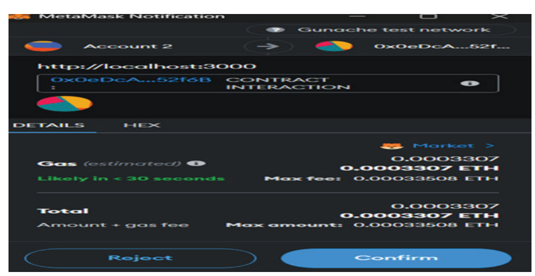

Fig. 7: closing the deal using the Metamask wallet

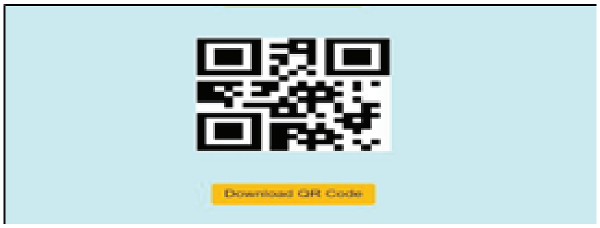

Fig. 8: Download QR code

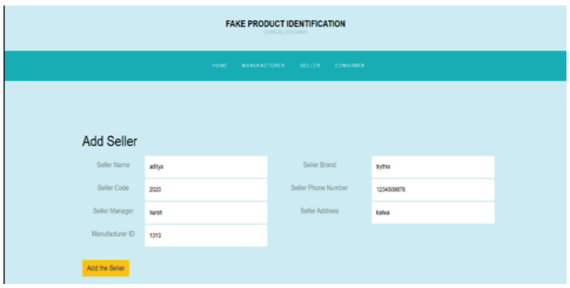

Fig. 9: Add Seller Details

Fig. 10: Selling Product to Seller

Fig. 11: Selling Product to Consumer

Fig. 12: Product Verification

In Figure 8 download QR code, A barcode is a label with information about the object it is attached to. Using QR codes as a deterrent to counterfeiting allows customers to determine the authenticity of the goods when adding new product details. Each time new product details are added, a new QR code is generated. so we need to download it.

INTEGRATION OF QR CODE WITH BLOCKCHAIN

They offer a practical and effective means of connecting tangible goods with their blockchain-based digital equivalents. Customers may obtain product information, which is securely recorded on the blockchain and includes facts like origin, manufacturing process, and authenticity verification data, by simply scanning a QR code. Because blockchain technology and QR codes are integrated, there is transparency, immutability, and traceability, which makes it more difficult for counterfeiters to create phony goods covertly. In Figure 9, the seller adds required details like its seller name, seller code, seller manager, manufacturer ID, seller brand, seller phone number, and seller address. To add all of the completed details to the blockchain, the seller hits the "add the seller" button after filling out all the fields. In Figure 10, when selling a product to the seller, the manufacturer needs to scan the QR code. After scanning the QR code, the product serial number gets automatically generated, and the field of seller code is filled out by the manufacturer. Finally, the manufacturer hits the "sell to seller" button to sell the product to the seller. In Figure 11, when selling a product to the consumer, the seller needs to scan the QR code. After scanning the QR code, the product serial number gets automatically generated, and the field of consumer code is filled out by the seller. Finally, the seller hits the "sell to consumer" button to sell the product to the consumer. In Figure 12 product verification , If the consumer wants to check if the product sold to them is fake or not,then they need to scan the QR code that is present on the product. After scanning the QR code, the product serial number gets automatically generated, and the field of consumer code needs to be filled out by the consumer. Finally, the consumer hits the "get product status" button to check if the product sold to them is fake or not. If the product is genuine, then the product verification result shows a genuine product; otherwise, the product verification result shows a not a genuine product.

CONCLUSION

In conclusion, the use of blockchain technology to address the issue of identifying counterfeit items has a lot of potential. Our main project improves product authenticity and traceability by utilizing the blockchain's decentralized, transparent, and immutable properties. With the use of a secure, proof-free certificate, customers may be sure of the legitimacy of their transactions, enhancing corporate security. The effort not only tackles the issue of counterfeiting, but also demonstrates how blockchain technology has the potential to transform the legitimacy of products.

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E-Commerce Website: Vocal for Local

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ABSTRACT

So many people have been inspired to start small businesses by covid-19 pandemic, but the lack of connections and customer support beyond networking makes growth difficult for small business owners. Additionally, the virulent disease has taken a financial toll on many existing local businesses. Here is now a need for a fanatical display place where clients can cooperate with emergent petite businesses and startups while business owners showcase their goods and set of connections.

KEYWORDS: *Covid-19 pandemic, Connection, Client exposure, Small businesses, Start-ups, Customers, Vocal for local, Web application.*

INTRODUCTION

India's startup culture has expanded significantly in recent years as those folks arise by way of new as well as surprising technologies for reaching their requirement. A Covid-19 endemic has step up this increment and forced nation also its people to create innovative display place with technologies that consent to individuals to work remotely every day. Alternatively, the epidemic also had a unhelpful economic impact on small businesses that did not have a remote office. Therefore, the ability of the network platform to handle such large traffic is insufficient. So we created a platform for such local businesses, that targets to resolve such a problem, helping local businesses and startups to spread and expand their business online. Its main goal is to perk up the relatedness and also making Electronic shopping extra proficient. The display place is as intended to offer consumers in addition to businesses intelligible, user-friendly and secure payment methods. The display place is drew to supply consumers in addition to companies with a accessible and practical crossing point permitting commerce to put up for sale their commodities worldwide moreover ensure payment security.

E-Business Provider

(1) Net: The vast internet dispersion has led to the growth of e-business and mobiles as essential tools for everyday life. The internet has become a crucial tool for buying, education, and contacting professionals. Digital platforms have also boosted global development, allowing for more efficient supply chains. The ICT revolution has opened up new markets and boosted global development. The International Telecommunication Union predicts that 3.2 billion people will have access to the internet by 2015. India's internet users are expected to grow from 10 million to 400 million in the next decade, with urban mobile internet users reaching 197 million in 2015, and rural users growing to 80 million. The ICT revolution has significantly boosted global development over the last 15 years.

(2) Analysis: Analysis is the systematic process of converting information into knowledge for improved resolution. As data grows exponentially, businesses need to focus on understanding consumer behavior, especially online sellers. While basic analytics features are available, depth analysis solutions are needed for better understanding.

(3) Social Site: Commerce is gradually more make use of social media (SM) for market their products also services. Social media refers to webs and computer programs which allow folks to communicate as well as share information on a internet using a computer or smart phones. Social media has done a nice function in a trademark making and informing various recommendation to the clients.

(4) Self-driving cars: Autonomous vehicles, utilizing AI, sensors, and GPS, eliminate human involvement. Businesses can capitalize on this growing niche by monitoring browsing and purchase trends.

Project's Objective

This web application is a on-line store for local traditional shops. A purpose of this project is to present online shopping applications to internet. This project tries to offer the return of buying an individual needs by online way to the clients of physical stores which are provide the local goods. It helps you buy products from stores anywhere on the web using Android devices. Thus, the customer will receive e-shopping and carrier service from his favorite store. This website can be used for whichever local store or multi-store business with a store.

LITERATURE SURVEY

Mitra Abhijit (2013) suggests that e-buying has triggered an additional revolt by altering the means goods with services are bought and sold. A new methodology has emerged. The position of geographic distance in notifying commerce connections is decreasing. E-buying is the outlook of shopping. By means of the introduction of 3G as well as 4G wireless expertise, internet financial system can extend steadily. In coming 3-5 years, the people using Internet in India will arrive at 30-70 million, if not exceed that of many developed countries. Then the internet economy will become more important in our nation. By the swift reach of the Internet, e-buying will take part in extreme vital job in 21st century, uncovering latest opportunities designed for huge in addition to petite trades. A management's role is to provide a lawful structure for e- business that is allows local and worldwide operate to get bigger its prospects while respecting fundamental human rights such as confidentiality, academic possessions rights, scam deterrence, buyer defence, etc. Awais Muhammad et al. (2012) point out to a employ of net has transformed the planet into a international hamlet. The application of the net has shortened spaces and got people together. The backbone of the country is trade and that will be mighty by reliance on electronic apparatus in which e-commerce participates a vital role.

E-commerce offers confidentiality, trust, and convenience, saving time and reducing costs. Electronic banking, or internet banking, is rapidly gaining popularity, allowing consumers to conduct transactions more easily and efficiently. This technology has also led to lower operational expenses and improved customer retention. However, there is a significant gap in customer satisfaction, particularly in terms of convenience, such as bank location, ATMs, and online banking. To address this, banks should make banking amenities more efficient and expand ATM services. Blasio's (2008) research does not support the idea that the internet reduces distance.

Urban consumers are more likely to use the internet, with factors such as transaction steps, website design, and inventory performance contributing to reliability in e-commerce. Stability in promotion, store availability, product diversity, fraud prevention, warranty, equality, and return policies are essential for customers to trust and have high ethical standards. Internet banking has revolutionized the banking industry by increasing efficiency and reducing time and costs. Understanding consumer behavior in different situations and integrating virtual and physical relationships is crucial for fostering meaningful customer relationships. Companies need time to prepare before adding taxes to their product/service lines, as consumers desire what they have always desired. Businesses must offer excellent service to ensure proper implementation of Service-Based Transactions (SST). Research shows that consumers' reactions to patriotic advertisements are influenced by their cultural orientations and chronic national identity. Restoring service during SST failures is vital for customers, as they expect prompt recovery from reported outages. The expansion of e-buying and e-banking has led to a larger market for e-banking, requiring banks to develop reliable internet systems. Technical issues, manageability, safety, and software.

SUMMARY TABLE

Sr No	Author's Name	Name of Title	Journal Name	Year
1.	Atharva Kulkarni	Vocal for Local	IJRASET	Feb 2022
2	Shahid Amin	Ecommerce	ITM University	Feb 2016
3	Sarika Shrivastava	Being Vocal For Local	National Multidisci-plinary E-commerce	June 2020
4	Sheetal Kandhare	Vocal For Local	IJCRT	June 2020
5	Prof. Girish Umartkar	Online Shopping for Retail Sector for B2C Collaboration	IJCRT	April 2022

Tools must be considered before adapting to a specific web environment. Failures in interpersonal service interactions are common, with rude or hostile service, delays, and problems with technology, service design, or delivery being common reasons for dissatisfaction.

METHODOLOGY

Proposed System: A user of the website must be register if fundamental information enter for showing all items present in website.

A project is designed to be aware of factors such as conflicting usage, payment security and improved connectivity. The platform is built using the MVC architectural model and consists of models (data processing logic), views (which expose data models to customer) and controllers (which control the way of data to database).

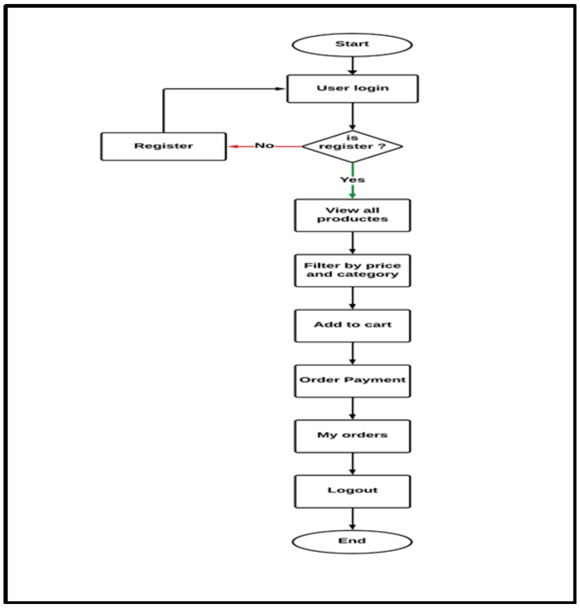

Fig 1: Flowchart for Consumer

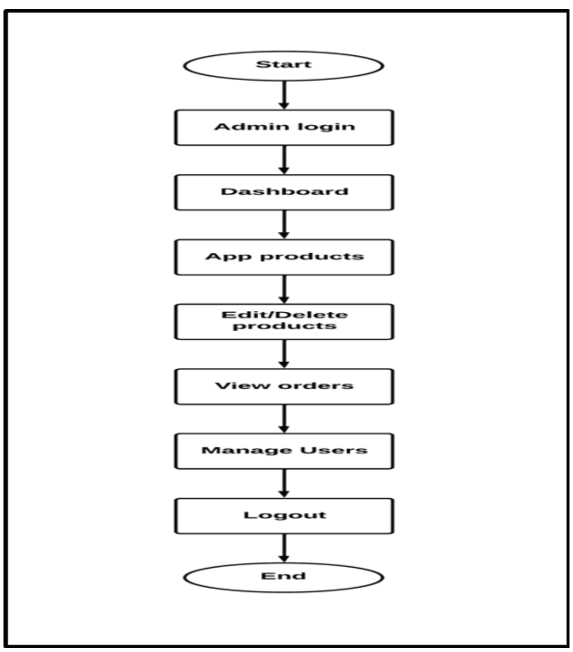

Fig 2: Flowchart for Admin

Here Admin can authenticate the user , add ,edit the products and can also have monitor on them.

IMPLEMENTATION

A project here is created via Web development that is consisting of a:-

a. Client- side JavaScript framework used is React JS.

b. Python Flask as a web framework

c. MySQL as a database

RESULTS

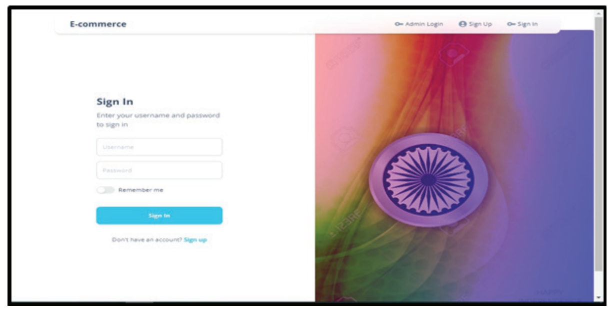

Fig. 3: Sign in for user

A newly visiting user will have to register here by entering significant information as for view products in a system.

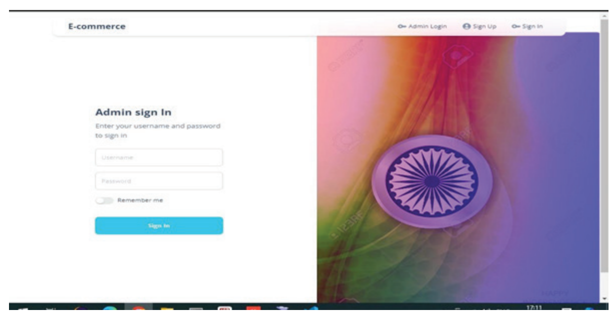

Fig. 4: Sign in for Admin

Admin can sign in into the platform by using his confidential details.

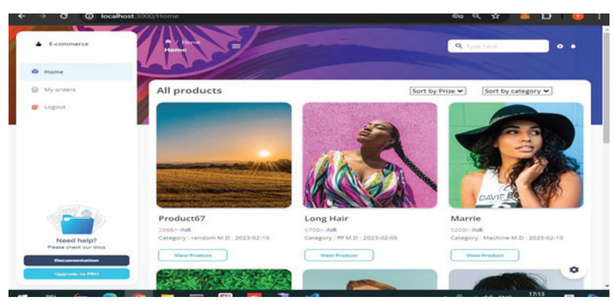

Fig. 5: User can see all products available

When new user sign in into the website then he can look that what are all types of products are here in this platform.

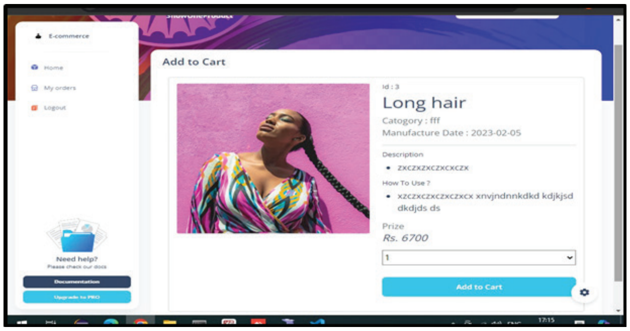

Fig. 6: Add to Cart

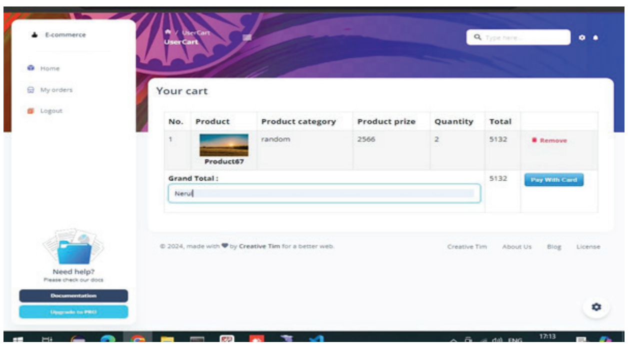

Fig. 7: Product that is in cart

A user can see products that he have already added into his cart.

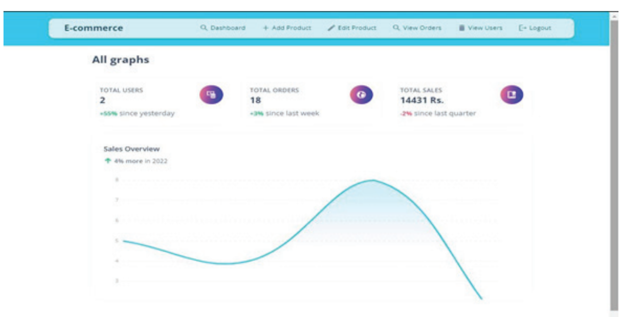

Fig. 8: Sales Overview

Admin can see what are the total users, how many orders are there, and most importantly the sales overview.

CONCLUSION

The challenges associated with e-commerce are also growing and pose a serious threat. The big future marketers need the right strategy. Ecommerce research shows that there are many variables that marketers needs to consider for succeeding in this model.

The electronic industry needs to focus on transaction order, i.e. website order. Reliability of design, replacement assurance, mobile commerce services, steadiness of promotions, reliability of stock availability, consistency in presentation, manufactured goods types, location based services, various compensation decision, correct content. Vocal for Local can be great technique designed for small businesses also startups to try their chance into on-line market via introducing their goods and mounting sellers network to local people as well as further sellings. A trouble-free, interactive platform earlier created to be trouble-free for small business shopkippers as well as consumers for knowing then use system efficiently. Environment currently carries fundamental electronic-commerce requirements like buying as well as advertising products. But the display place has the possibility to grow to point of an e-buying giant. Expecting employment on a platform containing translating concepts that are important to any platform into a mobile app, adding more payment integrations and making improvements to give users a variety of options to choose from, search product by voice ,also search from photos aiming to be the best platform.

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Towards Realistic Virtual Try-On: A ML based Approach

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ABSTRACT

Virtual try-on systems are transforming the online shopping experience for fashion consumers. This paper introduces a novel system that goes beyond existing solutions by delivering a highly personalized virtual try-on experience. Our system leverages advanced computer vision and machine learning techniques to achieve accurate garment fitting and realistic fabric simulation. We prioritize a robust backend infrastructure for efficient data processing and scalability, ensuring seamless user experience. Additionally, user-centric design principles guide the development of an intuitive and immersive interface, maximizing user engagement and satisfaction. Through extensive evaluations, we validate the system's effectiveness and usability, demonstrating its potential to bridge the gap between virtual and physical try-on and revolutionize online shopping.

KEYWORDS: *Computer vision, Data, E-commerce, Fashion, Machine learning, Online shopping, User experience, Virtual try-on.*

INTRODUCTION

Virtual try-on (VTO) systems are revolutionizing the fashion industry, allowing customers to virtually "try on" clothes and accessories before purchasing. These systems leverage computer vision techniques, particularly the Haar Cascade classifier, for real-time garment and accessory overlay. The Haar Cascade excels at detecting key body and facial features, enabling accurate placement of virtual items. This technology, combined with color filtering and feature tracking, ensures robust performance even in challenging lighting conditions.

VTO benefits both customers and businesses. Customers can make informed purchase decisions with a clearer understanding of fit and style. Businesses can benefit from reduced inventory costs, increased customer engagement, and a more engaging shopping experience. The future of retail looks increasingly virtual, and VTO systems play a key role in reshaping this landscape. Computer vision is the backbone of VTO. By harnessing the Haar Cascade classifier, these systems accurately identify body features, allowing for realistic garment placement. Real-time tracking ensures virtual items seamlessly adjust to user movement, enhancing the try-on experience. VTO technology continuously improves through the integration of additional computer vision techniques. This allows for tracking multiple individuals simultaneously, creating a more natural and engaging experience. The accessibility of sensor technology and image processing algorithms has fueled the widespread adoption of VTO systems, transforming the way we shop for clothes.

METHODOLOGY

E-dressing technology offers a revolutionary approach to clothing selection. Leveraging real-time video capture, the system utilizes facial and body detection algorithms to identify the user's physical presence within the camera frame. Product images, such as dresses or accessories, are then virtually masked onto the user's image, allowing for a seamless visual representation of how these items would appear when worn. This technology effectively creates an augmented reality dressing room experience, enabling users to make informed clothing decisions without the need for physical try-on.

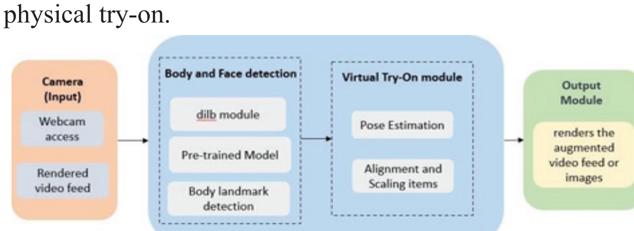

Fig. 1: Virtual Try-On Architecture

Virtual try-on technology is revolutionizing the online shopping experience by offering a more personalized and efficient way to assess clothing and accessories. Leveraging simulation software, this system creates a digital representation of the chosen item and overlays it onto a digital model of the customer's body. This model accounts for the customer's unique body shape and movements, ensuring a realistic portrayal of how the garment or accessory would look in real life. Accessible through websites and mobile applications, virtual try-on allows customers to visualize the item on themselves before committing to a purchase. Additionally, some systems offer the ability to personalize details like fit and color, further enhancing the user experience. Customer feedback on the virtual representation is crucial for refining the system's accuracy and realism, ultimately leading to a more seamless and satisfying online shopping journey.

Virtual Try-on System Architecture

The architecture of a Virtual Try-On System is meticulously crafted to seamlessly integrate diverse modules, ensuring a fluid and immersive user experience. The key constituents of the architecture are outlined below:

Input Module

Webcam or Image Feed: This module captures the user's body or facial image through a webcam or uploaded images.

Face and Body Detection Module

Face Detection: Employs a pre-trained face detection model for the identification and localization of faces within the input images or video stream.

Body Detection: Applies techniques like Haar cascades to discern the user's body in the video feed.

Facial Landmark Detection Module

Landmark Detection: Precision in locating key facial points, such as eyes, nose, and mouth, is achieved for accurate alignment and placement of virtual accessories.

Pose Estimation Module

Pose Estimation: Estimates the pose of the user's face or body to comprehend orientation and angles, crucial for the accurate alignment of virtual items.

Virtual Try-On System Module

Computer Vision Algorithms: Integrates sophisticated algorithms for virtual try-on functionality, incorporating feature extraction techniques to capture pertinent information about the user's body and clothing items. Alignment and Placement: Harmonizes the information from detected facial landmarks, pose estimation, and body detection to precisely position virtual accessories on the user.

User Interface Module

Real-Time Rendering: Displays augmented video feed or images with virtual try-on items in real-time.

Interactive Features: Furnishes users with interactive elements to select, customize, and experiment with different virtual accessories.

Output Module

Rendered Output: Produces a rendered video feed or images where virtual try-on items are seamlessly integrated.

Web Application Interface

Flask Server: Manages HTTP requests and renders web pages to facilitate user interactions.

User Input Processing: Effectively processes user inputs to trigger virtual try-on actions and customization.

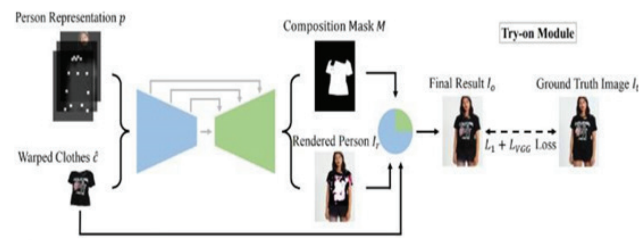

Fig. 2: Systematic flow of project

Pre-Trained Model

In the Virtual Try-On System, the utilization of a pre-trained Haar Cascade classifier for upper body detection is crucial for identifying and locating upper bodies in an image or video frame. This classifier is adept at recognizing patterns associated with upper body features, allowing the system to make informed decisions about the placement and alignment of virtual accessories.

Functional Requirements

User Registration and Login

User Registration

- Users are required to create an account to access personalized features.
- The registration form includes fields for basic information (name, email, password) and may include optional fields for additional user information.
- Users must confirm their accounts via a confirmation email.

Login Process

- Returning users can log in using their registered email and password.
- Emphasis on the importance of login for data personalization and tailored recommendations.

Profile Completion

- Upon registration, users can enhance their profiles by providing additional information such as name, gender, height, weight, and contact details.
- Users have the option to specify preferences, interests, and system-relevant details, including occasion preferences (traditional, formal, casual). *Browsing and Selection*

Browsing

- Users can explore a catalog of fashion products with filtering and sorting options.
- Search functionality enables users to find specific items.
- Personalized product recommendations are provided based on user preferences.

Selection

- Dedicated product pages display detailed information for user review.
- Users have the capability to add selected products to a wish list for virtual try-on.

WORKING MECHANISM

This virtual try-on system utilizes a combination of cutting-edge technologies to create a realistic and interactive user experience. Here's a breakdown of how it works:

User Input and Capture

- The user launches the virtual try-on app and grants permission to access the device's camera.
- The camera captures a live video stream of the user, or the user uploads an image for analysis.

User Analysis

The system employs computer vision techniques to analyze the user's image or video feed:

- Body and Face Detection: Advanced algorithms, potentially using pre-trained models like Haar cascades, identify and locate the user's body or face within the frame.
- Pose Estimation: The system estimates the user's pose (standing, sitting, arms raised, etc.) by analyzing body positions and orientations.
- Facial Landmark Detection (if applicable): For precise placement of virtual accessories on the face, the system pinpoints key facial features like eyes, nose, and mouth.

Virtual Item Selection

- The user explores a virtual wardrobe within the app and selects a clothing item or accessory to try on.

Virtual Placement and Rendering:

This is where the magic happens! Sophisticated computer vision algorithms get to work:

The system combines information about:

o User's body or face (from detection modules).

o User's pose (from pose estimation).

o Selected virtual item.

Using advanced techniques like image warping and deformation, the system virtually "drapes" the chosen item onto the user in real-time. This ensures the item realistically adapts to the user's unique proportions and movements.

User Interaction and Output:

- The final image or video is rendered, seamlessly blending the user's image with the virtual item.
- The user sees themself in real-time with the chosen item on, allowing them to:
  - o View the item from different angles by moving around.
  - o Potentially try on different colors, sizes, or styles of the same item (depending on the system's capabilities).

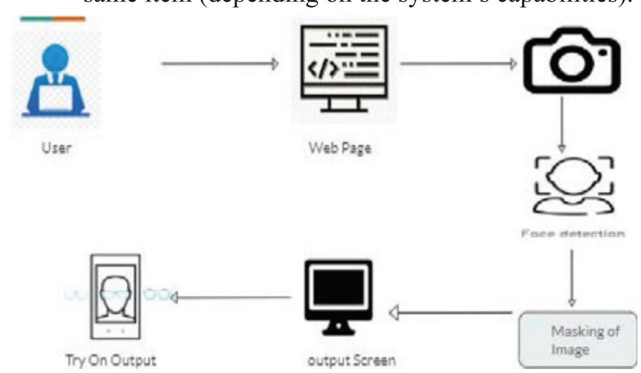

Fig. 3: Block Diagram

RESULTS

The system leverages user device cameras to capture live video or analyze uploaded images. Computer vision techniques involving body/face detection, pose estimation, and optional facial landmark detection are applied. User interaction allows selection of virtual clothing items and accessories. The system then combines user analysis data with the chosen item and employs image warping/ deformation for realistic virtual placement on the user in real-time. Finally, the rendered output seamlessly integrates the user's image with the virtual item, enabling interactive try-on experiences.

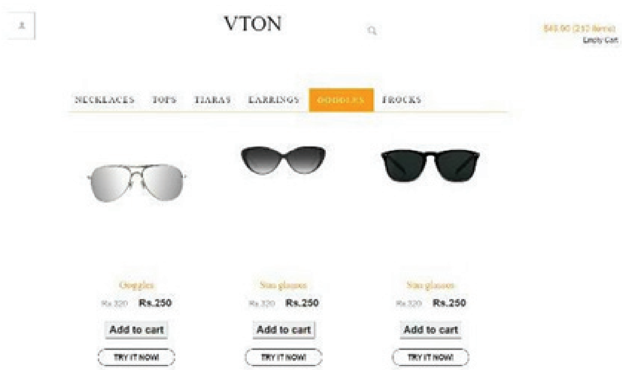

Fig. 4: User Interface for Virtual Try-On

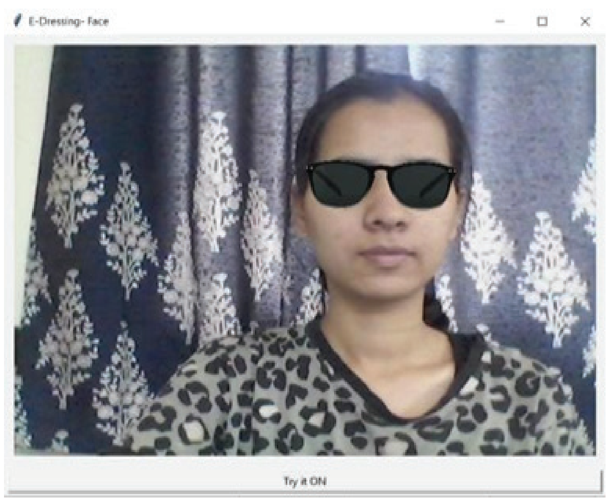

Fig.5 Output for virtual try-on

CHALLENGES AND FUTURE SCOPE

Challenges

- Accuracy and Realism: Continuously improving the accuracy of pose estimation, garment draping, and wrinkle simulation is crucial for a truly realistic experience. Factors like body types beyond standard sizing and complex garment materials can pose challenges.
- Data Bias: Training data for machine learning models needs to be diverse and representative to avoid biases in areas like body shapes, skin tones, and clothing styles.
- 3D Garment Modeling: Creating high-quality 3D garment models for a vast array of clothing items can be resource intensive.
- Limited Haptic Feedback: The virtual experience currently lacks the tactile sensation of trying on clothes, which can be a significant factor in purchase decisions.

Future Scope

- Advanced Personalization: Integration with body scanning technologies could allow for even more personalized virtual try-on experiences, catering to individual body shapes and measurements.
- Augmented Reality Integration: Virtual try-on could be seamlessly integrated with Augmented Reality (AR) to allow users to see how clothes would look in different environments or with other clothing items.
- AI-powered Outfit Recommendations: Artificial intelligence (AI) can be leveraged to analyze user preferences and suggest personalized outfit recommendations based on virtual try-on sessions and browsing behavior.
- Haptic Feedback Technology: The development of advanced haptic feedback suits could potentially simulate the feeling of different fabrics and textures, enhancing realism.
- Social and Interactive Features: Virtual try-on systems could incorporate social features, allowing users to share their virtual outfits with friends for feedback or participate in interactive fashion challenges.

CONCLUSION

Virtual try-on systems are revolutionizing the online shopping landscape by offering a more interactive and personalized way to assess clothing and accessories. By leveraging cutting-edge technologies like computer vision, machine learning, and augmented reality, these systems create a realistic simulation of how garments would look on individual users. This not only enhances the shopping experience but also empowers users to make informed purchase decisions with greater confidence.

While challenges remain in areas like accuracy, data bias, and haptic feedback, the future of virtual try-on is bright. Advancements in areas like 3D modeling, AI-powered recommendations, and social integration hold immense potential to further personalize and gamify the online shopping experience. Ultimately, virtual try-on systems have the potential to bridge the gap between the physical and digital worlds, making online clothing shopping as intuitive and fulfilling as the traditional in-store experience.

ACKNOWLEDGMENTS

We would like to express our sincere gratitude to Prof. Gitanjali Yadav Ma'am, our advisor, for her invaluable guidance, feedback, and encouragement throughout this research project. Her expertise in Machine learning was instrumental in shaping the direction and focus of this work.

We are also grateful to our Head of the Department Dr. Parikshit Mahalle Sir, our college Vishwakarma Institute of Technology, and faculties for their continuous and unwavering support throughout the project.

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Multi- Disease Prediction Using ML

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ABSTRACT

Machine learning and artificial intelligence have revolutionized healthcare by enabling advanced data analysis of extensive patient data. This study presents a novel Prediction system designed to concurrently identify multiple ailments, overcoming a common limitation in existing systems. By inputting relevant disease parameters, users receive a comprehensive output determining if they have any specified diseases. This system offers enhanced accuracy compared to single disease prediction models, thereby ensuring patient safety and well-being. Timely preventive measures can be implemented based on these predictions, contributing to increased life expectancy and improved healthcare outcomes.

KEYWORDS: *Deep Learning(DL), Disease detection, Diagnostics, Digital transformation, Healthcare.*

INTRODUCTION

The current healthcare industry, data has become the important aspect of patient care, consisting a health of patient-related information. the proposed system is a novel model for disease prediction in healthcare, by making the wealth of data generated in this digital era. the main target on addressing a significant limitation of existing models, which typically target one disease per analysis, leading to fragmented insights and inefficiencies in diagnosis and treatment planning. Currently, separate models exist for predicting diseases such as heart disease, diabetes, pneumonia, Parkinson's disease, and liver disease, with no integrated system capable of analyzing multiple diseases simultaneously. This proposal aims to deliver prompt and precise predictions of diseases by utilizing the symptoms input by users. The objective is to develop a system that can predict multiple diseases concurrently, enhancing efficiency and accuracy in disease prediction. We propose the use of Streamlit, a well known framework for building data-centric web applications, to develop a user friendly interface for disease prediction system. Initially, our system will focus on analyzing diabetes and heart-related conditions, delivering comprehensive and efficient disease predictions to users. Subsequently. One of the key features of our proposed system is its comprehensive consideration of all parameters contributing to the development of diseases. While existing systems tend to concentrate on specific diseases, our multi-disease prediction system offers a more holistic approach, allowing users to analyze multiple diseases through a single website. This approach not only enhances efficiency but also improves the user experience, making it easier for organizations to assess their patients' health reports. In summary, our proposal outlines a novel approach to disease prediction in healthcare, leveraging the power of data and machine learning to deliver accurate and efficient predictions. By integrating multiple disease predictions into a single system, we aim to revolutionize the way healthcare organizations analyze and manage patient health data, ultimately improving patient outcomes.

LITERATURE REVIEW

The majority of current studies focus on specific illnesses, necessitating the use of distinct models for analyzing different health conditions. For instance, a user interested in analyzing diabetes must employ one model, while another model is required for examining heart disease. This process is time-consuming. Moreover, if a user is afflicted with multiple illnesses and the current methodology can only predict one of them.

The main goal of this article is to develop a useful model with the capability to address range of diseases concurrently. Consequently, the Machine learning approaches utilized for this purpose are succinctly discussed [1].Numerous studies have investigated the application of machine learning algorithms in forecasting cardiovascular conditions. For instance, a study by Kaur and Singh (2020) proposed a prediction model for heart disease using SVM and K-nearest neighbor algorithms. The results indicated that in terms of accuracy, the SVM algorithm outperformed the K-nearest neighbor algorithm [2][3].Diabetes is another disease that has been extensively studied using machine learning algorithms. A study by Patil et al. (2021) developed a prediction model for diabetes using logistic regression and K-nearest neighbour algorithms. The results demonstrated that, in terms of accuracy, the logistic regression algorithm outperformed the K-nearest neighbor algorithm [4].Parkinson's disease prediction models have also been developed using machine learning algorithms. In a study by Acharya et al. (2020), the utilization of a Random Forest algorithm resulted in achieving a high accuracy rate for predicting Parkinson's disease. [2] Additionally, the study emphasized the significance of employing feature selection techniques to optimize the performance of the prediction model; the implementation of a Random Forest algorithm was instrumental. They utilized a dataset sourced from the UCI repository for both training and testing, focusing onpredicting heart disease. The results of the comparative analysis unveiled the following accuracies: SVM demonstrated an 83% accuracy, decision tree achieved 79%, linear regression yielded 78%, and k-nearest neighbor outperformed with an accuracy of 87% [5]. The system emphasizes the alarming rate of deaths caused by liver diseases in India, highlighting its status as a life-threatening ailment globally. Detecting liver disease at an early stage presents significant challenges. Leveraging automated programs employing machine learning algorithms offers accurate detection of liver disease. In their investigation, the scientists utilized Support Vector Machine (SVM), Decision Tree, and Random Forest algorithms, evaluating and appraising precision, accuracy, and recall metrics to quantitatively gauge performance. The achieved accuracies were 95% for SVM, 87% for Decision Tree, and 92% for Random Forest, respectively [6].

PROPOSED METHODOLOGY

The majority of prevailing machine learning models designed for healthcare analysis typically focuses on examining individual diseases separately. For instance, there are specific models for heart disease, diabetes, pneumonia, Parkinson's, liver conditions, and more health problems. If a user desires to predict. Multiple diseases, they are typically required to visit different websites or platforms. Unfortunately, there is no unified system is currently available that can simultaneously perform predictions for more than one disease. In our analytical procedures, we plan to employ machine learning algorithms in conjunction with Streamlit. Users interacting with this API will be required to transmit the disease parameters alongside the corresponding disease name. Following this, Streamlit will trigger the relevant model and provide the patient's condition in return. In Figure 1, a series of investigations were carried out on five health disorders: heart disease, diabetes liver disease, pneumonia, and Parkinson's disease, considering their established interconnections. The initial step involved importing datasets for each of these diseases, dataset for heart disease, dataset for diabetes, and, dataset for Parkinson, dataset for liver. Upon importing the datasets, the next step was data visualization. This visualization allowed us to gain insights into the data and better understand its characteristics. Following visualization, we performed data pre-processing, which included checking for outliers, handling missing values, and scaling the datasets to ensure they were ready for analysis. After pre-processing, the data was divided the dataset was partitioned into training and testing sets. The training set was employed specifically for conducting the model training process. Various machine learning algorithms, including SVC Algorithm/SVM Algorithm, Logistic Regression, CNN Algorithm [Deep Learning].

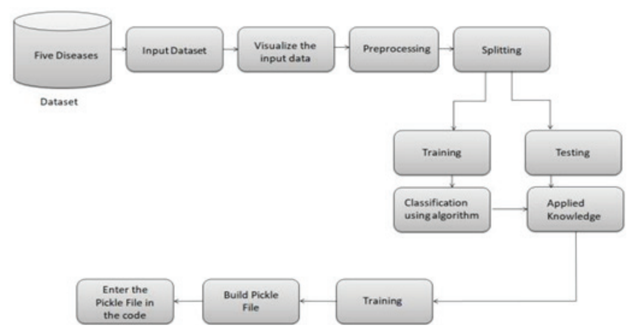

Fig. 1: Architecture Block Diagram

IMPLEMENTATION

Logistic Regression

Logistic regression is a commonly employed algorithm in machine learning, belonging to the realm of supervised learning methods. Its purpose revolves around forecasting a categorical dependent variable through the utilization of a predetermined collection of independent variables. Performing Logistic Regression using Python involves the following steps:

- Data cleaning/ Data preprocessing
- Fitting Logistic Regression with the training
- Making predictions on the test set
- Assessing test result accuracy through confusion matrix construction

Support Vector Machine/ Support Vector Classifier

The Support Vector Machine (SVM) algorithm stands out as a important binary classifier within the realm of supervised machine learning. It is highly regarded for its capacity to efficiently address both linear and non-linear classification tasks. SVM is increasingly recognized as a valuable alternative to conventional regression algorithms, such as Linear Regression. Steps in Support Vector Machine/ Support Vector Classification: In Python, an SVM classifier can be developed using the sklearn library.

- Loading Essential Libraries
- Importing the Dataset and Separating Variables
- Data Split
- SVM Classifier Initialization
- Model Training (Fitting)
- Generating Predictions
- Performance Evaluation

CNN Algorithm [Deep Learning]

Convolutional Neural Networks (CNNs) are a category of deep learning models widely employed in computer vision applications, including tasks such as image classification, object detection, and image segmentation. These networks are specifically engineered to autonomously and flexibly acquire spatial hierarchies their success has extended beyond image-related tasks to various domains like natural language processing and speech recognition, leveraging the extraction of features from input data. Convolutional Neural Network (CNN) typically involves several key steps.

- Data Collection and Preparation, Filter layer, Transfer function, Downsampling Layers., Dense Connected Layers, Transfer Function (Again), Dropout (Optional), Loss Function, Optimization Algorithm, Trading/Validation/Testing, Fine-Tuning (Optional), Deployment.

Dataset, Exploratory Data Analysis

The Dataset is taken from "www.Kaggle.com" into consideration for disease prediction purpose in this research work. This dataset is available on kaggle.com. The dataset is composed of 4 CSV files –

- heart.csv, diabetes.csv, parkinson.csv, liver.csv

The 'heart.csv' dataset consists of the following attributes:

- Gender
- Age
- Chest discomfort kind (4 types)
- Resting BP
- Serum cholesterol in milligrams per deciliter
- Fasting glucose > 120 mg/dl
- Resting ECG results (0, 1, 2)
- Max heart rate achieved
- Exercise-induced angina
- Oldpeak = Exercise-induced ST depression relative to rest

The identities and national identification numbers of the individuals were recently expunged from the repository, replaced with placeholder values.

	Unnamed: 0	Age	Sex	ChestPain	RestBP	Chol	Fbs	RestECG	MaxHR	ExAng	Oldpeak	Slope	Ca
0	1	63	1	typical	145	233	1	2	150	0	2.3	3	0.0
1	2	67	1	asymptomatic	160	286	0	2	108	1	1.5	2	3.0
2	3	67	1	asymptomatic	120	229	0	2	129	1	2.6	2	2.0
3	4	37	1	nonanginal	130	250	0	0	187	0	3.5	3	0.0
4	5	41	0	nontypical	130	204	0	2	172	0	1.4	1	0.0

Fig. 2 Statistical data about 'heart.csv'

The 'diabetes.csv' dataset consists of the following attributes:

- Gestations: Count of pregnancies
- Glucose: Blood sugar level 2 hours after oral glucose intake
- BloodPressure: Diastolic pressure (mm Hg)
- SkinThickness: Thickness of triceps skinfold (mm)
- Insulin: Serum insulin levels after 2 hours (mu U/ml)
- BMI: Body mass index (weight i n kilograms/(height in meters)^2)
- DiabetesPedigreeFunction:Genetic predisposition to diabetes
- Age: Years of age

The 'liver.csv' dataset consists of the following attributes:

- Age of the patient
- Gender of the patient
- Total Bilirubin
- Direct Bilirubin
- Alkaline Phosphotase
- Alamine Aminotransferase
- Aspartate Aminotransferase
- Total Protiens
- Albumin

- Albumin and Globulin Ratio
- Dataset: field used to split the data into two sets (patient with liver disease, or no disease)

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1
5	5	116	74	0	0	25.6	0.201	30	0
6	3	78	50	32	88	31.0	0.248	26	1
7	10	115	0	0	0	35.3	0.134	29	0
8	2	197	70	45	543	30.5	0.158	53	1
9	8	125	96	0	0	0.0	0.232	54	1

Fig. 3. Statistical data about 'liver.csv'

RESULT AND CONCLUSION

The proposed disease prediction system utilizes machine learning algorithms tailored to each specific disease, achieving high accuracy rates for diabetes, heart disease, Parkinson's disease, pneumonia, and liver disease prediction. The system employs the Support Vector Machine (SVC) algorithm for diabetes prediction, logistic regression for heart disease prediction, SVM for diabetes and Parkinson's disease prediction, and Convolutional Neural Network (CNN) for pneumonia prediction, with each algorithm demonstrating high accuracy rates. For diabetes disease SVM (78.33%), For Heart Disease-Logistic Regression(85.33%), For Parkinson Disease-SVM(87.7%) For Pneumonia Disease-CNN(94.53%).

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Intrusion Detection System in IoT Networks with Dataset Balancing and Explainable AI

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ABSTRACT

This paper addresses the critical need for securing Internet of Things (IoT) networks in contemporary smart environments, where intrusion attacks pose significant threats. Utilizing the ToN_ IoT dataset, the paper evaluates classification techniques for identifying intrusion attacks and assesses their suitability based on accuracy, along with addressing dataset imbalance through an analysis of oversampling techniques. The research further emphasizes the interpretability of algorithmic results by incorporating Explainable AI techniques, specifically SHAP and Lime. This enhances understanding by providing insights into the contribution of features from the dataset in specific classification results. Shifting to a broader context, the study investigates the efficacy of four machine learning algorithms on oversampled data—K-nearest neighbours, random forest, CART and naive Bayes. Notably random forest and CART consistently outperform other classifiers, demonstrating superior accuracy and precision-recall metrics across diverse intrusion classes. All algorithms are evaluated on dataset generated by oversampling using Random Over Sampler, ADASYN and SMOTE oversampling techniques.

KEYWORDS: *CART, Classification, Intrusion detection system, Machine learning algorithms, Random forest.*

INTRODUCTION

The research is situated within the domain of Internet of Things (IoT) security, with a specific focus on advanced intrusion detection techniques. Within this domain, several critical research problems demand attention and innovative solutions. One such challenge is the inherent vulnerabilities associated with the deployment of resource-constrained devices across diverse sectors such as healthcare [1], agriculture, transportation, and home automation [2]. These vulnerabilities pose a significant hurdle to the security of IoT networks. IoT networks face a diverse range of security threats. The multifaceted nature of threats underscores the complexity of securing interconnected devices in IoT environments. In the realm of research focused on securing IoT networks, a significant overarching challenge revolves around the scarcity of high-quality labeled datasets essential for developing and validating advanced intrusion detection techniques. The selected area of focus for in-depth exploration in this research is the development of effective intrusion detection techniques tailored specifically for securing IoT networks. This choice is deemed crucial due to the inherent risks associated with compromising the security of IoT systems. IoT networks are crucial for automation and enhancing sectors like healthcare, transportation, and smart homes. Security is crucial, as 98% of data remains unencrypted and outdated software versions increase vulnerability. The 2020 IoT Threat Report highlights the need for robust intrusion detection methods to protect connected devices [3].

The paper explores machine learning algorithms for intrusion detection in IoT ecosystems, focusing on the IoT_Modbus dataset. It proposes a novel approach using machine learning techniques for detecting backdoor, ransomware, and XSS attacks. The study highlights the importance of a balanced dataset for applying ML algorithms, and how oversampling techniques can be used to implement different algorithms. The paper emphasizes the need for transparency and interpretability in security systems, emphasizing the need for understanding the inner workings of machine learning algorithms in attack detection [4-10].

The paper advocates for Explainable AI (XAI) techniques, specifically SHAP and LIME, to enhance trust and confidence in security infrastructure. These techniques interpret machine learning algorithms' results, providing insights into attack classification. The paper aims to make decision-making transparent and understandable for cybersecurity stakeholders. It assesses the effectiveness of machine learning in securing IoT networks, contributing to deeper understanding of intrusion detection [11,12].

LITERATURE REVIEW

In a diversified IoT network, maintaining network security is the major concern. Research has been carried out to detect and prevent probable security threats in various ways. Rodda et al. [13] conducted an analysis of different classifiers for IDSs, revealing subpar performance in the U2R minority class. To address this, synthetic samples were used to oversample the minority class, and Gradient Boosting Decision Tree, K-Nearest Neighbor, and Fly Optimization Algorithm were employed to segregate normal and attack classes. Additionally, a distributed Cellular Genetic Programming framework for combining an ensemble of intrusion detection classifiers was developed by [14], achieving notable precision and recall values. Further advancements included the hybrid approach proposed by [15], which combined Support Vector Machine (SVM), K Nearest Neighbor, and Primal-Dual Particle Swarm Optimization to enhance accuracy for IDSs. Yuan et al. [16] utilized a combination of C5 Decision Tree and NB algorithm to develop A-IDS. The study explores intrusion detection in IoT networks using various datasets, including KDD-99, UNSWNB15, CICIDS-2017, NSL-KDD, BotIoT, IoT Network Intrusion Dataset, Aposemat IoT-23, and N-BaIoT. The study introduces a distributed detection system using machine learning (ML) approaches, using the ToN_IoT dataset. The study highlights the importance of diverse configurations for effective intrusion detection in IoT networks. The PCC-CNN, an IDS based on deep learning, outperforms traditional models with a 99.89% detection accuracy and low misclassification rates. These datasets provide benchmarks for efficient method comparison.

METHODOLOGY

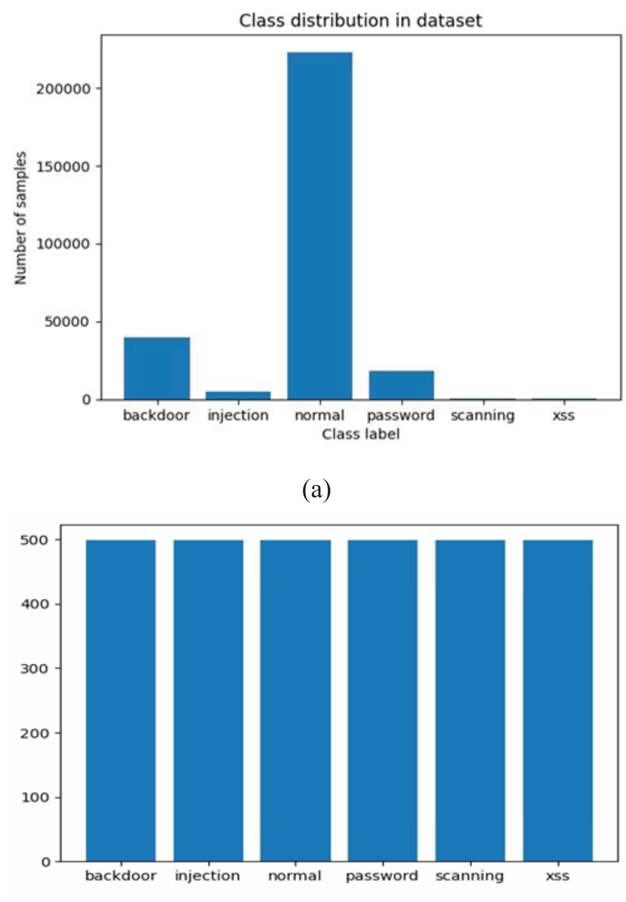
Methodology used for dataset selection, preprocessing of dataset, intrusion detection model building and evaluation are described in detail.

Dataset

The IoT_Modbus dataset, sourced from ToN-IoT datasets, provides detailed insights into IoT network interactions in fridges, garages, and Modbus connections. Researchers created a specialized testbed network to simulate real-world industry 4.0 networks, incorporating IoT and IIoT networks. The dataset's imbalanced nature highlights the importance of robust and adaptive detection models for attack detection, as normal events outnumber malicious activities in real scenarios [9].

Preprocessing Datasets

To tackle the issue of imbalanced dataset distribution, the pre-processing phase aimed at improving the accuracy of the machine learning model. Considering the substantial imbalance, where the 'Normal' class dominated the dataset while other attack classes had significantly fewer entries, the approach involved implementing oversampling techniques. This was crucial for establishing a more balanced dataset. In this particular study, the Random Oversampler, Adaptively generating minority dat samples (ADASYN) and Synthetic Minority Oversampling Technique (SMOTE) are utilized for this purpose. The original IoT_Modbus dataset comprised a total of 86,159 records.



(a)

(b)

Fig. 1: Distribution of dataset records (a) before re-sampling (b) after re-sampling

Synthetic instances were created for the minority classes using oversampling techniques, with the objective of attaining a more equitable distribution among all classes. This process involved generating additional instances for the underrepresented classes by extrapolating from the existing data, thereby augmenting their representation in the dataset. The aim was to mitigate the imbalance in class distribution and ensure that the model is trained on a more comprehensive and representative dataset, improving its ability to generalize and make accurate predictions across all classes. The primary objective was to enhance the model's capability to accurately classify instances of both normal and attack events. The distribution of the dataset is depicted in figure 1(a), while the balanced dataset after resampling using SMOTE is illustrated in figure 1(b).

Model Training and Evaluation

The study focuses on creating an intrusion attack prediction model for IoT networks using machine learning algorithms. The IoT_Modbus dataset serves as the knowledge base, and oversampling algorithms are used to compare the number of samples per class. The model is evaluated for accuracy using all three oversampling techniques, and features selected are explained using explainable AI techniques.

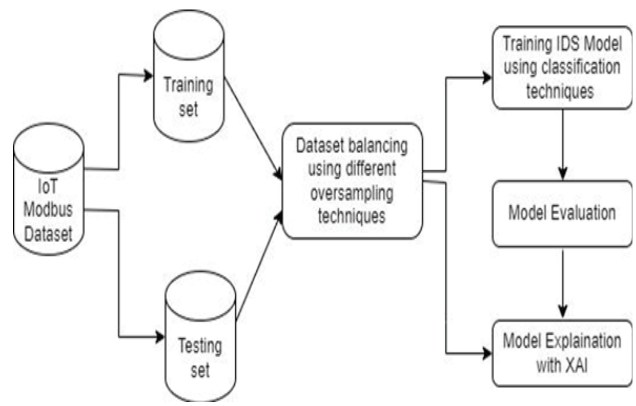


Fig. 2: Proposed Methodology for Building Intrusion Detection System

The study compared four machine learning techniques: RandomForest classifier, K-Nearest Neighbour (KNN) classifier, CART, and Niave Bayes classifier. KNN is a simple yet effective method for classification tasks, relying on the proximity of neighboring data points. Its effectiveness depends on the 'k' parameter and distance metric. Random Forest classifier is an ensemble learning technique that constructs multiple decision trees during training, avoiding overfitting. CART is a sophisticated recursive partitioning algorithm used in predictive modeling; segmenting datasets based on the most significant predictor variable. Naive Bayes classifier is a probabilistic model based on Bayes' theorem, assuming feature independence. It computes the probability of a given instance belonging to each class based on its feature values, choosing the class with the highest probability as the prediction.

EXPERIMENTAL RESULTS

The experiments involving machine learning implementations were conducted on computing systems equipped with Intel i5 CPUs supplemented by GPUs, and the systems were furnished with 16 GB of random- access memory (RAM). This hardware configuration was chosen to provide computational power and memory capacity suitable for the machine learning tasks, ensuring efficient execution and processing capabilities for the experimental procedures.

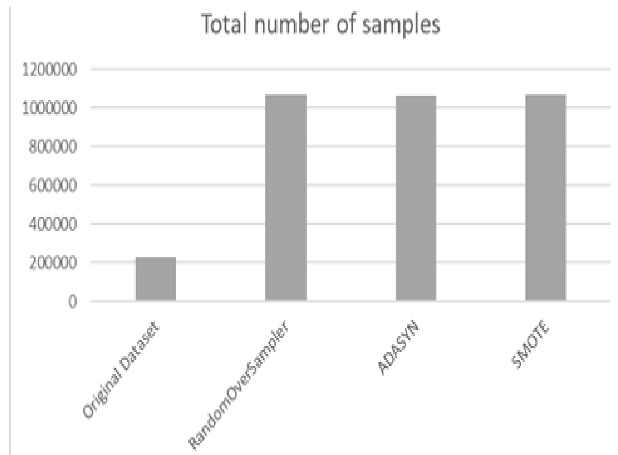


Fig. 3: Total number of samples in IoT_Modbus dataset after applying oversampling techniques

As part of data preprocessing step, after applying different oversampling techniques, total number of samples have been changed as mentioned in figure three. The number of samples is increased significantly after oversampling, which helps to remove side effects of applying machine learning algorithms on imbalanced dataset. Visual representation of effect after applying oversampling techniques is shown in figure four. The figure is plotted for first hundred samples. It is observed that the data distribution is random in fashion, and the oversampling techniques have not changed the underlying distribution for first two features from dataset.

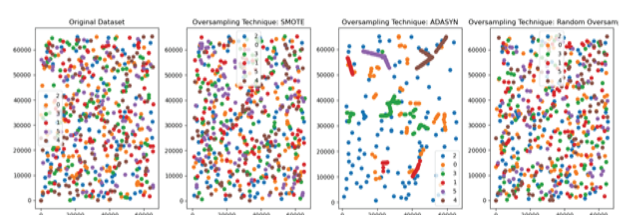


Fig. 4: Distribution of features from IoT_Modbus dataset after oversampling using different techniques

The classification algorithms were employed for identifying attack with six class labels: “backdoor”, “injection”, “normal”, “password”, “scanning”, and “xss”. Change in achieved accuracy are observed after applying machine learning algorithms. Random Over Sampler gives better accuracy than original dataset for all four machine learning algorithms. ADASYN over-sampler outperforms other samplers in case of random forest and CART classifiers. SMOTE oversampling technique is most suitable for Naïve Bayes classifier.

Table 1. Comparison of accuracy obtained by applying classification algorithms on oversampled datasets

Algorithm/ Accuracy	Original Dataset [10]	Random Over Sampler	ADASYN	SMOTE
KNN	0.77	0.8228	0.7614	0.7646
Random Forest	0.97	0.9842	0.9859	0.9855
CART	0.98	0.9844	0.9852	0.9845
NB	0.67	0.7963	0.7914	0.7967

EXPLANATIONS OF RESULTS USING SHAP AND LIME

Explainable AI (XAI) aims to improve the interpretation and trustworthiness of machine learning models by revealing their decision-making processes. It uses SHAP values, rooted in cooperative game theory, to distribute feature contributions to predictions, enhancing interpretability and trust. LIME, model- agnostic, elucidates complex model predictions on a local level, providing insights into the decision- making process on a per-instance basis. These methods help users understand the influence of each feature on predictions, enhancing the interpretability and trustworthiness of machine learning models, including multiclass classification models.

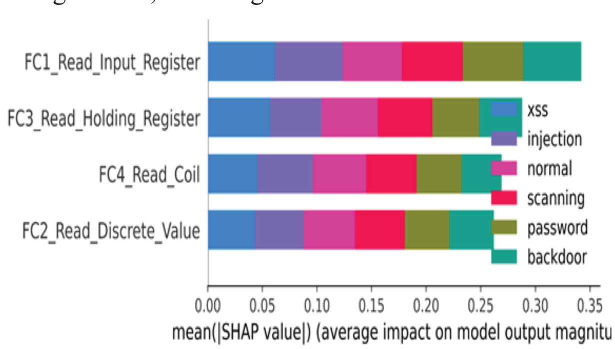


Fig. 5: Contribution of features in predicting intrusion category

Figure 5 shows the contribution of four features to intrusion categories in a dataset. LIME (Local Interpretable Model-agnostic Explanations) provides localized explanations for individual predictions by training a local surrogate model around the instance of interest. This simple surrogate model is easier to interpret and helps users understand the rationale behind a particular prediction. LIME is applied to predict probabilities for five types of intrusion attacks, providing valuable insights into the decision-making process.

Figure 6 exemplifies the application of LIME in predicting probabilities for five types of intrusion attacks for a single sample record from the dataset.

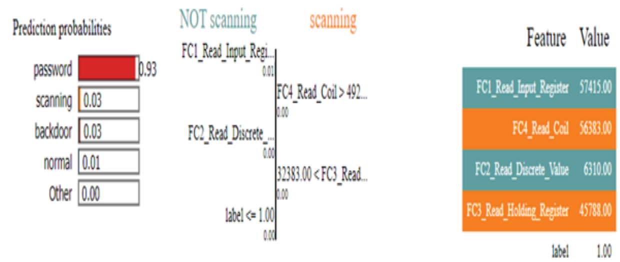


Fig. 6: Prediction of probabilities for five types of intrusion attacks for one sample and impact of five features on the prediction of attack.

CONCLUSIONS

In conclusion, this paper focused on addressing the critical issue of intrusion detection in IoT networks, recognizing the vulnerability of such networks to various security threats. Through the utilization of machine learning techniques, specifically the RandomForest Classifier, we aimed to enhance the accuracy and effectiveness of intrusion attack prediction in IoT environments. The research began with a thorough exploration of the challenges posed by imbalanced datasets and the inherent vulnerabilities of IoT networks to security threats. Leveraging the IoT_Modbus dataset from ToN-IoT datasets, which provided real-world network traffic data, we proceeded with preprocessing steps aimed at mitigating dataset imbalances. By employing oversampling techniques, we balanced the dataset to improve the performance of the machine learning model. Subsequently, the RandomForest Classifier was applied to the preprocessed dataset, taking advantage of its ensemble learning capabilities and robustness in handling complex datasets. The classifier was trained and evaluated using a combination of training and validation sets, with a focus on achieving accurate intrusion attack predictions. Throughout the experimentation phase, the RandomForest Classifier demonstrated promising results, showcasing its efficacy in accurately classifying instances of normal network activity and various intrusion attacks. The use of XAI techniques provided useful insights into effect of each feature from dataset on predicting anomaly category.

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Decision Support System for Stock Portfolio Optimization using Hill Climbing Algorithm

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ABSTRACT

The paper presents a financial decision support system (DSS) that uses AI's hill climbing algorithm for stock portfolio optimization. The system comprises three modules: the discounted cash flow model (DCF), a comprehensive financial health analysis, and a hill climbing algorithm. The DSS uses strong financial health indices to base portfolio selection, considering multiple dimensions of stock performance. The model is applied to fundamental stock data of the US stock market and presents an optimized portfolio with objective function values. Results show that selected stocks are fundamentally sound for long-term investment.

KEYWORDS: *Decision support system, Financial health analysis, Hill climbing algorithm, Stock portfolio optimization.*

INTRODUCTION

The stock market facilitates trading between buyers and sellers, representing companies worldwide. It has become a significant investment activity, with the growth of online platforms attracting millions of small investors. Portfolio optimization is the process of creating an investment portfolio that balances returns and risks. However, this is challenging due to factors like high dimensionality, uncertainty, volatility, and constraints like cardinality, category, risk tolerance, and budget. The dynamic nature of markets and computational complexity make optimizing portfolios difficult. Effective decision support systems use advanced optimization techniques, predictive analytics, and robust risk management strategies to navigate these challenges and generate optimal investment portfolios [1-2].

A variety of techniques are used by decision support systems (DSS) to take financial decisions, including stock trend prediction using candlestick charting and ensemble machine learning methods [3], stock price movement forecasting using fuzzy clustering rule-based expert system [4], fuzzy inference systems based on technical indicators [5], all of these methods depends upon technical parameters, which are prone to error when picking stocks over the larger time horizon. DSS determined by fundamental analysis approaches [6] have been shown to be more accurate and effective [7] when selection of stocks have longer time horizon view.

Objective of this paper is to create an optimized stock portfolio based on fundamental analysis of stocks. The financial DSS in this paper was checked using openly available financial stock data listed on the NYSE & NASDAQ. The intrinsic value computation, thorough evaluation of financial health [8], and a strategic nature inspired hill climbing algorithm [9] collectively empower investors to make informed choices, navigating the complexities of stock portfolio construction. By integrating these modules, our system introduces a new innovative approach to handle multiple constraints while selecting stock portfolio. NYSE (US), NASDAQ (US), Japan Exchange Group (JPX, Japan), NSE, India stock exchanges are among the largest in the world.

LITERATURE REVIEW

The use of decision support systems in the financial domain has been explored, with AI and machine learning algorithms being used for stock portfolio optimization. However, these algorithms often focus on technical factors and produce unhelpful projections. A study presented a new ensemble ML framework, integrating deep learning and AI with conventional candlestick charting, achieving over 60% accuracy for certain trend patterns [3].

The findings suggest FNN's superiority over ANFIS, emphasizing its enhanced performance in stock prediction based on fundamental financial ratios. This paper [7] addressed the stock selection challenge in the investment industry by proposing a combined soft computing model based on fundamental analysis. This paper [8] introduced a stock portfolio selection using decision support system, leveraging AI and ML. The DSS employs a unique approach, combining AI and ML with traditional mathematical models, facilitating sound financial analysis for stock portfolio creation and management. The study shows that decision support systems (DSS) can provide higher returns and diversify risk in the stock market. DSS-generated portfolios show strong financial health indices and ROI, outperforming market indexes by over 15%. They propose a robust portfolio optimization approach based on the knapsack problem, addressing challenges such as risk-return balance, transaction costs, complex constraints[1-2].

PROBLEM FORMULATION

The portfolio optimization based on a multidimensional knapsack problem [2] with the cardinality, floor and ceiling (quantity of stock), total budget, budget limit for individual stock, category (diversification and risk) constraints can be defined as follows:

$$\text{Maximize } f_i(x) = \sum_{i=1}^{n} WF_I \times SF_i + WPC_i \times SPC_i + WRG_i \times SRG_i + WNB_i \times SNB_i \quad (1)$$

s.t.

$$\sum_{i=1}^{n} sp_i x_i \le B, \quad (2)$$

$$aB \le x_i \le bB, \text{ where } 0 \le a \le b \le 1 \quad (3)$$

$$\sum_{i=1}^{n} z_i = k, \quad (4)$$

$$l_i z_i \le x_i \le u_i z_i \quad \forall i \in \{1,2,\ldots,n\}, \quad (5)$$

$$L_m \le \sum_{z_i \in c_m} x_i \le U_m, \quad (6)$$

$$x_i \in int, \quad \forall i \in \{1,2,\ldots,n\}, \quad (7)$$

$$z_i \in \{0,1\}, \quad \forall i \in \{1,2,\ldots,n\}, \quad (8)$$

The objective function in Eq.(1) seeks to combine weighted scores (SF, SPC, SRG, SNB) representing stock health fitness value, percent change in intrinsic value, revenue growth over next year and normalized budget respectively. The weights (WF, WPC, WRG, WNB) allow the author to assign importance to each criterion in the optimization process. Eq.(2) introduces the total budget constraint, which assure that the sum of the weights of all stocks does not exceed the available total budget. In this equation, 'spi' represents the stock price of stock 'i', B is the total budget, and xi is the integer variable representing the quantity of shares of stock 'i'. Eq.(3) introduces the budget constraint for individual stock, which set the boundaries for each stocks allocation from total budget. Eq.(4) introduces a cardinality constraint that specifies the upper limit of stocks that can be included in the portfolio. Here, 'k' denotes the highest number of stocks permitted in the portfolio. Eq.(5) gives the floor and ceiling constraint, which set the boundaries for the permissible range of quantity per stock. Eq.(6) introduces category constraint, when available stocks are categorized into different classes such as large-cap, mid-cap, small-cap based on market cap of stock. Recognizing the importance of diversification, this strategic approach aims to disperse the risk across various classes. Eq.(7) and Eq.(8) describe the structure of the decision variables, which consist of both binary and integer variables.

METHODOLOGY

A hybrid AI model serves as the foundation for the financial DSS for stock portfolio optimization. The three primary subsystems that comprise the DSS architecture are intrinsic value model, financial health analysis model and optimized stock portfolio using hill climbing algorithm. When combined, all three subsystems aimed at enhancing the decision-making process for stock portfolio optimization.

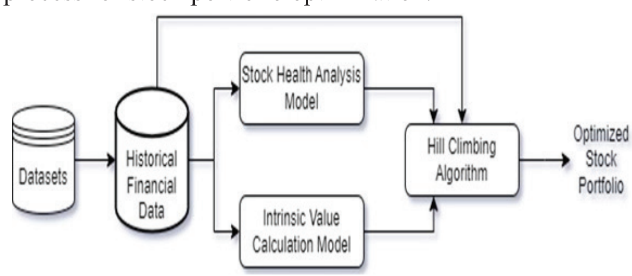

Fig. 1: Design of financial DSS for stock portfolio optimization

Model for Intrinsic Value of Stock

The worth of a stock discovered by fundamental evaluation and independent of its market value is known as its intrinsic value or real value. A discounted cash flow model (DCF) for calculating the intrinsic value of stock is used and it is depicted below in fig.2.

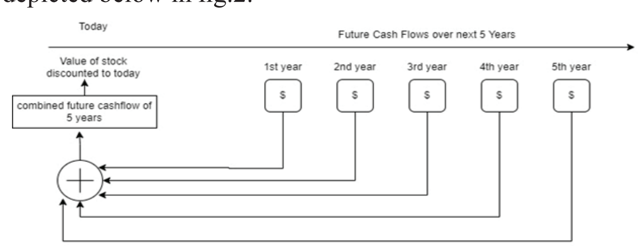

Fig. 2: DCF model for intrinsic value

To calculate discounted cashflow we need cashflow of stocks and discount rate for that particular stock. Discount rate is calculated using below formula.

Discount rate = Risk-free rate + Beta * Market Risk Premium

Risk-free rate is the rate of return you could earn with near zero risk. Market risk premium is the excess return investors receive, on average, by investing in that stock. Historically between 4.5% and 6.5% for the most part. Stock's sensitivity to fluctuations in the stock market, beta of stock. Higher beta means the stock is more riskier relative to broader stock market.

The intrinsic value of a company can be determined using the formula for DCF model.

Intrinsic Value = Σ sum(CF) ÷ (1 + discount rate) ^ time period

In the above intrinsic value formula, assets include the sum of cash flows of 'x' years and total cash, while liabilities consist of total debt on company. And the result is divided by the number of outstanding shares. Based on possibilities of output intrinsic value it can be classified as follows.

Intrinsic Value of Stock > Current Share Price → Undervalued – Potential Buy

Intrinsic Value of Stock = Current Share Price → "Correct" Market Pricing

Intrinsic Value of Stock < Current Share Price → Overvalued – Potential Sell

Model for Financial Health Evaluation of Stock

Critical financial attributes make up the inputs of the stock portfolio optimization model, which also includes expert knowledge base procedures for assessing each financial attribute [10]. The model, which is depicted in Fig.3, is divided into two phases. In the first phase, each attribute is rated after being subjected to a set of knowledge base rules. In the second phase, all of the ratings are weighted and added together to create an index value, which is then used as an input for the DSS's hill climbing algorithm to optimize the stock portfolio based on the company's excellent financial health in addition to its intrinsic value [10].

Fig.3 shows how to calculate fitness value for each stock based on most important parameters. To have a greater understanding about the stock, it is necessary to interpret the different stock parameters that have been gathered. Evaluating each factor's significance and meaning aids in making the final selection in a timely and accurate manner.

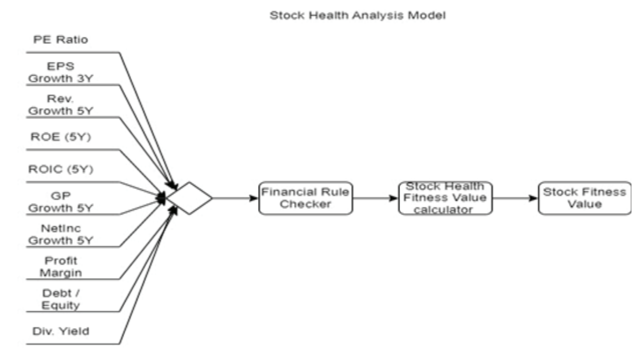

Fig. 3: Model for financial health evaluation of stock

Stock Portfolio Optimization Using Hill Climbing Algorithm

Below pseudocode of hill climbing algorithm used into decision making process of stock portfolio optimization.

Pseudocode of hill climbing algorithm for financial DSS
Function hill_climbing_algorithm(initial_portfolio): best_portfolio = initial_portfolio best_objective_value = evaluate_portfolio(initial_portfolio) best_total_budget_used = evaluate_total_budget_used(initial_portfolio) For i from 1 to max_iterations: neighbor_portfolio = generate_neighbor_portfolio(best_portfolio) neighbor_objective_value = evaluate_portfolio(neighbor_portfolio) If neighbor_objective_value > best_objective_value: best_portfolio = neighbor_portfolio best_objective_value = neighbor_objective_value best_total_budget_used = neighbor_total_budget_used Return best_portfolio, best_objective_value, best_total_budget_used // Running hill climbing algorithm best_portfolio, best_objective_value, best_total_budget_used = hill_climbing_algorithm(initial_portfolio)

Hill climbing [9] begins with the initialization of a solution, often chosen randomly. The optimization process hinges on an objective function defined as above over the solution space, guiding the algorithm towards optimal solution. Hill climbing iteratively explores the solution space by examining neighbouring solutions facilitating local exploration, moving towards the peak of the solution space. Termination criteria include reaching a pre-determined number of iterations, achieving a specified objective function value, or encountering a local optimum. The performance of hill climbing algorithms is evaluated based on their ability to converge to a near-optimal solution. So this type of heuristic algorithm's are used to solve problems which are non-polynomial in time to get better approximate solutions.

RESULTS AND DISCUSSION

Scenario 1: We have taken dataset of nearly 500 stocks as input from which we select n stocks (n=10). This n will act as a cardinality constraint. We satisfied different constraints such as cardinality, total budget, budget for each stock, diversification constraint to reduce risk. In diversification constraint we chose stocks from all 3 categories large-cap, mid-cap & small-cap. Below we can see a list of selected stocks in Table 1.

Initial stock portfolio obtained: Total Budget Used: 7806, Normalized Total Budget Used: 78%.

Table 1. Sample 1 initial stock portfolio

[42, 'Thermo Fisher Scientific', 518, 1, 2]	[6, 'Meta Platforms', 334, 1, 2]	[25, 'Oracle', 102, 1, 10]
[79, 'Applied Materials', 156, 1, 4]	[41, 'Cisco Systems', 89, 1, 8]	[148, 'General Mills', 167, 2, 3]
[116, 'Edwards Lifesciences', 75, 2, 8]	[119, 'Block', 70, 2, 10]	[183, 'Align Technology', 231, 3, 5]
[176, 'Ball Corporation', 158, 3, 5]		

In above selected stocks lists each stock denotes its stock id, stock name, stock price, category of stock, quantity chosen for stock respectively. After that neighbor portfolio/ solution is generated which satisfies given constraints. Then iterating using hill climbing algorithm based on objective function value of initial and neighbor solutions are compared and after comparing multiple solutions we get an optimal objective function value for given portfolio which is an optimized portfolio.

Best Portfolio Found: Total Budget Used: 9708.0, Normalised Total Budget Used: 97%, Best Objective Function Value: 6.8689 Here, a moderately modified random allocation strategy is employed in stock selection.

Table 2. Sample stock dataset with its attributes values

Stock_ID	Company Name	Stock Price	Category	Combined Fitness_Score	Intrinsic Value	percent from instrinsic_value	Rev Gr. Next Y	Lower_limit	Upper_limit	normalized fitness_score	normalized percent change from instrinsic_value	normalized Rev_Gr_Next_Y
1	Microsoft	374	1	3.4	128.2130242	-191.99	13.93	1	14	0.623955432	0.811475039	0.574638043
2	Alphabet	133	1	3.68	107.819	-24.25	11.32	2	12	0.70195	0.57286	0.402537
3	Amazon.com	148	1	3.03	18.61008	-699.78	11.35	1	11	0.520891	0.487669	0.402934
4	Eli Lilly and Company	597	1	2.51	80.94134	-638.19	15.81	3	13	0.376045	0.523275	0.59341
5	Visa Inc.	262	1	3.05	129.7601	-102.2	10.5	2	12	0.526462	0.86947	0.540389

Each stock must adhere to predefined constraints, and the quantity of each stock is determined within a specified range. The weights assigned to each stock range from 5% to 15% of the total budget. The resulting output provides a comprehensive view of the selected stocks and their quantities. The program initiates the stock selection process with an initial random allocation of stocks. The budget is then allocated to select stocks based on specific criteria, resulting in a specific set of stocks and quantities.

Table 3. Sample 1 optimized stock portfolio

[60.0, 'HDFC Bank', 65.0, 1.0, 3.0]	[82.0, 'American Express Company', 174.0, 1.0, 7.0]	[13.0, 'Taiwan Semiconductor Manufacturing Company', 102.0, 1.0, 11.0]
[3.0, 'Alphabet', 133.0, 1.0, 12.0]	[5.0, 'NVIDIA', 480.0, 1.0, 2.0]	[147.0, 'L3Harris Technologies', 208.0, 2.0, 4.0]

[114.0, 'ST Microelectronics', 78.0, 2.0, 6.0]	[135.0, 'Lennar', 145.0, 2.0, 11.0]	[153.0, 'United Microelectronics', 118.0, 3.0, 7.0]
[178.0, 'Coterra Energy', 224.0, 3.0, 4.0]		

The calculated objective function value for the selected portfolio is 6.87 which is optimized compared to our initial 2 portfolio's objective values which were 5.06 & 4.94. We got an optimized stock portfolio selected which is the main objective of our study.

Different Scenarios of Optimized Portfolio

Scenario 2: In scenario 2 we have changed total budget constraint from 10000 to 12000 as well as diversification constraint also changed by taking 4 of large cap and 3 of mid cap stocks and small cap stocks each which means risk is slightly increased in portfolio compared to scenario 1. For 3000 iterations we got objective function value 7.38 which is fairly good considering risk increased.

Best Portfolio Found: Normalised Total Budget Used: 96%.

Table 4. Sample 2 optimized stock portfolio

[304.0, 'Arch Capital Group Ltd.', 87.0, 2.0, 2.0]	[380.0, 'Neurocrine Biosciences, Inc.', 139.0, 3.0, 3.0]	[19.0, 'Johnson & Johnson', 155.0, 1.0, 11.0]
[94.0, 'BlackRock', 773.0, 1.0, 7.0]	[5.0, 'NVIDIA', 480.0, 1.0, 2.0]	[147.0, 'L3Harris Technologies', 208.0, 2.0, 3.0]
[60.0, 'HDFC Bank', 65.0, 1.0, 9.0]	[290.0, 'Monolithic Power Systems, Inc.', 732.0, 2.0, 1.0]	[375.0, 'Credicorp Ltd.', 175.0, 3.0, 2.0]
[410.0, 'Rexford Industrial Realty, Inc.', 53.0, 3.0, 1.0]		

Scenario 3: In scenario 3 we have changed total budget constraint from 10000 to 12000 as well as individual stocks budget constraints upper limit changed from 0.15 to 0.20. While calculating objective function we use weighted sum whose values are assumed. All 4 weighted values changed & more importance to growth factor is given after changed weights. For 3000 iterations we got objective function value is 6.82 & for 5000 iterations obj. value is 7.51 which is pretty much increased from 6.82 for earlier 3000 iterations. So this scenario is helpful to pick growth stocks available in the market.

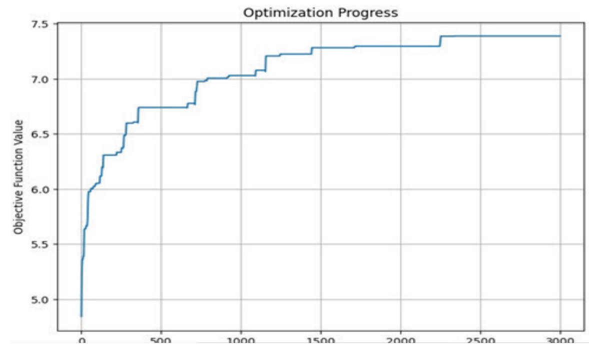

Fig. 4: Nature inspired hill climbing algorithm optimizing objective function

Here in fig. 4 we can see that as iterations increases objective function value also gradually increases, after 3000 iterations we got 7.38 as best objective function value which is our final output.

Best Portfolio Found: Total Budget Used: 10240.0, Normalised Total Budget Used: 85%, Best Objective Function Value: 7.5102.

Table 5. Sample 3 optimized stock portfolio

[60.0, 'HDFC Bank', 65.0, 1.0, 9.0]	[183.0, 'Vertex Pharmaceuticals Incorporated', 413.0, 1.0, 1.0]	380.0, 'Neurocrine Biosciences, Inc.', 139.0, 3.0, 2.0]
[304.0, 'Arch Capital Group Ltd.', 87.0, 2.0, 9.0]	[5.0, 'NVIDIA', 480.0, 1.0, 4.0]	[203.0, 'Fiserv, Inc.', 151.0, 1.0, 10.0]
[191.0, 'Cigna Corporation', 341.0, 1.0, 7.0]	[125.0, 'Lennar', 145.0, 2.0, 5.0]	[290.0, 'Monolithic Power Systems, Inc.', 732.0, 2.0, 2.0]
[375.0, 'Credicorp Ltd.', 175.0, 3.0, 1.0]		

CONCLUSION

In this research we implemented stock portfolio optimization model using hill climbing heuristic algorithm which iteratively optimizes portfolio based on objective function. Portfolio optimization based on fundamental variables instead of technical indicators gives us long term reliability. A hybrid DSS combining intrinsic value of stock, financial health analysis of stocks using hill climbing algorithm is an innovative approach to developing efficient and dependable financial systems. Results gave us different stock portfolios which shows model is flexible enough to satisfy multiple constraints, investors preference and risk profile.

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Finite Automata Application in String Identification

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ABSTRACT

Automata Theory is very useful in programming languages. It can have various applications. One of its applications is for the evaluation of regular expressions. In this paper, the discussion of pattern matching is done. The given input will be searched for the pattern. This proposed model will give the information about the content of the given input string. This concept needs a complicated programming model. Many techniques are present for the process of pattern matching. Finite Automata can be used in the pattern matching process to identify the patterns. It can also be used for making memory efficient by minimizing the number of states, minimize the number of transitions.

KEYWORDS: *Pattern matching machine, Finite automata, C++.*

INTRODUCTION

Method of taking input and performing some required operations at the center to provide the output based on a set of rules or algorithms is called Computation [2]. Automata principle is the study of abstract machines and automata. It also deals with computational problems and their solutions. A finite state machine abbreviated as FSM, can be used for representing any language . A language is what basically consists of a set of strings. Finite automata are used in diverse fields in solving complex problems, the use of algorithms and different techniques [1]. Finite automata require input as a string from enter tape hence the enter tape is split into cells and each cellular can have one enter image [2].

Finite automata are basically divided into two subtypes, deterministic finite automata (DFA) and nondeterministic finite automata which is also known as NFA[5]. Non-deterministic finite automaton is nothing but a finite set with one start state and a set of accepting states. It allows 0, 1 or more transitions from a state for the same input symbol. A DFA consists of a finite set of states and the finite set of some input tapes. This allows you to switch while having an input symbol other than the same input symbol. Pattern Matching checks a given sequence of tokens/strings for the presence of some pattern. Basically, input string is compared with a predefined stored pattern[6]. This paper discusses the same concept. It tells what the input string contains. Whether it contains a number, character or a symbol. This paper discusses finite automata construction based on programming. This machine is created by using C++ programming language.

LITERATURE SURVEY

Below are some of the papers which have been referred while doing research on the topic :

Jiwei Xue, Ygagao Li and author eighty Nan [1] use Finite Automata with a basic schooling which is one of the keys to organizing a lifelong studying software. The corresponding paper describes a finite type automata theory, and to ensure records protection, prioritizes -automaton restrained to reveal and filter out text statistics entered using well suited or asynchronous gear furnished by the network have a look at Ms. J. Nirmala, Mrs. V. Rajathi authors [4] used numerous finite automata having set of rules and size. So, time complexity is reduced with the use of various techniques. Programming languages are used for building numerous types of finite automata and to accept binary input strings. This paper intendedto observe distinctive processes of finite automata creation.Writer Robert L. Constable [3] used generally described automata styles which might be reflected in laptop behavior, programming language structures and device session policies. Systematic look at those patterns has mounted laptop concept, to offer thoughts, techniques and paradigm for a way achieving and hiding consequences in many components of PC modem theory.

Mikael Peterson introduces a new integration set of rules for time period pattern patterns in purposeful languages, addressing issues like replica code and bias exams. Bofivoj Melichar's paper explores infinite stop automatons for k-connected cables, demonstrating that "flexible gadget" and "shift and based" algorithms mimic this automaton. The corresponding DFA has a shape of O (mTM), with complex time O (n) for supported algorithms and determining automata. Ramanpreet Singh and Ali A. Ghorbanin discuss text mining, vector websites, and word patterns [5,6,9].

Krishna Kishore Thota, R. Jeberson Retna Raj refractory novel gerex model [8] bear in mind a tour robotic designed to enhance the show with near-up operation. The important thing is idea of the walk automaton has modified the characteristic inside the distribution of various tour numbers and a short time later they implemented it to the modified Deterministic Finite Automaton, referred to as a tour robotic.

METHODOLOGY

The proposed system will be used to match the pattern of the string. For this purpose, we have used a finite state machine. This machine will read input and these characters from input will be passed through various finite states. The machine is limited to taking input of only numbers and words. A total of four states have been created for this purpose. The need of states is that it enables reading characters and transitioning to new states. Initially we have a list of finite states. When the input character is read, based on the output of that state, the transition is limited to the new state.

The reading of input character and transition to new state is done continuously till the input character no longer corresponds to the output. When this is achieved it can be said that pattern matching is done. In short, we can say that the finite machine which we have proposed is able to identify the type of character present in the input string. No specific character is identified, only its type is identified as to whether it is number or word . It can also work with negative numbers also. In simple words it can be said that the output of our program is whether the input is a number or character.

PROPOSED SYSTEM

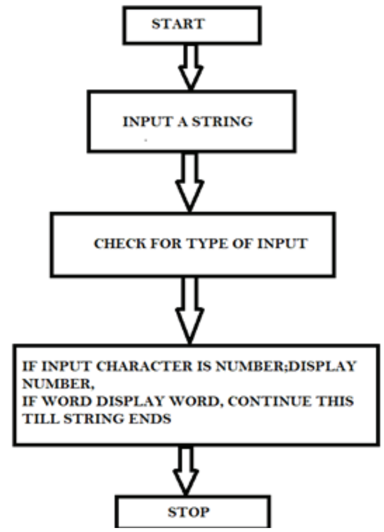

Fig. 1: Flowchart

ALGORITHM

Below is the algorithm which was used for doing pattern matching:

- List of finite states is created.
- Input is read.
- Based on the output of these firstly created states,transition to a new set is done.
- A continuous reading of input characters is done and transition to new states takes place.
- When input character no longer corresponds to any of the corresponding output and reaches the final state, then it can be said matching is done.
- Once it is done, the result will get displayed according to the input.

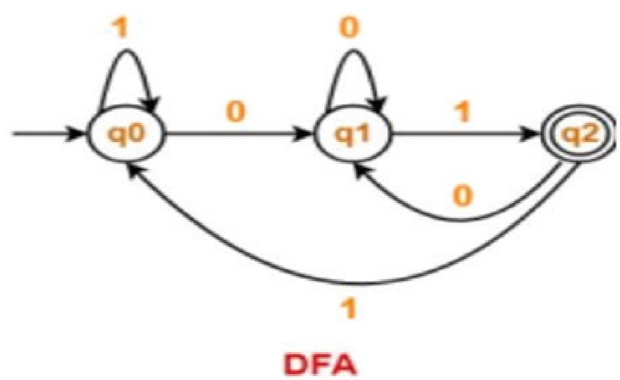

Fig 2. DFA

Let us understand DFA with an example. The below diagram is of a DFA which consists of three states (q0, q1, q2). The input string will be accepted by the DFA then only when it passes through two states (q0, q1) and reaches the final state (q2). It will pass the q0 state when the character of the input string is 0 and 1. Similar is for q1 and q2. At last, if the input string reaches to final state q2, we can say that the string is accepted. Below is the graph of time complexity of a novel finite automata:

X Axis- The lengths of input sequences & Y Axis-Time(1 unit=10/10)

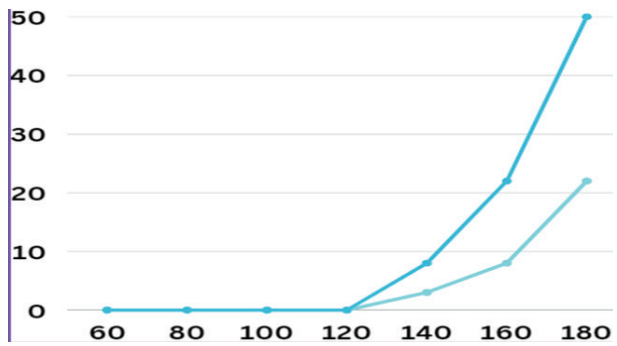

Fig. 3: Time - complexity graph [19]

TYPES OF AUTOMATA

An automaton is a machine that scans the input unit and either accepts or rejects it. The input unit is accepted when the automaton reaches its final state (accept) after we "read it". Thread reading is done using one mark at a time. Then use of the transformation function, the determination of what the next state will be, is done. If the automata are not in the final receiving state, the character unit is rejected or accepted.

Finite automata can be divided into two subgroups, DFA or NFA. The DFA determines, which means that from one region to another it is different. In NFA, unlimited automata, conversions can be made from a single region to several different regions by "reading" only one symbol. Automata are usually represented by a target graph where the arrows represent the function of the change. Finite automata are used in a variety of fields for complex problem-solving using different algorithms and techniques. There are two common algorithms used to match the pattern:

- KMP (Knuth-Morris-Pratt)
- BM (Boyer-Moore)

Both algorithms use the same methods. I the complexity of the algorithms takes the time of the line: O (m + n),where 'm' the length of the cord, and 'n' its length file. There are some different finite automata approaches:

- Algorithmic and problematic approach construction
- Finite automata construction based on programming
- Finite automata applications in various fields
- Approaches based on performances

Finite Automata is a state-of-the-art machine which uses a set of symbols as it inserts and changes their shape based on those symbols. Finite automata can also serve as a standard speech sensor. When a standard speech unit is provided as an input to finite automata, it transforms its status into a limited automaton, and also changes its real state of each. When the thread is fed successfully to an automaton and when the automata reach its final state, it is considered valid as a sign language token. A finite automaton mathematical model consists of:

i. Complete set of conditions (Q)

ii. Complete set of input markers (Σ)

iii. Initial condition (q0)

iv. Final set (qf)

v. Change function (δ)

The transition function (δ) locates a map of the completed state (Q) to a confined and fixed symbol for input (Σ), $Q \times \Sigma \rightarrow Q$. Let's see an instance of a confined automata construction:

- Allow L (r) to be the standard language conceded by finite automata (FA).
- Countries: The FA areas are depicted as circles. The names of the regions are written in circles.
- Initial condition: The initial state refers to the state in which the automata begin. The first shape is indicated by an arrow.
- Medium conditions: All Central Provinces have at least two arrows, showing one another.
- Final state: The automaton should be in this position if the input unit is correctly transmitted. The final state of automata is symbolized by two concentric circles. It can have odd number of arrows which are pointing at it.
- Transformation: When the requested character is found in the input, the transition from one mode to another occurs. The automata can either advance to the next place or stay in the same location during conversion. A directional arrow indicates movement from one place to another, with the arrow pointing to the destination. An arrow leading from the position to the automaton is drawn if it remains in the same place.

SCOPE OF RESEARCH

- We have focused our discussion in this work on the task scheduling technique known as the round robin. In order to compare the modified round robin algorithm with the traditional round robin methods for performance enhancement, we conducted a thorough literature review. The performance of the round robin algorithm has improved as a result of the improvised method we have provided.

FUTURE SCOPE

- Finite automata are not only important in automata theory, research and formal language, but also a very important explanatory tool provided by all employers present at all multiple nodes for improvement of analysis's speed and time. This creates a rich metadata index of the chorus. The detail deposit in the document model can be used to perform a variety of text analysis tasks, such as searching for logical titles in a specific set of documents.
- This field has the potential to be used for many other functions such as quiz, word order, word- based structure, abbreviation and keyword extraction. Researching these extensions will be exciting in the future. The proposed system discusses such an application where the input is sent to a limited automated pattern matching automata. Matching pattern using finite automata is very good.

CONCLUSIONS

- This paper uses the Finite State Automata model to monitor the input provided. It tells the story of what is in the string of a given unit. Whether there is a letter, number, symbol or words available. In addition, it can also be used to test text based on user text. Test results show that this method works. Below is an image of an output which we got after giving an input string as "Hello 123-456 world"-This method can also be used for applications to detect the occurrence of large numbers of keywords in a text character unit. Improved time can also be used to improve system efficiency. In addition, in order to avoid distortion, an error can be detected. Therefore, text analysis and classification techniques are used to reduce error rate and improve performance of the proposed system.

```
Found a word
Found a number
Found a number
Found a word
Program ended with with exit code: 0
```

Fig 4. Image of Output

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Randomly Generating Music Using Context-Free Grammars

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ABSTRACT

This paper aims to discuss the creation of music with the help of sequence generators with the aim of assisting artists in their integration. The series of steps is summarized to show the composition as nothing but a tabular flow of data refinement, and each and every step involved in the process is designed to benefit its functions. The basis of the proposal is context-free grammar i.e., CFG method which was basically developed to produce random strings. A sequence of strings is then modelled to produce an output like a song.

KEYWORDS: *Automata, Context-free grammars, Music algorithm.*

INTRODUCTION

Music, though it is a masterpiece in its entirety, tends to follow a set of man- made rules to turn sounds into fun things on the toes. These rules are primarily subjective and their meaning differs in a number of cases, mostly when time is involved, but this issue does not make it difficult to hide and for this reason, the creation of music was possible through computer science. The general process of creating a musical instrument is one of extreme perfection and should be considered in all human music genres possible, for this very reason we tried to provide a tool in this paper to support the artist's creative work using musical suggestions [7]. We have developed a program to define grammatical grammar (CFGs) and extensions sequence of non-terminal terminals using random production.[11] This is in contrast to the most common function of analyzing a series of pre-produced terminals into high- level nonterminal, which is a retrospective process. A series of inputs can be processed to give a sound or a song as an output. [5]

LITERATURE REVIEW

Authors Salim Perchy and Gerardo Sarria in their paper on Creation of Music using context-free grammars, [1] suggest that the Basics of the project are grounded in context-free grammars and discrete mathematics. In this paper, the authors discussed the overall design of a music sequence generator for the sake of helping musicians and artists in their work and making their tasks simpler. And they have successfully created an algorithm to generate strings from Grammar. The paper was so helpful for us to proceed further.

According to the paper 'Automatic Learning of Context-Free Grammar' published by Tai-Hung Chen, and Chun-Han Tseng, [16] learning context-free grammar from a given text sample is not an easy task. In the research paper, they studied the problem to learn context-free grammar from the masses. Also, they researched a technique that is completely dependent on the motion of minimal description of its whole length. Authors Abhishek Singh, and Andre L M dos Santos, published a paper 'Context-Free Grammar for the Generation of a One Time Authentication Identity'. [17] According to the paper, the authentication protocol has been proposed to generate a temporary authentication that can be used as a disposable password and then can be used for the creation of a loan card numbering number. The proposed protocol was developed using a free grammar by context and was in the field of learning theory. The protocol may be difficult to explore by the situation used in the authentication procedure. This article explains the relationship between learning theory and theories of theories. Based on experimental constraints to study the context of free grammar, they discuss an algorithm to generate these context-free grammars that are difficult to learn. Author Darrell Conklin published a paper 'Music Generation from Statistical Models. According to the paper, [2] the statistical models are not only useful to build such models but also solve the problem of musical style imitation. They think that to generate a piece from an analytic version is consequently to sample a piece that has an excessive probability in line with the version; probably better than its chance consistent with competing fashions. it's far essential to be aware that an excessive probability piece now does not include the simplest excessive opportunity events. The paper definitely helps in the development of the required domain in the field to generate random music. In the paper 'Grammar Based Music Composition' published by Jon McCormack, [15] the authors saw that parametric extension in the grammar part allowed and the specification of the data which is continuous for modulation as well as control. The data which is continuous is under a certain type of control of the context grammar. They use non-deterministic context grammar along with context-sensitivity. Additionally, it enables simulations of Markov's model, which is of order n, with a little more economical and accurate representation than those provided by the earlier transitive matrices. Furthermore, it has provided not only greater flexibility than the previous composition models based on Petri nets or finite state automata. It is possible to depict the relationships between any notes in sync with hierarchical grammatical representations when various symbols are used in the grammar. This allows for the formation of sophisticated musical compositions from very basic grammar. In accordance with Michelle P. Banawan's (2012) work, "A Context-Free Grammar for Demands Simulation," a CFG aims to restrict the selection of a system's use cases in order to conform to the discipline of requirements engineering. The suggested CFG was used to model and capture use cases, happenings (referred to as syntax categories), and other aspects of information system demands (also referred to as collecting of eligible endpoints).

```
sound:
  init any+ : 1

init:
  '+sin([220-880])' : 2
  '+saw([220-880])' : 1
  '+square([220-880])' : 5

any:
  '+sin([220-880])' : 2
  '+saw([220-880])' : 1
  '+square([220-880])' : 1


  '*sin([220-880])' : 5
  '*saw([220-880])' : 3
  '*square([220-880])' : 3
```

Fig. 1: Code

METHODOLOGY

We need to discover a solution for CFG to generate random music. There were various steps to perform the tasks. Algorithms used is

Here is an example of gen.py using this g rammar, which is saved in sound.yaml:

```
$ python gen.py "sound" sound.yaml
['sound']
['init', 'any+']
['+square([220-880])', 'any', 'any*']
['+square(349)', '*sin([220-880])', 'any', 'any*']
['+square(349)', '*sin(426)', '+sin([220-880])']
['+square(349)', '*sin(426)', '+sin(645)']
```

Fig. 2: Implementation of grammar

```
song:
— note note note note+ : 1

note:
— C : 1
— D : 1

— E : 1
— F : 1
— G : 1
— A : 1
— B : 1
A:  {sin(440) : 1}
Bb: {sin(466) : 1}
B:  {sin(494) : 1}
C:  {sin(523) : 1}
Db: {sin(554) : 1}
D:  {sin(587) : 1}
Eb: {sin(622) : 1}
E:  {sin(659) : 1}
F:  {sin(698) : 1}
Gb: {sin(740) : 1}
G:  {sin(784) : 1}
Ab: {sin(831) : 1}
A2: {sin(880) : 1}
Composing these two grammars gives us the following:
```

Fig. 3: Composing the grammar

PROPOSED SYSTEM

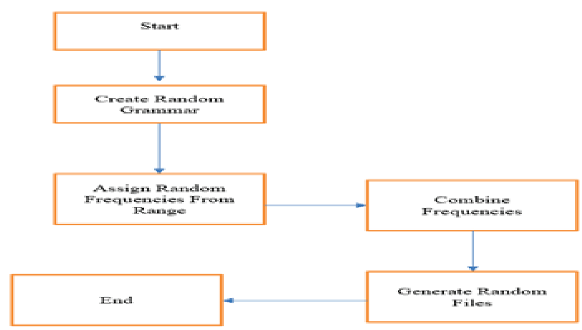

Fig. 4: Proposed System

Context Free Grammar

Only when formal grammar may be applied in any manner to nonterminal contexts can it be referred to be context-free grammar. It doesn't matter whatever symbols surround it; the RHS can always take the place of the single nonterminal on the LHS. The main distinction between it and context-specific grammar is this. The collection of rules that describe every conceivable string for the given language is known as a dignified grammar. Languages derived from context-free grammar are known as context-free languages, or FLLs. Similar lexical language can be produced by different category grammars. It's critical to distinguish between grammar and linguistic contents. Noam Chomsky developed context-free grammar in linguistics to explain word production and sentences in general language. Programming languages began to be more elaborately organized through the use of grammar as the number of concepts being used consistently rose. These days, we can see that Document Type Definition is a crucial component of XML, or extensible markup language. Although they are distinct from dependency grammars, some writers refer to context-free grammars as phrase structure grammars. However, the Backus-Naur form, or BNF, is another name for context-free grammar, or CFG, in the field of computer science.

Typically, a phrase structure grammar is a fixed grammar which contains specific rules of a certain form while creating.

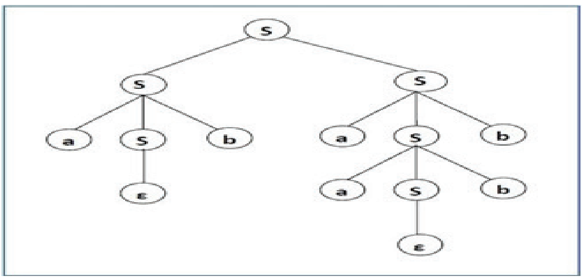

Fig. 5: CFG generator

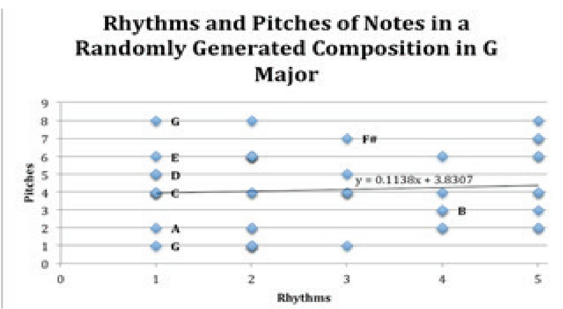

Fig. 6: Graph of pitches VS rhythms

Formal grammar can be called "context-free" only if the production rules can be applied in any way in the context of nonterminal. It is not important which symbols encircle it, the only nonterminal on LHS can every time be replaced by the RHS. This is the key point that makes it different from context-specific grammar. The dignified grammars are the set of rules which explain all possible strings for the provided language. Context-free languages (CFL) are the languages that are taken from context-free grammar. Various categorical grammars can produce similar lexical language. It is important to differentiate the contents of language from that of grammar. Context-free grammar was invented by Noam Chomsky in linguistics to describe sentences in general language and word formation. As the use of concepts that were repeatedly used increased, they started using grammar to elaborate the organization of programming languages. Nowadays, we can observe Document Type Definition as an essential part of Extensible Markup Language (XML).Although they are different from dependency grammars, writers occasionally refer to context-free grammars as phrase structure grammars. However, context-free grammar is sometimes referred to as the Backus-Naur form, or BNF, in computer science.

ADVANTAGES

- It offers a rigorous mathematics explanation that categorically excludes particular tongue kinds.
- The formal definitions mean that CFGs are computationally TRACTABLE - There is a possibility to write a computer program and it determines whether sentences are grammatical or not.

LIMITATIONS

- Lexically rules are often difficult in specific cases of Context-free grammar.
- Notations described in Context-free grammar are quite complex.
- By using context-free grammar, it sometimes becomes very difficult to reconstruct the recognizer.

FUTURE SCOPE

We will try to make formal rules easy in lexical grammar. Also, we will try to simplify the notation described in CFG. Then we will try to make the task of reconstructing the recognizer easy using lexical grammar. We will try to increase the speed of getting output. We will also try to propose a different system that generates random characters using CFC and then sequence them with musical chords.

RESULT AND CONCLUSION

Table 1: Example Musical Sequence Generated by the System

Time (s)	Note	Duration (s)
0	C4	0.5
0.5	E4	0.5
1	G4	0.5
1.5	B4	0.5
2	A4	0.5
2.5	F4	0.5
3	D4	0.5
3.5	C4	0.5

This table represents a simple musical sequence generated by the system, consisting of notes (e.g., C4, E4) and their respective durations. Each row represents a note played at a specific time.

Table 2: Example Musical Composition Generated by System

Measure	Notes	Duration (s)
1	C4 D4 E4 F4 G4 A4 B4 C5	1
2	B3 A3 G3 F3 E3 D3 C3 B2	1
3	C4 E4 G4 C5	2
4	B3 D4 F4 A4 B4	2

Table 3: Music Generation using Context-Free Grammars

Song Title	Sequence of Notes	Duration (seconds)
"Fantasy Prelude"	C4 E4 G4 E4 D4 C4	30
"Dreamy Waltz"	A3 C4 E4 F#4 A4 G#4	45
"Mystic Serenade"	G3 B3 D4 F4 A4 C5 B4	60

In this hypothetical output table, we have three generated songs titled “Fantasy Prelude,” “Dreamy Waltz,” and “Mystic Serenade.” Each song consists of a sequence of notes represented by their respective pitches (e.g., C4, E4, G4) and their durations. The duration column indicates the length of each song in seconds.

We have developed a program to define grammatical grammar (CFGs) and extensions sequence of non-terminal terminals using random production. This is in contrast to the most common function of analyzing a series of pre-produced terminals into high-level non-terminals, which is a retrospective process. A series of inputs can be processed to give a sound or a song as an output. We propose a system similar to those which generate random characters using context-free grammars and then sequence them with musical chords and then generate waveforms of the same which will then be converted into playable songs or sounds. New grammar can now be produced to generate different and unique sounds.

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Vision-Based Lane Detection System

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ABSTRACT

Accurate lane detection is critical for advancing autonomous driving technology. This paper presents a systematic overview of vision-based lane detection techniques and their role in intelligent transportation systems. We discuss challenges, advancements, and future directions in this field, emphasizing the significance of lane detection for road safety and vehicle autonomy. Our proposed pipeline integrates various stages, including camera calibration, distortion correction, thresholding, perspective transformation, and robust lane verification techniques. Leveraging computer vision algorithms such as Canny edge detection and Hough transform, our system achieves reliable lane detection under diverse road conditions. Experimental results demonstrate the effectiveness of our approach in detecting and tracking lanes. Future research directions include improving lane detection accuracy and integration with advanced driver assistance systems. In conclusion, this paper contributes to the advancement of autonomous vehicle technology by providing a practical pipeline for accurate lane detection. Vision-based lane detection systems will continue to play a crucial role in shaping the future of transportation as the automotive industry evolves toward autonomy.

KEYWORDS: *Advanced Driver Assistance System(ADAS), Autonomous driving, Computer vision, Lane detection, Lane tracking.*

INTRODUCTION

In the realm of autonomous driving, the ability to accurately detect and track lane boundaries stands as a cornerstone of safety and precision. As the world moves steadily towards autonomous vehicles, it is imperative that we develop advanced lane detection systems that are robust, reliable, and adaptable to the complexities of real-world driving scenarios. Detecting lane lines plays a crucial role in advanced driver assistance systems (ADAS), as numerous traffic regulations rely on these markings. Previously conducted research and existing models are complex and expensive to implement. Prior research is deep learning based which takes more computational cost to generate satisfactory results. Vision-based lane detection has emerged as a pivotal technology in the realm of intelligent transportation systems, offering significant advancements in road safety and vehicle autonomy.In recent years, advancements in computer vision algorithms and sensor technologies have propelled the development of sophisticated lane detection techniques. These techniques leverage camera sensors and image processing algorithms to analyze visual data and extract lane information in real-time [8]. The primary contribution of this paper lies in its systematic approach to integrating diverse methodologies into a cohesive framework for lane detection. Through experimentation and implementation, we demonstrate the effectiveness of our approach in detecting and tracking lanes in input videos. Additionally, we discuss future research directions, underscoring the potential for further advancements in autonomous driving technology.

RELATED WORKS

Research on lane marking detection and monitoring has shown high efficiency in using the Hough transform with optimized accumulator cells. This method reduces computational complexity by detecting vanishing points and implementing an adaptive region of interest. However, the processing time is too high for real-time applications. The method uses gradient and color cues, line clustering, and Edge Drawing lines [1-3].

The researchers proposed an algorithm for detecting road areas using vanishing points and line segment information. They used the Hough Transform for line segment detection and a lane detection approach that used image preprocessing, binary processing, dynamic threshold selection, and fitting the Hough transform model. The Kalman filter was also used to enhance lane detection performance. The algorithm was effective for straight roads and used stereo cameras to create a minimum-cost map. The researchers also proposed a model for lane detection using LiDAR and AVM camera data, color filtering, and edge feature detection. They also proposed an all-weather lane detection method based on image classification and a hybrid isometric operator, but did not address snowy weather conditions. They also implemented a comprehensive intensity threshold range to enhance the canny operator's effectiveness in identifying lane edges [4-14].

METHODOLOGY

The proposed system follows a comprehensive pipeline designed to facilitate accurate lane detection and tracking in real-world driving scenarios. The pipeline consists of several key stages, each contributing to the overall effectiveness of the system:

Camera Calibration and Distortion Correction

Camera calibration and distortion correction were crucial for accurate lane detection in the project. Camera calibration determined intrinsic and extrinsic parameters, while distortion correction used computed camera matrix and distortion coefficients to undistort images. OpenCV functions applied these corrections, mapping pixel coordinates to new locations. This process ensured accurate representation of the scene, improving the reliability and accuracy of subsequent image-processing tasks, ultimately contributing to the lane detection system's effectiveness.

Thresholding and Perspective Transformation

In the subsequent stages of the project, after camera calibration and distortion correction, the focus shifted towards preprocessing the images to enhance lane and road features for improved detection accuracy. This involved two main steps: thresholding and perspective transformation.

Thresholding: The process of thresholding involves using image processing techniques to extract lane and road features from undistorted images. Gaussian blurring reduces noise and smooths edges, while color and gradient thresholding isolate specific colors associated with lane markings. These techniques are combined to create binary images where lane and road markings stand out against the background, with fine-tuning to minimize false positives and negatives.

Perspective Transformation: After thresholding, perspective transformation was applied to obtain a top-down view of the road. This transformation corrected the camera's perspective and provided a more consistent representation of lane markings, regardless of the camera's position or orientation relative to the road. To implement perspective transformation, source and destination points were defined to define a mapping between the original and transformed images. These points formed a trapezoidal region encompassing the lane and road area in the original image. Using OpenCV's perspective transformation functions, the binary images were warped to achieve the desired top-down view. This transformation facilitated easier detection and analysis of lane markings, simplifying subsequent processing steps. By combining thresholding and perspective transformation, the images were effectively preprocessed to enhance lane and road features for improved detection accuracy.

Lane Detection

In the final stage of the lane detection project, the focus was on implementing the lane detection algorithm to identify the left and right lane markings accurately. This step involved analyzing the preprocessed binary images obtained from the thresholding and perspective transformation stages to locate the lane boundaries.

Lane Detection Algorithm

Identification of Lane Pixels: The lane detection algorithm began by identifying lane pixels within the binary images. This was typically accomplished using techniques such as the sliding window or search algorithm. In the sliding window approach, a window of a fixed size was placed at the bottom of the image, and the presence of lane pixels within this window was determined.

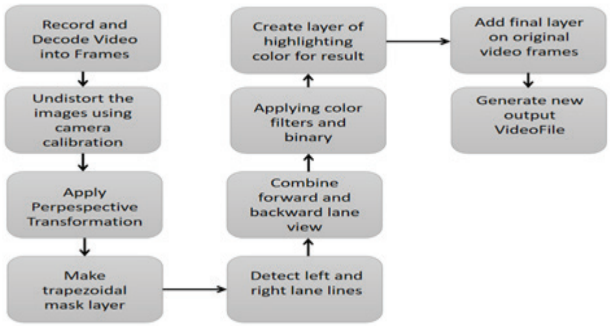
Once lane pixels were identified, subsequent windows were slid upwards along the lane to track the lane pixels.

Fitting Lane Lines: With lane pixels identified, a polynomial curve was fitted to these pixels to represent the left and right lane lines separately.

Polynomial regression, such as the least squares method, was commonly used to fit the curves to the lane pixels. The coefficients of the fitted polynomials represented the equations of the left and right lane lines.

Lane Line Visualization: Once the lane lines were fitted, they were visualized on the original undistorted image. The lane lines were typically drawn as solid lines overlaying the original image, providing a visual representation of the detected lanes. Additionally, the lane area between the left and right lane lines was often filled to enhance visualization.

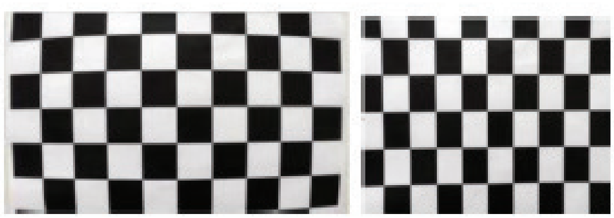
Integration with Input Video: Finally, the video processing loop that was previously used to process the input video frames was extended to incorporate the lane detection algorithm. As each frame was processed, the lane detection algorithm was applied to detect the lanes and generate the output layer. The resulting frames with lane visualizations were then displayed or saved as the output video. By adding the output layer with lane visualizations to the input video frames, the lane detection system provided an intuitive and informative representation of the detected lanes, enhancing the usability and effectiveness of the system.



Flowchart of our proposed pipeline of lane detection system.

IMPLEMENTATION

The camera matrix and distortion coefficients using chessboard images are calculated in OpenCV. It initializes with distorted image and chessboard dimensions and performs calibration to obtain camera matrix and distortion coefficients. The 'undistort' method returns an undistorted image using the calibration parameters [14].



a. Distorted images vs undistorted image

b. Different outputs after gray scaling

Thresholding is a technique of segmenting images that involves converting grayscale images to binary images and then separating image elements.

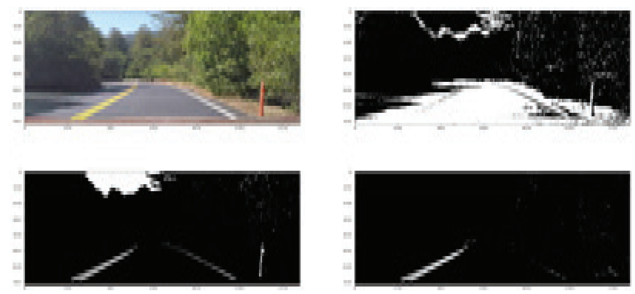
T = T[a, b, p (a,b), f (a,b)] …(1)

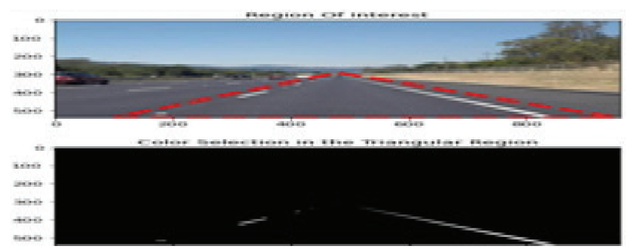
Where T stands for the threshold value, (a, b) for the threshold value's positional coordinates, and p (a, b) and f (a, b) for the grayscale picture pixels (a, b),[15]

To compensate for excessively bright or light road colors, the HLS color channel method is applied. Specifically, the L (lightness) channel threshold is decreased to mitigate shadow-induced frame borders, while the S (saturation) channel threshold is increased to include white and yellow lanes. The H (hue) channel indicates the direction of the line's color.

hls_threshold(image, l_thresh = (low_l, high_l), s_thresh = (low_s, high_s))

Output images after thresholding with different values A region of interest (ROI) is a specific area within the image where algorithms are applied. This is the area where we have to work on. This can be selected using some algorithms [6]. Use masking or cropping techniques to extract only the pixels within the defined ROI from the original image.





Selection of Region of Interest. After the edges detection technique, the next step is to apply the Hough transform and detect the road lanes. Here the image is marked as the x and y axes. The perspective transformation is used to convert a 3d world image into a 2d image. To center around the road part of the image, we move our point of view to a best-down perspective of the street. While we don't obtain any more information from this step, it's enormously easier to isolate lane lines and measure things like curvature from this perspective[14].

Attributes:src: Coordinates of 4 source points defining the region of interest in the front view.

dst: Coordinates of 4 destination points defining the corresponding region in the top view.

M: Matrix for transforming images from front view to top view.

M_inv: Matrix for transforming images from top view to front view.

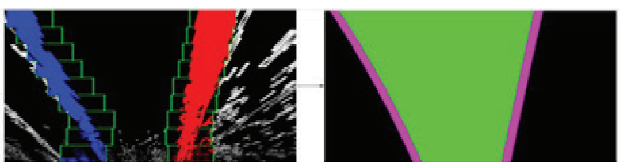
The below methods are applied,

forward(img, img_size=(1280, 720), flags=cv2.INTER_LINEAR) which transforms a front view image to a top view image.

backward(img, img_size=(1280, 720), flags=cv2.INTER_LINEAR) which transforms a top view image back to a front view image.

After perspective transformation on the forward section of the image

Now, we get all this information and draw the results back onto the original image. The space between the lines is colored green to determine the road surface. While the pipeline prepares for a single image, it can easily be applied to processing many images to detect the lane line on the road surface.



Lane Line detection and highlighting between regions

Input video frames and their respective output frames

This complete pipeline is used on several input videos, to detect the lanes as shown in the above instances of video. Our pipeline generates a .mp4 video as an output with proper and robust lane marking.

CONCLUSION

This paper discusses vision-based lane detection techniques and systems, highlighting their importance in autonomous driving and intelligent transportation systems. It explores their principles, methodologies, and advancements, highlighting their role in enhancing road safety, vehicle autonomy, and navigation accuracy. The proposed pipeline for lane detection and tracking uses advanced computer vision algorithms, enabling robust lane verification and visualization. The paper aims to contribute to autonomous vehicle technology advancement and foster further research.

FUTURE SCOPE

Vision-based lane detection is a rapidly evolving field, driven by sensor technology, computer vision algorithms, and artificial intelligence integration. Tesla's Autopilot uses vision-based algorithms for semi-autonomous driving, with future improvements focusing on accuracy and responsiveness to dynamic environments. Research is also exploring integrating vision-based lane detection with advanced ADAS features for enhanced vehicle safety and performance.

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Fuzzy Based Analysis of Software Quality Factor Understand-ability for Mobile Game Application

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ABSTRACT

Mobile gaming is becoming more popular, and end users demand fun and simple games. High-quality, user-friendly software is essential for keeping players pleased and returning back to mobile games. Mobile gaming stakeholders are constantly seeking for fresh applications to test and review while building new games. This project may benefit from measuring software quality-based qualitative attributes. Therefore, selecting the correct evaluation technique is crucial. Assessment uses fuzzy rate and fuzzy weight. The evaluation of a five-point fuzzy rating system needs simple survey or questionnaire inputs. The stakeholders who are accountable for the quality of the mobile app determine the fuzzy weight of metrics for a certain quality element. This is due to the fact that metrics are the fundamental building block for quantitative evaluation. When stakeholders analyze and contrast metrics for software quality factors and agree on their relevance, they may achieve the aim. This strategy will improve quality assessment overall. In this study, a novel Fuzzy based mathematical assessment method to access accurate fuzzy weight for the metrics of a particular quality factor will be provided in this paper. This knowledge may help the mobile gaming application industry build, evaluate and assign fuzzy weights of metrics, which will improve the translation of qualitative framework into quantitative ones. With the assistance of a fuzzy-based assessment approach and pair wise comparison, this study proposes a unique way for determining the relative ranking within the metrics for a certain quality factor. As a result, the appropriate fuzzy weight assigned to the metric. In this research, measurements of understand-ability quality factor of usability characteristic are taken into consideration, and a formulation developed to assign fuzzy weight to its metrics is presented with the assistance of a case study.

KEYWORDS: *Fuzzy logic, Metrics,Overall quality, Pair wise comparison, Quality factor etc.*

INTRODUCTION

The mobile gaming industry is one of the rapidly expanding fields that are seeing exponential growth over time. During the development process of any mobile application, the primary issue is the application's quality. End users are the assets that will become the promoters of the branding of any mobile application due to positive feedback. This is because end users are the ones that utilize the application. Usability is the characteristic that describes the quality according to the end users. As a result of the fact that usability is defined as a qualitative framework, it includes quality factors. It is not possible to take into consideration the qualitative framework for the purpose of assessment. The qualitative framework has to be transformed into a quantitative framework that can be measured as well. It was possible to accomplish this goal with the assistance of metric measurement that is associated with the quality factors. Using a five rating fuzzy scale system that ranges from VL (very low) to VH (very high), metrics is constructed in such a manner that they assess on a scale of five. Both the fuzzy weight and the fuzzy rate are considered to be fuzzy inputs. While fuzzy weight is determined by investors, quality managers, stakeholders, or what are generally referred to as decision makers in the mobile company, fuzzy rate is determined by the feedback that is provided in accordance with the prototype of the mobile application that is being developed. The purpose of this research was to offer a mathematical framework that is based on fuzzy logic and provides assistance to decision makers in determining the importance of fuzzy weight of metrics for a particular quality factor; this will be accomplished by the use of pair wise comparisons between the metrics of the particular quality factor. A fuzzy-based mathematical framework is analyzed and provided in this research. This framework is utilized to produce a correct relative ranking within the metrics of understandability quality factor. This ranking is then employed as an acceptable fuzzy weight for the metrics of understandability quality factor in accordance with the usability framework. The attainment of precise assessment and the achievement of accurate evaluation are both approaching one step closer for achieving an overall enhanced degree of accuracy.

LITERATURE REVIEW

The term "quality" is used to describe any product. Researchers have spent a lot of time researching quality models like Boehm's [1] and building simple models to describe quality. Maryol, Perez & Rojas [2] provided a quality model and software quality analysis approach. ISO, or the International Organization for Standardization, establishes quality standards globally. ISO 9126 [3] is one. These models are all- purpose; although they may be adapted to any software application by understanding its restrictions. Fuzzy logic is an effective technique to address evaluation uncertainty [4].

The next crucial question is how to quantify quantitative attributes. Quantification of quality factors analyses an approach to measure or justify software product quality. Researchers have shifted their attention significantly. Srivastavaet. alexamines fuzzy multi-criteria software quality measurement [5]. Software quality may be measured using multi-criteria decision-making [6]. Fuzzy logic may also assess aspect-oriented software stability [7] proposed by Dadhich & Mathur. Srivastava & Kumar [8] included project management, developer, and tester perspectives to the research. However, these studies still focus on developing a framework to ensure high-quality software and assessing it as desktop apps.

The next subject to be discussed is the framework for a mobile app that transforms the qualitative characteristics into a quantitative framework proposed by Mishra & Dadhich [9]. This research paper examined how mobile consumers see and expect software quality [10]. ISO 9126 now includes mobile situations [11].

FUZZY LOGIC

Fuzzy logic is a kind of logic that takes into account all of the values that fall between true and false, including the values that define its boundaries. The way that fuzzy logic operates is distinct from the way that crisp logic operates, which solely takes into account true and false values. This paper adopts triangular fuzzy membership function as shown in Figure 1. The mapping in between crisp value and fuzzy value illustrated in table1 and table 2.

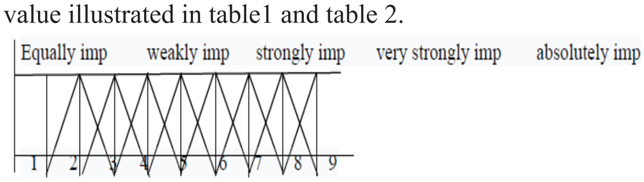

Fig. 1: Triangular Fuzzy Membership Function

Table 1. Relationship in Between Linguistic Variable & Fuzzy Value as per Figure 1

Comparison (crisp)	Linguistic variable	Fuzzy value
1	equally importance	(1,1,1)
2	In between equally importance & Weakly importance	(1,2,3)
3	Weakly importance	(2,3,4)
4	In between Weakly importance & Strongly importance	(3,4,5)
5	Strongly importance	(4,5,6)
6	In between Strongly importance & Very Strongly importance	(5,6,7)
7	Very Strongly importance	(6,7,8)
8	In between Very Strongly importance & Absolutely importance	(7,8,9)
9	Absolutely importance	(8,9,9)

Table 2. Relationship in Between Crisp Value & Inverse Fuzzy Value

Comparison (crisp)	Fuzzy value (Inverse)	Simplified fuzzy value
1/1	(1,1,1)-1	(1,1,1)
1/2	(1,2,3) -1	(1/3, 1/2, 1/1)
1/3	(2,3,4) -1	(1/4, 1/3, 1/2)
1/4	(3,4,5) -1	(1/5, 1/4, 1/3)
1/5	(4,5,6) -1	(1/6, 1/5, 1/4)
1/6	(5,6,7) -1	(1/7, 1/6, 1/5)
1/7	(6,7,8) -1	(1/8, 1/7, 1/6)
1/8	(7,8,9) -1	(1/9, 1/8, 1/7)
1/9	(8,9,9) -1	(1/9, 1/9, 1/8)

RESEARCH METHODOLOGY

Research Design

This paper presents a fuzzy-based assessment approach. The article considers five quality factors understand- ability, memorability, efficiency, challenge and user satisfaction as illustrated in table 3.

Table 3. Quality Factors to Access Usability

Characteristic	Quality Code	Quality Factors
Usability	QF1	Understand-ability
	QF2	Memorability
	QF3	Efficiency
	QF4	Challenge
	QF5	User satisfaction

This study employs a technique of conducting pair- wise comparisons among all metrics of understand-ability quality factor. The rationale for this approach is to determine the relative relevance of each metrics. Hence, this research constructs a matrix that compares metrics in pairs. This research focuses on the triangular fuzzy function.

Proposed Model

This paper adopts the algorithm discussed by (Nădăban & Dzitac, 2016, P-826) [12]. Following steps will explain the proposed model.

Step1. Design the usability framework for mobile game application.

Step2. Decide pair-wise priorities (crisp value) among metrics of particular quality factor.

Step3. Replace crisp value with corresponding fuzzy values as per linguistic variable.

Step4. Calculate fuzzy geometric mean (FGM) for all metrics of particular quality factor.

Step5. Calculate normalized fuzzy weight (NFW) from fuzzy geometric mean (FGM) for all metrics of particular quality factor.

Step6. Convert normalized fuzzy weight (NFW) in to corresponding crisp value and evaluate relative importance among all metrics of particular quality factor.

CASE STUDY

Suppose there is a mobile development organization 'ABC' whose stakeholders wants to evaluates relative ranking of metrics for understand-ability M1 to M5 and assign appropriate fuzzy weight as illustrated in table 4.

Table 4. Metrics M1 to M5 which defines and evaluate Quality Factor Understand-ability

Quality Factor	Metrics
Understand-ability	M1: icon of players are self-descriptive
	M2: reaction of environmental object as per user's action
	M3: time is feasible to complete each task
	M4: flow and logic of game easily understandable
	M5: skill set of players of mobile game are properly defined

Evaluate prioritization of metrics for QF1 Understand-ability

Following steps will explain the proposed model, which provides an explanation of the approach that may be used to determine the relative importance of all metrics by using pair-wise comparison methodology.

Step1: Design a pair-wise comparison framework matrix for each pair of metrics. Stakeholders & investors are mutually agreed upon following criteria imposed upon five metrics as illustrated in table5.

1. Metric M1 is 3 times more important than metric M3
2. Metric M1 has same importance as metric M5
3. Metric M2 is 3 times more important than metric M1
4. Metric M2 is 2 times more important than metric M3
5. Metric M2 is 3 times more important than metric M5
6. Metric M4 is 5 times more important than metric

M1,Metric M4 is 4 times more important than metric M2

7. Metric M4 is 4 times more important than metric M3
8. Metric M4 is 4 times more important than metric M5
9. Metric M4 is 2 times more important than metric M3

Table 5. Pair wise Comparison Matrix

	M1	M2	M3	M4	M5
M1	1	1/3	3	1/5	1
M2	3	1	2	1/4	3
M3	1/3	1/2	1	1/4	½
M4	5	4	4	1	4
M5	1	1/3	2	1/4	1

Step2. Replace fuzzy value by crisp value as per table 1 and table 2 and calculate fuzzy geometric mean (FGM) for each metric as illustrated in table6.

Computation of FGM for quality factor M1:

((1*1/4*2*1/6*1) 1/5, (1*1/3*3*1/5*1) 1/5, (1*1/2*4*1/4*1) 1/5) = (0.61,0.73,0.87)

Similarly calculated for other metrics M2 to M5.

Table 6. Computation of Fuzzy Geometric Mean (FGM) for each Metrics

	M1	M2	M3	M4	M5	FGM
M1	(1,1,1)	(1/4,1/3,1/2)	(2,3,4)	(1/6,1/5,1/4)	(1,1,1)	(0.61,0.73,0.87)
M2	(2,3,4)	(1,1,1)	(1,2,3)	(1/5,1/4,1/3)	(2,3,4)	(0.96,1.35,1.74)
M3	(1/4,1/3,1/2)	(1/3,1/2,1)	(1,1,1)	(1/5,1/4,1/3)	(1/3,1/2,1)	(0.35,0.46,0.69)
M4	(4,5,6)	(3,4,5)	(3,4,5)	(1,1,1)	(3,4,5)	(2.55,3.17,3.76)
M5	(1,1,1)	(1/4,1/3,1/2)	(1,2,3)	(1/5,1/4,1/3)	(1,1,1)	(0.55,0.69,0.87)

Step 3.Computation of normalized fuzzy weight for each metrics as illustrated in table7.

Computation of normalized fuzzy weight for metric M1:

(0.61, 0.73, 0.87) * (1/7.93, 1/6.4, 1/5.02) = (0.077, 0.114, 0.173)

Similarly calculated for other metrics.

Table 7 Computation of normalized fuzzy weight (NFW) for each Quality Factor

	FGM	NFW
M1	(0.61,0.73,0.87)	(0.077,0.114,0.173)
M2	(0.96,1.35,1.74)	(0.121,0.211,0.347)
M3	(0.35,0.46,0.69)	(0.044,0.72,0.137)
M4	(2.55,3.17,3.76)	(0.322,0.495,0.749)
M5	(0.55,0.69,0.87)	(0.069,0.108,0.173)

Step 4. Computation of crisp weight for each metrics, which also validate that crisp sum is 1.06 (almost 1). Step 4. Computation of crisp weight for each metrics, which also validate that crisp sum is 1.06 (almost 1). Crisp weight justifies overall relative importance in between the metrics for quality factor understand- ability as illustrated in table 8.

Step 5.Computation of relative importance with in metricsM1 to M5 as per crisp weight as illustrated in table 9 and table 10.

Step 6.Computation of fuzzy weight on the basis of relative distance in between metrics M1 to M5. One possible combination as illustrated table 11.

RESULT DISCUSSION

The ranking of the metrics M1 to M5 in relation to the crisp weight, which may be determined according on the order of importance outlined in Table 11. This confirmed findings and confirm a substantial correlation between the mathematical theoretical framework and the observed outcomes. The confirmed findings confirm a strong correlation between the theoretical framework and its actual implementation.

Table 8: Verification with Crisp Weight (Sum=1) and priorities of Metrics

	NFW	Crisp Weight	priority
M1	(0.077,0.114,0.173)	0.121	4th
M2	(0.121,0.211,0.347)	0.226	3rd
M3	(0.044,0.72,0.137)	0.300	2nd
M4	(0.322,0.495,0.749)	0.522	1st
M5	(0.069,0.108,0.173)	0.117	5th

Table 9: Relative importance with in metricsM1 to M5

	NFW	Crisp Weight	priority
M4	(0.322,0.495,0.749)	0.522	1st
M3	(0.044,0.72,0.137)	0.300	2nd
M2	(0.121,0.211,0.347)	0.226	3rd
M1	(0.077,0.114,0.173)	0.121	4th
M5	(0.069,0.108,0.173)	0.117	5th

Table 10. Allocation of fuzzy weight

Metric	Fuzzy weight
M4	VH
M3	H
M2	H
M1	M
M5	M

CONCLUSION & FUTURE SCOPE

This research study presents a technique with a special emphasis on the point of view of end users, which is both cutting-edge and efficient for evaluating the fuzzy weight of software metrics for a certain quality factor for mobile gaming applications. Through the use of this strategy, stakeholders in mobile application businesses are able to successfully achieve their objective of doing correct evaluation.

The study validates the methodology used for mobile app quality evaluation, ensuring precision in the software industry. It aims to improve the assessment of overall mobile application quality. The study will include a new component for high-priority mobile applications. It also highlights the potential of pairwise comparison with AI and ML algorithms for improved decision-making, feature selection, model assessment, and parameter modification, potentially improving machine understanding process optimization.

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An Insight into Tools-Techniques and Applications of Neuromorphic Computing

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ABSTRACT

Neuromorphic computing is an emerging field of research that seeks to develop such computer technologies that replicate the composition and capabilities of natural neurons in various real-life applications like autonomous vehicles, medical diagnostics, environment monitoring, robotics, cyber security, detecting and preventing of accidents etc. In neuromorphic systems the role of hardware that can rapidly perform repetitive parallel operations is vital. Such hardware in conjunction with Artificial Intelligence (AI) algorithms is used to mimic human brain and applied in various domains. This study explores various tools and techniques that are being used by various researchers to solve significant problems. Further, the work also analyses potential applications of neuromorphic computing in different domains. The study concludes with the discussion on suitability of tools and techniques for diverse applications.

KEYWORDS: *Neuromorphic computing, Biological neurons, Spiking Neural Network, Memristor, TrueNorth.*

INTRODUCTION

The term "neuromorphic computing" is derived from the words "neuro" (meaning "related to the nervous system") and "morph" (meaning "to change form or shape"). In this context, "neuromorphic" refers to the use of electronic circuits and systems that are designed to mimic the structure and function of the nervous system. This term "neuromorphic computing" was first created by California Institute of Technology engineering and applied science professor Carver Mead, in the 1980s [82]. Mead was interested in developing electronic circuits that could mimic the behavior of biological neurons and neural networks, with the goal of creating more efficient and intelligent computing systems. He was motivated by the composition and operations of the brain and believed that by mimicking the way neurons communicate and process information, it would be possible to create more powerful and flexible computing systems. A comparison between the human brain and neuromorphic computing is mentioned in table: -

Neuromorphic Computing	Human Brain
Typically has few million neurons only.	Approximately has 86 billion neurons.
It has a limited connectivity.	Highly interconnectivity with systems.
Fast processing speed.	Very fast in terms of processing.
Has limited learning capacities.	Has high learning capacities.
It has limited cognitive capabilities.	Wide range of complex tasks.

Neuromorphic computing has been rapidly advancing AI led technology in the field of computer science that comprises of designing and building computer systems that are modeled after the human brain and nervous systems. These systems are designed to process information like a human brain processes the information i.e. using networks of artificial neurons and synapses. It is a radical rethinking of transistor-level computer architecture, motivated by the structure and operations of biological neural networks found in the brain.Various techniques have been used to solve problems related to these domains:Spiking Neural Networks (SNN): - The approach was first proposed by Alan Hodgkin and Andrew Huxley in 1952 [35] at the University of Manchester in UK. SNNs architecture was based on a large-scale network of low power processors that communicate with each other using custom communication protocol. The network uses spikes or discrete events that represent the firing of neurons as their basic unit of information processing. The piece of research mentioned in [22] simplifies the model proposed by [35] explains the precise timing of spikes in biological neurons. SNNs are explored by various researchers and smeared in number of applications such as pattern recognition (images and speech) [27,28,29], robotics [30,31], neuroscience [36,37], natural language processing [32,33] and cognitive computing [34]. The discussed approach makes use of several parameters like basic input signals which are Spike Trains, Synaptic models, memristors and hardware accelerators. This approach was well suited for neuromorphic computing because parallel to the way the brain processes information, it does so in high parallel and with low energy use.One major challenge faced while developing SNNs is designing effective learning algorithms, as traditional supervised learning techniques do not work well with Spiking neurons.

TrueNorth was also a neuromorphic computing chip which was developed by IBM led by Dharmendra Modha in 2004 based on a digital architecture which uses many simple, low power processing cores to simulate neural network behaviour. This was first introduced in the paper[26] which describes the development of a software and hardware development Kit. TrueNorth is explored in applications such as networks for image and speech recognition [71,72], cognitive computing [73] and robotics [74,75] control due to its ability to perform complex computations with very low power consumption.

BrainScaleS is also one of the major tools which was developed by the University of Heidelberg in Germany by Karl Heinz Meier and Johannes Schemmel in early 2006[25] to study the behavior. These tools have generated many research that have advanced the understanding of the human brain and how does the brain processes. It includes:

- Neural computation includes how information is being processed and represented in the brain.
- Functioning of human brain and the interactions of various neurons with each other.
- The mechanism of learning and plasticity in the brain i.e., how neurons change their connections in response to experience.
- It is also being used to develop robotic systems that can learn and adopt new environments and tasks.
- New hardware architectures that can mimic the behaviour of neural systems leads to more efficient and powerful computing systems.
- Neural prosthetics that helps to restore functions to people with neurological disorders.

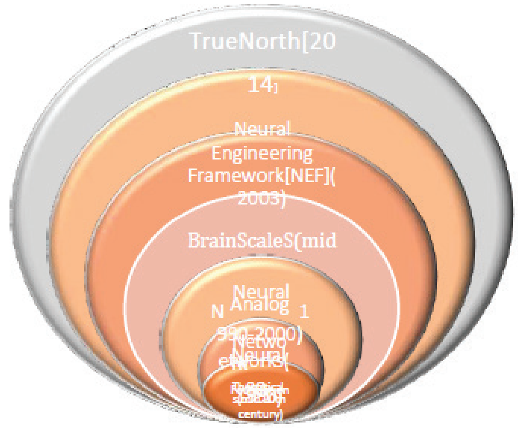

Fig. 1: Chronological order of development of neuromorphic tools

These fields have several applications in which neuromorphic computing is currently being applied such as brain inspired computing which includes speech recognition, natural language processing and object recognition. One more application is robotics and cybersecurity which emphasize interaction with humans and perform tasks such as picking and placing objects and analyzing network traffic that may indicate a cyber-attack. This technology can also help doctors in healthcare to diagnose diseases more quickly and accurately. Neuromorphic computing systems are designed to process sensory data such as images or sounds in real- time allowing for rapid detection and analysis of potential hazards or emergency situations.

LITERATURE REVIEW

Neuromorphic computing, a next generation of Artificial Intelligence (AI) unlike conventional capabilities it is a biologically inspired approach, energy efficient and faster capability to learn. Due to its potential to solve various challenging real life problems researchers have been using and exploring it for a decade. Here in this section, the paper discusses analytical study of research work done by researchers for different applications using Neuromorphic computing. The study done in [1] focuses on how the brain utilizes a few tens of Watts to power billions of processing units connected by kilo meter's of fibers and trillions of synapses. This information might open the door to an entirely new class of hardware. It also talks about switching from the "bit precise" computer paradigms of today to future ones. A number of technologies have been employed to solve this problem. The results indicate that A crucial tool for offering input on the neuronal models

created by neuroscientists is neuromorphic hardware. The Human Brain Project (HBP) and Neuromorphic Computing are two distinct computing paradigms that the Neuromorphic Computing Platform in the HBP uses to accomplish this goal and provide a greater coverage of this feedback.This study [2] discusses the development and testing of a new type of nanoscale non-volatile phase change synaptic device array that can imitate the associative learning capabilities of the human brain.This showed that the artificial synapse array was able to perform a range of associative learning tasks with high accuracy, including pattern recognition and classification, as well as the ability to generalize learned patterns to new stimuli. The research in [3] deals with the concept of neuromorphic engineering, which seeks to develop artificial systems that emulate the functionality of biological neural systems. It addresses the problem of providing a comprehensive overview of the current state of neuromorphic approaches for vision, auditory, and olfactory sensors. Several technologies that have been used while proposing this paper are spiking neural networks (SNNs), convolutional neural networks (CNNs), neuromorphic hardware, event-based sensors, and neuromorphic algorithms for signal processing. The research indicates that neuromorphic approaches for sensory processing have the potential to significantly improve the efficiency and robustness of sensory systems. The paper highlights several challenges that need to be addressed, such as the need for more efficient neuromorphic hardware, the development of more advanced neuromorphic algorithms, and the integration of multiple sensory modalities in a single neuromorphic system.

The study presented in [4] focuses on the development of an artificial optic-neural synapse for colored and color-mixed pattern recognition. They proposed a new approach to mimic the biological synapse between the optic nerve and the brain by using an electrochemical neuromorphic device. This device is designed to respond to both the intensity and color of the input signals, which allows for more efficient and accurate pattern recognition. The authors use a combination of fabrication, measurement, and analysis tools along with neuromorphic computing principles to develop and demonstrate their artificial optic-neural synapse for colored and color-mixed pattern recognition. The study proposed a novel approach to develop an artificial optic-neural synapse for efficient and accurate colored and color-mixed pattern recognition. This approach has the potential to be applied in various areas such as image processing and artificial vision systems. Implemented in a chip-emulation-based development environment that can be easily deployed on a Neuromorphic System- on-a-Chip (NSoC), a spiking neural network (SNN)- based classifier was proposed in [5]. They also spoke about how data produced by an electronic nose (e-nose) should be classified. The process of analyzing and categorizing the data produced by e-nose is intricate, computationally demanding, and resource-intensive. Spiking neural network (SNN) architecture, the Xilinx Zynq-7000 FPGA board, and other technologies are employed. Consequently, they suggested demonstrating a hardware-deployable neuromorphic system that may greatly reduce power and resource consumption compared to conventional software-based methods, all while achieving excellent classification accuracy for e-nose data. This study mentioned in [6] discusses the development of an artificial perception system that uses memristive devices to mimic the behavior of biological neurons. They proposed a theoretical framework for the design of an artificial perception system that can process visual, auditory, and tactile sensations.

The system is based on the principles of neuromorphic engineering and uses memristive devices to model the behavior of biological neurons. It presented an innovative approach for mimicking the behavior of biological neural systems using memristive devices, which could have significant implications for the future of artificial intelligence and related fields. A new type of neural network called a "multiterminal neuro-transistor network" (MNTN) was proposed in [7], which emulates the spatiotemporal information processing capabilities of the human brain. .Numerous technologies have been used in this paper such as Circuit design, Simulation software, Fabrication techniques, Data analysis tools. As a result this study presented that MNTNs have the potential to revolutionize the field of artificial intelligence by enabling the development of more powerful and efficient neural networks capable of processing complex spatiotemporal information. A local error signal-based approach was proposed in paper[8]. The error can be calculated at each neuron based on the difference

between the neuron's output and the desired output. These local error signals are then used to update the weights of the neuron in a more efficient and distributed manner. The paper addresses the problem of training deep neural networks more efficiently and effectively. The standard machine learning and deep learning libraries such as TensorFlow, PyTorch, or Keras were used to implement and test the neural networks. As a result the paper demonstrated that using local error signals for training neural networks is a promising alternative to traditional backpropagation, especially for large and complex networks where backpropagation may be computationally expensive or difficult to implement in hardware. The study in [9] addresses the problem of implementing efficient and accurate hardware-based Hopfield neural networks (HNNs) for artificial intelligence using neuromorphic computing. It also explains how neuromorphic computing is a promising approach to building intelligent systems that can mimic the behavior of the human brain, and how HNNs can be implemented on hardware platforms to provide efficient and accurate solutions to optimization problems. The design and verification methods used in the development of the BrainScaleS neuromorphic hardware system is thoroughly studied in [10]. The paper describes the challenges associated with designing and verifying such a complex system, including the need to balance performance, scalability, and energy efficiency. The tools that have been used to overcome this problem are BrainScaleS system, Verilog and VHDL simulation tools such as Cadence and Model Sim. As a result in this paper the tool successfully designed and verified a large- scale neuromorphic hardware system that can simulate the behavior of biological neural networks. highlights the importance of using a combination of design and verification methods to ensure the correctness and performance of a complex neuromorphic hardware system such as BrainScaleS.The sensor fusion framework that integrates complementary systems: the electromyography (EMG) signal from muscles and visual information was converse in [11]. It also discussed about the ability to discriminate between human gestures that can help in several applications, such as assisted living, healthcare, neuro-rehabilitation, and sports. Many technologies have been used to solve this problem Convolutional Neural Networks (CNNs),

Support Vector Machine (SVM), Dynamic Vision Sensor (DVS), and the EMG armband sensor. This research infers that neuromorphic alternatives have increased inference time, between 20 and 40%, with respect to the GPU system but have a significantly smaller energy- delay product (EDP) which makes them between 30× and 600× more efficient. The proposed work represents a new benchmark that takes neuromorphic computing toward a real-world scenario.

The research conducted in [15] compares the performance and power efficiency of artificial neural networks (ANNs) and spiking neural networks (SNNs) on digital hardware. In this research several techniques have been used such as Digital signal processors (DSPs), Field-programmable gate arrays (FPGAs), Custom integrated circuits, MATLAB, and Spinnaker. The research has stated that the SNNs can achieve comparable performance to ANNs on certain tasks while consuming less power and FPGAs are the most power-efficient platform for implementing.

ANALYSIS

Based on studies conducted so far it can be analyzed that neuromorphic computing, takes inspiration from the human brain, has great potential to enhance Abased systems. It highlights the advantages of neuromorphic computing over traditional computing systems, such as low power consumption, fast processing, and the ability to learn and adapt in real-time. Neuromorphic computing has been widely used in areas like robotics and sensory based techniques due to its ability to process large amount of data in real time and its architecture which works similarly as that of human brain functions in terms of accuracy and higher effectiveness and robustness which helps scientists to develop and deploy efficient and intelligent hardware models. It is being observed that the most widely used neuromorphic computing model was SpiNNaker (Spiking Neural Network)and True North. SpiNNaker was designed to simulate the behavior of large-scale neural networks, information processing and coding and decoding of neural networks while the TrueNorth was compatible for sensory data applications like image processing and speech recognition. These approaches have a lot of potential for further development in technology areas such as hardware and software optimization, brain machine interfaces and robotics .These approaches are very much suitable in several areas discussed in section II and have potential for further development and application in other domains as well. As of now SpiNNaker is proven as an appropriate tool for high scalability and TrueNorth for applications related to real time processing for large scale neural networks. The other approaches are in the early stage of their exploration which faces several challenges like power consumption, interconnectivity, and availability.

CONCLUSION & FUTURE WORK

In this study we discussed the enhancement of neuromorphic computing from its evolution to the current scenario. This includes the thorough survey of various neuromorphic computing tools & techniques and various applications on which they have been applied. It is being observed that the most widely used neuromorphic computing model was SpiNNaker (Spiking Neural Network) and TrueNorth. The other approaches are in the early stage of their exploration which faces several challenges like power consumption, interconnectivity and availability. This piece of research concluded as that the field of neuromorphic computing is an emerging field and many more research must be done in several areas of computing. A more accurate and effective method for processing sensory input can be created in the future as a result of advancements in neuromorphic computing. The data from event-based vision sensors may likewise be captured and processed using this method. This might potentially be a more efficient iteration of an existing method with more processing power.

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Applications of Deep Learning and Machine Learning: A Vision

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ABSTRACT

Machine learning is an claim of artificial intelligence that is now being discussed in the world of mainframes and in relative to the COVID-19 pandemic. Many contributions have been made by researchers to improve the accuracy of machine learning algorithms, and a great deal of work is being done quickly to increase machine intelligence. Learning is a basic human behavior process that also plays a crucial role in machines. In addition, a different deep learning concept starts to take center stage. A subset of machine learning is called deep learning, or deep neural networks. Although deep learning has stood deliberate and applied in a amount of contexts with impressive outcomes, further research in this area is necessary to support future practical uses. This paper's main area is to offer an insight survey for machine learning in addition to deep uses for knowledge in many fields. Certain applications have the new standard COVID-19 blues as well. A survey of recent and ongoing machine learning and deep neural learning tenders across several fields is provided, including examples.

KEYWORDS: *Deep neural learning (DL), Machine learning (ML), Machine intelligence (artificial intelligence).*

INTRODUCTION

Fig. 1 illustrates machine learning, a subclass of artificial intelligence. The organization studies since its knowledge because it is self-learning and is built on procedures. For example, the kind of data that is sent into the system helps it identify patterns and responds to those patterns at the output. In this instance, the system learns over time and becomes the cleverest deprived of humanoid input. It makes use of a numerical knowledge procedure that gains knowledge and gets better on its own without human assistance. Conversely, a deep learning system gains knowledge not only from its incoming data but also from its vast database. The broad field of artificial intelligence is the creation of intelligent machines. Machine learning is a major component of artificial intelligence development because intelligent behavior requires a great deal of information or understanding. Technology never stops trying to mimic human intelligence, which is why artificial intelligence has greatly now pay attention. Since the 1950s, the majority of computer scientists have focused on machine learning. As a result, as deep learning efforts continue in this direction and have garnered significant attention due to the COVID-19 outbreak, expectations from machines are rising [1]. Face recognition is one of the many applications that has acquired in the world without touch meanwhile it springs persons a greater intelligence of legitimacy because each being's look is dissimilar [2,3].

APPROACHES IN MACHINE LEARNING

As illustrated in Fig. 2, ML algorithms are classified into three groups for wide classification: supervised, unsupervised, and reinforcement learning. Supervised learning makes use of an procedure that needs outside assistance. Training and testing datasets are separated in the input database that is provided. The training database is used to forecast or categorize the output variable. During the database's training phase, algorithms attempt to identify certain shapes. They then apply these patterns to the database's testing phase, yielding estimation results [4].

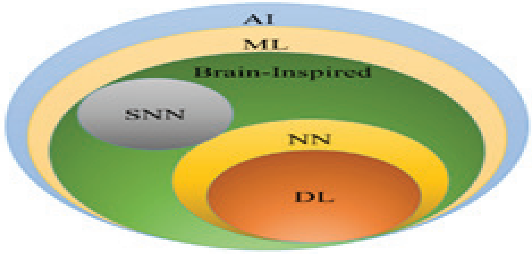

Fig. 1. Displays the association amid artificial intelligence (AL), machine learning (ML), and deep learning (DL) [34]

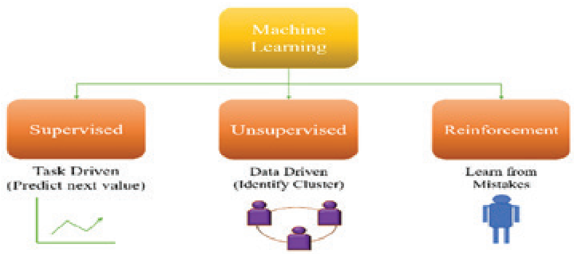

Fig. 2. Machine learning approaches [4]

An algorithm for machine learning that picks up certain traits from input data is called unsupervised learning. It uses previously learnt characteristics to identify the class of data after supplying a fresh database. The main use case for it is feature reduction required for grouping.

Action-based decision-concept learning is known as reinforcement learning.

Actions in this learning process are determined by the decisions made in order to increase the value of the output or desired favorable situation. The student, however, lacks any prior knowledge of the data. Once the scenario is provided, it gains the ability to determine the appropriate course of action based on the supplied circumstances. The learner's choice, or action, has an impact on the circumstances both now and in the future. Reinforcement learning is only possible under these two circumstances:

OVERVIEW OF MACHINE LEARNING

Arthur Samuel, a innovator in artificial intelligence (AI) and computer games, contributed to the evolution of machines in 1959 by coining the term "machine learning." Prior to then, the most popular computer- based chess game. Turing and Chambernowne designed a paper-and-pencil program in 1948. Subsequently, Dietrich Prinz unveiled his innovative chess playing system in 1951. Christopher Strachey developed the first draughts method in 1952. The draught session proceeded at a good clip. Nilsson wrote a volume on machine learning using design categorization in the 1960s. Duda and Hart noted in 1970 that design organization remained popular.

Applications of machine learning

Several machine learning-related application sectors and subfields have been demonstrated in the literature. The following is a list of the practical uses. as seen in Figure 3. Machine learning's broad field of computer vision teaches computers how to interpret, analyze, and recognize visual input. Key algorithms in computer vision include KNN, SVM, and Naïve Bayes. This field's subdomains include object detection, object processing, and object identification. Owing to the COVID-19 epidemic, modern technologies like facial recognition and iris scanning are in high demand right now because fingerprint authentication does not comply with distance standards. The face recognition with ML feature for banks and Aadhar cards in India will be helpful.

Fig. 3. Applications of machine learning and deep learning

Applications for handwritten recognition simplify labor for businesses with a lot of handwritten paperwork. For instance, colleges, testing facilities, law enforcement, etc. Documents can be scanned and digitalized in a matter of minutes. The technique of converting spoken words into writing is called speech recognition. It is helping to increase accessibility and is beneficial for the military, healthcare, automobile systems, and the creation of speech interfaces and voice assistants for daily use. Speech to text and automatic speech recognition are other names for speech recognition. Artificial neural networks, vector quantization, and dynamic temporal packaging are a few of the algorithms that are employed. The onward conversion of Indonesian relaxed to official linguistic using semi-supervised learning is provided by Wibowo, H. et al. 2020 [7], who also demonstrate an improvement in the translated results. The discovery of unusual behavior, credit ratings, and trends in customer transactions serve as the foundation for fraud detection and prevention. For the most part, classification and machine learning regression techniques in addition to neural networks are employed in scam identification. In order to detect credit card fraud, auto encoders using Tensor Flow and Keras are existence developed. This technology protects a significant amount of money for fee retrievals and cover aimed at monetary organizations.

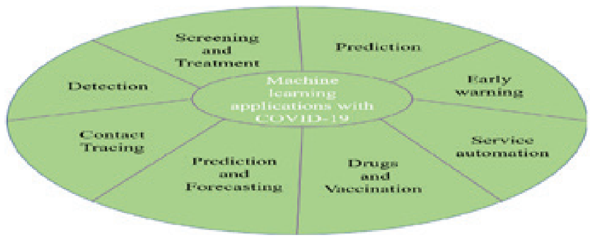

Fig. 4. Machine learning claims with COVID-19

For machine learning claims related to COVID-19

Making a diagnosis, determining who is most vulnerable, learning more about viruses, forecasting the disease's progress, mapping the virus's origins, finding helpful medications already on the market, and creating new medications. The critical duty completed by machine learning, as illustrated in Fig. 4, is predicting the next pandemic at the fastest pace possible. In COVID-19, machine learning is utilized to predict infection. The rapid global spread of this pathogen necessitates international response. As a result, ML may be used to forecast how new situations would behave. stop the disease from spreading while mathematical models for learning and analysis are taught to the machines through machine learning. An intriguing pattern can be found once the system has been trained. Researchers Li et al. [8] created a machine learning forecast perfect to identify cases that have been reported worldwide and in China, and Kumar et al. [9] used the autoregressive integrated touching average (ARIMA) perfect to forecast the spread of the coronavirus in the 15 most afflicted nations. Using CNN, Huang et al. [10] demonstrated the CNN model's efficiency in comparison to the MLP, LSTM, and utilized the vulnerable exposed-infectious-recovered (SEIR) and regression models statistical methods to assess and predict the COVID-19 delivery in India. Machine learning is an amazing subfield of artificial intelligence that is constantly and valuably contributing to technological advancement. When included, it has simplified several advances and produced numerous useful applications across a wide range of industries.

DEEP LEARNING REVIEW

Machine learning's sub classification of deep neural networks. It is a network model where the neurons have multiple layers and parameters. between the two parameters, input and output. DL employs an architecture based on neural networks. hence the term "deep neural networks." With DL, characteristics can be automatically learned and represented at several levels in a hierarchical fashion. In other words, the deep learning entire architecture is employed for the eye removal and modification process. This robustness of deep learning is due to its powerful process, which sets it apart from traditional machine learning methods.

The lower layers handle input data in a straightforward way or study the informal landscapes; the output is then sent to the higher coatings for learning compound landscapes. Deep learning is then appropriate for handling more complicated and large-scale data [12].

Background

The Turing machine built by connecting the neurons was demonstrated by McCulloch & Pitts (1943) [13]. Rosenblatt [14] shown in 1958 that the perceptrons would overlap if the information they were trying to learn was capable of being voiced. The limitations of perceptrons were first described by Minsky and Papert in 1969 [15], who suggested stopping research on neurons after at least ten years of operation. After then, the back-propagation technique was introduced by Geoffrey Hinton et al. (1985) [16]. Subsequently, in 1988, a hierarchical neural network known as Neocognitron [17] demonstrated proficiency in visual pattern recognition. Additionally, Yan LeCun examined backbone broadcast using CNN for file study in 1998 [18]. Subsequently, the Hinton laboratory resolved the DNN training problem in 2006 [19,20]. Between 2012 and 2020, a deep learning algorithm has become more and more emerging in numerous areas.

The necessity of using DL

Deep learning (DL) is a widely used worldwide knowledge approach in various industries, including robotics, vision, speech recognition, language understanding, biometrics, and customization. Its robustness comes from its autonomous learning process, which represents optimal characteristics for any given task, making it a valuable methodology in various sectors.

Deep learning (DL) is a generalization of transfer learning, allowing for use across various datasets and applications. Its high data and computation scalability, as demonstrated by Microsoft's ResNet, is particularly useful in big data analytics. DL addresses causal learning by providing meaningful data in situations where sufficient information is unavailable, such as graphics, computer vision, mobile intelligence, and energy-efficient techniques. Conventional machine learning techniques have shown superior results with less data input [21-24].

Applications of deep learning

Deep learning is used in big data for MAVIS-Microsoft voice credit. Human voices and talks are helpful in this learning process. the audio and video file search [26]. Google has also implemented deep learning in the big data setting for copy search, which facilitates picture understanding and makes image labeling, indexing, and annotation simple. Google's program, which can categorize photos and create bizarre and artificial artworks based on its expertise, is a deep fantasy. Furthermore, Facebook's announcement of deep text is also an artificial intelligence setup. This machine uses a deep learning-based method to comprehend language and can classify enormous amounts of data. It can also provide different related facilities, such housework junk mails and classifying trainers talking mails. DeepMind artificial intelligence is being used by Google Maps to estimate arrival times, and PSUs are using this technology for cybersecurity in light of the novel usual COVID-19 blues breakout. In 2020, Beattie and colleagues [27] introduced DeepMind Lab2D, a simulator that offers a scalable setting for studies on artificial intelligence. Google and Improbable work together to use augmented reality (AR) to replicate the real environment. For instance, an enhanced navigation system overlays the path on top of the real-time view of the road using augmented reality (AR). Ground personnel at Singapore's airport utilize AR glasses to display additional info about load ampules and expedite cargo areas. The largest obstacle facing parents and the country in the future will be identifying and treating developmental delays in children. A computer system developed by MIT researchers is able to recognize linguistic in adding to speech issues even prior to kindergarten. Children with autism, developmental disabilities, and language difficulties have obstacles in living a fulfilling life. Physical, emotional, and mental health are just a few of the wonderful results that can result from early stage analysis and its treatment. Amazingly, Photo Descriptions has made use of deep learning techniques. Rather than creating a statement that describes every aspect of the image, Andrej Karpathy and Li Fei-Fei worked on deep neural network training to identify several fascinating zones in the image. Computers typically operate automatically categorize pictures. Take Facebook and Google Photos, for instance. Deep learning techniques have demonstrated the ability to restore critically deteriorated vintage images (Wan, Z. et al., 2020 [28]). The concept of zooming in videos was made possible by deep learning and pixel renovation or pixel recursive wonderful resolve. In 2017, Google researchers trained a deep learning network with incredibly low-resolution face photos in order to predict a person's face using such photographs.

The CNN and LSTM-equipped recurrent neural network adds sound to silent films or videos. To select the suitable noises, a dataset of pre-recorded sounds is synchronized with the video frames. for a certain scenario. As a result, it indicates if the complete is actual or artificial and too provides a Turing-test setup for good results. A dynamic sky replacement and deep learning- assisted video harmonization are presented by Zou, Z. 2020 [29].The hardest things for a humanoid to learn are the complexities of linguistic, which include syntax, tonal nuances, semantics, and expressions. Natural language processing (NLP) is attempting to reach the best possible level with the use of deep learning. of achievement. While SVM and logistic regression required a lot of time, results from CNN, RNN, and reinforcement learning are now significantly better. A new toolset is offered by Ramamurthy, R. et al. 2020

[30] for the assessment of strengthening knowledge on NLP errands. Autonomous AI-equipped wagons remain the novel thing. Uber's AI lab is developing various intelligent features for driverless vehicles. According to Forbes, MIT is working on creating a system that would enable autonomous vehicles to navigate without a map. The open-source "scalable multi-agent reinforcement learning training school for autonomous driving," or SMARTS, was created by Zhou, M. et al. 2020 [31] and aids in teaching users how to use accumulating varied road user behavior model.

Claims with COVID-19 for deep learning

Deep learning is utilized in X-ray analysis to examine the body part that is impacted, such as lung ailments, tumors, fractures, and traumas. [32, 33], ResNet-50, Inception-v3, and Inception-ResNet-v2 models based on CNN utilized by Narin et al. [32] to predict COVID-19 patients with chest X-ray pictures and found that ResNet-50 had the highest detection accuracy (98%). Furthermore, by using chest X-ray pictures for feature extraction, a deep learning algorithm and support vector machine (SVM) are employed to classify the copy as well or sick. A 95.38% correctness was attained with ResNet50 and SVM using a variety of deep learning replicas, including Inception-v3, AlexNet, VGG16, Inception-ResNet-v2, VGG19, ResNet-18, ResNet-50, GoogLeNet, ResNet-101, DenseNet201, and XceptionNet. In 1972, Godfrey Hounsfield and Allan Cormack created the CT scan. Using X-ray technology and deep learning, the CT scan diagnosis method meticulously diagnoses inside organs that are sensitive [30, 34]. A CovidGAN is presented by Waheed, A. et al. 2020 [35] for enhanced Covid-19 discovery.

DISCUSSION

Many uses, including deep learning methods, processer idea, natural language dispensation, semantic analysis, and machine learning-based prediction fields. The newest field to use deep learning is ECRM (electronic customer relationship management). The primary objective of utilizing GPU (Graphics Processing Unit) computer hardware in deep learning eye production and information dependencies. As a result, deep learning is developing and will likely find new uses in a number of fields. According to Andrew Ng's Quora post, "deep learning is having a significant impact on and expanding quickly in a number of fields, including consumer finance, medicine, and precision agriculture.”

CONCLUSION

Machine learning uses a collection of procedures to analyze and comprehend information, draw conclusions after the situation, then make the best decisions possible. For deep learning, the system is dependent on artificial neural network layers. Comprehensive analyses of machine learning and deep learning are presented, lengthways by their various claims. These days, machine learning is being secondhand by everybody, either straight or circuitously. After getting produce references when spending on to updating photos on community media platforms. The evolution, salient characteristics, shared characteristics, and distinctions between deep learning and machine learning stay too explained. That expresses us that here is a novel possibility of deep learning with numerous requests that can crop extraordinary consequences in the upcoming. As investigate is a incessant procedure, a novel building may too change.

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Electrical TRAIN with Solar Charging System

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ABSTRACT

In recent years, there has been a growing global concern regarding the environmental impact of transportation systems, particularly in the context of reducing greenhouse gas emissions and promoting sustainable practices. This paper aims to explore the concept of integrating solar charging systems into electrical trains, presenting a sustainable approach to powering public transportation. This paper examines the advantages and implications of utilizing solar charging systems for electrical trains. Firstly, it highlights the environmental benefits, such as reduction of greenhouse gas emissions and mitigation of air pollution, contributing to improved air quality and public health. Additionally, the integration of solar charging systems can help reduce the reliance on traditional energy sources, enhancing energy security and resilience. Furthermore, the paper discusses the technical aspects of implementing solar charging systems for electrical trains. It explores the design and engineering considerations, including the installation of photovoltaic panels on train rooftops, energy storage solutions, and the integration of smart grid technologies. These advancements enable efficient energy capture, storage, and distribution, ensuring a reliable and sustainable power supply for the trains.

KEYWORDS: *Electrical train, Solar charging system, Renewable energy, Solar panel integration, Pantograph, Battery storage.*

INTRODUCTION

Transportation frameworks play a pivotal part in our every day lives, interfacing individuals and merchandise over different goals. Be that as it may, the natural affect of conventional transportation strategies, especially in terms of carbon emissions and dependence on fossil fills, has gotten to be a squeezing concern. As a result, there is requirement of a developing have to be maintainable options that can diminish nursery gas emissions and advance a greener future.

One promising arrangement is the integration of sun powered charging frameworks into electrical trains. Sun oriented vitality, as a clean and renewable asset, has picked up critical consideration in later a long time due to its potential to moderate climate alter and decrease reliance on non-renewable vitality sources. By saddling the control of the sun, electrical trains can work with negligible natural affect, making them a economical mode of transportation. The concept of coordination sun based charging frameworks into electrical trains includes the establishment of photovoltaic boards on prepare housetops, which change over daylight into power. This renewable vitality is at that point utilized to control the train's operations, lessening or indeed disposing of the require for conventional vitality sources. The abundance vitality produced can moreover be put away for afterward utilize, guaranteeing a solid control supply indeed amid periods of moo sunlight.

This paper points to dive more profound into the preferences and suggestions of coordination sun based charging frameworks into electrical trains. By analyzing existing investigate, case studies, and real-world illustrations, we'll investigate the specialized achievability natural affect, and potential financial benefits of this inventive approach to transportation.

LITERATURE SURVEY

Fayad, A.; Ibrahim, H.; Ilinca, A.; Sattarpanah Karganroudi [1] The Indian prepare UNESCO got to be, in 2011, the primary diesel-electric maker to introduce solar photovoltaic (PV) panels on the roofs of its buses. The 3 KW auxiliary generator and its trimmings have been excluded from preparation with this PV frame. The vitality produced from the solar photovoltaic panels is stored in batteries and used to operate seven 6W controlled lights in each of the buses, as well as charge versatile phones during the five-hour journey. In Australia, solar-oriented ranches were introduced along or near the railway and expanded to solar-powered planks on house roofs. All the vitality produced is stored in batteries mounted on the diesel electric fixture. The specified control of 0.015 GW needed to operate the preparation comes from 8% from train roofs, 58% from solar cultivation and 34% from solar railway plates [12]. Following the story of the exploratory tests in India and Australia, train companies began to construct su- powered slabs on the tunnels above the trains, such as the Belgian tunnel, this sun tunnel connecting Schoten and Brasschaat was the primary European tunnel. It contains 16,000 photovoltaic panels, produces almost 3.6 GWh and reduces annual CO2 emissions by around 2,500 tons [18]

Examination of how solar energy can be effectively integrated into the power systems of trains to reduce reliance on conventional energy sources. Analysis of the current state of electrical train systems, including their power consumption patterns, operational efficiency, and technical specifications. Review of literature discussing the design, implementation, and performance of solar charging systems specifically tailored for trains, considering factors such as solar panel types, installation methods, and charging efficiency. Exploration of recent technological advancements aimed at improving the effectiveness, reliability, and scalability of solar charging systems for trains. Assessment of the environmental benefits, such as reduced carbon emissions, and economic implications associated with the adoption of solar charging systems in train transportation. Investigation into regulatory frameworks, government policies, and incentives that influence the deployment and adoption of solar- powered trains, including discussions on regulatory challenges and potential solutions.

PROBLEM STATEMENT

Overhead Line Issues: Problems with the overhead catenary system, such as wire breaks, insulator failures, or pantograph issues, can disrupt power supply to trains. Power Distribution Faults: Electrical substations along the railway network may experience faults leading to power supply interruptions or voltage fluctuations. Transformer Problems: Transformers play a crucial role in stepping up or down voltage levels for efficient power distribution. Issues with transformers can lead to power supply disruptions or electrical hazards.

The objective is to design and implement an electrical train system that incorporates a solar charging infrastructure to reduce dependency on non-renewable energy sources and minimize environmental impact. The system should efficiently harness solar energy through strategically placed solar panels along the train route or on the train itself. Key considerations include developing advanced energy storage solutions to store excess energy generated during sunny periods for use during low-light conditions or peak demand periods. The system should be scalable to accommodate varying train sizes and routes, while also ensuring seamless integration with existing railway infrastructure and operational protocols. Additionally, factors such as reliability, cost-effectiveness, and regulatory compliance must be addressed to ensure the viability and sustainability of the solution.

DESCRIPTION

An electrical train with a solar charging system integrates photovoltaic (PV) panels onto its roof, which are made up of solar cells that convert sunlight into electricity through the photovoltaic effect. These panels are strategically positioned to capture the maximum amount of sunlight throughout the train's journey. The electricity generated by the solar panels is then directed to a charge controller, which regulates the flow of electricity to ensure efficient charging of the onboard batteries. The charge controller also protects the batteries from overcharging, which can extend their lifespan. The onboard batteries serve as a storage system for the solar-generated electricity. This stored energy can be used to power various components of the train, including lighting, heating, air conditioning, and auxiliary systems. In some cases, the stored energy can also supplement the traction power needed to propel the train, reducing the demand for grid electricity during operation.

By harnessing solar power, the train reduces its reliance on traditional fossil fuels and grid electricity, thereby lowering carbon emissions and environmental impact. Additionally, the use of solar energy can potentially reduce operating costs over the long term, as it provides a renewable and free source of electricity once the initial investment in solar infrastructure is made. The block diagram is shown in figs 1 and 2.

PROPOSED WORK

The line is powered by AC 230 V. The pantograph is connected to the transmission line, the current is exchanged using a rectifier (to change the AC current to the direct current of modern times) and then to the learning motor further, while there is enough light on the sun-oriented plate, the battery receives a charge via a solar panel via a price regulator. at the same time, the current day is additionally given to the battery to charge. It means that at the same time the train is running on the source in addition to charging the battery. through this switch we used regulation for operating changes. At any point the top van is turned off, the battery can be turned on and pressure to learn without delaying train movement. For the operation of the train, we used an RC controller, which is controlled by software in a mobile phone.

Train the characteristics of the wheels in either the front or changed course and cleared or night directions are controlled by the Bluetooth RC Controller app. Basically, pantograph operation (i.e. raising and lowering) is done through a PC application in the Bluetooth RC Controller application. we put a pointer on the train that offers an indication if the pantograph is connected or not. we've applied a battery indicator that additionally provides voltage monitoring to display the sum of the battery price in the event that the pantograph is in a workable country and vice-versa an Electric Driven Road Frame (ERS) in which there is an exchange of electrical vitality when moving from the street to electrical education for power and charging the battery, which can be an idea with excellent capacity to reduce reliance on conventional sources and accelerated energy productivity within the transport sector. ERS is expressed as a vigorous controlled exchange from the journey to teaching while the train is in operation and can be carried out through a variety of manipulative business innovations from the journey to teaching. in this article, we used the Catenary machine technology, which runs electrical learning, but we got used to it Gadget Line AC. This control is collected through a collector and a rectifier is used to change over 2.30 AC to 12 V DC and with this electrical control the battery is charged and able to power the learning. in this innovation, equipped for the applied low-power battery (12V-7AH lead corrosive battery), therefore the trend weight and the initial haul of the train additionally decreases. Reduces the inactive charge time of electric learning and increases the ride separate from the stunning train. when the pantograph is disconnected or whatever deterrents in the overhead structure now do not affect the operation of learning due to the fact that the adjustment takes over located and battery can HE be the nation and move the power to teach.

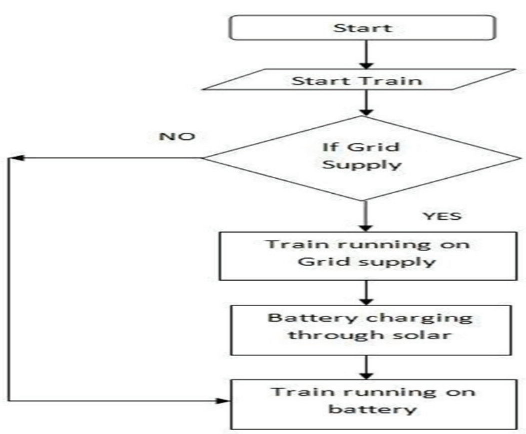

Fig. 1: Flowchart of proposed Electrical train with solar charging system

We have given pointer on the train which gives sign in case pantograph is associated or not

1. If the power is on, the tram will run and the battery will be charged at the same time.
2. In case the flexible Cut OFF will only work on batteries.
3. If the train is stationary, the time battery will be charged.

Pantograph unit

The line is powered by alternating voltage 230V. Fumiograph is associated with the immunization line, the current is exchanged by this rectifier to change AC to DC) and then input sy train engine Basically the operation of the pantograph, filling up and down) is done by a computer program on the Bluetooth RC application controller. In the train, we put a painter that shows whether the pantograph is connected or not. The development of the wheels of the train in either a switched course and cleared or the correct direction is controlled by the Bluetooth RC Controller app. We put an indicator on the train to show whether the pantograph is connected or not. We have used a battery indicator which vover gives a voltage check of the battery charge in case the pantograph is in working condition and vice versa. At that time we used Catenary System technology on which we Electric train rum but we used Two Line AC System. This control is collected through a pantograph and a rectifier is used to change over 230 AC to 12 V DC and with this electrical control the battery is charged and able to drive the train.

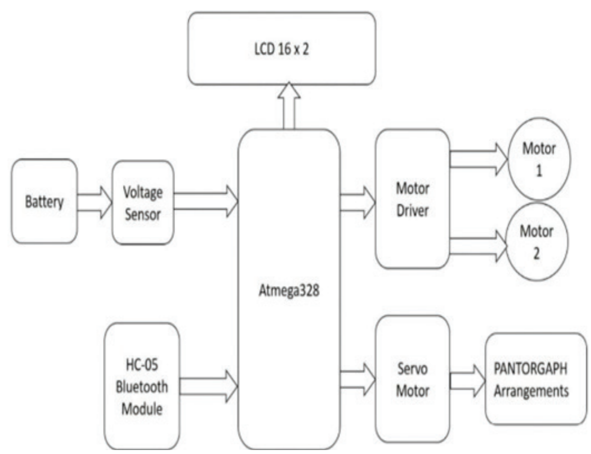

Fig. 2: Block diagram of Grid system

Solar Unit

The adequate light on sun oriented board the battery get charges through solar board through charge controller. At the same time, the uw battery current is additionally supplied for charging. This means that at the same time the train runs on power and the heating element is charged at the same time. For operational changes we used alter over that's Switch. At any point the overhead power will be turned off, the battery will be fucked and the train will run without any delay in the movement of the train. To control the train, we used an RC controller, which is controlled by a program in a mobile phone.

In this innovation, it switches to a used low-capacity battery (12V-7AH lead corrosion battery), which additionally reduces the total weight and the initial yield of min. Reduces the inactive charging of the electric train and increases the ride separated from the stunning train. When the pantograph is disconnected or any deterrent in the overhead structure will affect the operation of the train because the alternator will come on and heat up, introduce and drive forward the ERS (Trail An Electric Street Framework) in which the exchange of electrical vitality occurs when moving from the train. street to an electric train for powering as well as charging butter, which could be a concept with incredible potential to reduce dependence on conventional resources and increase vitality productivity within the transportation division. ERS is expressed as the energy exchange of street-to-train control when the train is in a desolate state, and can be realized through various innovations of street-to-train control exchange.

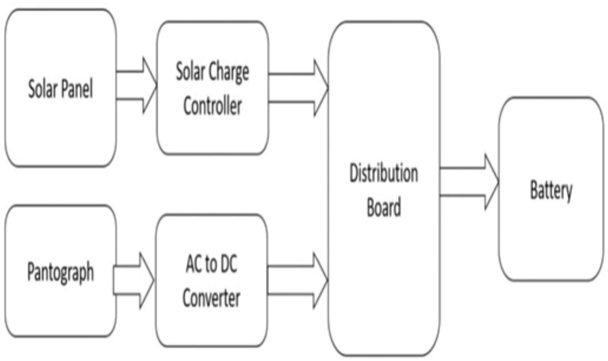

Fig. 3: Block diagram of solar system

Over all main components in a system

1. Atmega 328 Microcontroller:- The ATmega328 is a versatile 8-bit microcontroller commonly used in DIY electronics and embedded systems. It's the core component of the Arduino Uno board and offers features like flash memory for program storage, SRAM for data storage, analog-to-digital conversion, and various communication interfaces, making it appropriate for a wide extend of projects.
2. L298 Motor Driver:- L298N is a dual H-Bridge motor controller that allows speed and direction control of two DC motors at the same time, the module can control DC motors that have a voltage between 5V and 35V, with a peak current of up to 2A.
3. Servo Motor:- Servo motors are precise motors used for controlling angular position. They have feedback systems for accuracy, operate via a three-wire interface, and come in various sizes and torque ratings. They're commonly used in robotics, automation, and hobby projects.
4. DC geared Motor- The HC-05 is a Bluetooth module for wireless communication over short distances. It operates via serial communication, supports master/slave modes, and can be configured using AT commands. It's commonly used in various projects for Bluetooth connectivity.
5. Bluetooth module HC-05- The HC-05 is a Bluetooth module for wireless communication over short distances. It operates via serial communication, supports master/slave modes, and can be configured using AT commands. It's commonly used in various projects for Bluetooth connectivity.
6. Charge control- Charge control is a process or system used to manage the charging of batteries, typically in electronic devices or electric train. Its purpose is to regulate the charging current and voltage to ensure safe and efficient charging, while also protecting the battery from overcharging, over voltage, and overheating.

FUTURE SCOPE

Long term scope for electrical trains with sun powered charging frameworks is promising. It offers the potential for more economical and eco- friendly transportation by diminishing reliance on fossil powers and minimizing greenhouse gas outflows. Executing sun oriented charging frameworks can moreover upgrade the flexibility of railroad systems by giving an alternative power source, particularly in inaccessible regions or amid crises. As renewable vitality innovations proceed to development, coordination sun based charging frameworks into electrical trains may end up more productive and cost-effective, contributing to a cleaner and greener transportation infrastructure.

Innovation Advancements: Advances in solar panel technology, energy storage systems, and control electronics could enhance the efficiency and cost-effectiveness of solar charging systems for trains.

Adaptability and Flexibility: Future systems may be designed to adapt to various train types, routes, and operational needs, allowing widespread adoption across different railway networks.

Integration with Smart Grids: Integration with smart grid technologies could improve coordination between solar charging systems, energy storage, and grid power, optimizing energy use and grid stability.

Generally, the future scope of electrical trains with sun powered charging frameworks is characterized by continuous innovative headways, expanding appropriation, and integration with broader supportability activities pointed at tending to climate alter and advancing clean vitality arrangements within the transportation division.

RESULTS AND ANALYSIS

The proposed unit with use of Atmega328 microcontroller is developed as prototype as shown in Fig. 4:.

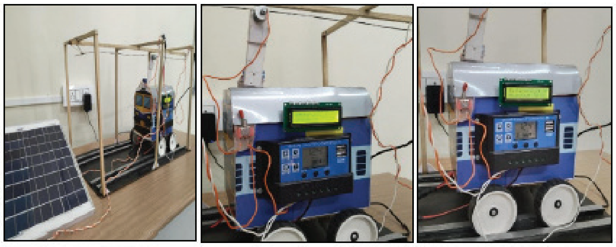

Fig. 4: Prototype Circuit of Proposed Electrical train with solar charging system

1. If the power is on, the tram will run and the battery will be charged at the same time.
2. In case the flexible Cut OFF will only work on batteries.
3. If the train is stationary, the time battery will be charged The LCD is display the percentage & battery of voltage.

CONCLUSION

This system reduces the static charging time of the electric train and increases the range of the train. When the pantograph is disconnected or any obstructions in the catenary system do not affect the train operation as the switchover will occur and the battery will be in the ON state and will continue to power the train. The overall weight and initial cost of the train is also reduced. By tackling sun powered vitality to control the prepare, it diminishes reliance on conventional fossil fills, driving to lower nursery gas outflows and contributing to a cleaner transportation framework. Moreover, joining sun oriented charging foundation along the prepare course can improve its proficiency and unwavering quality, making it a practical alternative for feasible urban and intercollegiate travel. Be that as it may, it's significant to consider the achievability, adaptability, and cost- effectiveness of actualizing such a framework on a bigger scale combining electrical trains with sun powered charging frameworks presents a promising arrangement for accomplishing greener transportation systems within the future.

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Precision Farming: A Synergy of IoT and Deep Learning for Sustainable Cultivation

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ABSTRACT

Precision farming, a transformative approach in modern agriculture, converges the power of Internet of Things (IoT) and Deep Learning technologies to usher in a new era of sustainable cultivation. This paper explores the intricate synergy between IoT devices and advanced machine learning algorithms, focusing on their collective impact on agricultural practices. The deployment of IoT sensors facilitates real-time monitoring, enabling data-driven decision-making in areas such as irrigation, fertilization, and pest control. Concurrently, Deep Learning algorithms, notably Convolutional Neural Networks (CNNs), revolutionize crop health assessment and yield prediction through the analysis of high-resolution images captured by advanced imaging technologies.

The paper delves into the specific methodologies employed in integrating IoT and Deep Learning, emphasizing their role in optimizing resource utilization, enhancing crop resilience, and fostering environmentally conscious farming practices. Furthermore, it outlines the potential contributions of this symbiotic relationship in addressing contemporary challenges such as food security, climate change adaptation, and efficient land management. Through a comprehensive exploration of Precision Farming, this paper aims to provide insights into the transformative potential of technology in cultivating a more sustainable and resilient agricultural future.

KEYWORDS: *Machine learning, Crop monitoring, Agriculture.*

INTRODUCTION

Modern agriculture stands at the nexus of innovation and necessity, with the burgeoning global population necessitating a paradigm shift in cultivation practices. In response to this challenge, precision farming has emerged as a transformative approach, harnessing cutting-edge technologies to optimize resource utilization, enhance crop yield, and promote sustainability. Among these technologies, the integration of the Internet of Things (IoT) and Deep Learning holds exceptional promise, offering a synergistic alliance that redefines the landscape of sustainable cultivation.

The deployment of IoT devices in agriculture marks a revolutionary leap, providing real-time insights into the intricate dynamics of the farming ecosystem. Sensor networks strategically positioned across fields capture a myriad of data points, ranging from soil moisture levels and temperature fluctuations to spectral characteristics of crops. This wealth of real-time information becomes the cornerstone for data-driven decision-making, empowering farmers to adapt dynamically to evolving environmental conditions. In the realm of precision agriculture, IoT serves as the vigilant eye, continuously monitoring the pulse of the land and offering a responsive platform for optimal farm management.

Complementing this IoT infrastructure, Deep Learning algorithms add a layer of intelligence that transcends traditional agricultural practices. High-resolution images captured by drones equipped with advanced cameras become the canvas for Convolutional Neural Networks (CNNs) to paint a detailed portrait of crop health. These algorithms, trained to recognize intricate patterns indicative of diseases, nutrient deficiencies, and overall plant well-being, revolutionize the speed and accuracy of crop assessment. Additionally, the predictive capabilities of Deep Learning models contribute to anticipatory decision-making, enabling farmers to proactively address potential challenges and optimize yield.

As we embark on this exploration of Precision Farming, the fusion of IoT and Deep Learning takes center stage. This paper endeavors to unravel the intricacies of their symbiotic relationship, unveiling the transformative potential that lies in their collaboration. Beyond the technical nuances, the integration of these technologies speaks to a broader narrative—a narrative of sustainability, resilience, and a harmonious coexistence between technology and agriculture. In the following sections, we will delve into the methodologies, challenges, and potential contributions of this synergistic alliance, seeking to illuminate the path toward a more sustainable and efficient agricultural future.

LITERATURE SURVEY

Research paper [1]proposes a comprehensive framework for smart agriculture leveraging the Internet of Things (IoT). The study explores the integration of IoT devices for real-time monitoring of soil conditions, weather patterns, and crop health. It discusses the potential of IoT-based precision farming to enhance resource efficiency and sustainability in agriculture

A study by P. M. Atkinson et.al.[2] providesa detailed examination of the applications of deep learning in the analysis of remote sensing data. It explores the potential of advanced neural networks to extract meaningful information from satellite and drone imagery. The paper discusses the state-of-the-art techniques, challenges, and future directions in applying deep learning to remote sensing data for agricultural purposes.

Focused on machine learning applications in agriculture, the study in paper[3] explores the integration of predictive analytics for crop management. It discusses how machine learning algorithms can be employed for yield prediction, considering environmental factors, historical data, and agronomic practices. The study emphasizes the potential of machine learning in enhancing process of decision-making as well astotal agricultural yield.

Addressing the application of deep learning in plant health assessment, the review study in [4] focuses on image-based disease detection. It discusses the advancements in Convolutional Neural Networks (CNNs) for recognizing patterns indicative of diseases and nutrient deficiencies in crops. The paper provides insights into the methodologies and challenges in utilizing deep learning for crop health assessment.

A broader perspective, exploring the evolution of precision agriculture, technology adoption patterns, and the economic impacts of sustainable practices were studied in[5]. It discusses the integration of IoT and advanced technologies in precision agriculture, emphasizing the need for sustainable and efficient farming practices in the context of evolving agricultural landscapes.

The comprehensive review [6]delves into the multifaceted applications of IoT in agriculture. Focusing on precision farming, the paper explores the integration of IoT technologies to enhance crop monitoring, resource utilization, and decision-making processes. Through an exhaustive examination of existing literature, the authors present an overview of the current landscape, challenges, and prospects of IoT applications in agriculture.

Addressing the increasing need for automated plant identification, the research paper[7] explores the application of deep learning techniques in natural environments. By leveraging advanced neural networks, the study aims to develop robust models capable of accurate plant identification. The paper discusses the methodology, challenges, and possible applications of deep learning in enhancing our understanding of plant species diversity in various ecological settings.

Gubbi et.al [8]provides a thorough analysis of the diverse applications of IoT in agriculture. Focusing on real-world implementations, the paper examines how IoT technologies contribute to precision agriculture by monitoring environmental conditions, automating processes, and improving overall farm efficiency. The review aims to consolidate existing knowledge and provide insights into the growing landscape of IoT applications in the agricultural segment.

The study in [9]offers a detailed overview of the advanced techniques in applying deep learning to remote sensing data. Focusing on agriculture, the paper explores how advanced neural networks can be employed to extract valuable information from satellite and drone imagery. The tutorial discusses methodologies, challenges, and probable applications of deep learning in remote sensing for agricultural purposes.

The wide-ranging applications of machine learning in agriculture are explored in [10]. With a focus on crop yield prediction, the authors delve into the integration of machine learning algorithms to analyze diverse datasets encompassing environmental factors, historical yield data, and agronomic practices. The paper discusses the potential of machine learning to enhance decision-making processes and improve overall agricultural productivity.

This comprehensive review[11] investigates the integration of remote sensing and IoT to foster sustainable agronomy practices. Exploring the synergy between these technologies, the paper discusses how remote sensing data can be leveraged in conjunction with real-time IoT data for precise monitoring, resource optimization, and environmental sustainability. The review aims to provide a holistic sympathetic of the probable benefits and challenges accompanying this integrated approach in agriculture.

COMPARATIVE ANALYSIS

Paper title	Focus	Methodology	Potential Contribution
Smart Agriculture: An IoT-Based Approach for Precision Farming	Emphasis on IoT-based precision farming.	Proposes a comprehensive framework for smart agriculture	Discusses how IoT-based precision farming can enhance resource efficiency and sustainability.
Deep Learning for Remote Sensing Data: A Review	Examines applications of deep learning in remote sensing data analysis	Explores state-of-the-art techniques in applying deep learning to satellite and drone imagery.	Discusses how deep learning can extract meaningful information from remote sensing data for agricultural purposes
Applications of Machine Learning in Agriculture	Explores diverse applications of machine learning in agriculture	Discusses the integration of predictive analytics for crop management	Highlights the potential of machine learning in enhancing decision-making processes and overall agricultural productivity.
Image-Based Plant Disease Detection: A Review	Concentrates on image-based disease detection using deep learning.	Discusses advancements in Convolutional Neural Networks (CNNs) for recognizing disease patterns in crops.	Provides insights into methodologies and challenges in utilizing deep learning for crop health assessment.
Toward Sustainable Precision Agriculture: Evolution, Technology Adoption, and Economic Impacts	Takes a broader perspective on the evolution of precision agriculture and its economic impacts.	Explores technology adoption patterns in precision agriculture.	Discusses the economic impacts of sustainable precision agriculture practices.
IoT Applications in Agriculture: A Comprehensive Review	Broad examination of IoT applications in agriculture.	Comprehensive literature review to understand the current landscape, challenges, and prospects	Provides an overview of how IoT technologies can enhance precision farming, focusing on crop monitoring, resource utilization, and decision-making processes.
Deep learning for plant identification in natural environments	Application of deep learning for plant identification in natural environments.	Utilizes advanced neural networks to develop models for accurate plant identification.	Addresses the need for automated plant identification, discussing methodologies, challenges, and potential applications in diverse ecological settings.
A Review on IoT Applications in Agriculture	In-depth review of IoT applications in agriculture	Examines real-world implementations to consolidate existing knowledge.	It aims to provide insights into the evolving landscape of IoT applications in agriculture, with a focus on monitoring environmental conditions and improving farm efficiency.
Deep Learning for Remote Sensing Data: A Technical Tutorial on the State of the Art	Application of deep learning to remote sensing data.	Offers a technical tutorial on state-of-the-art techniques for extracting information from satellite and drone imagery.	Explores methodologies, challenges, and potential applications of deep learning in remote sensing for agricultural purposes

Based on the comparative analysis, several potential research scopes could further contribute to the field of precision agriculture:

1. Interdisciplinary Integration: Investigate the synergies and challenges of integrating various technologies (IoT, Deep Learning, Machine Learning, Remote Sensing) in a unified precision agriculture framework.
2. Advanced Plant Identification Techniques:Develop and evaluate advanced deep learning models for plant identification in diverse natural environments, addressing challenges such as variability in lighting conditions and plant species diversity.
3. Holistic Precision Agriculture Approaches: Explore holistic precision agriculture approaches that combine the strengths of both IoT and remote sensing technologies, considering real-time monitoring, resource optimization, and sustainability practices.

4. Predictive Analytics for Precision Farming: Investigate the effectiveness of predictive analytics using machine learning algorithms for anticipating and mitigating agricultural challenges, with a specific focus on crop yield prediction.
5. Optimizing Resource Utilization: Develop strategies for optimizing resource utilization based on the insights gained from IoT data, such as intelligent irrigation systems, targeted fertilization, and pest control.
6. Human-Technology Interaction in Agriculture: Study the human-technology interaction aspects in precision agriculture, including farmer acceptance, usability, and the socio-economic impacts of adopting advanced technologies on agricultural practices.
7. Environmental Sustainability Metrics: Define and assess metrics for evaluating the environmental sustainability of precision agriculture systems, considering factors like energy consumption, water usage efficiency, and overall ecological impact.
8. Validation and Benchmarking: Undertake empirical validation and benchmarking studies to evaluate the performance and reliability of different precision agriculture models and technologies in real-world agricultural settings.
9. Innovations in Data Fusion: Explore innovative approaches for data fusion, combining information from various sources, including IoT devices, remote sensing, and traditional agricultural databases, to enhance decision-making precision.
10. Human-Centric Precision Agriculture: Investigate the integration of human-centric design principles in precision agriculture technologies, considering farmer needs, usability, and the socio-cultural aspects influencing technology adoption.

These research scopes span a range of topics, from technical advancements in machine learning and IoT to more applied areas like sustainable farming practices and human-technology interaction. Researchers can choose a scope based on their interests, expertise, and the specific challenges identified in their respective agricultural contexts.

CONCLUSION

This comparative analysis reveals a diversity of research foci within the broader theme of precision agriculture. While some papers specialize in specific technologies like IoT or deep learning, others take a more holistic approach, considering sustainability and economic impacts. Combining insights from these papers could offer a comprehensive understanding of the evolving landscape of precision agriculture. Together, they showcase the interdisciplinary nature of leveraging technology for sustainable and efficient agricultural practices. Researchers may find inspiration in methodologies, challenges, and potential contributions presented in these diverse studies for further exploration in their own work.

ACKNOWLEDGEMENT

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MATLAB Image Processing Used to Locate Fabric Flaws

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ABSTRACT

For the textile sector to prosper in the fiercely competitive global market, quality control is crucial. Manual checking is done to detect defects in the fabric produced by the textile industry, but the process is laborious and prone to error. Finding fabric flaws accurately is an essential part of quality control. Cloth flaws have caused unsatisfactory losses and decreased textile industry revenues. An image processing-based framework has been developed to address these problems, allowing for the efficient and automatic identification of faults. The produced cloth has a design and texture that are comparable. There is a flaw in the fabric when these patterns and textures are twisted, changing the appearance and characteristics of the substance. "Minor" and "major" mistakes or flaws are possible. Identifying the issue region is crucial for cutting the cloth at the right spots. This work tests for defects such as end out, holes, and oil stains. The creation of an automated method to detect Fabric defects is the aim of this endeavor. This proposed work provides a technique that reduces the physical strain on employees when they conduct manual fabric examinations. The image processing in this study was done using "MATLAB". Defects are shown in the data form using a histogram. The screen displays the defect sizes that have been found.

KEYWORDS: *Fabric flaws, Fabric industry, Flaw measurement, MATLAB, Image processing.*

INTRODUCTION

A crucial factor in any industry is quality. Similarly, maintaining production quality is crucial for a business in the textile industry. The fabric's quality is still determined by hand testing. However, due to boredom and inattention, the results of the manual checking fall short of expectations. Even with the help of highly skilled inspectors, only 70% of fabric issues may be found. About 90% of the flaws in simple textiles may be found by hand, but complicated fabrics provide more difficulties. Therefore, automatic fabric problem identification can result in the timely production of high-quality products. There has been a recent increase in interest in the topic of automated fabric inspection. Like other businesses, the textile industry strives to meet consumer demand and minimize loss from subpar products and fabric faults by producing things in huge quantities at a high level. Identification of product flaws must be done quickly and accurately in order to keep up a high manufacturing tempo. The material is being woven using larger roll sizes, which may lead to a lower production quality before any inspection. In this market, many businesses prioritize just-in-time delivery over producing high-quality goods. Fabric imperfections might result in a 50%–60% price reduction for the material. The primary objective of the textile business today is to produce first High-quality cloth embodies quality This fine fabric is free from all surface and minor structural flaws as well as any significant defects. The fabric left over after the first quality is known as second-class fabric. If this type of cloth contains several minor flaws in addition to a few serious structural or surface flaws, the maker might have to pay for them. It really only costs 45% to 65% of the price of first-quality material to sell second-quality clothing. Because manufacturing happens so quickly, the manufacturer must be able to identify, assess, and resolve errors. This may result in a drop in the production of second-quality fabric and an increase in the production of first-quality fabric, taxing the inspection departments of the manufacturers. Relative to hiring a large workforce, investing in automated fabric fault identification is less expensive. Real-time fabric inspection is a difficult task because there are many different kinds of issues related to the weaving process used as well as post-production faults like oil stains and holes. Modern looms are capable of identifying some issues on their own, but after weaving is complete, a sizable percentage of defects still need to be examined. Thus, computerized fabric inspection is essential to raising the bar for fabrics. The automatic technique for recognizing fabric issues will take care of flaws in the fabric like holes, oil stains, misprints, and color leakage. Fabric businesses could suffer financial losses if these flaws remain unidentified. Fabric flaws may be automatically detected using MATLAB's image processing technique. By using this strategy, you might obtain great precision with little effort and expense. This MATLAB-based technique for image processing makes it possible to identify the image's imperfections. Before the output is produced, the image is placed through thresholding, histogram, and noise filtering procedures. One could classify the image of the fabric as a typical textured image. When deciding whether or not the material is defective, it is crucial to ascertain the precise location and degree of the flaws. Patterns can be seen regardless of their size, brightness, orientation, or location within the visual field.

METHODOLOGY

Measurements and identification of the cloth's flaws are done using color pictures of the fabric under test. The block diagram that is shown below aids in providing an overall technique illustration. The color image is the input that this process needs to function. Color photographs are converted to an 8-bit grayscale format to facilitate the extraction of image descriptors and the approach. Variations in lighting, the fabric's structure, and pollutants within the fabric all contribute to noise. These can be eliminated from the image by applying a median filter on it. This filtered image is converted to binary form in order to make the issue region easy to detect. Binary pictures are a better way to express an image's region of interest.. Through thresholding, the picture is converted into a two-level image. Isolating the pixels in a picture that represent the item is the aim of thresholding. The flaws are clearly obvious in the thresholded image. Through the histogram output, a data representation of the defects is made available. A histogram is essentially a visual representation of the data distribution. It is a probability distribution estimate for a variable. To determine the magnitude of the problem, it is necessary to eliminate any minuscule noise that may be present in the image. Therefore, we need to carefully clean the picture to maximize the accuracy of the diameter measurement.Tiny holes are also removed by filling the picture. Even after noise reduction, there are little blobs on the edge of the picture. For the purpose of eliminating blobs on the boundary and bigger than two pixels, MATLAB provides specific commands. "Regionprops" is the tool that will provide the blob's length in the picture. Thus, the result shown on the command window will be the fabric defect measurement. The magnitude of the revealed fabric flaw is considered an approximation that is helpful in keeping track of error.

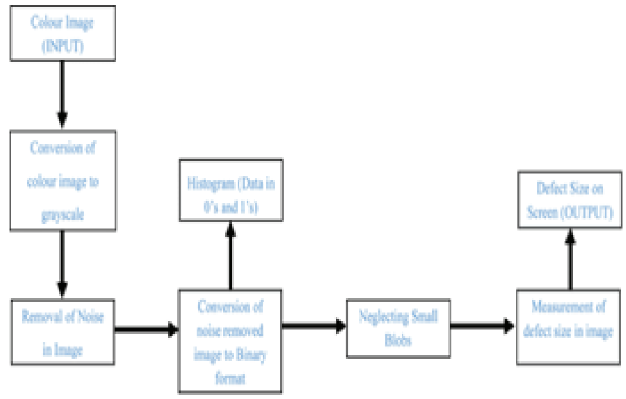

Fig. 1: Block Diagram of Proposed Work

RESULTS

The original image and image with size measured is shown in the figure below. The size is entered in command window which is firstly in pixels and in the second command window image we can observe the actual flaw size in centimetres.

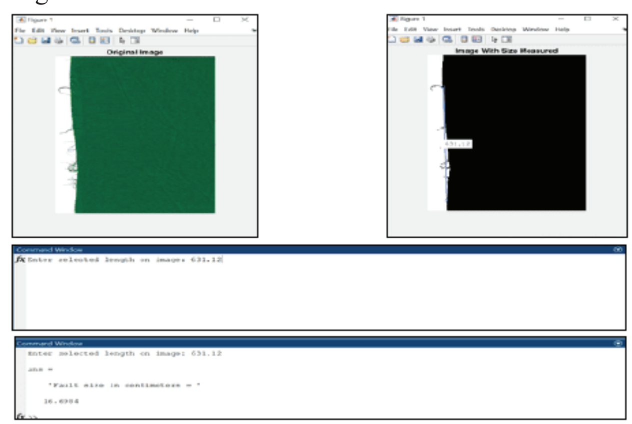

Fig. 2: Result for the image 1 under test

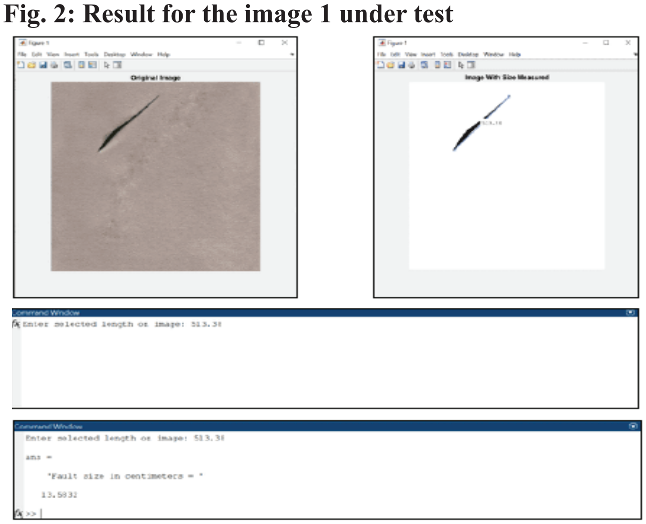

Fig. 3: Result for image 2 under test

Similarly 100 images were tested and the accuracy for this is around 92%. Accuracy is calculated based on the size measured by the software compared with actual physical measurement done with the help of a measuring scale.

CONCLUSION & FUTURE SCOPE

During the manufacturing process, cloth may have several defects. It is hard for a person to find every imperfection. Any fabric company has to be able to identify problematic materials in order to succeed. Accurate and timely defect detection is vital to the fabric business, and this requires real-time quality control. Inadequate and labor-intensive manual control results in significant loss. However, because automatic quality control operates autonomously and in real time, it is far more efficient than human manufacturing. At the moment, there is very little accuracy in any of the strategies that researchers have recommended for identifying faulty fabric. This study, however, examined the drawbacks of the conventional method for identifying fabric flaws and provided an alternative. Limitations of the conventional method for identifying fabric flaws and suggested a novel strategy. A manufacturer should make an effort to reduce any flaws in the fabric by employing automated processes such as fabric fault identification in order to reduce the loss resulting from fabric defects. The makers will benefit from this tactic since it will notify them ahead of time of any faulty textiles. This would eliminate the tedious process of manually assessing the fabric's quality. It has been shown that a class of fabric problems may be identified using a supervised defect detection technique. It is feasible to identify the faults in a fabric picture, according on testing results from a variety of faulty photographs. The accuracy of this approach is 91.29% overall. It is possible to develop all of this capability in a user-friendly MATLAB application function. This can be handled for an infinite number of fabric defect identifications in the future. There are also flaws in fabrics with textures and patterns. It is also possible to locate faults in a continuous roll of cloth by using video segmentation. It could also be possible to create a smartphone app for remote fault diagnosis in the future.

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Impact Analysis of Different Faults in Hybrid Distribution System

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ABSTRACT

The hybrid distribution system offers several advantages, including improved reliability, reduced environmental impact, and increased energy efficiency. This is achieved through the integration of traditional power generation and energy storage with renewable sources like solar and wind. However, the integration of diverse energy sources and storage technologies raises new challenges, particularly in fault tolerance and system efficiency. This study presents power flow analysis, MATLAB-Simulink fault finding in distribution power systems, and the assessment of various issues affecting other nodes. By analyzing waveform displays resulting from different faults, we can evaluate the severity of specific defects. A scaled model has been developed to investigate common problems in distribution networks, incorporating a solar PV inverter unit and existing AC line in the hardware model. The research validates that the proposed method is effective in analyzing power flow and finding faults, thereby making a substantial contribution to enhancing the reliability as well as stability of power systems.

KEYWORDS: *MATLAB-Simulink, PMU (PLL based positive sequence).*

INTRODUCTION

In power systems, faults will inevitably arise. These faults are critical to the stability, ruggedness, cost of maintenance, and affects reliability of the power system. Maintaining the electrical system's dependability and efficiency requires early fault detection and location. The consumers attitude may affect to the existing distribution system while transferring supplies from islanding to integrating mode or vice versa. Numerous methods have been pushed forward to identify faults in power systems. Consumers production of renewable energy and the feeding of their excess energy into the utility system provide issues for the modern period. Therefore, it is crucial to analyse any typical load flow approach used by the system. Three bus distribution systems are the main subject of this paper's approach to load flow analysis in distribution systems. The efficiency of the suggested methodology is verified by virtual tests with MATLAB Simulink software. Accurate detection on a hardware prototype model is also demonstrated, and the study is ensured by its understandability. This report is structured to provide a thorough explanation of the suggested approach, as well as background data, a study of the relevant literature, and an assessment of the system's current approach. The suggested methodology, block diagrams, flow chart, and data charts are reviewed in the middle portion. Lastly, a review of the results with tabular representation, the LCD display results, and the shortcomings of the suggested methodology are given.

METHODOLOGY

The tool MATLAB is used for simulation of the distribution system model. Power flow analysis is performed the on this system.

Steps followed

Methodology for Performing Load Flow Analysis for 3-Bus System- Define the system model, Represent the 3-bus system with a single-line diagram, clearly showing the buses, lines, and their connections. Define the type of each bus

Slack Bus: The bus with known voltage and angle (usually bus 1), PV Bus: The bus with known active power generation and voltage magnitude, PQ Bus: The bus with known active and reactive power demand. Collect the system data, including line impedances (R + jX) for each branch. Active and reactive power generation (P and Q) at each PV bus. Selected a load flow analysis Gauss-Seidel Method which is simple iterative method suitable for small systems. Implement the selected method: Gauss- Seidel Method and initialize the voltage magnitudes and angles at all buses with estimated values.

Flow chart for the system

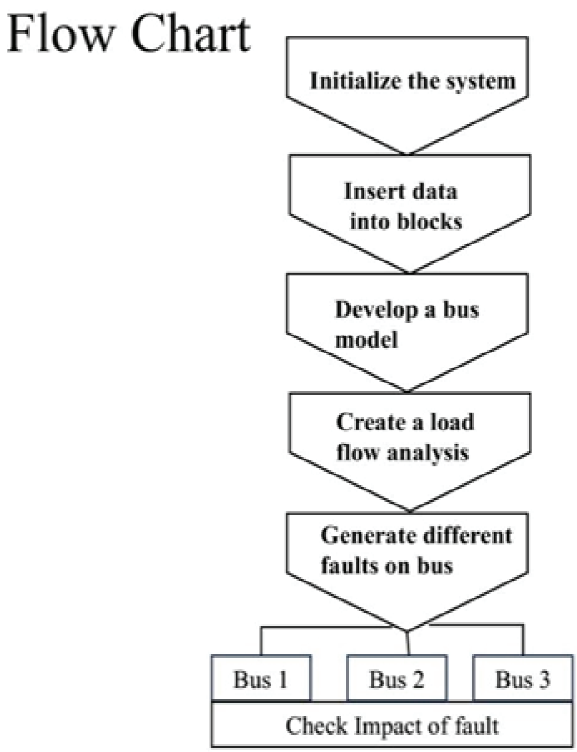

Fig. 1: Flow chart for the expected task

After initializes all the system parameters configured the specified buses and collected all the data and implemented the proper equation using load flow methods by utilizing appropriate tool of Simulink analyses the result By performing Load flow analysis, we can optimize the flow of electricity through a network. It's like having a map and compass for the complex world of power grids. Predicting System Behaviour, prevent overloads, optimize generation, Supporting System Expansion and Integration, Ensuring Voltage Stability, maintain stable voltage levels, Enhancing System Reliability, identify critical element above load flow plays a very important role.

MODELLING

Solar inverter model-

Developing a solar inverter model for a 3-phase output grid-connected system involves several stages-

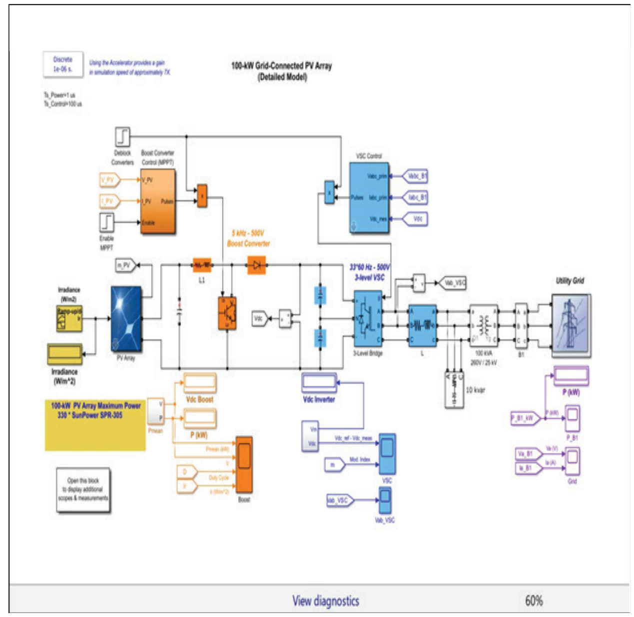

Fig. 2: Solar array model with different controlling strategies

By appropriate initializing the irradiance on the solar PV array by the standards and the expected output power of the system the inverter model is generated in the MATLAB Simulink model

System Design

Determined the voltage and current ratings of the solar panel array, the grid voltage and frequency, and the desired output power of the inverter Choose the inverter topology- Voltage Source Inverter (VSI): which provides high efficiency and good controllability.

Selected the control strategy- Choose the control algorithms for inverter output regulation, grid synchronization and Maximum Power Point Tracking (MPPT).

Modelling

Developed the mathematical models for solar panel array and inverter and model the control algorithms in software by implementing the chossen MPPT, and Inverter output regulation algorithms using software tools like MATLAB or Simulink. Simulate the system performance: Run simulations to analyse the inverter's behaviour under different operating conditions and ensure it meets the desired specifications. After going to initialize the system in Simulink we got the results of output three phase waveform and we checked all the terms and conditions which are needs to be satisfy before going to integrate the system. It consists of a different stage like a solar array model, inverter model and the filter circuit.

Hybrid Distribution System

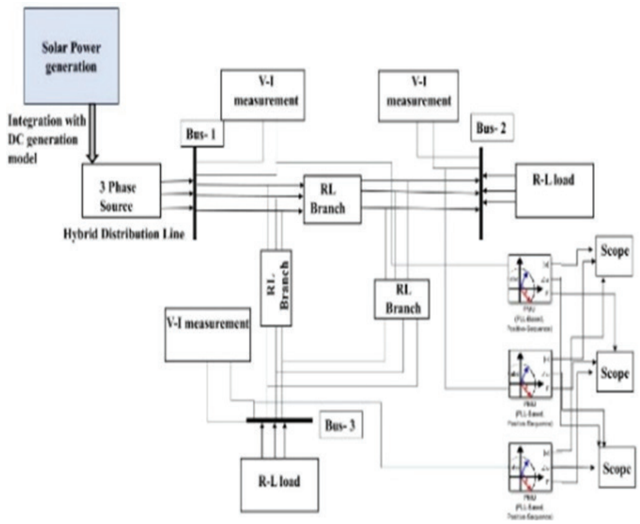

Fig. 3: AC-DC Hybrid Distribution model

Hybrid distribution system with solar panel and PV array combination –

A hybrid distribution system combining solar panels and a PV array offers a variety of benefits for power generation and distribution. It Increases energy generation, Enhanced reliability but it needs to design System sizing, Battery storage, Inverter selection, Smart grid integration. Overall, a hybrid distribution system with solar panels and a PV array is a promising solution for cleaner, more reliable, and potentially cost-effective power generation.

Table 1. It shows the different fault scenario and the fault occurring on a power distribution system. We created the various symmetrical and asymmetrical fault on hybrid distribution system and checked the variations the system parameters. Different types of faults initialize on the bus 1, bus 2 and bus3 and checked their effect on another two buses in terms of its magnitude of current in ampere.

Table 1. Different fault scenario

Fault occurs on-		Bus 1 (Amps)			Bus 2 (Amps)			Bus 3 (Amps)		
Sr. no.	Fault type	Bus1	Bus2	Bus3	Bus 1	Bus2	Bus3	Bus 1	Bus2	Bus3
1.	Without fault	9.787	6.436	3.36	9.787	6.436	3.36	2671	1.16	2671
2.	3 phase to ground fault	2729	1.19	3.36	2664	2663	0.465	2671	1.54	2671
3.	3 phase faults	230	120	120	2663	2663	0.624	2667	1.17	2667
4.	Double- line to ground fault	2733	1.51	0.4728	2667	2667	0.448	2675	1.117	2675
5.	Line to ground fault	2728	1.174	0.4824	2662	2662	0.457	2670	1.13	2670
6.	Line to line fault	230	120	120	2311	2309	1.708	2317	3.272	2315

Table 2- shows the different magnitude of voltages when faults occur on the system and the drastically decreased in magnitude of voltage we can see through this graph after fault occurs in the system.

Fault occurs on-		Bus 1(kV)			Bus 2 (kV)			Bus 3 (kV)		
Sr. no.	Fault type	Bus1	Bus2	Bus3	Bus 1	Bus2	Bus3	Bus1	Bus 2	Bus 3
1.	Without fault	24.9	24.9	14.4	24.9	24.9	14.4	24.9	24.9	14.4
2.	3phase to ground fault	0.0047	0.0047	0.0027	0.6416	0.00461	0.3412	0.560	0.358	0.00267
3.	3 phase faults	0.230	0.120	0.120	0.6228	0.00463	0.1638	0.542	0.237	0.551
4.	Double- line to ground fault	1.44	1.44	0.0282	14.4	14	0.2566	0.5532	0.223	0.02813
5.	Line to ground fault	14.3	14.32	0.0308	14.4	21	14.4	0.0293	14	14
6.	Line to line fault	0.120	0.230	0.230	0.6396	0.00461	7.266	0.549	0.2126	7.204

Table 2. Voltage magnitudes in different fault scenarios

RESULT AND CONCLUSION

I. System stability is ensured by the power flow analysis results, which verify that the power and voltage fluxes stay within allowable bounds. The fault detection study shows how quickly and precisely the system can identify defects, which is essential for the power system's protection.

II. Together with the solar PV bus, the 3-bus system is used in MATLAB-Simulink to evaluate the power flow analysis and defect detection.

III. The simulation data demonstrate that the power flow analysis applying the gauss seidel approach accurately calculates the Power and voltage flows in the system.

IV. Following are different result which get from the MATLAB Simulink model while interchanging the PV array and traditional distributed system

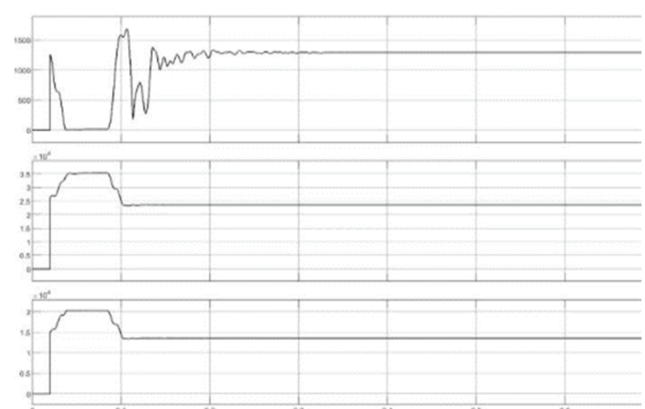

Fig. 4: Impact of fault on different buses in terms of current magnitude

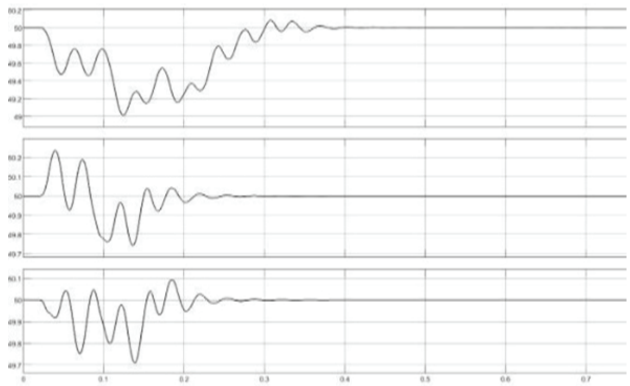

Fig. 5: Disturbances in frequency due to faulty bus

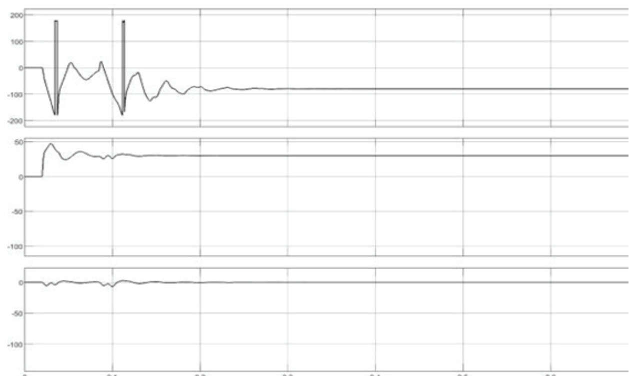

Fig. 6: Impact on Phase magnitude

HARDWARE DESIGN

Solar Inverter Model

DC-AC inverter: The DC-AC inverter is a switching circuit that converts the constant DC voltage into an AC voltage. The DC-AC inverter uses a series of transistors to switch the DC voltage on and off very rapidly. This creates an AC voltage that can be fed into the grid or used by a local, off-grid electrical network.

12v dc to AC equivalent

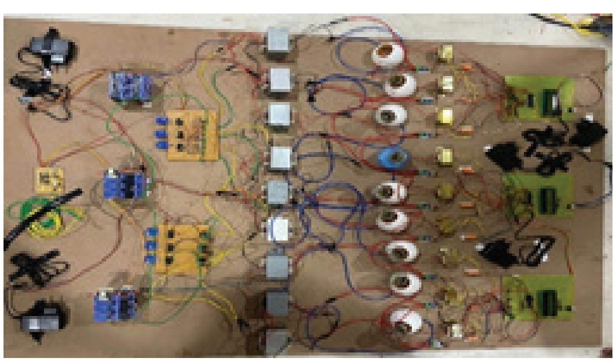

Fig. 7: Hardware model for 3 bus system

Control unit: The control unit is a microprocessor that controls the operation of the inverter. The control unit monitors the converter, the MPPT, and the inverter. It also monitors the AC output of the inverter and the battery.

Material used –

Solar panel-60W Polycrystalline12V IC 4047

Boost up transformer 12V-230V AC

Measurement Unit

and potential transformer (with 12V output) and also LCD display is provided to measure voltage and current magnitude on different busses. AT Mega 328 controller is used which consist of in- built ADC (Analog to digital). On load bus or PQ bus undervoltage fault initializes on the system by varying the potentiometer on the inverter side and the fault severity is shown on the display screen. As per setup value in the microcontroller the "faults occur" term we can see on the display.

Table 3. Hardware model results

Fault occurs on-		Bus 1(volts)			Bus 2 (volts)			Bus 3 (volts)		
Sr. no.	Fault type	R1	Y1	B1	R2	Y2	B2	R3	Y3	B3
1.	Under voltage fault	180v	141v	159v	164v	179v	133v	178v	155v	90v

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Automation of Wiper, Head-light Control and Seat-belt Alarm Indication for Four-wheeler Vehicle

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ABSTRACT

Safety of a person sitting in four-wheeler or any vehicle is very vital and many vehicles are designed considering the safety. Most of these safety designs of these vehicles depend on manual operations. The paper presents an advanced safety system for automobiles by integrating multiple features such windscreen wiper which have feature of self-starting on rain water detection by sensor. The seatbelt safety system capable of giving warning indication until seatbelt wear by a person seat in the car; The automatic headlight system adaptive to switch on itself by detecting intensity of light. This paper focuses on providing safety system based on automation, so driver can pay full attention on driving even in rainy season and in night mode. This work presents the automation system for a vehicle, which is equipped with different sensors and actuators to make better provisions of driver and passenger safety.

KEYWORDS: *Automation, Microcontroller, Sensors, Safety, Vehicle*

INTRODUCTION

During rainy or foggy weather conditions, the conventional windscreen wiper requires manual operation by the driver, with the wiper frequency typically adjusted based on the driver's visual perception. However, engaging the wiper switch can divert the driver's attention and potentially jeopardize their safety. In traditional vehicles, head-light is also operated by driver. In accident, if seatbelt is not weared then driver may get in danger. In vehicle, the safety issues very essential factor during design and manufacturing time. The proposed work was dedicated to provide safe condition to driver by solving above problems.

The automation requirements in vehicles have spurred innovations in automotive electronic systems. Research efforts predominantly focus on advancing electronics systems to effectively and safely supplant traditional mechanical and hydraulic components. The escalating power requirements have driven the evolution of electronics-based automotive systems. This proposed work focuses on automation system to provide solution of above problems.

The goal of this article is to implement safety system for vehicles using an embedded platform with help of microcontroller. The windscreen wiper is operated automatically considering amount of rain and fog condition. Head-light of vehicle will ON automatically when intensity of light falls below visible light intensity. It also provides alarm indication to driver for seatbelt wearing.

LITERATURE REVIEW

The authors begin by providing an overview of the traditional windscreen wiper systems and highlight the limitations associated with manual operation, particularly during adverse weather conditions such as rain or fog. They then propose a novel design that utilizes infrared sensors to detect environmental factors and automatically adjust the wiper speed and frequency accordingly. One of the strengths of the paper lies in

its detailed description of the system architecture and the components involved, including the infrared sensors, MCU, and control algorithms. The authors thoroughly explain the operation of the system and provide insights into the implementation process. Moreover, the experimental results presented in the paper demonstrate the effectiveness and reliability of the proposed intelligent windscreen wiper system. The authors showcase the system's ability to accurately detect rainfall intensity and adjust the wiper speed in real-time, thus improving driver visibility and safety.

Additionally, further discussion on the practical implications, such as cost-effectiveness and scalability, would enhance the paper's relevance to automotive manufacturers and researchers [1,6].

The paper explores the challenges associated with car body control and proposes a novel design solution to enhance communication efficiency and reliability. The authors provide a comprehensive overview of existing car body control systems and communication protocols, highlighting the limitations and inefficiencies that arise from using separate CAN and LIN buses. Furthermore, the paper presents experimental results that validate the effectiveness and reliability of the proposed design. However, there are areas where the paper could be further strengthened. For instance, a more thorough discussion of the potential challenges and limitations associated with implementing the proposed design in real- world automotive systems would enhance the paper's relevance and applicability. Additionally, a comparison with existing car body control bus designs or alternative integration approaches could provide valuable insights into the advantages of the proposed solution [2,8].

The CAN-bus serves as a quintessential bus control technology employed in constructing the electric vehicle body network. This system is crafted using embedded software and various software development tools to ensure robust functionality. Rigorous testing of the entire body CAN network communication systems validates their efficacy, ensuring compliance with specified requirements [3,7].

A smart infrared windscreen wiper, employing an infrared rain sensor, was developed utilizing the STC12C5616AD microcontroller. The system utilizes a high-luminance infrared diode as the light source to illuminate the automobile windscreen. An infrared receiver captures the optical signal, converting it into voltage, which is subsequently shaped, sampled, and processed by the MCU. The MCU adjusts the motor's intermittence by generating varied duty cycles. Experimental validation demonstrates the sensitivity and reliability of the system as designed in this study [4,10].

Presently, the expenditure on electronics in high-end automobiles can surpass 23% of the total manufacturing expenses. It is estimated that over 80% of automotive advancements originate from electronic innovations. Historically, conventional wiring was employed to establish connections between various components. However, this approach contributed to increased vehicle weight, resulting in diminished performance and challenges in meeting reliability standards. Consequently, wiring harnesses have emerged as the sole component within vehicle electrical systems that are both costly and complex. For instance, in a 1998 press release, Motorola revealed that substituting wiring harnesses with LANs in the four doors of a BMW led to a 15-kilogram reduction in weight, while simultaneously augmenting functionality [5,9].

SYSTEM ARCHITECTURE

The Fig. 1 shows the proposed work in this dissertation. Microcontroller along with the slaves used to acquire the data from various sensors. Depending on the sensor data collected, the display shows the various status of parts of the vehicle. According to weather conditions, these sensors are working, senses the data, provide to Microcontroller and the results are displayed on display.

Automatic Lights

In night mode and cloudy condition, the light sensor senses the intensity of the light and accordingly sensor works and gives a command to the controller to switch on the light.

Automatic Wipers

In rainy season or at the time of servicing of the vehicle when the waterfall is detected by the rain sensor accordingly it gives a command to the controller to start the wiper.

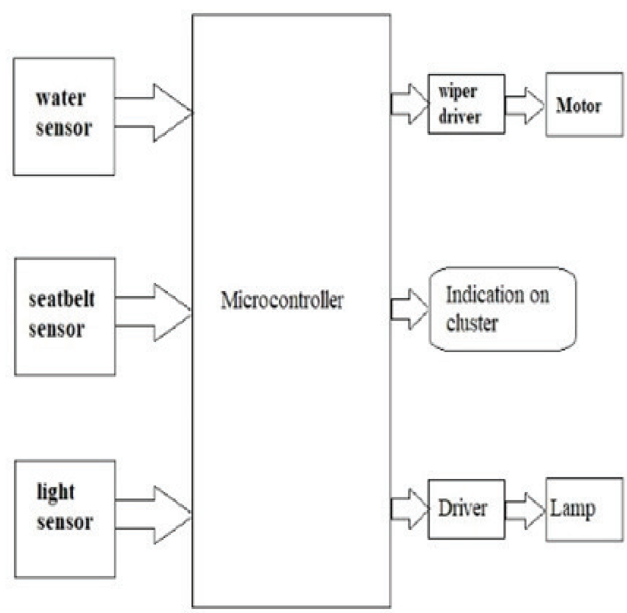

Fig. 1: Architecture of Proposed System

Seatbelt sensor

When a person seated in the vehicle and suppose if he forgets to wear the seatbelt then that is sensed by the sensor accordingly controller works and gives the alarm until he wears the seatbelt.

HARDWARE DESIGN

The proposed hardware comprising following building blocks:

1. ARM7 Controller
2. Seatbelt Sensor
3. Light Sensor
4. Rain Sensor

ARM Processor: The fundamental component of the system is the ARM controller, renowned for its rapid data processing capabilities enabled by the pipelining technique. Specifically, the ARM7TDMI-S stands out as a versatile 32- bit microprocessor, recognized for its exceptional performance, making it an ideal choice. The processor is shown in Fig. (2).

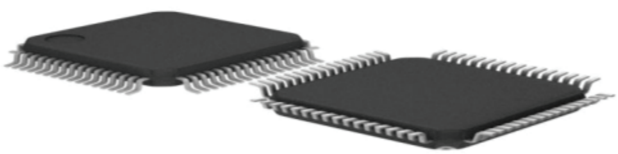

Fig. 2: ARM7 TDMI Processor

Project requirements:

- I• Inbuilt CAN support
- Low power consumption
- Single or dual 10-bit ADC(s)
- Flash Memory to execute programming code LPC 2148 ARM controller is selected with following features
- Two interconnected CAN provide interfaces with advanced filters. The system incorporates either a single or dual 10-bit ADC(s) along with a 10- bit DAC. It also features a sizable on-chip Flash Program Memory of 128/256 KB. With a 128-bit wide interfacing capability, the system can operateat a high speed of 60 MHz.

Light sensor: Ambient light sensors function akin to the human eye, detecting light intensity or brightness levels. These sensors are commonly integrated into industrial lighting, consumer electronics, and automotive systems. Due to adaptable feature of turning on, turning off light when required, light sensor can conserve battery power, eliminate need of the manual adjustment and provide extra safety shown in Fig. (3).

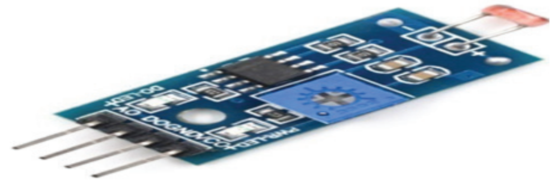

Fig. 3: Light Sensor Module

Rain sensor: The rain sensor consists of two components. The first component is the functional sensor, represented by a plaque that directly interacts with rainfall, as illustrated in Fig. (4).

The plaque features two closely positioned strips of conductive material, deliberately separated to maintain an open circuit. However, when the surface comes into contact with rain, the water bridges the gap between the strips, completing the circuit and allowing for the measurement of a distinct voltage.

Liquid crystal Display (LCD): It's an electronic display module with diverse applications. The 16x2 LCD display, a fundamental module, is widely employed across various devices and circuits. These modules are favored over seven-segment and other multi- segment LEDs due to their cost-effectiveness, ease of programming.

Fig. 4: Rain Sensor

Fig. 5: LCD LM016L Module

The 16x2 LCD display features two lines, each capable of accommodating up to 16 characters. Each character is represented by a 5x7 pixel matrix on the LCD. The display incorporates two essential registers: the Command register and the Data register. On the other hand, the Data register holds the data necessary for display on the LCD, with the information typically encoded in ASCII format representing the characters to be displayed

SIMULATION RESULTS

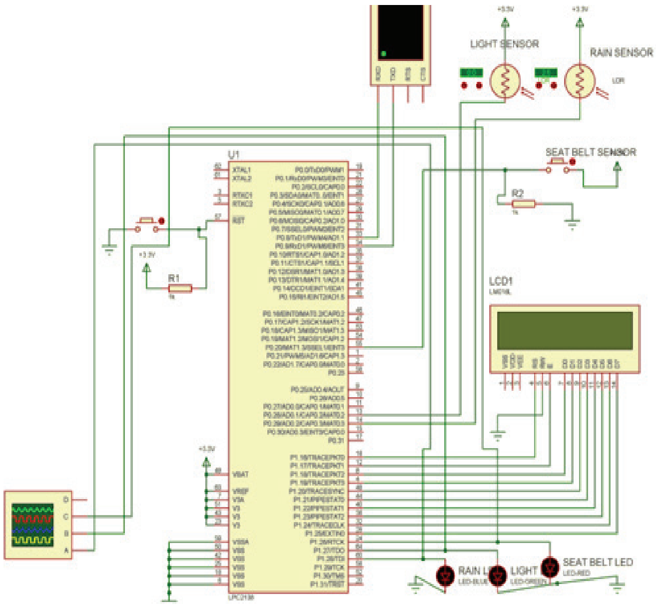

Fig. 6: Simulation of Proposed System

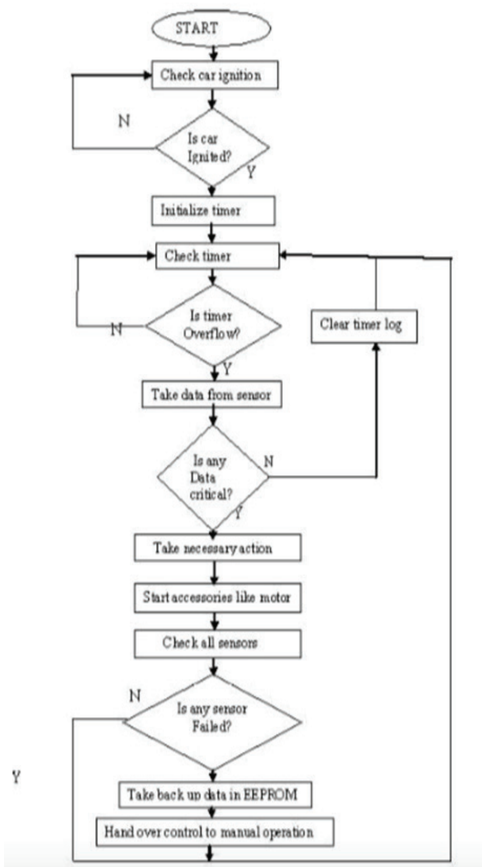

Fig. 7: Flowchart of Proposed System

The Proteus software is used for simulating the proposed system and hex file is generated using Keil software. The hex file is used to program the simulation and verify the results. The simulation prepared in software is depicted in the Fig. (6). The program logic is elaborated in the following flow chart shown in Fig. (7).

The light intensity and rain related results are displayed on LCD. The images shown in Fig. (8) illustrates the different parameters like raining or not, light intensity and whether seat belt is connected or not. These parameters are continuously monitored and controlled using microcontroller whenever necessary actions to be taken.

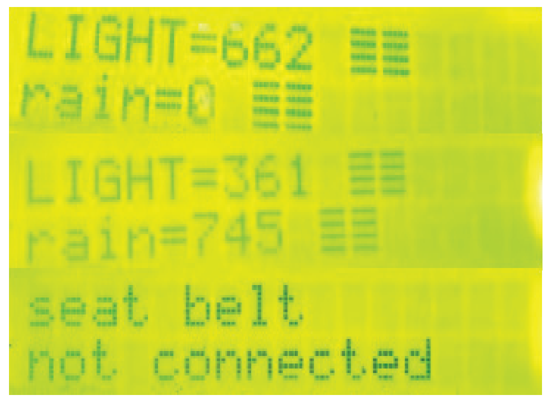

Fig. 8: Simulation Results of Proposed System

CONCLUSION

The proposed method introduces the safety system of different parts of the car or four-wheeler vehicle with a combination of ARM processor. Safety of the vehicle is an important factor, because now-a-days we found cases of car accidents. The envisioned body control module system addresses challenges encountered in automotive applications, offering practical value and significance. With ARM serving as the primary controller, the system maximizes the high-performance capabilities of ARM to facilitate seamless data sharing among nodes, thereby improving collaborative functionality and efficiency. Furthermore, the proposed system is illustrated and demonstrated through simulation results and hardware prototype results.

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Role of DNS in Computer Network & its Implementation in Cisco Packet Tracer

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ABSTRACT

In the ever-evolving landscape of computer networks, the Domain Name System (DNS) plays a pivotal role that goes beyond its seemingly simple task of converting user-friendly domain names into machine-understandable IP addresses. This translation is essential because computers need IP addresses to discover devices on a network, but humans find domain names easier to remember and use. The internet would be less accessible and useful without DNS since users would have to memorize lengthy, complicated strings of numbers. The DNS serves as the backbone of modern network communication by providing a centralized and distributed system for translating domain names into corresponding IP addresses. This paper examines DNS role and significance in enabling smooth and effective communication over the internet and other computer networks.

KEYWORDS: *Computer network, Domain name system, IP addresses.*

INTRODUCTION

Without conversations, web-based banking, messaging and other important web-based administrations, the modern world would be unimaginable. [1]. Any information is now available on the fingertip with the help of internet in which DNS plays important role. These days, the global business performance of all organizations depends on the computer network. As a result, there is an increasing need for computer networking specialists, which fuels the growth of the industry. [2]. DNS is far more important than just its fundamental features. Improving network efficiency is one of its primary contributions. DNS caching systems save previously resolved domain names and their associated IP addresses, thereby reducing network traffic. As a result, there is less need for repeated translation requests, which results in quicker response times and lower network latency. Furthermore, DNS load balancing optimizes resource utilization and avoids server overloads by dividing incoming network traffic among several servers. Together, these techniques help to create a network infrastructure that is more responsive and dependable.

DNS's role in enabling global internet accessibility cannot be overstated. Domain name resolutions are guaranteed to be scalable and dependable by the authoritative name servers that oversee the hierarchical DNS system, which is divided into zones. This structure makes it easier to create country-code TLDs and top-level domains (TLDs), which allows websites to target particular audiences and geographic areas. Additionally, by supporting linguistic variety and supporting non-English characters, internationalized domain names (IDNs) and multilingual domain names help create a more welcoming online environment.

Furthermore, DNS's vital significance is highlighted by its security consequences. Cybercriminals frequently use DNS as an attack vector to tamper with or intercept network communications. Threats to network integrity include DNS hijacking, distributed denial-of-service (DDoS) attacks, and DNS cache poisoning. To reduce these dangers and validate DNS answers, organizations use DNS security methods such as DNSSEC (DNS Security Extensions).

DNS is becoming more and more important as technology advances. The expansion of devices connected by networks and the rise of the Internet of Things (IoT) require effective and seamless communication.

In this paper, I have simulated the two DNS network scenarios in LAN & MAN in cisco packet tracer. Packet Tracer, a virtual networking simulation software crafted by Cisco, serves as a comprehensive platform for mastering and comprehending diverse concepts within computer networks. Within Packet Tracer, networking devices manifest in realistic representations, affording students the opportunity to engage directly with them, configuring settings, toggling power states, and customizing functionalities to deepen their understanding [3].

KEY ASPECTS HIGHLIGHTING THE IMPORTANCE OF DNS

Human-Readable Addresses: DNS enables users to utilize easily remembered domain names (such as www.abcd.com) rather than numerical IP addresses (such as 192.168.1.1) to access websites and other online resources. People now find it easier to browse the internet as a result.

Address Resolution: Domain names and IP addresses are mapped by DNS, which functions as a distributed database. DNS translates a domain name entered by a user in a web browser to the matching IP address, allowing internet-based device communication.

Load Balancing: DNS can distribute incoming network traffic among several servers to achieve load balancing. This is achieved by associating multiple IP addresses with a single domain name, and DNS can rotate through these addresses to distribute the load evenly.

Redundancy and Fault Tolerance: DNS enables the development of fault-tolerant and redundant systems. Organizations can guarantee that their services continue to function even in the event that one or more DNS servers fail by setting up several DNS servers and utilizing strategies like round-robin DNS or anycast.

Email Delivery: By giving details about the mail servers in charge of processing emails for a specific domain, DNS is essential to email communication. This contains details like mail exchange (MX) records, which list the mail servers for a certain domain that are supposed to receive emails.

Authentication and Security: To help guarantee the integrity and authenticity of DNS data, DNS offers a number of security techniques, including DNS Security Extensions (DNSSEC). Attacks like DNS spoofing and cache poisoning are less common thanks to DNSSEC.

Content Delivery Networks (CDNs): CDNs are used by a lot of websites and online businesses to enhance user- facing content delivery. By utilizing DNS to route users to the closest or best CDN server according to their location, latency can be decreased and performance can be enhanced.

Dynamic IP Assignment: DNS can be used to link a domain name to a dynamic IP address for users whose Internet service provider has assigned them one. This is especially crucial for hosting and remote access services.

DNS is an essential part of the internet's architecture, offering a vital function that makes it possible for users to easily and effectively engage with the resources they are looking for online. It is essential to the scalability, dependability, and accessibility of the internet.

DNS RESOLUTION PROCESS

Step 1 - Local DNS Server: When you input a domain name into your web browser, your computer initially checks its local DNS cache. If the IP address associated with the domain is already stored, the browser retrieves it directly from the cache, bypassing the need for additional requests.

Step 2 - Recursive Query: Your computer makes a recursive DNS query to the local DNS server if the IP address is not in the local cache. This server queries other DNS servers to carry out the resolution procedure, or it returns the IP address.

Step 3 - Iterative Queries: If the local DNS server doesn't have the requested information, it forwards the query to the root DNS servers. The root servers direct the query to the appropriate TLD server based on thedomain extension (e.g., .com). The TLD server, in turn, directs the query to the authoritative DNS server responsible for the specific domain.

Step 4 - Authoritative DNS Server: The authoritative DNS server holds the IP address information for the requested domain. It sends this information back through the hierarchy to the local DNS server.

Step 5 - Local DNS Server Response: Finally, the local DNS server sends the IP address back to your computer, which can now use this information to connect to the desired server.

SIMULATION RESULTS & DISCUSSION

DNS Setup in LAN

Step 1- Create Network in cisco packet tracer

Setup the DNS server in LAN using devices, links in workspace of cisco packet tracer.

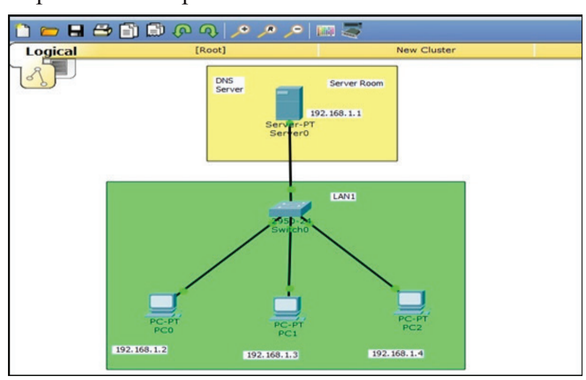

Fig. 1: DNS server setup in LAN

Step 2- Configure HTTP Service:

Click on Server and go to services tab. Select HTTP service turn it on and click on index.html edit. Write HTML code for HTTP service and save it. Overwrite the existing code while saving. This will create the webpage for which DNS will resolve IP address.

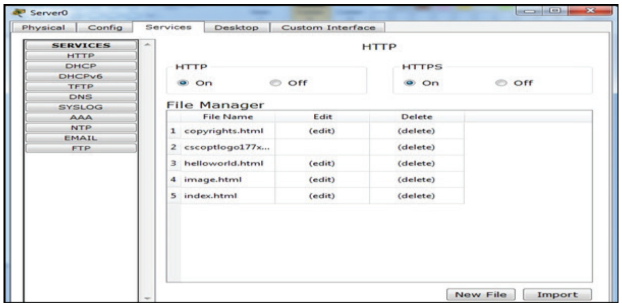

Fig. 2: Configure HTTP Service(Click on index.html edit)

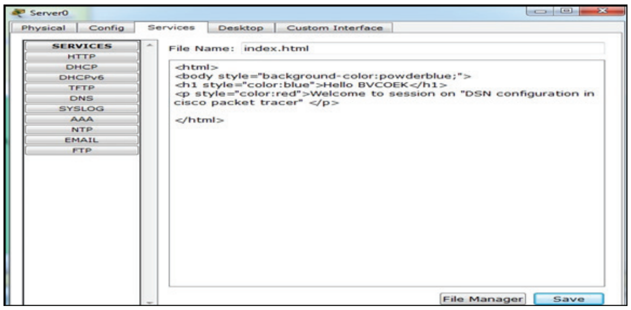

Fig 3: HTML Code for HTTP Service

Step 3- Configure DNS Service:

Go to desktop tab by clicking on server and configure IP address for DNS server as shown in figure 4. Now go to service tab again and select DNS service, put the domain name and IP address as shown in figure 5.

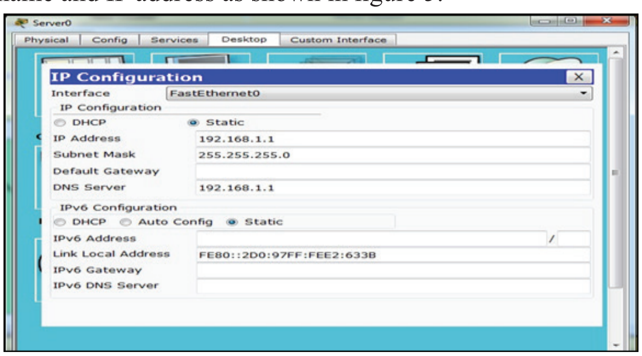

Fig. 4: Configure DNS Server IP address

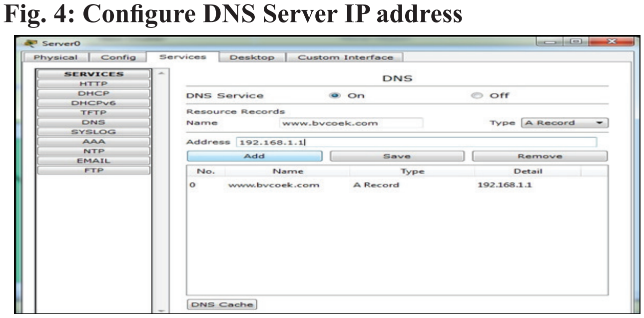

Fig. 5: Configure DNS Service (put domain name & its corresponding IP Address and Click on Add)

Step 4- Configure PC's

Go to desktop tab by clicking on PC and configure IP address for PC0, PC1, PC2 as shown in figure 6,7,8. Put same DNS server IP address in each PC.

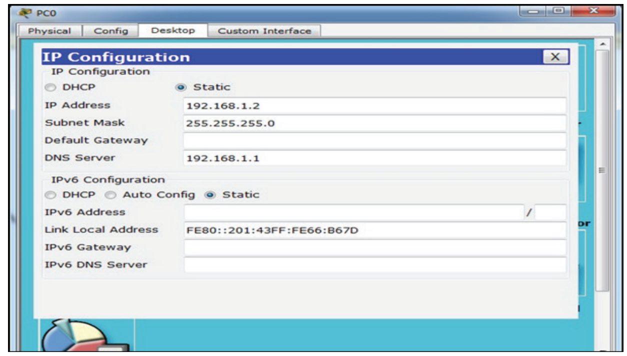

Fig. 6: Configure PC0 IP address

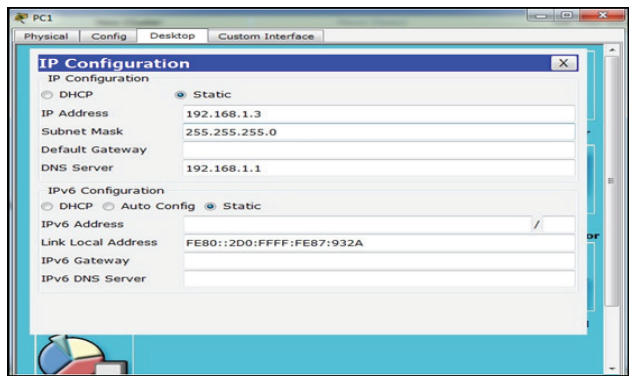

Fig. 7: Configure PC1 IP address

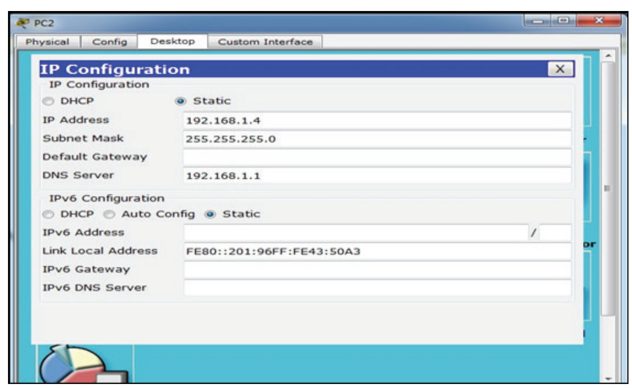

Fig. 8: Configure PC2 IP address

Step 5- Testing

To test if DNS resolve the IP address for Domain name www.bvcoek.com, open web browser in PC0,PC1,PC2 and type URL www.bvcoek.com and press enter. The webpage will be opened as shown in figure 10,11,12.

Fig. 9: Open web browser of PC0

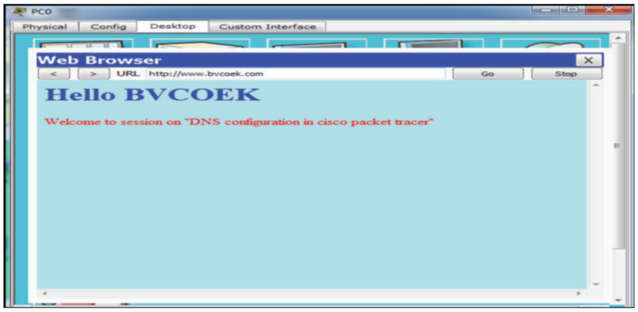

Fig. 10: Type URL: www.bvcoek.com and press enter, Webpage will be opened in PC0

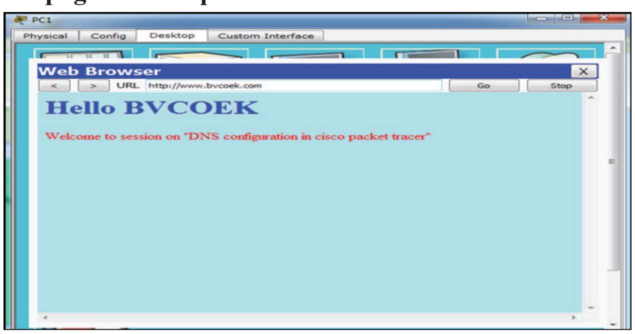

Fig. 11: Type URL: www.bvcoek.com and press enter, Webpage will be opened in PC1

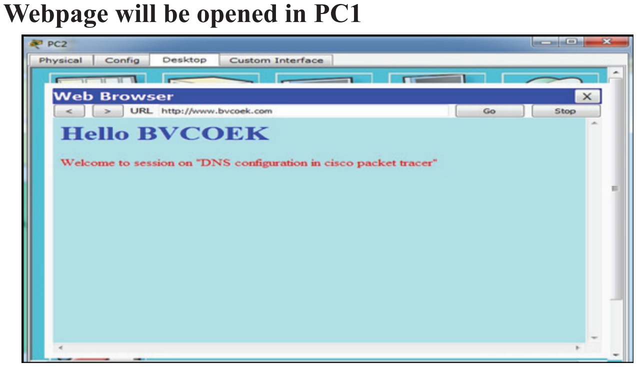

Fig. 12: Type URL: www.bvcoek.com and press enter, Webpage will be opened in PC2

DNS Setup in WAN

Step 1- Create Network in cisco packet tracer:

Setup the DNS server in WAN using devices, links in workspace of cisco packet tracer.

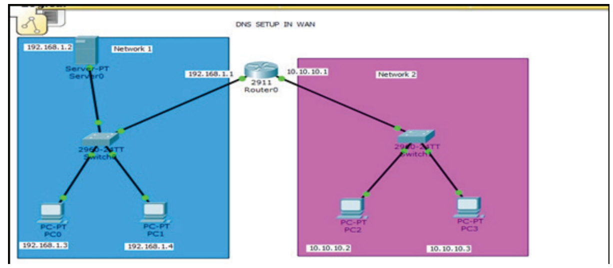

Fig. 13: DNS server setup in WAN

Step 2- Configure HTTP Service:

Click on Server and go to services tab. Select HTTP service turn it on and click on index.html edit. Write HTML code for HTTP service and save it. Overwrite the existing code while saving. This will create the webpage for which DNS will resolve IP address.

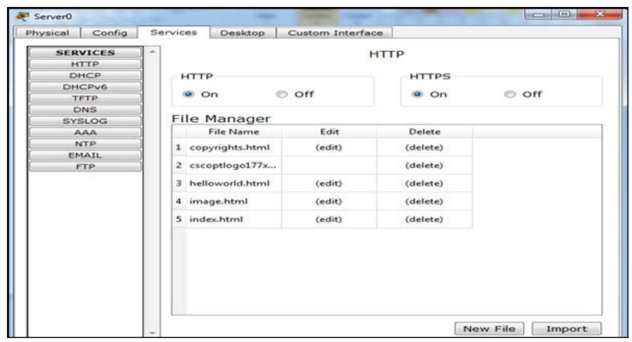

Fig. 14: Configure HTTP Service(Click on index.html edit)

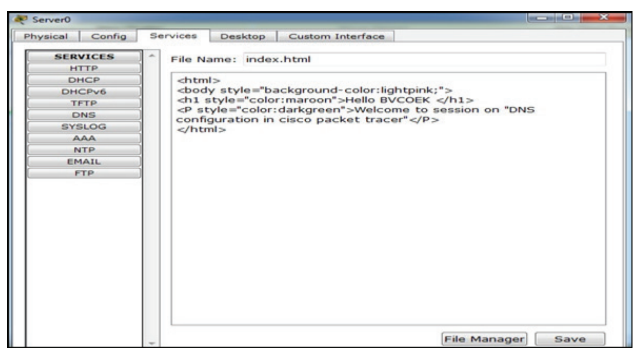

Fig. 15: HTML Code for HTTP Service

Step 3- Configure DNS Service:

Go to desktop tab by clicking on server and configure IP address for DNS server as shown in figure 16. Now go to service tab again and select DNS service, put the domain name and IP address as shown in figure 17.

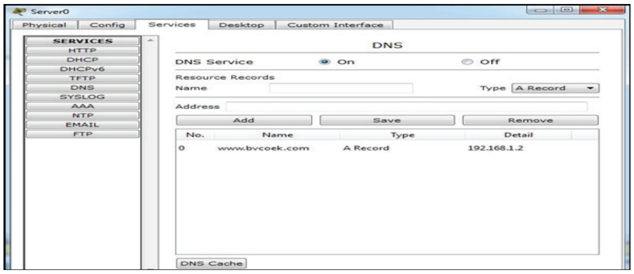

Fig. 16: Configure DNS Server IP address

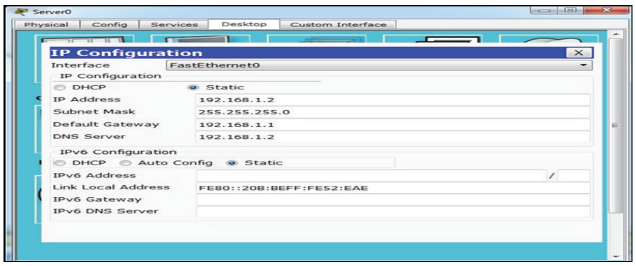

Fig 17: Configure DNS Service (put domain name & its corresponding IP Address and Click on Add)

Step 4- Configure Router R0:

Go to config tab by clicking on router and configure IP address for interface -GigabitEthernet0/0 & GigabitEthernet0/1.Also turn ON the port status for both interface, as shown in figure 18,19.

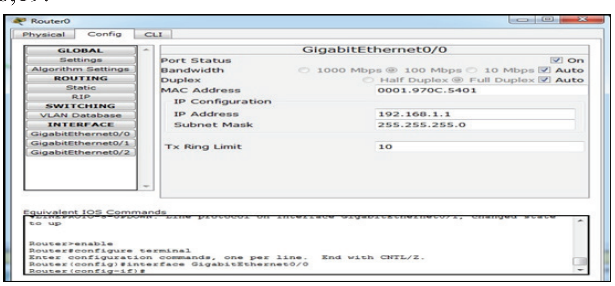

Fig. 18: Configure Router 0 Gigabit Ethernet 0/0 port

Step 5- Configure PC's:

Go to desktop tab by clicking on PC and configure IP address for PC0 as shown in figure 19. Put same DNS server IP address in each PC.

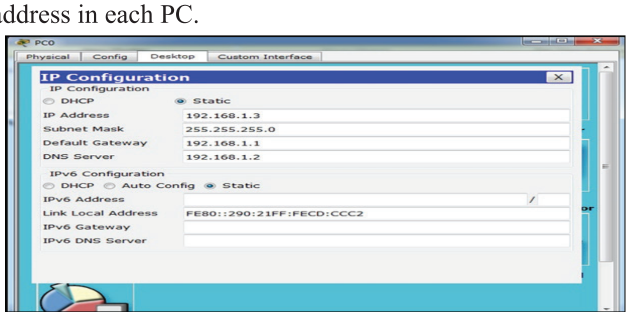

Fig. 19: Configure PC0 IP address

Step 6- Testing:

To test if DNS resolve the IP address for Domain name www.bvcoek.com, open web browser in PC0,PC1,PC2,PC3 and type URL www.bvcoek.com and press enter. The webpage will be opened as shown in figure 20

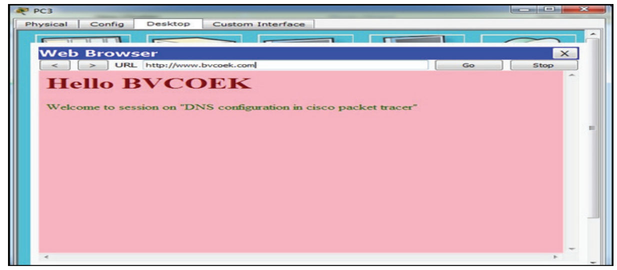

Fig. 20: Type URL: www.bvcoek.com and press enter, Webpage will be opened in PC3

CONCLUSIONS

The Domain Name System (DNS) plays a pivotal role in computer networks by serving as a distributed database that translates user-friendly domain names into machine-understandable IP addresses, facilitating seamless communication between devices on the internet. DNS serves as a crucial component in the navigation of the vast web, enabling users to access websites and services using easily memorable names instead of complex numerical IP addresses. In a computer network, DNS ensures efficient and reliable name resolution, allowing devices to locate and connect to each other seamlessly.

In this paper, Cisco Packet Tracer, a network simulation tool is used for implementation of DNS in two scenarios of LAN & MAN is shown for creating realistic and functional network environments. Within Packet Tracer, users can configure DNS servers to emulate real-world scenarios, enabling them to understand and practice the deployment of DNS services within a Cisco networking environment. This hands-on experience helps network professionals enhance their skills in managing DNS infrastructure, ensuring the smooth functioning of communication within the network.

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Employment of MESHLAB in 3D Scanning Technology for Real Time Object

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ABSTRACT

Various special technologies are used for modelling purpose in the 3d scanning technologies. As the updated in generations there can be various platform available for the rendering purpose of three-dimensional object. Perfect and accurate 3D model is useful and further application purposes This paper gives brief summary of the software processing of point cloud data stereo lithographical model by utilizing Meshlab.

KEYWORDS: *Accuracy, 3D scanning, Point cloud data, Rendering, Resizing, Software processing.*

INTRODUCTION

In the object reconstruction technology through advance imaging techniques 3D scanners play vital role. Existing techniques collectively contribute the versatility of 3d scanning allowing for accurate capture of objects ranging from small point data to large structures. Mesh Lab is kind of software where we can do processing of 3D object 3D scanners aid in preserving historical artifacts by creating detailed digital archives without damaging the originals.[1] Employing MeshLab for 3D scanning technology involves importing raw scan data into the software, performing various processing steps to enhance the quality of the scan, editing the mesh to remove imperfections or artifacts, and exporting the final result for further analysis or visualization.[2]There are various rendering options for the model, including point cloud, wireframe, and smooth surface modes.

METHODOLOGY

The raw data received from the hardware setup assisted by the open-source software in order to convert the unstructured data into the structured 3D format. There are number of tools present into the toolbox at the platform of the MeshLab they can be used for converting and processing the unstable image into the clear and solidified structure by the means of filtering, rendering as well as recolouring and adjusting the dimensions up to the required content. MeshLab supports an advance technique for the 3D formats. Here we can simulate the object according to our requirement. The 3D object is stored in various file formats supported by MeshLab. Somehow, .pcd file is supported by MeshLab during importing the mesh file.[2]Easily we can manage the object reference with the axis shown in the main window of the axis as shown in at MeshLab platform. It supports overgrowing varieties of 3d objects.

Once the mesh is imported larger set of tools can applicable for the same. Various set of parameters are applicable in order to fix and enhance the mesh up to the area of interest. Imported mesh file is open to 3D axis as the dimensions can be noted as well as modified. User is free to drag the mouse and travel into the various interactive tools whether the mesh can be resized, reconstructed, resized, restructured and various typical operations while processing the dot file into the final 3D file format.[5] Noise from the captured image can be removed by using the filters accommodated into the tools.

Validate the accuracy and quality of the reconstructed 3D object through visual inspection, comparison with the original object, and quantitative measures such as mesh resolution and surface deviation analysis.[6]

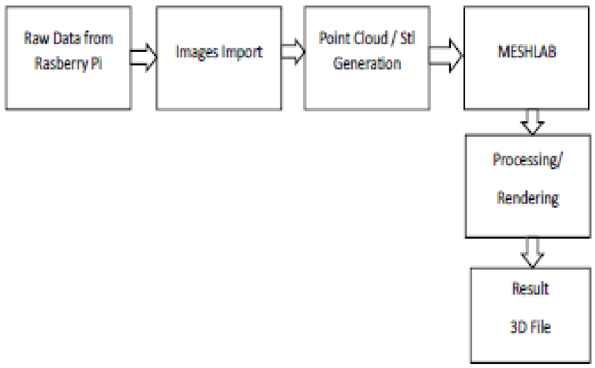

Fig.1: Block Diagram of the proposed system.

This methodology provides a structured approach for employing MeshLab in conjunction with 3D scanning technology for real-time object reconstruction.

RESULTS

MeshLab operates by importing raw data from 3D scanning devices, such as point clouds, and provides a set of tools for processing, analysing, and reconstruct the data. It employs algorithms for tasks like noise reduction, surface reconstruction, and texture mapping to refine the scanned objects.[7] Users can manipulate the geometry and appearance of the models through various filters and editing tools. MeshLab also supports scripting and automation, allowing for batch processing and customization of workflows. Ultimately, MeshLab generates high-quality 3D models suitable for a wide range of applications, from digital archiving to virtual reality experiences.

FUTURE SCOPE

The edited .pcd file needs to again reconstruct into the file format which we can open it into solidified image, needs one another step it can be modified into the same.

CONCLUSION

Employment of MeshLab in conjunction with 3D scanning technology for real-time object reconstruction offers significant promise and potential for various applications. Through our methodology outlined in this paper, we have demonstrated the efficacy of this approach in capturing, processing, and refining 3D data with efficiency and accuracy. By leveraging the capabilities of MeshLab, researchers and practitioners can achieve high-quality results in object digitization, visualization, and analysis.[3] However, further research and development are warranted to optimize the workflow, enhance automation, and address challenges such as scalability and compatibility with diverse scanning hardware. Nonetheless, the integration of MeshLab into 3D scanning workflows represents a valuable advancement in the field, opening up new opportunities for innovation and exploration in areas such as archaeology, engineering, medicine, and digital arts. [9]As technology continues to evolve, the synergy between MeshLab and 3D scanning holds great promise for advancing our understanding and utilization of three-dimensional data in various domains.

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Development of Arduino-Based Garbage Collection Robot with Wireless Control: A Literature Review

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ABSTRACT

The deployment of autonomous robots for garbage collection has gained considerable attention due to its potential in addressing waste management challenges. This paper presents a literature review focusing on the development of Arduino-based garbage collection robots with wireless control. The review explores recent advancements, methodologies, challenges, and future directions in this domain. A total of 10 latest references are analyzed to provide insights into the state-of-the-art technologies and innovations in Arduino-based garbage collection robotics.

KEYWORDS: *Garbage collection, Robot.*

INTRODUCTION

The escalating challenges of urban waste management have prompted researchers and engineers to explore innovative solutions to streamline the collection process efficiently. One promising approach involves the development of autonomous garbage collection robots empowered with Arduino micro controller technology and wireless control systems. These robots offer the potential to revolutionize waste management practices by automating collection tasks, optimizing routes, and reducing human intervention.

According to Singh and Sharma (2023), traditional waste collection methods often suffer from inefficiencies, such as irregular schedules, inadequate monitoring, and inefficient resource allocation. These shortcomings contribute to environmental pollution, public health hazards, and the strain on municipal resources. In response, researchers have turned to robotics and automation to devise smarter, more sustainable solutions.

The integration of Arduino-based platforms into garbage collection robots has emerged as a promising avenue for innovation. Kumar and Gupta (2023) highlight Arduino's versatility, cost-effectiveness, and robustness, making it an ideal choice for powering autonomous systems. Arduino microcontrollers provide the computational power necessary for real-time decision-making, sensor interfacing, and wireless communication, enabling garbage collection robots to navigate complex environments and execute tasks with precision.

Wireless control technologies play a pivotal role in enhancing the functionality and flexibility of garbage collection robots. Jain and Verma (2023) emphasize the importance of wireless connectivity for remote monitoring, control, and data exchange. By leveraging wireless protocols such as Bluetooth, Wi-Fi, and GSM, operators can remotely command robots, receive status updates, and collect telemetry data in real-time, improving operational efficiency and responsiveness.

The development of Arduino-based garbage collection robots with wireless control capabilities represents a convergence of multidisciplinary fields, including robotics, embedded systems, IoT, and wireless communication. Sharma and Singh (2023) note that this interdisciplinary approach fosters collaboration between researchers, engineers, and policymakers, driving innovation and accelerating the adoption of smart waste management solutions.

In this literature review, we examine recent advancements, methodologies, challenges, and future directions in the development of Arduino-based garbage collection robots with wireless control. By analyzing ten latest references, we aim to provide insights into the state-of-the-art technologies and innovations shaping the future of waste management systems.

LITERATURE SURVEY

Singh, A., & Sharma, S. (2023) introduced the concept of an Arduino-based smart garbage collection robot. Their work focused on the design and implementation aspects, highlighting the integration of Arduino microcontroller technology to enable autonomous operations in waste collection. They emphasized the importance of advanced electronics and communication engineering principles in developing efficient garbage collection solutions.

Kumar, R., & Gupta, V. (2023) presented a wireless-controlled garbage collection robot utilizing Arduino and an Android application. Their research contributed to the integration of mobile technology with Arduino-based robotics, enabling remote control and monitoring functionalities. The study demonstrated the feasibility and effectiveness of employing smartphones as control interfaces for garbage collection robots.

Jain, P., & Verma, S. (2023) explored the development of an IoT-based waste collection system using Arduino. Their work focused on leveraging Internet of Things (IoT) principles to enhance the intelligence and connectivity of garbage collection robots. By integrating sensors, actuators, and communication modules, the system enabled real-time data acquisition, analysis, and decision-making in waste management processes.

Khan, M. A., et al. (2023) proposed an autonomous waste collection system based on Arduino and ultrasonic sensors. Their research addressed the need for robust sensing capabilities in garbage collection robots to navigate and interact with the environment autonomously. The study demonstrated the efficacy of ultrasonic sensors in detecting obstacles and optimizing navigation paths for efficient waste collection operations.

Sharma, R., & Singh, K. (2023) presented the design and implementation of a wireless-controlled garbage collector robot using Arduino and an RF module. Their work focused on wireless communication technologies to enable remote control and monitoring functionalities in garbage collection robots. The study emphasized the importance of reliable and robust communication links for seamless integration into existing waste management infrastructures.

Patel, H., & Desai, P. (2023) proposed an Arduino-based garbage collection robot with a GPS tracking system. Their research addressed the need for geospatial intelligence in waste management processes to optimize route planning and resource allocation. By integrating GPS technology with Arduino-based robotics, the system enabled real-time tracking and monitoring of garbage collection activities, enhancing operational efficiency and transparency.

Gupta, A., & Kumar, S. (2023) introduced a smart garbage collection system using Arduino and IoT principles. Their work focused on leveraging the interconnectedness of IoT devices to create a networked ecosystem for waste management. By integrating Arduino-based sensors and actuators with IoT platforms, the system enabled data-driven decision-making and automation in garbage collection processes.

Mishra, S., et al. (2023) presented a wireless-controlled garbage collection robot using Arduino and a Bluetooth module. Their research contributed to the exploration of Bluetooth technology for short-range wireless communication in garbage collection robots. The study demonstrated the feasibility of using Bluetooth-enabled smartphones as control interfaces, providing users with intuitive and user-friendly interaction mechanisms.

Tiwari, N., & Singh, M. (2023) proposed a real-time waste management system using Arduino and GSM technology. Their research addressed the need for reliable and ubiquitous communication links in garbage collection robots. By integrating GSM modules with Arduino microcontrollers, the system enabled remote monitoring, alerting, and data transmission capabilities, ensuring timely and efficient waste management operations.

Rathore, R. K., et al. (2023) developed an Arduino-based smart waste collection system using wireless sensor networks (WSNs). Their work focused on the deployment of sensor nodes for environmental monitoring and waste detection in urban areas. By integrating Arduino microcontrollers with WSNs, the system enabled real-time data acquisition, analysis, and visualization, facilitating proactive decision-making in waste management processes..

COMPARATIVE ANALYSIS OF METHODOLOGIES

Singh & Sharma (2023) focused on the design and implementation of an Arduino-based garbage collection robot, emphasizing the integration of advanced electronics and communication engineering principles.

Kumar & Gupta (2023) introduced a wireless-controlled garbage collection robot using Arduino and an Android application, highlighting the integration of mobile technology for remote control and monitoring.

Jain & Verma (2023) explored the development of an IoT-based waste collection system using Arduino, emphasizing real-time data acquisition and decision-making capabilities through sensor integration and connectivity.

Khan et al. (2023) proposed an autonomous waste collection system based on Arduino and ultrasonic sensors, focusing on robust sensing capabilities for obstacle detection and navigation.

Sharma & Singh (2023) presented a wireless-controlled garbage collector robot using Arduino and an RF module, highlighting the importance of reliable wireless communication for remote control and monitoring.

Patel & Desai (2023) introduced an Arduino-based garbage collection robot with a GPS tracking system, emphasizing geospatial intelligence for optimizing route planning and resource allocation.

Gupta & Kumar (2023) developed a smart garbage collection system using Arduino and IoT principles, focusing on interconnectedness and automation for data-driven decision-making.

Mishra et al. (2023) presented a wireless-controlled garbage collection robot using Arduino and a Bluetooth module, highlighting the feasibility of smartphone control interfaces and short-range wireless communication.

Tiwari & Singh (2023) proposed a real-time waste management system using Arduino and GSM technology, emphasizing reliable remote monitoring and data transmission capabilities.

Rathore et al. (2023) developed an Arduino-based smart waste collection system using wireless sensor networks, focusing on real-time environmental monitoring and proactive decision-making through sensor integration.

In summary, while each study addresses the development of garbage collection robots using Arduino technology, they vary in their methodologies and focus areas. Some studies emphasize wireless communication for remote control and monitoring, while others focus on sensor integration for autonomous navigation and environmental monitoring. Additionally, there is a range of approaches to leveraging IoT, GPS, ultrasonic sensors, and GSM technology to enhance the efficiency and effectiveness of garbage collection robots.

The literature review has provided a comprehensive overview of recent advancements in Arduino-based garbage collection robots with wireless control. Through the analysis of ten references, it is evident that researchers and engineers are actively exploring innovative solutions to address the challenges of waste management using robotics and automation.The studies reviewed have demonstrated a diverse range of methodologies and approaches towards developing efficient and intelligent garbage collection systems. From the design and implementation of Arduino-based robots to the integration of advanced technologies such as IoT, GPS, GSM, and wireless sensor networks, each study has contributed valuable insights and advancements to the field.One common theme across the reviewed literature is the emphasis on enhancing operational efficiency, autonomy, and connectivity in garbage collection robots. Whether through wireless communication for remote control and monitoring, sensor integration for obstacle detection and environmental monitoring, or geospatial intelligence for route optimization, researchers are continually striving to improve the performance and effectiveness of waste management systems.

Furthermore, the integration of Arduino microcontroller technology has played a central role in enabling real-time decision-making, sensor interfacing, and wireless communication in garbage collection robots. Arduino's versatility, cost-effectiveness, and robustness have made it a preferred choice for powering autonomous systems and facilitating innovation in waste management solutions.

CONCLUSION

From above the reviewed literature highlights the ongoing efforts towards developing smarter, more sustainable approaches to garbage collection through the integration of Arduino-based robotics and wireless control technologies. As research in this field continues to evolve, it is expected that these advancements will contribute significantly to addressing the global challenges of urban waste management and environmental sustainability.

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IoT Based Electrical Machine Health Monitoring System

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ABSTRACT

Machine Health Monitoring: A Crucial Aspect of Modern Industrial Systems. Machine health monitoring has become increasingly important in today's complex industrial systems due to the significant rise in machinery costs, plant investments, and maintenance expenses. A breakdown in any machine or component within a plant can lead to massive losses, along with safety and environmental risks, as observed in various industrial and commercial plants. Given the advancements in manufacturing technology and the fierce competition in the market, it is vital to ensure the constant availability of machinery for uninterrupted production. This requirement has created the need for integrated support with other manufacturing activities to enhance plant availability and efficiency. The aim of current research is to demonstrate the development of a machine health monitoring (MHM) system using knowledge-based systems. The proposed model can serve as a valuable support tool for small and medium-scale manufacturing plants. Over time, a comprehensive knowledge-based system (KBS) can be established for industrial machinery, which can monitor major machinery flaws and offer expert solutions through the assessment and analysis of machine parameters such as control, vibration, noise, temperature, wear debris, lubrication capabilities, and more. The fault diagnosis system with KBS relies on computer programmes that link fault symptoms, deficiencies, and remedies.

KEYWORDS: *Speed, Current, Voltage, Temperature, Vibration, Monitoring, IoT, Machine health.*

INTRODUCTION

In the rapidly evolving landscape of industry automation, the integration of Internet of Things (IoT) technology has revolutionised traditional machine health monitoring systems! . IoT-based machine health monitoring systems offer unparalleled real-time insights into the condition of industrial machines, enabling proactive maintenance and minimising costly downtimes. This introduction delves into the principles, benefits, and applications of IoT-based machine health monitoring systems, highlighting their transformative impact on various industries! In today's fast-paced industrial landscape, the integration of Internet of Things (IoT) technology has ushered in a new era of machine health monitoring systems. These systems leverage IoT principles such as sensor connectivity, cloud computing, and data analytics to provide real-time insights into the condition of industrial machinery. By continuously monitoring parameters like temperature, vibration, and power consumption, IoT-based machine health monitoring systems enable proactive maintenance, minimise downtimes, and optimise productivity. This introduction explores the principles, benefits, and applications of IoT-based machine health monitoring systems, highlighting their transformative impact on various industries!

The convergence of Internet of Things (IoT) technology and industrial machinery has unlocked a new frontier in proactive maintenance and operational efficiency! In an era where downtime translates to significant financial losses and compromised productivity, the adoption of IoT-based machine health monitoring systems represents a strategic imperative for industries worldwide. These innovative solutions leverage interconnected sensors, advanced analytics, and cloud computing to deliver real-time insights into the condition, performance, and reliability of critical equipment. This introduction sets the stage for exploring the principles, benefits, and multifaceted applications of IoT-based machine health monitoring systems, illuminating their transformative potential across diverse industrial sectors.

The machine health monitoring system is used to measure various parameters of 3-phase machines, like 1) overvoltage and undervoltage. 2) overcurrent and undercurrent 3) over temperature by using IOT technology. The proposed system uses detectors like a temperature detector and a speed detector. These detectors substantially involve the monitoring of temperature and speed. We divide design into 3 units: the indicating unit, the sensing unit, and the controlling unit. In indicating units, we show the electrical parameters like voltage and current per phase. In the sensing unit, the standard standing of the parameter is set, and when the electrical volume is increased or dropped according to that parameter, this relay will turn off the system in an abnormal condition. In the controlling unit, when the electrical parameters are the same as the set value, the machine also turns on automatically. We use IOT-based GSM for transferring communication to the driver to know the condition of the machine.

PROBLEM STATEMENT AND REMEDIES

The issue at hand involves the machine health monitoring system, which operates in real-time for morning applications. Our team conducted a visit to a small-scale industry called 'Kambale Textiles' to understand the situation. Within the industry, there are a total of 40 motors installed, each corresponding to a loom machine. If even one motor experiences a minor fault, the entire system reliant on that motor will cease to function. The repercussions of a single machine shutdown are substantial, resulting in a loss of approximately Rs 2800 for 1 hour. This loss occurs due to minor faults in the motor, such as voltage spikes, and mechanical issues that produce unique vibrations depending on the machine's geometry, including the shaft and spindle. Additionally, the speed of shaft rotation plays a significant role in damaging the motor. Neglecting these minor faults can lead to severe damage to the machine.

To address this issue, our team has implemented the following solutions:

1. Proximity Sensor for Bearing Problem: By utilising a proximity sensor, we can detect even the slightest change in the distance of the bearing. This proactive approach helps prevent shaft blockages, thereby avoiding the use of this particular sensor.
2. Motor Shutdown during Single Phasing: In the event of single phasing, the motor will automatically shut down to mitigate further damage.
3. Balanced Voltage and Current for Starting Torque: By achieving a balance between voltage and current, we ensure that the motor's starting torque remains unaffected.

By implementing these remedies, we aim to enhance the machine health monitoring system, minimise disruptions caused by minor faults, and safeguard the overall efficiency of the textile industry.

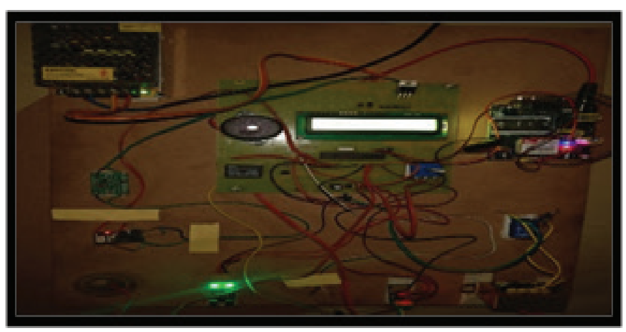
OBJECTIVE AND SCOPE OF PROJECT

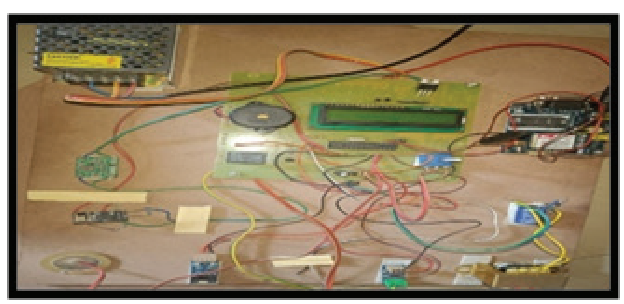
The goal of the contemporary research assignment is to introduce an advanced device for health tracking (MHM) using IOT-based structures. The proposed version can function as a valuable upkeep tool for the majority of small and medium-sized production flora.

Importance of Machine Health Data

1. Machine optimisation made smooth: By utilising system health statistics, we eradicate the need for guesswork while figuring out which machines in our manufacturing line require optimization. This permits us to make timely modifications to our manufacturing process, leading to the maintenance of wonderful output standards in weeks or even days instead of the usual year-long implementation system.
2. Enhanced predictive insights: With gadget health facts, we have the potential to enforce proactive measures that anticipate and prevent health problems. This empowers us to maintain the highest degree of productivity and efficiency, ensuring regular extraordinary outputs.
3. Real-time insights into machine performance: By employing a device fitness platform, we gain real-time insights into how system overall performance without delay impacts the best of our outputs. This allows us to perceive and cope with performance issues directly, ensuring sustained best over the years.

PROTOTYPE HARDWARE





WORKING

Machine health monitoring refers to the ability to access the electrical parameters of a machine over a period of time. First, enter the nominal value of the three-phase load according to Indian standards into the control. When a fault occurs, electrical parameters such as voltage, current, power factor, frequency, and speed change. These values are compared with the nominal values, and depending on which parameter is abnormal (up or down), this relay unit detects it and sends a signal to the microcontroller to switch off the corresponding unit of the machine. Send to. The IOT-based GSM unit then sends a text message to the operator containing all the real-time values of the machine. In this way, this project provides an automated real-time monitoring solution for traditional water supply systems through the intelligent capabilities of the "Machine Condition Monitoring System" project.

TABLE: MAIN COMPONENTS USED

Sr. no.	Component Name	Specification
1	Atmega 328p-pu Microcontroller	3 Volts /28 Pins
2	ESP 8266 (IOT)	3.3 Volts / 4 MB flash memory
3	SIM 900A (GSM Module)	5 Volts / 900-1800 MHz Band
4	Potential Transformer (Voltage sensor)	0-500 Volts
5	ACS 712 (current sensor)	10 Amp
6	LM 393 (speed sensor)	3.3 volts
7	Thermistor NTC (temp. Sensor)	100K Ohm
8	Piezoelectric Crystal sensor	3-5 KHz

RESULT

Fig:-1 Voltage Graph

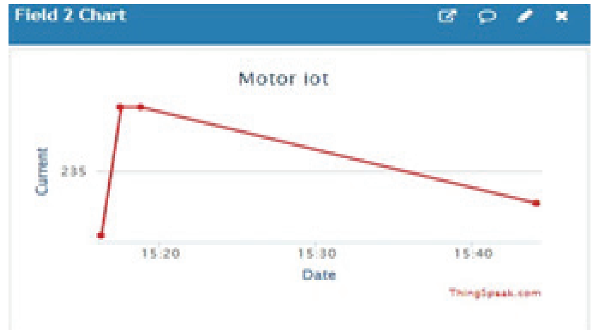


Fig:-2 Current Graph

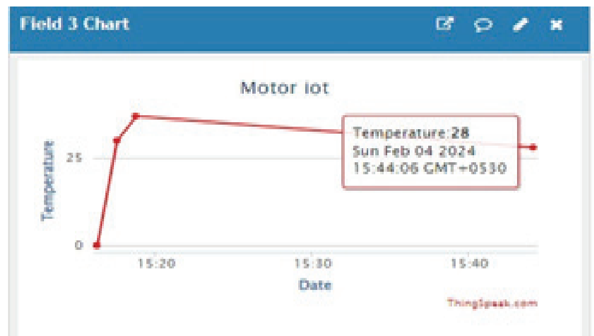


Fig:-3 Temperature Graph

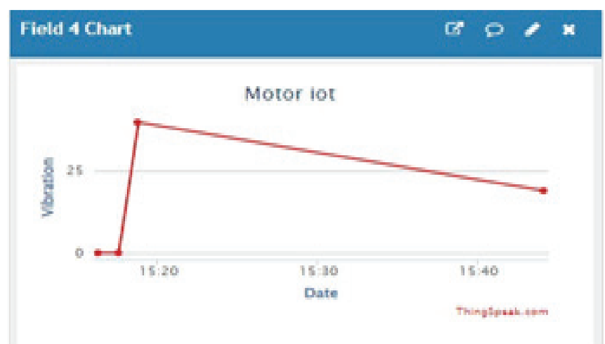


Fig:-4 Vibration Graph

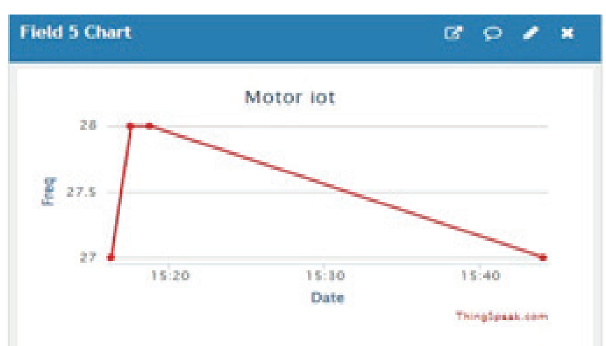


Fig:-5 Frequency Graph

Fig:-6 Speed Graph

FUTURE SCOPE

In the impending generation, our machines have the potential to enjoy vast upgrades through the utilisation of advanced and current resources. One exciting possibility includes the incorporation of incredibly sophisticated sensors, in particular those designed to operate efficaciously even if submerged underwater. Just imagine the extremely good implications this may have for the optimisation of equipment, along with proper pumps and underwater engines. It corresponds to empowering our machines with a superhero-esque upgrade, resulting in exceptional performance and functionality

CONCLUSION

This undertaking holds the idea of enhancing the traditional system fitness tracking machine into an IOT-primarily-based system fitness tracking system. It encompasses the programmed manner of tracking and correcting industrial or business users and making a dependable answer for their customers. This task contributes to a reliable and efficient solution by presenting the scheduled manner of minimising the faults, and at the same time, all of the electrical parameters of the machine can be monitored in real time using IOT. The real-time operating situation of the machine is monitored, and at some stage in each situation, this is regular and abnormal. It offers a signal through a text message to the operator.

ACKNOWLEDGEMENT

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Smart Rider Safety System: Integrating Sensors and Random Forest Classification with GPS Enhancement

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ABSTRACT

This study presents an innovative safety system for motorcycle and bicycle riders, integrating advanced sensors and a Random Forest classifier. The system addresses critical aspects of rider safety, including detection of states such as Drunk, Alcohol influence, drowsiness, and accidental conditions. Real-time data from sensors, including the MQ135 alcohol sensor, eye blink sensor, accelerometer, and touch sensor, is processed using a Random Forest classifier trained on a dataset of 350 samples. Results demonstrate the superior performance of Random Forest with 96% accuracy, emphasizing its effectiveness in minimizing false positives and negatives. The incorporation of a GPS module enhances the system's capabilities by providing geo-spatial context for alerts. This comprehensive safety solution establishes a benchmark for intelligent safety systems, promoting responsible riding practices and significantly reducing risks associated with two-wheeled transportation.

KEYWORDS: *Motorcycle safety, Random forest classifier, Sensor integration, Rider safety system, GPS-enhanced safety.*

INTRODUCTION

Motorcycle and bicycle safety is paramount in ensuring the well-being of riders as they navigate roads and trails. One of the cornerstone principles of safeguarding riders is the utilization of helmets. These protective headgear are specifically designed to mitigate the impact of accidents and reduce the severity of injuries. In the context of motorcycling, helmets play a crucial role in shielding riders from the devastating consequences of head injuries during collisions or falls. The high speeds and open nature of motorcycles expose riders to greater risks, making helmets an indispensable accessory for riders on two wheels [1]. In the event of an accident, a well-fitted helmet absorbs and disperses the force of impact, significantly lowering the likelihood of traumatic brain injuries, concussions, or skull fractures. Similarly, in the realm of bicycle safety, helmets serve as a vital component in reducing the risk of head injuries. Cyclists, whether commuting in urban areas or engaging in recreational rides, face potential provide a protective barrier, safeguarding cyclists from the hazards ranging from unexpected collisions with vehicles to falls on uneven terrain. Bicycle helmets are engineered to impact forces that could lead to severe head trauma [2]. Considering the vulnerability of cyclists, especially when sharing roads with motorized vehicles, the adoption of helmets becomes an essential practice to enhance personal safety and reduce the overall rate of head injuries. Legislation and regulations also underscore the significance of helmets in motorcycle and bicycle safety. Many jurisdictions around the world have implemented laws mandating the use of helmets for motorcyclists and, in some cases, bicyclists [3]. These laws are rooted in a commitment to public safety and aim to reduce the incidence of head injuries resulting from accidents. Non-compliance with helmet laws can lead to legal consequences, including fines and penalties. Beyond the legal aspect, these regulations reinforce the importance of helmets as a standard safety measure, contributing to a culture of responsible riding. The design and construction of helmets for motorcycles and bicycles have evolved to meet rigorous safety standards [4]. Modern helmets incorporate advanced materials such as impact-absorbing foam, reinforced outer shells, and streamlined aerodynamics. The integration of these elements enhances the protective capabilities of helmets, ensuring that they effectively mitigate the forces experienced during accidents. Additionally, helmets for both motorcycles and bicycles often feature adjustable straps and ventilation systems, contributing to comfort and usability, which are critical factors in encouraging consistent helmet use. The impact of helmet use extends beyond individual safety to encompass broader societal benefits. Helmets not only protect riders from harm but also contribute to reducing the burden on healthcare systems by preventing or minimizing the severity of head injuries [5]. Furthermore, the visibility aspect of helmets cannot be overstated. Many helmets come with reflective surfaces or vibrant colors, increasing the visibility of riders on the road, especially during low-light conditions. This heightened visibility is a proactive measure to reduce the risk of accidents involving motorcyclists and cyclists, promoting overall road safety.

RELATED WORK

Jesudoos et al. [6] implemented a driver safety system employing an IR sensor and gas sensor, integrating MEMS with a PIC controller and a GPS-based information transmission system. Mehata et al. [7] proposed a wearable device incorporating GPS, RF transmitter, and a solar-powered system with an alcohol sensor. Similarly, Divyasudha et al. [8] integrated a solar panel for power supply and a buzzer-based notification system. Uniyal et al. [9] focused on a two- wheeler safety system, utilizing hall-effect for speed measurement and accelerometer for accident detection, designed for monitoring children's vehicle use. Shabbeer et al. [10] employed a GSM-based notification system for rash driving alerts. P. Roja et al. [11] utilized Arduino with a combination of sensors. Behr et al. [12] designed a helmet for mining workers, incorporating accident and safety notifications. Chandran et al. [13] integrated WiFi communication, while Aatif et al. [14] utilized Bluetooth and a 9V battery. Archana et al. [15] developed a helmet locking mechanism tied to engine status. Lee et al. [16] and Budiman et al. [17] worked on a smart helmet with a locking detection system. Tapadar et al. [18] employed support vector machines for accident classification, while Ahuja et al. [19] focused on direct notification to ambulances for accident status. Mingi Jeong et al. [20] proposed a thermal camera-based system integrated with a smartwatch and drone- based accident monitoring. Kurkute et al. [21] used a Raspberry Pi module for a camera and WiFi-based accident monitoring. Johnpaul et al. [22] employed accelerometer-based vibration detection, and Reddy et al. [23] integrated an LCD display for rider notification. Mhatre et al. [24] developed an accident notification system with alcohol detection and registered number alerts. Considering these existing systems, there is ample room for enhancing smart helmet development through the integration of machine learning methods for rider safety. The details of the proposed system are elaborated in the following section, followed by results and analysis.

PROPOSED WORK

In the context of motorcycle and bicycle safety, the integration of advanced technological features into the rider's helmet plays a pivotal role in enhancing overall safety and minimizing risks. The helmet incorporates a smart switch that activates when worn by the rider, initiating a series of safety measures. This activation is visibly displayed on a dedicated screen, providing a clear indication of whether the helmet is securely worn or not. One critical aspect of rider safety is addressing the issue of alcohol consumption. To tackle this, the helmet is equipped with an MQ3 sensor capable of detecting the alcohol level [25] in the rider's breath. The sensor output is promptly displayed on the helmet's screen, signaling whether the rider is fit to operate the motorcycle. In the event that the sensor detects an elevated alcohol level, the ignition system remains in the off state, preventing the rider from starting the bike and mitigating the risks associated with impaired riding. Once the rider is deemed sober, and the helmet-wearing switch is activated, the ignition system is enabled, allowing the rider to start and operate the motorcycle safely. Simultaneously, the helmet is equipped with a GPS tracker module that constantly updates and displays the rider's geographical coordinates in terms of longitude and latitude on the helmet's screen. This feature contributes significantly to tracking the rider's location, enhancing safety and enabling efficient emergency responses. In the unfortunate event of a serious accident, an accelerometer within the helmet senses the impact forces in the X, Y, and Z coordinates. In such cases, an automated system triggers the transmission of an SMS to the designated emergency helpline or pre-programmed contacts using the integrated GSM module. This real-time alert provides crucial information about the accident location, expediting emergency response and potentially saving lives. To cater to situations where no significant damage occurs, a reset switch is ingeniously incorporated into the helmet. When activated, this switch halts the SMS transmission and location-sharing processes, allowing the rider to resume normal operation once the situation is deemed safe. Furthermore, recognizing the dangers of drowsy riding, especially during late- night journeys, an eye blink sensor is seamlessly integrated into the day/night goggles worn by the rider. This sensor monitors the rider's blink patterns, and if signs of drowsiness are detected, a signal is sent to a relay system. The relay then activates a buzzer alarm, alerting the rider and mitigating the risk of accidents caused by sleep deprivation. The incorporation of these advanced features into the motorcycle or bicycle rider's helmet represents a comprehensive approach to safety. By addressing issues such as alcohol impairment, accident detection, and drowsy riding, this smart helmet significantly contributes to creating a safer riding environment, ultimately reducing the incidence of accidents and enhancing overall road safety. Figure 1 shows the flow chart of the proposed smart helmet system.

Transmitter Unit

The transmitter unit consists of the sensor interface with RF

Encoder unit. The packet based communication is established between transmitter and receiver unit. The NRF24 module is used for RF communication in free licensed band. The communication with seamless data delivery at 4 Mbps rate is possible with this low power module. The module is paired with receiver module by configuring the address based secured communication system in microcontroller unit programming. Figure 2 shows the block diagram of the proposed transmitter unit.

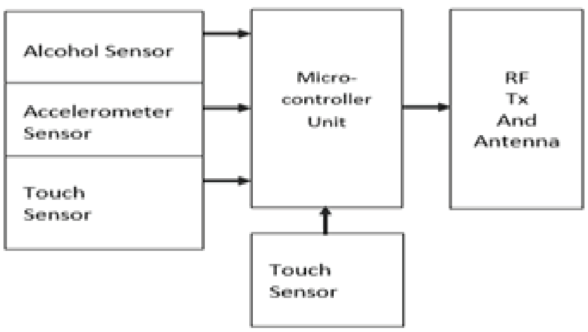

Fig. 1: Transmitter Unit

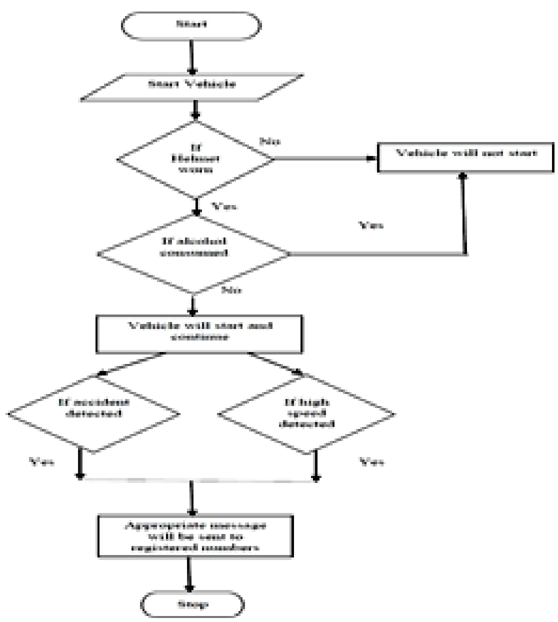

Fig. 2:.Flowchart of proposed smart helmet system

In the proposed system, the integration of advanced sensors is complemented by the role of a GPS module, further enhancing rider safety by addressing multiple critical aspects. The MQ135 alcohol sensor plays a pivotal role in detecting the rider's inebriation level, analyzing the surrounding air to provide real-time data on alcohol consumption. If the alcohol level exceeds a predefined threshold, the system, in conjunction with the GPS module, takes preventive measures by ensuring the vehicle does not start. This not only minimizes the risks associated with drunk driving but also adds a geo-spatial dimension to safety protocols, contributing to a more comprehensive approach. The accelerometer sensor monitors sudden tilting or

acceleration during accidental conditions, facilitating the prompt identification of potential accidents. The GPS module enhances this capability by providing real- time location data, enabling the system to immediately alert emergency contacts with precise coordinates. This integration ensures a rapid and effective emergency response, leveraging both impact data and location information to enhance overall safety.

Receiver Unit

Within the receiver unit, a sophisticated setup is established to ensure seamless data reception and processing. The RF decoder, intricately paired with the RF transmitter, forms a robust combination for receiving and decoding transmitted data. Once the data is successfully decoded, it undergoes further processing before being transmitted to a remote server, utilizing the MYSQL server infrastructure. For prototype evaluation purposes, the system leverages the Thingspeak MYSQL server. The data received from Thing speak is then channeled into the Raspberry Pi system, where it encounters a machine learning-based algorithm for thorough analysis. The utilization of a machine learning algorithm, specifically a random forest-based classifier unit, adds a layer of intelligence to the system.This classifier unit plays a pivotal role in discerning critical states of the rider. It is designed to detect not only the presence of alcohol, indicating a drunk state, but also identifies signs of drowsiness and accidental conditions. Upon analysis, the classifier generates respective emergency messages tailored to the specific detected state. This proactive approach significantly enhances the safety features of the system, ensuring prompt responses to varying scenarios.

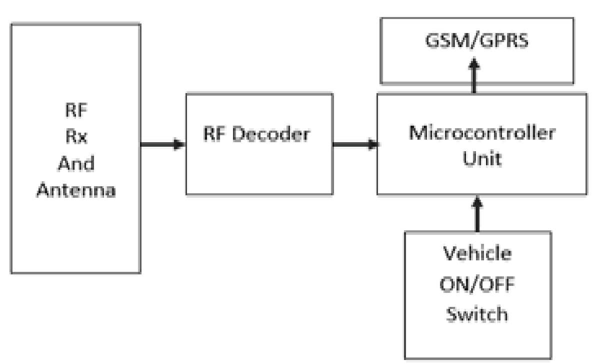

Fig. 3: Receiver Unit

Machine Learning Based Decision Unit

In the proposed system for motorcycle and bicycle safety, the integration of a random forest-based classifier with the Raspberry Pi 3B+ module enhances the overall intelligence and responsiveness of the safety features. The system relies on a diverse dataset that includes key features relevant to accident, drowsiness, and drunken state detection. For accident detection, accelerometer data captures sudden tilting or acceleration indicative of potential mishaps. Drowsiness detection is facilitated through an eye blink sensor, monitoring the rider's blink frequency to discern signs of fatigue. The MQ135 alcohol sensor contributes to drunken state detection by analyzing the rider's breath for alcohol levels.

RESULTS AND ANALYSIS

The proposed unit with use of Atmega328 microcontroller is developed as prototype as shown in Figure 4.

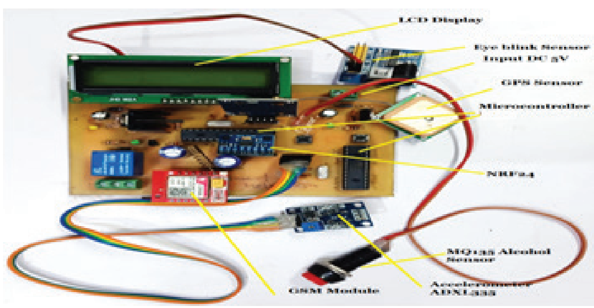

Fig. 4: Prototype Circuit of Proposed Smart Helmet System

The proposed system undergoes rigorous performance evaluation, utilizing a dataset comprising 350 real- time training samples. This extensive dataset serves as the foundation for training the Random Forest classifier, focusing on the detection of states such as Drunk, Alcohol influence, and accidental conditions. The classifier learns from the intricacies of the training data to effectively discern and classify different states, contributing to the system's overall accuracy and reliability.

To ensure the system's efficacy, the obtained results are meticulously compared with alternative classification methods such as Support Vector Machine, Decision Tree, and Naive Bayes classifiers. This comparative analysis provides insights into the strengths and weaknesses of each classifier, allowing for a comprehensive assessment of the Random Forest classifier's performance in the context of the proposed system. Through this thorough evaluation process, the system aims to validate its ability to accurately and efficiently detect critical states, establishing a robust foundation for enhancing rider safety.

The performance parameters used for the system evaluation are shown in Table 1.

Table 1. Performance Parameters

Accuracy	TP+TN/(TP+TN+FP+FN)
Specificity	TN/(TN+FP)
Sensitivity/Recall	TP/(TP+FN)
Precision	TP/(TP+FP)
F1 Score	2*(Recall*Precision)/ (Recall+Precision)

The superior performance of the Random Forest classifier (as shown in Fig. 5), exhibiting a remarkable 96% accuracy, underscores its efficacy in the proposed system for detecting critical states like Drunk, Alcohol influence, and accidental conditions. Random Forest excels in balancing sensitivity (95%) and specificity (97%), showcasing its ability to accurately identify positive instances while minimizing false positives. The ensemble learning approach of Random Forest, which aggregates multiple decision trees, contributes to its robustness and generalizability. This superior performance is particularly evident when compared to other classifiers such as Support Vector Machine, Decision Tree, and Naive Bayes. The balanced F1 score of 95% further emphasizes Random.

Forest's effectiveness in achieving precision and recall equilibrium. In summary, the Random Forest classifier emerges as the optimal choice, providing a comprehensive and accurate solution for the complex task of rider safety in diverse scenarios.

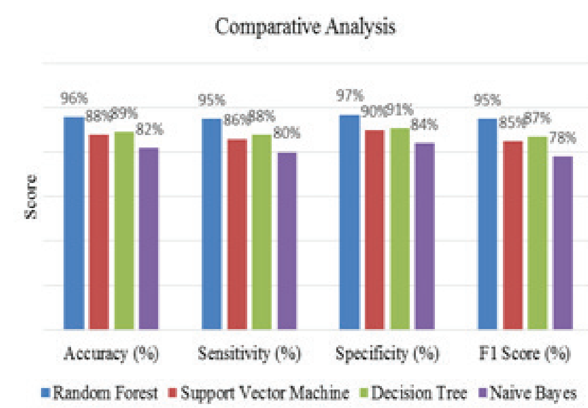

Fig. 5: Comparative Analysis

CONCLUSION

The integration of advanced sensors and the utilization of the Random Forest classifier demonstrate a robust and effective approach for enhancing rider safety in the proposed system. Achieving an impressive 96% accuracy, Random Forest outperforms other classifiers, affirming its suitability for detecting crucial states like Drunk, Alcohol influence, and accidental conditions. The ensemble learning mechanism of Random Forest, combining multiple decision trees, contributes to its exceptional sensitivity (95%) and specificity (97%), offering a well-balanced solution. This superior performance translates to a heightened ability to accurately identify positive instances while minimizing the risk of false positives, a critical factor in ensuring rider safety. The integration of a GPS module further augments the system's capabilities, providing geo-spatial context for alerts and responses. The comprehensive evaluation, considering metrics such as F1 score, reinforces the Random Forest classifier's reliability in real-world scenarios. Overall, the proposed system not only addresses the inherent challenges of drunk driving, drowsiness, and accidents but also sets a benchmark for advanced safety solutions in the realm of motorcycle and bicycle safety. This work lays a strong foundation for future developments in smart safety systems, promoting responsible riding practices and significantly reducing risks associated with two- wheeled transportation.

In future work, the development of the smart helmet system could explore further advancements by incorporating real-time machine learning algorithms to enhance rider safety and responsiveness, and also consider integration with emerging technologies such as edge computing for more efficient data processing and analysis.

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Automatic Power Factor Correction Panel for Minimizing the Consequence in Industrial Area

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ABSTRACT

This paper describes the project implemented for Programmed Power Factor Correction Panel by using Microcontroller in industrial sector to minimize penalty. In industries a huge load is inductive nature, this load draws more reactive power for current magnetization. This reactive power is waste and not used for actual work and causes low power factor. This results in power issues, losses as well as higher electricity bills and heavy penalties. To reduce these losses, penalties we need to improve Power Factor. Our project is used to reduce penalty which is caused by low power factor in the industries as well as at any platform where power factor is low. Power factor show how efficiently given power is utilized. Low power factor increases the load current as well as losses and reduces efficiency of equipment or system. Aim of our project is to compensate reactive power by capacitor switch with programmed control using microcontroller 8051.In our project we are using microcontroller (AT89S52/C51) of 8051 family. It has advantages that it reduces cost of extra hardware that is timer, A DC and RAM. To reduce penalty, the problem is need to maintain power factor within boundary. This device corrects power factor by measuring crossing of voltage in addition current waveform and thereby phase angle among voltage and current. Then measures the requirement of reactive power and determines capacitor required, accordingly switches capacitors in circuit using relay. Capacitors are automatically taken in system and power factor of the system is then shown on display.

KEYWORDS: *Power factor, Microcontroller8051, Power, Capacitor bank, Penalty, Transformer, LCD.*

INTRODUCTION

In Industries, load is inductive in nature. It includes motors, furnaces likewise. As current drawn by load is large it increases size of conductor used to give supply to the system. And increases cost for conductor also, more reactive power is drawn by the system there is loss of power, reduction in efficiency of supply system. Low power factor means you are not utilizing power efficiently and because of that electrical supply company charges penalty to consumer, whose premise's power factor is lower than given limit. And this limit is 0.97, consumer power factor should not be less than 0.97. If it is less then consumer charged with heavy penalty. In previous methods, power factor was improved to reduce losses, improve efficiency by shunt or static capacitor, synchronous condenser, phase advancer and it is done manually. In our project we are improving power factor automatically by switching capacitor through the relay in the circuit by using microcontroller. Capacitor fulfills the requirement of reactive power by the system. Our project is used to reduce penalty which is caused by low power factor in the industries as well as at any platform where power factor is low. Power factor show how efficiently given power is utilized. Low power factor increases the load current as well as losses and reduces efficiency of equipment or system. Aim of the project is to compensate reactive power through capacitor switching with programmed control using microcontroller 8051. In our project we are using microcontroller (AT89S52/C51) of 8051 family. It has advantages that it reduces cost of extra hardware that is timer, ADC and RAM. To reduce penalty, the problem is need to keep power factor within limit. This device corrects power factor by measuring crossing of voltage and current waveform and thereby phase angle among voltage and current. Then measures the requirement of reactive power and determines capacitor required, accordingly switches capacitors in circuit using relay. Capacitors are automatically taken in system and power factor of the system is then shown on display.

Objective

1. To design and implement microcontroller based P.F. correction panel to recover the P.F. of the system to wanted value about greater than 0.9.
2. To improve the use of active power efficiently.
3. To reduce the losses and improve the efficiency of the system.

4. To avoid penalty charged by electricity Supply Company due to low P.F.

5. To get automatic power factor correction.

LITERATURE SURVEY

M. Chandana, et al. [4] discussed Power Factor improvement techniques which can be implemented for power system, industries and for residential to make efficient use of power and increases efficiency of system and equipment. In this work they use microcontroller so it reduces cost as it reduces the cost of additional equipment like timer, ROM, RAM. But in this care must be taken for overcorrection of power factor otherwise system or equipment becomes unstable also capacitor life reduces. Arpitha Raju, etal[5] discussed that P.F. correction can be used for power system, industries microcontroller is used cost is reduced. Maintenance should be taken that overcorrection can rises voltage and current so its unstable equipment and system and capacitor banks life diminishes. Ashwini Kokate, etal. [3] they have implemented by the allot the process used to overcome the power loss due to low factor unlimited with same residential and minor industrial unit. The static capacitors are used in industries to recover the power factor in industry & distribution areas. They use capacitor one when power factor of any distributed line can also be improved in small cost and less rating capacitors. Chaudhary Deepak, etal.[6] The power factor correction methods can apply in the industries to make the system is stable and due to the system becomes constant and efficiency of the system increases. Use of microcontroller several parameters is controlled; the switching of the capacitor bank is done automatically. Marayan Nabihah Zaidi & Adlan Ali. [7] discussed that Power factor correction and also for household for making them stable and also for increasing efficiency of system. As can be useful by the electrical Utility to advance the constancy and effectiveness of the Transmission network or, it can be fixed by the Electrical purchaser to decrease costs charged by the Electrical provider. Form paper it is seen that Inactive PFC require lager inductor than active PFC but it Stationary cost fewer. This is an informal method to precise the Non linearity in a load with capacitor bank but it none as operative as active PFC. Energetic PFC is a power electronic system that improved the Wave shape of current tired via a load to accurate the Power factor. The aim is to keep the power factor Corrected look purely resistive so that the voltage and current remain in phase and the reactive power consumption is zero Sagar S. Patil and R. A. Metri, [8] In this article author present harmonics problematic which is created by non-linear load for removing the harmonics shunt active filter is used. S. S. Patilet, etal.[9] This article recommends the pi with SMC controller for eliminating the harmonics. Anant Kumar Tiwari [10] explained that the automotive power factor correction with capacitive load banks is actuale ffective as it diminishes the cost by decreasing the power strained from the supply. As it works automatically, workforce Are not essential and this Automated Power factor Correction via capacitive load banks can be secondhand for the industries purpose in the future. APFC panel helps to Overcome this by keeping power factor close to unity. APFC can be used in industries like Automobile Industries, Metal Industries, Cement Industries, Textile Machinery, Windmill &Power Station, Printing Industries, Hospitals, Malls, Banks, etc. Prasad Phad, et al. [11] They have implemented by the small power factor mains to the growth in the load current, rise in power loss, and reduction in efficiency of the total system. In this paper we are consuming a technique of the reactive power compensation by capacitor switch with automatic control using microcontroller 8051.

EXISTING APPROACH

Power Factor

$$\cos\emptyset = \frac{VI\cos\emptyset}{VI}$$

Power factor is cosine angle among voltage and current. In the industrial sector power factor is most concerned factor. if power factor is not maintained then this effect on overall system. Most of time for less power factor industry are responsible for penalty. there are some existing methods with the help of that power factor will be improved. With the help of passive filter & active filter it is possible to improve the power factor but economically it is costly.

Causes of Low Power Factor

1. Lamps which are operated with chokes and ballast.

2. Transformer at no load is very inductive and therefore have low power factor.

3. Motors like induction motor and generator also.

Equipment which consists inductive load causes low power factor. As inductive load produces magnetic field, for this it draws more current and reactive power. Therefore, it rises apparent power and the effect is low power factor, low efficiency of apparatus or arrangement.

Power Factor Improvement Techniques

Small power factor means you are not utilizing power efficiently and it draws more current than for high power factor. For the equivalent quantity of active power used for actual work. To recover the low power factor of inductive load reactive power is injected in circuit via capacitor bank. Capacitor fulfills requirement of reactive power of inductive load. For linear load, low power factor can be compensated by passive network of capacitor and inductor.

Passive PFC- It consist large inductor in compare is on with active power factor correction, but cost is low than active PFC and it is easy to correct nonlinearity by capacitor but not efficiently as active PFC.

Active PFC- It improve wave shape of current to improve PF. As it forms purely resistive load, so phase angle between V and I become zero, and reactive power consumption is reduced as PF improved.

There are various conventional methods for improving or correcting PF are as follow:

Static capacitor-This method is most widely used. They supply reactive power to load, required by inductive load for magnetizing work

Synchronous condensers- When synchronous motor operated at no load in overexcited condition, it act as capacitor and draws leading current therefore t can improve lagging PF.

Phase advancer- It is used to recover PF of induction motor. Reason of low PF is that its stator draws the exciting current which lags voltage by 90.

PROPOSED APPROACH

Automatic power factor correction panel is designed by using microcontroller (AT89S52/C51). This system collects the data and analyzes to correct PF. Current and voltage sign are taken from core ac supply through current transformer and potential transformer.

The voltage and current signal are the converted into square wave by using ZCD. V and I sample signal then feed to two interrupt pins of microcontroller that is INT0 and INT1. The phase angle difference which is indicated by difference between the starting of both V and I waveform.

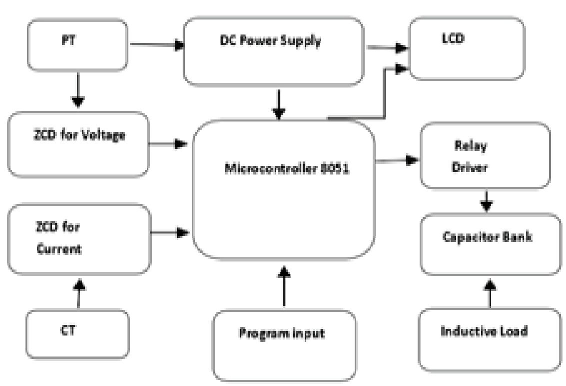

Fig. 1: Block diagram of APFC

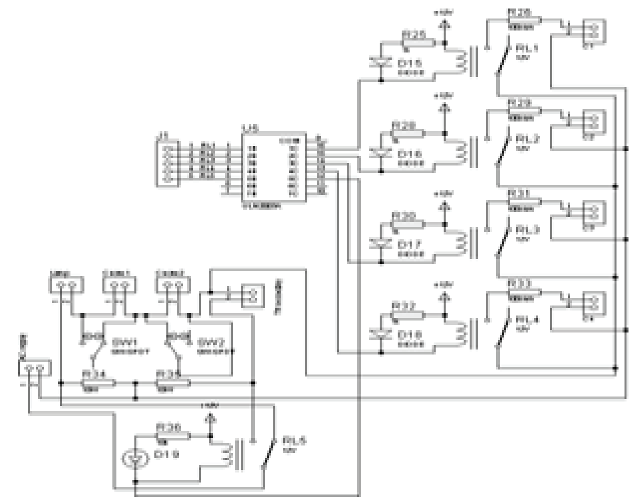

Fig.2. Block Diagram of Proposed System

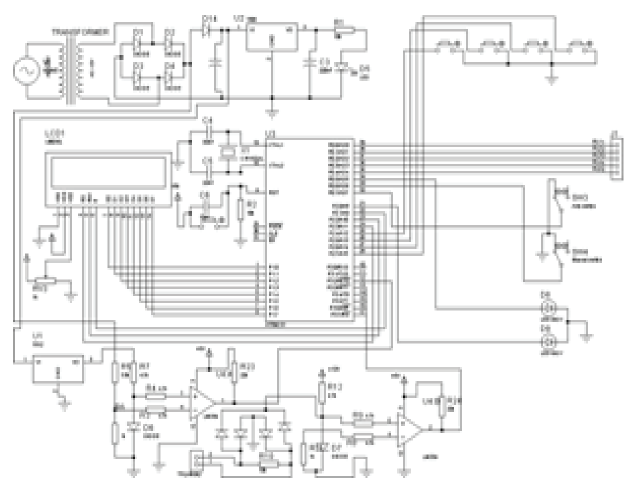

Fig. 3: Circuit Diagram of Proposed System

SIMULATION RESULTS

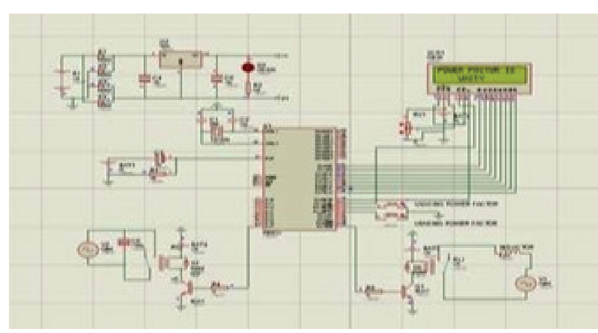

Fig. 4: Automatic Power Factor Correction Panel Simulation on Proteus

In simulation, were present the overall concept of project. We use two switches which gives signal to microcontroller that load is lagging or leading. Here two relays used which can connect capacitor or inductor when relay is operated. In simulation here unity power factor shown, as it is virtual for min practice as we implement project it will be less than unity but near unity.

HARDWARE

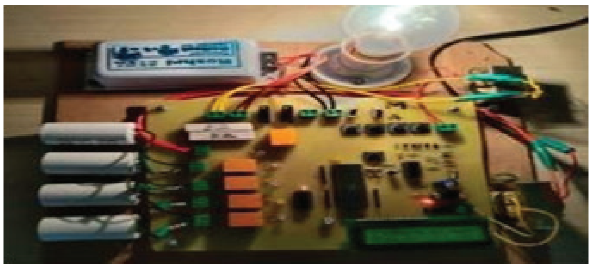

Fig. 5: Hardware Implemented of APFC

Fig. 6 : Hardware Implemented of APFC–R Load

Fig. 7: Hardware Implemented of APFC–RL Load

The hardware for RL Load with P.F. of 0.95 which displayed on LCD.

Case1: As soon as Resistive load in circuit, as shown in fig. 6 Then there is negligible or not one phase angle among the voltage and current. So, in this case power factor of the load is near 1.00 and that is shown on LCD is 0.98 to 0.99.

Case 2: When inductive load is also connected in circuit, here is phase angle among voltage and current signal. Microcontroller monitors system, sense the phase interruption and giving to lag it adds the required rate of capacitor to accurate the power factor of system.

Table 1: Proposed system Results

Load	P.F. without Capacitor	P.F. with Capacitor
R load(60W)	0.99	0.99 with Capacitor Off
L load (40W)	0.4	0.95 with two Capacitor On
RL Load	0.8	0.95 with one Capacitor On

Table1 shows the result of proposed system which shows P.F. for R, L, RL Load with and without Capacitor and also showing how many capacitors is on and off.

CONCLUSION

It is observed that power factor shows how efficiently power is used by consumer. Power factor is most important for electrical supply utility and consumer. When power factor utilized by consumer is below limit then utility charges heavy penalty to consumer. To minimize these penalties, we need to improve this power factor, so by installing desired value of capacitor in circuit power factor is improved to 0.9 to 0.95. Then it reduces losses and improves efficiency of system or equipment. In this paper we projected advance way of power factor improvement by using microcontroller 8051. As we use microcontroller it reduces some additional cost of extra hardware such as RAM, ROM, timer, input and output ports. Automatic power factor correction panel has many rewards compared to the conventional power factor improvement. It operates automatically so manpower is not required. But care should be taken for overcorrection, it results in more V and I because of which system and equipment becomes unstable, also life of capacitor banks is gets reduced.

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Fast Current Only Based Fault Detection Method in Microgrid Using Real-Time Simulation

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ABSTRACT

A key component of microgrids' effective and dependable operation is their ability to identify faults using simple currents quickly. Because of their separated energy resources and varied load profiles, microgrids need reliable fault detection systems to ensure fast and precise fault identification. This research presents a fault detection method only on the current-based input signal. The detection method just looks at the data that is currently available, it reduces operational complexity and expense by doing away with the need for additional sensors. Current controller, Frequency controller, Power monitory unit, Voltage controller. Rapid separation of problematic segments is ensured by the use of high-speed fault detection, reducing potential harm and loss. By handling the difficulties of real-time monitoring and maintaining the dependability of power distribution systems, this research advances fault detection techniques in microgrids. By putting this strategy into practice, microgrid systems may become more resilient and perform better overall, improving their ability to withstand fault events and act quickly and effectively. A complete simulation using the MATLAB/Simulink platform has been conducted to examine the system's performance using the suggested methodologies. The digital simulator is used to implement the full system in the real-time platform to verify the efficacy of the suggested strategies.

KEYWORDS: *Current controller, Frequency controller, Microgrid, Power monitory unit, Voltage controller.*

INTRODUCTION

A microgrid is a micro, decentralized energy system that may function both on its own and in combination with the larger power grid. It is an example of a small-scale, self-contained electrical network that combines different distributed energy sources (DERs), including energy storage devices, distributed generators, also renewable energy sources [1]. Providing a dependable, robust, and efficient power supply to a particular region, or community. Microgrids are intended to improve energy security and sustainability by encouraging local generation and consumption, in contrast to typical centralized power systems, which generate electricity at huge power plants and transfer it over great distances to end consumers. They provide more control over the generation and use of energy by giving the option to operate independently or link to the main grid [9]. When an electrical circuit fails and deviates from the typical operating parameters, it may give rise to an unusual condition known as a fault in the context of power systems. Power system failures can occur in several ways, including open circuits, short circuits, and other electrical network disturbances [2]. Numerous things, such as defective equipment, unfavorable environmental conditions, or human mistakes, might lead to these errors. Different kinds of short circuit faults might arise from phase to phase, causing an erratic current signal in the MG supply line and MG itself [4]. When these problems appear, the system behaves erratically and becomes unstable. Electrical failures also affect the quality of the electricity supplied to the system [3].It may be dangerous to humans as well as animals and actively affects the operating voltage. Microgrids frequently run separately from the main grid or in conjunction with it. It's critical to quickly isolate any fault that arises within a microgrid to stop it from damaging the main grid or the remainder of the microgrid. Quick isolation is made possible by the location of faults inside the microgrid being determined by quick current-only fault detection techniques. In conclusion, quick fault detection techniques based solely oncurrent are critical to the dependable and resilient operation of microgrids [1]. By using these techniques, microgrids can maintain vital loads, integrate renewable energy sources, react quickly to disturbances, and improve overall grid stability. A lot of hardware, especially in the domain of power systems and power electronics, focuses on real-time simulation technology[7]. A method for simulating real-world systems and processes in a computer environment with incredibly low latency is called real-time simulation. Numerous industries, including power generation, electric vehicles, aerospace, and others, frequently use real-time simulation tools [5]. To save downtime, stop cascading failures, and maintain grid stability, early fault detection in electrical transmission lines is crucial, and this project meets this need. Improving a microgrid's energy management involves fault detection. The microgrid control system can ensure optimal energy flow and usage by shifting electricity, activating backup systems, or adjusting component operation by identifying and isolating problems [8].Frequent fault monitoring gives useful information for maintenance and diagnostics. Recognizing patterns of problems or recurrent defects enables preventive maintenance, which lowers downtime and extends the life of microgrid components overall [10].

MICROGRID

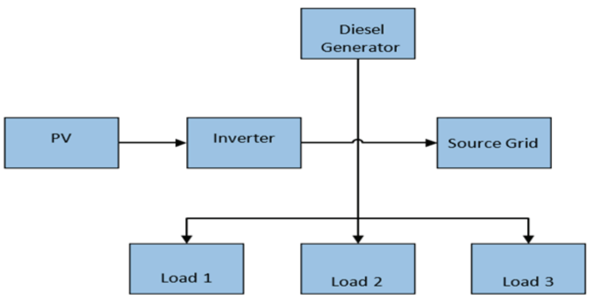

Fig. 1: Block diagram of Microgrid system

PV Array- A photovoltaic (PV) array in the context of a microgrid is a collection of solar panels that transform light from the sun into electrical energy. When a PV array is connected to a microgrid as a load, its solar energy is used inside the microgrid instead of being exported to the larger grid. Matching Loads Within the microgrid, the PV array's energy output can be utilized to supply the local energy needs. When photovoltaic output is high enough, it can balance off the requirement for additional electricity, lowering dependency on outside energy sources.

Inverter- Working of an Inverter in PV is an essential component in transforming the PV Array. It provides the DC power into the AC power appropriate to the microgrid as an inverter. The inverter technologies are engineered to guarantee efficiency, dependability, and compatibility of the electrical properties with the microgrid. This fault detection technique interacts with the inverter in real time when it finds a fault.

Diesel Generator- With a microgrid, a diesel generator functions as a distributed energy resource (DER) capable of supplying electricity as required. A diesel generator is frequently utilized in a microgrid to increase the microgrid's resilience and dependability as a backup power source or as a component of the generating mix. Load of Diesel generators can react dynamically to variations in the microgrid load through sophisticated control systems. They can adjust their output in response to demand, guaranteeing peak performance and fuel economy. Synchronization controls ensure that the generator's frequency and phase match those of the system when it operates in parallel with other generators or the grid.

A pulse Width Modulation- (PWM) is an important component of a microgrid that regulates the voltage and output power of an inverter or power converter using pulse width modulation techniques. In renewable energy systems, such as solar or wind-powered microgrids, this kind of generator is frequently used to change the Direct Current produced with the help of renewable energy sources into alternating current (AC) for usage in the microgrid. The inverter's switches' on/off times are regulated by the PWM generator, which produces a modulated waveform that resembles a sinusoidal AC waveform.

VARIOUS TYPES OF FAULTS IN MICROGRID

The Single line to ground fault is the One conductor who makes contact with the ground or an accidental path to the earth in a single line to ground fault. This defect is frequently seen in one that involves only one phase, or line, and the earth. Through the ground, the fault current flows towards the source [4]. Double Line Fault (DL) is the short circuit between two phases that occurs in this kind of failure without involving the ground. DLG- or double Line-to-ground fault is the two separate single line-to-ground faults that occur simultaneously on separate phases and are referred to as double line-to-ground faults. Here, two conductors independently come into contact with the ground. It is crucial to remember that these two ground faults could occur simultaneously.. Fault Triple Line-to-Ground (TLG) is the three distinct single line-to-ground faults that concurrently occur in order phases and are referred to as triple line-to-ground faults. Although less frequent than the other scenarios, this one is nonetheless possible. Similar to the double line to ground fault, there's a chance that the three ground faults aren't all in one place [5]

HARDWARE

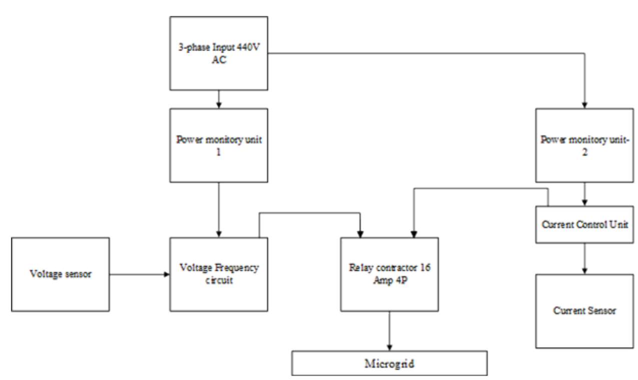

Fig. 2: Hardware of the system

Components Needed for Hardware

Power Monitoring Units: An apparatus called a Power Monitoring Unit (PMU) is used to control and monitor electrical power in a variety of contexts, such as residences, companies, and industries. A PMU may be used in a project hardware environment to track various metrics such as voltage levels, current flow, and power consumption in a system or network of devices. It has the types such as

- Analog Power Monitory Unit
- Digital Power Monitory Unit

Voltage Frequency Control Unit: Circuitry for Voltage Regulation: VFCUs come with circuitry that is intended to control and stabilize voltage levels within specified ranges. This uses transformers, voltage regulators, and power electronics-based control methods including voltage control loops and pulse-width modulation (PWM).

Circuitry for controlling and stabilizing the electrical output frequency within predetermined tolerances is also included in VFCUs.

Current Control Unit: A CCU's main job is to manage and regulate a system's current flow. This frequently entails using power electronic components in different topologies, such as voltage-controlled or current-controlled arrangements, such as transistors (MOSFETs, IGBTs) or thyristors (SCRs). Current is sensed with the help of a current sensor.

Relay: Current Rating: A maximum current of 16 amps is permitted for this relay..

Pole Configuration: The relay has four independent sets of contacts that may be controlled independently, making it a 4-pole. Usually, each pole has two contacts one ordinarily closed and the other normally open that can be connected or absent by switching on the relay coil.

LOAD PROTECTION FOR MICROGRID

Current Control Unit

1. Over Current/Undercurrent
2. Phase Reversal
3. Phase Fail
4. Current Asymmetry

Voltage and Frequency Control Unit

1. Over Voltage/Under Voltage
2. Under Frequency/Over Frequency
3. Phase Reversal
4. Phase Fail
5. Voltage Asymmetry

CONCLUSION

In conclusion, As a result, fast current-based fault detection in microgrids provides a quick and efficient way to find issues, enhancing the overall stability and dependability of these dynamic energy systems. Although it makes the process of detecting faults easier, it is crucial to take into account its compatibility with various microgrid setups and its capacity to integrate with other parameters to achieve thorough and exact fault identification.

ACKNOWLEDGEMENTS

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An Interleaved Boost Power Factor Correction Converter with a Model Predictive Controller

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ABSTRACT

To improve the performance of Power Factor Correction (PFC) converters, the paper offers a unique method of integrating an Interleaved Boost design with a Model Predictive Controller (MPC). For sustainable nonconventional energy sources, the interleaved boost converter is built and simulated. Two-phase DC-DC boosts using interleaving converters provide several advantages over standard boost converters, such as improved power factor, minimal current ripple, and superior efficiency. To raise the power factor, a model predictive controller is used. MATLAB is used to mimic the recommended investigation.

KEYWORDS: *Converter, Interleaved boost converter (IBC), Model predictive controller (MPC), Power factor correction (PFC).*

INTRODUCTION

Due to the rising environmental pollution, sources of renewable energy, such as windmills and solar are replacing traditional ones. This has raised the demand for DC-DC converters. DC-DC converters are used to obtain high voltage gain and to increase the voltage supplied to the necessary output voltage [1]. Power electronics research on bidirectional power converters has expanded substantially in importance. Bidirectional converters allow electricity to move both waysas opposed to traditional unidirectional converters[2]. The benefits of high output power, tiny filtering volume, and low current ripples make an interleaved boost converter (IBC) a practical choice for rectifying the power factor (PFC) [3].

The power factor, an essential component of electrical systems, measures how well electrical power is transformed and used. Power Factor Correction (PFC) converter research has been widely researched due to the need for enhanced power quality and energy efficiency in today's power systems. The main subject of this work is the Interleaved Boost Converter, which has included benefits such as greater power density, increased stability, and less component stress [4]. An important and modern technique for controlling electrically powered machines and power converters is the Model Predictive Controller MPC. The inverter must be in every feasible switching state to apply this control strategy. When it comes to flexibility in limitations, multivariable cases, basic nonlinearities, and added system needs, the MPC approach outperforms the PI controller and PWM procedures. For power converter commands in apps that run in real-time, MPC may be the best option [5].

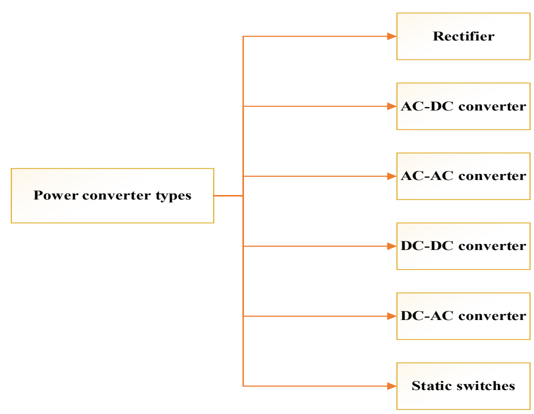

Fig. 1. Types of Power Converter

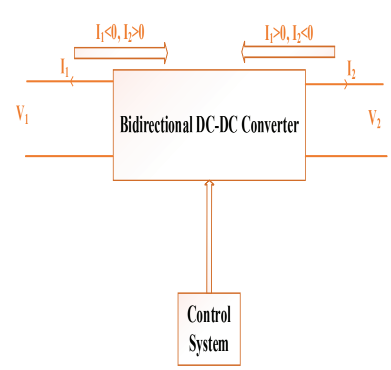

Fig. 2. The structure of a bidirectional DC-DC Converter

Converters are crucial parts of many systems, and their functions vary according to the particular needs of the system. As seen in Fig. 1, the main functions of the various types of converters can be generally characterized. Converters are categorized as either buck, boost, or buck-boost depending on how high or low the output voltage about the input voltage. A bidirectional DC-DC converter is a type of DC-DC converter that is specifically created to make it easier for electrical energy to go both ways between two DC sources. Bidirectionaltopologies minimize system size and increase system performance by integrating energy storage components and power sources. This eliminates the need for two separate forward and backward power flow converters. The bidirectional DC-DC converters' overall design. As shown in Fig. 2, the main functions of a bidirectional DC-DC converter are Bidirectional Grid integration, renewable energy systems, electric vehicles (EVs), power transfer, energy storage systems, etc. [2] [6].

A Model of Predictive Controller Electric drives, power electronics, and power system applications now frequently use MPC as a controller alternative. MPC manifests in two different ways while controlling power electronics. Careful analysis of the input and output variables, accurate plant model selection, suitable controller parameter tuning, and proper variable selection for the cost function are the main advantages of any process that effectively applies the MPC technique. This paper describes research that looks at how controller performance changes and focuses on applying the MPC technique to interleaved boost converters [7]. The maximum bandwidth is provided by MPC, which can handle both linear and nonlinear models. Predictive control methods for boost converters have been well studied [8].

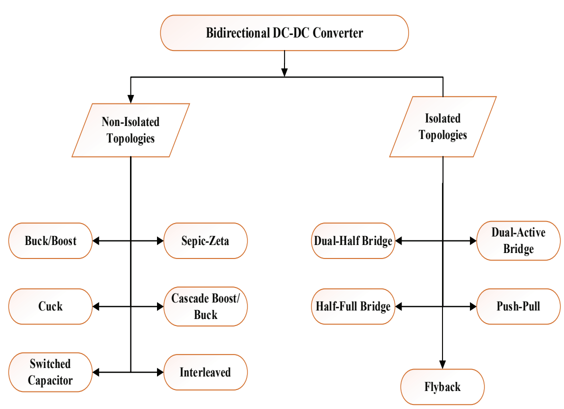

Fig. 3. Bidirectional DC-DC Converter

Bidirectional DC-DC Converter designs may be classified into two main fundamental groups: isolated and non-isolated topologies. Without requiring magnetic separation, power is transported across non-isolated topologies. Despite this, the non-isolated topologies are less complicated in terms of configuration and are not impacted by the drawbacks of galvanic isolation, such as magnetic interference or undue weight. They also lack the benefits of galvanic isolation, such as a high step-up voltage gain ratio. Thanks to these attributes, they are suitable for circumstances where size and weight are important factors. Moreover, as Figure 3 illustrates, other designs are mostly based on voltage-boosting methods, such as switched capacitors and interleaved multilayers [2] [9].

INTERLEAVED BOOST PFC CONVERTER

Fig. 4. shows an illustration of a two-phase interleaved boost converter schematic diagram. To create two parallel channels between the input and output circuits, inductor L1 and inductor L2, switch Q1 and switch Q2, and diode D1 and diode D2 must be placed in parallel. The circuit makes use of all identical components to accomplish interleaving functionality [1].

The diodes D1 and D2 are in the off state and the switches SI and S2 are activated when the inductor currents increase. The output load current is provided by the capacitor C1. Fig. 5 illustrates a schematic that shows the conduction route during this period.

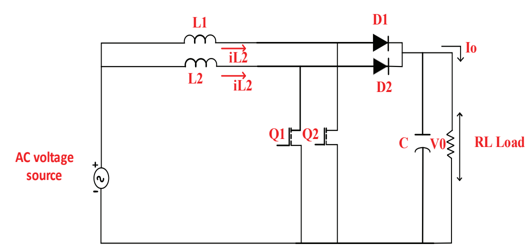

Fig. 4. Schematic diagram of Interleaved Boost Circuit

$$\frac{diL1}{dt} = \frac{Vs}{L1} \tag{1}$$

$$\frac{diL2}{dt} = \frac{Vs}{L2} \tag{2}$$

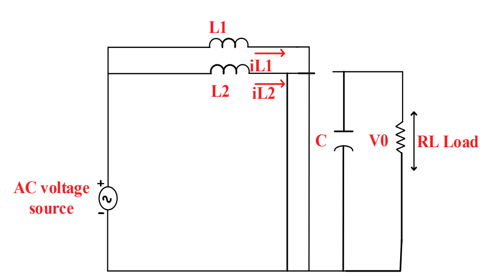

Fig. 5. Equivalent circuit during mode 1

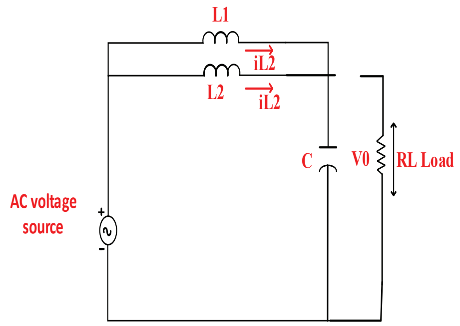

Fig. 6. Equivalent circuit during mode 2

In mode 2, switch Q1 is in the on position, switch Q2 is in the off position, and D1 is in the on position, while D2 is in the off position. Figure 6 shows the operation of mode 2.

$$\frac{diL1}{dt} = \frac{Vs}{L1} \tag{3}$$

$$\frac{diL1}{dt} = \frac{Vs}{L2} - \frac{V0}{L2} \tag{4}$$

In mode 3, the relevant diodes, such as D1 and D2, are in the on and off states, respectively, while the switches Q1 and Q2 are in the off and on states. The IBC operating in mode 3 is seen in Figure 7 [1] [8] [11].

$$\frac{diL1}{dt} = \frac{Vs}{L1} - \frac{V0}{L1} \tag{5}$$

$$\frac{diL2}{dt} = \frac{Vs}{L2} - \frac{V0}{L2} \tag{6}$$

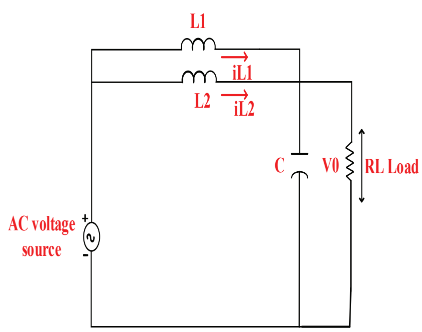

Fig. 7. Equivalent circuit during mode 3

MODEL PREDICTIVE CONTROLLER

An optimizer and a plant model are part of the MPC methodology. The cost function (CF) is minimized by the optimizer at each sampling moment. The plant model uses a set of optimum control inputs (u) produced by the optimizer to anticipate the value of the output variable in the future.

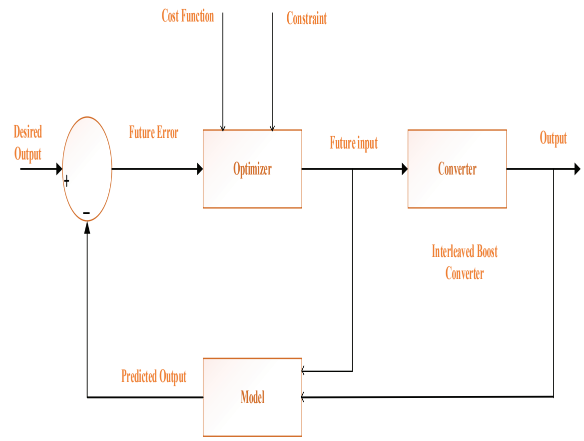

Fig. 8 MPC control block diagram of IBC

The cost function is a mathematical expression that quantifies the performance or optimization of the control inputs over a finite prediction horizon [5] [7].

$$J=\sum_{K=0}^{N-1} L\big(x(k),u(k)\big) + M\big(x(N)\big) \tag{7}$$

Where: J = total cost,

N = prediction horizon,

x(K) = as the system is at time k,

u(K) = input control at time k,

L = stage cost,

M = terminal cost.

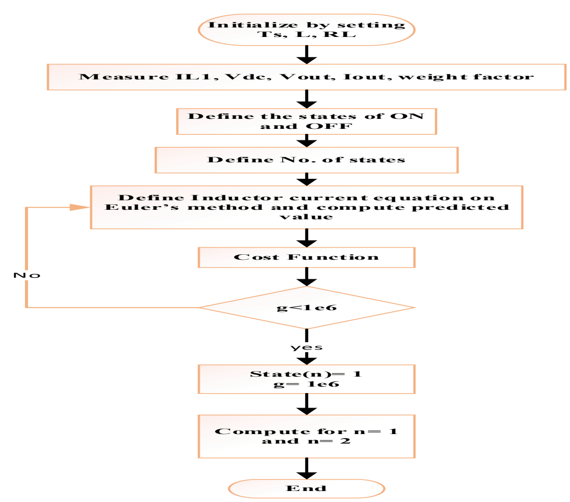

Fig. 9 Control Algorithm of MPC

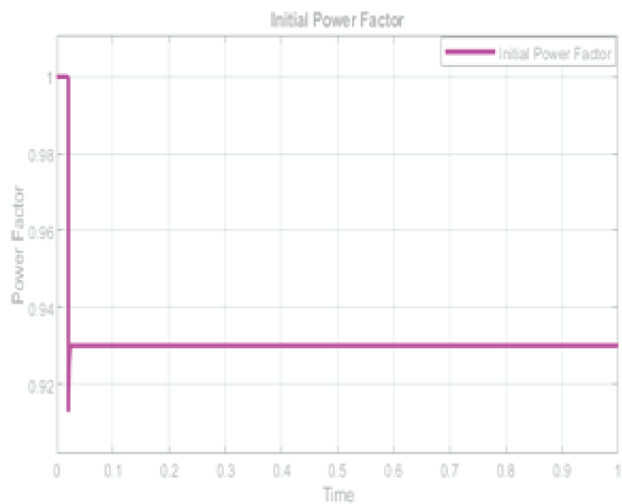

Fig. 10 Initial Power Factor

The inductor current is essential to energy transmission and the general functioning of the Boost Power Factor Correction (PFC) interleaved converter using Model Predictive Control (MPC). Equations 8 and 9 represent the Inductor currents iL1 and iL2 respectively

iL1=(Ts⁄L)*(Vin-iL1*RL-Vout*(1-States(n))+iL1(8)

iL2=(Ts⁄L)*(Vin-iL2*RL-Vout*(1-States(n))+iL2 (9)

Euler's method is a widely used numerical technique for estimating an ordinary differential equation's (ODE) discrete-step solution. Euler's method should be considered when considering system dynamics numerical integration inside an MPC framework, even if it is not the primary tool for Model Predictive Control (MPC).

FIGURES AND TABLE

The logical flow of the method is shown visually in this flowchart, which facilitates comprehension of the MATLAB code's execution sequence.

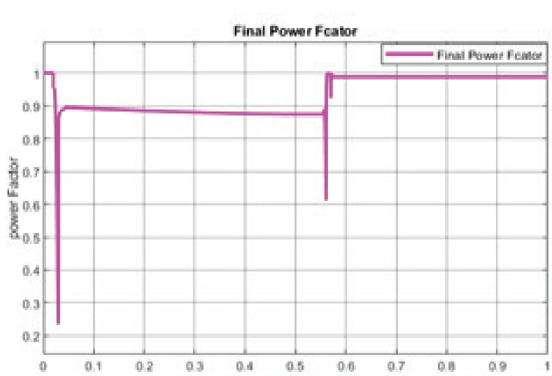

Fig. 11 Final Power Factor

Sr. No.	Component	Rating
1	AC source	325V, 50Hz
2	Register	1000 ohm
3	Inductor	2000e-3H
4	Inductor L1 and L2	10e-3H
5	Capacitor	2000-6F

Table 1. Design value of interleaved boost converter

CONCLUSION

To sum up, one promising way to improve efficiency is to use Model Predictive Control to power factor adjustment using interleaved boost converters. By improving the energy economy and delivering power with reliability, the study aims to develop power electronics. The aim was to examine the efficacy of Maximum Power Compensation (MPC) in real-time interleaved converter control for dynamic power factor optimization.

ACKNOWLEDGEMENT

The management of Shivaji University and Walchand College of Engineering Sangli are much appreciated by the writers for providing the resources needed to carry out this research.

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Design and Fabrication of Semi-Automatic Roof Cleaning Machine

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ABSTRACT

Clean and professional office space facility strengthens production, builds a healthy workplace, and is compatible with all employee's Department of Safety and Health requirements. Cleanliness is the most important part because dust particles can cause the industry to lose order can reduce the efficiency of devices and these dust particles can also cause the product to fail. Therefore, high industrial ceilings should be repaired, after a certain period. High-roof dry dust cleaning machine (HRDDCM) will help clean ok dust particles and dry dust particles are considered distinct factors that make the industry have a high ceiling, where people's hand hygiene can be life-threatening.

KEYWORDS: *Cleaning, Health, High ceiling, Industry, Safety.*

INTRODUCTION

Generally speaking, industrial hygiene is used in industrial buildings such as factories, warehouses, power plants, and other similar buildings. There is no easy way to define factories, power plants, and other industrial cleaning facilities because areas where there are many types that an architect may encounter. It can be large spaces like factories, factories, warehouses, other industrial areas industrial cleaning office cleaning. Such work requires on-the-job training and a thorough understanding of safety procedures. Are special tools available or chemicals that industrial cleaners must use to do their job? Cleanliness is as important in any industry as dust can be it destroys the production process in the factory, and employees are injured. So that's one plan designed to isolate small particles of rust within limited surface area industrial roofs and shade, on an elaborate grid they have to work from the ground up with minimal cleanup labour effort and avoidance of labour hygiene hazards life. High Roof Dry Dust Collector Mechanism (HRDDCM) is a manual cleaning operation machine safest and the most effective way to clean industrial roofs up to 15 meters high, walls and ventilation systems in different sectors. In addition to this, the machine also cleans areas where the machines are not there. They use the designed device from the ground up, so it's safe and cost-effective. We can pick up a wide variety of brushes and tools as well as resources to help repair less accessible areas. The manual, chemical and mechanical cleaning methods cannot meet hygiene requirements. It is a manual cleaning the most common approach today. There is a roof manpower was used to clean it with wire brush scrubbing. This process is time-consuming and tedious. In the traditional approach of cleaning, cleaners need to climb on top of those roofs and carry out the cleaning operation through scrubbing with the help of wire brushes. This technique is tiring and at the same time, it consumes a variety of time. Also, the man or woman sporting out the cleaning operation can critically injure himself, if he falls off the roof inflicting accidents. There are probabilities of a man or woman getting unconscious due to extended publicity to warmness in the course of warm weather conditions. Cleaning roof surfaces is a hard mission, as the floor isn't always even and now tends to break easily upon mechanical loading. However, a no. of attempts have been made to cleanse the various roof surfaces at present, only a few are devoted towards industrial roof cleansing.

It's especially crucial on shaded or much less sun-exposed areas, like the north and west sides of roofs. Cleaning also can enlarge the roof's functionality and prevent troubles like oxidation on steel roofs. Maintaining a clean roof is not just much aesthetics; it is also about retaining the structural integrity of your house. Regular cleaning prevents damage because of debris buildup and guarantees your roof's durability.

PROBLEM DEFINITION

Problem Statement

Cleanliness is the most important factor in the industry because dust particles can harm the industry. It can reduce machinery and infrastructure these dust particles can also cause failure. Cleanliness particles and dust particles are considered distinct factors that make the industry have a high ceiling, where human signature cleanup can be expensive or life-threatening.

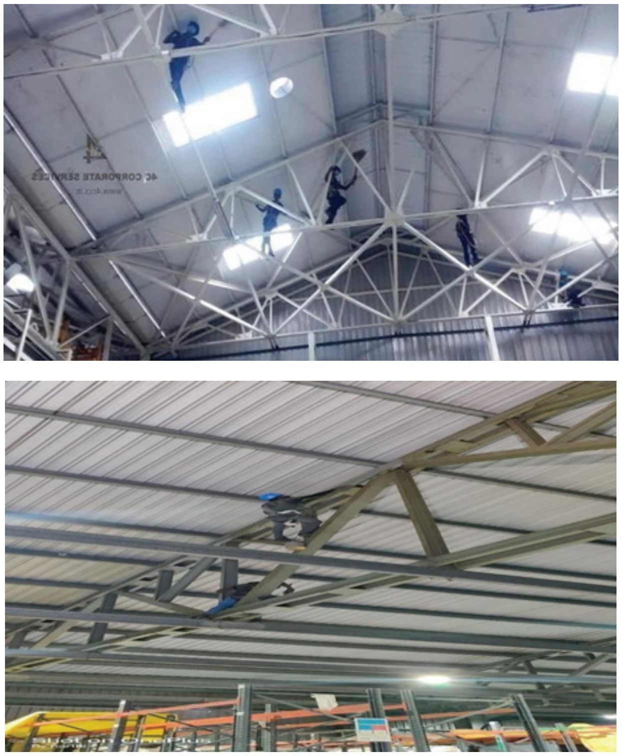

Fig. 1: Industrial Cleaning

The industry should have high-quality roof cleaning cost-effective as compared to existing systems of about 4- 5 lakhs, where small businesses get it is very important to wash according to standards. They need to be organized changes in maintenance and control for the customer. The user should reduce the weight of the storage pipe to avoid other occupational health issues and save time on cleanliness.

The purpose

Industrial Hygiene Management (HRDDCM) is the safest and most efficient way to reduce the altitude of the building.

(HRDDCM) system for low purity reduces a lot of time as man-hours compared to many independent cleaners.

This design reduces both effort and burden-operated cleaning and labour supply support to a long length of suction pipe.

OBJECTIVES

1. The Ceiling cleaning process is one of the most difficult tasks involved in getting rid of algae, moulds, lichens, dust and algae from the surface.
2. The roof is complicated to clean while the ceiling height is also very high another human effort is needed which also feels reproductively comfortable, in addition to muscle pain.
3. Considering all the challenges above, we should have a semi-automatic roof cleaner capable of cleaning dirt, grime, mud and more on the rooftops.
4. Enabling the device on access to rooftops and heights that are difficult to reach the higher things.
5. An electrical drive is provided for user-friendly control of the machine so that it can be achieved with greater accuracy by someone with less technical background.
6. To build devices that will consider personal safety, save time as well don't mess with the fake roof. This style of decorating the roof can be guest rooms, offices etc. giving you a more attractive appearance. This method is short, medium and large applications.

CONCEPTUAL DESIGN

Designed with ease of access in mind operating, maintenance, scheduling, and cost savings. Most of them are the important parameter is the weight of the device and its easy access to the roof. The design is a simple frame mounted on some driver wheels.

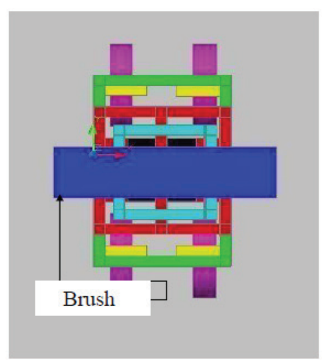

Fig. 2(a) Top View

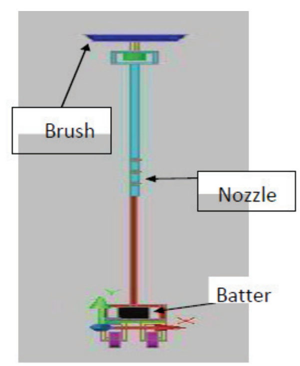

Fig. 2(b) Front View

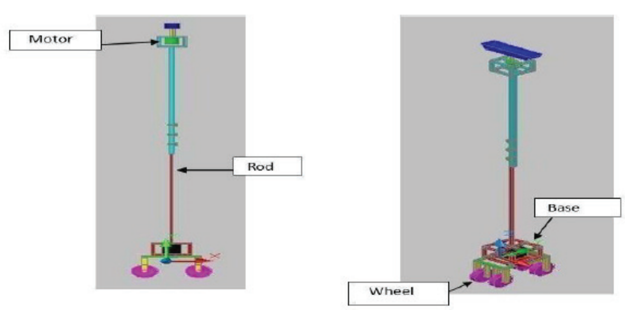

Fig. 2(c) Isometric View

LITERATURE SURVEY

Rohit Patil says Current developments: Remotely controlled robots & control systems for cleaning the inner walls of the duct, more especially remotely controlled robots and a control system for proper cleaning of side walls and roof walls and the bottom wall of the tap despite the change in slope duct and to easily check the clean condition of a duct in real-time and after cleaning process, improvement comes from within duct cleanliness status and so on reduces maintenance time. [1] Asifali A described feature of self-driving vehicles' internal wall cleaning devices is a rectangular tube with horizontal top and bottom walls and the walls of the vertical side, together, form a chassis, a means of transportation attached to said floor wall and auxiliary traction chassis up there to get there, a reversible and the drive motor mounted on said chassis operates associated with said modes of transportation in connection with the transportation of goods, the suction pump is mounted on said chassis near the front the end of that is ventilation and exhaust drive motor on that chassis and operational connection the suction pump has a removable filter receptacle attached to it suction pump and in communication with said air, a removable brush carrier suction head connected to said suction pumps types.

Bedis Prachi K says automatic rectifiers in the program, no dust rolls are considered during cleaning especially dust containing small particles e.g. invisible fine dust and sand. Because most of the cleaning is done with a self-cleaning agent in the confined space of a maintenance area, the dust that has become the cleaning is collected on the ground and then rounded. [2]

Roof cleaning involves removing algae, mould, lichen, and moss from roofs, which can be challenging due to height and slippery surfaces during rainy seasons. A semi-automatic roof cleaning machine is designed to tackle this issue, capable of cleaning various substances on roofs with reliable slopes and accessing hard-to-reach areas at higher altitudes. It features user-friendly controls for individuals with limited technical knowledge, prioritizing safety, time efficiency, and preventing damage to the roof structure. This method is applicable for various settings such as hotels and offices, enhancing the aesthetic appeal of the buildings, and is suitable for small, medium, and large roof cleaning projects.

ADVANTAGES

1. Requires less manual labor.
2. You can cleanse and shine at the same time.
3. We can use a brush to clean up dirt and dust.
4. Takes less time to operate.
5. With mechanical brushes and mops, this machine will reduce maintenance time and finish the job faster.
6. Low power consumption.
7. These machines cost very little in terms of maintenance.

CONCLUSION

Roof repairs are not common in today's environment the practice in a country like India, is that it is done with his help somewhere he's tired of it. These workers are forced to climb onto the roof perhaps for free and stand at much higher heights for security measures. Intention to generate an idea of a Semi-automatic ceiling cleaning machine, with due respect and concern for the safety of these workers. This device will work and enable individuals to perform roof cleaning services with little physical effort and no effort accommodation.

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Eight Discipline Methodology, a Structured Problem Solving Technique for Small-Scale Industry

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ABSTRACT

The application of the 8D technique in small-scale companies entails several important factors, such as resource limitations, team makeup, and the scalability of solutions. Smaller businesses might not have specific teams for quality improvement, but they can still solve problems more effectively by involving people from diverse departments in cross-functional teams. Furthermore, performing root cause analysis and creating workable solutions can be facilitated by utilizing straightforward but powerful problem-solving tools and methodologies.

Small-scale industries can systematically address quality concerns and minimize defects, improve customer happiness, and boost competitiveness by implementing the 8D technique. In addition, the 8D methodology's systematic approach helps SSIs find and fix the core causes of issues, which stops them from happening again and promotes a continuous improvement culture.

KEYWORDS: *Continuous improvement, Problem-solving, Resource constraints, Root cause analysis, Quality improvement.*

INTRODUCTION

Many disciplines are generally worried about "8Ds" method. The tools used may be observed in textbooks and reference materials utilized by exceptional guarantee specialists. As an instance, an "Is/isn't always" worksheet is a not unusual tool employed at D2, and Ishikawa, or "fishbone," diagrams and "5-why evaluation" are commonplace gear employed at step D4. In the past due 1990s, Ford developed a revised version of the 8D procedure that they named "worldwide 8D" (G8D), which is the present-day international widespread for Ford and lots of different companies in the automotive supply chain The manual for this method was initially published in 1987 and is titled crew-oriented problem-solving (TOPS). Ford World Headquarters in Dearborn, Michigan has served as the pilot site for the manual and any ensuing guidance materials. Ford calls their state-of-the-art model G8D (global 8D). The widely used Ford 8Ds guide covers bankruptcy through a chapter that explains how to approach identifying, measuring, and resolving technical problems. It starts with a purposefully mobile group and ends with a problem-solving solution that has been successfully implemented.

The "8Ds" approach often causes concern in several fields. One can see the instruments in textbooks. The major revisions to the process are as follows:

- Including a D0 (D-Zero) step at the beginning of the procedure. The team records the symptoms that prompted the attempt at D0, as well as any emergency reaction activities (ERAs) that were carried out before the official start of the G8D. D0 also incorporates standard assessing questions meant to determine whether a full G8D is required. The assessing questions are meant to ensure that in a world of limited problem-solving resources, the efforts required for a full team-based problem-solving effort are limited to those problems that warrant these resources.
- The concept of escape points is added to D4 through D6. The earliest control point in the control system that comes after the root cause of an issue and should have identified it but didn't is known as an "escape point." The objective here is to think about what went wrong with the control system to let these problems escape alongside attending to the fundamental cause. To comply with International 8D, the group must locate and confirm an escape route at D4. The team is then required under D5 and D6 to select, confirm, carry out, and validate long-term corrective measures to address the escape point.

Currently, there are notable applications of the 8D technique outside of the automotive sector. It is widely used in food production, health care, and high-tech production industries as part of lean initiatives and continuous improvement methodologies.

Fig. 1: Eight Disciplines Methodology

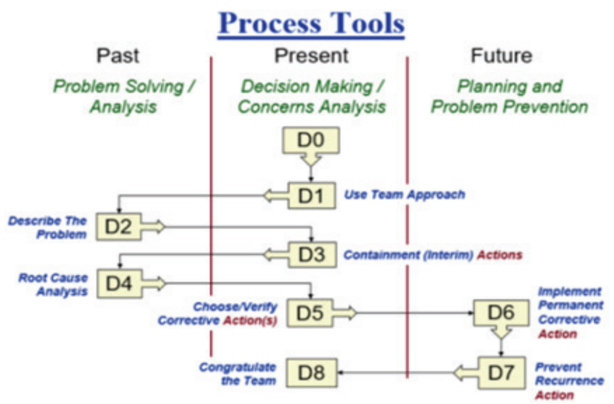

Fig. 2: Eight Discipline Method as a Process Tool

The automotive manufacturer Ford created the Eight Disciplines technique (8D), which is a method or version of traditional problem-solving techniques that is typically employed with the assistance of good engineers or other experts. Focused on developing products and procedures, its goal is to identify, address, and eliminate common problems. Identifying the root causes of the problem, it generates a lasting solution that depends solely on the statistical assessment of the issue at hand and its genesis. Although it started with eight levels, or "disciplines," it was eventually expanded to include a stage for early strategy design. 8D adheres to the PDCA cycle's basic principles.

WHY APPLY EIGHT DISCIPLINES OF PROBLEM-SOLVING (8D)?

The reason the 8D method is so well-liked in the industry is that it provides your engineering team with a consistent, comprehensive, and observable way to address any issues that may arise at different points along your manufacturing technique. When used properly, you can expect the following advantages:

- Greater familiarity with a framework for solving issues;
- Improved team-oriented resolving issues abilities rather than reliance on the individual;
- Creation and growth of a database of previous failures and lessons learned to prevent difficulties in the future;
- Improved proficiency with the essential statistical resources needed for solving problems;
- Boosted efficiency and efficacy in resolving issues and practical understanding of Root Cause Analysis (RCA);
- Increased effectiveness in solving issues discussions through more open and transparent communication;
- Greater understanding of problems by management.

Designed to convey best-in-class approaches to problem-solving, 8D improves the quality and reliability of your products and equips your engineering team to tackle future obstacles when used efficiently.

LITERATURE REVIEW

The 8D problem-solving approach, according to Khalid Mahmood, is a thorough and practical method used to tackle problems in a variety of areas, such as manufacturing processes in factories and across the entire supply chain, including sub-suppliers, production, product design, and services. Protecting client interests while putting corrective measures in place is its main goal. Production enterprises must manage their operations in a way that ensures sustainability and minimizes the impact on the environment. This includes compliance with government regulations and environmental goals outlined in agreements like the Paris Agreement and the Sustainable Development Goals for 2030. [1]. He also compares the available methods of problem-solving with the 8D methodologies as shown in the given table.

Table 1. Comparison between problem-solving methodologies

Concept	Origin	Aim	Focus	Method
Six Sigma	Motorola (1987)	Improve process capability	Reduce variations in process inputs	Lesson learn use to implement change
Total Quality Management (TQM)	Japan Panasonic (1990s)	Improve quality and processes control	Customer Complaints Management	Resources matrix of consumption, vogue results.
8D	Ford Car (1980s)	Solve complex problems	Reduce failures and implement solutions	8D methodology Implemented

Scope Parameters	8D	DMAIC
1. Provides Structure	Yes	Yes
2. Provides containment action evaluation	Yes	No
3. Provides concepts and tools	No	Yes
4. Data driven	No	Yes
5. ISO standards available	No	Yes

Table 2. Comparison of scope as per Anand Bewoor

Anand Bewoor draws attention to the DMAIC framework's adaptability in combining equipment and data-driven methodologies. Nonetheless, there are situations in which the 8D process is better, especially if the client is already dealing with a serious issue that has important commercial ramifications. As recommended by DMAIC for short in such critical circumstances, an "immediate response" technique is necessary to solve the problem right away rather than looking into its underlying causes. However, especially in cases when the problem is complicated, it should be handled as a Six Sigma project if it becomes necessary to eliminate the underlying cause. It is clear from the case study covered in the paper that there aren't many significant distinctions between the two methods. The main difference is seen in the third stage of the 8D approach, which is called. [2]

Rajeev Rathi emphasizes the 8D methodology's adaptability in examining the underlying causes of production firms, resolving implementation issues, contrasting Agile and Lean measurements, and incorporating different Lean principles. Even if it seems intimidating at first, with the right instruction, its efficacy can be understood by using tried-and-true methods like the Pareto principle. When integrated with current processes, its interoperability with Lean Six Sigma improves efficiency and requires less training. Although it can be used independently, it is more frequent and advantageous to combine it with other approaches. Despite initial concerns, understanding its functions and importance is critical for every company. The method's organized approach improves problem-solving abilities, helps detect and resolve challenges consistently, and helps avoid failures in the future. [3]Arturo Realyvásquez-Vargas analyzes in his evaluation report how the 8D methodology's use has improved production system efficiency and effectiveness by utilizing statistical methods and techniques at low operating costs. Furthermore, the implementation of the 8D method has enhanced the organization's competitiveness for safety and quality. It has also greatly increased managerial and staff dedication, accountability, and involvement. All of these improvements have streamlined and improved the organization's problem-solving process, particularly when it comes to assigning tasks to lower organizational levels. Additionally, the 8D technique speeds up the process of gathering problem data and shortens the time it takes for operations and quality groups to communicate. In order to prevent losses, minimal organizational modifications or greater care from engineers may be required during the execution phase when difficulties develop. Successful strategy implementation requires effective communication. [4]A major component of 8D methods for problem-solving, according to Sevilay Uslu Divano˟glu, is dealing with both chronic problems and failure occurrences. The uniqueness of this study has become its application of the 8D technique for addressing active and persistent failures; it also offers a ground-breaking analysis of well-known technologies, like the methodologies of Failure Mode Effect Analysis (FMEA) and Value Stream Mapping (VSM), that fall under the 8D framework, providing a new model and an efficient approach. The study's objectives are to reduce quality failures and maximize operational efficiency in the context of lean production by implementing the 8D technique, including quality techniques like Failure Mode Effect Analysis (FMEA), within the automotive industry. [5]

METHODOLOGY

- The Eight Disciplines Techniques (8D) represents a methodology or approach. centred on improving processes and products
- It creates a permanent corrective action based on a statistical study of the problem and on the problem's genesis by identifying the fundamental causes.
- Its objective is to locate, address, and eliminate persistent issues.
- Although it started with eight phases, or "disciplines," an initial planning stage was added later.
- 8D adheres to DMAIC and PDCA cycle logic.

Fig. 3: PDCA Cycle

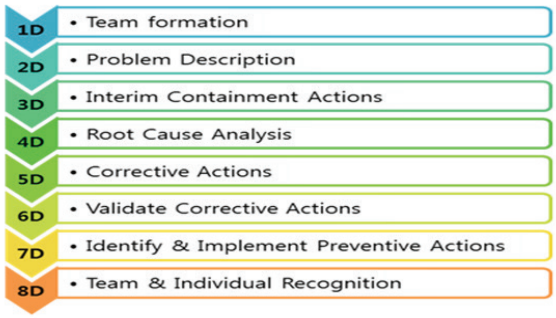

Fig. 4: 8D Steps

What is 8D?

1D: Team Formation

The 8D method is employed for tackling real-world problems through collaborative teamwork. It relies on a coordinated and guided effort where the team comprises individuals actively engaged in the process and assigned specific tasks. These teams are typically small in size, consisting of members best suited to address the issue at hand.

2D: Problem Description

The possibility of a solution arises with a detailed problem description. Facts must be used to solve problems rather than views, with an emphasis on being clear about the nature of the problem, how often it occurs, and how much of a failure it is. Clear and precise descriptions help the team prioritize work and move toward a conclusion. For example, deciding on containment measures requires knowledge of defective products that have already been delivered to a consumer. The basis for efficient problem-solving is a well-described problem.

3D: Interim Containment Action

Intermediate containment measures are essential in this 8D stage to reduce the impact of the problem on the customer while we find the root cause and carry out long-term corrective steps. To be sure these acts do not trigger more issues, they need to be carefully recorded with precise details. Product codes, lot numbers, and dates are examples of specific data that are necessary to confirm the efficacy of these measures.

4D: Root Cause Analysis

Even in rare instances where numerous causes may exist, locating and removing the problem's core cause is crucial to successfully preventing recurrence. To identify the underlying cause, a methodical and thoroughly documented investigation that weighs all potential influences against the issue description and test results is necessary. The identification of root causes may be challenging and frequently hidden other other factors. For this reason, a variety of analytical techniques, including Is/Is Not, Five Whys, and Ishikawa Fishbone, are required.

5D: Corrective Actions

Corrective actions aim to eradicate the root cause and prevent the issue from recurring. Thorough documentation is crucial for each action, with assigned responsibilities and planned implementation dates. Upon completion, the actual implementation date and results must be recorded. Multiple corrective actions are typically required for each identified root cause.

6D: Verification of Corrective Actions

Verifying that the steps carried out in phase 5D were successful in removing the underlying problem is the goal of the 8D step. If it turns out that the primary reason hasn't been adequately treated, more steps need to be taken. Periodically, it might be required to go back to step 4D's investigation of root causes and repeat the cycle.

7D: Preventive Actions

At first, step 7D in the 8D report can seem identical to step 5D. But where they diverge is in their ultimate objective and purpose. Preventative activities in step 7D concentrate on removing possible problems' causes and preventing them from happening in the future, whereas steps 5D and 7D try to stop the recurrent occurrence of current problems. The activities in Step 7D are anticipatory and focused on possible future occurrences. These decisions are frequently supported by findings from FMEA analyses or undesirable trend observations. Specific concerns make one consider possible problems that might occur with the same method or product.

8D: Team and individual recognition

Following the 8D process, it's critical to record lessons gained and recognize the contribution of every member of the team as well as the work of the organization. This gives the Champion a chance to thank everyone who helped to resolve the problem. In industries such as assembly and automotive, the 8D methodology has become the norm, requiring a methodical and systematic approach to problem-solving that is team-based.

CONCLUSION

The methodology emphasizes collaborative teamwork, thorough problem description, interim containment actions, root cause analysis, corrective actions, verification of corrective actions, preventive actions, and team and individual recognition. Through these steps, organizations can address both existing issues and potential future problems, fostering continuous improvement and innovation. The 8D Technologies serves as a powerful tool for organizations seeking to address complex problems, improve operational performance, and meet customer expectations in today's competitive business environment.

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A Review on Roof Cleaning Machine

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ABSTRACT

Cleaning the windows of high-rise buildings often comes with significant costs and requires a considerable workforce. Traditional methods involve using specialized tools and teams to ensure safety while cleaning the exterior surfaces. While the vacuum cleaner provides thorough cleaning, it is bulky, expensive, and prone to prolonged cleaning times and potential failures. On the other hand, the lifting cable cleaner, although fast, does not deliver satisfactory cleaning results. To address these issues, the proposed cleaner integrates lifting and suction mechanisms, along with rubber wheel support to ensure smooth movement. This approach aims to optimize the design for better performance. Previous research has explored similar solutions, such as a handheld greenhouse cleaning device that utilizes rotary brushes and water spraying for dust removal. Experimental models incorporating deceleration motors and vacuum methods have demonstrated viable cleaning principles, despite facing challenges related to complexity and cost. Nevertheless, the combined approach shows promise for efficiently and effectively cleaning glass surfaces in high-rise buildings.

KEYWORDS: *High-rise building, Significant cost, Considerable workforce, Specialized tools, Safety.*

INTRODUCTION

In our day nowadays life cleansing performs an important role public places like airports, Railway stations, hospitals, and malls are cleaned often. Without cleaning there is a chance of unfolding in diseases. Usually, cleansing uses a high-quality concept approximately the region. Now afternoon COVID-19 is a deadly disease disorder that forces us to smooth our surroundings regularly to avoid spreading of ailment. There are many various types of cleaning machines or devices on the market nowadays for each business and home use. In recent years, floor cleansing robots have become greater famous for busy and ageing populations due to a lack of workers. However, in India, unemployment is greater and for this reason, there is a want to increase less labor-orientated cleansing devices. Hence, the existing paintings are aimed at the layout, improvement and evaluation of a manually operated street and floor greenhouse cultivation, as a new frontier in modern agricultural improvement, has steadily converted the traditional planting approach. It performs a critical role in boosting crop yields, enhancing first- rate, and ensuring off-season vegetable availability in China. While artificial intervention permits the advent of the finest growth situations, prolonged utilization ends in the accumulation of dirt on greenhouse surfaces and the capacity increase of algae, impacting light transmission. [1]

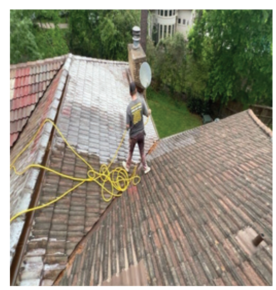

Fig. 1: Conventional Roof Cleaning

However, due to the massive peak and huge span of greenhouses, traditional guide cleaning proves hard and yields subpar results. In current years, both domestic and global researchers have substantially studied greenhouse cleansing devices.

Fig. 2: Conventional Under Roof Cleaning

This paper examines the shape and concepts of diverse greenhouse cleansing machines and outlines the predicted development trajectory of the greenhouse cleansing era in China.

LITERATURE REVIEW

S. Rajesh explains in his work traditional methods of cleaning high-rise building windows involve manual labour and climbing equipment, resulting in significant time and cost consumption. Consequently, there is an increasing demand for unmanned cleaning devices. This project aims to develop a compact climbing cleaning machine utilizing suction cups to adhere to glass surfaces, integrating features from existing cleaners for improved efficiency. These existing cleaners are categorized into two types: vacuum chamber cleaners, known for their high cost and weight, and lifting cable cleaners, which offer speed but compromise on cleaning quality. The proposed combined cleaner incorporates both a lifting mechanism and suction cups to ensure stability on glass surfaces, complemented by rubber wheels for seamless motion. Operated by a microcontroller, the cleaner is equipped with a rotating brush for effective cleaning. While the lifting mechanism can be manually operated, the cleaning process itself is automated. [1]Dajun Chen describes a pioneer in managed-surroundings agriculture; the Netherlands has made great strides in greenhouse technology studies and development. The US has correctly advanced and deployed glass greenhouse cleaners and multi-span plastic greenhouse cleansing devices. The glass greenhouse cleaner contains a strolling unit, cleaning equipment, and a manipulation machine. Utilizing adjoining ditches as self-going walk tracks, the machine employs smooth, non-water-absorbing brushes to dislodge dust from the greenhouse floor, flushing it into the ditches.

Moreover, a mobile platform, controlled through computer programming, allows particular motion management, facilitating automated shifts all through cleaning operations. [2]To eradicate manual scavenging nationwide by August 2021, the government aims to revise legislation to mandate mechanized cleaning. To integrate mechanized methods for cleaning sewers and septic tanks under the Manual Scavenging Act, the term 'manhole' will be substituted with 'machine-hole' in the official documentation. Despite the country's inclination towards cost-effective alternatives due to the perceived low value of life, the adoption of robotic cleaning is hindered by its higher costs. One of the most pressing global challenges concerning sewage sludge revolves around its treatment and disposal, influenced by factors like volume, weight, and pollutants released into the environment. The progress in robotics has enabled robots to address various practical challenges encountered by humans regularly [3]This project introduces a finite element-based durability assessment for a novel ceiling fan blade cleaner. Its objectives include designing a portable, versatile, and ergonomic cleaner that is easy to operate. The study focuses on sponge and plastic materials commonly used in the industry. The structural three-dimensional solid modelling of the ceiling fan cleaner was developed using SolidWorks software. The obtained results demonstrate that both surfaces of the ceiling fan blades are effectively cleaned when using a sponge, with dust and cobwebs collected in the dust-box. The durability assessment findings are instrumental in enhancing component design during the early development phase, reducing costs, and time to market, and enhancing product reliability and customer confidence. [5]In urban areas of India, the traditional method of sewage disposal involves manual scavenging, wherein individuals enter manholes to manually clear scales and clogs without any technical equipment.

This practice, aside from being unhygienic and posing health risks, has often resulted in fatal accidents. Therefore, sewer workers should be prohibited from entering sewage systems for block removal, except in exceptional circumstances such as damaged manhole doors caused by heavy vehicular traffic or blockages where mechanical equipment cannot be utilized. Instances, where human entry is unavoidable, include interlinking sewer mains, removing malfunctioning submersible pump sets, or repairing damaged manholes or sewer lines. Mechanization is crucial to replace human intervention in sewage cleaning, as it can pose serious risks to human lives. Advances in mechanization over the past few decades have introduced machinery and mechanical equipment capable of addressing various practical challenges encountered daily. This paper examines the mechanization of manual scavenging and the role of mechanical equipment in modern sanitation practices. Keywords: Mechanization, Sewage, Manual scavenging, Mechanical equipment. [6]

METHODOLOGY

Existing Problems in Greenhouse Cleaning Equipment Development

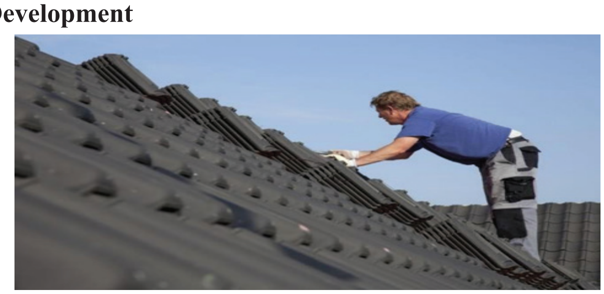

Fig. 3: Climbing on the roof

Lack of Attention and Standardization: Despite the advanced development of greenhouse cleaning systems in countries like the Netherlands, there's a lack of attention and standardization globally. Many farmers have traditionally taken into consideration that greenhouse cleaning is useless and are hesitant to invest in mechanical cleansing answers.

In China, unique challenges arise due to versions in greenhouse materials, making plans, and layout, necessitating adaptability in the greenhouse cleansing system.

Fig. 4: Roof cleaning with a water jet

Simple Equipment and Inadequate Cleaning Performance

Currently, most of the greenhouse cleansing equipment evolved in China lacks sophistication, automation, and stability. Consequently, manual labour is still required to a large extent for greenhouse cleaning, main to unsatisfactory cleaning effects.

Research Gaps and Need for Refinement

While glass greenhouses and plastic arch sheds have acquired a sizeable interest in terms of cleaning gadget development, there may be a study hole concerning sunlight greenhouses, a universal kind in northern China. Sunlight greenhouses are favoured for his or her low fees, lightweight, and powerful environmental regulations. However, studies on cleansing equipment for sunlight greenhouses stay largely at the patent degree, with no dedicated studies teams or equipment available. g.

Traditional methods of roof cleaning involve manual labour, which can be time-consuming, dangerous, and inefficient. Moreover, the use of harsh chemicals or high-pressure washing techniques can damage the roof surface and the surrounding environment. Therefore, there is a need for a conventional roof cleaning machine that can automate the cleaning process while ensuring gentle yet thorough cleaning without causing any damage.

Fig. 5: Before and After

Fig. 6: Conventional cleaning method

OBJECTIVES

Current Challenges in Roof Cleaning

Traditional methods of roof cleaning often involve manual labour, which is time-consuming, labour- intensive, and potentially hazardous. Additionally, the use of harsh chemicals or high-pressure washing techniques can damage the roof surface and the surrounding environment. Therefore, there is a growing need for automated and environmentally friendly solutions to address these challenges.

Existing Roof Cleaning Technologies

Several roof cleaning technologies exist in the market, ranging from manual tools such as brushes and scrapers to more advanced equipment like pressure washers and chemical treatments. While these methods are effective to some extent, they often lack efficiency, safety, and environmental sustainability.

Advantages of Conventional Roof Cleaning Machines

- Conventional roof cleaning machines offer several advantages over traditional methods. These include:
- Automation: Conventional roof cleaning machines automate the cleaning process, reducing the need for manual labour and improving efficiency.
- Safety: By minimizing the need for workers to climb onto roofs, these machines enhance safety and reduce the risk of accidents and injuries.

Key Features of Conventional Roof Cleaning Machines

- Mechanical Brushes: Conventional roof cleaning machines often incorporate mechanical brushes or soft bristles to scrub away dirt, debris, and contaminants from the roof surface.
- Low-Pressure Water Jets: Some machines utilize low-pressure water jets to dislodge stubborn stains and grime without causing damage to the roof.
- Safety Mechanisms: To ensure user safety, these machines are equipped with features such as automatic shut-off mechanisms, emergency stop buttons, and protective barriers.

CONCLUSION

In conclusion, conventional roof cleaning machines represent a promising solution to the challenges associated with manual roof cleaning methods. By combining automation, safety, and environmental sustainability, these machines offer a more efficient, cost-effective, and environmentally friendly approach to roof maintenance. Continued research and innovation in this field are essential to advance further the capabilities and adoption of conventional roof cleaning machines.

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Design, Development and Experimental investigation of Miniature Moving Magnet Pulse Tube Cryocooler

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ABSTRACT

The pursuit of compact and efficient cryogenic refrigeration systems is imperative across scientific, industrial, and medical domains, particularly in space exploration where ultra-low temperatures are essential. This research presents a comprehensive study encompassing the design, development, and experimental validation of a miniature moving magnet pulse tube cryocooler tailored for space applications. The design phase prioritized portability, cooling efficiency, and reliability, resulting in the integration of a moving magnet compressor and pulse tube mechanism. Meticulous conceptualization and component selection ensured optimal performance within constrained space environments. The development process focused on precise fabrication, assembly, and calibration to translate the conceptual blueprint into a functional prototype. Experimental investigations rigorously evaluated the cryocooler's performance under diverse operational conditions, analyzing critical parameters such as cooling efficiency, power consumption, and transient response. The compact design renders the cryocooler well-suited for space applications, offering potential benefits for cooling sensitive instruments and scientific experiments in extreme environments. This research represents a significant advancement in compact cryogenic refrigeration technology, underscoring its potential for widespread adoption and addressing emerging challenges in cryogenic cooling applications, particularly in space exploration.

INTRODUCTION

Pulse tube refrigeration systems have undergone substantial development since their introduction in the mid-1960s, primarily in response to the growing demand for reliable and efficient cryogenic cooling solutions. The evolution of pulse tube refrigerators has been driven by continuous efforts from researchers and engineers aimed at improving their design and performance. Progress in technology and a deeper comprehension of thermodynamics have significantly contributed to enhancing the efficiency and effectiveness of pulse tube cryocoolers.

Operating Principles of Pulse Tube and Thermoacoustic Refrigerators

Pulse tube refrigerators operate by utilizing pressure oscillations to produce cooling effects, while thermoacoustic refrigerators generate cooling using acoustic power, eliminating the need for moving parts. The efficiency of both types of refrigerators is influenced by factors such as phase shifts between flow and pressure, acoustic streaming, and compliance effects. A comprehensive understanding of the thermodynamic processes involved in these refrigeration systems is vital for maximizing their performance.

Recent Advances in Improving Efficiencies of Pulse Tube Cryocoolers

We've devised mechanisms to create beneficial phase shifts between flow and pressure in pulse tube refrigerators. Innovations like inertance tubes and compliance components have been introduced to boost the efficiency of pulse tube cryocoolers. Furthermore, techniques such as acoustic streaming effects and thermal buffer tubes have been employed to amplify acoustic power and improve cooling performance. Additionally, flexure-bearing compressors and mechanical pressure oscillators have been developed to ensure high efficiency in small-scale cryocooling systems.

ASSEMBLY OF MINIATURE MOVING MAGNET PULSE TUBE CRYOCOOLER

Here's how a moving magnet pulse tube cryocooler generally works

Basic Components

- Compressor: Provides high-pressure gas to the system.
- Cold Head: The part of the cryocooler that achieves the desired low temperatures.
- Pulse Tube: A tube that cyclically expands and contracts to create a temperature difference.
- Moving Magnet: The piston or displacer driven by an electromagnetic motor.

Principle of Operation

- The compressor compresses the working gas (typically helium) to a high pressure.
- The compressed gas is fed into the pulse tube where it is then expanded and contracted by the movement of the piston (moving magnet).
- As the gas expands and contracts in the pulse tube, it undergoes adiabatic cooling and heating cycles.
- These cycles create a temperature difference along the length of the pulse tube.
- At the cold end of the pulse tube, the gas cools significantly, and this cold gas is then directed to the cold head.
- The cold head interfaces with the target cooling surface, absorbing heat and lowering its temperature.

Role of the Moving Magnet

- The moving magnet serves as the driving mechanism for the pulse tube.
- It moves back and forth within the pulse tube, creating pressure oscillations that drive the refrigeration cycle.
- The movement of the magnet is typically controlled by an electromagnetic motor.

Advantages

- Compact Size: Moving magnet pulse tube cryocoolers can be designed to be relatively small compared to other cryogenic cooling systems.
- Vibration-Free Operation: Since there are no moving parts in contact with the cold end, vibration levels can be minimized, making them suitable for applications requiring stability.
- Applications:
- These cryocoolers find applications in various fields including infrared detectors, medical imaging, spectroscopy, and space missions where compact, reliable cooling systems are required.

Challenges

- Achieving high efficiency and cooling power at very low temperatures can be challenging.
- Designing reliable and durable moving magnet systems that can withstand the harsh operating conditions of cryogenic environments.
- Overall, moving magnet pulse tube cryocoolers offer a promising solution for achieving low-temperature cooling in compact and reliable systems, making them valuable in a wide range of scientific and industrial applications

Generator/Displacer

- In a pulse tube cryocooler, the generator and displacer are critical components that contribute to the operation and efficiency of the system. They play distinct roles in the thermodynamic cycle of the cryocooler. Let's delve into their functions:
- Generator:
- The generator is a heat exchanger located at the warm end of the pulse tube cryocooler.
- Its primary function is to transfer heat from the working gas (typically helium) to the ambient surroundings.
- During the compression phase of the cycle, the working gas is pressurized by the compressor and then enters the hot end of the pulse tube.
- In the generator, the high-pressure gas releases heat to the surroundings, causing it to cool down and lose energy.
- This cooling of the gas in the generator is essential for maintaining the thermodynamic cycle and ensuring that the gas is sufficiently cooled before entering the expansion stage.
- Displacer:
- The displacer is a moving component within the pulse tube cryocooler that helps to create the necessary pressure oscillations.
- It is typically driven by a piston or moving magnet mechanism.
- The displacer's movement creates pressure differences within the pulse tube, which drive the cyclic compression and expansion of the working gas.

- During the compression phase, the displacer helps to compress the gas in the pulse tube, leading to adiabatic heating.
- Conversely, during the expansion phase, the displacer helps to expand the gas, leading to adiabatic cooling.
- The displacer's motion is carefully controlled to ensure efficient heat transfer and fluid dynamics within the pulse tube.

Both the generator and displacer are integral to the operation of the pulse tube cryocooler, working in tandem to create the necessary thermodynamic cycles for cooling. The efficiency and performance of the cryocoolerdepend significantly on the design and optimization of these components, along with other critical elements such as the pulse tube, regenerator, and cold head. Improvements in the design and engineering of these components can lead to enhanced cooling capacity, reduced energy consumption, and improved reliability of the cryocooler system.

In a cryocooler, the pulse tube is a key component that plays a crucial role in the thermodynamic cycle responsible for achieving cooling. The pulse tube cryocooler operates on the principle of the Stirling cycle, utilizing the oscillating flow of a working gas (usually helium) to transfer heat from the cold end to the warm end of the system. Here's how thepulse tube functions within a cryocooler:

Basic Structure: The pulse tube is a sealed, elongated tube typically made of a highly conductive material such as stainless steel or copper. It is often equipped with a regenerator at one end and interfaces with the cold head at the other end. The pulse tube is designed to cyclically expand and contract, generating pressure oscillations within the working gas.

Compression and Expansion: The pulse tube cryocooler begins its cycle with the compression of the working gas. As the gas is compressed, it enters the pulse tube where it is then directed towards the cold end. At the cold end, the gas undergoes expansion due to the pressure oscillations generated by the displacer or moving magnet mechanism. During expansion, the gas cools adiabatically, absorbing heat from the surroundings and lowering the temperature of the cold end.

Heat Transfer: As the gas expands and contracts within the pulse tube, it undergoes cyclic temperature changes. The regenerator, often located near the cold end, helps to enhance the heat transfer process by capturing and releasing thermal energy during the compression and expansion phases. The pulse tube facilitates the transfer of the cooled gas from the cold end to the warm end, where it is then reheated and compressed again in the next cycle.

Efficiency and Optimization: Designing the pulse tube for optimal performance involves considerations such as length, diameter, material selection, and geometric configuration.

The geometry and dimensions of the pulse tube are tailored to maximize heat transfer efficiency and minimize losses due to friction and thermal resistance.

Computational fluid dynamics (CFD) simulations and experimental testing are often used to optimize the design and performance of the pulse tube.

Applications: Pulse tube cryocoolers find applications in various fields including cryogenic research, medical imaging, infrared detectors, and space exploration.

They offer advantages such as compact size, low vibration, and high reliability compared to traditional cryogenic refrigeration systems.

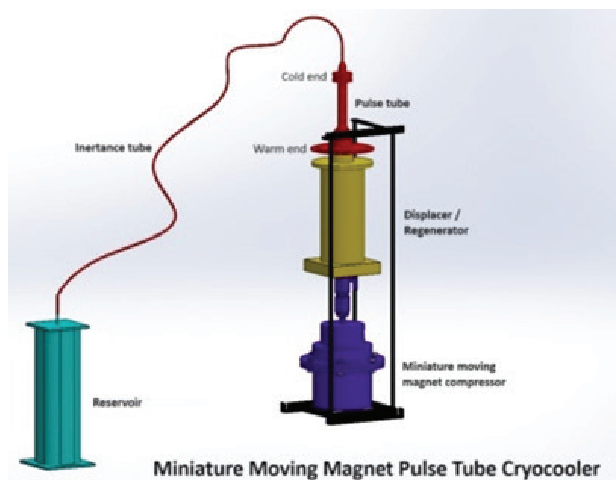

Fig. 5: Miniature Moving Magnet Pulse Tube Cryocooler

CONCLUSION

The culmination of the study on "Design, Development, and Experimental Investigation of Miniature Moving Magnet Pulse Tube Cryocooler" marks a significant advancement in the field of compact cryogenic refrigeration systems. This research journey has illuminated various critical insights and advancements, underscoring the potential of the developed cryocooler and laying the groundwork for future innovations in cryogenic cooling technology. Beginning with the design phase, meticulous planning and component selection underscored the importance of balancing performance and practicality. By integrating a moving magnet compressor and pulse tube mechanism, the cryocooler design showcased adaptability and ingenuity, setting the stage for subsequent development and experimentation. The development phase served as a pivotal moment, where theoretical concepts materialized into functional prototypes. Precision in fabrication, assembly, and calibration resulted in the realization of a miniature moving magnet pulse tube cryocooler. This successful execution affirmed the feasibility and promise of the proposed design, propelling the research forward towards empirical validation.

Experimental investigations formed the cornerstone of the research, providing invaluable insights into operational dynamics and performance characteristics. Rigorous testing under diverse conditions facilitated comprehensive assessments of parameters such as cooling efficiency and power consumption. The empirical data served as a catalyst for refining performance and optimizing design, driving iterative enhancements towards greater efficiency and reliability. The compact nature of the developed cryocooler holds vast implications across various domains, from portable scientific instruments to aerospace systems and medical devices. Its ability to deliver efficient cryogenic cooling solutions in constrained environments signifies transformative potential for numerous industries. In conclusion, this research represents a substantial contribution to compact cryogenic refrigeration technology.

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Optimization of Process Parameters in Drilling of Composite Material (GFRP)

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ABSTRACT

Now a days in machining industries optimization of parameters plays an important role during drilling operation. This paper represents the optimization of cutting parameters such as spindle speed, feed rate and tool material in drilling of glass fibre reinforced polymer (GFRP). In drilling operation of GFRP, the surface roughness of hole is an important aspect which results in maximum stress on bolts and rivet, towards to damage of component. In the experiment conducted three factors are chosen such as depth of cut (DOC), feed rate (FR) and spindle speed (SP). The range and levels for every factor are chosen from manufacturer's catalogue for drilling operation. The experimentation was carried out by using design of experiment methodology i.e. Taguchi L18 orthogonal array was used. From ANOVA result it is observed that, tool material having more influence than that of feed rate. The obtained optimum parameters are as SP 1000 rpm, FR 0.05 mm/ rev and tool material solid carbide.

KEYWORDS: *GFRP, Drilling, Surface roughness, Cutting parameters, DOE.*

INTRODUCTION

In engineering domain, the technology of material has identified the use of composite materials plays an important role for enormous applications, with respect to its chemical and mechanical properties. During the first phase of fabrication the tentative shape of composite material is fabricated. According to dimensional accuracy point of view the shape of composite structure is obtained from adequate machining [1]. The present work focused to reduce the damage by optimizing the drilling parameters while drilling of GFRP material [2-3]. While drilling of GFRP materials it is observed delamination is a major problem associated with it. Peel-up and pullout are the two delaminations where as related to the peel-up delamination mechanism [4-5]. The responses of drilling experiments, such as torque, tool wear delamination, tool life depends on the process parameters and tool parameters. Process parameters include feed rate, spindle speed and temperature whereas tool parameters include tool geometry and tool material. Before the conduct of experimentation such studies are useful in predicting the responses by carefully selecting the process [6-7].

EXPERIMENTAL PROCEDURE AND METHODOLOGY

Strategy of experimentation is nothing but planning and conducting the experiments. There are following steps which include in the strategy of experimentation. The selected work piece material for experimental work is GFRP material. The Tool material Solid carbide twist drill, HSS drill (ϕ = 10mm) is used while doing experimentation. The process factors, SP, FR, tool material were chosen while taking the experimental trials. According to principle of design of experiment and as per design data book; levels for each factor are chosen as follows and Table 1 indicates controlled factors.

Table 1. Controlled parameters

Sr. No.	Process Parameters	Levels		
1	SP (r. p. m.)	800	1000	1300
2	FR (mm/revolution)	0.05	0.1	0.15

3	Tool material (ϕ=10mm)	HSS	Solid carbide	

Experimental Design

There is need for a systematic methodological approach by using experimental methods. The DOE is an effective method while conducting the experiments. Experiment is done by using three spindle speeds, three feed rates and two tool materials [8]. Depending upon the factors chosen and there levels, a suitable experimental design L18 orthogonal array is selected. Experimental work is carried out by using design of experiment principles. Randomization: With this principle order of experiment to be carried out are selected randomly. Due to systematic bias between trials is avoided. Replication: Replication implies repetition of run of each factor combination. Blocking: Blois used to restrict the range of levels in factor. This principle is used to reduce variability in experimentation due to factors in which we are not interested. For experimental work following orthogonal array is used [9-12]. Three values of spindle speed, three values of feed rate, and two types of tool materials-32x 21= 18 trials.

Experimental set up

According to methodology and as per requirement of experimentation of composite material GFRP [13-14], the following equipment's and instruments are used. The high speed steel and solid carbide twist drill of diameter 10mm is used in present investigation. Drilling operation is carried out on a VMC drilling machine. This machine is controlled by MITSUBISHI M70 control system. Spindle speed of the machine is between 500 to 8000 rpm. Spindle power of this machine is 11×15 KW.

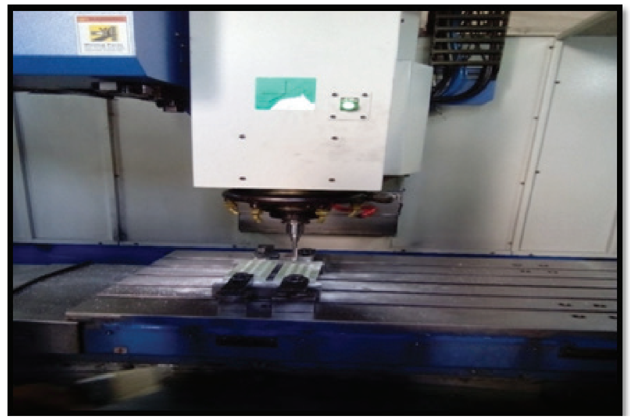

Fig. 1: VMC drilling machine

RESULTS AND DISCUSSION

The experimental runs were taken out on vertical drilling machine by using design of experiment. The trials were taken on Glass fiber reinforced polymer by considering the process factors - SP, FR and tool material and the results are tabulated in Table 2.

Table 2: Surface Roughness Values

Sr. No.	SP (r.p.m.)	FR (mm/rev)	Tool Material	Surface roughness			Mean Ra (µm)
				Trial 1 (Ra 1)	Trial 2 (Ra 2)	Trial 3 (Ra 3)	
1	800	0.05	1	10.68	15.92	16.68	14.42
2	1000	0.05	1	10.39	16.03	16.67	14.36
3	1300	0.05	1	13.49	11.68	17.01	14.06
4	800	0.1	1	14.80	16.41	14.89	15.36
5	1000	0.1	1	10.31	13.49	11.55	11.78
6	1300	0.1	1	12.11	7.60	19.80	13.17
7	800	0.15	1	13.84	14.32	16.36	14.84
8	1000	0.15	1	14.90	12.69	12.36	13.31
9	1300	0.15	1	11.57	19.80	16.08	15.81
10	800	0.05	2	3.31	3.04	4.31	3.55
11	1000	0.05	2	3.52	3.52	4.19	3.74
12	1300	0.05	2	3.50	3.37	3.28	3.38
13	800	0.1	2	6.40	7.43	6.73	6.87
14	1000	0.1	2	6.36	9.04	5.70	7.03
15	1300	0.1	2	8.35	9.24	4.41	7.33

16	800	0.15	2	7.90	9.09	6.61	7.86
17	1000	0.15	2	8.13	6.61	6.30	7.01
18	1300	0.15	2	7.99	7.71	3.50	6.04

ANOVA for S/N ratio

The following Table 3 shows effect of cutting parameters during drilling operation on the response parameter. From Table 3 it is observed that the tool material having greater impact on response parameter as compared to SP and FR. Following Table.3, it is cleared that tool material is more significant (77.89%) parameter while as FR factor has moderate significance (9.6%) and spindle speed is not significant parameter.

Table 3. Response Table for S/N ratio

Source	DF	Seq SS	Adj MS	F	P	% Contribution
SP	2	1.051	0.525	0.14	0.870	0.286
FR	2	35.298	17.649	4.72	0.031	9.6
Tool material	1	286.232	286.232	76.49	0.000	77.89
Error	12	44.902	3.742			12.218
Total	17	367.481				100

Also it is concluded that value of S/N ratio is constantly increased by increasing the spindle speed from 800 rpm to 1000 rpm and decreased by decreasing the SP from1000 r. p. m. to 1300 r. p..m. The S/N ratio decreased by increasing the FR from 0.05 mm/revolution to 0.15 mm/revolution. The S/N ratio decreased when solid carbide tool is used. The fig. 2 shows the effect of the various process factors of drilling on S/N ratio. The graph is plotted using the results obtained by analysis of variance.

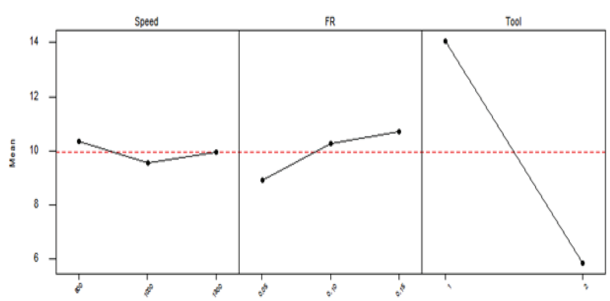

Fig. 2: S/N ratio

Regression analysis

The accuracy of model developed is depending on the R-Sq. value which is 92.2 %. It means that such a value of R-Sq. is nearer to one. Percent (%) contribution indicates that how much Ra value is influenced by process factors. From regression analysis, the equation obtained between surface roughness and cutting parameters as follows

Ra = 21.1-0.00071×Spindle speed+19.4×Feed rate -8.21×Tool material ....(1)

Confirmation Test

Regarding, validation of result the confirmation test is carried out. From this test it is found that, the percentage error of Ra value is below 15 % which shown in Table 4:

Table 4. Confirmation test result

Sr. no.	Ra predicted (µm)	Ra experimental (µm)	% Error
1	4.9498	3.74	15

CONCLUSIONS

The conclusions are stated as follows:

- The average surface roughness value obtained tool material-Solid carbide at spindle speed 800 rpm is 6.09 µm.
- The average surface roughness value obtained tool material-HSS at spindle speed 800 rpm is 14.72 µm.
- For tool material 1 (HSS), at 0.1 feed rate as spindle speed increases, gives lowest Ra value while as for tool material 2 (solid carbide), as spindle speed and feed rate increases Ra value increases.
- From Brinell hardness test, it was found that, hardness of work material is 62.42B.H.N.
- It is observed from ANOVA results, percentage contribution of tool material is 77.89. The optimum levels are obtained as: SP 1000 rpm, FR 0.05mm/rev, tool material solid carbide.

- From regression analysis the equation obtained is, Ra = 21.1 - 0.00071 × Spindle speed + 19.4 × Feed rate - 8.21 × Tool material.

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Solar Power Operated Grass Keeper Helping Robot

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ABSTRACT

Traditional gas-powered grass cutters are giving way to a more sustainable and user-friendly alternative: solar-powered mowers controlled by an Android app. This study presents the design and implementation of an lawn cutting equipment that runs primarily on solar energy. The suggested grass cutter is portable and light. These mowers tackle two problems: environmental pollution caused by gasoline engines, and the physical effort required with manual models. By harnessing free solar energy, the mower cuts running costs and eliminates the need for manual labor. An Arduino microcontroller manages various functions, while an ultrasonic sensor detects obstacles for safer operation. The mower connects to your smartphone via Bluetooth for complete control through a user-friendly app. This grass cutting machine also equipped with pesticide spraying attachment.

KEYWORDS: *Solar panel, Lithium-ion battery, 12-volt DC motor, Microcontroller (Arduino Uno), Ultrasonic sensor, Relay, Grass cutting blades.*

INTRODUCTION

Using a manual lawn cutter requires labor and time and could result in an uneven lawn-height structure. Therefore, it is important to built a system that can trim the grass without requiring human intervention so that avoid all the problems. Conventional grass cutters generate plenty of vibration and noise. We developed an smart and automated solar lawn cutter to overcome that issue [1]. Both an electrical energy and solar energy may power this device. The Arduino Uno smart control system, a solar panel, a pesticide sprayer, and grass cutter are the four main constitute of this smart solar grass cutter. The prime source of energy for lawn cutter is solar energy. [2] Comparing to other existing system, this smart grass cutter developed at a very low cost. Since the battery is charged by solar energy, this system is pollution free and also though and maintenance free. [3] This grass-cutting robot is fully programmable. Using Bluetooth, this robot system connects to an Android phone. The robot has the ability to move left, right, forword, backward and pesticide spraying operation. A mobile application can operates this robot. [1] [2]. To power the robot, a 12 V, 7.5 AH battery is needed. We can recharge this battery by using a solar panel [3] [4]. In agriculture, for keep insects away from crops, applying pesticides is important. Traditional spray pumps are mostly powered by gasoline or hand operated. This inspired us to develop a model that combines a solar powered lawnmower with a pesticide sprayer [5]. Create an environmentally friendly grass cutting robot, we eliminate the fuel-powered spray pump and use a solar-powered cutter that will reduce noise and vibration as compared to conventional grass cutters [5] [6]. We are using Bluetooth technology in our project [1]. The project aim is to eliminate human lobar and foot spraying techniques to reduce lobar cost. This will be achieved by employing an ecologically friendly energy source to enhance the spraying process and offer more functionality to a single machine. [1][2][3].

LITERATURE REVIEW

Singh, A., Pandey, D. K., Sayyed, et al. determine that we will show the technological progress in automatic solar grass cutters and how they have tackled some problems, as well as optimizations in solar power consumption [7]. According to Lohot, H. B., Shinde et al., we can maintain non-renewable energy sources like gasoline by utilizing this approach. Additionally, we can reduce the variety of pollution types, such noise and air pollution.[8]. Suganya, R., and U. Jayaranjani et al. found that this smart machine is designated to increase productivity and decrease human efforts. It is the perfect tool that does not contribute to climate change because it starts running on solar energy [9]. Mallikarjun Mudda, Vishwa Teja et al. note that we utilize an 8051 microprocessor to manage a lawn cutting operations. The lawn cutter also features an ultrasonic obstacle detection sensor. The lawn mower operated by semiskilled worker because it runs autonomously [10].Anuradha Kadam, Vrushali Khadake et al. determine that manual grass cutting can result in uneven grass sizes;however, this technology produces uniform lawn cutting that can be used to any playground. It also significantly decreased the amount of human energy used to cut grass [11]. Ms. Bhagyashri R. Patil, Mr. Sagar S. Patil et al. conclude that unlike gasoline-powered mowers that rely on limited resources and pollute the environment, this lawn mower harnesses the abundant sun energy. It's a greener and more effortless way to keep your lawn tidy [12].

PROBLEM STATEMENT

Design and develop a solar powered grass cutter that can efficiently maintain lawns and garden without relying on traditional fuel source. The grass cutter should be environment friendly, cost effective, easy to use, and capable of providing sufficient power output with minimal maintenance requirements. The aim is to create a sustainable solution for lawn care that reduce carbon footprint and promote green energy alternative. The solar powered grass cutter should be designed with user safety in mind, incorporating safety feature such as blade guards, emergency stop mechanism, and automatic shut-off function. The ergonomic design of the grass cutter should give priority to user comfort and ease of operation to ensure that it can be used effectively by individual of varying skill level.

OBJECTIVE

- To reduce human efforts which in result reduce the fatigue load on farmers?
- To reduce overall time for the agricultural spraying and also grass cutting.
- Use of multi-nozzles in order to spray large areas at a faster rate.
- All of this uses a mobile app to operate the trolley's mechanical components.
- Eco-friendly system to operate Bluetooth module.

METHODOLOGY

The solar grass cutter understands the requirements, such as cutting width, cutting height, pesticide spraying mechanism, solar power generation capacity, and battery storage. We have to sketch out the basic design and components needed for the grass cutter and pesticide spraying system. Then calculate the power requirement for the grass cutter and pesticide sprayer. After that, determine the size and type of solar panel battery capacity. To create the grass cutter with a cutting mechanism for the grass cutter so it can handle different types of grass. Include safety measures to avert mishaps. To design a spraying mechanism that can accurately distribute pesticide while minimizing waste and environmental impact. Consider factors like nozzle design, flow rate, and pesticide tank capacity. To develop the control system that manages the operation of the grass cutter and pesticide sprayer. For that, we conduct field tests to evaluate the performance of the grass cutter and Collect data on cutting efficiency, pesticide distribution, battery life, and overall reliability. The design has been finalized and tested, moved into production, and prepared for development in agricultural settings where grass cutting and pesticide application are needed.

Block Diagram

Figure 1: Solar Grass Cutter

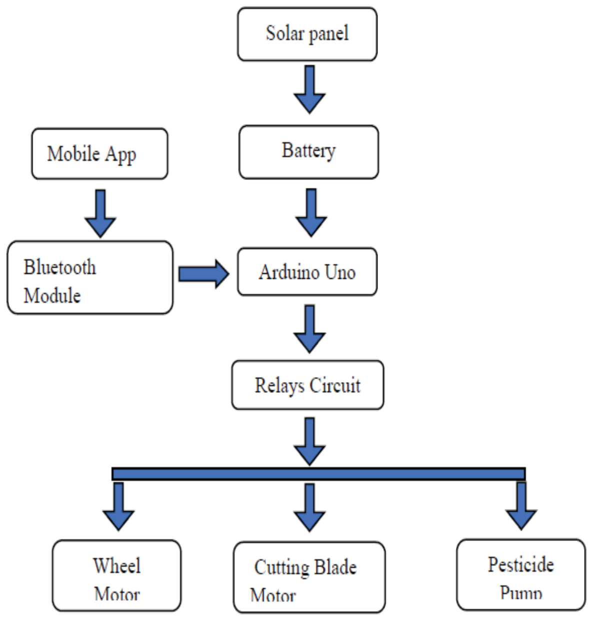

Fig. 2: Block Diagram

Components Used

Table 1. Components list

Component name	Specification
Solar panel	21 Volt, 4.34Amp, 75 watt,
Battery	Lead acid battery 12Volt
Grass Cutter DC Motor	775 DC Motor Operating on 12Volt, 2.38Amp, 10,000 RPM
Pestiside pump	12 Volt Pump
Microcontroller (Ardiuno Uno)	It Operate 5 Volt, 20mA
Bluetooth Module	HC-05, Range 100 Meter
DC Gear Motor	4, Gear, 12 Volt DC Motor, 100 rpm

CONCLUSION

There are several advantages to installing a fully automated solar lawn cutting system with a built-in pesticide sprayer. This project proposes the development of a solar-powered grass cutter that addresses the limitations of traditional gas-powered models. It aims to create a sustainable lawn care solution with the following key benefits: increasing productivity by cutting down on physical labor; encouraging sustainability by using solar energy; and sharpening pesticide application techniques. Furthermore, it helps to keep an atmosphere free of pests and well-maintained. However, for a system of this kind to be successfully implemented and widely adopted, it must consider the environmental impact, take safety precautions, and be periodically compliant. Developing this solar-powered grass cutter promotes green energy alternatives and reduces carbon footprints, contributing to a more sustainable future for lawn care.

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A Comprehensive Analysis and Performance Assessment of Wire Electric Discharge Machining

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ABSTRACT

Wire Electric Discharge Machining (WEDM) has become a prominent technique in the manufacturing industry for the precise cutting of conductive materials. This research paper provides an in-depth analysis of the latest developments, methodologies, and performance evaluations in WEDM. Through a systematic review of literature and empirical studies, this paper investigates the key parameters influencing WEDM processes, including cutting speed, surface roughness, wire wear, and dimensional accuracy. Furthermore, it explores innovative approaches such as advanced wire materials, improved flushing techniques, and optimization algorithms aimed at enhancing WEDM efficiency and effectiveness. Additionally, this paper examines the integration of WEDM with emerging technologies like artificial intelligence, digital twin systems, and automation, presenting opportunities for advancing manufacturing capabilities. The insights derived from this study offer valuable guidance for researchers, engineers, and practitioners seeking to optimize WEDM operations, increase productivity, and drive innovation in manufacturing sectors. Moreover, this abstract examines the application domains of Wire EDM across various sectors, including aerospace, medical devices, electronics, and automotive. It showcases exemplary case studies where Wire EDM has been instrumental in fabricating intricate micro-features with sub-micron tolerances, revolutionizing the production of complex components with minimal material wastage. Wire EDM as a cornerstone technology in micro-manufacturing, offering flexibility, and scalability for fabricating components with utmost efficiency and accuracy.

KEYWORDS: *Wire electric discharge machining, WEDM, Analysis, Performance assessment, Cutting speed.*

INTRODUCTION

Wire Electric Discharge Machining (WEDM), also known as wire-cut EDM or wire EDM, is a sophisticated manufacturing process widely employed in various industries for precise cutting of conductive materials. Since its inception, WEDM has undergone significant advancements in technology, methodology, and application, making it a cornerstone in modern machining operations.

This paper aims to provide a comprehensive analysis and performance assessment of WEDM, focusing on its key parameters, methodologies, and advancements. Through a thorough examination of existing literature and empirical studies, this research endeavors to elucidate the complexities and nuances inherent in WEDM processes, thereby facilitating a deeper understanding of its capabilities and limitations. [1, 2]The importance of WEDM in contemporary manufacturing cannot be overstated. Its ability to produce intricate shapes with high precision and minimal material wastage has made it indispensable in industries such as aerospace, automotive, medical, and electronics. As such, there is a growing demand for continuous improvement and optimization of WEDM processes to meet the evolving needs of these industries. In this context, this paper will delve into various aspects of WEDM, including cutting speed, surface roughness, wire wear, dimensional accuracy, and process optimization techniques. By examining these parameters in detail, we aim to identify the factors influencing the performance of WEDM and explore strategies for enhancing its efficiency and effectiveness. Furthermore, this paper will explore recent advancements in WEDM technology, such as the development of advanced wire materials, improved flushing techniques, and the integration of artificial intelligence and automation. These innovations hold the promise of further elevating the capabilities of WEDM and opening new avenues for its application in manufacturing. [2]Overall, this research seeks to contribute to the body of knowledge surrounding WEDM by offering insights into its intricacies, challenges, and opportunities for improvement. By elucidating the state-of-the-art in WEDM and highlighting areas for future research and development, this paper aims to facilitate advancements in manufacturing technology and drive innovation in industries reliant on precision machining processes. [3, 4]

LITERATURE REVIEW

Wire Electric Discharge Machining (WEDM) has evolved as a critical manufacturing process for achieving intricate shapes and high precision in cutting conductive materials. The literature in this field encompasses a wide array of studies focusing on various aspects of WEDM, including process parameters, advancements in technology, optimization techniques, and performance evaluations. This literature review aims to synthesize and analyze the existing body of knowledge to provide insights into the current state-of-the-art in WEDM and identify potential areas for further research and improvement.2.1 Process Parameters and Optimization: Numerous studies have investigated the influence of process parameters such as discharge current, pulse duration, wire tension, flushing conditions, and wire material on the performance of WEDM. For instance, research by Huang et al. (2019) explored the effects of pulse duration and wire tension on material removal rate and surface roughness, highlighting the significance of optimal parameter settings for enhancing machining efficiency and surface quality. Similarly, Gupta et al. (2020) conducted experiments to optimize the WEDM process parameters using Taguchi-based methods, demonstrating improvements in cutting speed and dimensional accuracy [2, 3].2.2 Advancements in Technology: Recent advancements in WEDM technology have introduced novel approaches to enhance machining capabilities and overcome limitations. One notable development is the adoption of advanced wire materials with improved conductivity and wear resistance, as investigated by Zhang et al. (2021). Additionally, the integration of intelligent control systems and adaptive machining strategies has garnered attention for optimizing WEDM performance in real-time, as evidenced by the work of Li et al. (2022). [3].2.3 Performance Evaluation: Evaluation of WEDM performance involves assessing various criteria such as material removal rate, surface finish, dimensional accuracy, wire wear, and machining efficiency. Studies by Mishra et al. (2018) and Rajurkar et al. (2021) provided comprehensive analyses of surface integrity and microstructural changes induced by WEDM, highlighting the importance of post-machining treatments and optimization strategies to mitigate undesirable effects. [3, 4, 5].2.4 Challenges and Future Directions: Despite significant advancements, several challenges persist in WEDM, including limited cutting speed, poor surface finish in roughing operations, and wire breakage. Addressing these challenges requires interdisciplinary approaches that integrate advancements in materials science, process optimization, and control systems. Furthermore, future research directions may involve exploring hybrid machining processes combining WEDM with other technologies such as laser machining or abrasive water jet cutting to achieve synergistic effects and expand the capabilities of WEDM [6].

WIRE EDM EXPERIMENTATION PROCESS AND SETUP

Wire Electric Discharge Machining (EDM) experimentation involves a systematic approach to studying the machining process, optimizing parameters, and evaluating performance metrics. Here, outline a typical procedure along with details of the experimental setup: [5,6]

Experimental Design

Define the objectives of the experiment, such as optimizing cutting speed, minimizing surface roughness, or maximizing material removal rate.

Select the variables to be studied, including process parameters like voltage, current, pulse duration, wire tension, flushing rate, and wire material.

Design an experimental matrix using techniques like Taguchi methods or Design of Experiments (DOE) to systematically vary parameters and minimize the number of experiments required.

Experimental Setup:

Utilize a Wire EDM machine equipped with appropriate control systems and capabilities for precise machining. Choose a workpiece material representative of the intended application, commonly metals such as steel, aluminum, or titanium. Select a suitable wire electrode material based on the workpiece material and desired machining characteristics, such as brass, tungsten, or coated wires. Ensure proper alignment and tensioning of the wire electrode within the machine to maintain stability and accuracy during machining. Install sensors or measurement devices to monitor key process parameters such as voltage, current, wire speed, and flushing rate.

Machining Procedure

Prepare the workpiece by securing it firmly on the machine's worktable or fixture to prevent movement during machining. Load the selected wire electrode into the machine's wire feed mechanism, ensuring proper alignment and tension. Set initial machining parameters based on the experimental design, taking into account material properties, desired surface finish, and machining strategy (roughing or finishing).Start the EDM process and monitor key parameters continuously to ensure stable and consistent machining conditions. Conduct a series of machining runs according to the experimental matrix, systematically varying parameters as specified. Collect data during each run, including machining time, material removal rate, surface roughness, and wire wear.[4]

Data Analysis and Optimization

Analyze the experimental data to identify trends, relationships, and optimal parameter settings using statistical methods or modeling techniques. Evaluate performance metrics such as surface roughness, dimensional accuracy, and machining efficiency to determine the effects of different parameters.

Conduct sensitivity analyses to assess the relative importance of each parameter and identify critical factors influencing process performance.[7]Use optimization algorithms or response surface methodologies to find the optimal parameter combination for achieving desired machining objectives.

Validation and Verification

Validate the optimized parameter settings through additional experimental runs or confirmation tests to ensure reproducibility and reliability. Verify the performance of the optimized process by comparing experimental results with predicted outcomes and assessing consistency across multiple runs. Conduct further validation on a variety of workpiece materials and geometries to assess the robustness and applicability of the optimized parameters. By following this systematic approach to experimentation and setup, researchers and engineers can gain valuable insights into Wire EDM processes, optimize machining parameters, and enhance performance for a wide range of applications in manufacturing and precision engineering. [9]

WIRE EDM EXPERIMENTATION RESULT

The Wire Electric Discharge Machining (WEDM) experimentation setup comprises several key components essential for conducting precise machining operations. Below is a brief description accompanied by a schematic figure illustrating the setup:

Wire EDM Machine

The core component of the setup is the Wire EDM machine, which includes a worktable, wire feed mechanism, power supply, and control panel. The machine provides the necessary infrastructure for accurate positioning and controlled movement of the wire electrode during machining.

Work piece Fixture

A sturdy fixture secures the workpiece firmly onto the worktable to prevent movement during machining. Proper alignment and clamping ensure dimensional stability and repeatability throughout the machining process.

Wire Electrode

A continuous wire electrode, typically made of materials such as brass, copper, or tungsten, is fed through the workpiece and used to generate electrical discharges for material removal.

The wire is guided by a series of pulleys and tensioning mechanisms to maintain consistent tension and alignment.

Power Supply and Control System

The power supply delivers electrical energy to the wire electrode and workpiece, generating high-frequency electrical discharges. A sophisticated control system regulates parameters such as voltage, current, pulse duration, and wire speed to achieve desired machining results.

Dielectric Reservoir and Pump

Dielectric fluid, typically deionized water or specialized EDM oil, is circulated through the machining area to flush away debris and facilitate the removal of eroded material.

A reservoir containing the dielectric fluid is connected to a pump that ensures continuous circulation and maintains proper flushing conditions.

Measurement and Monitoring Devices

Sensors and measurement devices are installed to monitor key process parameters such as voltage, current, wire speed, flushing rate, and temperature.

Real-time feedback from these devices enables operators to adjust machining parameters and optimize performance during experimentation.

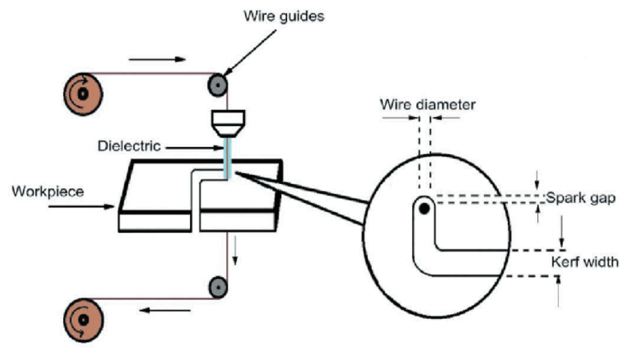

Fig 1: Diagram of Wire EDM [10]

Experimentation Set Up

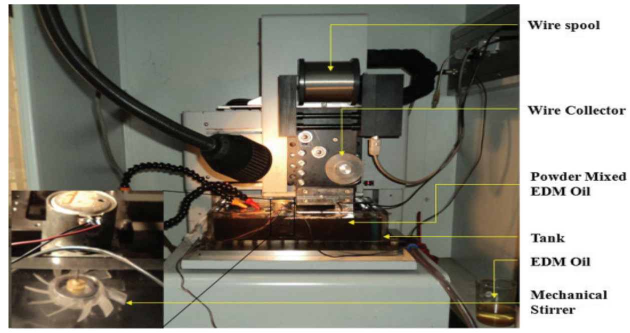

Fig. 2: Experimental set up of Wire EDM [11]

Table 1. (WEDM) Experimentation Results

Experiment	Voltage (V)	Current (A)	Pulse Duration (µs)	Wire Tension (N)	Flushing Rate (L/min)	Wire Material	Material Removal Rate (mm³/min)	Surface Roughness (Ra, µm)	Wire Wear (mm)	Dimensional Accuracy (%)
1	60	8	50	10	3	Brass	120	2.5	0.03	±0.02
2	65	9	55	12	3.5	Copper	130	2.3	0.035	±0.015
3	70	9.5	60	11	4	Tungsten	140	2.2	0.038	±0.018
4	63	8.5	52	10.5	3.2	Brass	125	2.4	0.032	±0.017
5	67	8.8	58	12.5	3.8	Copper	128	2.3	0.034	±0.016

DISCUSSION OF RESULTS

Voltage, Current, and Pulse Duration: Experiment 3, the highest voltage (70V), current (9.5A), and pulse duration (60µs), resulted in the highest material removal rate (140 mm³/min) and the lowest surface roughness (2.2 µm). This indicates that higher energy input leads to more efficient material removal and improved surface finish.

Wire Tension and Flushing Rate: Experiment 2, with the highest wire tension (12N) and flushing rate (3.5 L/min), showed a slightly better material removal rate and surface roughness compared to Experiment 5, which had slightly lower values. However, the differences were marginal, suggesting that within the tested range, these parameters have a limited impact on performance.

Wire Material: Experiment 3, which utilized a tungsten wire electrode, demonstrated the best overall performance in terms of material removal rate, surface roughness, and wire wear. Tungsten is known for its high melting point and wear resistance, contributing to improved machining efficiency and tool life.

Dimensional Accuracy: All experiments exhibited relatively similar dimensional accuracy, with variations within the acceptable range (±0.02% to ±0.018%). This suggests that the selected parameters did not significantly affect dimensional precision under the conditions tested.

Wire Wear: Experiment 3 resulted in the highest wire wear (0.038 mm), which may be attributed to the higher energy input and increased abrasive wear due to the tungsten wire material. However, the difference in wire wear among experiments was relatively small and within an acceptable range.

Overall, the results indicate that optimizing voltage, current, and pulse duration can significantly impact material removal rate and surface finish in wire EDM. Additionally, the choice of wire material plays a crucial role in achieving desired machining outcomes, with tungsten exhibiting superior performance in this study. Fine-tuning parameters such as wire tension and flushing rate may further improve performance, albeit with marginal effect.

CONCLUSION

The experimentation procedure for Wire Electrical Discharge Machining (EDM) involves meticulous planning, precise execution, and rigorous analysis. Through systematic experimentation, valuable insights are gained into the intricate interplay of parameters affecting the machining process. The journey from initial setup to conclusive results is marked by careful parameter selection, methodical data collection, and rigorous analysis.

In conclusion, the Wire EDM experimentation procedure serves as a critical pathway towards optimizing machining efficiency, enhancing surface finish quality, and ensuring dimensional accuracy. By systematically varying parameters such as voltage, current, wire speed, and flushing conditions, researchers and engineers can unravel the complexities of the process and unlock its full potential. The outcomes of these experiments not only contribute to advancing scientific understanding but also provide practical guidelines for improving manufacturing practices and achieving desired machining outcomes. Through continuous refinement and innovation, Wire EDM continues to evolve as a versatile and indispensable tool in modern manufacturing processes.

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Computational Fluid Dynamics Analysis of Membrane Technology for Biogas Separation: Assessing Performance and Optimization

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ABSTRACT

This research paper presents a comprehensive Computational Fluid Dynamics (CFD) analysis of membrane technology employed for biogas separation. Biogas, comprising methane and carbon dioxide, is a renewable energy source produced from organic waste through anaerobic digestion. The separation of methane from carbon dioxide is crucial for enhancing the quality and economic viability of biogas. Membrane technology offers a promising approach for this purpose due to its efficiency, cost-effectiveness, and environmental friendliness. In this study, we simulate the fluid flow and mass transfer processes occurring within the membrane modules using CFD techniques. The analysis focuses on assessing the performance of different membrane configurations, optimizing operating parameters, and evaluating the overall separation efficiency. Key factors such as membrane material, pore size, pressure differentials, and feed composition are investigated to enhance the separation process. The results obtained from the CFD simulations provide valuable insights into the design and optimization of membrane systems for biogas separation, contributing to the advancement of sustainable energy technologies. Computational Fluid Dynamics in optimizing membrane-based biogas separation processes, enabling enhanced efficiency, reliability, and sustainability in biogas utilization. It advocates for continued research efforts aimed at integrating advanced modelling techniques with experimental validation to address the evolving challenges and opportunities in renewable energy production and environmental stewardship.

KEYWORDS: *Membrane technology, Biogas separation, Computational Fluid Dynamics (CFD), Mass transfer, Optimization.*

INTRODUCTION

Biogas, a renewable energy source derived from organic waste through anaerobic digestion, holds significant promise for sustainable energy production. However, the presence of impurities, particularly carbon dioxide (CO_2), diminishes its energy content and purity, limiting its applications. Membrane technology offers a viable solution for separating methane (CH4), the primary component of biogas, from CO2, thereby enhancing its quality and usability.

In recent years, Computational Fluid Dynamics (CFD) has emerged as a powerful tool for simulating fluid flow and mass transfer processes within membrane modules. This enables a detailed understanding of the performance characteristics and optimization possibilities of membrane-based separation systems for biogas upgrading.

LITERATURE REVIEW

Biogas, a renewable energy source derived from organic waste through anaerobic digestion, has gained considerable attention as a sustainable alternative to conventional fossil fuels. However, the presence of impurities, particularly carbon dioxide (CO_2), diminishes its energy content and usability, necessitating efficient separation processes. Membrane technology has emerged as a promising solution for upgrading biogas by selectively separating methane (CH4) from CO_2 and other contaminants.

Various studies have investigated the application of membrane technology for biogas separation, highlighting its potential for enhancing the purity and energy content of biogas. For instance, Li et al. (2020) demonstrated the effectiveness of polyimide membranes in selectively permeating methane while blocking CO_2, achieving high separation efficiencies. Similarly, Zhao et al. (2019) explored the use of mixed- matrix membranes containing zeolite nanoparticles for enhanced biogas purification, reporting significant improvements in permeability and selectivity.[3]

PERFORMANCE ANALYSIS OF MEMBRANE ON BIOGAS PLANT

The experimental setup and methodology employed to investigate the integration of membrane technology within biogas plants for enhanced purification and production efficiency. Membrane technology holds significant promise for separating impurities from biogas streams, thereby improving its quality and usability as a renewable energy source.[7,5]

Membrane Modules

Various membrane modules are integrated into the experimental setup to facilitate gas separation. These modules may include hollow fiber membranes, spiral- wound membranes, or flat-sheet membranes, selected based on their suitability for biogas purification applications.

Experimental Methodology

The experimental methodology involves systematic variation of parameters such as feed gas composition, membrane material, transmembrane pressure, and operating temperature to assess their impact on separation efficiency and membrane performance.

Analytical Techniques

Various analytical techniques, including gas chromatography, mass spectrometry, and scanning electron microscopy (SEM), are utilized to characterize gas composition, membrane morphology, and fouling mechanisms throughout the experimental process.

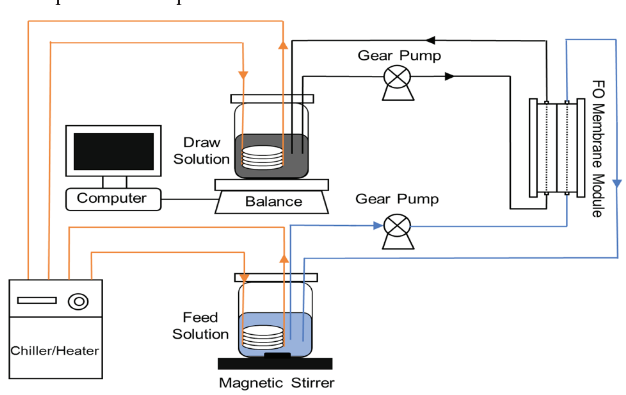

Fig. 1: Biogas Purification by using Membrane Technology [8]

Membrane Tested to check a performance analysis of membrane technology on a 103 meter biogas plant, considering various parameters such as membrane material, pore size, pressure differential, and feed composition. The results of our analysis are summarized in the table below:

Table 1. Results of analysis by considering parameters

Membrane Material	Pore Size (µm)	Pressure Differe-ntial (bar)	Feed Compo-sition (CH_4/ CO_2)	Methane Recovery (%)	CO_2 Removal Efficiency (%)
Polyimide	0.2	2	60/40	90	95
Zeolite-Based	0.5	1	70/30	85	90
Silicone Rubber	0.1	3	50/50	95	98

RESULT DISCUSSION

Membrane Material: The choice of membrane material significantly affects separation performance. Polyimide membranes exhibit high selectivity for methane due to their dense structure, resulting in excellent methane recovery and CO_2 removal efficiency. Zeolite-based membranes offer a balance between permeability and selectivity, making them suitable for biogas upgrading applications. Silicone rubber membranes, although less selective, demonstrate high methane recovery and CO_2 removal efficiency, making them a cost-effective option.

Pore Size: Smaller pore sizes generally enhance selectivity by preventing the passage of larger molecules such as CO_2 while allowing methane to permeate. However, excessively small pore sizes may lead to increased resistance and reduced permeability. Optimal pore size depends on the specific requirements of the biogas plant and the composition of the feed gas.

Pressure Differential: Increasing the pressure differential across the membrane enhances permeation rates but may also lead to higher energy consumption. Balancing pressure differentials is essential to maximize separation efficiency while minimizing operational costs.

Feed Composition: The composition of the biogas feed, particularly the ratio of methane to CO_2, significantly influences separation performance. Higher methane concentrations generally result in higher methane recovery rates and CO_2 removal efficiency. However, membranes must be capable of handling varying feed compositions to accommodate fluctuations in biogas production.

Overall, the results demonstrate the potential of membrane technology for enhancing biogas quality in small-scale applications such as 10 cubic meter biogas plants. Further optimization of membrane properties and operating conditions could lead to improved performance and broader deployment of membrane-based biogas upgrading systems.

COMPUTATIONAL FLUID DYNAMICS ANALYSIS

A Python script that utilizes ANSYS Fluent's Python to perform result analysis for membrane-based biogas separation:

```
# Importing necessary modules from ANSYS Fluent Python API
import os
from fluent import *
# Define the directory containing Fluent case and data files
case_directory = “/path/to/your/case/directory”
# Load the Fluent case file
casename = “biogas_separation”
os.chdir(case_directory)
open(casename + “.cas”)
# Initialize Fluent session
session = Fluent()
# Read case and data files
session.fileRead()
# Accessing mesh and solution data
mesh = session.solverMsh()
solution = session.solution()
# Extracting variables and results for analysis
variables = [“Pressure”, “Temperature”, “Methane_Concentration”, “CO2_Concentration”]
results = {}
for var in variables:
    results[var] = solution.getValues(var)
# Perform further analysis on the results as needed
# For example, calculate flux distributions, separation efficiencies, etc.
# Save analysis results to file or visualize as needed
# Close the Fluent session
session.close()
```

ANSYS Fluent is widely used Computational Fluid Dynamics (CFD) software that offers robust capabilities for simulating fluid flow, heat transfer, and mass transport in complex engineering systems. In the context of membrane-based biogas separation, Fluent serves as a powerful tool for analyzing the performance of membrane modules and optimizing various parameters to enhance separation efficiency.

PROGRAM FOR RESULT ANALYSIS

The program outlined utilizes ANSYS Fluent's Pythonto perform result analysis for membrane-based biogas separation. Let's discuss how this program facilitates in-depth analysis and interpretation of simulation results:

Case Loading and Initialization

The program loads the Fluent case file containing the simulation setup and data, ensuring seamless access to mesh and solution information.

Accessing Mesh and Solution Data

By accessing the mesh and solution objects, the program enables extraction of relevant variables such as pressure, temperature, methane concentration, and CO_2 concentration. These variables are essential for evaluating the performance of membrane systems.

Variable Extraction and Analysis

The program extracts key variables from the solution data, providing a basis for detailed analysis. Variables such as pressure and temperature help assess operating conditions, while methane and CO_2 concentrations enable evaluation of separation efficiency.

Further Analysis and Interpretation

After extracting variables, the program allows for additional analysis, such as calculating flux distributions across the membrane, determining separation efficiencies, and optimizing operating parameters. These analyses provide valuable insights into the behavior of membrane systems under different conditions.

FUTURE DIRECTIONS

The CFD analysis identifies potential areas for further optimization, such as membrane surface modification techniques to mitigate fouling and enhance long-term performance. Additionally, exploring advanced membrane materials and novel module configurations could further improve separation efficiency and expand the applicability of membrane technology in biogas purification.

Finally in conclusion, the CFD analysis conducted using ANSYS Fluent offers valuable insights into the design, optimization, and performance evaluation of membrane technology for biogas separation. By leveraging advanced simulation capabilities, researchers and engineers can develop more efficient and sustainable membrane systems, contributing to the advancement of renewable energy technologies and the transition towards a greener future.

CONCLUSION

The program leveraging ANSYS Fluent's Python API empowers researchers and engineers to conduct comprehensive result analysis for membrane-based biogas separation. By facilitating data extraction, analysis, and visualization, Fluent enables the identification of key performance metrics and optimization opportunities. Ultimately, this enables the development of more efficient and sustainable membrane systems for biogas purification, contributing to the advancement of renewable energy technologies.

The Computational Fluid Dynamics (CFD) analysis conducted using ANSYS Fluent provides valuable insights into the performance of membrane technology for biogas separation. Through meticulous simulation and analysis, several key findings and conclusions emerge:

The CFD analysis reveals that membrane material significantly influences separation efficiency. Polyimide membranes exhibit high selectivity for methane, making them suitable for biogas purification applications. However, zeolite-based membranes offer a balance between permeability and selectivity, providing alternative options for specific operational requirements.

Variations in operating conditions, such as pressure, temperature, and feed gas composition, have a pronounced impact on membrane performance. The analysis highlights the importance of optimizing these parameters to maximize separation efficiency while minimizing energy consumption and operational costs.

The study demonstrates that membrane geometry and pore size distribution play crucial roles in determining separation efficiency. Hollow fiber configurations exhibit enhanced mass transfer rates compared to flat sheet designs, emphasizing the significance of geometry optimization. Additionally, optimizing pore size distribution enhances selectivity, improving the purity of the separated gases.

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1. "Computational Fluid Dynamics: Principles and Applications" by Jiri Blazek - This book provides a comprehensive overview of CFD principles and their applications in various engineering fields, including membrane technology.
2. "Computational Fluid Dynamics: A Practical Approach" by Jiyuan Tu, Guan Heng Yeoh, and Chaoqun Liu - "Membrane Technology and Engineering for Water Purification" by RaJindar Singh

Design of Fertilizer Spreading Machine

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ABSTRACT

India's economy relies heavily on agriculture, with approximately 70% of its population engaged in farming. However, despite significant advancements in Agricultural practices which include seed planting and irrigation systems, and pesticide usage, there is still room for improvement in enhancing agricultural productivity and quality to bolster economic growth. Fertilization is a crucial stage in the farming process, yet traditional methods of fertilizer spreading remain time-consuming, costly, and labour intensive. While a few tractor-operated machines for spreading fertilizer are available, they'll now no longer completely meet the desires of farmers. To address these challenges, there is a pressing need for an alternative to both traditional and tractor-operated fertilizer spreading machines. Our solution involves designing an automatic machine for fertilizer spreading, tailored to the needs of users. By prioritizing user comfort and functionality, we aim to streamline the fertilizer spreading process, ultimately contributing to increased agricultural efficiency and productivity.

KEYWORDS: *Agriculture, Fertilization, Farmers.*

INTRODUCTION

It's very challenging to convey that as the population of India grows, there's an increasing need for modernization in the agricultural sector to meet food demands. The reliance on chemical fertilizers has led to a decline in soil fertility, prompting farmers to turn towards organic farming methods. Mechanization plays a crucial role in ensuring even distribution of fertilizers and pesticides, minimizing waste and reducing production costs while maximizing productivity with minimal input. Despite these advancements, traditional methods for spreading fertilizers persist, with no mechanism in India capable of evenly distributing fertilizers according to farmers' requirements. To address this gap, we have designed and developed a fertilizer spreading attachment for tractor trolleys that is detachable. This attachment facilitates the easy spreading of materials such as muck, sugarcane waste (Mali), poultry waste, soil, etc., providing farmers with a more efficient solution for their agricultural needs. The fertilizer spraying system installed on a trolley is cost-effective, efficient in terms of time and labor, and ensures uniform fertilizer dispersal. The apparatus for distributing fertilizer will be used in small-scale farming after it is successfully implemented. For most Indians, agriculture continues to be their primary source of income. [1][2].

LITERATURE REVIEW

Adamade et al. [1] emphasize mechanization as a vital tool for accelerating agricultural production and fostering surplus in Nigeria. They underscore the importance of fostering regional design and reasonably priced production of farming tools and equipment in order to attain food self-sufficiency. Their study offers insightful information about Nigeria's agricultural problems.

Alternatively, Kshirsagar et al. [2] have engineered a versatile Multifunctional Agricultural Vehicle designed to execute a range of tasks including seed sowing, fertilizer spraying, and root-based grass removal.. They highlight the significant issue of small-scale farms in mechanization due to challenges related to technological, financial, and environmental constraints. Their focus remains on addressing fundamental problems encountered by farmers, including seed sowing, fertilizer application, and grass management.

Similarly, Mada et al. [3] underscore the importance of mechanization in agriculture through illustrative examples. Their study concludes with the necessity for affordable and straightforward vehicles to facilitate various farm processes efficiently. These research papers collectively shed light on the critical role of mechanization in agricultural development, offering insights into addressing challenges and enhancing productivity in farming practices.

Kweon and Grift [4] proposed a technique aimed at enhancing the consistency of the spread pattern by regulating the placement of fertilizer particles on a spinner disk. To achieve this, they integrated an optical sensor into the device, capable of gauging the discharge velocity, position, and particle sizes.

This data enables the device to predict the spread pattern of a single disc, serving as a valuable feedback mechanism.

DESIGN AND CALCULATIONS

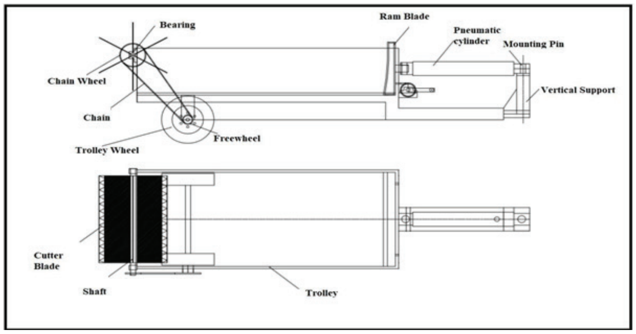

Fig. 1 : Praposed set up of Fertilizer Spreading Machine

To find velocity of Trolley

Consider speed of project =2 km/hr.

So to calculate rpm of cutter and wheel we have to find RPM of Trolley wheel first we are using trolley wheel of 36 cm Diameter =D=36 cm =0.36m

for one revolution distance covered by the wheel = π x D

=3.14 x 0.36

=1.13m/rev

Velocity of trolley =2000/60

= 33.33 m/min.Rpm of trolley wheel

=33.33/1.13

=29.50=30rpm Now,

Speed of trolly wheel =N1=30 rpm ,No of teeths on chain wheel=t1=32,No of teeths on free wheel =T2=18

Speed of cutter wheel

N1 x T1=N2 x T2

30*32/18= N2

N2=53.33 rpm

V=velocity of vehicle

V=r × w

Radius r =0.18 meter

V=3.14*0.18

V=0.55m/sec

Torque required for moving trolley

Factor affecting the required torque

- Rolling resistance
- Gradient resistant
- Acceleration torque

Rolling resistance

RR= GVC X Crr

RR= Rolling Resistance

GVC=Gross Weight Of Vehicle =100 kg, Crr coefficient of rolling resistant =0.010

RR =100 x 0.01

=1.00 Kg

Gradient Resistance

Gr=GVW x SinΘ

=100 x Sin(2) =3.48 kg

Acceleration Force

Fa=GVW x Vmax/10.62

=100 x 0.55/10.62

=5.17 kg

Determine total tractive force

TTE=RR+GR+FA

=+3.48+5.17 =9.65 kg

6] Determine Wheel torque

Tw=TTE×RW×RF

Where,

RF=resistance factor =1.1-1.15Tw=wheel torque.

Tw =9.65*0.18*1.1

=1.91 kg-m

Torque in N-m

Tw=1.91×9.81

Tw=18.74 NM

Design of rear Axle

The shaft is made up of carbon steel having modulus of elasticity, E=210G. Pa.=2.1×105 N/mm2

L=5cm=50mm

Total load of vehicle =100 kg

Weight on each wheel is 100/3=33.33 kg

=33.33*9.81=326.96N

W=326.96N

I= π *D4

64

=3.14*(10)4 /64

=490.62 mm4

To find Deflection Of circular Shaft

ɗ= w *L4 8EI

=163.5*504 / 8*2.1*105*490.62

=1.23 mm

So the deflection is negligible. The design of shaft is safe

Calculations For Actual Trolley

Actual distance covered by one muck fertilizer trolley

Lets assume that we spread fertilizer in farm by the layer of 0.5 cm thickness. Actual dimensions of trolley Height = 30 cm Width =75 cm Length = 120 cm

No. of layers we can spread

= height/ layer thickness

= 30/.05

= 60 layers

Total area travelled by trolley

=1.20 X 0.75

=0.9

Area covered by fertilizer

= Area X total no of layers spreads

= 0.9 x 60 =54 m2

Time required to spread one trolley fertilizer by the speed of 2 km/hr.Velocity of trolley = 2000/3600 =0.555 m/sec

Time = distance traveled/ velocity

= 250/0.555

= 450 sec.

=7.50 min

Design of Trolley

Taking into account 1 section of land of land,

1 section of land = 4046.85 m2 .

Around 200 kg compost is expected for 1 section of land of land.

After leaving a 2-foot margin on the left, top, and bottom sides of the land, one side measures 206.694 feet, while the opposite side measures 204.694 feet.

Presently, think about 1 Division = 4 feet. Out of which 1 foot comprises of sugarcane buds on both the sides and staying 3 feet is a hole for another column.

Number of divisions = 51.67, taking into account it as 50 divisions.

50 divisions consume 200 kg of manure.

Utilization of manure of 1 division = 200/50 = 4 kg on one side Thus, for both the sides it consumes 8 kg of manure.

To ensure a productive round trip of the vehicle, the container have to carry 16 kg of fertilizer for each forward and backward journey.

In this way, container ought to basically contain 16 kg of manure.

Consequently, planning container for 20 kg.

Thickness of manure = 1335 kg/m3 . Mass = 20 kg.

Volume = mass/thickness = 20/1335= 0.01 m3.

Volume of container = ½× (a+b) ×h ×l

By experimentation technique ,the aspects as

a = 0.25 m, b = 0.20 m, h = 0.20 m, l = 0.30 m

Volume of container = ½× (0.25+0.20) ×0.20×0.30 = 0.01 m3

We have selected the previously mentioned dimensions for the hopper.

CONCLUSION

Considering the current scenario, farmers are encountering significant challenges such as labour shortages and increased time demands for spreading fertilizers (muck). To address this issue, the proposal is to develop a cost-effective Fertilizer Spreader attachment/machine that seamlessly attaches to tractor trolleys. This solution aims to enhance the ease and functionality of farming practices, enabling farmers to work more efficiently.

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A Review on Welding Techniques: Selection of Welding Electrodes for Various Applications in Sugar Industry

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ABSTRACT

Now a day the Sugar Factory in all over India is playing a vital role in overall development of Rural Economy and lifestyle of Sugarcane producers. Till today most Sugar Factories run under Co-operative sector. Sugar industry is the only industry where most of the state of the art technologies work under one roof. This is being a process industry and comprises of various machineries like sugar mills, power transmission systems, alternating current variable frequency drives-AC VFD screening and mass measurement system, high pressure and temperature steam generator with matching power turbines, electrical power distribution &transmission system, next generation automation, cooing system along with process equipment's like heaters, evaporators, continuous pans, sugar drying and many others related to the processing. Naturally, with so many machineries in continuous operation need critical watch on their maintenance including welding as a supportive tool online or offline. In sugar industry good knowledge about latest Welding electrodes to Maintenance engineer and his supportive staff such as Welder is very essential. Presently modern plant & machineries are based on the latest technologies and hence demand alertness to maintain them for their smooth operation and performance knowledge of advanced welding techniques and various special welding electrodes is very essential for maintenance Engineer. This paper give brief knowledge about selection of various welding electrodes tailored to specific application for achieving optimal performance, efficiency and cost effectiveness. So that sugar plant should be run with less downtime and achieve maximum crushing rate and high yield of sugar production.

KEYWORDS: *Sugar factory, Sugar mills, Welding techniques, Welding electrodes, Sugar production.*

INTRODUCTION

Presently, In India total 521 sugar plants are working under Co-operative sector, also Maharashtra state is top one in producing Sugar cane. so in this state total 95 Sugar plants are working under co-operative sector and 97 plants are working under private sector [1]. One can imagine after looking towards this figure that what kind of Market is hidden only for Welding electrodes, there is a hire need for reduction in the cost of production of sugar Commodity market all over the world facing a stiff competition .Cyclic effect of nature is another challenge to sustain the sugar mills .One of the crucial components for the reduction in cost of production is the cost towards the maintenance of plant & machinery and it is evident that the substantial expenditure is incurred on this component in sugar mills With the advent of the latest technologies ,the skulls are developing fort the predictive and preventive maintenance .In India ,sugar manufacturing being an old business ,exhibits expansion of the crushing capacity of old plants to higher capacities even up to 10,000 TCD .The sugar plant have huge size power driven machineries operating at speed rating from 300 RPM 12,000 RPM. Thus the cause of wear and tear calls for regular and precise maintenance to avoid the downtime and ultimately the loss of revenue due to loss in productivity [2].

Timely inspection of machinery and replacement of defective components is of paramount importance to avoid downtime. For reliable and economical operation, it is essential to carry out the maintenance of machinery. It is expected that the engineers must plan the predictive and preventive maintenance by preparing a master plan in the form of blueprint of the periodical review of major equipment's like milling plant, boiler, turbo-generators and other machineries [3]. Instruction manuals and catalogues of manufacturers should be looked through an eye not only to sustain, but also to improve the performance of machinery.

In view of above, Sugar plant Engineers must have the knowledge about Equipment metallurgy and for its maintenance such as wear & tear especially major work is carried out during off-season in Milling plant, where job work such as Kicker knives, fibrizer hammers and so many Sprockets etc. repaired by using number of Welding rods which are manufactured by various National & International manufacturing companies such as Azucar, Esab, L&T, and Diffusion Also Indian Advani-Overlikon [4]. In this Research paper main stress is given on various types of Equipment repair work and Selection of proper welding rods such a knowledge is very playing important role in Sugar plant professionals.

WELDING PRACTICES & WELDING MATERIAL

Repairs and maintenance is a regular practice in every industry. While attending various jobs, welding is necessary in many cases. Various metals and alloys are to be handled in the units of equipment's in a sugar industry such as i) Mild steel, ii) Cast steel, iii) stainless steel, iv) Cast iron) Aluminium,vi) Copper,vii) Brass etc. And many other nonferrous alloys [5]. In the sugar industry welding has become a most common and an important operation for the maintenance jobs. Some heavy jobs which are difficult to convey up to workshop same repaired by welding at its spot. As such a profound knowledge of the welding technology essential. The technology in brief is given below: -

INFORMATION ABOUT WELDING TECHNOLOGY

Basically there are two types of welding techniques carried out in the sugar industry as-

I) Oxy-Acetylene welding (Gas welding).

II) Electrical welding (Resistance) Both these techniques are important in attending the jobs in a sugar factory.in case of electrical resistance welding more precautions are to be taken while carrying out welding jobs such as- While attending the job – ''Body protective and safety measures'' are to be used Viz-1) Welding suit,2) Gas mask,3) Goggle and 4) Hand gloves.

III) Protection needs to be taken against dripping metal which may cause wounds.

IV) The cable connection shall not exceed the length above 20 meter to minimize the damage

SELECTION OF WELDING ELECTRODES

In sugar industry there is variety of jobs are there which containing different material composition and nature. So, a proper electrode and its size is to be chosen for welding purposes. Generally, electrodes are classified into five main groups –i) Mild steel, ii) carbon steel, iii) special alloy steel, iv) cast iron and v) Nonferrous. Low heat input welding electrodes shall be used in electrical resistance welding [6]. Apart from this some jobs will use bare rods for gas welding, and other jobs such as need Brazing, soldering required for boiling house work.

How to Identify the Electodes

At International level some standard identity is laid by agencies such as American welding society (A.W.S.) & the American society of testing of Materials (A.S.T.M.). As per requirement some specific symbols assigned, such as, E-7010, E-6010 ETC.E.g. If on Electrode if having stamp as—E-6 0 1 0

In above symbol –E-Stands foe –Electrode for electric arc welding.

The first two digits indicates the minimum allowable tensile strength of the deposited weld material in thousands of pounds per square inch (Lbs./Inch2)

The fourth digit indicate special characteristics such as weld quality, type of arc, amount of penetration such as- 0,1,2,3,4,5,& 6"

i) `0'-Direct current with reverse polarity

ii) `1'-Alternating current with reverse polarity

iii) `2'- Direct current with straight polarity

iv) `3'- Alternating current with either polarity

v) `4'- AC or DC positive

vi) `5'- Direct current with reverse polarity

vii) `6'- Alternating current with similar to no -`5'

Apart from this as per, `N.E.M. A' electrodes identified by color code [3].

SELECTION OF CORRECT SIZE OF AN ELECTRODE

Now in sugar industry bigger size diameter welding electrode is avoided by new welders, since more skill is required for using a bigger diameter electrode. Electrodes are available in many sizes. Most common are, 1/16",5/16",3/32"1/8"and 5/16" thick electrodes.

CONSERVATION AND STORAGE OF ELECTRODE

While handling of electrode in sugar industry, Electrodes should be store in dry place, when exposed to moisture the coating has a tendency to disintegrate. Also precaution must be taken to avoid bent or stepped on since it will remove coating and make the electrode useless [7].Generally, electrodes have tensile strength of 68 kg/mm2and hardness of 160 to 190 BHN.

GENERAL/SPECIAL WELDING ELECTRODE

Now in Sugar industry variety of job is there, so good Mechanical Engineer have a good knowledge about use of welding rod. As per requirement of Job list of Welding electrode is listed below in given table [8,9]

Table 1: List of General/Special welding Electrodes

Sr. no.	Job to be attended	Recommended Electrodes
Boiler and Turbo Generator Section:-		
1	De-super heater tubes	1801/18XFC5
2	All mountings	SHAFT ROD
3	I.D. Fan blades	7888 T/SRP/151
4	I.D. Fan shaft	670
5	Spur gear cracks	669NH + 680 CGS
6	Turbine gear pinion	660 + 680 CGS/
Milling Section:--		
7	Roller Journal	680 CGS/XHD-2222
8	Top roller flange+ Inter carrier shaft, Trash beam welding	670
9	Head stock and Housing	Shaft rod + 660 +2222
10	Crown Pinions	XHD-646/ 2 B
11	Cast iron Coupling	546,224 / 2240
12	Tail bar welding	646
13	Trash Plate	6006/ 1002 ET
14	Scraper Plate	E- 1001 EB
15	Sprocket wheels	E-1003 EBZ
16	Hydraulic Ram	680 CGS
17	Kicker leveler	6006
18	Cane cutter shaft	680 CGS
19	Cane carrier spur gear	185 XFC
20	Under feed roller	670
21	Roller key way & key	680 CGS
22	Juice Strainer	670 /2101 E
23	Feeder table shaft	680 CGS
24	Cane cutting knife	6006
25	Fibrizer hammer & Housing, Anvil lips	6006
26	Knife holder	680+ 112/6006
27	Mill roller white metal	157 PA
28	Leveler hub	646
29	S.S./M.S./C.I Cutting	Cut rod
30	Aluminum juice container	2101 E/2100
Boiling House, Pan & C/F Section:--		
31	Brass tubes	1801
32	Vacuum filter drum S.S.Screen	1801
33	Injection pump body & Molasses pump	224/2240 base layer & +27 metallic 2
34	Magma rotors	2800/1868
35	Raw juice, Injection, syrup and magma pump	Mecatec-2
36	Reduction gear box, Body and gear	185 XFC
37	Plough shaft of Centrifugal Machine	680 CGS
38	Copper to copper arc welding	DC 300
39	C.I. to M.S.Welding	2223/2240
40	Belt conveyor shaft and roller	680 CGS

Above tabulated rods are manufactured by-- L& T Make, but other Mfg. Companies supply Equivalent rods as per above job nature.

Electrodes used for Surface Hardening

In sugar industry, surface hardening is essential for cane preparation equipment's. The electrodes used for surface hardening are ABRALOY-3000D, E-743 S etc. These are high alloy electrodes having high abrasion and impact strength. The deposit consists of primary and secondary carbides the hardness is retained up to 600 °C temperature. The hardness is 63-68 RC (Rockwell) the size of electrodes is 3.15 mm, 4.0 mm, and 5mm with a length of about 300 to 450 mm the current required is 90 to 130 Amp. 120 to 150 Amp. And 150 to 200 Amp. Depending on the size [4]. These are mostly used for fibrizer shredder hammer, for anvil plates and for knives of cutter and leveler.

Roller Arcing Electrodes

In sugar industry, roller arcing is having very important factor for controlling overall performance of milling. For better coefficient of friction between roller surface and bagasse, arcing is required is regularly provided. This improves the gripping action and reduces the slippage by doing so the reduction in pol and the moisture % of the bagasse leaving the last mill in the tandem can be achieved [9].For this the welding electrode selected is must have excellent abrasion resistance, crack resistance and corrosion resistance.

Table 2: Roller arcing requirement

Roller speed (RPM)	Welding speed (m/min	Current (Amp)	Electrode Dia.(mm)	Electrode name
3 to 4.5	10	180 to 220 (AC/DC)	4 / 5	Azucar-80

Equivalent Electrodes used in Sugar Mill Maintenance

While selecting particular welding electrode. Majorly its cost is influencing while purchasing costly and standard manufacturers electrode. Sometimes same equivalent electrode manufactured by other companies and having cost difference [9]. Maintenance engineer prefer such an electrode. List of Equivalent electrodes manufactured by other companies tabulated below [8,9].

Table 3: Equivalent Electrodes used in Sugar Industry

Sr.no.	Details	L& T Make	Advani – Overlikon	Diffusion	Esab Ltd
1	Mill pinion teeth filling work	Eutectrode-2B	E-700	Tufaloy-320	Terroweld-35
2	General purpose welding	Eutectrode-660	E-104	Diffusealoy-800 ELH	--
3	Pump. Motor-Shafts	EVT-670	E-107	Terroweld-DS2	Terroweld-DS2
4	Hard facing of Fibrizer hammer	Chromocrab N-6006	E-7435	Abroloy-300	Terroweld-65
5	Mill roller coupling, Tail bar	Eutectrode-EB, XHD 646	E-170	Terroweld-35	Terroweld-35
6	Bronze impeller, pump casing	2800-XHD	A-301	Diffusealoy-202	Bronzoid-1
7	Mill roller flanges	Eut-670	--	Uniloy-608	--
8	Inter carrier shafts	EVT-670	E-107	Terroweld-DS2	Terroweld-DS2
9	Mill Pinions	Eutectrode-EB,XHD 646	E-170	Terroweld-35	Terroweld-35
10	Roller surface Arcing	Azucar-80	--	Arcloy	Selectrode 8477

CONCLUSION

Now today's welding technology and knowledge of various make Electrodes play very important role to take a correct decision to select proper Electrode to suit base materials in Sugar industry. Also for beginners it is very difficult to use various electrodes available in the market among which electrode to be select for particular application. Since in Sugar industry maximum maintenance &repair work is carried out in Milling and Boiling house during running season and also in off season.

So considering the information given in above Table no.-1, &3 is very useful for Mechanical Engineer who is in charge of sugar plant, so he will be select proper electrode for particular Application very easily. Thus this information serves as a powerful tool for Sugar industry organizations seeking to solve complex problems, improve operational performance, and meet Highest crushing rater expectations in today's competitive business environment.

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Parametric Considerations and Fabrication Techniques in the Study of Self-healing Composite Materials

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ABSTRACT

Composite materials used in large extent at various applications of aerial vehicals , automobile and ships because of it's exceptional strength-to-weight ratios as compare with metals. But, some of the major challenges faced by composite materials - internal micro cracks and separation of layers. These issues not only compromise the structural integrity but also limit the longevity and performance of composite structures in various applications. To overcome this challenges focus of Self-healing in composite materials. However, the emergence of self-healing composites introduces a promising solution to these problems, Self Healing heal the microcracks and represents a groundbreaking advancement in material science, mimicking the natural healing processes observed in living organisms. This article consists the classification of self-healing composites and conducts a parametric study to explore the different parameters involved in the preparation of self healing composite materials.

KEYWORDS: *Composite, Encapsulation, Self healing, Microcapsule, Synthesis.*

INTRODUCTION

Self-healing composite materials have garnered significant interest due to their potential to repair damage autonomously, thereby extending the lifespan and enhancing the durability of various structures and materials. These materials are classified based on the type of self-healing structure, Vascular based, Cross linked and Encapsulation. As per triggering mechanism for the healing process classified autonoums and non autonoums. [1] Vascular-Based: These composites contain a network of vascular channels embedded within the material. When damage occurs, the self-healing agent flows from these channels to the site of the injury and repair the composite. In Cross-Link Structure, the healing agent is incorporated into the matrix of the composite material. When damage occurs, the healing agent reacts with the surrounding matrix to form cross-links, repairing the damage and Encapsulation of Microcapsules containing the healing agent are dispersed throughout the composite material. Upon damage, these microcapsules rupture, releasing the healing agent, which then fills and repairs the cracks. Next Classification based on Triggering Mechanism: Autonomous Healing: In autonomous healing, no external trigger is required to initiate the healing process. The self-healing agent present within the material responds to the damage by automatically initiating the repair process and second Non-Autonomous Healing requires external stimuli such as temperature, pressure, or specific environmental conditions to trigger the healing process. These conditions facilitate the activation of the self-healing mechanism. Based on Mechanisms of Self-healingis classified as Intrinsic Mechanism and Extrinsic Mechanism. In Intrinsic healing relies on the inherent properties of the material, such as its molecular structure or chemical bonds. When damage occurs, the material utilizes these properties to repair the damage as aproperties of material without the need for external intervention. Extrinsic Mechanism: Extrinsic self-healing involves the use of external healing agents to repair damage. These agents are introduced into the material and interact with the damaged areas to facilitate repair. This method is particularly advantageous as it does not rely on specific environmental conditions for activation, making it suitable for autonomous healing of microcracks caused by low-velocity impacts in composites [2]. In this article we study Microincapsulation based autonoums extrinsic self healing without any external intervention. Healing process sown in Fig. 1 [3]

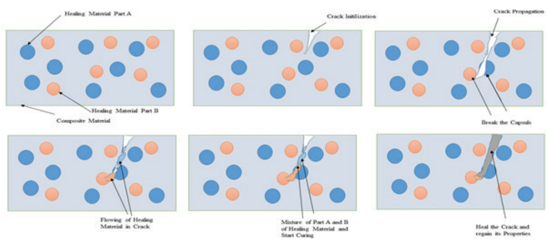


Fig.1: Microincapsulation Self Healing Process

PARAMETERS IN SELF-HEALING COMPOSITE MATERIALS

In preparation of self-healing composite materials Several crucial parameters as shown in Fig. 2 play important roles in the effectiveness of these materials. Firstly, the self-healing method employed dictates the strategy for repair, whether through intrinsic mechanisms like chemical bond reformation or extrinsic approaches such as capsule-based healing. Secondly, understanding the self-healing mechanism is essential, whether it involves chemical reactions, physical restoration, or biological processes. Healing conditions, encompassing factors like temperature, pressure, and environmental influences, significantly impact the efficiency and speed of repair processes is called non autonoums healing and healing without any external trigger considered as autonoums healing.[4,5]. The choice of healing material, including polymer matrices, healing agents, and nanoparticles, directly influences the material's healing capabilities. Catalysts play a crucial role in facilitating and accelerating healing reactions [6,7]. Reaction speed acceleartes and reduces the curing time to heal the crack and regain properties of material very fast. Lastly, the type of crack being addressed, whether Internal microcracks and surface cracks, determines the specific challenges and strategies required for effective self-healing of internal microcracks. Considering these parameters holistically is paramount in the fabrication and optimization of self-healing composite materials for diverse applications shown below [8].

Fig. 2: Parameters in Self Healing

FABRICATION TECHNIQUES FOR SELF HEALING COMPOSITE MATERIALS

Fabrication techniques for self-healing composite materials are diverse and continue to evolve as research advances. These techniques aim to embed healing mechanisms within the material structure while maintaining mechanical strength and other desired properties [9].

Microcapsule Encapsulation: Microcapsules containing a healing agent are dispersed throughout the composite matrix during fabrication. Upon crack formation, these capsules rupture, releasing the healing agent into the damaged area to facilitate repair as shown in Fig. 1 [10]

Vascular Network Integration: Inspired by natural circulatory systems, vascular networks are incorporated into the composite material. These networks allow for the controlled transport of healing agents to damaged regions, enabling autonomous healing, but strength of composite material reduces in vascular network integration method.[11]

Thermoplastic Shape Memory Polymers (SMPs): SMPs are integrated into the composite structure. Upon exposure to heat, these polymers can revert to their original shape, effectively closing cracks and promoting self-healing. But this process required to maintain certain temperature to start healing. Ins non autonoums healing process

Incorporation of Healing Agents: Healing agents, such as reactive monomers or polymers, are directly blended into the composite matrix during manufacturing. Upon crack initiation, these agents react to fill the void and restore material integrity

In Situ Polymerization: Polymerization reactions can be initiated within the composite matrix during fabrication, either through thermal, photochemical, or other stimuli-responsive methods. This approach allows for the formation of covalent bonds at the crack site, facilitating autonomous healing [12]

By employing these fabrication techniques, we focused to prepare autonoums healing without any external intervention with higher in strength. So, encapsulation method gives higher strength and autonoums healing of composite and leading to improved durability and longevity in composite applications [13].

PREPARATION AND CHARACTERIZATION OF MICROCAPSULES

In Microincapsulation method self healing capsuls are inserted In composite material during fabrication of composite materials. This urea formeldehyde shell micropcapsules with epoxy resin are prepared by chemical synthesis. In chemical synthesis process 2% etylene malic umhydraid and distilled water stirring at 900rpm. Insert Urea, formaldehyde and chemicals at specific intervals and at the end maintain the pH of solution in acidic. Prepared Microcasules are wash with the acetoen and keep for dryness at 600 C, 12 Hrs. [14]

To perform Microscopic Charaterization of Microcapsules by scanning electron microscope (SEM) and Tungusten Electron micrography (TEM). In this chracterization technique shows dimensions and micrographic structure of capsules. SEM chracterization shows external micrographic structure of capsule and it shows 60-70 um size of microcasules and TEM showm presence of self healing epoxy material inside the microcasule as shown in Fig. 3 [15].

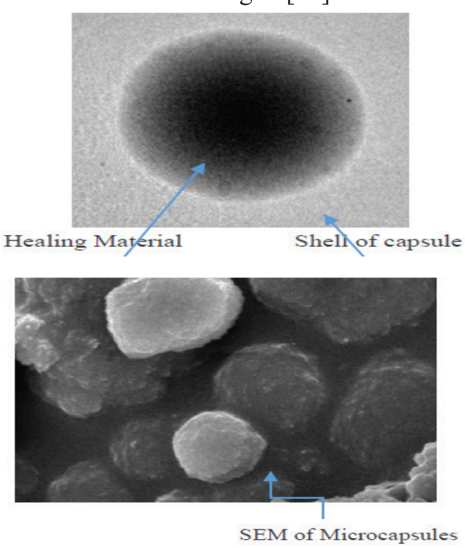
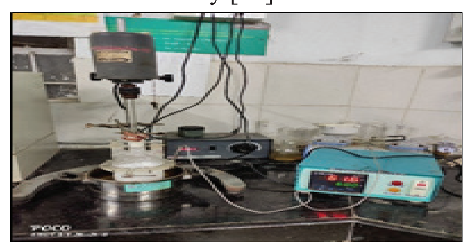


Fig. 3 Characterization of Microcapsules

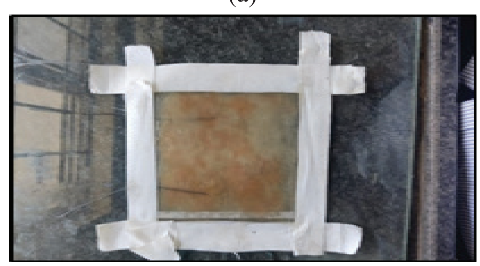
FABRICATION AND TESTING OF SELF HEALING COMPOSITE MATERIALS

The fabrication process of self-healing composite material involves the insertion of microcapsules into the composite matrix. This is achieved through the hand lay process of composite manufacturing, ensuring uniform. distribution of the microcapsules within the material. This is achieved through the hand lay process of composite manufacturing as shown in fig. 4, ensuring uniform distribution of the microcapsules within the material. A precise ratio of 10% by weight of microcapsules to the weight of the composite material is maintained to optimize the self-healing properties. Once the microcapsules are integrated, the composite material is left to dry for a period of 48 hours. This drying phase is essential for allowing the composite to fully set and stabilize, ensuring optimal bonding between the matrix and the microcapsules. [16]

In testing the self-healing composite, the tensile strength of both components, one with microcapsules and the other without, is measured. Identically dimensioned components of the composite material are prepared for consistency. Using tensometers, the strength of both components is evaluated in two distinct cycles. Upon analysis, the results from the second cycle demonstrate that the self-healing composite with microcapsules exhibits higher strength compared to the normal composite material. This outcome suggests that the incorporation of microcapsules containing healing agents contributes to the enhanced mechanical performance of the composite. The observed effectiveness of the self-healing mechanism, which enables the repair of damage within the material, thus reinforcing its structural integrity. Such findings validate the potential of self-healing composites for applications where durability [17].



(a)



(b)

Fig. 4: Micocapsule Preparation Setup, Composite Material

CONCLUSION

In this article we successfully fabricated microcapsule inserted self healing composites and it gives better results as compare with normal composite materials in terms of regain its properties of self-healing. These innovative materials have the potential to enhance the performance, durability, and sustainability of diverse applications. As research and development in this field continue to progress, self-healing composites are poised to become the future of materials, paving the way for safer, more resilient, and longer-lasting structures and products.

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Performance of CI Engine for Different Fuel Blends: A Review

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ABSTRACT

Study presents a comprehensive investigation into standard characteristics, and system (CI) engine fueled with a blend of diesel and hydrogen, considering various engine operating parameters. The utilization of hydrogen as an aid to diesel fuel for engine to enhance engine performance and mitigate emissions. The experimental setup involved varying engine various parameters consider as injection timing, compression ratio, and hydrogen-diesel blend ratio to analyze their impacts exhaust emissions. The study employed advanced diagnostic techniques, including in-cylinder pressure measurements; exhausts gas analysis, and emissions characterization. Results indicate that insight of hydrogen to diesel as a fuel leads to improved combustion efficiency, reduced enhanced thermal efficiency under certain operating conditions. However, the optimal blend ratio and engine settings for maximizing performance while minimizing emissions varied depending on the specific operating conditions. This investigation provides the important with utilizing diesel-hydrogen blends in CI engines and various applications of engines, offering guidance for optimizing engine operation and fuel composition to achieve sustainable and efficient combustion.

KEYWORDS: *CI engine, Diesel-hydrogen blend, Exhaust emissions, Variable engine parameters.*

INTRODUCTION

The increasing concerns regarding environmental sustainability and energy security have led to a heightened focus on alternative fuels and cleaner combustion technologies for internal combustion engines. Among these alternatives, hydrogen has emerged as a promising supplementary to its high energy content, clean combustion characteristics, and potential for renewable production. This review delves into the behavior and exhaust emissions of CI engines when utilizing a blend of diesel and hydrogen. The incorporation of hydrogen into diesel fuel shows promise in enhancing combustion efficiency, reducing pollutant emissions, and diversifying the fuel mix towards sustainable energy pathways. However, a thorough understanding of the intricate interactions between engine parameters and fuel properties is essential for optimizing the performance of such blends in CI engines. The main aim of this review is to consolidate existing literature and investigate the impact of varying engine parameters, such as injection timing, compression ratio, and blend ratio, on combustion characteristics, Furthermore, it will pinpoint knowledge gaps and suggest directions for future research to advance the understanding of diesel- hydrogen blends' potential for in internal combustion engines. Ultimately, this review seeks to contribute to the development of cleaner and more environmentally friendly propulsion systems, facilitating the transition towards a low-carbon future. [3, 4].

LITERATURE REVIEW

Wang, H., Sun, H., & Zhang, C. (2020) Examine the combustion and emission characteristics of a diesel engine that was fueled with a diesel/hydrogen dual-fuel. The research aimed to analyze the impact of hydrogen addition on the engine's performance, combustion efficiency, and exhaust emissions. The findings revealed enhancements in combustion stability and a decrease in the emissions [1].

Subramanian, K. A., & Arunachalam, S. (2019) Performance, and emission characteristics of a CI engine fueled with diesel and hydrogen blend examined. Study concentrated on altering the ratios of hydrogen-diesel blends and found that higher hydrogen content resulted in improved emissions hydrocarbons (HC) [2].

Mahalingam, A., & Renganarayanan, S. (2018) The investigation delved into the combination of hydrogen fuels. The study emphasized advancements in combustion efficiency and the mitigation of CO and HC emissions through the incorporation of hydrogen, especially under heavier engine loads [3].

Ganesan, S., Nagalingam, B., Kumar, N., & Nagappan,B. (2017) A thorough examination combustion, emissions in case CI engine was powered by diesel- hydrogen blends. The focus of their research was on enhancing combustion efficiency and minimizing emissions by optimizing engine parameters, including injection timing and blend ratio [4].

Raju, R. S., & Reddy, K. H. (2016) Were examined by conducting an investigation on the utilization of hydrogen and diesel blends. The findings of their research demonstrated improved and decreased emissions when hydrogen was added, especially when advanced injection timings were employed [5].

Hwang, J. T., Kim, S. H., Park, S. H., & Bae, C. (2015)The impact of hydrogen incorporation on the efficiency attributes was investigated. The research findings indicated enhanced combustion stability CO and HC utilizing blends, suggesting potential advantages for emission control approaches [6].

Varatharajan, P., Vedharaj, S., & Annamalai, K. (2014) The impact of hydrogen supplementation was analyzed. The research findings indicated enhanced combustion efficiency and decreased levels of emissions, leading more environmentally friendly ignition processes [7].

Selvan, K. A., & Rathinam, E. (2013) The study conducted an analysis utilizing hydrogen and diesel dual fuel under varying injection pressures. The findings indicated the ideal injection pressure levels that enhance combustion efficiency and decrease CO and NOx emissions when using hydrogen-diesel mixtures [8].

Subramanian, K. A., & Nagarajan, G. (2012) Hydrogen blends were examined in a thorough investigation. The findings of the study emphasized the promising prospects of incorporating hydrogen into the fuel mixture, as it was found to significantly improve combustion efficiency and decrease CO and HC [9].

Kegl, B., Mavec, T., Pehan, S., Trop, S., & Katrašnik, T. (2011) The researchers running on hydrogen-diesel mixtures. Their study highlighted the significance of finding the right blend ratios and engine configurations to enhance combustion efficiency and decrease pollutant emissions [10].

A CASE STUDY

The increasing worries about environmental pollution and the necessity for sustainable energy sources have led to a research focus on different fuel. This research project delves into the performance, combustion traits compression ignition (CI) engine running on a mixture of diesel and hydrogen under different engine settings. The primary goal of this study is to determine the feasibility and potential advantages of using hydrogen- diesel blends as a viable substitute for traditional diesel fuel. Introduction: Diesel engines have historically served as the main power source for a variety of applications due to their efficiency and dependability. However, concerns regarding their environmental impact, particularly in terms of emissions like nitrogen oxides (NOx) and particulate matter (PM), have prompted a quest for cleaner alternatives. Hydrogen known for its high energy density and zero emissions during their use. Methodology: The research involves conducting experiments on a CI engine fueled with different combinations of diesel and hydrogen under varying engine conditions. Crucial parameters are methodically altered to evaluate their impact. Thorough measurements and analyses are carried out to assess how these parameters influence the engine's operational efficiency and environmental impact.

Results and Discussion

Performance

The engine's power output and thermal efficiency are found to vary with the hydrogen blending ratio and engine load. Higher hydrogen blending ratios generally result in improved combustion efficiency and thermal efficiency due to hydrogen's higher combustion properties. Optimal blending ratios are identified, balancing the benefits of hydrogen enrichment with the limitations such as reduced energy density and increased fuel consumption [12].

Combustion Characteristics

Combustion analysis reveals changes in with varying engine parameters. Hydrogen addition leads to faster combustion rates and shorter ignition delays, contributing to improved combustion stability and reduced emissions of unburned hydrocarbons (HC) and carbon monoxide (CO) [8].

Exhaust Emissions

Emission measurements demonstrate reductions in NOx and PM emissions with hydrogen blending, attributed to the inhibitory effect of hydrogen on NOx formation and improved combustion efficiency.

However, emissions of nitrogen dioxide (NO2) may increase at higher blending ratios due to the oxidation of nitrogen monoxide (NO) to NO2 in the hydrogen combustion [14, 18].

CONCLUSION

A thorough examination of literature, covering experimental investigations and theoretical assessments, has revealed numerous significant discoveries and patterns.

This enhancement in combustion characteristics is credited to hydrogen's rapid combustion rate, which encourages more thorough combustion and diminishes the creation of unwanted by-products.

Secondly, the optimization of compression ratio, and blend ratio has been identified as crucial for maximizing the benefits of diesel-hydrogen blends. Variations in these parameters have been shown to influence combustion behavior, thermal efficiency, and emissions profiles, highlighting the need for tailored engine calibration to achieve optimal performance.

Furthermore, while diesel-hydrogen blends offer significant potential for reducing emissions, challenges such as engine knock, combustion stability, and cold-start performance must be addressed to ensure practical viability. Future research efforts should focus on developing advanced engine control strategies, combustion models, and fuel injection systems to overcome these challenges and further optimize the utilization of diesel-hydrogen blends in CI engines.

Finally in conclusion, the study of diesel-hydrogen blends in CI engines shows great promise in achieving cleaner and more efficient combustion. Through further investigation the importance of ongoing research and innovation in alternative fuels and combustion technologies to tackle the issues of climate change and air quality deterioration. The analysis demonstrates offering enhancements in performance, combustion characteristics, and exhaust emissions when compared to traditional diesel fuel. By optimizing blending ratios and engine parameters, significant reductions in pollutant emissions can be achieved without compromising engine performance. Additional research is necessary to address challenges related to hydrogen storage, distribution, and combustion stability.

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Comparative Analysis of Different Impeller Designs and Positioning for Mixing Effectiveness using CFD

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ABSTRACT

Effective mixing is essential in various industrial processes, influencing product quality and process efficiency. This study focuses on comparing different impeller designs and their positions in enhancing mixing effectiveness using Computational Fluid Dynamics (CFD). The research explores three impeller designs - T-shaped, flat 5-bladed, and edge beater - positioned at center and offset locations within a cylindrical tank. CFD simulations were conducted to analyze mixing efficiency. Results indicate that impeller design significantly impacts mixing, with the edge beater impeller demonstrating superior performance due to its scraping action and minimized dead zones. Moreover, impeller positioning affects mixing, with offset positions exhibiting enhanced turbulence, fluid movement, and optimized trajectories, resulting in improved mixing efficiency. Overall, the edge beater impeller in an offset position is recommended for effectively mixing calcium alginate and milk in dairy industry applications, offering valuable insights for process optimization and product quality improvement.

KEYWORDS: *Mixing, Impeller, CFD, Simulation, Milk, Calcium alginate.*

INTRODUCTION

Effective mixing plays a pivotal role in numerous industrial processes, serving as a fundamental unit operation in various fields such as chemical, pharmaceutical, food, and biotechnology industries. The ability to homogenize, blend, and disperse substances accurately and efficiently is crucial for ensuring product quality, consistency, and performance. In the manufacturing industry, mixing impacts diverse stages of production, ranging from raw material preparation to final product formulation. Whether it involves combining ingredients for pharmaceutical tablets, dispersing additives in food products, or achieving optimal chemical reactions in reactors, the efficacy of mixing directly influences the overall process efficiency and the quality attributes of the end product. Poor mixing can lead to issues such as uneven distribution of components, inconsistent product quality, reduced yield, and increased production costs. Mixing can be passive or active. Passive mixing generally takes places on account of natural flow of materials due to their interfering paths or variation in velocities with progress of flow. However active mixing involves use of blades. Blades play a crucial role in determining the efficiency and effectiveness of mixing processes. They serve as the primary mechanism for imparting momentum to the fluid, generating flow patterns that facilitate the desired mixing objectives. The design and configuration of blades significantly influence various aspects of mixing performance, including fluid velocity distribution, shear rate, turbulence intensity, and residence time.

Various studies have been found in the past focusing on mixing improvements. Pukkella et al. [1] reported that the use of baffles provided better mixing of solid suspensions, and interfaced baffles were much better in mixing as compared to traditional ones. Li and Xu [2] observed that feeding positions, flow pattern and impeller speed have great influence on mixing process. Li et al. [3] reported that the particle shape had a great influence on fluid-particle interaction as well as particle distribution in stirred tanks. Guler et al. [4] evaluated the hydrodynamics and mixing conditions of stirred tank PBR and reported vortex formation around impeller. Dagadu et al. [5] performed mixing analysis in stirred tank and observed that mixing was not uniform throughout the tank on account of varying eddy viscosity. Wang et al. [6] observed that increasing the speed of propeller is conducive to the mixing of fluids in the tank. Wang et al. [7] reported that increasing the blade inclination correspondingly increased the turbulent kinetic energy in the stirred tank. Satjaritanun et al. [8] observed that rotation speed, impeller diameter, impeller clearance, tank diameter, liquid height and blade number all affect the mixing efficiency. Gu et al. [9] reported that self-similarity impeller increased he axial circulation capacity in stirred tank as compared to Rushton turbine impeller. Afedzi et al. [10] observed that efficient mixing is greatly dependent on the configuration of the impeller. Wutz et al. [11] explored the effect of baffles, stirrer, diameter, bottom layout, in and outlet setups for the mixing performance of industrial tanks. Youcefi et al. [12] reported that installation of inclined slots reduces power consumption and vortex size compared to conventional vessel configurations used for mixing. Ghanaatian and Raiszadeh [13] observed that the relative location of the impeller in the height of the melt, the diameter of the rotor and the presence of baffles in the crucible affect the efficiency of mechanical stirring. Chen and Sun [14] for the case of cement slurry mixing reported that increasing rotational speed decreased the stirring time to achieve stability of cement slurry and further reducing distance between impeller and tank bottom improved the mixing effect. Mao et al. [15] observed that radial flow impeller consumed lesser power than axial flow impeller for the case of cement slurry mixing. In view of the above, it can be concluded that mixing is affected by variety of parameters like types of fluids being mixed, tank design, viscosity, blade arrangements, baffles, flow directions of fluids, etc. Considering milk industry, calcium alginate beads have various applications, particularly in the field of dairy product encapsulation and controlled release. The use of calcium alginate beads in the milk industry enables the production of dairy products with enhanced nutritional value, improved sensory characteristics, and prolonged shelf life, contributing to the development of healthier and more appealing dairy offerings for consumers. Thus the milk industry requires mixing of milk with calcium alginate beads. Therefore, the quest for enhancing mixing effectiveness has been a focal point of research and development efforts, with advancements in computational fluid dynamics (CFD) offering valuable insights into understanding and optimizing different impeller designs for achieving superior mixing performance. This paper aims to conduct a comparative analysis of various impeller designs through CFD simulations, shedding light on their respective strengths and limitations in facilitating efficient mixing processes. Further the effect of positioning of impeller inside the impeller tank has been also given due consideration.

EXPERIMENTAL WORK

In this research work, it was planned to check the effectiveness of mixing of milk and calcium alginate beads inside tank with assistance of impeller. For this three different impeller designs viz. T-shaped, flat 5-bladed and edge beater were chosen. Further two positions, center and offset, were considered for each of the impellers. A CFD analysis was performed using Ansys so as to comparatively arrive at the mixing effectiveness. The methodology incorporated in the work has been summarized in Fig. 1. As a preliminary requisite, data input is required for different impeller modelling and tank. This data in the present research was obtained from the past work of Muttalib [16]. This consisted of design data and variables like density, viscosity, rotation speed, etc. The actual design was then drafted on paper later followed by geometric model in CAD software. The cylindrical tank was considered to be of 3.2 m in diameter and 2.8 m in height from industrial application perspective. The dimensions of the impeller as well as its distance from the tank's bottom surface is as shown in Table 1. The geometry of the different impellers in center position with the tank are shown in Fig.

Table 1 Distance between impeller and tank

Impeller type	D (m)	W (m)	C (m)
	1.8	0.5	0.4
Flat 5-bladed	1.8	0.8	0.1
Edge beater	1.9	2.1	0.1

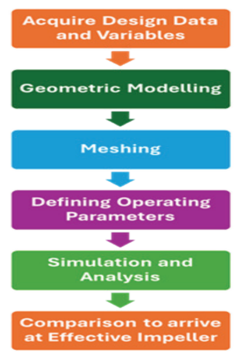
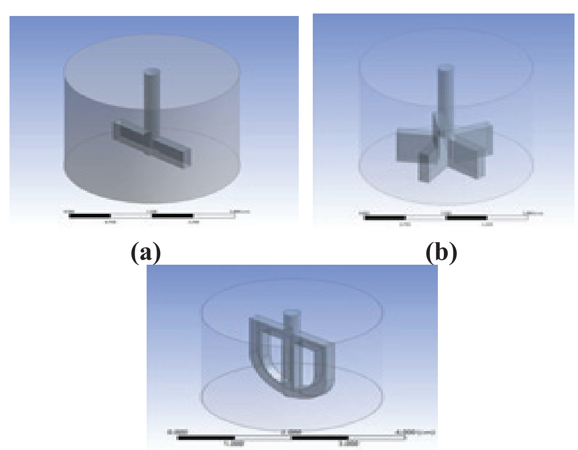


Fig. 1: Methodology incorporated in the work



(a) (b)

(c)

Fig. 2 Geometric model of tank with (a) T-shaped impeller, (b) Flat 5-bladed impeller, and (c) Edge beater impeller

The geometric model was then imported into Hyper Mesh platform and then meshing was performed using unistructural tetrahedral and wedge meshes. The geometry of mixing tank is not complex so as to make use of fine mesh; however still additional mesh elements around the inner domain were chosen so as to get improved mesh quality and results. An example of meshed tank, impeller and fluid in-between has been shown in Fig. 3. The meshed model was then imported into Ansys Workbench. Boundary conditions and operating parameters were then specified for getting solution through Ansys Fluent platform. The tracer method was used to track the interface between tracer and the fluid in the tank. The flow distribution pattern of calcium alginate beads was simulated using the K-epsilon turbulence model while the same for impeller rotation was using the multiple reference frame method. The impeller was rotated at a constant speed of 150 rpm. The result of different types of impellers and impeller positions were then arrived at so as to determine the effective mixing.

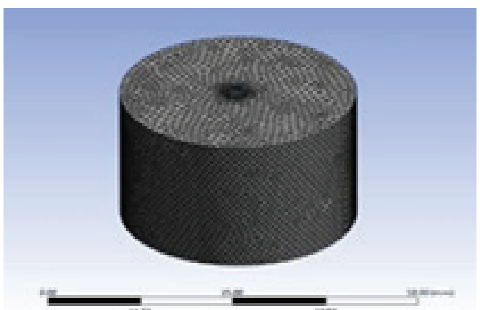
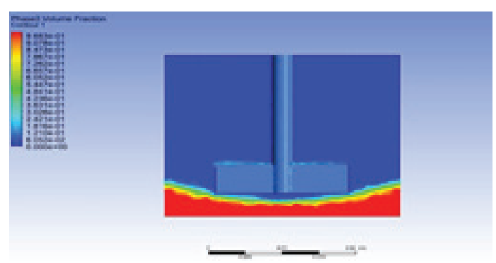


Fig. 3: Meshed model of tank, impeller and fluid

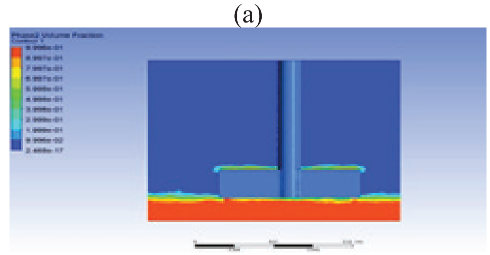
RESULTS AND DISCUSSION

It is to be understood that physical experiments with different impellers and fluids may be performed for better analysis of mixing by keeping continuous close observation on mixing phenomena. But as calcium alginate is whitish in color, almost same as that of milk, the result of mixing of both cannot be thus visualized. Further the use of resources and modification in setup every time for betterment is time consuming and costly. Majority of the times, the factor of time consumption becomes so large in exploration of better designs, that the actual production in the industries get crucially delayed further affecting their ROI (return-on-investments) and profits. This puts limitations on physical experiments and manufacture as well as modification of impellers in our current case. Under such circumstances, computation domain approach of CFD comes to rescue. CFD becomes significant as it allows the user to view the trend of process happening in the domain and helps to identify the exact location of the reaction during the simulation.

Post-CFD simulation, an analysis was performed for each of the impeller types so as to get a comparative idea on the mixing characteristics of the two mediums, i.e. milk and calcium alginate. Mixing of the fluid can be checked from the result of volume fraction of milk and calcium alginate beads. Further the pressure drop should be as low as possible for good mixing and for high-efficiency impeller. Contour plot function was used for display of results in graphical format. The variables of contour plot applied in the study were velocity, pressure and volume fraction. It is learnt that different shapes and configuration of the impeller affect the mixing and fluid motion. The VOF (volume of fluid) analysis for different conditions is shown in Fig. 4-6. The densities of milk and calcium alginate are different, the latter having higher density. Hence calcium alginate tries to settle down at the bottom of the tank naturally when introduced with milk. Due to this agitation or stirring effect is required for proper mixing of the calcium alginate with milk. Simply put these are initially two different phases prior to mixing and thus VOF can aid in better analysis during mixing. In VOF simulations, the computational domain is discretized into gird of cells, and the volume fraction of each fluid phase within each cell is tracked as the simulation progresses in time. The volume fraction basically represents the proportion of each fluid phase within a given cell, with values ranging from 0 to 1. A volume fraction of 0 indicates that the cell is entirely filled with one fluid phase, while a volume fraction of 1 indicates that the cell is entirely filled with another fluid phase; intermediate values represent mixtures of the two fluid phases. VOF enables to accurately capture the shape and movement of fluid interfaces during mixing.

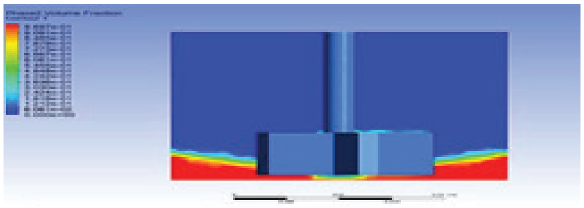


(a)

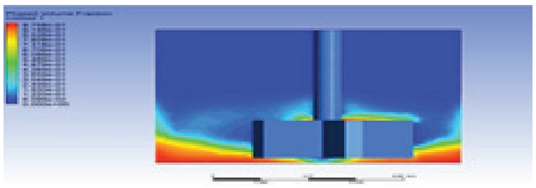


(b)

Fig. 4: VOF for T-shaped impeller (a) Center position, and (b) Offset position



(a)



(b)

Fig. 5 VOF for 5-bladed impeller (a) Center position, and (b) Offset position

(a)

(b)

Fig. 6 VOF for Edge beater impeller (a) Center position, and (b) Offset position

Considering the T-shaped impeller, its design basically consists of a central shaft with radial arms forming a t-shape. Fig. 4a and Fig.4b show the VOF for T-shaped impeller with center position and offset position respectively. Generally T-shaped impellers are known for providing efficient radial flow and agitation within the mixing vessel. In the current work, the T-shaped impeller provided comparatively poor agitation and mixing, as can be deduced from VOFs from amongst all the impellers. However as compared to center position, the offset position improved agitation and mixing by some extent. In view of 5-bladed impeller, its design comprised of central shaft with 5 equally spaced radial spanning arms also called as blades. The blades may be flat or curved, however in current case only flat bladed design was considered. The VOF for 5-bladed impeller with center position and offset position is shown in Fig. 5a and Fig. 5b respectively. Traditionally 5-bladed impellers offer versatile mixing characteristics as they provide good radial flow and agitation. It can be seen that, as compared to T-shaped impeller, the 5-bladed impeller provided better agitation and mixing. This is because the T-shaped impeller had only two arms which induced a limited stirring effect, while the 5-bladed impeller had 5 arms which induced relatively higher stirring effect. Thus, the settled calcium alginate at the bottom gets notably dispersed due to the 5-blade's collective stirring effect and it properly mixes with the milk as seen from the VOF in the regions around the blade. However in contrast to 5-bladed impeller with center position, the same with offset position offers relatively more agitation and hence leads to better mixing effect. Considering the edge beater impeller, its design is characterized by their flat, paddle-like blades that are positioned at the edge of the impeller hub. They facilitate scraping the vessel walls to ensure thorough mixing. Fig. 6a and Fig.6b show the VOF for edge beater impeller with center position and offset position respectively. It can be seen from amongst all the impeller designs, the edge beater design is the best for providing effective mixing. The paddle-like blades scrape the tank walls, prevent material buildup and thus ensure thorough mixing. Further in contrast to center position, the offset position enhanced agitation and mixing to some extent. Overall it can be deduced that the edge beater impeller facilitated enhanced stirring and thus effective mixing as compared to others on account of efficient scraping action, enhanced agitation and minimized dead zones.

Further having a keen focus on the impeller positions, it can be deduced that the positions do affect the mixing for all the impeller designs. Compared to impellers with center position (see Fig. 4a, Fig. 5a, Fig. 6a), the impellers with offset position (see Fig. 4b, Fig. 5b, Fig. 6b) were appreciably effective in enhancing the stirring effect and thus provided better mixing. This is because the offset position comparatively induced asymmetrical fluid flow patterns within the mixing tank, leading to increased turbulence and better mixing efficiency. The offset shaft position alters the trajectory of fluid particles as they interact with the impeller blades. This change in trajectory leads to more efficient fluid movement and dispersion throughout the mixing tank, resulting in better mixing performance. Additionally, the offset shaft position also increases the shear forces exerted on the fluid by impeller blades thus facilitating breakup of agglomerates, dispersion and thorough mixing. Further there is creation of zones of higher and lower fluid velocity within the mixing tank, resulting in an optimized residence time distribution. This ensures that the fluid spends sufficient time within the mixing zone, allowing for more effective mixing and dispersion of ingredients. The offset shaft position also minimized the formation of dead zones or areas of stagnant fluid within the mixing tank. This reduces the risk of incomplete mixing and ensures that all regions of the tank receive adequate fluid circulation and agitation.

CONCLUSIONS

The following conclusions can be arrived at from the experimental study.

- Calcium alginate offers dairy industries a versatile ingredient with various functional properties due to which it needs thorough mixing with milk.
- Use of CFD simulations can be beneficial for comparing different designs wherein physical testing of the same would be difficult, highly time consuming and costly.
- Both, the design of impeller as well as its position inside mixing tank significantly influence the mixing efficiency.
- The edge beater impeller provided the best stirring and effective mixing as compared to T-shaped and 5-bladed impellers on account of efficient scraping action, enhanced agitation and minimized dead zones.
- The offset position of impeller in contrast to center position offered better mixing due to enhanced turbulence and fluid movement, optimized fluid trajectories, increased shear forces, optimized residence time and minimized dead zone.
- Overall the edge beater impeller with its offset position inside mixing tank is recommended for effective mixing of calcium alginate and milk.

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Experimental Investigation on Surface Roughness using Hybrid Fluid

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ABSTRACT

This study presents an experimental investigation on surface roughness utilizing a hybrid fluid in machining processes, aiming to enhance surface finish quality. Traditional cutting fluids combined with nanoparticles form the hybrid fluid, offering improved lubrication. Through controlled cutting tests on various workpiece materials, including metals and alloys, surface roughness measurements were conducted using profilometers. Statistical analysis revealed significant improvements in surface finish quality with the hybrid fluid compared to conventional fluids, attributed to its enhanced lubrication and chip evacuation capabilities. These findings underscore the potential of hybrid fluids in optimizing machining processes Optimum Condition for superior surface integrity and hold promise for enhancing industrial manufacturing efficiency and quality.

KEYWORDS: *Surface roughness, Hybrid fluid, Turning, Process parameters etc.*

INTRODUCTION

Surface roughness analysis plays a vital role in various engineering and industrial applications, as it directly impacts the performance and functionality of components, devices, and systems. Achieving the desired surface finish is crucial to ensure optimal efficiency, durability, and reliability of mechanical and electronic equipment [1]. In this context, the use of coolants and nanofluids has gained significant attention, offering promising solutions for improving surface quality and thermal management [2]. Ethylene Glycol and Propylene Glycol, two commonly used glycol-based coolants, have been widely employed in diverse engineering applications, primarily for their excellent thermal properties, corrosion resistance, and low toxicity. These coolants are crucial in heat transfer systems, such as radiators in automotive and industrial cooling systems, and they play a significant role in maintaining temperature control in electronic components, enhancing overall system efficiency [3]. Nan fluids, on the other hand, have emerged as a cutting-edge technology in the field of heat transfer and surface enhancement. Nanofluids are engineered suspensions of nanoparticles in a base fluid, where the nanoparticles' unique thermal and mechanical properties can significantly enhance the heat transfer characteristics and surface quality of the fluid. Among the various nanoparticles available, aluminium oxide nanoparticles have shown exceptional promise due to their high thermal conductivity, chemical stability, and abrasion resistance [4-5].This study focuses on the combined application of ethylene glycol and propylene glycol as base coolants with the addition of aluminium oxide nano particles [6-7]. The investigation aims to evaluate how the introduction of these nanofluids affects the surface roughness of materials and components in different industrial contexts. By studying the synergistic effects of coolants and nanofluids on surface roughness, this research seeks to offer insights into improving heat transfer efficiency and surface quality and longevity of machinery and electronic systems [8-9]. The outcome of this analysis holds potential for a wide range of metal cutting industries. It can inform engineers and researchers on the most effective strategies for achieving optimal surface finish, contributing to enhanced performance, reduced energy consumption, and extended service life of critical components and systems [10-11]. Furthermore, the findings from this study may also have environmental implications, as improved thermal management can lead to energy savings and a reduced carbon footprint.

EXPERIMENTAL PROCEDURE

Preparation of Hybrid Fluid: The hybrid fluid is formulated by combining a semi synthetic coolant as the base fluid with aluminum oxide nanoparticles as additives. The composition is optimized to achieve desired properties such as enhanced lubrication, cooling efficiency, and surface finish improvement. The synthetic coolant acts as a carrier fluid for the nanoparticles, ensuring uniform dispersion and stability during machining operations.

Experimental Setup: The experimental setup involves selecting an appropriate workpiece material and configuring the machining apparatus with controlled parameters. The workpiece holder, cutting tool, and coolant delivery system are arranged to ensure consistent machining conditions. Environmental factors such as temperature and humidity are monitored and regulated to minimize variability.

Surface Roughness Measurement: Surface roughness Ra measured using a profilometer. Initial measurements are taken with conventional cutting fluids to establish baseline values. The hybrid fluid, containing aluminum oxide nanoparticles, is then applied during machining operations. Multiple passes are conducted, and surface roughness data is recorded for analysis.

Data Analysis: The recorded surface roughness data is analyzed to evaluate the effectiveness of the hybrid fluid in improving surface quality. A comparative analysis is performed between results obtained with the hybrid fluid and those obtained with conventional cutting fluids. Statistical methods are employed to assess the significance of any observed differences.

Interpretation of Results: The findings from the data analysis are interpreted to elucidate the impact of the hybrid fluid on surface roughness. The advantages of incorporating aluminum oxide nanoparticles into the synthetic coolant are discussed, highlighting improvements in lubrication, cooling, and surface finish. Limitations of the experimental approach are identified, and recommendations for further research or practical applications are provided based on the results obtained.

RESULTS AND DISCUSSION

The material Mild steel IS 2062 is used for experimental work. Tungsten coated carbide insert with specification CCMT-090308 with 0.8 mm radius is used for experimentation. The total nine pieces of specimen work piece were cut out on cutting machine. The experimental trials were carried out on CNC machine by taking process parameters such as feed rate (FR), cutting speed (CS), and depth of cut (DOC) and results are tabulated in Table 1 which are as follows.

Table 1: Experimental Surface Roughness Values

Sr. No.	CS (m/min)	FR (mm/rev.)	DOC (mm)	Ra (µm)
1	141	0.12	1.5	1.745
2		0.3	2	1.847
3		0.5	2.5	0.850
4		0.12	1.5	1.562
5		0.3	2	1.687
6		0.5	2.5	0.956
7	141	0.12	1.5	1.254
8		0.3	2	1.458
9		0.5	2.5	0.876
10	172	0.12	1.5	1.568
11		0.3	2	1.786
12		0.5	2.5	0.948
13		0.12	1.5	1.401
14		0.3	2	1.090
15		0.5	2.5	0.806
16		0.12	1.5	1.524
17		0.3	2	1.456
18		0.5	2.5	1.065
19	204	0.12	1.5	1.587
20		0.3	2	1.876
21		0.5	2.5	0.984
22		0.12	1.5	1.598
23		0.3	2	1.985
24		0.5	2.5	1.156
25		0.12	1.5	1.854
26	204	0.3	2	2.245
27		0.5	2.5	1.025

Analysis of the result

Every trial of experimental work having combination of different levels of factors, therefore it is necessary to report the effect of each factor. The performance of each parameter is based on sum of square deviation of mean. By doing ANOVA analysis one can say the parameter is significant or insignificant. From experimental result also, it can be studied that effect of variables on response parameter. Table 2 shows signal to noise ratio and Table 3 shows response table for means. The response parameter surface roughness is calculated smaller the better accordingly signal to noise ratio. From table 2 and 3 it is observed that FR and DOC having significant influence on surface roughness under hybrid fluid mode. Figure 1 shows signal to nose ratio and from fig 1 the optimum condition obtained is CS (204 m/min), FR (0.30 mm/Rev.), DOC (2.5 mm).

Table 2: Response Table for Signal to Noise Ratios

Level	CS	FR	DOC
1	-2.33	-3.85	-3.85
2	-2.09	-4.64	-4.64
3	-3.69	0.37	0.37

Delta	1.59	5.01	5.01
Rank	3.0	1.5	1.5

Table 3: Response Table for Means

Level	CS	FR	DOC
1	1.34	1.55	1.55
2	1.28	1.70	1.708
3	1.58	0.95	0.95
Delta	0.29	0.75	0.75
Rank	3.0	1.5	1.5

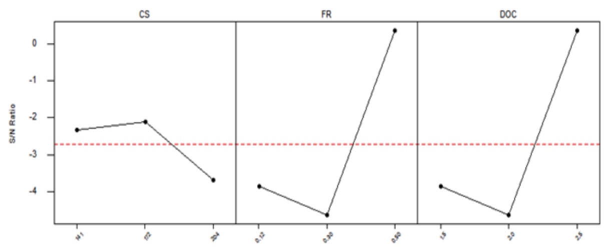

Fig. 1: optimum condition

Regression Equation

Regression analysis was implemented to develop prediction models using the predictors such as cutting speed, feed rate, depth of cut and tool nose radius under hybrid mode with nano fluid in turning of mild steel. The Minitab software was used for the analysis of experimental work and to develop the predictive model for surface roughness. The regression equation obtained from the results is, Ra = - 18.4 + 0.00369 CS - 45.0 FR + 16.5 DOC

CONCLUSION

The experimental investigation conducted on surface roughness using the hybrid fluid containing aluminum oxide nanoparticles has provided valuable insights into the potential benefits of utilizing advanced coolant formulations in machining processes. The results demonstrate a clear improvement in surface finish achieved with the hybrid fluid compared to conventional cutting fluids across varying cutting parameters.

The study underscores the critical influence of CS, FR, and DOC on surface roughness. By optimizing these parameters, manufacturers can enhance product quality and productivity. Further research could explore additional factors for even greater improvements in surface finish quality.

The investigation highlights the importance of optimizing machining parameters for surface roughness (Ra). Specifically, employing a FR = 0.50 mm/rev., CS = 204 m/min., and DOC = 2.5 mm consistently yielded superior results across and leads to optimal surface roughness value of 0.806 µm.

The regression equation obtained from the results is : Ra = - 18.4 + 0.00369 CS - 45.0 FR + 16.5 DOC.

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A Review on Potential Alternative Fuels and Blending with Petrol for Spark Ignition (S.I.) Engines

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ABSTRACT

The national economy depends heavily on gasoline, a key energy supply. With comparable combustibility to SI engine fuels, alcohol fuel is derived from renewable resources. In internal combustion (IC) engines, they can therefore be combined with gasoline. Alcohols have altered the way we power vehicles and lessened our reliance on using fossil fuels as a source of energy. As substitute fuels for car engines, low-carbon alcohols like methanol and ethanol have gained popularity. Ethanol and butanol are very competitive renewable fuel substitutes for SI engines, offering numerous benefits such improved antiknock performance. Researchers suggested a number of substitutes, including acetone, n-butanol, methanol, ethanol, and isobutanol. As the above example shows, these options were used under various engine operating conditions and produced somewhat varying performance and emissions outcomes. As a result, it is imperative to compare and assess these alternatives' environmental behaviour and performance in SI engines under identical conditions. In this review, different properties of alternative fuel have been discussed thoroughly. Though electric vehicles will be on the road instead of conventional engines, there are several potential alternative fuels for spark ignition engines at least for next few decades.

KEYWORDS: *Alternative fuels, Acetone, Amyl alcohol, Hexane, Pentane.*

INTRODUCTION

Numerous studies have been conducted globally to identify viable substitute fuel sources that could eventually supplant finite fossil fuel stocks. Alternative fuels are anticipated to meet the specifications of fossil- based fuels while also having low pollutant exhaust emission values [1]. Research has demonstrated that the attributes of alcohol-based fuels are comparable to those of fossil fuels and that their emissions of pollutants are reduced. Apart from the utilization of pure alcohol- based fuels, research is still ongoing in the context of mixes added to fossil fuels at certain rates [2]. In terms of noise pollution, environmental pollution, and global warming, automobile emissions have been a significant issue in recent decades. Under the context of international accords, automotive manufacturers are required to create their automobiles within the parameters of pollution restrictions. There are strategic management plans to lower dangerous emission levels and lower national carbon footprints in a lot of state management programs [3]. Emission reduction studies are becoming more and more significant in this setting, which motivates researchers to look for intriguing substitutes. Test fuels containing mixed fuel with 10%, 20%, and 30% gasoline by volume were used to test fusel oil in gasoline engines.

By 2050, about 90% of the global population is expected to reside in developing nations, which suggests that biomass energy will likely remain a staple unless global energy trade patterns drastically alter [5]. Unfortunately, because biomass energy is mostly used in rural parts of underdeveloped countries where it frequently provides more than 90% of the total energy needed it has typically been assigned the lowest priority, if it is given any consideration at all. Planners and others face challenges when it comes to biomass because of its many origins, end uses, and interactions with land use, which have a multitude of socioeconomic ramifications from production to consumption [6]. Eyidogan et al.[8] conducted an investigation using experiments on the addition about adding ethanol and methanol to gasoline. The results showed that the use of alcohol mixtures (E5, E10, M5, and M10) increased brake specific fuel consumption in comparison to gasoline and generally decreased CO, HC, CO2, and NOx emissions. Danaiah et al. [9] have also conducted studies along these lines. In an HCCI engine, Calam et al. [10] investigated the emission characteristics and engine performance of mixes of n-heptane, ethanol (E25 fuel blend), methanol (M25 fuel blend), fusel oil (F25 fuel blend), naphtha (N25 fuel blend), isopropanol (IP25 fuel blend), butanol (B25 fuel blend), and n-heptane. This study found that how much water the fusel oil contains caused an increase in the CO and HC readings. Emissions and combustion are influenced by the water content of fusel oil. The test findings are improved when the fusel oil's water content is purified using sodium chloride. In general, blends of ethanol and methanol fuels have been observed to improve engine performance like brake power, volumetric efficiency, torque etc. and lower pollutant emissions (unburned hydrocarbons (UHC) and carbon monoxide (CO). Alcohol-based methanol fuel works better in spark-ignition (S.I) engines and suitable for use with gasoline at a lower mixing ratio. Methanol, however, has drawbacks, particularly when it comes to its energy content and vapor lock characteristics. With this in mind, Sharudin et al. [11] blended 5–15% isobutanol into methanol-gasoline mixtures (M5) to study engine performance and emission outcomes.

In comparison to other blended fuels, M5B15 has been shown in an experimental investigation to improve engine braking power, brake thermal efficiency, as well as exhaust gas temperature (EGT). It has been discovered that the quantity of water present in fusel oil influences engine performance and increases the fuel's octane number, volumetric efficiency, and engine torque when mixed with gasoline. It also lessens knocking and nitrogen oxides (NOx). Additionally, experiments are conducted by blending diesel fuel with fusel oil. In their experimental study, Şimşek et al. [12] compared their results with the initial operating specifications of a gasoline engine while conducting trials for six various fuel mixture ratios like F0, F10, F20, F30, F40, and F50 etc. at constant speed and varying ratios. A thorough investigation of the impacts on the duration of combustion in a single cylinder & variable compression ratio was carried out by Szwaja et al.[13]. The Waukesha engine was run on gasoline blends containing 0%, 20%, and 60% n-butanol, and the B20 and B60 fuels' reducing the sensitivity of combustion was examined. A wide variety of working speeds ranging from 2600 to 3400 r/min have been explored experimentally for both gasoline-only and gasoline-plus-butanol combinations. Results indicate that cylinder pressure, exhaust temperature, power, torque, and volumetric efficiency all marginally reduce the leaning effect of the n-butanol addition. Koç et al. [14] examined the operation of unleaded gasoline blends (E50 and E85) and neat unleaded gasoline (E0) in a single cylinder, four- stroke SI engine under experimental settings involving a wide variety of throttle openings. The mixture of gasoline and ethanol allowed for a higher compression ratio without experiencing knock, and it was discovered that adding gasoline to ethanol increased torque, power, and fuel economy.

ALTERNATIVE FUELS

Hexane

Hexane is a naturally occurring six-carbon aliphatic molecule that is present in both natural gas and the paraffin component of crude oil. Pure hexane is a volatile, colorless liquid that burns easily and is lighter than water. It smells like gasoline and has an olfactory threshold of approximately 465 mg/m^3 (130 ppm).

The molecular weight of hexane is 86.17 g mol–1. Henry's Law constant (1.8 atm m-3 mol-1), Solubility in water of 9.5 mgl-1, and approximately one hundred twenty millimeters of Hg of vapor pressure are all present in n-hexane at 20°C (USEPA, 2011). [15] The logarithmic partition coefficient of water/octanol is 3.90. The following are the conversion coefficients for airborne n-hexane: 1 ppm = 3.58 mg m-3 and 1 mg m-3 = 0.28 ppm. In the surrounding atmosphere, hexane can only exist as a vapor if it is discharged into the air since n-hexane is heavier than air and has a vapor density of 2.97. The burning of gasoline and the petroleum industry account for the great bulk of n-hexane emitted into the atmosphere. Only when n-hexane is released into the environment will it persist as a vapor in the surrounding air. The atmosphere will undergo photochemical reactions generated hydroxyl radicals to destroy vapor- phase n-hexane; this reaction has an estimated three- day half-life in air.

- **Chemical Name:** n-Hexane
- **Molecular Formula:** C6H14
- **Alternative Words:** Dipropyl, Esani, Heksan, AI3-24253, Hexanen, Hexyl hydride, NCI C60571, HSDB 91, Skellysolve B, Gettysolve B
- **Chemical Structure:** CH3CH2CH2CH2CH2CH

Pentane

Pentane is a naturally occurring 5-carbon aliphatic molecule that is present in both natural gas and the primary paraffin percentage of crude oil. Pentane, the first liquid among the alkanes, which is colorless, combustible, and lighter than water [17]. Its olfactory threshold is 900 ppm, and at 5000 ppm, a moderate odor intensity is detected. It has a pleasant scent. It also exists as two other isomers: C(CH3)4 neopentane and (CH3)2CHCH2CH3 isopentane. Physically and physiologically, isopentane (2-methylbutane) appears to resemble straight-chain pentane. Physically and physiologically, neopentane (2, 2-dimethylpropane) is comparable to butane. The environment will react with photochemically generated hydroxyl radicals to destroy vapor-phase pentane.

- **Chemical Name:** n-Pentane
- **Molecular Formula:** C5H12
- **Alternative Words:** Pentane (ACGIH, NIOSH, OSHA, DOT); Pentan (Polish); Pentanen (Dutch); Pentani (Italian); UN1265 (DOT)
- **Chemical Structure:** $(CH_3)_2CHCH_2CH_3$ [18]

Amyl Alcohol

Amyl alcohol is a chemical molecule having the general formula C5H11OH. It is one of these alcohols, and there are eight known isomers. Of the eight isomers that have been found, iso-amyl alcohol is the most significant. Typically, iso-amyl alcohol is produced by fermentation of potatoes, grains, and fuel oil through a number of procedures (including extraction, distillation, and drying). Chemical techniques can also be used to synthesize them. The chemical formula for iso-amyl alcohol is (CH3)2CH-CH2CH2-OH. The boiling point of it is 131 °C, a mass density of 810 kg/m3, and a molar mass of 88.148 g/mol. Alcohol and ether can be mixed with it readily and is utilized in synthesis, photography, the pharmaceutical business, and determining the fat content of milk [19]. The liquid is discolored and smells bad. For iso-amyl alcohol, the Corban ratio is high. Iso-amyl alcohol has high solvent qualities and blends readily with diesel fuel; as the number of carbons in alcohols grows, so may the ease of mixing them with fuels. [22].

Butanol

The chemical formula for butanol, also known as butyl alcohol, is C4H9OH. It has five different structures, spanning from a primary alcohol with a straight chain to a tertiary alcohol with a branched chain. All of these structures have a butyl or isobutyl group connected to a hydroxyl group (which is sometimes denoted by the symbols BuOH, n-BuOH, and i-BuOH) [23]. N-butanol has a lower octane number than ethanol and methanol, but it is almost comparable to gasoline. It was discovered that the amount of contaminants in the flammable mixture decreased when butanol was added. It was brought on by the oxygen found in butanol's composition, which enhanced combustion by lowering the amount of solid particles in the exhaust. Furthermore, the production of hyperthermal chemicals (NOx) was also decreased because butanol evaporates at a greater temperature and less calorific value than that of gasoline.

Ethanol

Ethyl alcohol and fermentation alcohol are other terms for ethanol. Although the term "alcohol" is frequently used to refer to ethanol, especially when discussing beverages, it actually pertains to a wider group of substances having the same formula ROH, where R stands for one or more alkyl groups made up of hydrogen and carbon atoms and OH stands for the hydroxyl group composed of hydrogen and oxygen atoms, respectively [28]. The molecular formula for ethanol is C2H5OH, where C, H, and O stand for carbon, hydrogen, and oxygen atoms, respectively. Ethanol belongs to the alcohol family. It appears clear and colourless, and ethanol is perfectly miscible with water. When ethanol is diluted with water, it tastes slightly sweeter; when it is concentrated, it tastes more intense and scorching; and it smells pleasant, like ether [29]. It is extensively utilized in rubbing compounds, solvents, colognes, lotions, tonics, and medications in addition to organic synthesis. In addition to being flammable, the flame that burns ethanol is light blue and has good fuel qualities for internal combustion engines It is also more volatile than water. Its average octane (99), motor octane number (MON) (90), and research octane number (RON) (109), are all higher than the ordinary gasoline's 88 [30]. The fermentation of carbohydrates produced from sugar, starch, or cellulosic materials, or the reaction of ethylene with water, are the two main processes used to manufacture ethanol. For the manufacture of fuel, the former is preferred. Since fermentation ethanol can be purified, ethylene-derived ethanol is being replaced by the latter for use in industrial-grade ethanol applications such as solvents, cosmetics, medications, and so forth. The process of turning coal, natural gas, or wood into synthesis gas (carbon monoxide and hydrogen). is being done through certain innovative techniques that are being developed [31]. However, the cost of producing gas produced using synthesis from sustainable sources.

Methanol

A transparent liquid with one carbon atom per molecule, methanol (CH3OH) is the most basic alcohol. Many CO2-

free sources, such as plant matter and municipal solid waste, can be utilized to make methanol, which is widely used and mostly synthesized from natural gas [34]. Cars currently run on methanol. Not only does it boost the vehicles' performance, but it is also regarded as significantly safer, which is why it has been the preferred fuel for the Indianapolis 500 for almost thirty years. When it ignites, it causes less severe fires than gasoline and is less flammable than gasoline. It appears that methanol similarly dissolves and dilutes easily in water and biodegrades swiftly if spilled. Even if coal, biomass, or natural gas can be used to make it to distill methanol. Methanol was briefly very popular as an internal combustion fuel in the 1980s [35]. There is very little interruption if fuel cell automobiles run on gasoline, but many believe that methanol will act as a bridge to straight hydrogen. Methanol may have been used in early fuel cell vehicles, but quick developments in the manufacturing and storage of straight hydrogen may surpass any liquid fuel stage. Hydrogen is extracted from hydrocarbon molecules utilizing partial oxidation and autothermal reformers when it is obtained from gasoline or methane [36]. Alcoholic fuels have been used in one form or another for as long as internal combustion engines have been around. Propanol, butanol, ethanol, and methanol are the four types of alcohol that can be used as fuel. In an attempt to minimize CO2 emissions and our reliance on oil, ethanol has gained popularity over the past few decades and is now frequently added to gasoline in both Europe and the US [22]. Alcohols are harder to mix with diesel; this is especially true for methanol, as the two liquids separate easily and require an emulsifier to stabilize the mixture. There isn't much research—at least not in the public or academic domains—on the topic of blending alcohols with diesel. The one study that was located states that a 3:2 volume ratio of methanol to emulsifier is necessary, but it was conducted in 1984.

Acetone

The organic chemical having the formula OC (CH3)2 is acetone. The most basic form of a ketone is this flammable, colorless liquid. Acetone is a useful solvent in and of itself and is frequently the solvent of choice for laboratory cleaning due to its miscibility with water and almost all other organic solvents. Produced yearly in excess of 3 billion kg, mostly as a precursor to polymers [31]. It is a typical organic chemistry building unit. Apart from being produced artificially, acetone can also be found in nature, as it is bio-synthesized in tiny quantities within the human body. Acetone seems to have all the necessary qualities for a basic fuel, and these are typically found halfway between methanol and petroleum. Propene can be used directly or indirectly to make acetone. The cumene process typically involves alkylating benzene with propene, which yields cumene (iso-propyl-benzene), which is then oxidized to produce acetone and phenol. Acetone is often employed as a solvent for the safe transportation and storage of acetylene, despite the fact that it is combustible in and of itself and cannot be safely pressured as a pure compound. Acetone is first added to vessels made of a porous material, and then acetylene is added, which dissolves into the acetone. About 250 liters of acetylene can be dissolved in one liter of acetone [25].

Hydrogen

Hydrogen is appealing from a variety of angles. First and foremost, there are a number of ways to manufacture hydrogen, some of which are long-term sustainable. These include techniques based on biomass, solar energy, and wind. Second, there are other ways to use hydrogen energy, including gas turbines, fuel cells, and engines. Thirdly, in today's power systems, using hydrogen as a fuel produces nearly no emissions of pollutants and has a comparatively high thermal efficiency. Global efforts to reduce carbon emissions have recently served as a strong stimulus for a number of advances in the creation of novel hydrogen technologies, including solar thermo-chemical processes and high-pressure [38] storage. As a result, there is a renewed interest in using hydrogen as a flexible energy source in powertrains. Hydrogen has some benefits over gasoline that make it a good choice for internal combustion engines.Due to its elevated diffusivity, it is advised to blend the air and fuel throughout the intake process. Due to its wide flammability threshold, engines may run in extremely lean settings to increase thermal efficiency and can tolerate a high exhaust gas recirculation (EGR) rate to reduce NOx emissions without risking a misfire [39]. Incorporating little amounts of a fuel with a high energy density, like hydrogen (H2), to engines running on ethanol is one technique to make up for it. The expanded flammability limit, flame speed, and high lower heating value of H2 are among the characteristics that make ethanol an excellent engine fuel option. These features enable combustion to occur in weak or diluted regimes, hence reducing carbon emissions [40].

CONCLUSION

A number of substitutes for gasoline fuel in spark- ignition engines were suggested by researchers. This paper presents the review of a comprehensive analysis that compares and assesses the environmental behavior and performance of these alternatives in order to assist in suggesting the future generation of automotive alternatives.

- According to the results presented by previous researchers, isobutanol $<$ ethanol $<$ methyl-butanol is the general order of knock-limited performance at equal oxygen weight percentage. When examined on an equivalent oxygen weight basis, methyl- butanol consistently outperformed isobutanol in terms of knock-limited chemistry performance and outperformed it when compared on a volumetric blending basis. This is true even though the oxygen weight percentages and octane numbers of all the fuel mixes are comparable.

- At the higher loads tested, pre-spark heat release was evident in all of the fuels.
- Burn time and combustion variability were comparable for comparable combustion phasing in all evaluated fuels. Blends with comparable oxygen weight showed similar fuel consumption trends as evaluated by ISFC, while methyl-butanol mid- and high-blends were able to achieve reduced ISFC at increasing loads.
- Ethanol < isobutanol < methyl-butanol was the order of least to maximum particulate reduction for the three alcohols based on oxygen weight percent.
- With increased engine speed and a decrease in the percentage of ethanol blended, volumetric efficiency exhibits negative behavior.

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A Systematic Review on Weighing, Packaging, Dispensing and Sorting Techniques Using Machine Learning Approach in Automation Industry

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ABSTRACT

This paper's primary goal is to learn about techniques of machine learning, various types of packaging system and weighing system. In response to the growing demands for efficiency and precision in the food industry, this research presents the design and development of an innovative Food Weighing, Packaging, and Dispensing Machine equipped with advanced machine learning techniques for intelligent food separation. The system aims to streamline food processing operations, enhance accuracy in portioning, and optimize overall production processes. The hardware component of the system consists of a robust weighing mechanism integrated with a high-speed packaging and dispensing system. This ensures precise and consistent portioning of food products, reducing wastage and enhancing the overall quality of the packaged items. The design emphasizes modularity and adaptability, allowing for easy integration into existing production lines. The machine learning aspect focuses on developing a sophisticated algorithm to enable the automated separation of different food items based on their unique characteristics. Using computer vision and sensor data, the system can identify and classify various food items with high accuracy. This intelligent separation capability not only enhances the efficiency of the packaging process but also enables customization for specific product requirements. Key features of the proposed system include real-time monitoring, adaptive learning, and feedback mechanisms, allowing the machine learning model to continually improve its accuracy over time. The integration of an intuitive user interface facilitates easy operation and monitoring, providing operators with real-time insights into the production process. In conclusion, the proposed Food Weighing, Packaging, and Dispensing Machine with Machine Learning-based Food Separation represents a significant advancement in food processing technology. By combining precision engineering with cutting-edge machine learning techniques, the system aims to elevate the efficiency, accuracy, and adaptability of food packaging processes, ultimately contributing to a more sustainable and resource-efficient food industry.

KEYWORDS: *Food weighing, Thermal packaging, Dispensing, Sorting, Machine learning techniques.*

INTRODUCTION

In the ever-evolving landscape of farming and food technology, the imperative of ensuring the safety and quality of food remains a paramount concern driving ongoing innovation in packaging practices. With the global population steadily increasing and consumer expectations rising, the pressure to deliver food products that are not only safe but also of high quality has never been greater. In response to these challenges, packaging technologies have advanced significantly, with a notable approach involving the integration of small particles—whether organic, inorganic, or a combination of both—into packaging materials. This innovative practice serves a dual purpose: enhancing the protective capabilities of packaging while also aligning with increasingly stringent environmental regulations aimed at reducing waste and promoting sustainability throughout the supply chain. In 2023, the UK government took a significant step forward with the introduction of the Packaging Extended Producer Responsibility (EPR) rule, which effectively holds those involved in packaging and food production accountable for the life cycle of their products. This regulatory measure underscores the growing recognition of the pivotal role played by responsible packaging practices in ensuring the integrity and safety of packaged goods while also promoting environmental stewardship. Simultaneously, the emergence of nanoparticles as a viable option for improving packaging efficiency and efficacy has opened up new avenues for enhancing food safety and quality standards.

Global food safety remains a top priority for consumers, governments, and the food industry alike. Packaging plays a crucial role in meeting these demands by acting as the first line of defense against contamination and spoilage, ensuring that food products reach consumers in a safe and fresh condition. Balancing various factors such as customer preferences, food safety standards, cost-effectiveness, and environmental considerations is essential in the design and implementation of packaging solutions. While plastic remains a prevalent choice in the packaging landscape due to its affordability and versatility, efforts to explore sustainable alternatives are gaining traction in response to growing environmental concerns. Active packaging has emerged as a key strategy in addressing food safety and quality concerns. Designed to extend shelf life, maintain product quality, and ensure safety, active packaging incorporates specialized features such as oxygen scavengers, ethylene absorbers, moisture absorbers, antimicrobial agents, flavor and aroma release systems, temperature indicators, modified atmosphere packaging (MAP), and intelligent packaging. These features actively interact with packaged products to preserve freshness, inhibit microbial growth, delay oxidation, and absorb unwanted gases, thereby enhancing overall product stability and safety.

In contrast, passive packaging serves primarily as a protective barrier, shielding products from external factors such as physical damage, moisture, light, and oxygen, without actively altering the environment within the package. Key characteristics of passive packaging include its ability to preserve the physical integrity of products during handling, storage, and transportation, as well as its effectiveness in providing protection against light, UV radiation, moisture, and gas transmission. While active packaging offers additional functionalities and benefits, passive packaging remains fundamental in providing basic protection and containment for a wide range of products across various industries. Research conducted between 2000 and 2021 has yielded invaluable insights into the use of active packaging in the food industry, guiding researchers in understanding current trends and identifying areas for further improvement. This research serves as a foundation for ongoing innovation and development in active packaging technologies, ultimately aiming to enhance product quality, safety, and shelf life. Through continued collaboration and advancement, the packaging industry remains committed to addressing evolving consumer needs while upholding stringent safety and quality standards, thereby ensuring the integrity and freshness of packaged products for consumers worldwide.

ACTIVE PACKAGING

Active packaging refers to a type of packaging technology that goes beyond traditional passive containment and protection functions. It actively interacts with the packaged product or the environment surrounding it to extend shelf life, maintain product quality, and enhance safety. Active packaging systems are designed to release or absorb substances into or from the packaged food, thereby modifying the internal atmosphere, controlling moisture, inhibiting microbial growth, or providing other functionalities to preserve the product.

Fig. 1: Active Food Packaging

Fig. 2: Passive Food Packaging

Here are some key features and types of active packaging:

- Oxygen Scavengers: These active packaging components absorb oxygen from the package's headspace, reducing oxidative reactions that can lead to food spoilage and degradation. Oxygen scavengers are often used in packaging for products sensitive to oxidation, such as meats, nuts, and certain fruits.
- Ethylene Absorbers: Ethylene is a natural plant hormone that accelerates ripening and senescence in fruits and vegetables. Ethylene absorbers remove excess ethylene from the package, slowing down the ripening process and extending the shelf life of produce.
- Moisture Absorbers: Moisture-absorbing active packaging components help regulate humidity levels inside the package, preventing moisture-related issues such as mold growth, clumping, or texture changes in products like snacks, baked goods, and dehydrated foods.
- Antimicrobial Agents: Active packaging may incorporate antimicrobial substances to inhibit the growth of bacteria,

molds, and other microorganisms, thereby extending the shelf life and enhancing the safety of perishable foods.

- Flavor and Aroma Release Systems: These active packaging systems are designed to release specific flavors or aromas into the packaged food, enhancing its sensory characteristics and consumer appeal. They are commonly used in products such as cheeses, coffees, and teas.
- Temperature Indicators: Active packaging may include temperature-sensitive indicators that change color or provide visual cues to indicate temperature abuse or fluctuations during storage or transportation, helping ensure product safety and quality.
- Modified Atmosphere Packaging (MAP): MAP involves modifying the composition of gases (e.g., oxygen, carbon dioxide, nitrogen) within the package to create an optimal atmosphere for preserving the product. MAP extends shelf life by slowing down biochemical reactions and inhibiting microbial growth, commonly used for fresh produce, meats, and packaged snacks.
- Intelligent Packaging: Some active packaging systems incorporate sensors, RFID tags, or other electronic components to monitor environmental conditions inside the package, providing real-time data on factors such as temperature, humidity, and gas concentrations. Intelligent packaging enhances traceability, quality control, and shelf life management.

Active packaging offers several benefits, including:

Extended shelf life and improved product quality

Enhanced safety by inhibiting microbial growth and reducing spoilage

Preservation of sensory attributes such as taste, texture, and aroma

Reduced need for additives and preservatives

Improved consumer convenience and satisfaction

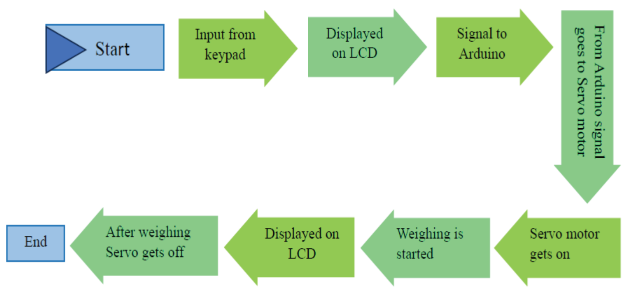
Overall, active packaging plays a crucial role in modern food packaging systems, helping manufacturers meet consumer demands for fresher, safer, and higher-quality food products while also addressing sustainability and waste reduction goals.

PASSIVE PACKAGING

Passive packaging refers to packaging materials and systems that primarily act as a protective barrier, providing containment and shielding products from external factors such as physical damage, moisture, light, and oxygen without actively altering the environment within the package. Here are some key aspects of passive packaging:

Protective Barrier: Passive packaging serves as a barrier between the product and the external environment, preventing contamination, spoilage, and physical damage during handling, storage, and transportation. Preservation of Product Integrity: One of the primary functions of passive packaging is to maintain the physical integrity and quality of the packaged product throughout its lifecycle. This includes protecting the product from external forces that could cause deformation, breakage, or deterioration. Barrier Properties: Passive packaging materials often exhibit specific barrier properties tailored to the requirements of the packaged product. These properties may include resistance to moisture, oxygen, light, aroma transfer, and microbial ingress, depending on the product's sensitivity and shelf-life requirements. Material Selection: Passive packaging materials can vary widely depending on the nature of the product being packaged and the desired protective properties. Common materials used for passive packaging include paperboard, corrugated cardboard, plastics, glass, metals, and composite materials. Packaging Formats: Passive packaging can take various forms, including boxes, cartons, bags, pouches, bottles, cans, jars, and trays. The choice of packaging format depends on factors such as product characteristics, packaging volume, transportation requirements, and consumer convenience. Environmental Considerations: While passive packaging primarily focuses on product protection, there is increasing emphasis on sustainability and environmental considerations in packaging design..Regulatory Compliance: Passive packaging must comply with regulatory standards and requirements governing packaging materials, safety, labeling, and recycling. Regulations may vary depending on the region and the type of product being packaged. Cost-Effectiveness: Passive packaging solutions are often chosen based on their cost-effectiveness, balancing the need for product protection with the economic viability of packaging materials. Customization: Passive packaging can be customized to meet specific product and branding requirements. This includes incorporating branding elements, product information, and labeling onto the packaging to enhance consumer appeal and communication. Role in Supply Chain: Passive packaging plays a crucial role in the supply chain, ensuring the safe and efficient transport of products from manufacturers to consumers. Effective passive packaging solutions contribute to product integrity, customer satisfaction, and overall supply chain efficiency. In summary, passive packaging serves as a foundational element in product protection and preservation, providing a critical barrier against external factors while maintaining product integrity and quality throughout the supply chain. As the packaging industry evolves, there is a continued focus on innovation, sustainability, and regulatory compliance to meet the changing needs of consumers and the environment.

METHODOLOGY



The methodology employed in this research encompasses a multidisciplinary approach, integrating principles from engineering, food science, and machine learning. The development process begins with a comprehensive review of existing packaging technologies, weighing systems, and food separation techniques to identify gaps and opportunities for innovation. Following the review, the design phase focuses on conceptualizing a robust and versatile food weighing, packaging, and dispensing machine. Key considerations include precision weighing mechanisms, high-speed packaging capabilities, and modular design for easy integration into existing production lines. Prototyping and testing iterations are conducted to refine the design and ensure optimal performance under various operating conditions.

Real-world validation and performance evaluation are conducted to assess the system's reliability, accuracy, and efficiency in food weighing, packaging, and dispensing operations.

CONCEPTUAL DIAGRAM

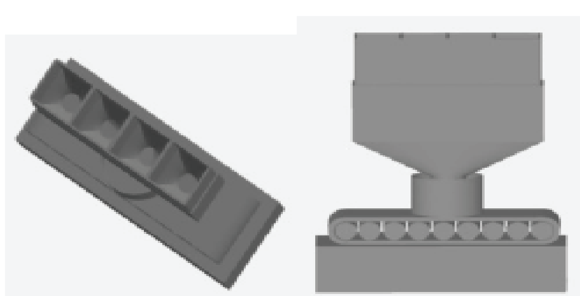


Fig. 3: Schematic diagram of automatic food weighing, packaging, dispensing and sorting machine using machine learning techniques

The conceptual diagram as shown in figure 3 illustrates the interconnected components of the food weighing, packaging, and dispensing machine, highlighting the integration of hardware and software subsystems.

GRAPH OF PACKAGING INDUSTRY

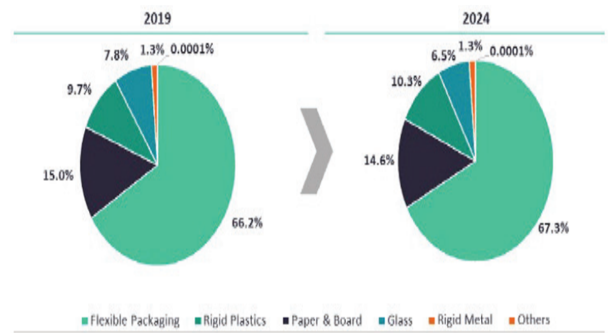


Fig. 4: System of packaging

The graph depicts the historical trends and future projections of the packaging industry, emphasizing the growing demand for advanced packaging solutions driven by factors such as population growth, urbanization, and changing consumer preferences.

CONCLUSION

In conclusion, this paper presents a comprehensive overview of the design and development of a Food Weighing, Packaging, and Dispensing Machine integrated with machine learning-based food separation techniques.

By leveraging advances in engineering and artificial intelligence, the proposed system offers enhanced precision, efficiency, and adaptability in food processing operations.

The integration of advanced weighing mechanisms, high-speed packaging systems, and intelligent food separation algorithms enables the automation of key processes while ensuring accurate portioning and customization of packaged products. Real-time monitoring and feedback mechanisms further enhance operational efficiency and quality control, facilitating seamless integration into existing production lines.

Looking ahead, continued research and innovation in food packaging technologies are essential to address evolving consumer demands, regulatory requirements, and sustainability goals. By harnessing the synergies between engineering, food science, and machine learning, the food industry can unlock new opportunities for improving product quality, safety, and shelf life while minimizing waste and environmental impact.

Overall, the proposed Food Weighing, Packaging, and Dispensing Machine with Machine Learning-based Food Separation represents a significant advancement in food processing technology, poised to revolutionize the way food products are weighed, packaged, and distributed in a rapidly evolving global market.

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Innovations and Challenges in Laser Beam Machining of Hybrid Fiber Reinforcement Polymer Composites: A Critical Review

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ABSTRACT

Hybrid composites are composite materials composed of multiple reinforcing fibers and matrix components. Because of their optimal blend of strength, stiffness, and other tailored traits, these composites surpass single-fiber composites in terms of mechanical properties and can be used in a range of sectors. However, machining hybrid composites presents issues due to their heterogeneous structure and shifting fiber orientations, making traditional machining procedures less effective. The primary goal of this review study is to solve machining difficulties in order to develop hybrid fiber reinforced polymer composites. The goal of this review is to help with the development, characterization, and implementation of enhanced cutting performance and efficient machining techniques, with a focus on Laser Beam Machining (LBM).In summary, the review study aims to advance the area of fiber reinforced polymer composites by addressing the challenges involved with machining these complex materials. It underlines the need of optimizing process parameters in Laser Beam Machining for optimal material removal and improved cutting performance. Furthermore, the research focuses on characterizing hybrid composites to ensure that their mechanical properties meet the needs of the application. The review intends to improve the usage of hybrid composites in a variety of industries by providing helpful insights into these features, as well as to stimulate their ongoing research and implementation for real-world engineering applications.

KEYWORDS: *Hybrid composite, Laser beam machining, Polymer, Matrix.*

INTRODUCTION

Nowadays, hybrid composites are employed in a variety of hybrid composites are employed in a variety of applications where strength and light weight are important considerations, such as roof tiles, storage tanks, partition boards, walls, and floors. Hybrid composites offer more options for controlling material stiffness, strength, and cost. In addition, hybrid composite materials, which are used in many applications where strength and light weight are crucial, are showing promise. Fiber Reinforced Polymer (FRP) materials require precision, non-contact cutting, which is made possible by Laser Beam cutting (LBM). Because of their diverse fiber orientations and heterogeneous structure, FRPs provide difficulties for conventional machining techniques. Complexities in FRP structures can be overcome by controlled material removal made possible by LBM's focused laser beam. LBM provides improved cutting performance, reduced heat-affected zones, and high precision through the integration of Computer Numerical Control (CNC). This procedure optimizes FRP's parameters, making it useful in the maritime, automotive, and aerospace industries. It also makes it easier to construct complex designs while preserving the material's intended mechanical qualities. [1,30]Hybrid composites are materials created by mixing two different kinds of fiber in a single matrix. Hybrid composite materials are more difficult to process using traditional machining techniques due to the heterogeneous structure of their fibers. So, an unconventional machining process known as "laser beam machining" employs laser light to complete the machining task. The laser light hits the work piece at its greatest temperature, causing it to melt. The method involved using thermal energy to remove material from a surface. LBM can be used to treat materials with complex forms and sizes specifically including hard-to- reach surfaces. [2]

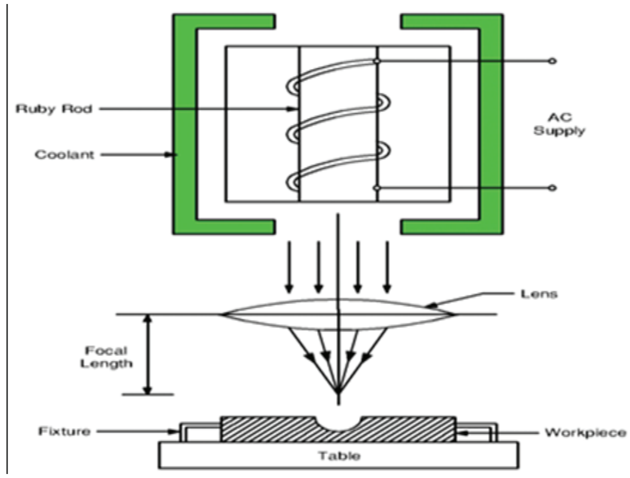

Fig. 1: Laser Beam Machining Process

Overall, the significant research efforts in these areas show a strong interest in hybridization, optimizing LBM procedures, and developing models for laser machining of polymer composites. Through precise manufacturing methods, these efforts aim to enhance the usage of composite materials in numerous industries and increase their overall performance. [2-14]

LITERATURE REVIEW

Hybridization in FRP composites allows for tailoring the material properties. By combining different fibers, the hybrid composite can leverage the strengths of each fiber type, resulting in a synergistic effect that enhances overall performance. For example, combining carbon fibers with glass fibers can provide a balance between high strength and stiffness (carbon fibers) and impact resistance (glass fibers). Most importance of the research Glass/Carbon fiber as a great choice is available for Affordability, accessibility, rigidity, and strength are all advantages of hybridization [1]

The growing need for lightweight, corrosion-resistant materials in naval applications has resulted in the growth of hybrid polymer composites. To improve mechanical qualities and endurance, these materials combine various types of fibers, such as carbon, glass, or natural fibers, with polymer matrices. This research provides a complete examination of the performance of hybridized composites made of polymers in marine conditions. The analysis continues with a discussion of hybrid polymer composites' existing challenges and future opportunities in maritime environments. Overall, this review provides a thorough examination of the capabilities of composite materials for marine use. It is an invaluable resource for naval researchers, engineers, and industry experts interested in the advancement and application of hybrid composites [3]The concept of fiber hybridization in polymer composites, which involves combining different types of fibers within a single composite material to achieve improved mechanical properties and enhanced functionality. This leads to provide a comprehensive overview of various aspects related to fiber hybridization. Studies show how different fiber combinations can result in increased or customized mechanical performance. [4] The various fibers have been embedded with appropriate matrix enabling the production of composites that are hybrids through different manufacturing techniques. [5] The reviewed by highlighting potential future directions and research opportunities in the field of fiber hybridization. They suggest investigating advanced fiber combinations, exploring novel processing techniques, and optimizing composite performance through design and manufacturing advancements. [6]The findings of Hybrid composite provided valuable insights into the design and development of hybrid composites, highlighting the potential for achieving superior mechanical performance through the careful selection and combination of different fiber types. The physical attributes of hybrid composites are also discussed particularly the modulus and tensile strength of elasticity. The authors analyze hybrid composite capability to single-fiber composite performance while looking at the potential cumulative benefits of incorporating different fiber types. [7,8].The characterization results demonstrate that hybrid composites have higher toughness and impact resistance than standard carbon/epoxy composites. [9]

To improve the mechanical characteristics and results showed that interlayer hybrid materials have better mechanical characteristics than single-fiber composites. The hybrid effect leads to increased strength, stiffness, and energy absorption capacity. They offer the potential to enhance the structural performance and durability of infrastructure systems, such as bridges, buildings, and pipelines. [10] Coir-based and fibers of carbon reinforced resin hybridization polymeric composites are used in all of them. Natural fibers combined with high-performance carbon fibers give a distinct and enticing set of attributes for specialized applications needing a mix of lightweight, strength, and environmental sustainability. [12]By examining the mechanical properties of these thermoplastic composites in various configurations, the study aimed to provide insights into the potential applications and performance trade-offs of the different composite materials [14] Overall, these summaries highlight the potential benefits and applications of hybrid composite materials, in addition to their enhanced mechanical characteristics and the significance of fiber hybridization in achieving improved performance in a wide range of engineering applications.

Literature Review on Hybrid Composite

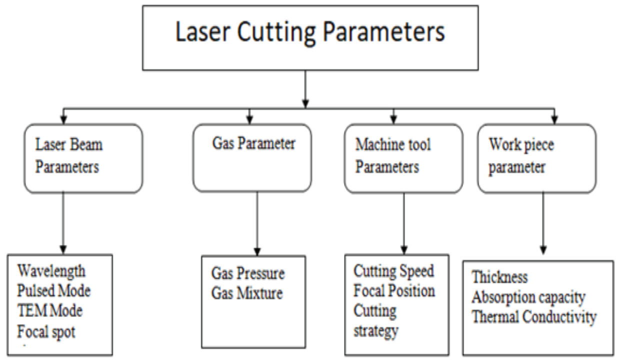

Fig. 2: Domains of the laser-cutting parameters for processing.

It's important to recognize that the domains of particular laser-cutting parameters may overlap, and the ideal values within these ranges can vary based on the material's properties, thickness, and desired cutting results. To obtain the desired cutting quality, speed, and efficiency, the appropriate combination of settings frequently necessitates experimenting and testing. Furthermore, different laser cutting machine manufacturers and models may have varied specs and parameter ranges.[26- 30]

The optimization of process parameters involves identifying and changing important variables that impact the cutting performance of LBM on hybrid composites. Researchers intend to enhance surface quality, material removal rates, and overall cutting efficiency by fine-tuning parameters such as pulse frequency, cutting speed, assist gas pressure, laser power and focus position. Furthermore, the review study focuses on hybrid composite characterization, which involves evaluating, and accurately characterizing hybrid composites for specific technological applications and efficiently optimizing the machining process.[1-14]The literature study on process parameter optimization for Laser Beam Machining (LBM) of composite materials focuses on investigating and assessing numerous works related to the optimization of laser cutting parameters for composites. The primary goal is to increase the quality and efficiency of composite material laser cutting operations. Carbon fiber reinforced plastics (CFRPs), glass fiber reinforced plastics (GFRPs), aramid fiber reinforced polymers (AFRPs), Kevlar fibers, basalt fibers, and other composite materials have been studied by researchers. [12-58]

Laser beam cutting offers numerous benefits for processing hybrid composites, including precision, minimal HAZ, reduced delamination, and high processing speeds. To maximize the advantages and overcome potential challenges, careful parameter optimization and material characterization are crucial during the laser machining process.

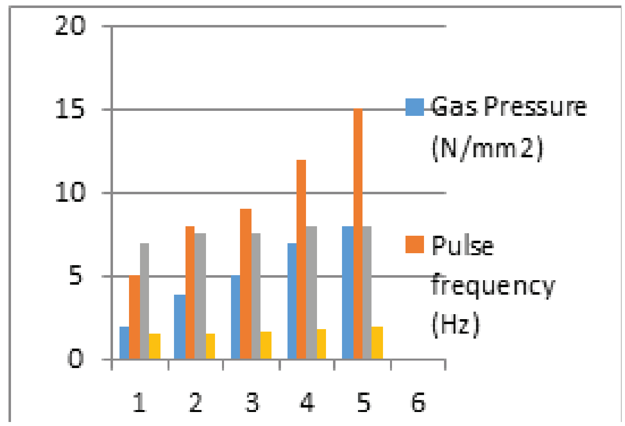

Fig. 3: Hybrid FRP of Laser process parameter

Laser variables for processing such as laser power, cutting speed, pulse width, focal length, and assist gas interact and influence final cut quality and kerf width. Using experimental methods, researchers explored the individual and combined effects of these feature as shown in fig. 3.

Effect of Laser Beam Machining on with different Hybrid Composite

LBM appears to be a viable non-traditional approach for addressing these issues and providing precise material removal with minimal heat damage. The purpose of is to provide an overview of LBM's Hybrid Composite Machining research. It emphasizes the benefits of LBM, such as non-contact machining, precision control, and reduced tool wear, which make it appropriate for complex geometries. It goes over how to modify process parameters to increase surface cleanliness and material removal rates, as well as the specific problems of machining hybrid composites.[2]

By studying the effects of laser processing on GFRP composites and evaluating the cut surface quality using metrics like HAZ, taper angle, and kerf width, researchers can optimize the laser cutting parameters for improved results. This technology opens up new possibilities for lightweight and durable designs in aerospace structures, automotive components, marine vessels, and construction materials. Additionally, it contributes to the broader adoption of GFRP composites in various applications, leading to more sustainable and efficient solutions in engineering and manufacturing. [1,12] In multipurpose laser cutting parameter optimization for coir and carbon fiber reinforced epoxy hybrid polymeric composites. Response Surface Methodology (RSM) is indeed a sophisticated statistical method for multi-objective optimization. In the context of the multipurpose laser cutting parameter optimization for coir and carbon fiber reinforced epoxy hybrid polymeric composites, RSM proved to be a valuable tool for investigating the relationship between laser cutting settings and the desired objectives, namely the reduction of kerf-taper and surface roughness, in a more efficient manner [13].

Overall, the summaries emphasize the necessity of laser cutting in diverse composite materials, its advantages, and the significance of optimizing cutting parameters to obtain precise and high-quality cuts while minimizing material damage.

Comments on Laser Cutting Machining with different parameters

Process factors such as gas pressure, pulse width, pulse frequency, and cutting speed are critical in defining the quality and efficiency of the cutting process in the context of Hybrid Fiber Reinforced Polymer (FRP) laser cutting. In hybrid FRP laser cutting, a laser is used to cut through composite materials, where the fibers give strength and reinforcement. The purpose of these investigations is to better understand the impacts of laser cutting settings on the cut surface quality, material removal rate, and other mechanical properties of composites Researchers frequently examine and adjust process parameters such as laser power, pulse frequency, cutting speed, assist gas pressure, focus position, and others. To discover the ideal combination of these factors that results in enhanced cut quality, precision, and accuracy while reducing material damage, the response surface methodology (RSM) and other optimization techniques are often used.[14-26].Examine each factor and how it relates to laser machining on hybrid composites:

a) Gas Pressure:-Increasing pressure of gas, on the other hand, might result in greater kerf widths and consequent damage to the underlying fibers. Continuous research and testing will continue to increase our understanding of how gas pressure affects the laser cutting process, leading to more precise and efficient cutting procedures as laser cutting technology evolves and new composite materials are developed. b) Pulse width:-Longer pulses can cause greater penetration and a widening of the heat-affected zone (HAZ).c) Pulse frequency:- Lowering the frequency of pulse repetition can improve cutting quality by allowing the material to decrease in temperature between pulses .d) Cutting speed: Higher cutting rates may increase production but may affect cut quality, particularly when the laser does not have enough time to thoroughly penetrate the material. In connection with this different methods of optimization (Design of experiment, Response Surface Methodology, Genetic Algorithm and Artificial Neural Networks) are effective for improving laser machining parameters in hybrid composites. These allow systematic and efficient parameter space exploration, resulting in higher cutting quality, reduced experimentation time, and increased process efficiency for laser machining in hybrid composite materials.[1-30]

Important findings regarding to the Laser processing parameter

1. Laser cutting of composites at the ends to get a narrower kerf width.
2. Higher cutting rates result in reduced heat transfer and thermal damage to the surrounding area since the laser beam spends less time on a given location of the material.
3. As cutting speed increases, heat energy is dispersed over a broader region, resulting in less material being removed and a narrower cut.
4. Gas pressure directly impacts the kerf width.
5. A narrower kerf width is related with a shorter pulse width, while a broader kerf width is connected with a longer pulse width.
6. Increased pulse frequency can result in a narrower kerf width.

To acquire the best possible outcomes, the experimenting process may require numerous iterations. Consulting with professionals who have practical experience with laser machining of hybrid composites can significantly accelerate up the optimization process and provide beneficial recommendations.

CONCLUSION

Overall, the literature review on the Laser Beam Machining of Hybrid Fiber Reinforced Polymer Composites provides valuable insights into laser cutting technology advancements and potential applications in the aerospace, automotive, marine, and other industries where composite materials are widely used.

The analyzed literature reveals that laser cutting is a viable non-traditional method for machining composites due to its non-contact nature and low specific energy consumption. The research contributes to current efforts to maximize the benefits of laser cutting techniques and build efficient and precise composite material manufacturing processes. By carefully selecting the most suitable cutting parameters, researchers improved surface smoothness, minimized heat damage, and raised material removal rates. Researchers can iteratively optimize hybrid composites by combining experimental work, simulations, and analysis, refining their qualities and performance until they match the precise needs of the application. This iterative approach guarantees that the finished composite material is strong, efficient, and cost-effective, while also taking sustainability and manufacturability into account. Furthermore, a multidisciplinary approach integrating these three components aids in comprehending the complicated behavior of hybrid composites, making them suitable for a wide range of sophisticated technical applications.

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Design and Development of Robotic Grippers for Safety Manipulating Medical Tools, with Enhancing Precision in Healthcare Procedures

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ABSTRACT

This paper represents designing and developing of Robotic Grippers for Safety Manipulating Medical Tools, with Enhancing Precision in Healthcare Procedures. Both industrial and non-industrial applications use robotic grippers, and their use is growing daily. Many researchers are looking at the use of robotic grippers in various medical procedures, including those involving the kidney, heart, and brain, due to their accuracy and precision. Robotic grippers are typically used to increase precision and accuracy while streamlining processes and minimizing issues. This study's main objective is to employ grippers to decrease human mistake. The grippers' open and closed jaw function as a medical tool, controlled by a two-degree-of-freedom controller. Motors are used as instrumentation in the grippers.

KEYWORDS: *Accuracy, Grippers, Medical tools, Precision, Robotics.*

INTRODUCTION

The use of robotic technologies has become a game-changer in the rapidly changing field of healthcare, boosting the skills of medical personnel and improving the accuracy of delicate procedures. The creation of sophisticated robotic grippers designed specifically for the safe and accurate handling of medical instruments is a pressing need in the healthcare industry that this project seeks to fill. The main objective is to develop a flexible, intelligent, and ergonomic gripper system that will greatly increase the precision and effectiveness of medical procedures while also guaranteeing the safety of patients and healthcare professionals. The need for robotic systems that can precisely handle a wide variety of medical instruments has increased as medical procedures become more complex. By combining advanced robotics, complex sensing technologies, and careful design principles, this project seeks to close this gap by creating a robotic gripper that can both deftly secure medical instruments and intelligently adjust to the changing needs of various medical procedures.

Beyond traditional manipulators, the envisioned robotic gripper will have safety features to guard against unintentional harm and provide a sensitive touch appropriate for the intricate details of medical instruments. Modern sensing systems integrated into the gripper will provide medical practitioners unprecedented control over the instruments they use by giving them real-time input. By redefining the parameters of safety and precision in medical procedures, this initiative aims to usher in a new era in which human-robot collaboration improves patient care overall. This project aims to provide a dependable and user-friendly robotic gripper system that complies with strict healthcare requirements through an iterative design and testing procedure. The ultimate goal is to provide medical professionals with a tool that not only satisfies the strictest safety regulations but also makes a substantial contribution to the development of precision medicine, ultimately leading to better patient outcomes and influencing the course of future healthcare treatments.

Physical Model Based Approaches

The practical-model-based approach focuses on estimating mathematical or actual models to describe the component's physics and degradation events. The physical-model-based method is built upon a detailed understanding of the gripper's mechanics. This approach yields more accurate results than the data-driven approach because the models compute mathematical parameters that characterize the developmental functioning of formation and expression. A physical model's initialization is formulated using physical equations. Appropriate factors are taken into consideration in relation to the model's anticipated goal. Numerical techniques are then employed to solve the equations. The exact and precise application of this model version to real-world scenarios poses a variety of practical concerns about the estimations' confidence, accuracy, and precision.

3D Printing Approaches

In order to construct the gripper construction, thermoplastic material is melted and extruded layer by layer in one of the most popular 3D printing processes. FDM is renowned for being user-friendly and reasonably priced. SLA creates exact and intricate pieces by curing liquid resin with a UV laser. LA-produced grippers often have smoother surfaces and better resolution, which makes them appropriate for applications that call for small details. Layer by layer, powdered material (usually nylon or similar polymers) is selectively fused using a powerful laser in SLS. SLS is appropriate for a variety of materials and can create robust grippers with intricate shapes. Certain sophisticated 3D printers may print in various materials at once or in batches. The performance and longevity of grippers can be improved by combining conventional manufacturing techniques with 3D printing, such as adding metal components or using 3D printed Molds for injection moulding. This capability allows the creation of grippers with varying odometer (softness), allowing for features like soft-touch surfaces or compliant.

LITERATURE REVIEW

Maxwell Samuels, Lu Lu, and Cong Wang [1] made a robotic hand with two fingers and numerous degrees of freedom is called a two-finger multi-DOF folding robot gripper. Its form can be changed to accommodate different sized and shaped things. When not in use, the folding feature helps it to preserve space. This gripper provides fine control and flexibility for automated activities such as pick-and-place and assembly.

Trung Thien Hoang et al. [2] created a soft robotic fabric gripper with adjustable stiffness and gecko adhesion, which is a lightweight, flexible robotic hand that can attach to surfaces in a similar way to a gecko. In applications like manufacturing and medical processes, it's perfect for delicately handling things with irregular shapes or delicate handling.

In Gripping performance of soft grippers with fingerprint-like surface texture for objects with slippery surfaces, Tianze Hao et al. [3] found that soft grippers with surface textures that resemble fingerprints provide superior gripping capability for slippery objects. Their rough surface and flexible design increase friction, which is advantageous when handling smooth or delicate objects in the food processing and pharmaceutical industries.

Youssef Amin et al. [4]in Embedded real-time object hardness classification for robotic grippers Robotic grippers with incorporated real-time hardness classification can swiftly determine and classify an object's hardness. This enables the gripper to dynamically modify its grip force, improving handling in real-time applications for items with different hardness's.

Sugato Hajra et al. [5] revolutionize self-powered robotic systems with triboelectric nanogenerators, which convert frictional energy into electricity. Triboelectric nanogenerators transform self-powered robotic systems and provide independent, sustainable power sources for extended operation in a variety of settings.

Noam Nahum and Avishai Sintov [6] in the research paper explores improving the manipulation of thin objects using off-the-shelf parallel grippers by incorporating a vibration finger. This addition aims to enhance grip, reduce slippage, and improve stability during robotic manipulation, with potential applications in manufacturing.

Idris Sancaktar et.al [7] in a study introduces an adapted Particle Swarm Optimization (PSO) algorithm for the inverse kinematics of a six-degree-of-freedom robot designed for fracture treatment with an external fixator.

Pradipta Biswas et.al [8] in a review examines the substantial growth in the surgical robotics industry, which has evolved into a multibillion-dollar market. The study focuses on existing commercially available robotic surgical systems, analysing them based on target anatomical locations and providing insights into their working principles and regulatory statuses.

Xing Wang et al. [9] address manpower constraints in fruit harvesting by presenting a revolutionary soft robotic gripper with four tapered soft robotic fingers and a multi-mode suction cup designed for effective apple harvesting in orchards. The gripper's compliance and force exertion are assessed using FEA and tests, and a twist-pulling motion is used for apple detachment.

Boran Wang et.al [10] in a paper introduces a systematic design approach for a soft gripper using innovative bimorph-like pneumatic bending actuators, emphasizing the importance of quantitative analysis in designing compliant grippers.

S. Najarian et.al[11] in a paper reviews the evolution of robotics in medicine, highlighting its transformation from entertainment to a crucial tool in various scientific fields, particularly in surgery. The review encompasses early and recent developments in robotic and computer-assisted systems across different surgical branches, emphasizing improvements in precision, stability, and dexterity.

Trinh Xuan Hiep et.al [12] in a study introduces a simple yet effective soft-fingered gripper design using an innovative asymmetric tube with a variable cross-section, addressing challenges associated with complex mechanisms in soft grippers. The proposed mathematical modelling and experimental validation demonstrate the gripper's enhanced performance, analysing the impact of robot arm motion on gripping capability.

ARCHITECTURE

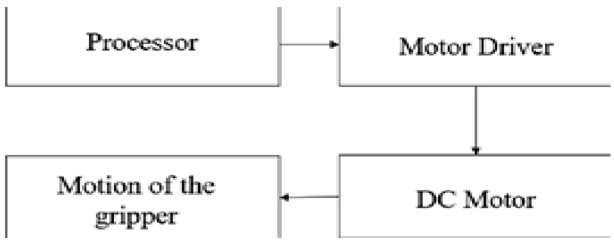

Fig. 1: Block Diagram

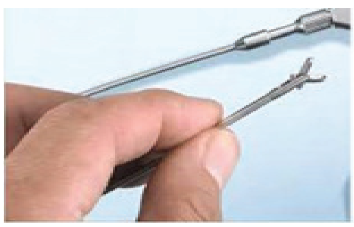

Fig. 2: Conceptual image

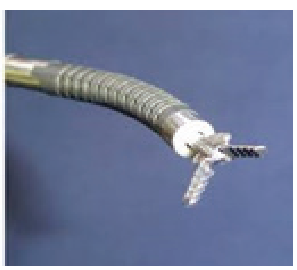

Fig. 3: Conceptual image

In fig.1 there is a block diagram of the project that represents major components like processor, motor driver, DC motor and motion of the gripper. With these components grippers are going to actuate. Processor can drive the DC motor with the help of motor drive and then motion of the gripper can actuate the jaws. In fig.2 we can see small jaw of two fingers and long pipe like structure. It has special application is that it is very small because we are going to use these grippers in medical surgery as a medical tool. In fig.3 there is jaw having sharpness for cut the cottons or threads during the surgery. Like this we can design these jaw as per our applications.

CONCLUSION

The creation of robotic grippers for safely manipulating medical equipment with increased precision in healthcare procedures marks a significant step forward in medical robotics. The revolutionary soft-fingered gripper design, which incorporates an asymmetric tube with a changeable cross-section, has shown encouraging results in terms of simplicity, efficacy, and compliance. The proposed mathematical modelling and experimental validation were successful in analysing the gripper's performance during interactions, providing useful insights into its potential.

Sensor integration, safety measures, and a sophisticated control system guarantee exact manipulation while simultaneously addressing safety concerns in medical environments. The gripper's compliance and force exertion have been thoroughly tested, highlighting its usefulness for sensitive medical duties.

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Optimization of Brake Lever by Using Finite Element Analysis

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ABSTRACT

The brake lever constitutes a pivotal element in bicycle and motorcycle assemblies, serving as the primary interface for the transmission of the rider's force to the braking system. Its design optimization is paramount for achieving superior performance, safety, and user comfort. This research endeavors to enhance the brake lever design using finite element analysis (FEA), targeting objectives such as augmenting strength, diminishing weight, and refining overall functionality. The study commences with the meticulous creation of a comprehensive computer-aided design (CAD) model for the brake lever. Following this, material properties are accurately assigned, and a finite element mesh is meticulously generated. Loading conditions are then meticulously defined to simulate real- world scenarios, and suitable boundary conditions are applied. Subsequently, finite element analysis is executed to scrutinize stress distribution, displacement, and deformation under varying loading conditions. Utilizing the analysis outcomes as a guide, areas necessitating improvement are identified, and corresponding design alterations are proposed. Employing optimization methodologies such as parameter manipulation and geometric adjustments, the study endeavors to attain the predefined objectives.

KEYWORDS: *Optimization, Brake lever, Modeling, FEA.*

INTRODUCTION

With continuous advancements and breakthroughs in the automotive and heavy vehicle sector, the demand for enhanced performance metrics like fuel efficiency, emission reduction, and cost-effectiveness has escalated significantly. Adhering to these requisites is pivotal for securing a competitive edge in the global market. Among various strategies, the pursuit of vehicle weight reduction stands out as a paramount approach in the heavy vehicle industry. [1] This investigation aims to achieve an optimal design for a truck brake pedal through the integration of topology and shape optimization methodologies. Presently, optimizing fuel efficiency, curbing carbon dioxide emissions, and minimizing manufacturing expenses have become focal points for automotive and heavy vehicle designers, owing to technological advancements. Within the automobile industry, there's a keen interest in sourcing inexpensive and lightweight materials that are readily available.[2] While traditional brake pedals predominantly utilize metal, composite materials have found successful application in clutches and accelerator pedals in automotive vehicles. This study focuses on exploring variable materials for conceptualizing brake pedal profiles, achieving a weight reduction of 78% compared to current metallic pedals and 64% compared to aluminum, in accordance with General Motors specifications. Ferrous metals and alloys, including cast iron, steel, and nickel, constitute the majority, representing 68% by weight, while nonferrous metals such as copper, zinc, aluminum, magnesium, titanium, and their alloys make up 10 to 15%. Commercial vehicles typically incorporate plastics in about 20 to 30% of interior components [3]Today, product optimization is driven by the vision of reducing weight and consequently, cost. Balancing functional stiffness while minimizing material usage and cost presents a significant challenge. This study aims to identify maximum functional stress locations in the baseline design and optimize them using Finite Element Analysis Software, ensuring functionality is maintained in the optimized design. [5]

Selection of material

The focus of this study lies in identifying the most appropriate material composition for the application of brake levers. Brake pedals serve as crucial components in all automotive vehicles, acting as the interface between occupants and the braking system. Initial observations suggest that the current design may be overly robust for its intended purpose. Finite Element Analysis (FEA) will be employed to subject the brake lever to cantilever loads, with the Optistruct solver utilized for topology optimization. The existing brake pedal model was constructed using Solid Works modeling software. Subsequently, a novel, lightweight design for the brake lever is proposed.. The selection of new material is based on following lever criteria.

Table 1: Composition of materials

Name of Material	Percentage Composition Details
45 steel	Mn (0.5-0.8%) + Cr (0.25%) + C (0.42-0.5%) + Ni (0.25%) + S (0.04%) + Cu (0.25%) + Si (0.17-0.37%) + P (0.035%) + As (0.08%) + Fe (97%)
Structural Steel	Mn (0.181%) + Al (0.023%) + Cr (0.036%) + C (0.075%) + Ni (0.032%) + S (0.007%) + Cu (0.082%) + Si (0.014%) + P (0.009%) + Ti (0.002%) + Fe (99.539%)
7075 AL	Mn (0.04%) + Zn (5.6%) + Si (0.08%) + Cu (1.5%) + Si (0.17-0.37%) + Mg (2.5%) + Fe (0.3%) + Al (bal.)
AL 6061 T6	Zn (max 0.25%) + Si (max 0.4-0.8%) + Cu (0.15-0.40%) + Mg (0.8-1.2%) + Fe (max 0.7%) + Cr (0.04-0.35%) + Al (bal.)

Research Methodology: A compliant mechanism is a structure devoid of joints or links, which flexibly deforms to generate a desired force or displacement. It serves as an elastic member facilitating the transmission or transformation of force, energy, and motion within mechanical systems. Compliant mechanisms inherently undergo elastic deformation. Positioned between structural design and rigid body mechanism design, compliant mechanism design represents a spectrum.

DATA ANALYSIS AND INTERPRETATION

Modelling of lever

The static structural is carried on lever model. Detailed geometry full model is shown in Fig. 3.1 and a The finite element methodology is used for the same. This analysis is done in the commercially available Ansys Workbench 19.2. Geometrical dimensions of lever are considered as follows;

- Overall length of the lever = 360 mm
- Width of the lever = 20 mm
- Height of the lever = 225 mm

Meshing

After the modelling in Solid Works parasolidx_t model is imported to Ansys Workbench 19.2. Materials are created in Ansys engineering data. Fig. 4.2 shows the mesh model of brake lever:

STRUCTURAL ANALYSIS

Material Used for analysis:

1) 45 Steel 2) Structural Steel 3) 7075 AL 4)AL 6061 T6

Material properties: The four compositions are selected for structural analysis. The properties of these compositions are listed as :

Table 2 : Material properties

Properties	45 Steel	Structural Steel	7075 AL	AL 6061 T6
Density (Kg/m3)	7600	7850	2810	2700
Young's Modulus (GPa)	207	210	71.7	68.9
Yield strength (MPa)	370	240	503	276
Poisson's Ratio	0.30	0.33	0.33	0.33

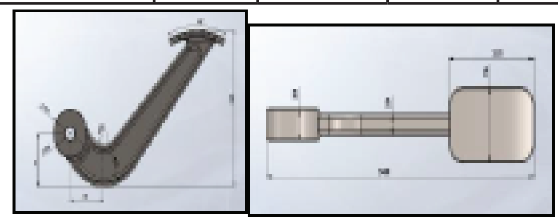

Fig. 1 : 3D Model

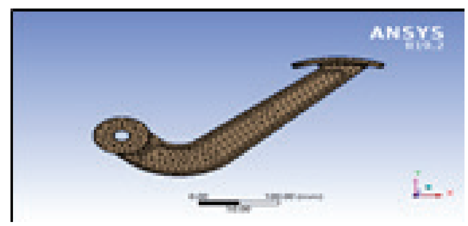

Fig. 2: Meshing of Lever

BOUNDARY CONDITIONS

Boundary conditions are the input values for given analysis. For static structural analysis displacement and force boundary condition are important and equivalent von-Mises stresses and deformation in lever body is calculated. For fix support, lever side surface is selected.

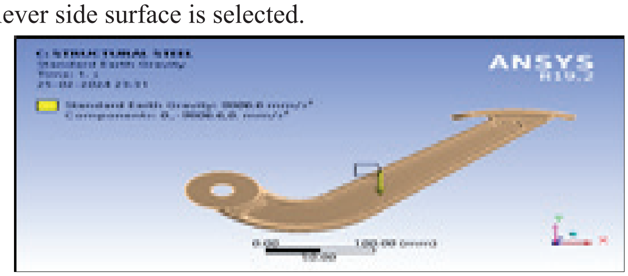

Fig. 3: Apply Gravity

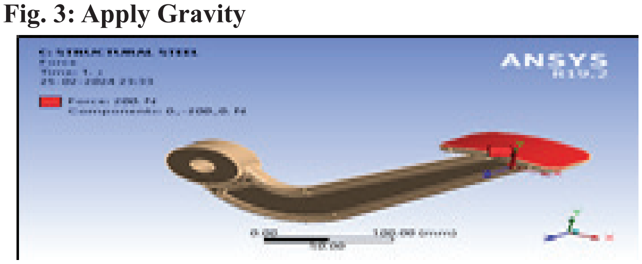

Fig. 4: Loading and Boundary Conditions

SOLUTIONS

C45 Material Results

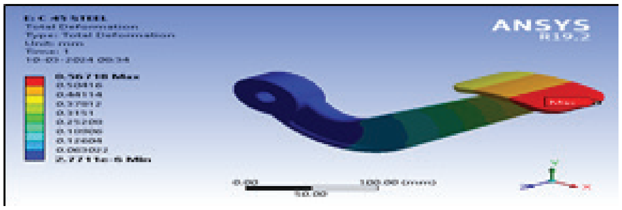

Fig. 5: Total Deformation

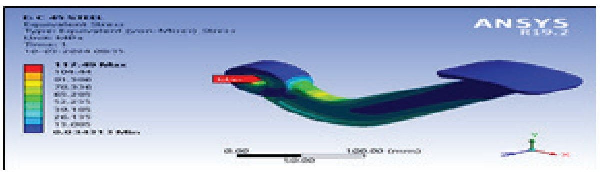

Fig. 6 : Equivalent Von Mises Stress

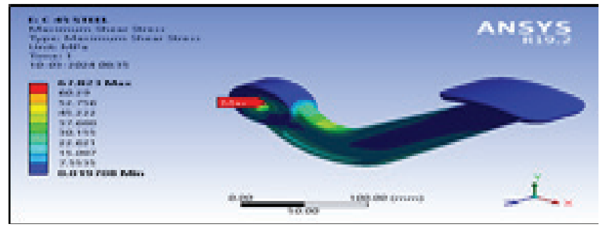

Fig..7 : Maximum Shear Stress

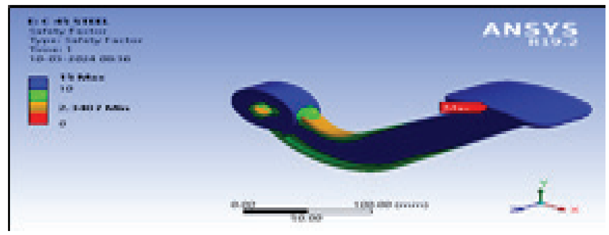

Fig. 8: Safety Factor

RESULT SUMMARY

Table 4: Result and discussion

SR. No.	Material used for Analysis	Equivalent von-Mises Stresses (MPa)	Deformation (mm)	Maximum Shear Stress (MPa)	Safety Factor	
					Min	Max
1	C 45	117.49	0.567	67.82	2.340	15
2	Structural Steel	103.52	0.353	59.76	2.415	15
3	7075 Aluminum	126.28	1.761	72.89	3.983	15
4	AL 6061 T6	79.61	1.155	45.95	3.140	15

CONCLUSION

This study has demonstrated the effectiveness of finite element analysis (FEA) in optimizing the design of brake levers for bicycles and motorcycles. Through a systematic approach encompassing CAD modeling, material assignment, finite element mesh generation, and analysis of stress distribution, displacement, and deformation, significant improvements have been achieved in the strength, weight, and overall performance of the brake lever. The iterative optimization process, guided by the insights gleaned from FEA results, has allowed for continuous refinement of the design, resulting in a final configuration that meets or exceeds safety standards and performance requirements. By leveraging optimization techniques such as parameter adjustments and geometry refinements, engineers and designers have been able to achieve a balance between structural integrity, weight reduction, and functional efficiency. The validated optimized design represents a significant advancement over the initial design iteration, offering tangible benefits in terms of enhanced performance, reduced weight, and improved user experience. These findings underscore the importance of employing FEA as a powerful tool in the design and development of critical components such as brake

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3-DOF Pick and Place Robotic Arm

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ABSTRACT

We aim to demonstrate the capabilities of a 3 DOF robotic arm and explore its potential applications in diverse fields. By combining mechanical design with modern sensing and control techniques, we strive to push the boundaries of robotics and contribute to the advancement of automation technology. Key aspects of the project include the selection of appropriate actuators, sensors, and control algorithms to enable accurate positioning and gripping of objects. The performance of the robotic arm was evaluated through experimental testing, demonstrating its ability to reliably pick and place objects with varying shapes and sizes.

KEYWORDS: *Robotic arm, Controller, End effector, Gripper, Actuator.*

INTRODUCTION

The project aims to design and construct a 3 DOF robotic arm enhance their task with precision and accuracy. By utilizing modern materials, sensors, and control systems, the robotic arm will be can do mimic human-like movements while offering improved efficiency and repeatability. Robotic arm are becoming essential instruments in many different sectors, helping a pick and place operation, the three degree of robotic arm (3DOF) robotic arm is one of the most flexible and adaptive robotic arm designs available. This robotic arm has three robotic joints, which allow it to move in three dimensions and provide flexibility and dexterity for a range of challenging jobs. Developing a robust mechanical structure that balances strength, weight, and range of motion to ensure optimal performance. Control System Development: Implementing advanced control algorithms to coordinate the movement of each joint, allowing for smooth and accurate operation. Application Development: Exploring various applications for the robotic arm, ranging from pick-and-place tasks in industrial settings to assisting in research laboratories or even educational purposes as well as in medical purpose.

LITERATURE REVIEW

The autonomous robotic arm design presented in this research is based on industrial applications. A working prototype was built. With this framework, it would be easier for people to keep a safe distance from potentially dangerous objects when working in a workplace setting. Businesses are heavily encouraged to use robots, especially for security and financial reasons. They used a 3 DOF manipulator into their design effort. Assuming a deterrent is detected interestingly it stops the work. Once more in the event that the issue isn't cleared, a criticism framework, for example, ringer gets gone on to welcome this issue on notice of a faculty to clear the object[1] This paper was a proposal on tackling the issue of binding a line on a remote surface utilizing a laser shaft with the assistance of a mechanical arm comprising of 6 servo engines constrained by Arduino miniature regulator. The mechanical laser arm was gotten 81.28 cm far from a white board. Joysticks can likewise be utilized to situate the automated arm, in that the Arduino regulator was separated from the PC[2]. Kinematic Examination The part of specialist which manages the investigation of arrangement of bodies without giving any significance to some other component like power, mass is called kinematic. There are two classifications of kinematics for automated arm: forward kinematics Converse kinematics [3]

In this paper, they have utilized 4 stepper engines to make joint of the automated arm of the development will be direct with the assistance of potentiometer. the regulator utilized is Arduino UNO.[4]

This research focuses on the design and implementation of a plan to manage the point of the mechanical arm using a Cortex ARM M3 LPC1768 Microcontroller with an ultrasonic sensor and a PC framework-based computerized regulator. The mechanical arm has five degrees of freedom (DoF) and can move freely since each joint has a servo engine. A microcontroller is used by servo engines to control their position. [5].

COMPONENTS

Stepper motor

The motor is used to control the angular moment of the robot. It is regularly used in the robotics arm and manipulators it is used in robotic gripper and end effectors in our pick and place robotic arm. In essence, stepper motors consist of a central rotor, which is a gear-shaped piece of iron, surrounded by a number of "toothed" electromagnets grouped as a stator. A microprocessor or an external driving circuit powers the electromagnets. One electromagnet is powered in order to attract the teeth of the gear magnetically and cause the motor shaft to revolve. The gear's teeth are somewhat misaligned from the next electromagnet when they are aligned with the first one. This indicates that the gear spins a little to align with the subsequent electromagnet when it is switched on and the previous one is shut off. The technique is then carried out once

• Stepper motor driver

The driver used to control the stepper motor. It converts low level control signal to high voltage. It controls the speed of the motor, direction, timing adjustment step pulses sequence and it gives perfect positioning and control of motion in robot by fluctuating the pulse/ voltage

• Connection of stepper motor and driver

• Arduino Controller

Arduino is a central processing unit of the system .it receives the signal from the sensors and command of the program. It coordinates the each of joint movement. again. A complete rotation consists of an integer number of steps, each of which is referred to as a "step".

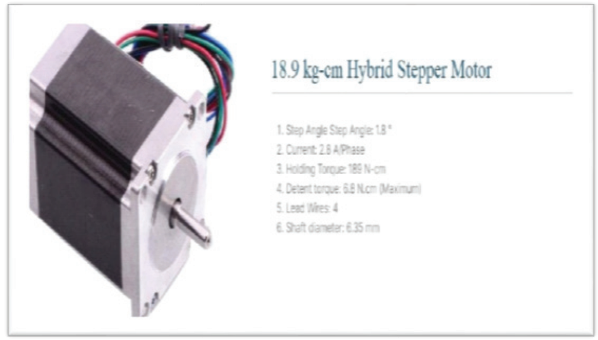

Fig. 1: Stepper Motor

It is it can in-corporates mechanisms feedback thus it is also known as the brain of system.

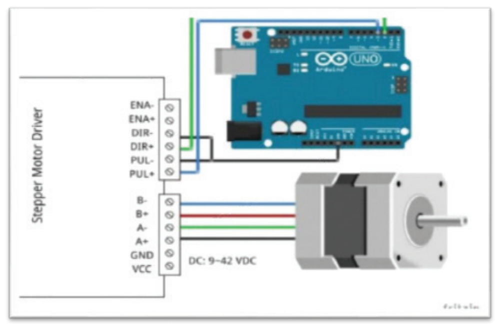

Fig. 2: Connections between driver-motor-Arduino

SAMPLE CODE FOR 3D ROBOTIC

System Modelling

The initial step of planning regulators for a framework is demonstrating. In other word, we really want the actual qualities or the numerical conditions of the framework to plan a decent regulator. Displaying contains kinematic and elements. Kinematic is the movement science.

Table 1. 20 KG data sheet for the motor for motor

Sr no.	General specifications		Electrical specifications	
1.	Step Angle	1.8	Rated Voltage(V)	3.2
2.	Temperature Rise(C)	80 Maximum rated current Phase on rated current (A)		2.8
3.	Ambient temperature(C)	-20 +50	Resistance Per Phase(10%)	1.13 (25C)
4.	Number of Phase	2	Inductance (Per Phase 20% mH)	3.6
5.	Insulation Resistance	100M (500VDC)		
	Holding of Torque(Kg.cm)	20.0		
6.	Insulation Class	Class B	Detent of Torque(Kg.cm)	0.68

7.	Maximum .radial force(N)	75 (20mm from the flange)	Rotor Inertia (Kg. cm)	480
8.	Maximum .axial force(N)	15	Weight (Kg)	1

Table 2. 46 KG data sheet

General specifications		Electrical specifications	
Step Angle	1.8	Rated Voltage(V)	2.53
Temperature Rise(C)	80 Max rated current 2phase on)	Rated Current(A)	5.5
Ambien Temperature (C)	-20+50	Resistance Per Phase(10%)	0.46
Number of Phase	2	Inductance Per Phase (20%mH)	4.0
Insulation Resistance (M©)	(500VDC) 100Min	Holding Torque (N.m)	4.6
Insulation Class	Class B	Detent Torque(N.m)	0.12

Max. radial force(N)	220 (20 mm from the flange)	Rotor Inertia (2Kg. cm)	1400
Max. axial force(N)	60	Weight (Kg)	2.3

Overall connections between Motor, Arduino, Driver.

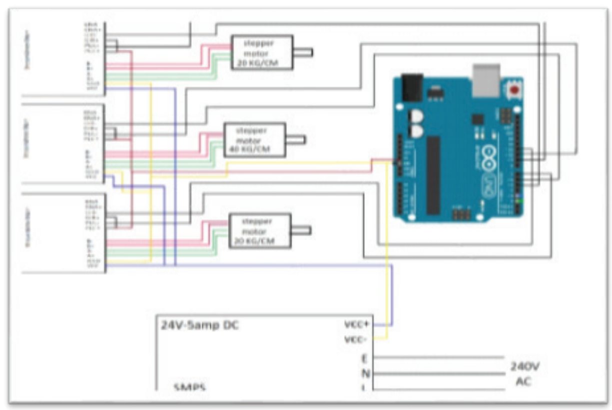

Fig. 3: Wiring Diagram

Case :Robot position with L2-40°

JOINT No.	JOINT TYPE	Joint offset (b)m	Joint angle (theta) deg	Link length (a) m	Twist Angle (alpha) deg	Initial Value (JV) deg orm	Final value(JV) deg orm
1.	Revolute	0.390	Variable	0	90	0	0
2.	Revolute	0	Variable	0.240	0	0	0
3.	Revolute	0	Variable	0.235	0	0	40

JOINT No.	JOINT TYPE	Joint offset (b)m	Joint angle (theta) deg	Link length (a) m	Twist Angle (alpha) deg	Initial Value (JV) deg orm	Final value(JV) deg orm
L1.	Revolute	0.390	Variable	0	90	0	0
L2.	Revolute	0	Variable	0.240	0	0	0
L3.	Revolute	0	Variable	0.235	0	0	0

Case :Robot position with L2-40°

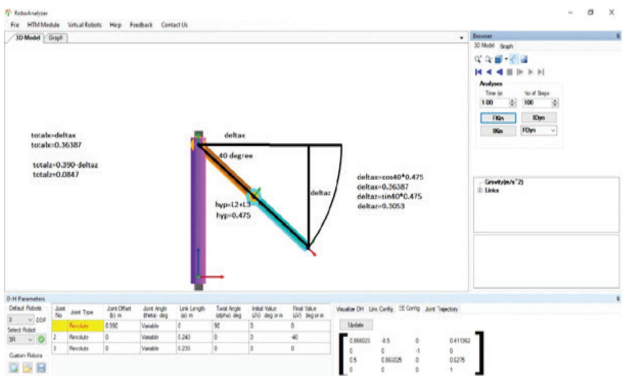

Fig. 4: Robot position with L2-40°

CONCLUSIONS

The 3 DOF robotic arm successfully handled pick and place tasks, showing promising capabilities in industrial settings. While its range of motion and load capacity met requirements, opportunities exist to improve its speed and accuracy, which could enhance overall productivity. Further refinements could unlock even greater potential for streamlining operations and maximizing efficiency. Further research and refinement in areas such as trajectory planning, obstacle avoidance, and human-robot interaction will continue to enhance the capabilities and versatility of 3 DOF robotic arms, paving the way for advancements in robotics technology and its integration into diverse fields that concentrates on the position, speed increase, and subordinates of them without in regards to the power and force.

Controller development attributes are read up in kinematic science for robot and contain two parts forward kinematic and backwards kinematic. In other hand, the connection between these developments and the power and force is concentrated on in element.

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A Mathematical Model for the Fuel Utilization of Neem Biodiesel Exclusively for Brakes on a Single-cylinder Diesel Engine

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ABSTRACT

Due to modernization, demand for petroleum-based fuels is increasing, but in the natural world, they are running out over time, which also adds to pollution and other environmental problems. So, it is necessary to find alternatives for such fuel and study their performance. Neem biodiesel is one prominent alternative to diesel. The requirement for diesel is very high because of its low cost, high compression ratio of engine, excellent brake thermal efficiency and low BSFC. The effectiveness of 10% neem biodiesel as a diesel substitute is the main topic of this essay. A VCR diesel engine's efficiency is expressed in terms of BSFC at various compression ratios. and the prediction equation of BSFC for different compression ratios and loads. It is observed that BSFC is minimum 0.21 Kg/Kw.h at load 7Kg and compression ratio 16. The prediction equation shows results very close to the experimental results for low compression ratios.

KEYWORDS: *Brake-specific fuel consumption, Compression ratio, Neem biodiesel, Diesel engine, Regression equation.*

INTRODUCTION

Fossil fuels currently supply a large amount of India's energy needs. In addition to contributing significantly to air pollution, petroleum-based fuels hasten the depletion of conventional energy supplies because of growing demand. Preserving air quality and reducing air pollution are the goals of the Air Act of 1981. Thus, other sources that will solve these issues are required. India is an agricultural nation, hence there is great potential for producing vegetable oils from various oil seeds. The only edible oil fuel that is the subject of this work is non-edible oil. Edible oils are excessively costly and in high demand. Despite the concerned researchers' recommendation to use vegetable oils in diesel engines, no workable vegetable oil-source engines could be found. This demand is directly correlated with fuel usage. Due to a shortage of fossil fuel reserves, India is mostly dependent on imported fuels, which has a significant effect on the country's economy. India needs to find a substitute to keep up its growth rate. A viable substitute for our diesel needs is bio-diesel.

SELECTION OF FUEL

Neem oil: Neem is scientifically known as "azadirachta indica" and it is a member of the Meliaceae family The neem oil plant grows quickly and can continue to produce for 150–200 years. Its high oil content of 39.7 to 60% has been established, and it has been found to be able to withstand drought and poor soils at Nimbidin, nimbin, and nimbostrol—compounds containing sulfur—are the cause of this bitter taste.

METHODOLOGY

Experimental Design

The test to be conduct on single cylinder computerized diesel engine having I.C. Engine software "EnginesoftLV" to direct find out performance parameters as per experimental design given below

Test will be conducted as per testing parameters given below.

Compression Ratio	18,17,16,14
load	1,3,5,7
Blend%	10
bio fuels	Neem biodiesel

For the combo trials listed above, as indicated below,

Table 1: Experimental parameters

Sr. No.	Compre-ssion ratio	Load	Blend %	Sr. No.	Compre-ssion ratio	Load	Blend %
1.	18	1	10	9.	16	1	10
2.	18	3	10	10.	16	3	10
3.	18	5	10	11	16	5	10
4.	18	7	10	12	16	7	10
5.	17	1	10	13	14	1	10
6.	17	3	10	14	14	3	10
7.	17	5	10	15	14	5	10
8.	17	7	10	16	14	7	10

PERFORMANCE PARAMETER

a. Brake power: Crankshaft power available

b. Indicated power: Power development above the engine cylinder piston.

c. Brake specific fuel consumption: The rate at which fuel is burned to produce one kilowatt-hour of electricity is known as brake specific fuel consumption, or BSFC.

d. Brake thermal efficiency: The braking power to heat supply rate ratio.

e. Indicated thermal efficiency: The ratio of the rate at which heat is provided to the indicated power.

f. Mechanical efficiency: Mechanical efficiency is the Brake power to indicated power ratio.

The engine's performance is measured using the aforementioned criteria, but in this research, performance is examined in connection to BSFC.

EXPERIMENTAL SETUP & PERFORMANCE TESTING

A single cylinder, four-stroke diesel engine with a variable compression ratio makes up the arrangement. Natural aspiration engines such as the TV-SR are made in India by Kirloskar Oil Ltd.For loading eddy current type dynamometer is connected. Without stopping the engine, it is possible to change the compression ratio. With the required instruments, a setup is made for crank-angle and combustion pressure measurements. Again, the computer interfaces signals via the engine indicator in order to obtain observations and results. Additionally, interfaces for temperature, load, fuel flow measurement, and air flow are provided. The setup comprises of a stand-alone panel box with a water flow measurement calorimeter, a fuel measuring unit, a process indication, and an engine indicator. The configuration facilitates the examination of the performance of the VCR engine in terms of heat balance, indicated thermal efficiency, mechanical efficiency, specific fuel consumption, IMEP, volumetric efficiency, frictional power, heat balance, and A/F ratio. "EnginesoftLV" is offered for online performance evaluation from the perspective of lab-based engine performance analysis software.

Fig. 1: Experimental Setup

OBSERVATION TABLES

Compression Ratio = 18

Table 2. Engine performance at compression ratio 18 with 10% neem

Speed (RPM)	Load (kg)	Mano. Deflection(mm)	Fuel flow(Secs / 10ml.)	Jacket water (LPH)	Calorimeter water (LPH)	Engine water in (DegC)	Engine water out (DegC)	Cal. water in (DegC)	Cal water out (DegC)	Ex. temp. cal. In (DegC)	Ex. temp. cal out (DegC)
1494	1	84	66.62	300	80	25	29.25	25	28.5	141	78
1488	3	82	56.25	150	80	25	31.75	25	28.5	183	102
1485	5	81	47.52	150	80	25	32.75	25	29.5	225	117
1480	7	80	40.87	150	80	25	33.5	25	30.5	273	129

6.2 Compression ratio = 17

RESULT AND DISCUSSION

Following are results for 10% Neem Bio-Diesel by using computerized VCR diesel engine with I.C. Engine software "EnginesoftLV" (Apex Engineering ,Miraj)

Result Table

Table 3 : Result at compression ratio 18 with 10% neem

Compression Ratio= 18

BP (kW)	BMEP (BAR)	BSFC kg/kWh	BTh.eff.(%)	Air flow (kg/h)	Fuel flow (kg/h)	Vol eff (%)	A/F Ratio	Heat Equi.of work (%)	Heat by jacket coolingwater (%)
0.28	0.34	1.58	5.43	29.75	0.45	86.05	66.34	5.43	28.33
0.85	1.03	0.63	13.69	29.40	0.53	85.36	55.34	13.69	19
1.41	1.72	0.88	19.24	29.22	0.63	85.01	46.46	19.24	18.43
1.97	2.41	0.37	23.09	29.04	0.73	84.77	39.71	23.09	17.38

Compression ratio= 14

BP (kW)	BMEP (BAR)	BSFC kg/kWh	BTh.eff. (%)	Air flow (kg/h)	Fuel flow (kg/h)	Vol eff (%)	A/F Ratio	Heat Equi.of work (%)	Heat by jacket cooling water (%)
0.28	0.34	2.21	3.88	29.75	0.62	86.86	47.88	3.88	28.87
0.50	5.21	1.30	6.61	29.40	0.65	729.99	45.35	6.61	28.83
1.40	1.72	0.72	16.83	29.40	0.71	86.29	41.27	16.83	29.38
1.95	2.41	0.41	20.91	29.04	0.80	85.41	36.25	20.91	28.93

BSFC calculation by regression equation

Regression equation for BSFC

To measure the linear relationship between BSFC and two independent variables load and compression ratio, let us consider BSFC as y, load as X_1, compression ratio as X_2.

Here multiple regression equation as

$$y = a_0 + a_1X_1 + a_2X_2$$

Now to find the values of a_0, a_1, a_2, we use the following formulae.

$$a_1 = \frac{(\sum x_2^2)(\sum x_1y)-(\sum x_1x_2)(\sum x_2y)}{(\sum x_1^2)(\sum x_2^2)-(\sum x_1x_2)^2},$$

$$a_2 = \frac{(\sum x_1^2)(\sum x_2y)-(\sum x_1x_2)(\sum x_1y)}{(\sum x_1^2)(\sum x_2^2)-(\sum x_1x_2)^2},$$

$$a_0 = \bar{y} - a_1\overline{X_1} - a_2\overline{X_2}$$

Where

$$\sum x_1^2 = \sum X_1^2 - \frac{(\sum X_1)^2}{n},$$

$$\sum x_2^2 = \sum X_2^2 - \frac{(\sum X_2)^2}{n},$$

$$\sum x_1y = \sum X_1y - \frac{(\sum X_1)(\sum y)}{n},$$

$$\sum x_2y = \sum X_2y - \frac{(\sum X_2)(\sum y)}{n},$$

$$\sum x_1x_2 = \sum X_1X_2 - \frac{(\sum X_1)(\sum X_2)}{n}$$

For calculations preparation of following table

Table 4 : Calculations Preparation

y	X_1	X_2	X_1y	X_2y	X_1X_2	X_1^2	X_2^2
1.58	1	18	1.58	28.44	18	1	324
0.63	3	18	1.89	11.34	54	9	324
0.88	5	18	4.4	15.84	90	25	324
0.37	7	18	2.59	6.66	126	49	324
1.46	1	17	1.46	24.82	17	1	289
0.68	3	17	2.04	11.56	51	9	289
0.44	5	17	2.2	7.48	85	25	289
0.37	7	17	2.59	6.29	119	49	289
1.70	1	16	1.7	27.20	16	1	256
0.67	3	16	2.01	10.72	48	9	256
0.46	5	16	2.3	7.36	80	25	256
0.21	7	16	1.47	3.36	112	49	256
2.21	1	14	2.21	30.94	14	1	196
1.30	3	14	3.9	18.20	42	9	196
0.72	5	14	3.6	10.08	70	25	196
0.41	7	14	2.87	5.74	98	49	196
$\sum y$ =14.09	$\sum X_1$ = 64	$\sum X_2$ = 260	$\sum X_1y$ = 38.81	$\sum X_2y$ = 226.03	$\sum X_1X_2$ = 1040	$\sum X_1^2$ = 336	$\sum X_2^2$ = 4260

Using above table values

$$\sum x_1^{\,2} = \sum X_1^{\,2} - \frac{(\sum X_1)^2}{n} = 336 - \frac{64^2}{16} = 80,$$

$$\sum x_2^{\,2} = \sum X_2^{\,2} - \frac{(\sum X_2)^2}{n} = 4260 - \frac{260^2}{16} = 35,$$

$$\sum x_1 y = \sum X_1 y - \frac{(\sum X_1)(\sum y)}{n} = 38.81 - \frac{(64)(14.09)}{16} = -17.55,$$

$$\sum x_2 y = \sum X_2 y - \frac{(\sum X_2)(\sum y)}{n} = 226.03 - \frac{(260)(14.09)}{16} = -2.9325,$$

$$\sum x_1 x_2 = \sum X_1 X_2 - \frac{(\sum X_1)(\sum X_2)}{n} = 1040 - \frac{(64)(260)}{16} = 0$$

Hence $a_1 = \frac{(\sum x_2^{\,2})(\sum x_1 y) - (\sum x_1 x_2)(\sum x_2 y)}{(\sum x_1^{\,2})(\sum x_2^{\,2}) - (\sum x_1 x_2)^2} = -0.2194,$

$$a_2 = \frac{(\sum x_1^{\,2})(\sum x_2 y) - (\sum x_1 x_2)(\sum x_1 y)}{(\sum x_1^{\,2})(\sum x_2^{\,2}) - (\sum x_1 x_2)^2} = -0.0838,$$

$a_0 = \bar{y} - a_1 \bar{X_1} - a_2 \bar{X_2} = 3.12$

Hence the regression equation is

$y = 3.12 - 0.2194X_1 - 0.0838X_2$

Table 5: BSFC calculation by regression equations

Sr. No.	Neem %	Load	Compre-ssion ratio	BSFC By experiment	BSFC by Regression equation
1	10	1	18	1.58	1.39
2	10	3	18	0.63	0.95
3	10	5	18	0.88	0.52
4	10	7	18	0.37	0.08
5	10	1	17	1.46	1.47
6	10	3	17	0.68	1.03
7	10	5	17	0.44	0.59
8	10	7	17	0.37	0.16
9	10	1	16	1.70	1.56
10	10	3	16	0.67	1.11
11	10	5	16	0.46	0.68
12	10	7	16	0.21	0.24
13	10	1	14	2.21	1.73
14	10	3	14	1.30	1.29
15	10	5	14	0.72	0.84
16	10	7	14	0.41	0.41

CONCLUSION

One well-known substitute for diesel is neem biodiesel. Thus, an analysis of neem biodiesel's performance at various loads and compression ratios is required. Fuel consumption particular to brakes is examined in terms of performance. Brake-specific fuel consumption is lowest at compression ratio 16 and load 7 kg and highest at compression ratio 14 and load 1 kilogram, according to BSFC analysis for various compression ratios and loads. The graphical findings show that BSFC declines with increasing load. BSFC rises when the compression ratio falls. Variation between results of experiments and mathematical model is less than 10% so mathematical model is verified. Due to less vibrations, the regression equation produces results that are quite close for low compression ratios.

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Library Assistant Robot for Auto-Pick System

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ABSTRACT

The goal of the library management system is to manage library processes through a series of operations such as book borrowing and book borrowing. This article demonstrates the use of robots in library management systems. A robot has been developed that can track the arrangement of bookshelves in a library along a predetermined route. The number of the book that needs to be removed is used as input to the robot. The robot obtains the book data by comparing the stored RFID tag with the books on the shelf. This project involves creating a robot model for searching and selecting books. Finding books in a library is a time-consuming and difficult task. As libraries offer more and more services and resources, they continue to purchase large quantities of books and printed materials. To automate the process of book search and selection, a robotic model will be employed to simplify the task. Various research efforts will be conducted to study the functionality and components of library robots. A remarkable new mobile robot has been introduced, specifically crafted to make libraries more comfortable, convenient, and efficient. People everywhere are embracing this innovative solution with enthusiasm and approval.

KEYWORDS: *RFID, Library management, RFID scanner, Book shelves.*

INTRODUCTION

Libraries are increasingly adopting automation to enhance efficiency and user experience. One innovative solution is the Library Assistant Robot for an Auto Pickup System. This paper explores the design, functionality, and benefits of such a system in modern library environments, focusing on its integration with Robot Operating System (ROS) and the use of Radio Frequency Identification (RFID) technology. Traditionally, library operations have been labor-intensive, requiring library staff to manually retrieve and shelve books. This process is time-consuming and prone to errors, leading to inefficiencies in the library's operations. Additionally, the manual handling of library materials increases the risk of damage and loss. As libraries strive to enhance their services and improve user experience, there is a growing need for automated solutions to streamline these processes. The present condition of libraries is characterized by a shift towards automation and digitalization. Many libraries have adopted technologies such as RFID to manage their collections more efficiently. Design and development of a Library Assistant Robot for Automated Book Retrieval System: A Feasibility Study. In the realm of library automation, the development of a library assistant robot presents a groundbreaking solution to streamline book retrieval processes. This innovative robot is equipped with advanced features that enable users to control its movements remotely through SMS commands, providing a convenient and efficient means of navigating the library space. Through rigorous experimentation, the robot has exhibited a remarkable capability to accurately retrieve books of varying thickness and weights from different shelf levels, achieving an impressive accuracy rate of up to 97.33%. By automating the book retrieval process and delivering the requested items to the borrower table, the robot significantly enhances operational efficiency within the library setting. This feat is made possible through the integration of cutting-edge technologies such as GSM, RFID, and sensory systems, which work in tandem to optimize the robot's functionality and performance. Furthermore, the physical layout of the library has been redesigned to accommodate the robot's movement between shelves, ensuring seamless navigation and operation within the library environment. The successful design and development of this library assistant robot underscore its feasibility and potential to revolutionize traditional library services through automation and technological innovation. The primary objective of this research is to design and develop a Library Assistant Robot capable of autonomously retrieving and delivering books to patrons, integrating ROS for navigation and RFID for book identification. The system aims to reduce manual labour, improve accuracy, and enhance overall efficiency in library operations. The Library Assistant Robot is equipped with a variety of sensors, including RFID readers, cameras, and proximity sensors, to navigate the library environment and identify book locations. The robot communicates with a central server, which contains information about the library's inventory and user requests. ROS provides a framework for controlling the robot's movements, processing sensor data, and communicating with other components. It allows for the development of complex robot behaviours and facilitates integration with different hardware components. RFID tags are attached to each book in the library, containing information such as the book's title, author, and location. The robot uses RFID readers to scan the tags and identify the books, enabling it to retrieve them efficiently. The robot's design incorporates a robust chassis for stability and durability, along with a modular storage system to accommodate different book sizes. It uses a combination of SLAM (Simultaneous Localization and Mapping) and path planning algorithms to navigate through the library aisles and locate specific books.

When a user requests a book, the robot receives the request from the server and calculates the optimal path to the book's location. It then uses its sensors to navigate to the bookshelf, retrieve the book, and deliver it to the user's designated pickup point. The Library Assistant Robot offers several key benefits to both libraries and patrons. For libraries, it reduces labour costs associated with manual book retrieval and shelving. It also minimizes errors in book tracking and inventory management. For patrons, the system provides a convenient and efficient way to access library materials, saving time and effort. The Library Assistant Robot for an Auto Pickup System, integrated with ROS and RFID technology, represents a significant advancement in library automation. By leveraging robotics and AI technologies, libraries can improve operational efficiency and enhance user experience. Further research and development in this area could lead to even more sophisticated and versatile library automation solutions in the future.

In the past, libraries relied heavily on manpower to handle their daily tasks. With countless books being borrowed and returned regularly, maintaining order on the shelves was quite the challenge. Based on the literature I've reviewed, it seems a solution was devised: a robot programmed to follow specific paths, ensuring the books are arranged neatly on the shelves. The process of scanning book positions typically starts with infrared sensors scanning a designated section of the bookshelf. The primary goal of this research was to develop a system capable of identifying and retrieving specific books from the shelves. Different scanners are used by different researchers, RFID, Barcode, QR code can be used for scanning purpose. Although using RFID is the most relevant. Different types of Arduinos are available in the market and can be used for the project. Knowledge of programming language is important to implement it in the use of Arduino for this project. There are various problems faced by the researchers which have been added in the future scope the problem associated is how to hold the book properly without it getting dropped. The book position scanning process normally begins with scanning of a certain range of bookshelf by IR sensors. For enhancing accuracy of pickup process, infrared sensing systems are added to the manipulator. This paper delves into the crucial aspect of integrating robotic technology to create a completely autonomous system, much like a navigation system equipped with surface tracking capabilities. A Radio Frequency Identification (RFID) reader is incorporated into the navigation system to detect RFID tags embedded in each book. Using the information from these tags, the system generates a tracking report, pinpointing any missing or misplaced books for the end users.

SCOPE OF THE PAPER

The objective of this paper is to develop and create the Library Assistant Robot, designed to locate specific books requested by users on the shelves. Once found, the robot will promptly deliver the book to the user. Sensors are used for detection purpose. The use of RFID tags and RFID scanner is used for this Library robotic model.

METHODOLOGY

The need for decreasing the chaos in libraries reflects towards the creation of this automated system. There are many mishaps taking place in the library from misplacing of the books to difficulty in finding the required book. We've all experienced the frustrations of a disorganized library—whether it's misplacing returned books or struggling to find specific ones when needed. Keeping track of every book in the library is essential, and any disorder tends to cause headaches later on. To address these challenges, this project was initiated. Its goal is to tackle these issues in a modern, technologically advanced, and innovative manner. For best optimal design the problems faced in the libraries are analysed and research has been done and then the system is prepared accordingly. For this, help of papers and Journals is taken to study about the system for the robot. To easily keep account of the books and to find them, it is decided to give them each a unique identification. A RFID tag with unique code, which is unique to each book is created. The tag is attached to the books. By this process each book has their own one-of-a-kind identification which will further help in finding any particular book when needed.

There is a reason why specifically RFID tags are used as identifying marks because for this project we plan to use RFID scanner. RFID scanning technology is up to date the best for the scanning process for this project. In our library system, there are four key sequences of events that require careful attention to minimize task time: handling random user requests, retrieving books, and ensuring efficient delivery and return processes. These aspects demand focused efforts to streamline operations and enhance overall efficiency. These tasks are now done by the designed scanner and therefore the process of identifying and retrieving the books has become easy. Experiments are carried out for the creation of the RFID tags which are embedded in each book. Based on the tag information tracking process is done by the robot using the scanner. This will also help in keeping a tracking report of missing and misplaced books of the library for the end users of the robot model. The process of finding the RFID tag by the robot using the scanner is done with the help of Arduino programming.

Designing of the model was done using available designing software's like Solid works. The model parts like the base of the robot, gripper, wheel, Support were designed in appropriate dimensions on the software SolidWorks and then were assembled together. This gave a preliminary model for the Library Assistant robot. For the mobilization of the robot, wheels are attached to the base of the robot so it is able to easily transverse along the aisles of the library. The system for adjusting the height of the robot is also added in the model so that the robot can readily reach any shelf of the library. The arm on the robot would have the Gripper attached to it, which would pick and place the books.

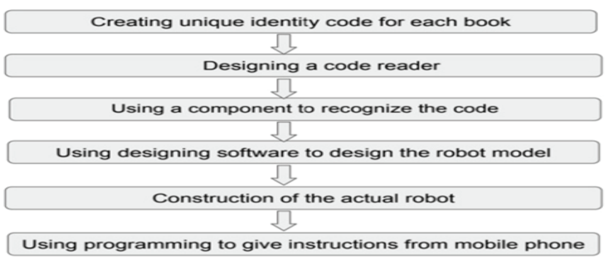

Fig. 1: Flowchart

APPLICATIONS

The utilization of this technology is applicable in educational institutions such as schools and colleges, specifically within their library systems. By implementing this technology, library staff can alleviate the burdensome task of shelf reading, allowing for more efficient allocation of resources within the library. By automating the book finding and selection process, this robot has the capability to independently navigate the library aisles and scan for the desired book, effectively reducing the workload of library staff. This innovative system employs a unique approach that minimizes the need for human intervention and streamlines routine tasks within a specified timeframe, thereby increasing efficiency and simplifying daily operations.

RESULT AND CONCLUSION

To summarize, Pick and Place Robots play a crucial role in accelerating the process of picking up and relocating items with reasonable production rates. This paper explores the utilization of a pick and place robot to automate the task of retrieving library books and delivering them to the borrower's table. At the outset, the robot is positioned at its starting point. Users input the required book's number via an android application linked to a Bluetooth module. Subsequently, the robot commences its movement along a predefined path, guided by IR sensors. These sensors relay vital information to the robot, directing its movements according to preset instructions.

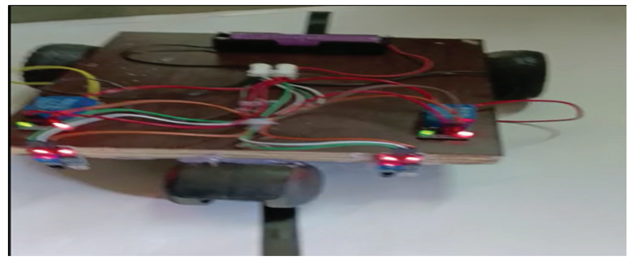

Fig. 2: Robotic base programmed with Line Follower

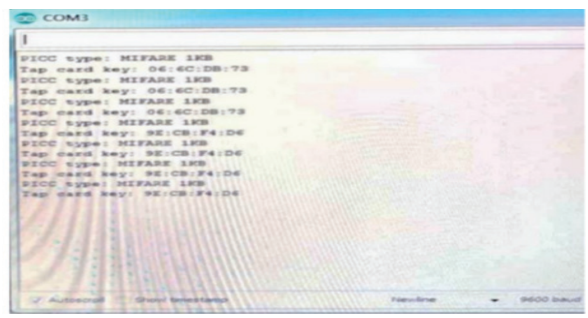

Fig 3: RFID key identification output

Upon reaching the designated destination, the robot's RFID reader scans for a match between the book's code and the tag affixed to the desired book. Upon detection, the robot employs its arms to pick up the book and securely hold it. Returning to its initial position, the robot presents the book to the user, completing the task efficiently.

OUTCOMES

This project will give the way for providing bigger effective purpose for library applications. This system approaches a novel method which decreases the man power and will make life easy doing regular task within stipulated time. It can be used to automate the process of the book finding and picking. Automated pickup service improves customer service thus taking some workload off the other staff members. This innovative robot provides a solution to the challenging task of shelf reading in libraries, offering a more efficient allocation of resources. By autonomously navigating the library aisles and scanning for specific books, it alleviates the workload of library employees. Its functionality promises ease, accuracy, and cost-effectiveness, ultimately reducing reliance on human labour while enhancing speed and efficiency.

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Comparison of Airfoils-NACA 4412 & NACA 2415 using CFD Analysis

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ABSTRACT

In this paper, a complete analysis of both the airfoils i.e., NACA 4412 & NACA 2415 is done to check the lift and drag forces and coefficient. In this study, two airfoils of NACA in series with different shapes were studied using Computational Fluid Dynamics (CFD) to investigate the airflow around two types of airfoils - NACA 2415 and NACA 4412. To verify the CFD model, the simulation results were compared to available experimental data. The k-ω SST turbulence model was used. The CFD simulations provided information on the lift coefficients, lift- to-drag ratios, and pressure distributions around the airfoils, which were then compared.

KEYWORDS: *Airfoil, Drag coefficient, Lift coefficient, NACA series.*

INTRODUCTION

An airfoil is a specially shaped cross-section with a curved upper surface that balances lift and drag effectively. Its asymmetrical design, with a curved top and flat bottom, generates lift when air flows over it. The curved top creates a low-pressure zone above the airfoil, while the flat bottom reduces drag. The airfoil's efficiency depends on factors like shape, size, angle of impact, and the speed and density of the fluid passing through it. Scientists have extensively researched airfoils to enhance the efficiency of moving objects. The performance of an airfoil is affected by several factors, including its shape, size, angle of attack, and the speed and density of the fluid it is moving through. Numerous studies have focused on enhancing the effectiveness of dynamic structures through the use of airfoils. Various shapes of airfoils have been extensively researched for their performance. Sreejith and Sathyabhama8 (2018) specifically looked into how boundary layer trips impact the aerodynamic behaviour of the E216 airfoil. Their findings revealed that implementing boundary layer trips can enhance the airfoil's aerodynamic performance by reducing or eliminating laminar separation bubbles. This research investigates how the aerodynamic shape of an airfoil influences lift, drag, and pressure distribution. Lift coefficients and lift-to-drag ratios are compared for different airfoil shapes, providing insights into their impact on each other. The study enables the selection of airfoils based on their shape, pressure and velocity distributions, and lift and drag values. In summary, this paper contributes to the existing body of knowledge on airfoil aerodynamics by providing a comprehensive CFD analysis of NACA 4412 and NACA 2415 airfoils.

Objectives

1) The earlier research done with the CFD analysis, which was carried out, didn't consider perforations on the surface. The quality of meshing also looked average from the contour images provided.
2) To fill the gap between CFD analysis of an aerofoil the results would be analysed and compared with credible sources. It aims to understand the effect of perforations on the airflow around the aerofoil
3) While CFD simulations offer a powerful tool for analysing airfoil aerodynamics, ensuring the accuracy and reliability of these simulations is essential.Further validation and verification studies comparing CFD results with experimental data for NACA 4412 and NACA 2415 airfoils under various conditions can enhance confidence in the numerical predictions.

Theory

An airfoil is a shape that produces an aerodynamic force when placed in an airstream. This force has various uses, such as in the design of aircraft wings, propeller blades, wind turbine blades, and the blades of compressors and turbines in jet engines. Hydrofoils are also examples of airfoils.

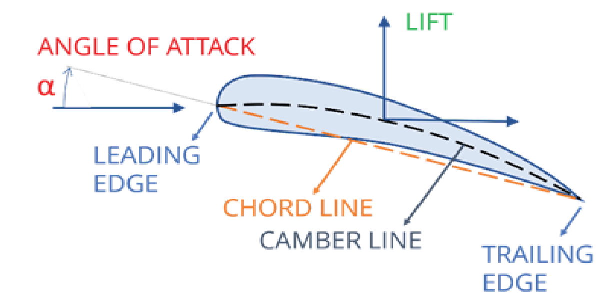

Fig. 1: Terminology of Airfoil

The leading edge is the front part of the airfoil which has the most curvature. As the AOA increases, lift also increases, though drag goes up as well, but not as quickly as the lift.

Lift Coefficient - $C_l = \frac{2L}{\rho V2S}$

Drag Coefficient - $C_d = \frac{2F\ d}{\rho V2A}$

NACA stands for the National Advisory Committee for Aeronautics. This organization was instrumental in pushing forward aviation technology, specifically in the advancement of airfoils, which are the shapes of wings and other aerodynamic surfaces.

The NACA four-digit wing sections define the profile in a specific way:

The first digit describes the maximum camber (curvature) as a percentage of the chord (the straight line from the front to the back of the wing).

The second digit describes the distance of the maximum camber from the airfoil's leading edge, in tenths of the chord.

The last two digits describe the maximum thickness of the airfoil as a percentage of the chord. For instance, the NACA 2415 airfoil has a maximum camber of 2%

METHODOLOGY

Setting Parameters

The Airfoils from the NACA website have been selected i.e., NACA 4412 & NACA 2415 from the literature study of various airfoils, it is decided to use these airfoils for this study.

Table 1: List of Simulations and their variables and parameters for both the airfoils

Domain type	Inlet velocity (m/s)	Output Parameters to be analysed
Single Airfoil	5 & 10	Lift and Drag Coefficient of the airfoil, Velocity and Pressure contours.

All simulations and post-processing were completed using ANSYS Fluent software since it offers ideal setup choices for aerodynamic analysis.

Design Modeler

The data points for the airfoil edge were collected from the NACA website to create the airfoil's outline. The data file which was saved as a text file was imported into the design modeler using the 3D Curve tool. The surface from the edges tool was used to create a 2D surface. The airfoil had to be analysed in an open to atmospheric pressure condition. The figure below (Fig 2) depicts the construction of the airfoil domain of NACA 4412 & NACA 2415 respectively (Fig 3) of NACA 4412 & NACA 2415 respectively. The purpose was to aid in creating a structured and uniform mesh near the airfoil.

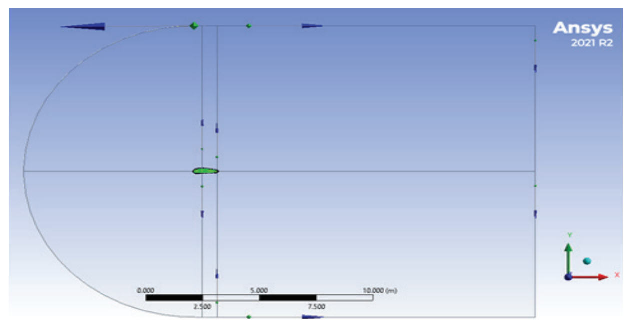

Fig. 2: Domain made in Design Modeler for single NACA 4412(a) & NACA 2415(b) airfoil analysis

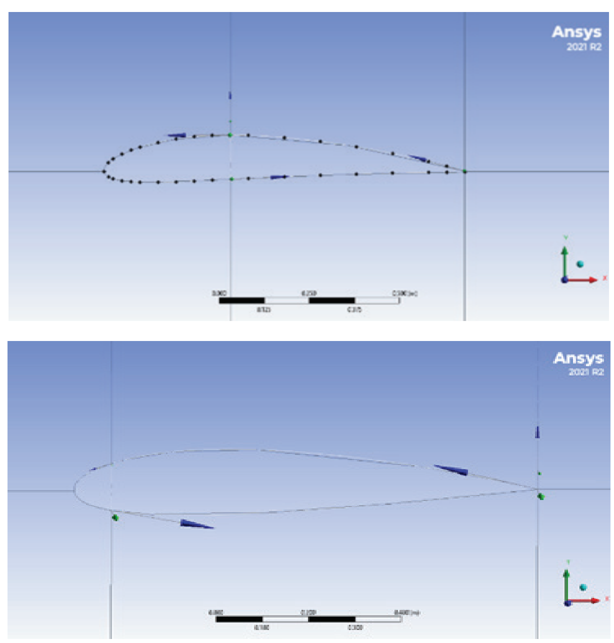

Fig. 3: Projection of lines over NACA 4412(a) & NACA 2415(b) airfoil

Meshing

The grid generates nodes and elements that have an impact on how accurate the results are. The accuracy increases with the number of nodes and elements. However, at a certain point, even with more nodes and elements, the outcomes remain relatively constant. We refer to this as mesh independence. A named selection tool was used to name the input, output, and airfoil. Once the project opened in mesh, the line body had to be suppressed so that when an edge was selected, the line didn't get selected. The physics preference was set as CFD and the solver preference as Fluent. A finer mesh was necessary on the boundaries of the airfoil and a coarse mesh in the domain because we were interested in knowing what was happening close to the edges of the airfoil. The mesh was made very fine close to the airfoil and coarse farther out in the domain by using the edge size or number of divisions option and adding a bias factor. The figure below illustrates how fine the mesh looked, close to the airfoil (Fig 8) of NACA 2415 respectively. The table below gives details about the edge sizing/ number of divisions, and the bias factor for all the edges (Table 3) and the (Fig 4) & (Fig 6) provide a reference for the edge code. To generate a mapped mesh, the whole fluid domain was face-meshed. At the boundary layer of the airfoil, the aspect ratio of the mesh was seen to be very high, but since the flow was expected to be travelling in the same direction, this issue was ignored. The semi-circular boundary on the left- hand side was named the velocity inlet. It defines that a fixed velocity will be specified in the setup part for this boundary. The other three other boundaries of the domain were named pressure outlets. This means that the boundaries selected will be open to the atmosphere. The airfoil edges were named as airfoil so that they can be defined as stationary walls9. The number of nodes and elements in the final mesh is shown below (Table 2).

Table 2: Nodes and Elements for Single Airfoil Analysis

Wind Velocity (m/s)	Nodes	Elements
5	200900	200000

Table 3: Edge sizing settings for different edges of both NACA 4412 & NACA 2415

Edge Code	No of Edges	Number of Divisions	Bias Factor
A	7	354	50000
B	3	212	300
C	3	141	-
D	4	100	-

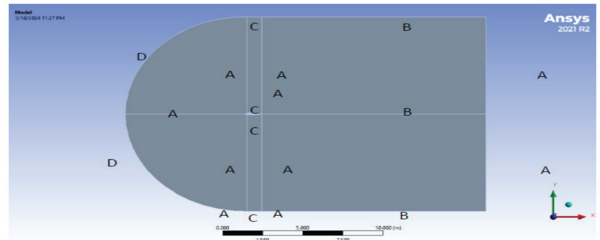

Fig. 4: Edge Selection for specifying edge sizing for NACA 2415

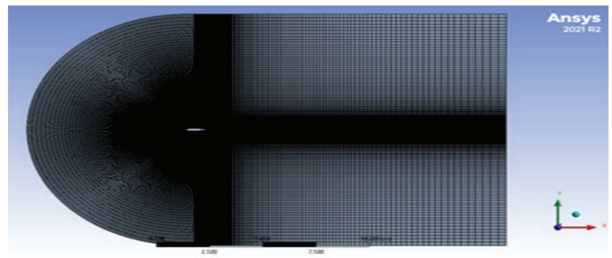

Fig. 5: Meshing of single NACA 2415 airfoil domain

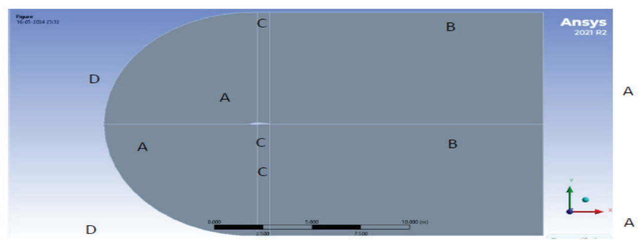

Fig. 6: Edge Selection for specifying edge sizing for NACA 4412

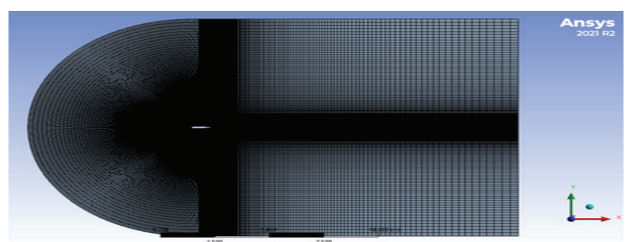

Fig. 7: Meshing of single NACA 2415 airfoil domain

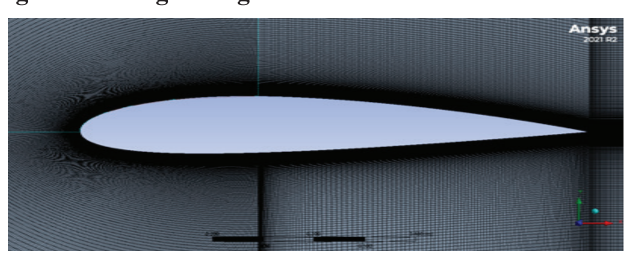

Fig 8: Biasing to create fine mesh near the NACA 2415 airfoil edges

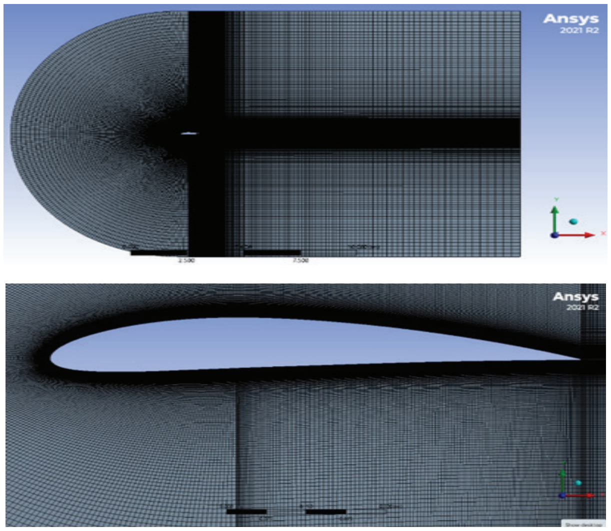

Fig. 9: Meshing (a) & Biasing to create a fine mesh (b) of a single NACA 4412 airfoil domain

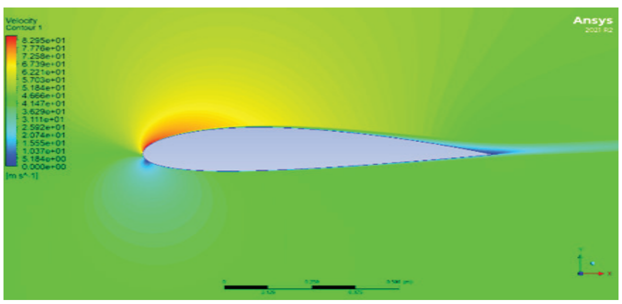

Fig. 10: Velocity contour for NACA 2415 airfoil

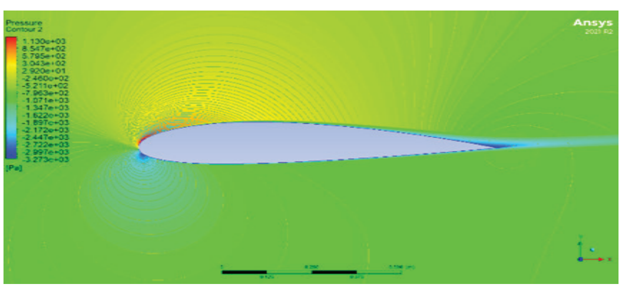

Fig. 11: Pressure contour for NACA 2415

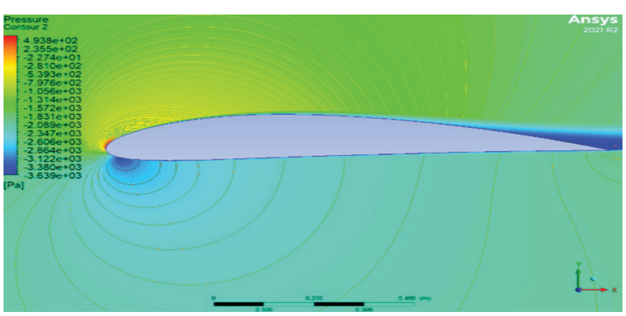

Fig. 12: Velocity contour for NACA 4412 airfoil

Setup

Boundary conditions must be added to the domain after meshing is complete. A solver based on pressure was chosen to avoid compressible flow. SST K-ω viscous model was employed because it offers more accurate findings close to walls. Near the airfoil edges, this was required. The fluid used was air (pre-defined). 5 m/s of inlet velocity was delivered to the inlet under boundary conditions. Using operating conditions, the pressure value was set at 101325 Pa, which is the atmospheric pressure.

Analysis

Lift and drag graphs were created for the single airfoil so that they could be compared to published sources. Velocity and pressure contours were examined using the contour tool. The fluid flow pattern was understood using the streamline function.

RESULTS

As the air approaches the leading edge, some part of it goes above the airfoil, and the rest below the airfoil. The air molecules flowing over the airfoil get squeezed and they move faster, whereas the air molecules flowing below the airfoil are much slower compared to them. The fast-moving molecules spread out and cause the pressure to decrease above the airfoil. It is evident from the pressure contour (Fig 11) & (Fig 13) that there is a difference in pressure between above and below the airfoil. The dark blue indicates a region of low pressure and the red region indicates high velocity. These findings support the airfoil's fundamental aerodynamic theory.

Table 4: Comparison of results of NACA 4412 & NACA 2415

	NACA 4412		NACA 2415	
	Experi-mental Data	**CFD Analysis**	**Experi-mental Data**	**CFD Analysis**
Lift Coeffi-cient	1.699	1.5626093	0.336340	1.0238
Lift Force	-	145.398 N	-	194.089 N
Drag Coeffi-cient	0.0287	0.02734616	0.024184	0.01488
Drag Force	-	-29.3045 N	-	-24.3801 N

CONCLUSION

This paper explores the optimization of airfoil design using computational fluid dynamics (CFD) approaches. The key factors affecting airfoil performance are examined. An airfoil analysis is generally based on Bernoulli's principle, which states that as the pressure of a fluid flow increases2, the velocity decreases. Pressure and velocity are inversely related. In this investigation, the aerodynamic performance of NACA 4412 and NACA 2415 airfoils was studied using the CFD software Ansys Fluent, with a constant velocity. Velocity and pressure contours were presented to analyse the flow around the airfoils. The lift coefficient (CL) increases until flow separation occurs, at which

point CL starts decreasing with further increases in the angle of attack (AoA). The calculated results were validated by comparing them with the available literature. The results of computational fluid dynamics for the NACA 4412 airfoil were compared with existing experimental data, showing a strong agreement between the two. The lift force decreases as the air temperature rises. Interestingly, the lift coefficient increases with higher air velocity. The lift force rises quickly when the air velocity increases. However, the lift and drag forces do not change much when the turbulence intensity varies.

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Design and Comparison of Materials for Airbus A380 Wing using Finite Element Method

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ABSTRACT

An Aeroplan flies in air with the phenomena of Air Pressure and this pressure can cause various stresses and deformation in Aeroplan Wing. The Main purpose of this project is to find out the stresses and deformation in Aeroplan wing for different materials and comparing it with currently used material. For Analysis, Reference of Airbus A380 Aeroplan is done using ANSYS software version 19.2 and its 3D Model is designed using SolidWorks. Different Material gives different result, considering its stresses and deformation values, cost and availability in market, Final material is suggested which can be used as alternate material for Aeroplan wing in replacement of current material.

INTRODUCTION

While Designing and actual production of Aeroplan wing various factors need to be considered and special attention to its structure is required. This factors may include two primary considerations, Wing must have high strength to weight ratio, high fatigue life since it is subjected to alternate repeated loadings during flight [7]. In current scenario various materials are used to develop Aeroplan wing and this materials gives different types of structural behavior. The wing is considered as one of the main element in Aeroplan as it not only provides stability but also main factor for plan lift and also it is the space where fuel is stored. It counters the force of gravity by using either static lift or by using the dynamic lift of an airfoil, or in a few cases the downward thrust from jet engines [8]. For Analysis purpose the Airbus A380 Aeroplan wing is taken as reference and its structural model is created using SolidWorks software and then its analysis is done in Ansys 19.2. Here structural and thermal analysis are important to compare such as temperature distribution, equivalent stress(von-mises), maximum shear stress and total deformation generated in the airbus A380 wing for the current material and alternate materials.

INTRODUCTION TO THE WING DESIGN

The 4 Forces

Flight is made possible by 4 forces working in concert. The thrust and drag are the first two forces, and the lift and gravity are the second pair, also known as weight. In order to move through a medium, whether it be air, water, or on the ground, it is necessary to apply a force against it. This force, is known as thrust, that is countered by the opposition of the medium through which the object is moving. This principle of buoyancy is also what allows steel ships to float on water. However, for birds and airplanes, it is not possible to adjust their density to be less than that of the surrounding air. Instead, a different force, known as lift, is employed to achieve flight.[6]

The Lift

Lift is delivered by the properties of the cross-sectional shape of the wings of winged creatures and planes. This shape is known as the aerofoil, or airfoil within the US and Canada. When the wing accelerate through the discussed parts the airstream into two parts, one traveling over the wing and the other traveling beneath the wing. Furthermore, the aero foil acts at an point to avoid the stream of discuss descending. Newton's laws of movement at that point portray the era of a response constrain pushing the wing, and hence the plane, upward. For level flight, lift and weight adjust each other out, having the same greatness, or measure, but acting in inverse headings. Weight, in science and material science, is the constrain on protest delivered by gravitational increasing speed.[8]W = m x g.

Wing Dimensions

The shape of wing is crucial for achieving flight, and lift is commonly determined by considering the wing as 2-dimensional structure. Presented below is a top view, front view & side view of an Airbus wing.

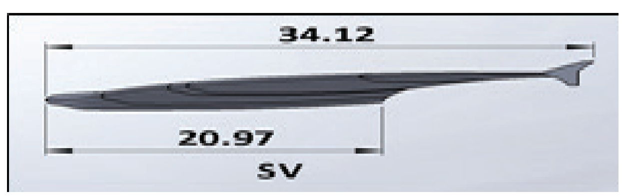
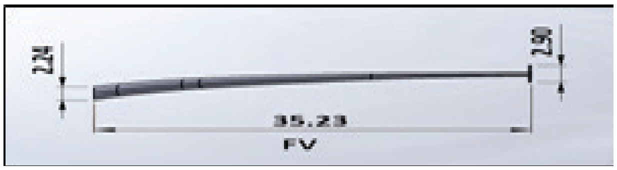
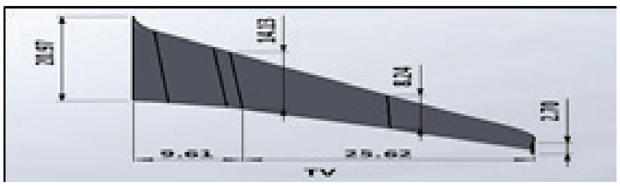


Fig. 1: Geometry Dimension Summary

Three-Dimensional Modelling

- Length of the wing = 35.23 m





- Width of the wing = 20.97 m
- Height of the wing = 2.90 m

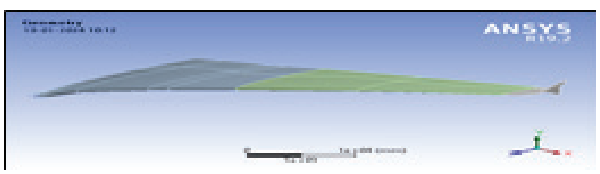


Fig. 2: CAD model of a wing

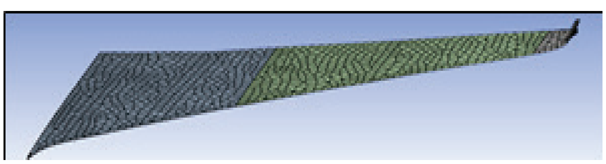


Fig 3: Meshed Model of air bus Wing

Mesh Image

Done the modelling in Solid Works and then that wing model is analyzed using Ansys Workbench 19.2. Materials are created in Ansys Engg Data. Fig. shows the mesh model of air bus wing model.

Meshing method

Wing blade: Tetrahedron mesh, Wing tip & edge: Tetrahedron mesh

Size of the Element

Wing blade: 700 mm, Wing edges and tip: 600 mm

Total Number of Nodes & Element:

Nodes: 18373,Elements: 10711

ANALYSIS OF CURRENT MATERIAL

Chemical Composition

Table 1: Carbon fiber chemical composition [6]

Current Density (Am-2)	O (%)	C (%)	N (%)	O/C
0	25.8	68.8	0.8	0.375
5	25.4	64.4	0.8	0.394
10	28.0	62.8	0.8	0.446
30	26.8	63.3	0.8	0.423
60	23.9	63.0	0.8	0.379

Carbon Fiber Material Results

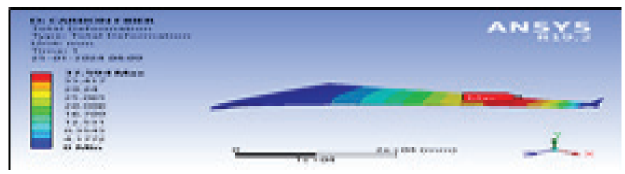


Fig. 4: Total Deformation

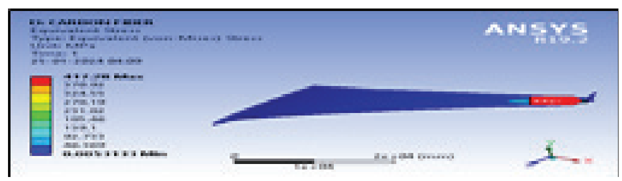


Fig. 5: Equivalent Stress

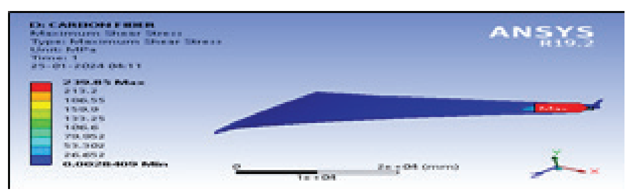


Fig. 6: Maximum Shear Stress

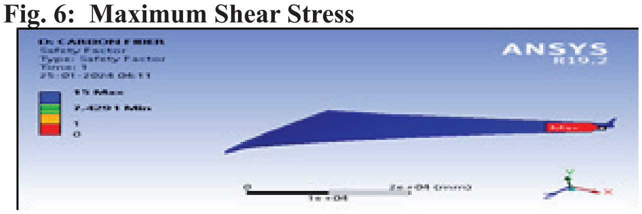


Fig. 7: Safety Factor

Here we observe that Current material has more deformation and von-mises stress hence to overcome this drawbacks and to find a alternative material for Aeroplan wing further analysis is done.

PROPERTIES OF ALTERNATE MATERIALS

Structural Steel Material Properties

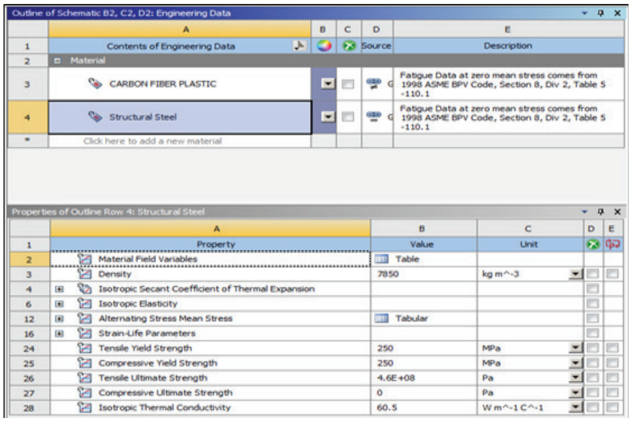


Fig. 8: Structural Steel material property

Structural Steel Chemical Composition

Table 2: Structural Steel chemical composition

SR. NO.	ELEMENT	COMPOSITION (wt%)
1	Manganese (Mn)	0.181
2	Aluminum (Al)	0.023
3	Chromium (Cr)	0.036
4	Carbon (C)	0.075
5	Nickel (Ni)	0.032
6	Sulphur (S)	0.007
7	Copper (Cu)	0.082
8	Silicon (Si)	0.014
9	Phosphorus (P)	0.009
10	Titanium (Ti)	0.002
11	Iron (Fe)	99.539

Aluminum Alloys 3003 Chemical Composition

Table 3: Aluminum Alloys 3003 chemical composition [10]

SR. NO.	ELEMENT	COMPOSITION (wt %)
1	Iron (Fe)	0.7
2	Manganese (Mn)	1 – 1.5
3	Copper (Cu)	0.20-0.50
4	Silicon (Si)	0.6
5	Other	0.15

Titanium Chemical Composition

Table 4: Titanium chemical composition [7]

SR. NO.	ELEMENT	COMPOSITION (wt%)
1	Vanadium (V)	4.22
2	Aluminium (Al)	5.48
3	Tin (Sn)	0.0625
4	Zirconium (Zr)	0.0028
5	Molybdenum (Mo)	0.005
6	Carbon (C)	0.369
7	Silicon (Si)	0.0222
8	Chromium (Cr)	0.0099
9	Nickel (Ni)	< 0.0010
10	Iron (Fe)	0.112

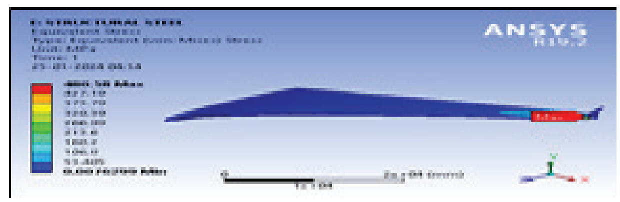


Fig. 9: Equivalent Stress

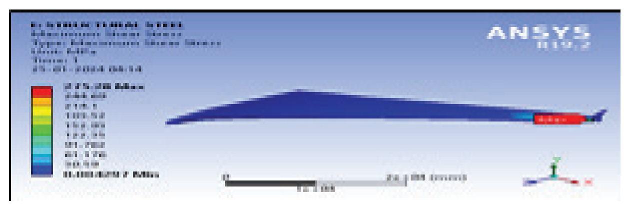


Fig. 10: Maximum Shear Stress

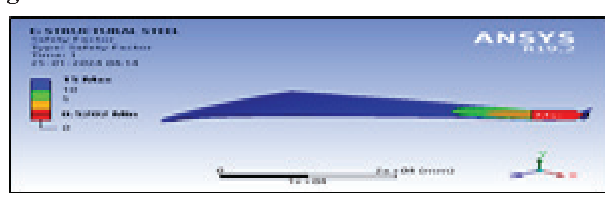


Fig. 11: Safety Factor

Aluminum Alloys 3003 Results

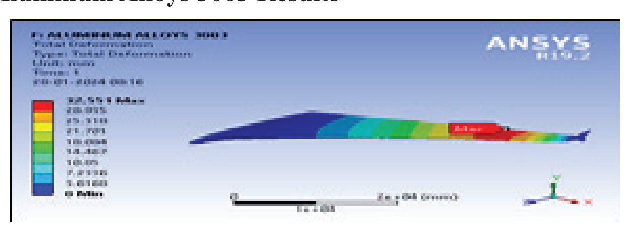


Fig. 12: Total Deformation

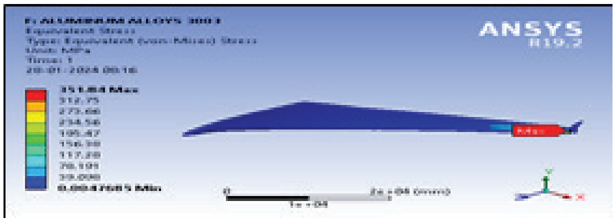


Fig. 13: Equivalent stress

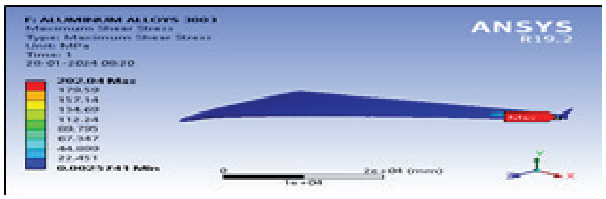


Fig. 14: Maximum Shear Stress

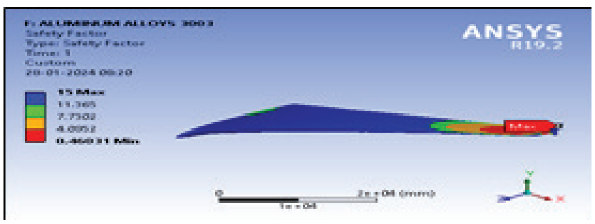


Fig. 15: Safety Factor

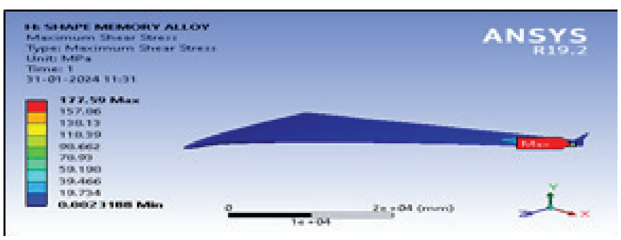


Fig. 16: Maximum Shear Stress

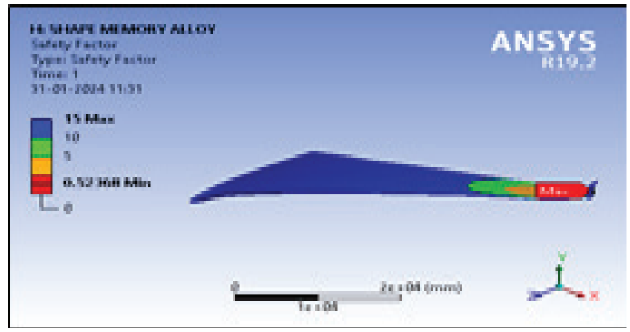


Fig. 16: Safety Factor

The graphical representation illustrates the changes in equivalent von- Mises Stresses, total deformation caused by stresses, temperature distribution, total heat flux counters within the A380 wing for carbon fiber, Structural steel, aluminum alloys, titanium and shape memory alloys.

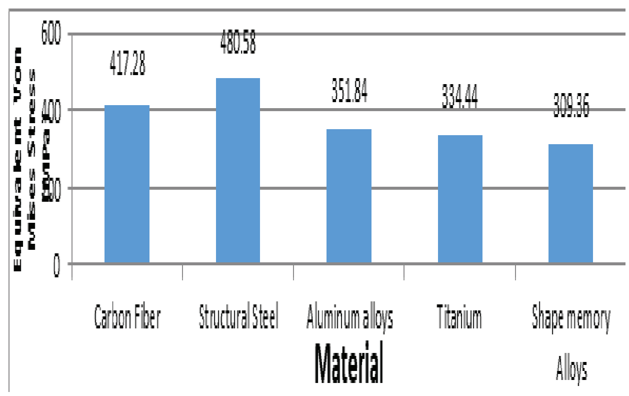


Fig. 29: Comparison of the equivalent von-Mises Stresses

CONCLUSION

Table 6: Overall Results

SR. No.	Material used for Analysis	Equivalent von-Mises Stresses (MPa)	Deformation (mm)	Maximum Shear Stress (MPa)	**Safety Factor**	
					Min	Max
1	Carbon Fiber	417.28	37.59	239.85	7.4291	15
2	Structural Steel	480.58	47.09	275.28	0.52	15
3	Aluminum alloys	351.84	32.55	202.04	0.46	15
4	Titanium	334.44	32.15	191.73	2.48	15
5	Shape Memory Alloys	309.36	28.82	177.59	0.52	15

Design and comparison is done for different materials for Airbus A380 Wing body using Finite Element Method. From Fig. 29, it is observed that in shape memory alloy equivalent von-Mises stresses are less compared to other material. From Fig. 30 deformation in shape memory alloy and deformation in all other four compositions have very small difference hence

To summarize, the steady state thermal and static structure simulations have successfully replicated the structural behavior of a wing. It is observed that the Shape Memory Alloy exhibits lower stresses and deformation compared to other materials. Additionally, the availability of Shape Memory Alloys in Indian market is evident from the provided table. The validation of results using ANSYS, based on previous studies, is selected compositions are suitable for the study. In fig, maximum shear stress in shape memory alloy is less as compared to other material considered reliable as the percentage error falls within an acceptable range.

Table 7: Cost

	Material used for Analysis	Availability	Cost in Rs.
1	Carbon Fiber	Some difficult	900/ Kg
2	Structural Steel	Easy	80/ Kg
3	Aluminum alloys	Some difficult	350 / Kg
4	Titanium	Easy	5500/ Kg
5	Shape Memory Alloys	Easy	2000/ Kg

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Design and Optimization of Hybrid Power Generator using Darries and Savonius Wind Turbine

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ABSTRACT

Emission from burning fossil fuels leads to global warming and many environmental issues. Considering the effects of emissions, the main concern is to work on alternative energy sources. Wind turbines are one of the fastest growing sources of electricity generation. Wind turbines are classified based on the axis of rotation as Vertical Axis Wind Turbines (VAWT) and Horizontal Axis Wind Turbines (HAWT). VAWT is easy to manufacture and can work at low speed. Therefore, it is the most popular type of wind turbine for small amounts of energy generation in urban areas. In this paper the design of blades for combination of darrieus and savonius has been studied for the urban and metro cities. The blades have been tested for different terrains and at different times to check the output with the help of wind and solar panels.

KEYWORDS: *Renewable energy, Vertical Axis Wind Turbine (VAWT), Solar energy, Darrieus and savonius type blades, Hybrid system.*

INTRODUCTION

Nuclear fusion processes are the source of the sun's energy production. A significant amount of energy is released during this fusion and travels as radiation to the surface of the planet. Throughout the year, there is no shortage of alternative energy on the world. There is no shortage of alternative energy. This clean, low-cost energy is available on the market. The technology is appropriate for the hybrid power generation system due to its great efficiency and incredibly low maintenance costs. It only has issues during certain times of year or in overcast conditions. [5]. Due to growing environmental pollution, rising energy consumption, and decreasing fuel supplies, the primary focus on renewable energy resources has expanded dramatically in recent years. Wind, hydroelectric power, geothermal energy, biomass, and solar energy are some examples of renewable energy sources. Since wind is one of these resources that is less expensive than the others, a lot of research is being done to improve the technology for producing electricity using wind power [2]. One of the renewable energy sources that is developing the fastest is wind power, with a 487 GW peak capacity roughly 4% of the world's electricity produced [1]. To increase the penetration of alternative energy technology in cities and semi-urban areas, the event of an efficient turbine (WT) and resource evaluation methods are essential [3]. In the field of wind technology, Vishal D. Dhareppagol et al proposed a new turbine model that uses maglev to reduce the inner friction of the rotor. This model is considered revolutionary as it produces 20% more energy than a standard turbine while also reducing operating costs by 50%. It is decided to use this model is intended to demonstrate its superiority over a standard horizontal axis turbine in terms of efficiency in a range of wind conditions and to further its steady ascent toward widespread adoption as a dependable source of power generation in the near future [10].When the principles are examined more closely, it becomes clear that VAWTs can produce electricity in situations where typical HAWTs cannot be due to factors like turbulent wind flows and high air current velocities. The fact that VAWTs have no yawing mechanism and can accept wind from any direction is another significant benefit [4]. It is anticipated that the Maglev turbine, which made its debut at the wind generation Asia exposition in Beijing, will advance alternative energy technology to a new frontier incorporating maglev (Maglev) into a turbine system to boost its effectiveness. Increasing a turbine's efficiency will result in more power being produced, which will reduce the need for costly, polluting power generators [11]. The railroading turbine's damping is minimized by the features of the maglev turbine, which include minimal mechanical contact, friction, etc., allowing the turbine to start with low wind and run on breeze [12]. Hybrid solar-wind systems offer many benefits. Reliability is one advantage. Combining solar and alternate energy generation resources improves system reliability, which in turn improves system energy service. This implies that if one type of energy were to disappear, another would be able to continue providing the service. Additional benefits include stability and less maintenance needs, which minimize downtime during repairs or regular maintenance [7]. Typically, small wind turbines are chosen for on-site use. Their maximum power output is 100 kW, and they are typically situated in isolated, rural, and off-grid locations without access to the national grid [8].

CRITICAL PARAMETERS

Wind speed: a windmill's output may be significantly impacted by this. The wind is the only source of power for the turbine. The generator's shaft brushes past the magnetic coils because of the wind rotating the axis, which might be horizontal or vertical, producing an electrical current.

Blade Length: Given that the blade's length and the swept area are directly related, this could be significant. With each revolution, larger blades catch more wind because they have a larger swept area. They will have even greater torque as a result.

Base Height: The windmill's underside height has a significant impact. Because the wind speed increases with altitude, a windmill's productivity will grow with its height.

Fundamental Design There are stronger bases than others. The base plays a crucial role in the construction of the windmill since, in addition to supporting the machine, it must also withstand the force of the wind and its own weight. A weak tower will undoubtedly fall if it is exposed to those factors. Therefore, to ensure an accurate comparison, the undersides must be equal.

Aerofoil-style blades are used in wind turbines. Understanding the weight and worth of blades is essential when developing a blade's scale. A vertical shaft with a height and diameter of 6000mm and 19.75mm, respectively, has been employed in the four-blade type.

PROCEDURE

Problem Identification

- Conventional power hack saw machine used for cutting low-carbon steel rods.
- The time required for each cut ranges from 15 to 20 minutes.
- Workmen handle the material transportation of stock jobs.
- The entire process is manually operated.

Mechanical Component Design: This stage involves the design of various components such as shafts and gears with the help of SolidWorks software for better visualization of concept and to simulate it.

Design Evaluation: Simulation of components performed to check the material strength to select suitable material. Manual drawings are created for fabrication purposes, including dimension selection.

Fabrication: All designed elements, including the frame and shaft, are manufactured within the workshop.

Parts such as support rods are also selected according to specifications and fabricated on-site.

Assembly: All manufactured and selected parts are assembled together.

Testing: The prototype has to test in different terrain and at different conditions to get the results. The terrain selected are one the hills, beside the highway and in normal urban area. It has to test in different timing to check the output of wind energy and intensity of solar radiations.

DESIGN OF MAGLEV TURBINE

1. The First Law of Faraday's Electromagnetic Induction is used which states that whenever a conductor is placed in a varying magnetic field emf is induced which is called induced emf, if the conductor circuits are closed current are also induced which is called induced current.
2. Utilising a system of neodymium and copper coils, magnets are fixed to the turbine base, and the coils on the turbine's stable plate begin to generate electricity.
3. In order to use this power again, it is stored it in the battery.
4. Using solar panels to form the proper trapezium shape above the wind turbine

Total weight of turbine with magnet= 1.3 kg

The plate diameter = 30 cm.

According to the magnet weight capacity, Ring magnet Grade: N52

Gap between two magnets = 25 mm.

The of 25 mm has taken as coil height is of 20 mm.

The approximate weight capacity of Ring magnet = 1.5 kg

The Fig. 1 illustrates Ring Magnet and the assembly position of it.

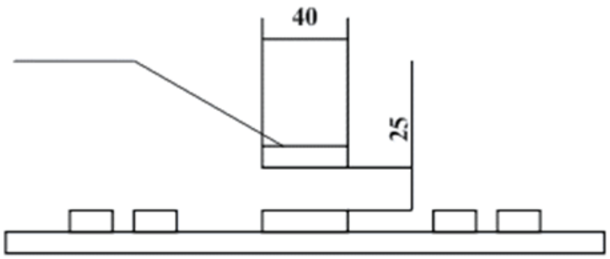

Fig. 1: Ring Magnet

The extra weight considered while designing as an element of safety (FOS), so while rotating the turbine it could be possible, because of vibrations, it moves up and down the side.

If an bigger size of plate diameter selected, weight will increase and magnet won't maintain the space, hence, design is safe with plate diameter 30 cm.

Disc magnet is selected for this operation.

Current weight of disc magnet= 0.02 kg

Current weight of ring magnet= 0.07 kg

In this prototype 8-disc magnets used so total weight of magnets = 0.16 kg

If increase this weight turbine weight will increase which isn't acceptable.

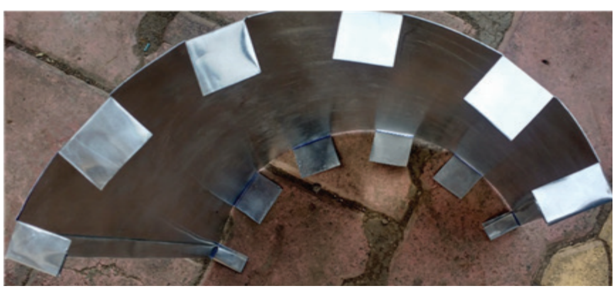

Fig. 2 - J TYPE Blade profile

Area Of Turbine

Surface area = $2\pi r2 + 2\pi rh$

= 2 × 3.14 × 225 + 2 × 3.14 × 15 × 50

= 1413 + 4,710

= 6,123 cm2

Volume Of Turbine

There is a special formula for locating the degree of a cylinder. the degree is what proportion space takes up the within of a cylinder. the solution to a volume question is often in cubic units.

Volume = $\pi r2h$

= 3.14 × 225 × 50 = 35,325 cm3

Voltage Calculations:

1. From wind turbine:

V= 15 volt

I= 1 amp

V = I × R I= VR R= VI

V= Volts I= Current in Amperes R= Resistance in ohms

R = 15/1

R = 15 Ohms

Power = V × I

Power = 15 x 1

Power from turbine = 15 watts

2. From Wind Solar Panels:

V= 20 volt

I= 1.5 amp

V = I × R I= VR R= VI

V= Volts I= Current in Amperes R= Resistance in ohms

R = 201.5

R = 13.33 Ohms

Power = V × I

Power = 20 x 1.5

Power from turbine = 30 watts

Total watts by combining solar and turbine in parallel = 30 watt + 15 watt = 45 watts.

Fig. 3 illustrates, two stage model of wind turbine with air flow direction.

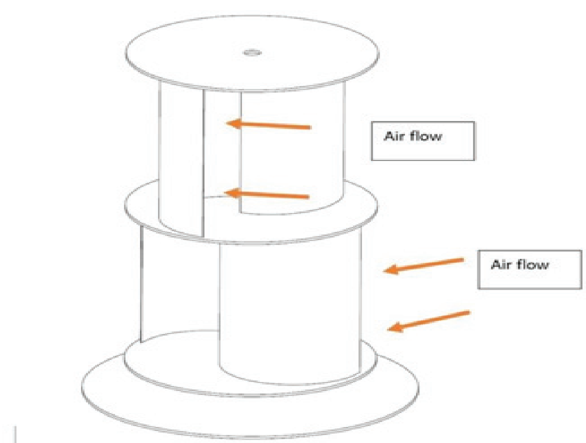

Fig 3: Model of wind turbine

FABRICATED MODEL

The Fig. 4, Illustrates Fabricated Model of Optimized hybrid Power Generator. The material used is galvanised steel for the turbine blades and MS for the frame.

Fig. 4: Fabricated Model of wind turbine

RESULT

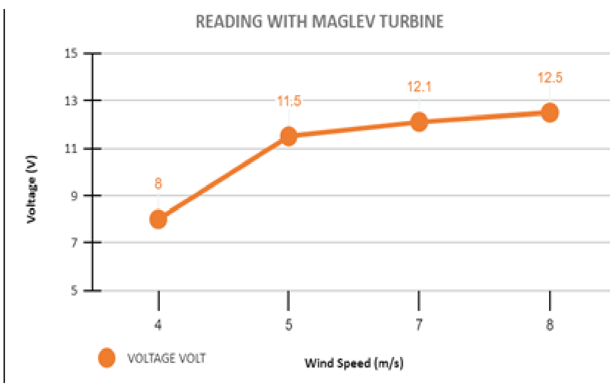

Fig. 5: Wind speed vs Voltage generation

Fig. 5 depicts the relationship between wind speed and voltage generated from a hybrid energy generator. As wind speed increases, the voltage generated also increases. This is a typical behaviour for wind turbines, as higher wind speeds provide more kinetic energy for the turbine blades to capture and convert into electrical energy. The graph indicates that the initial voltage can be generated at a wind speed of 4 m/s. This suggests that the wind turbine begins generating electricity at this minimum threshold speed. The highest voltage is generated at a wind speed of 8 m/s. This implies that the wind turbine operates most efficiently at this wind speed, likely due to the optimal balance between blade rotation speed and available wind energy.

Understanding these relationships is crucial for optimizing the performance and efficiency of wind energy systems, as it allows engineers to design turbines that can effectively harness the available wind resources.

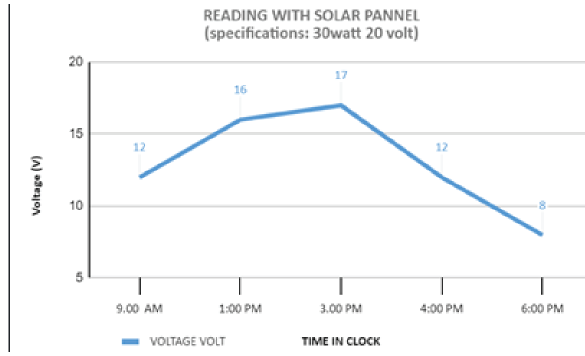

Fig. 6: Time in clock vs Voltage generated by solar panel.

Fig. 6 shows the variation of voltage generated by a Hybrid energy generator over the course of a day, likely influenced by intensity of solar energy. The voltage starts at around 12 volts at 9:00 AM. This suggests that there is some baseline voltage being generated, possibly due to ambient light or other factors. The voltage reaches its maximum value between 1:00 PM to 3:00 PM in the afternoon. This peak corresponds to the period when the sun is at its highest point in the sky, resulting in maximum solar radiation and thus maximum energy generation by the solar panels or other solar-powered devices. After 3:00 PM, the voltage starts to decrease. This decline is likely due to the diminishing intensity of sunlight as the sun begins to set. The best voltage produced by a Hybrid energy generator is observed during the afternoon period from 1:00 PM to 3:00 PM. This is the time when the device operates most efficiently and generates the highest amount of electrical energy from the available sunlight. Understanding these patterns in voltage generation throughout the day is important for optimizing the performance of solar energy systems and for planning energy usage or storage accordingly.

CONCLUSION

Indeed, both wind turbine and solar radiation energy conversion systems hold significant promise for generating renewable electricity, even in less-than- ideal conditions. Their potential contributions are multifaceted and extend to various socio-economic contexts. Wind turbines can harness wind energy and convert it

into electricity, making them viable in various locations. While ideal conditions involve consistent and strong winds, advancements in turbine technology have made them adaptable to a range of environments. Additionally, in less developed Solar energy conversion systems utilize photovoltaic panels to capture sunlight and convert it into electricity. The utilization of high-strength, low-weight materials and adaptation to local conditions enhance the feasibility and impact of wind turbines and solar energy conversion systems, paving the way for a more sustainable and resilient energy future globally.

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Design and Fabrication of Plastic Recycling Machine and Testing of Its Products

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ABSTRACT

Plastic products are much more convenient to human beings instead of having much environmental and health concerns. The study of literature review summarizes various types of recycling techniques implemented and their advantages, and improvements in the existing technologies. A Small attempt is made to recycle the plastic with the help of a recycling unit. The plastic recycling unit contains a cylindrical shell in which the waste plastic is collected. From the bottom of the shell, a heater or burner will be provided to melt the plastic, at the end of the process, output in the form of molten material will be poured into the mold box which is similar in shape to a block or brick. The block of strength will be tested after cooling. Various factors can be considered to prove its benefits over the conventional one such as Compression test, water absorption test, weight, life span are discussed in the paper. In this work, the outcomes of the compression test, Water Absorption Test and the comparison with the usual method are also discussed.

KEYWORDS: *Plastic waste, Plastic recycled paver block, Conventional brick, Compression test.*

INTRODUCTION

The world is incomplete without plastic. Today plastic has become an integral part of everyone's lifestyle. Plastic can take many years to decompose. Rapid increment in the global plastic production came into picture from 1950 onwards, For the last 70 years, yearly production of plastic is increased in between 200-fold to 381 million tons. Plastic is composed of majorly toxic pollutants which create adverse effect on the environment, plants, wildlife, and human beings. Waste plastic has become a significant problem worldwide, and proper disposal of it is a challenging task. Only 9.1% of plastic is recycled out of total plastic production. There is a need for different strategies and equipment to tackle this problem. The day starts with brushing the teeth with plastic toothbrushes, having yearly production of plastic is increased in between 200-fold to 381 million tons. Plastic is composed of majorly toxic pollutants which create adverse effect Based on study out of different types of plastics which is discussed here, research focus more on thermoplastics.

Classification of Plastic

1. Thermoplastics

2. Thermosetting

Types of thermoplastics

1. Polyethylene Terephthalate (PET), 2. High-Density Polyethylene (HDPE), 3. Polyvinyl Chloride (PVC), 4. Low-Density Polyethylene (LDPE) 5. Polypropylene (PP)

LITERATURE REVIEW

Processing Methods

The previous research on plastic processing methods has been discussed. Plastic Manufacturing industries were finding it difficult to produce good quality products out of plastic. An injection molding machine solves this problem. Poonam G. Shukla in the year 2008 stated the development of an injection molding machine, as similar to the use of syringe for injection. Molten plastic is introduced into the closed cavity with the application of plunger thrust. After some curing and setting process, final product is obtained [1].Since injection molding machines are too costly for small- scale and medium-scale industries; in June 2019 Yosi Agustina Hidayat mentioned economical and efficient processing as well as recycling methods of plastics. Plastic could be reduced by various techniques like reducing, landfills, incineration, recycling, and reuse. Viable option is achieved using Analytic Hierarchy Process (AHP) method which is reliant on the simplicity of execution, impactfulness, operational costs, and detrimental consequences that it generates. Based on these factors, recycle is the most feasible system to execute [2].

Technologies

This parameter indicates various technologies and types of machinery used in the past to recycle plastic. Generally, plastic recycling technologies involves processes such as sorting, cleaning, washing, shredding and then processing of plastic is done. Processing includes extrusion process, pyrolysis process, or simply heating or melting to obtain desired output. Out of these procedures, shredding and extrusion stages involves machinery. In September 2010 Briggs M. Oguned stated the design parameters of the shredding machine. Here mild steel is preferred for the hopper and shredding chamber with an AC motor of 5 Hp. After calculating all the parameters it has been concluded that MTC (Material Test Report or Certificate) is affected after the increase in mass at 150Kg, efficiency is increasing and up to 300Kg, it is decreasing. Th average efficiency of the machine is found to be 97% [3].

Materials Used

B. Shanmugavalli in the year 2017 stated the use of different materials for the recycling of plastic waste. LDPE plastics, quarry dust, coarse aggregates, and ceramic waste have been used in the mixture. The mixture is specifically of 50 microns plastic bags along with the crushed sand less than 4.75mm thickness and coarse aggregate passing through a 12mm sieve and ceramic waste of specific composition [7]. Also Ch Sravan Kumar Reddy studied the use of LDPE poly bags and aggregate which is nothing but a crushed stone or natural sand which can pass through a sieve of 4.25mm sieve for the making of paver blocks in the year 2019[9]. R. S. Kognole concluded in the year 2019 that water absorption of plastics sand bricks is 0% and hence it can be used for construction, so there are different materials used for plastic bricks, polythene, high-density polymer, PET, plastic waste, and river sand concluded that plastic sand bricks give an alternate option of bricks to the customer at affordable rates[6].

Temperature Range

According to M. Suriyaa (2016), the topic of this research study is the use of recycled plastic in the production of bricks. The materials were mainly recycled plastic PET bottles, carry bags, HDPE, and LDPE. They were gathered, chopped, and then melted at a temperature between 90 and 110 degrees Celsius to form a liquid state. The sieved sand of 600 microns was added to liquid plastic and stirred continuously, the hot mixture is poured into a mold for 24 hours after getting drying, to check its properties several tests were conducted, they are compressive test, and water absorption test, and hardness test[5].

Ratios / Compositions / Proportion and the Final Quality

B. Shanmugavali concluded the results of the following experiments of the different mixture as shown in Table1. [7].

Table 1. Three Mixtures with the composition of the products

Composition/Ratios	Mix A	Mix B	Mix C
Plastic	1	1	1
Quarry Dust	0.75	1.5	1.5
Aggregate	0.75	2	2
CeramicWaste	0	0.75	0

of aggregate and (1:2) i.e. 1Kg of plastic and 2Kg of aggregate gives perfect bricks of enough good strength. [9]. S. S. Chauhan mentioned the best proportions which gives desired results shown in the Table 2 below[7].

Table 2. Mixture Proportions

Mixing Ratio	1:2	1:3	1:4

PLASTIC WASTE RECYCLING UNIT

In the Plastic Waste Unit, the shredded Waste is placed into the heating chamber. The heating chamber contains all the mixture including plastic waste and aggregates. The whole mixture is to be heated in the chamber at the desired temperature of around 180-250˚C. The chamber is provided with stirrer to make the mixture properly mix with each other. The stirrer will mix the plastic properly with the other aggregates like sand, quarry dust, etc. It will rotate inside the chamber to bind the mixture. The heating chamber will be closed by placing the top flange at the top surface of the heating chamber. Top flange will be fixed into the chamber with help of the nut and bolts. Also there is temperature gauge provided on the surface of the chamber.

DESIGN AND CALCULATIONS

The Fig.1 represents the cad model of plastic recycling unit for making the plastic recycled blocks, the cad model is made with the help of the solid works software.

Material Selection

Mostly Mild steel is preferred for constructions and fabrications in most of the industries. Mild steel contains a small percentage of carbon, that's why it is also called as low carbon steel or sometimes plain carbon steel. Carbon Content: 0.2% - 0.3% Manganese: 0.3% - 0.6%

Properties

Tensile Strength: 440 N/mm^2 Density: 7850 Kg/ m^3,Young's Modulus: 200*10^3 N/mm^2 Hardness: 70 HRB,Stresses acting on the shell:,Circumference or Hoop Stress,Longitudinal Stress

The required operating temperature for whole process is 450˚C maximum. For C45,

$\therefore \sigma ut = 320 N/mm^2$

$\therefore$ FOS = 4

$\therefore \sigma t = \sigma ut$ / FOS

$\therefore \sigma t = 320/4 = 80 N/mm^2$

$\therefore \tau = \sigma t /2 = 80/2 = 40 N/mm^2$

In general, corrosion allowances will range from 1.5- 5 mm. Hence adding corrosion allowance of 3 mm to the thickness to avoid corrosion on the walls of shell.

$\therefore$ t =0.5626 mm + 3 mm = 3.5626 mm.

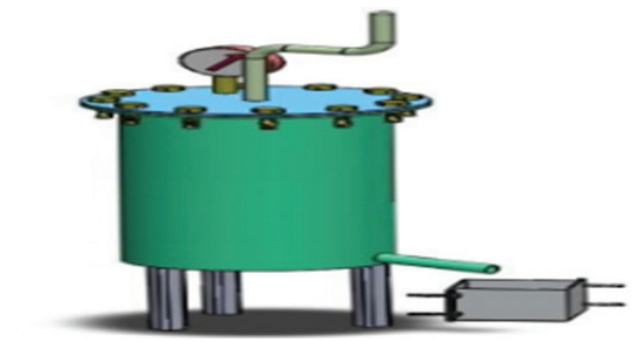

Fig. 1: Cad model of plastic recycling unit

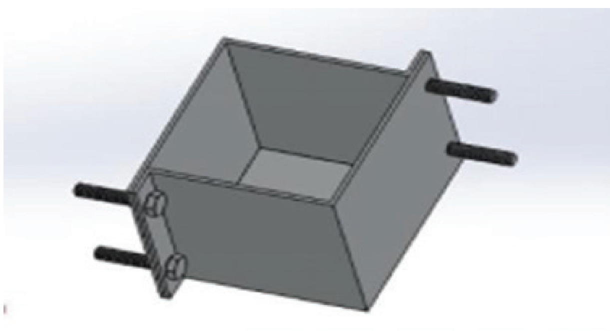

Fig. 2: Cad model of mold box

Figure 2 represents the cad model of mold box, the output in the form of molten plastic will be poured in mold box, the cad model is made with the help of the solid works software.

Dimensions of Mould Box – Length = 75mm, Height = 75mm, Breadth=75mm , Thickness = 2mm

EXPERIMENT

Apparatus required: Thin Shell, Stirrer, Heater, Mold box, valve. The plastic waste is heated in temperature of then melting point nearly around 150- 250 °C. Waste is uniformly mixed and with help of the heater or burner required temperature will be provided from bottom of unit. The final output in the form of molten plastic will be collected in the mold box, allowed to cool for around 20-24 hrs,

Types of plastics used

Polypropylene, Acrylonitrile Butadiene Styrene (ABS), Low Density Polyethylene (LDPE).

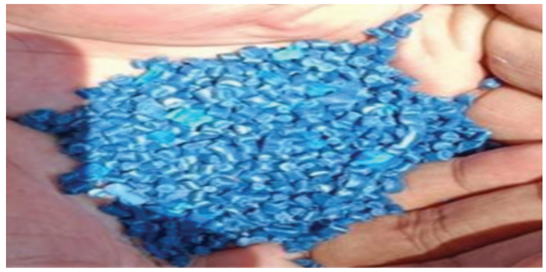

Fig. 3: Plastic used during experimentation

Fig. 4: Actual Plastic recycling unit

Figure 3 shows the picture of plastic i.e. ABS, LDPE which we used during experimentation.

Experiment Setup

The actual plastic recycling equipment, shown in Figure , is utilized in experiments to create recycled plastic blocks.

Molten plastic into the cavity

Fig. 5: Actual Mold box

Fig. 6: Molten plastic poured into the mold box

Figure 5 shows the picture of actual mold box, the output in the form of molten plastic will be poured in this mold box. Figure 6 shows the picture of the output which is in the form of molten plastic poured into the mold box.

Results Obtained

Fig. 7: Block 1

Fig. 8: Block 2

Figure 7 shows the picture of Block no. 1, which is obtained after the cooling of that molten plastic which is poured into the mold box at atmospheric temperature. Figure 8 shows the picture of block no. 2, which is having a Better shape and strength.

Testing of Result

After obtaining the result, the testing of the results are carried out such as compression testing and water absorption .Weight of the block formed after processing is around 506 grams. Whereas weight of conventional one is 2.9 kg.

Fig. 9: Weight of conventional clay brick

Specifications

Table 3,4 & 5 provide the Specifications & Compression test results of Block 1 and Block 2 with all dimensions.

Table 3. Specifications of Block 1 and Block 2

Dimensions	Length	Breadth	Height	Volume	Area
Block 1	73 mm	93 mm	72 mm	488800 mm^3	6789 mm^2
Block 2	90 mm	77 mm	72 mm	498960 mm^3	6930 mm^2

Table 4. Compression test results of Block 1

Serial No.	Load (N)	Compressive Strength (N/mm^2)
1	30×10^3	4.41
2	40×10^3	5.89
3	50×10^3	7.36

Table 5. Compression test results of Block 1

Serial No.	Load (N)	Compressive Strength (N/mm^2)
1	30×10^3	4.32
2	40×10^3	5.77
3	50×10^3	7.21

Table 6 represents Comparative Study between Plastic Brick and Conventional Brick based on load capacity, strength , weight and water Absorption test.

Table 6. Comparative study between Conventional brick and plastic brick [17]

Comparison	Conventional Brick	Plastic Brick
Load Carrying Capacity	35×10^3 (N)	50×103 (N)
Strength	3.5 to 5 (N/mm^2)	7.21 to 7.36 (N/mm^2)

Weight	2.9 kg	0.504 kg
Water Absorption Test	3.8%	0%

CONCLUSION

Plastic's non-biodegradable nature raises global concerns. The objective of the study is to reduce the plastic waste as much as possible and create the sustainable building material for the betterment of the society. Plastic waste is processed in a simple unit which changed its phase from solid to liquid and then again to solid which in the form of plastic recycled brick. Use of plastics having low melting point and suitable properties made the process easier. The plastic brick has been tested under the compression testing machine and Water Absorption Test and it has been found that it is giving the better strength than that of conventional bricks. Durability, cost effectiveness, light weight and longer lifespan are the pros over conventional brick. This kind of recycled bricks can be utilized to avoid unnecessary heat loss which subsequently lead to energy conservation. Plastic recycled bricks can be useful in the construction of footpaths, garden beds and in the garden for making of benches.

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A Review on - Implementation Barriers for BIM in Indian Construction Sector

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ABSTRACT

Approximately 70% of construction professionals in India have either adopted BIM or are in the process of doing so, according to a survey undertaken by the National Institute of Construction Management and Research (NICMAR). In the worldwide industry of construction, building information modeling (BIM) is now a game-changer, providing a host of opportunities for cost optimization, collaboration, and project efficiency. However, several of implementation problems have prevented its widespread acceptance in the Indian construction industry. This review study seeks to identify and examine the main obstacles to the successful use of BIM in India, such as regulatory limits, labour shortages, refusal to change, modern technology limitations, and issues with interoperability. By synthesizing existing literature and case studies, this paper provides insights into the complex landscape of BIM adoption in India, highlighting the need for strategic interventions and industry-wide initiatives to overcome these barriers.

In conclusion, while the adoption of Building Information Modeling (BIM) in the Indian construction sector presents immense potential for enhancing project outcomes and driving industry innovation, several significant barriers must be addressed. From addressing technological gaps and investing in workforce development to fostering a culture of collaboration and addressing regulatory complexities, concerted efforts are required from stakeholders across the construction ecosystem. Overcoming these implementation barriers will not only unlock the full benefits of BIM but also contribute to the overall growth and sustainability of India's construction industry in the digital era.

KEYWORDS: *Building Information Modeling (BIM), Indian construction sector, Technological limitations, Interoperability issues, Regulatory constraints, Industry-wide initiatives, Collaboration, Cost-optimization.*

INTRODUCTION

The Building Information Modeling (BIM) has gained evidentiary traction in the Indian construction industry as a powerful tool for efficient project management and collaboration. BIM involves creating digital visualizasion of physical and functional characteristics of a building, allowing stakeholders to visualize the entire construction process before actual implementation. In India, BIM adoption has increased due to several factors, including government mandates, technological advancements, and a shift towards sustainable construction practices.

One of the driving forces behind the adoption of Building Information modeling (BIM) in India is the government's emphasis on infrastructure development and digital transformation in the construction sector. Initiatives like the Digital India campaign and the Smart Cities Mission have encouraged construction companies to embrace BIM technologies for better project outcomes. Government bodies such as the National BIM Committee of India (NBCI) have also been instrumental in promoting BIM standards and best practices across the industry, further fueling its adoption.

Additionally, advancements in software tools and cloud-based platforms have made BIM more accessible and user-friendly for Indian construction firms of all sizes. From architectural design and structural analysis to project scheduling and cost estimation, BIM offers a comprehensive suite of tools that streamline work flows, improve collaboration among stakeholders, and enhance overall project efficiency. As a result, an increasing number of construction projects in India are leveraging BIM to optimize processes and deliver higher-quality buildings within budget and timeline constraints.

BENEFITS FOR THE INDIAN CONSTRUCTION INDUSTRY

The adoption of building implementation modeling, particularly BIM, brings several benefits to the Indian construction industry. One of the primary advantages is improved project coordination and communication among project teams, including architects, engineers, contractors, and clients. BIM enables real-time collaboration and data sharing, reducing errors, conflicts, and delays during the construction phase. This leads to smoother project execution, better decision-making, and ultimately, higher project success rates.

Cost efficiency is another significant benefit of building implementation modeling in India. By simulating construction processes and identifying potential clashes or inefficiencies early in the design stage, BIM helps optimize resource allocation, minimize material wastage, and reduce rework costs. This is particularly beneficial in a market like India, where cost control and budget management are crucial factors for construction companies to remain competitive and profitable.

Moreover, building implementation modeling enhances project transparency and accountability, which are essential in the context of regulatory compliance and quality assurance. BIM facilitates accurate documentation, tracking of project milestones, and performance monitoring, ensuring that construction projects meet regulatory standards and client expectations. This transparency builds trust among stakeholders and enhances the overall reputation of the Indian construction industry in terms of delivering high-quality, sustainable, and compliant buildings.

FUTURE POTENTIAL OF BUILDING IMPLEMENTATION MODELING

Looking ahead, building implementation modeling is poised to play an even more significant role in shaping the future of the Indian construction industry. With rapid urbanization, infrastructure expansion, and the growing demand for sustainable buildings, BIM will continue to evolve as a fundamental tool for project planning, design optimization, and life cycle management. As technologies such as artificial intelligence (AI), Internet of Things (IoT), and augmented reality (AR) become integrated with BIM platforms, the industry can expect enhanced functionalities and innovative solutions for complex construction challenges.

CURRENT GLOBAL SCENARIO

In this review , the global context about problems in implementation of BIM in construction industry is studies as the India can be considered as a one of the leading country in construction industry.

For 4D BIM modeling P. Farnood Ahmadi[3] concluded that the popularity of project management and Building Information Modelling have led to improvements in architectural and structural design and construction techniques and facility operations. As a result, new applications, such as 4D simulations and project scheduling, emerge and evolve: 4D-BIM scheduling is an essential component of this approach using BIM standards. Furthermore, the integration of BIM technology within the early design phase may significantly limit poor building quality and planning inefficiency. Therefore, the present paper goals and objectives within the context of the advantages, risks opportunities and dangers Brad field , in addition to the need for utilizing 4D information models within construction projects.[3,8] Managerial and technical issues were studied which can be the barriers in implementation of 4D BIM. The increasing demand for custom-made prefabricated buildings poses challenges due to unique client needs, tight deadlines, and shared resources across projects. This study suggests using Lean Production Philosophy and Building Information Modeling (BIM) together to tackle these complexities. By combining Lean principles' efficiency with BIM's detailed 4D modeling, logistics management in Engineer-to-Order (ETO) prefabricated building projects can be improved. The research develops a logistics planning model using BIM 4D, enhancing understanding of how Lean and BIM can work together in site logistics. Practical insights are provided for logistics planning and control using BIM, aligned with the Last Planner System. The study used design science research and tested the model in a steel fabricator company. In essence, this research shows how integrating Lean and BIM can streamline logistics in ETO prefabricated building projects, benefiting cost, time, and safety goals.[1,7]

INDIAN SCENARIO

Ritu Ahuja et.al.(2016) Summarized, construction sector has embraced ideas like lean and green initiatives on its own, driven by a range of internal and external factors. Substantial coordination have been documented among these frameworks. It is anticipated that these paradigms might provide further advantages for building projects if they are combined and utilized. Furthermore, this study suggests and recognizes Building Information Modelling (BIM) as a tool that helps to achieve lean and environmentally friendly project outcomes. The study asserts that, when applied to construction projects, the causal combinations of four BIM capabilities—MEP energy and environment analysis, constructability analysis, structural analysis, and structural analysis—can result in sustainable building methods. It does this by using the crisp set qualitative comparative analysis method to examine the causal combinations of various BIM capabilities.[1,2] BIM is now a days can be used in safety engineering in India [9] In point of Risk management , Risk assessment in construction involves using various mathematical models, from quantitative to fuzzy methods, to identify and manage risks. Techniques like Monte Carlo simulation and sense analysis are crucial but require skillfulness. Combining quantitative and qualitative methods in teaching enhances risk assessment. Researchers explore methods like AHP and fuzzy logic to incorporate uncertainty into assessments. There's no one-size-fits-all approach; the method chosen should match organizational capabilities and team skills. Risk assessment aids decision-making, resource allocation, and risk mitigation in construction. Continued research will refine these methods, benefiting the industry overall[8], also The Indian construction industry faces challenges in adopting BIM, leading to low maturity levels in its use. This study focuses on understanding and developing BIM capabilities within organizations. Through Interpretive Structure Modeling, it identifies key BIM capabilities like visualization, energy analysis, and structural modeling, providing a roadmap for effective BIM implementation and improved project delivery[1,2]. The construction industry is inclined to accidents due to multitasking and lacking safety planning, impacting productivity. This study assesses BIM awareness, benefits, and barriers in Indian construction, highlighting BIM's potential for safety management. A survey of 171 professionals suggests the need for improved BIM awareness, education, and training for optimal implementation and benefits realization[9]

CONCLUSION

In summary, the adoption of Building Information Modeling (BIM) in the Indian construction sector has great potential, but there are significant barriers that need to be addressed. Efforts are needed to bridge technological gaps, invest in workforce development, proper and systematic collaboration, and address regulatory difficulties. Overcoming these barriers will unlock the benefits of BIM and contribute to the growth and sustainability of India's construction industry. Furthermore, the digital twin concept, which involves creating virtual replicas of physical assets using BIM data, holds immense potential for asset management, maintenance optimization, and performance monitoring in India's built environment. By harnessing data analytic and predictive modeling through digital twins, construction companies can improve operational efficiency, reduce downtime, and enhance sustainability practices. This holistic approach to building implementation modeling aligns with India's vision of smart cities, green buildings, and infrastructure resilience, driving continued adoption and innovation in the years to come.

A summarized list of BIM advantages in Indian Construction industry

Sr No	Advantages in Indian Construction Sector	Source in literature
1	Lean and green outcomes on construction projects.	[1,7]
2	Reduce coordination risks	[1,4,8]
3	Increase Speed in prefabrication	[2,14]
4	Can reduce Accidents	[5,6,9]
5	Visualization	[4,2,6]

A summarized list of BIM implementation limitations in Indian Construction industry

Sr No	BIM implementation limitations in Indian Construction Sector	Source in literature
1	Poor implementation practices	[1,9,14]
2	Low productivity	[1,2,14]
3	Less Awareness in Indian sector	[2,5,6,7,8,9]
4	Data Management	{5,6,9]

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RCC Beams Wrapped with Polymer based Fiber Jacketing Subjected to Pure Torsional Load: A Review

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ABSTRACT

Concepts of material mechanics can be used to study and design all of these actions: the fundamental law between concrete and steel, the stress equilibrium condition, and the strain compatibility condition. Torsion is the term for the rotational moment that results from the application of an eccentric load or force to a structural part other than a bending plane. Additionally, architects and designers created innovative structures with aesthetically pleasing overhanging parts that are prone to torsion. It is well known that, after steel, concrete is the second most commonly used construction material during both infrastructural and industrial development. Although concrete is homogeneous and strong enough to withstand compression, its tensile strength makes it brittle. For enhancement of ductility effect in the concrete body, the retrofitting technique is one of the best solutions. Such techniques also provide improvements in the durability, strength, etc. of existing structures or earthquake-affected structures. The retrofitting method is particularly appropriate for repairing work. Polymer fiber materials have been used for the required structures' retrofitting for over thirty years. Fiber jackets made of polymers include CFRP, GFRP, FRP, aramid, and others. Any of the jacketing listed above can be used for execution work, depending on factors including cost, quantity needed, appropriateness, and availability.

KEYWORDS: *Rotational moment, Brittle type material, Retrofitting technique, Polymer based fiber jacketing.*

INTRODUCTION

According to the type of loading on the structure, there are four types of loadings, like axial load, shear force, bending and torsion moments, etc., that can develop in the structural members. Torsion was always viewed as a secondary effect until the 1960s, at which point In order to reduce the safety factor, researchers proceed from working stress to the limit state and then try to go up to the ultimate load method. Concrete is a brittle type material with low tensile resistive capacity; even with reinforcement introduced into the concrete body, it can break under failure load. To strengthen existing structural elements with a significant torsion effect, composite materials based on polymers can be widely utilized. In general, the fibers consist of glass, carbon, aramid, plastic, etc. Other fibers have also been utilized, including asbestos sheets, paper, and wood. All of the above mentioned fiber sheets, however, needed a good adhesive—vinylester, epoxy, etc.—to accomplish adequate surface bonding. Despite having been around for almost a century, starting in 1905, polymer fiber has been efficiently used in concrete as a main stream technology for the past three to four decades. Because polymer based fiber has a strong tensile stress resistive tendency, it is used in composite materials with concrete because even it has a lower elasticity modulus as compare to concrete and also having less stability in compressive force. These materials go by names like FRP, GRP, CRP, aramid, etc., depending on their use.

LITERATURE REVIEW

As mentioned earlier, FRP's history has been around for almost a century, starting in 1905. Polymer fiber has been efficiently used in concrete as a mainstream technology for the past three decades. Polymer based fiber acted as a composite action material used to enhance the capacity of existing old structural members with a predominant torsional load effect. Most commonly, the fibers are made of plastic, glass, carbon, aramid, etc. Here is an attempt to study the behavior of RCC beams strengthened by FRP techniques influenced by pure torsion load.

FIB Technical Report (2001)

The report discusses how tricky it is to accurately figure out the effective strain level in FRP (Fiber-Reinforced Polymer) due to various factors. However, with detailed experimental data and basic modeling, it's possible to estimate this strain level. The model used assumes that there's no interaction between steel and FRP in resisting torsion in the beam. The formula provided helps calculate how much the FRP contributes to the beam's ability to resist torsion, whether it's a full or U-wrapping shape. This knowledge is crucial for designing strong and reliable structures using FRP materials. The following formula pertains to the FRP strengthening contribution towards the overall beam's torsion capacity (for both full and U-wrapping shapes,

$$T_{frp} = \frac{2\, E_f . \varepsilon_f . t_f . w_f . b . h . cot(\theta)}{S_f} \quad (1)$$

$$T_{frp} = \frac{E_f . \varepsilon_f . t_f . w_f . b . h . cot(\theta)}{S_f} \quad (2)$$

Where,

E_f = FRP young's modulus.

t_f = Thickness of the FRP.

b & h= C/s outer dimensions,

w_f= FRP strips width.

S_f= FRP strips spacing.

θ = Angle made by major inclined cracks with respect to longitudinal beam axis.

Deifalla Ahmed And Ghobarah A. (2005A)

They made the hypothesis that the extrinsic faced reinforcement of FRP and the inside conventional reinforcement of steel would not interact with each other. The following formula can be used to calculate the reinforcements' overall contribution (T_r) to the RC beam's torsion capacity:

$$T_r = T_S + T_{frp} \quad (3)$$

Where,

T_S & T_{frp} = Torsional strengthening contribution by steel and FRP material, respectively.

Equation (3) assumes that there is no direct contact between the steel and the FRP, which is not absolutely dependable with each other. However, internal steel reinforcement is yielding or deteriorating in most cases, requiring strengthening. As a consequence, the analysis may be made simpler by using this assumption.

Deifalla Ahmed and Ghobarah A (2005B)

They suggested that contribution of torsional strength by conventional inclined type steel reinforcements (T_s) to the total torsion capacity of the RC beam be determined with the following formula using the Mohr circle equilibrium space truss and the hollow tube analogy:

$$T_{frp} = \frac{2\, A_O . f_y . A_t . [\cot(\beta_s) + \cot(\theta)]\sin(\beta_s)}{S_s} \quad (4)$$

Where,

A_O =Space or area cover under shear flow path.

f_y = Yield stress of the reinforcement.

A_t = Area of torsion resisting reinforcement.

θ = Angle of inclination of the principal cracks.

β_s= Inclination angle of steel reinforcement.

Similarly, the FRP sheet contribution (T_{frp}) to the torsion carrying capacity can be determined by:

$$T_{frp} = \frac{2\, A_{of} . E_f . \varepsilon_f . A_f . [\cot(\beta_f) + \cot(\theta)]\sin(\beta_f)}{S_f} \quad (5)$$

Where,

A_{Of} = Space or area under shear flow path where strengthening carried out.

E_f = FRP sheet's young's modulus.

ε_f = Effective average strain of FRP.

β_f = Angle made by fiber orientation with respect to longitudinal beam axis.

S_f = FRP strips spacing.

A_f = FRP effective area can be calculated by using:

$$A_f = n_f . t_f . w_f \quad (6)$$

Where,

n_f = No.s of FRP layers

w_f = FRP strips width.

Equation 6 states that using multiple layers of FRP is the equivalent as using a single layer of FRP with the same total area.

Chalioris Constantin E. (2007)

In order to observe the torsional capacity of RCC beams including the strengthening by fiber polymer wrapping material, he predicted an analytically approachable investigation. He used a prior experimental database containing twenty-four specimens created by other researchers and cast twelve test specimens for this test program. He suggested the analytical approach depicted in Figure 2.1, which includes the inclusion of two distinct theory based models: a softening truss model for the post-cracking response for reinforced concrete specimens and a smeared cracking model up to the prior-cracking stage for plain concrete beam specimens.

Many comparisons with mathematically predicted drawn curves and results from experimentation are made as part of this proposed methodology. The elastic means pre-cracking and next post-cracking responses of RCC beams reinforced by the FRP system under torsional moments can now be clearly modeled by virtue of this study.

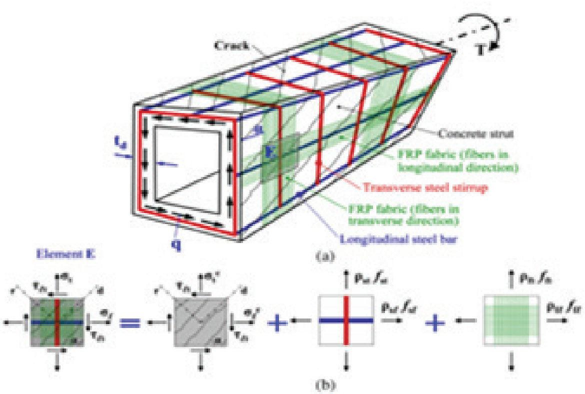

Fig. 1: Space truss of FRP materials used for strengthening the RCC beam in pure torsion.

Chalioris Constantin E. et al. (2008)

They conducted research on the total behavior of RCC beams strengthen with FRP (fiber reinforced polymer) strengthened by using CFRP (carbon fiber-reinforced polymer) continuous epoxy-bonded sheets in the shape of strips as an external transverse reinforcement. In this experiment, there were fourteen T and rectangular shaped beam specimens tested under pure torsion load. The parameters that are investigated include the cracking torsion moment, ultimate torsion moment and angle of twists in prior cracking and post-cracking stages in the curves, as well as the failure modes in specimens. In the present study, it was shown that the rectangular beam specimens strengthened with full wrapping—that is, continuous wrapping with fiber-reinforced polymer sheets—performed effectively and showed higher values of torsional behavior than the beam specimens strengthened with fiber-reinforced strips. Additionally, the experimentation revealed that U-jacket premature debonding failure can occur, resulting in significant reductions in maximum torsional carrying capacity of T-shaped beam specimens.

Zojaji A. R. and Kabir M. Z. (2012)

To estimate the torque-carrying capacity of RCC beams wrapped in FRPs (fiber-reinforced plastics), they have attempted to develop a new computational SMMT (softened membrane model) for torsional resistive response. Three different types of theories like compression field theory, modified compression field theory and softened truss model developed by other researchers existed prior to this study. However, with equilibrium equations considering tension stress into account, the behavior of the torque-twist curve may be predicted using this SMMT model. By comparing the graphs obtained from current theoretical approaches with the graphs obtained from experiments, the suggested analytical model of torque-twist curves was validated. There are two categories like solid sections and hollow rectangular sections were taken into consideration for the specimens. This work demonstrated the validity of the theoretically suggested analytically based model that was used to determine the torsional behaviour of RCCbeam specimens strengthened by FRP, fiber reinforced polymer systems both before and after the fractured.

Tibhe Shraddha B. and Rathi Vijaykumar R. (2015)

They studied the utilization of FRP (fiber-reinforced polymer) as an external wrapped reinforcement to increase the torsional carrying capacity of members while avoiding torsional brittle failure. In their experimental work, a total of 39 rectangular shaped beams of cross section of 150mm × 300 mm and having length of 1200 mm were cast. Out of those, 03 numbers are control beam specimens and the remaining 36 tested specimens are categorized into two types. The two classes of beam specimens are compared to control specimens in terms of parameters such as torsion resistive moment, angle of twist, ductility factors, etc. In this case, that was found that CFRP carbon fiber bonded beams had more ability to support torque than GFRP-bonded beams.

Fig. 2 FRP bonded beams

Atea Rafid Saeed (2017)

Twelve T-shaped reinforced beams, both with and without CFRP (carbon-fiber reinforced (wrapped) polymer) reinforcement, were cast and tested. The main focus of the study is to examine how reinforced concrete beams with continuity in the beam and slab parts behave when strengthened using three-sided CFRP material. Out of 12 numbers of beams, two numbers of specimens are control beams, which contain only by conventional reinforcement. The remaining ten numbers beam variables were incorporated into the testing program. These included the influence of strengthening the flange, the influence of orientation the fibers like 90° and 45° with respect to the central longitudinal beam axis, the influence of combining longitudinal directional and transverse direction CFRP strips, the influence of bolt anchorage with CFRP strips in both web region as well in flange region, and the influence of utilization of continuous type CFRP strips at the joint of the flange and web portion. In this experiment, strain measurements of CFRP materials, torque-twist curves, and beam elongations were used to compare the parameters. Additionally, it has been observed how CFRP materials affect ultimate torque and cracking along with their failure mechanisms.

Sachin B. Kandekar and Rajshekhar S. Talikoti (2018)

They presented their research on the behavior of M30 grade reinforced concrete (RCC) beams with aramid fiber under pure torsion. An organic fiber with a high enough modulus and strength to be employed as reinforcement in composite materials is referred to as aramid fiber. They reasoned that brittle-type failure results from excessively undesired loading, while torsional failure generally happens in seismically affected places, which are vulnerable to abrupt collapse. Therefore, by applying aramid fiber as a composite material to the U-shaped beam's surface rather than its entire length, ductility can be added to reinforced concrete beams at the post-cracking stage. Twelve numbers of beams measuring 150 mm x 300 mm x 1000 mm were cast by the authors. In accordance with IS 456-2000, the beam specimen for torsion is designed. The purpose of this study is to examine the torsional response of aramid fiber-strengthened beams that have three faces and are fully wrapped, 100-mm-wide U-shaped wrapped strips composed of epoxy resin. They examined the beam specimens' mode of failure, angle of twist, ultimate loads, and initial cracking loads. According to the results, the totally wrapped RCC beam specimens had more torsional strength than the controlled beam specimens. It is also a relatively simple technique for strengthening RCC beams.

CONCLUSION

After having an appearance at the literature, it is noted that FRP-reinforced systems have been used since the 1980s to strengthen reinforced concrete beams, particularly those in existing structures. In the form of fully or partially wrapped FRP systems, FRP systems can be place around reinforced concrete elements to increase their torsional strength. Depending on the working conditions, requirements, cost, etc., polymer fiber jacketing can be used in three-sided U-shaped wrapping, two-sided vertical wrapping, or four-sided fully wrapped configurations. Fiber reinforced plastics and polymers, carbon fiber reinforced polymers, glass fiber reinforced polymers, aramid fibers, etc. are some categories for polymer fiber jacketing. The authors have conducted ample study and have created theoretical analyses in the form of FEM models and softened truss models of Hsu with modifications to material parameters. Some of them have even used elastic theory to generate equilibrium and compatibility equations. The best materials for fiber polymer jacketing are those that provide a good connection with concrete, are ductile, impact resistant, have a high tensile strength to weight ratio, and are good at arresting cracks. However, it was more expensive, needed specialized adhesive materials and labor, was sensitive to fire, etc. Additionally, there is a risk of premature debonding failure in any kind of deficiency, which would result in a significant drop in torque carrying capacity, etc.

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Literature Review on Alternatives for Partial Replacement of Fine Aggregate

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ABSTRACT

It is true that there are difficulties associated with using fine aggregate in the manufacturing of concrete, especially in terms of supply and environmental effects. Scholars have been diligently investigating substitutes or additives for conventional fine aggregates. Recycled concrete aggregate (RCA), manufactured sand (M- Sand), quarry dust, expanded clay aggregate (ECA), industrial byproducts, biodegradable materials, nanomaterials, etc. are a few of the interesting substitutes.

Each of these options has benefits and drawbacks, and their acceptability is determined by things like performance needs, cost effectiveness, and local availability. To identify sustainable ways to lessen the environmental impact of producing concrete, further research and innovation in this area are crucial.

KEYWORDS: *Brick debris, Compressive strength, Fine aggregate, Marble sludge, Saw dust ,Textile mill sludge.*

INTRODUCTION

Concrete stands as a cornerstone of modern infrastructure, ubiquitous in construction projects worldwide. Its attributes of affordability, durability, and strength have made it indispensable in the development of various structures, from residential buildings to monumental infrastructure like expressways and nuclear plants. However, the concrete industry's exponential growth has placed immense strain on natural resources, particularly aggregate, constituting up to 70-75% of concrete's composition. With annual global concrete production estimated at a staggering 11 billion metric tons, the demand for aggregate, predominantly sourced from natural rock formations and river sand, continues to escalate. The overreliance on natural fine aggregate, particularly river sand, has prompted environmental concerns due to its unsustainable extraction and ecological ramifications. To mitigate these issues, researchers and engineers have fervently pursued alternative materials that meet the technical requisites of fine aggregate while also being locally available in abundance. The quest for sustainable infrastructural growth necessitates a paradigm shift towards eco-conscious construction practices. This entails not only reducing the depletion of natural resources but also minimizing environmental impact throughout the concrete production lifecycle. By exploring and implementing alternative materials, the construction industry can strive towards achieving a harmonious balance between developmental needs and ecological preservation. This paper delves into the diverse array of alternative fine aggregate materials, their technical feasibility, and their potential to revolutionize the concrete industry towards a more sustainable future.

FINE AGGREGATE

Fine aggregate in concrete refers to the sand-sized particles that fill the spaces between coarse aggregates. Typically, it consists of natural sand or crushed stone with particle sizes smaller than 5mm. Fine aggregate plays a crucial role in concrete mixtures by providing cohesion, workability, and reducing voids within the mixture. It enhances the durability and strength of concrete while influencing its finishing characteristics.

Properly graded fine aggregate ensures a dense and durable concrete matrix, essential for structural integrity and longevity in various construction applications, including buildings, bridges, and pavements.

LITERATURE REVIEW

Textile Mill Sludge

Utilizing textile sludge waste in the production of construction bricks offers a sustainable solution for solid waste management. By incorporating this waste material into brick manufacturing, it reduces the reliance on clay, which is often scarce in many regions. This approach not only addresses the challenge of textile waste disposal but also contributes to the conservation of natural resources. Additionally, it enhances the environmental sustainability of brick production by reducing the overall environmental footprint associated with clay extraction. By repurposing textile sludge waste in this manner, it serves as a practical and eco- friendly approach to waste management in construction industries.

Fig. 1: Textile Mill Sludge (TMS)

Loganayagan.S et.al.[1] studied that initial drying of the sample sludge in a hot air oven at 100°C for 24 hours produced a moisture content of 36%. It was then manually pulverized with a trowel to fine particles while still at room temperature. For the investigation, sludge particles that were retained on a 75-micron sieve after passing through a 300-micron sieve were chosen.

The sludge that was unable to be handled in its dry state after passing through a 75-micron screen was excluded from the study. By using this technique, it was made sure that the particles chosen for the investigation were the right size and state for examination. According to the study, it might not be possible to replace all al the fine aggregate in concrete with textile effluent sludge.

Mr. G. J. Kulkarni, et.al.[2] studied that up to 32% of textile mill sludge (TMS) can be effectively incorporated into concrete without compromising compressive strength, as determined through testing concrete cubes with varying percentages of TMS. In a subsequent stage of experimentation, with TMS fixed at 32%, fly ash is introduced to replace cement following BIS guidelines. This combination of TMS (32%) and fly ash (20%) proves successful in M20 grade concrete, demonstrating its suitability as a building material.

However, it's noted that as the percentage of sludge increases, the workability of the concrete decreases, evidenced by reductions in slump values and compaction factor. Despite this, the resulting concrete with 32% sludge and 20% fly ash achieves a compressive strength of 20.22 N/mm², which is close to the characteristic strength and within laboratory precision.

Mr S.Sakthivel et.al.[3] With more than 21,000 units

-5,285 of which are located in Tamil Nadu -the Indian textile sector brings in a sizable sum of money from exports. However, because of the large amount of waste materials produced, including liquid and solid waste, it also presents environmental concerns. Large amounts of water are used in the desizing, bleaching, and dyeing processes in the textile industry, which results in the release of extremely harmful effluents. This effluent is treated by Effluent Treatment Plants (ETPs), which use chemicals including alum, lime, ferric chloride, and polyelectrolyte to purify the wastewater. However, the outcome of this procedure is the production of Textile Mill Sludge (TMS). This research presents the successful substitution of textile mill sludge for a portion of the fine aggregate in concrete. It suggests that the proportion of sludge from textile mills not go above 30%.

Saw dust

Fine wood particles make up sawdust, a byproduct of cutting, grinding, or sanding wood. Additionally, some insects like carpenter ants and animals like woodpeckers create it. Sawdust is a major component in the creation of particleboard and presents fire risks in the manufacturing process. It is often used to make particleboard; coarser versions are used to make wood pulp. Sawdust is used for a variety of uses, mostly in the woodworking industry, and its use supports sustainable resource management in the wood processing industry, despite its possible risks.

Fig. 2: Sawdust

Er. Ilyas Mir et.al.[4] indicates a noteworthy 57% rise in the control slab's flexural strength, which rose from

1.43 N/mm² after 7 days to 2.24 N/mm² at 28 days. Similarly, the slab that had 25% sawdust replaced showed a 45% rise, going from 1.15 N/mm² at 7 days to 1.67 N/mm² at 28 days. In addition, the slab with 50% sawdust replacement showed development from 7 to 28 days, going from 0.89 N/mm² to 1.12 N/ mm² . A grade 15 concrete should reach a flexural strength of

1.2 N/mm² after 28 days, according per BS 1881, part 4 (1970).

The slab that replaced 25% of the sawdust with a value of 15.9 N/mm² had a compressive strength that is comparable to grade 15 concrete, which has a lightweight requirement of 15 N/mm².

A. Abdullahi et.al.[5] studied that the optimal replacement of sand with sawdust is 10%. Beyond this threshold, the resulting concrete fails to meet the strength requirements outlined in BS 8110 (1997).

Brick debris

Brick debris, a byproduct of demolished bricks, finds eco-friendly use in concrete production. Its incorporation helps alleviate stagnant waste accumulation while potentially saving up to the total cost of cement in conventional methods.

Fig. 3: Brick debris

R. Veerakumar, et.al.[6] reveal that the compressive strength of the concrete is optimized when 10% of the fine aggregate is replaced by crushed brick debris, compared to conventional concrete. This suggests that incorporating brick debris into concrete mixes can enhance the overall performance of the material while effectively addressing environmental concerns and reducing costs.

Shruthi H G , et.al.[7] reveals that the maximum compressive strength is achieved when 40% of fine aggregate is replaced with brick powder. Compressive strength remains largely unchanged for 10% and 20% replacements, showing minimal variation compared to normal concrete. The optimal result is observed at a 40% replacement level, indicating the effectiveness of this substitution ratio in enhancing concrete strength.

CONCLUSION

By analyzing existing research, it seeks to identify and understand alternative materials that can effectively replace fine aggregate in concrete mixtures. These consist of Textile Mill Sludge, Saw dust and Brick debris. The literature review suggests that fine aggregate replacement in concrete can be achieved through the use of alternative materials or a combination thereof.

- Textile Mill Sludge offers potential benefits in waste management and resource conservation, careful consideration of optimal replacement percentages is crucial to maintain concrete performance.
- The literature analysis emphasizes that decreasing slump values and compaction factors imply a decrease in workability as the percentage of sludge in concrete increases. Even yet, the concrete with 32% sludge and 20% fly ash still manages to achieve an impressive compressive strength of 20.22 N/mm². This strength fits within the range of laboratory precision and is closely correlated with the characteristic strength.
- The compressive strength of the slab with 25% sawdust replacement reached 15.9 N/mm², aligning with the specified value of 15 N/mm² for grade 15 lightweight concrete according to BS 8110 (1997). This demonstrates the effectiveness of incorporating sawdust into the concrete mix, as it maintains or even exceeds the required strength standards for lightweight concrete. Such results indicate the potential of sawdust as a viable alternative material in concrete production, offering both structural performance and sustainability benefits.
- The results of the study indicate that using brick debris in place of fine aggregate at a rate of 15% can significantly increase strength. This suggests that, in comparison to traditional mortar and concrete mixes, 15% is the best replacement level that may be attained. Brick debris can be used as a sustainable alternative material while simultaneously boosting concrete performance according to this optimal substitution ratio. It is advised to do additional testing and validation to corroborate these results and investigate possible uses in the manufacturing of concrete.
- Thorough testing and quality control measures are

necessary to ensure that the use of Textile Mill Sludge enhances sustainability without compromising the structural integrity and durability of concrete structures.

- Further research and development in this area can lead to innovative solutions for environmentally friendly construction practices.

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Literature Review on Community Waste Water Treatment

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ABSTRACT

These days, many developing countries cannot afford wastewater treatment methods due to their high cost, need for more space to establish treatment plants, and requirement for the use of certain materials. They need more reasonably priced, environmentally responsible, and compact options. Vermifiltration is a simple, inexpensive, environmentally friendly, chemical-free way of purifying canteen wastewater. It makes use of the Eisenia fetida earthworm species. Through their munching, the earthworms could be able to reduce and decompose the organic waste. It is thought to be a state-of-the-art, safe-for-the-environment technology that provides a long-term way to cleanse wastewater without creating or handling sludge.

KEYWORDS: *Biochemical oxygen demand, Chemical oxygen demand, Total dissolved solids,Total solids, Total suspended solids, Waste water and Vermifiltration.*

INTRODUCTION

Community wastewater treatment systems are most typically seen in large-scale residential and commercial complexes in the United States. All of the equipment required to treat the waste from the development typically is housed in a community wastewater treatment facility. Following treatment, the effluent is often disposed of via a drip system or spray irrigation. The primary goals of the community wastewater management system are to shield people and animals from coming into contact with the produced wastewater, also known as effluent, and to keep nearby bodies of water pure. Environment agencies at the state or local level typically govern the planning and setting up of these treatment systems, requiring adherence to strict guidelines such as the "Guidelines."

Community wastewater treatment

The phrase "wastewater as a resource" denotes a paradigm shift from what was formerly thought of as a liability to an indispensable resource that can be used to address the problems associated with sanitation and water supply. However, until technology is introduced to make the transformation a reality, calling wastewater a resource is merely empty words. Wastewater has long been seen as a risk and a possible source of illness. By constructing routes that allow the sludge, chemicals, and other solid materials found in wastewater to be safely disposed of to reduce harm to humans, people tend to avoid wastewater.

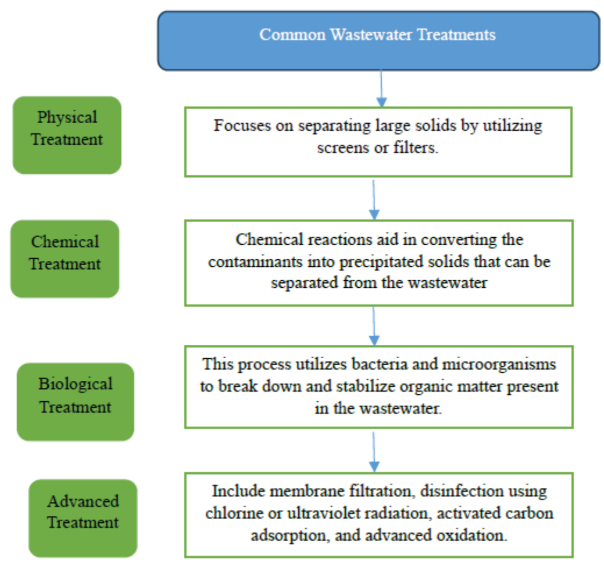

Fig. 1: Flowchart to show common wastewater treatment

It is important to remember that the alternatives for treating wastewater can change based on the particulars and environment of the wastewater. The best course of treatment is chosen based on technical, ecological etc.

Fig. 2: Schematic diagram of vermifiltration kit

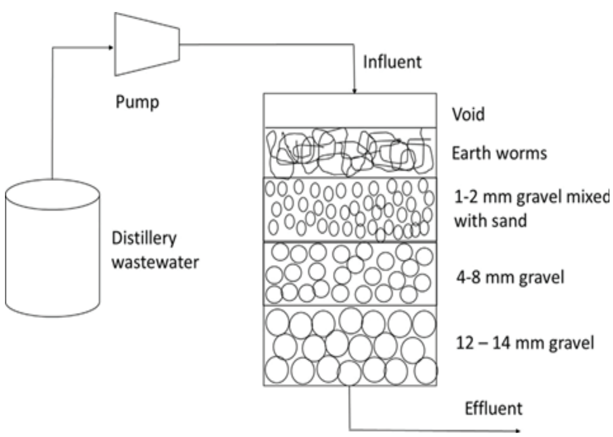

Fig. 3: Vermifiltration technology working principle

LITERATURE REVIEW

Omkar Ghule et.al.[1] studied that water scarcity is a global issue, particularly affecting developing nations unable to afford costly wastewater treatment plants. Vermifiltration, a decentralized solution utilizing earthworms in a biological reactor, offers promise. The system filters organic material from wastewater while providing a habitat for aerobic bacteria, crucial for decomposition. The study assesses vermifiltration's efficiency in treating sewage by analyzing parameters like pH, total dissolved solids, and removal of biological and chemical oxygen demand. Results are compared with water quality standards. This research addresses the urgent need for low-cost wastewater treatment options, crucial for sustainable water management worldwide, especially where centralized systems may be inadequate. The experimental data confirms that vermifiltration outperforms non-vermifiltration methods in removing BOD, COD, and solids from wastewater. Vermifiltration technology is a viable option for decentralized wastewater treatment because it also exhibits better cost-effectiveness, odor control, and efficiency. These results demonstrate how vermifiltration might potentially address wastewater management concerns with increased economy, efficiency, and decentralization potential.

Nandini Misal et.al[2] revealed that vermifiltration is a low-cost, chemical-free, space-saving, and environmentally beneficial method of treating community wastewater. The operation of the Eisenia-based Vermifilter. Fetida earthworms were used to analyze key wastewater parameters, including pH, BOD, COD, TS, TSS, TDS, oil, and grease, in the college canteen. The parameters were significantly reduced by the Vermifilter. Overall, the findings show that Earthworms considerably break down the waste material without producing sludge. The outcomes are quite pleasing.

Jayashree Dhote et.al.[3] reveals a positive correlation between hydraulic retention time (HRT) and the number of earthworms, with an increase leading to higher removal efficiency. Specifically, the presence of earthworms resulted in removal efficiencies of approximately 69-70% for COD, 85-90% for BOD, 75-85% for TDS, and 87-89% for TSS. These findings underscore the importance of optimizing HRT and earthworm population for maximizing the effectiveness of vermifiltration in wastewater treatment, ultimately leading to improved removal efficiencies of various pollutants.

Patel Jatin B [4] describes the basic workings of vermifiltration and positions it as an extremely efficient wastewater treatment method. It emphasizes the use of vermifiltration as a decentralized on-site treatment option. Earthworms are important for filter bed aeration and pollutant breakdown since they are both productive and protective species. The vermifiltration process gets stronger as the earthworm population increases, guaranteeing that there is enough oxygen available for aerobic decomposer microorganisms.

Because the treated effluent from vermifiltration has higher phosphate and nitrate content, it can be used in horticulture or sewage farming. Interestingly, vermifiltration does not produce sludge; instead, organic matter and solids are consumed by earthworms, which then turn them into beneficial vermicompost that is enriched in phosphate and nitrogen and is perfect for use as fertilizer.

Priyanka Tomar et.al.[5] presents an opportunity to evaluate the effectiveness of a vermibiofiltration system, primarily constructed using the wetland weed Cyprus rotundus and the live biomass of a local earthworm species, P. sansibaricus, for treating urban wastewater. Previous scientific methodologies primarily focused on utilizing either plants or earthworms individually in the design of biofiltration units.

By integrating both plant and earthworm components into the biofiltration system, this study aims to explore synergistic effects that may enhance wastewater treatment efficiency. The use of Cyprus rotundus, known for its ability to absorb nutrients and contaminants from wastewater, alongside P. sansibaricus, which contributes to organic matter decomposition and nutrient cycling, offers a holistic approach to wastewater treatment.

Victor Gutiérrez et.al.[6] reveals that full-scale VF treatment of sewage at 0.5 m3 /m2d and 0.6 Kg

COD/m2d produces statistically significant reductions ($p < 0.05$) of COD (77%), BOD5 (84%), TN (53%), and TP (36%). Seasonality had a major impact on the elimination of TN, BOD5, and COD. While TN is destroyed at a 21% greater rate in fall and winter, COD and BOD5 are eliminated at 9% and 11% higher rates in spring and summer, respectively. This is due to the fact that temperature affects the development and activity of microbes and earthworms, which alters removal efficiency.

Nahid Ghobadi et.al.[7]The vermifiltration system, as designed, demonstrated resilience in operating continuously over long-term periods, even in the face of fluctuations in organic input within the wastewater. This reliability underscores the suitability of vermifiltration as an effective alternative for treating hospital wastewaters, presenting a notable advantage of this technology. The vermifiltration process effectively reduced biochemical oxygen demand (BOD5), chemical oxygen demand (COD), and total suspended solids (TSS) in the hospital wastewater. Additionally, the pH of the wastewater was neutralized through vermifiltration. These results highlight the efficacy of vermifiltration in improving the quality of hospital wastewater, making it a promising solution for sustainable and effective wastewater treatment in healthcare facilities.

Sudipti Arora et.al.[8] The vermifiltration process demonstrates significant reductions in biochemical oxygen demand (BOD) and chemical oxygen demand (COD) by 70–82%, as well as a remarkable 99.9% decrease in coliforms from wastewater. These findings indicate that vermifiltration is an effective technology for domestic wastewater treatment. Moreover, the study observes a decrease in the population count of total bacteria, fungi, and actinomycetes during the vermifiltration process.

Significantly, the isolated microorganisms show antibacterial activity, indicating that several bacteria, including Enterobacter, Bacillus, Alcaligenes, E. Coli, and Klebsiella, may prevent other pathogens from growing in the vermifiltration system. The release of some antibacterial chemicals by these microbes may be the cause of this antibacterial effect. Overall, these results underscore the potential of vermifiltration as an efficient and sustainable method for domestic wastewater treatment, offering significant reductions in organic pollutants and pathogens, as well as the presence of natural antibacterial mechanisms within the system.

CONCLUSION

By analyzing existing research, following conclusions are drawn out:

- Overall study show that earthworms are important for waste material degradation that doesn't result in sludge. The very excellent results show that vermifiltration is a traditional, safe, economical, environmentally friendly, and space-saving method that doesn't produce sludge.
- The study reveals a positive correlation between hydraulic retention time (HRT) and the number of earthworms, with an increase leading to higher removal efficiency. Specifically, the presence of earthworms resulted in removal efficiencies of approximately 69-70% for COD, 85-90% for BOD, 75-85% for TDS, and 8789% for TSS. These findings underscore the importance of optimizing HRT and earthworm population for maximizing the effectiveness of vermifiltration in wastewater treatment, ultimately leading to improved removal efficiencies of various pollutants.
- Environmental managers are showing a great deal of interest in natural treatment solutions. Because of their low startup costs, ease of maintenance, potential longer life cycles, and capacity to recover a range of resources—such as treated wastewater for irrigation, organic humus for soil amendment, and energy in the form of biogas—natural treatment technologies are thought to be feasible. • Conclusions suggest that vermifiltration can be readily implemented by common society as a sustainable and effective method for wastewater treatment.
- To enhance the efficiency and sustainability of vermifiltration, further research is recommended, focusing on optimizing wastewater feeding mechanisms, developing effective cleaning protocols, integrating vermifiltration with other treatment technologies, and exploring alternative earthworm species with greater efficiency.

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A Review Paper on Seismic Retrofitting of RCC Buildings

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ABSTRACT

The Bhuj earthquake (EQ), which struck on January 26th , 2001 in Gujarat, India, inflicted widespread damage on medium and high-rise structures. This calamitous event prompted a re-evaluation of our professional standards, building regulations, construction materials, and the education provided to civil engineers and architects. Moreover, the existing Indian building codes lack sufficient provisions for assessing seismic resilience in structures not originally designed to withstand earthquake forces. To mitigate future devastation from seismic activity, it is imperative to conduct thorough seismic evaluations of buildings using contemporary expertise. Any buildings found to be deficient in seismic resistance must undergo retrofitting or reinforcement measures as necessary. This paper aims to offer an overview of past endeavors in devising global level seismic retrofitting strategies and assess their efficacy.

KEYWORDS: *Damage, Earthquake , Retrofitting, Seismic codes, Seismic evaluation.*

SEISMIC RETROFITTING

This paper offers a comprehensive examination of retrofitting techniques employed worldwide, encompassing both empirical and theoretical advancements in this domain. It delves into the specifics concerning steel X-bracing, infill walls, and shear walls, exploring their effects on diverse seismic parameters within structures.

Jong-wha bai [1] A scientific study was undertaken to assess the impact of the Loma Prieta earthquake and Northridge earthquake on various building types. Findings from the study revealed that the failure of columns in the majority of reinforced concrete buildings led to significant structural damage. Beam members exhibited flexural cracks, while shear walls and beam-column joints showed signs of shear cracking while the Northridge EQ. Consequently, retrofitting and refurbishment of already constructed structures are imperative to enhance their seismic resilience. The study includes an exploration of four distinct procedures for seismic evaluation of structures as outlined by FEMA, alongside a broad discussion on retrofitting classification, distinguishing between structural and member levels. This study serves as a valuable starting point for retrofitting interventions on structurally deficient buildings.

Sugano S. [2] Author covered both historical and modern developments in the field of retrofitting throughout our conversations. Additionally, we performed a pushover analysis after conducting experimental research on a single-bay, one-story simple frame model that was reinforced utilizing varying degrees of structural retrofitting techniques. The results were displayed as pushover or capacity curves that depicted the lateral load vs. displacement format. Retrofitting with monolithic walls produced the largest load at the performance point, according to data. When steel X-braces were added, the ductility of the frame was significantly increased in compare to previous techniques of retrofitting. At the same time, the structure's initial weight was barely affected, meaning that the stiffness of the frame increased. Additionally simple to install and maintain are steel X-braces. Although infill walls performed admirably, they sometimes draw greater lateral load, which can result in column failure. The lateral load carrying capacity of the concrete block reinforced frame was limited to 0.62 times that of a shear wall. When compared to the bare frame model, it was also demonstrated that precast panels and steel K-bracings improved the performance point. Our research shows that, in comparison to the bare frame, retrofitting techniques greatly increase the lateral strength and stiffness of structures.

Viswanath K.G., Prakash K.B., Anant Desai [3] A study performed to assess the seismic performance of RC structures that had been modified with concentric steel bracing. Using STAAD Pro software, the study was completed for a four-story building situated in seismic zone IV in compliance with IS: 1893-2002 requirements. Examined was the efficiency of several kinds of steel bracing in restoring the structure, with an emphasis on the columns on the periphery. The study also looked into how the distribution of steel bracing affected the retrofitted building's seismic performance, measuring storey and global drifts.

Maheri and Sahebi [4] To assess the effectiveness of various diagonal bracing designs in supporting the in-plane shear strength of concrete frames, numerous pushover tests were carried out on a variety of model frames. The test results showed that the shear resistance capability of concrete frames may be significantly increased by adding diagonal steel X-bracing. In particular, it was found that the X-braced model frame had 4 times the strength of the unbraced frame. The results presented that the compression brace's buckling failure happened right after the tension brace's tensile failure, which caused the system failure. Furthermore, the braces' mode of failure highlighted how crucial the brace-to-frame link is. Weak connections prevented the braces from being fully utilized.

Maheri and Akbari [5] have carried out a thorough investigation on the seismic behavior factor (R) of reinforced concrete structures with steel X and knee braces. The purpose of our study was to determine how several factors, such as bracing system type, applied load contribution from the bracing system, and frame height (H), affected the R factor. According to our research, the H of the lateral load-resisting system had a substantial impact on the R factor, whereas the other two parameters only had a localized effect on R values. This is explained by the direct relationship between system height and the dual system's ductility capability.

Guneyisi and Altay [6] investigated the seismic nature of the 5-story RC building in great detail. The purpose of the study was to use nonlinear static and dynamic models to assess the efficacy of retrofitting techniques for shear walls and steel bracing. The findings demonstrated that the critical deformations of inelastic systems determined by ATC40 approaches were substantially smaller than those obtained through nonlinear time history analysis, suggesting that the former approach was overly conservative. According to the study, shear walls are more effective than steel bracing at increasing stiffness and optimizing lateral load carrying capability. Shear walls also regularly outperformed steel bracing in terms of roof displacement in every earthquake ground motion record. These results demonstrate how well shear walls work as a retrofit technique to enhance the current's seismic performance.

Kadid A and Yahiaoui D. [7] examined the seismic behavior of buildings made of reinforced concrete (RC) and strengthened with a variety of steel bracing systems, such as inverted V, X, ZX, and zipper bracing. Our objective was to evaluate these bracing systems' efficacy and how they affected the three- and six-story buildings' ability to support loads.

Static nonlinear pushover analysis was done on the buildings using various bracing cross-sections in order to accomplish this. The findings demonstrated notable improvements in the six-story building's ability to support loads. Specifically, the 140-ton section shown increases in load-carrying capacity of 6.04, 5.24, 5.16, and 4.47 for ZX bracing, zipper bracing, X bracing, and inverted bracing, respectively, as compared to the bare frame. Similarly, the load-carrying capacity of the three-story building rose with zipper bracing, ZX bracing, and X bracing by factors of 16.1, 13.0, and 9.1, respectively.

Furthermore, the inclusion of steel braces resulted in a decrease in lateral drift, which is a measure of damage. This reduction was especially apparent at the first floor of the three-story structure and the second and third floors of the six-story building. Steel braces were found to be an efficient way to reduce damage in reinforced concrete structures. Furthermore, section characteristics were found to have a considerable impact on the lateral strength of structural systems. With larger section dimensions, bracing systems showed improved capacity; the tube section outperformed the other sections.

Rai and Goel [8] The primary lateral load system used in steel buildings that employ chevron type bracing (CBFs) is the subject of this study's evaluation of their seismic performance. It centers on a building that sustained significant damage during the 1994 Northridge earthquake. The main objective is to outline and provide examples of the seismic assessment techniques that can be applied to identify structural defects in CBF buildings. This includes the application of nonlinear dynamic analysis, the results of which are compared with field research carried out subsequent to the earthquake. The study includes analytical projections of seismic demand, probable failure/damage extent, and resultant ramifications in the event that future earthquakes become more severe.

The paper also offers several upgrading strategies for insufficient CBFs, all of which are intended to meet a specific performance criteria. The viability and effectiveness of these plans are then compared. Because of their powerful brace and weak beam design, existing CBFs are susceptible to considerable damage or possibly collapse, according to inelastic dynamic analysis conducted for more intense ground movements. The paper makes recommendations for how to increase the seismic resistance of CBFs, such as reducing local brace member buckling to postpone brace fracture. Furthermore, it suggests that two-story X braces be used instead of the traditional chevron bracing design to avoid instability and floor beam plastic hinging.

Umehara and Jirsa [9] The study concentrated on how sub-assemblage behavior was affected by the brace slenderness ratio, which was changed by varying the kl/r ratio. It was observed that the bracing system's elastic capacity held true for all kl/r values. The hysteresis loop for kl/r = 40, on the other hand, clearly showed superior balance when comparing sub-assemblage responses for kl/r values of 40 and 120. This was explained by the buckling parameter controlling buckling and hysteretic behavior.

However, it is frequently impracticable to keep the brace slenderness at a level low enough to prevent inelastic buckling. Braces that can buckle elastically, like cables, can be used to overcome this obstacle. To prevent brace member buckling and increase frame ductility, cables are advised in place of steel sections for brace components.

Mulgund G. V. and Kulkarni A. B. [10] Five various retrofiting strategies were applied to an 8 stories structure with identical plan geometry masonry infill walls.

The strut width and brick masonry modulus were calculated using guidelines found in a particular paper. The infills were depicted using the same document's guidelines, which called for single compressive struts. Using ETAB 9.5 software, modeling was done. A pushover analysis was done with a displacement control method that had a target displacement of 4% of the building's overall height [ACT40].

The outer infill design (model II) showed a 25% shorter time period than the bare frame model (model I), according to the analysis results. In a similar vein, the natural period of all other soft storey models (models III to V) was 20% shorter than that of the bare frame model (model I). Furthermore, it was found that, at the collapse prevention performance level, the base shear in model II increased by roughly 48% for the first mode load pattern when compared to the bare frame model, while it increased by nearly 40% in the soft storey models (models III to V) when compared to the bare frame model (model I). It was discovered that entirely masonry infill panels performed noticeably better than bare frame and soft storey.

Kasim Armagan Korkmaz, Fuat Demir and Mustafa Sivri [11] have noted that while infill masonry walls (IMW) are frequently thought of as non-structural elements, it is standard procedure to omit them from numerical assessments of reinforced concrete structural systems. However, brick infill walls have a major impact on structural response while being classified as non-structural. This is especially true in places like Turkey, where RC buildings with masonry infill walls are the norm. It is therefore essential to comprehend how these walls affect earthquake reaction. In order to investigate this, we looked at a 3 stories R C frame building with various proportions of masonry infill walls. Five different models were examined.

SAP2000 was used for the analysis and design of the RC building. This study highlights the design and construction variables that contribute to the below average seismic performance of RC structure in Turkey with masonry infill walls.

Davis Robin, Krishnan Praseetha, et al.[12] have studied the impact of infill walls following an earthquake using two common existing buildings located in India's mild Seismic Zone III. Ordinary moment-resistant frames made of reinforced concrete were used in the construction of these two structures, designated A1 and A2. The FEM program SAP 2000 was used to generate and analyze the structural models of buildings A1 and A2. At G + 7 stories (25.4 m) in height, Building A1 had a comparatively symmetrical layout and elevation. Conversely, building A-2 was a G + 4 storey structure 16.8 in height with uneven plan and vertical layout.Based on these findings, it was concluded that existing buildings with open-ground storeys exhibited deficiencies and required retrofitting measures.

Murty and Jain Sudhir K. [13] study focused on Twelve single-bay, one-story RC frames, scaled down to 1:2 proportions, were applied to a reverse cyclic scale displacement-controlled loading test at the Indian Institute of Technology Kanpur's Structural Engineering Laboratory. Ten of these frames had masonry made of burned clay bricks filled in with cement mortar; the columns were made to flex before shear collapse. Both full-scale (223×112×68 mm) and scaled-down (116×54×36 mm) burnt-clay bricks were used in the infill brickwork. The test specimens included the following: (a) full-scale brick frames; (b) full- and reduced-scale brick frames with unreinforced masonry; and (c) full- and reduced-scale brick frames with unanchored and anchored reinforced masonry.

According to test results, URM-filled frames demonstrated an average strength gain of roughly 70% over bare frames, whereas RM-filled frames shown an average strength increase of roughly 50% over bare frames.

Sucuoglu and Erberik [14] A 3 storied unreinforced masonry building that not collapsed during the 1992 Erzincan EQ has had its seismic performance carefully examined. According to the investigation, internal friction causes brick wall elements to display an impressive ability for energy dissipation. It should be noted, nonetheless, that the mechanical properties determined by laboratory testing are the only basis for these conclusions. Because of this, the validity of these results depends on the practical attainment of the identical material qualities.

Smith and Coull [15] A design process for infilled frames has been presented, which is based on the standards used for diagonally braced frames. This method takes into account three possible ways that infill can fail: crushing of an infill corner, diagonal cracking through the masonry, and shear failure along the masonry. It is assumed that the diagonal compression strut's effective width equals one tenth of the infill panel's diagonal length. Gravity loads should be taken into consideration when engineering the frame in the early stages of design.

Girgin Konuralp [16] In order to investigate the seismic response of moment-resisting RC frames with masonry infills, a parametric analysis was conducted. The strut model was utilized to capture the infills' global impacts on the frames. 3 nos of 5-story, 3-bay concrete identical frames that were constructed in accordance with Turkish codes were the subject of the investigation. To evaluate the seismic response of the frames under four different loading situations, pushover analysis was performed.

The study emphasized how crucial it is to take masonry infills into account when evaluating moment-resisting reinforced concrete frames seismically, especially when attempting to predict the final state. It was discovered that infills without elevation anomalies had a good effect on buildings. On the other hand, damage tended to concentrate on the levels where the discontinuity occurred in infilled frames with irregularities, like soft storeys. Additionally, the research demonstrated that infills improve the initial stiffness and lateral resistance of frames, which leads to a significant decrease in global lateral displacement. One element influencing the post-yield behavior of the frames, which in turn affects the distribution and sequence of damage formation, was found to be the infill arrangement. The study advised investigating additional infill options in order to generalize the findings. The study also demonstrated how a well-executed pushover analysis can provide insightful information about the structural factors influencing a structure's performance during strong earthquakes. It did, however, issue a warning that the accuracy of response estimations in pushover analysis can be impacted by the selection of static load distribution.

Anshuman S, Dipendu Bhunia and Bhavin Ramjiyani [17] According to the Indian seismic zoning map, a 15-story reinforced concrete building was chosen and exposed to earthquake loading in Zone IV in order to determine the best location for shear walls in multi-story buildings taking into account both elastic and elasto-plastic behaviours. Total three models that were examined. A wide column frame analogy approach was used to conceive shear walls. In this method, the shear wall was represented as a wide column with the same dimensions, connected to the frame by connecting beams. In order to determine the best placement for shear walls in the building, the results were compared between the bare frame model and the models with shear walls at the inner and outer sides, accounting for factors such shear pressures, bending moments, and storey drifts. According to the research, top deflection was reduced and kept within allowable bounds by the addition of shear walls in the sixth and seventh frames or, in the shorter direction, the first and twelfth frames. Furthermore, the addition of shear walls in the sixth and seventh frames or the first and twelfth frames in the shorter direction reduced the bending moment and shear force in the first and twelfth frames. The results acquired from elastic analyses were deemed sufficient as the performance point in the inelastic study stayed modest and within the elastic limit. The author suggested installing shear walls in the 6th and 7th frames and the first and twelfth frames in the shorter direction frame based on these findings.

CONCLUSION

Seismic retrofitting strategies are essential for mitigating the destructive impact of earthquakes on infrastructure and communities worldwide. This paper explores a variety of retrofitting approaches implemented globally, showcasing their diversity and efficacy in bolstering structural resilience.

From conventional methods such as reinforcing existing structures with shear walls and bracing systems to innovative techniques like base isolation and passive energy dissipation systems, the array of retrofitting strategies underscores the importance of adaptability and innovation in seismic risk mitigation efforts. Furthermore, advancements in materials science, computational modeling, and structural monitoring technologies have expanded the repertoire available to engineers.

Among the discussed retrofitting strategies, retrofitting with shear walls, particularly for high-rise buildings, emerges as a reliable solution for mitigating lateral forces generated by earthquakes. Shear walls not only enhance structural stability but also reduce lateral displacements within the structure, making them a vital component in seismic retrofitting endeavors.

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Recent Innovation and Trends in Civil Engineering

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ABSTRACT

Civil engineering is a dynamic field that continually evolves with the integration of new technologies and innovations. This research paper explores the latest developments and emerging trends in civil engineering, with a focus on key areas such as sustainable infrastructure, advanced materials, smart cities, and digital construction processes. By conducting a comprehensive review of recent literature and analysing relevant case studies, this paper highlights the importance of these advancements in addressing contemporary challenges and shaping the future of civil engineering.

KEYWORDS: *Advanced materials, Digital construction methods, Recent inventions, Smart cities, Sustainable infrastructure.*

INTRODUCTION

Civil engineering thrives on continuous innovation, which is crucial for shaping infrastructure's planning, design, construction, and maintenance. As the world evolves rapidly, civil engineers are at the forefront of addressing complex challenges while advancing sustainability, efficiency, and cutting-edge solutions. The current focus in civil engineering is on four main areas: sustainable infrastructure, which aims to reduce environmental impact and conserve resources; advanced materials that enhance structural performance and support sustainable construction; smart cities leveraging technology and data to optimize urban systems and improve quality of life; and digital construction methods like Building Information Modelling (BIM), virtual reality (VR), augmented reality (AR), drones, and robotics, which are transforming project planningand execution with increased accuracy and efficiency.

SUSTAINABLE INFRASTRUCTURE

Civil engineering emphasizes sustainability to address environmental, social, and economic impacts. Sustainable practices reduce resource use, waste, and environmental harm while preserving ecosystems. Projects focus on adapting to climate risks and enhancing resilience against extreme weather and sea-level rise. Sustainable approaches maximize resource use and minimize impact through recycled materials and renewable energy. These projects ensure fair distribution of benefits, consider vulnerable populations, and enhance community engagement. Sustainable investments reduce lifecycle costs, increase asset value, and mitigate risks, providing long-term economic advantages.

Recent Innovations in Sustainable Building Materials

Recent advancements in sustainable building materials offer innovative solutions to reduce environmental impact. Recycled aggregates, made from crushed concrete and construction waste, help conserve resources and minimize waste. Bio-based composites, crafted from renewable materials like bamboo, hemp, or recycled plastics, provide strong and eco-friendly alternatives to traditional materials. Carbon-neutral concrete technologies, including carbon capture and alternative binders, aim to reduce or offset emissions from cement production, enhancing the sustainability of concrete.

Case Studies of Sustainable Infrastructure Projects

1. The High Line in New York City is a prime example of sustainable urban regeneration, converting an abandoned elevated railway into a bustling public park. The project uses sustainable design principles such as green infrastructure, native flora, and recycled materials to revitalise the local neighbourhood while maintaining historic components and encouraging environmental care.

2. Masdar City in Abu Dhabi is an eco-friendly urban development that aims to set a standard for sustainable living. To reduce energy consumption and greenhouse gas emissions, the city uses renewable energy, water conservation measures, zero-carbon transit systems, and innovative building technology. Masdar City demonstrates innovative design and building practices aimed at generating a carbon-neutral and resilient urban environment.

ADVANCED MATERIALS

Materials science is crucial in civil engineering, offering innovative solutions to enhance infrastructure performance, durability, and sustainability. Recent advancements have led to the creation of new materials with superior properties, revolutionizing how civil engineers design and construct bridges, buildings, and transportation systems.

Nanotechnology in Construction Materials

Nanotechnology, which operates at the nanoscale, is increasingly utilized in civil engineering to enhance the performance of building materials such as concrete, asphalt, and coatings. Nanoparticles like nano- silica and nano-titanium dioxide improve concrete's compressive and flexural strength, while also enhancing its resistance to chemical and mechanical degradation. This technology enables the development of self- compacting concrete with better workability and lower water content. Additionally, nanomaterials help reduce the environmental impact of construction. For instance, photocatalytic nanoparticles embedded in concrete surfaces can degrade air pollutants, improving urban air quality. Nanomaterial-based coatings also offer water and oil repellency, boosting the durability and sustainability of infrastructure.

Self-Healing Materials

Self-healing materials, which autonomously repair damage, are promising for extending infrastructure life and cutting maintenance costs. Advances include microcapsule-based systems that release healing agents to seal cracks and biological self-healing, where bacteria or fungi produce mineral deposits to fill cracks in materials.

Lightweight and High-Performance Materials

Lightweight and high-performance materials enhance structural applications by reducing dead load, increasing efficiency, and improving earthquake resistance. Recent advances include Fiber-Reinforced Polymers (FRP), which offer strength and corrosion resistance for reinforcing structures; Ultra-High-Performance Concrete (UHPC), known for its high strength, durability, and resistance to damage; and engineered wood products like cross-laminated timber (CLT) and laminated veneer lumber (LVL), which provide sustainable, lightweight alternatives to traditional materials, suitable for modern construction.

SMART CITIES

Smart cities represent a transformative approach to urban development, leveraging technology to improveefficiency, sustainability, and accountability. They rely on infrastructure connectivity enabled by the Internet of Things (IoT) to collect real-time data and optimize services like transportation, energy, and waste management. Data analytics and artificial intelligence (AI) guide decision-making by analysing urban data to enhance resource allocation and urban planning. Smart cities also prioritize citizen engagement through digital platforms, fostering community involvement and feedback. Additionally, they emphasize sustainability and resilience by incorporating renewable energy, energy-efficient buildings, and green infrastructure to reduce environmental impact and adapt to climate change.

Integration of Internet of Things (IoT) Devices for Real-time Monitoring and Management of Infrastructure

The Internet of Things (IoT) is pivotal for enabling the connectivity and data exchange essential for smart city initiatives. By deploying sensors, actuators, and smart meters across urban environments, data on traffic, air quality, energy usage, and waste generation is collected and transmitted to centralized platforms. This data informs decision-making and helps optimize urban infrastructure and services. For example, smart traffic management systems use IoT sensors to adjust traffic lights in real-time, reducing congestion. IoT- enabled sensors in smart energy grids monitor energy consumption and detect faults, enhancing efficiency and reliability. Similarly, smart trash management solutions use IoT sensors to monitor waste levels, optimize collection routes, and minimize operational costs, while reducing environmental impact.

Application of Artificial Intelligence and Data Analytics for Optimizing Urban Infrastructure and Services

Artificial intelligence (AI) and data analytics are vital for enhancing urban infrastructure and services. AI analyzes large datasets to predict trends and optimize resource use. Examples include detecting equipment failures for preventative maintenance, improving public transport systems by analyzing passenger and traffic data, and monitoring air quality to identify pollution hotspots and inform environmental policies.

Case Studies of Smart City Projects Demonstrating the Benefits of Integrated Technology Solutions

Singapore's Smart Nation Initiative: Singapore is a prime example of a smart city, with efforts like the Smart Nation Initiative focused at using technology to improve urban living. The city-state has deployed a variety of smart solutions, such as smart transit systems, digital government services, and smart energy grids, resulting in increased efficiency, sustainability, and quality of life for citizens. Barcelona's Smart City Project: Barcelona's smart city project, "Barcelona Smart City," combines IoT devices, data analytics, and public participation platforms to improve municipal services and infrastructure. The city has installed smart parking systems, trash management solutions, and energy-efficient street lighting, resulting in less traffic congestion, cleaner streets, and lower energy use.

DIGITAL CONSTRUCTION METHODS

Building Information Modelling (BIM) offers a digital representation of the physical and functional characteristics of buildings and infrastructure, enabling stakeholders to explore and refine a project before construction begins. BIM enhances the construction industry by improving collaboration through a centralized platform for data sharing, leading to fewer errors and better outcomes. It also provides enhanced visualization with 3D simulations, which help detect design conflicts early and optimize performance. Additionally, BIM contributes to cost and time savings by streamlining project planning and coordination, reducing rework and delays. Furthermore, BIM models support facility management by offering detailed information on building components and maintenance schedules, ultimately improving building performance and extending asset lifespan. Overall, BIM transforms construction processes by increasing efficiency, reducing costs, and fostering innovation.

Use of Drones and Robotics for Site Surveys, Inspections, and Construction Tasks

Drones and robotics are increasingly transforming the construction industry by enhancing site surveys, inspections, and construction tasks. Drones provide high-resolution aerial imagery and 3D models of construction sites, aiding in site planning, progress tracking, and identifying safety risks. They also enable detailed inspections of hard-to-reach areas, improving safety and accuracy. Robotics contribute by performing tasks like bricklaying, concrete pouring, and demolition with precision, resulting in faster construction and higher quality. Together, drones and robotics enhance safety, efficiency, and productivity while reducing costs and risks. Virtual Reality (VR) and Augmented Reality (AR) are revolutionizing construction project visualization and coordination. VR and AR allow stakeholders to explore immersive virtual models of designs, facilitating better communication and decision- making. They also enable the overlay of digital models on physical sites, improving project coordination and reducing conflicts. Additionally, VR and AR are used for training, simulating construction tasks and safety procedures to enhance worker competence and safety. 3D printing, or additive manufacturing, is reshaping construction through rapid prototyping and on-site fabrication. It allows for quick creation and testing of design prototypes, speeding up the design process and reducing costs. On-site fabrication reduces logistics and material waste while enabling the production of customized building components. 3D printing also facilitates the creation of complex geometries and intricate architectural shapes, expanding design possibilities and promoting innovation.

CHALLENGES AND OPPORTUNITIES

Implementing new technology in civil engineering faces several challenges, including high initial costs for equipment, software, and training, resistance to change from stakeholders concerned about job displacement or unfamiliarity with new tools, and a lack of standardized protocols that can hinder interoperability and collaboration. Additionally, there is often a skills gap among professionals and outdated regulatory frameworks that can impede technology adoption. To overcome these barriers, opportunities for collaboration between academia, industry, and government are crucial. This includes forming research partnerships, advancing technology transfer programs, leveraging public-private partnerships, and securing government funding. Knowledge sharing platforms also play a key role in fostering innovation. Education and training programs are essential for preparing civil engineers with the necessary skills for future technology, emphasizing continuous professional development, hands-on experience, multidisciplinary training, soft skills, and ongoing adaptation to keep pace with technological advancements.

CONCLUSION

In conclusion, the integration of new technologies in civil engineering presents both significant opportunities and challenges. Advances such as Building Information Modelling (BIM), drones, 3D printing, and AI are revolutionizing the industry by improving efficiency, safety, and project outcomes. However, barriers such as high initial costs, resistance to change, lack of standardization, and regulatory hurdles must be addressed to fully realize these benefits. Collaboration among academia, industry, and government can drive innovation through research partnerships, technology transfer, public-private collaborations, and funding initiatives. Furthermore, robust education and training programs are essential to equip civil engineers with the skills needed to adapt to evolving technologies. By overcoming these challenges and leveraging collaborative efforts, the civil engineering field can continue to advance, delivering sustainable and efficient infrastructure solutions for the future.

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Analysis of Affordable Low Cost Housing Buildings

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ABSTRACT

The affordable cost housing as the term indicates the reduction in cost of houses. However this does not mean cheap construction, but relates the ratio between efforts and effects. Economy, to be achieved is not only by cheap materials and low cost things, but also by using new type of materials and by employing good and workable planning. Affordable cost housing is not merely reducing the area and thereby reducing the cost, but it implies use of space as the requirements of people. Ideal accommodation is the one in which all family activities can be carried smoothly and effectively. If given well-planned homes it can be achieved in a comparatively smaller area. While designing the projects for affordable income group foremost attention should be given to the cost of construction. It should be within the reach of middle income group. Due attention should be given to satisfy their mental, physical, social or community needs. Affordable cost housing is more concerned with achieving maximum economy by means of mass production, bulk procurement and building technology as associated with the techniques which seek to reduce time of construction rather than use of labour. In this research paper analysis of low cost affordable housing buildings is done. The research is done with the help of actual case studies for better understanding.

KEYWORDS: *Affordable housing, Construction, Eco-friendly construction, Low cost buildings, Zero energy buildings.*

INTRODUCTION

Land prices and construction costs are increasing more rapidly than the overall price index. Moreover the prices of construction materials are also increasing more rapidly. Affordable housing and that does not imply low standard or lower finishing, certain minimum standard has to be maintained. The objective can be achieved if all other related services are also coordinated and designed with affordable cost emphasis within overall system below the low cost threshold. Affordable cost planning cannot be separated from urban planning because large size of urban population constitutes the economically weaker and middle income group section. Metropolitan cities develop as per various town planning and city planning schemes. The reason for high (unaffordable) price of housing in the market lies in factors like high land prices, cost of construction, transaction cost, taxes & legal charges and profit margins of private operators.

Such schemes provide for reservation of open spaces, for recreational facilities, for green belts and such other beneficial purposes for the society. However, due to growing population, most of these open spaces are illegally occupied by creating big slums. Planned rehabilitation of these slum dwellers, by providing them affordable cost shelters having architectural value, the beauty of the surrounding areas and the beauty of the city as a whole will necessarily be improved.

It should be noted that about 40% of the city's population having middle income, is living in rental settlements, where even essential necessities of human beings are not available. By providing adequate shelter, their living standards can be increased. Thus the society will be largely benefited, as these people from the bulk of our society.

AFFORDABLE HOUSING DEMAND

The increase in inflation rate has affected the medium income and low income groups at a large scale in terms of housing requirements. The increase in rate of construction materials day by day has led to escalate the construction cost which has went beyond limit of middle class society. The scenario demands for low cost affordable housing for all with involvement of both government and private sector. The land for such projects can be allocated through Central or State Governments through their own land available in and nearby urban areas or else government should exempt stamp duty and other land acquiring related taxes for the private real estate sector so that they buy such land and start the project. This can become the first step for price reduction of such schemes. The next step would be reduction or subsidy in rates for the construction materials used for such affordable housing schemes so that the builders, developers could be encouraged to work in these projects.

ANALYSIS OF AFFORDABLE HOUSING

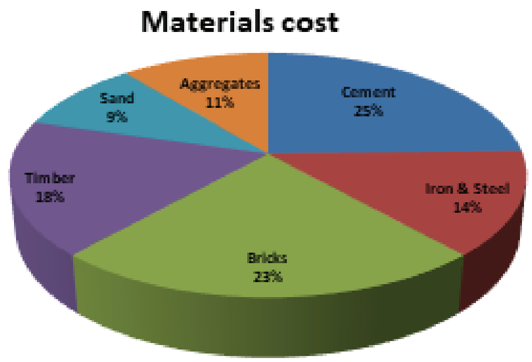

Fig. 1: Breakup of Cost of Housing

USE OF FOUNDRY WASTE SAND IN CONSTRUCTION

Waste foundry sand generated per day from the foundries is anyways of no use to the foundries. Waste management of foundry sand, now becomes important issue for foundries of the ferrous and non-ferrous family. Usually the foundries in which the CO2 sand is used creates more waste.

Transportation distance will usually be the largest economy factor in determining viable market. Hauling costs are generally the same as for other locally sourced sand and gravels. Small may be generated enough material on a weekly or a monthly basis to satisfy the need for construction sand.

1) For M-20 grade concrete, strength required is 20 N/mm2 Hence, if using foundry sand then it is recommended that upto 25% foundry sand is mixed to natural river sand to get same strength.
2) Strength is reduced as increase percentage of foundry sand in concrete due to

a) More fine than natural river sand.
b) Foundry sand is burned upto 14000C Hence required more water while mixing in concrete to get same workability. Due to increase in water content, strength is reduced.

COST ANALYSIS COMPARISON FOR USE OF FOUNDRY WASTE SAND IN CONCRETE-

1) Cost of natural sand =Rs.6800/-per cu.m
2) Cost of foundry sand = Rs.4200/-per cu.m.
3) Natural sand required for 10 cu.m of M-20 PCC = 4.2 cu.m
4) Cost of natural sand of 10 cu.m of M20 PCC = 4.2 x Rs.6800/- = Rs.28560/-
5) Cost of foundry waste sand for 10 cu.m of M20 PCC = 4.2 x Rs. 4200 = Rs. 17640/-

Hence, cost of saving in sand 10 cu.m of M20 PCC if natural sand is replaced by foundry waste crushed sand = (Rs. 28560/-) – (Rs.17640/-) = Rs. 10920 /-

CASE STUDY- 1 OF LOW COST AFFORDABLE HOUSING PROJECT

- Place- Islampur, Dist. Sangli, Maharashtra
- House Owner- Mr. Patil.

Introduction

A visit to a house at Islampur which is constructed in wire-cut bricks. A bungalow second of its kind, designed by Ar. Pravin Mali. His concept is to make use of bricks and construct a Arch or vault as a replacement for a conventional slab using wire-cut Khanapur bricks which will help to reduce the construction cost and provide a different Architectural aesthetics to the house without any extra expenditure on the Architectural features.

Major Features of the House

1. The bungalow is a G+1 structure having ground floor.
2. Ground floor consists of 1 Living room, 1 Kitchen, 1 Bedrooms and 1 Bath, 1 W.C.
3. Semicircular Arch is provided in each room instead of slab having regular dimensions of room.
4. The total height of the Arch above the ground is 3.2m.
5. The Arch is constructed in Khanapur wire cut bricks so no need of plastering and colouring.
6. For bonding purpose regular Cement mortar is used.
7. Steel reinforcement is not used anywhere in the Arch, it is completely made up of bricks.
8. The house has sufficient natural light throughout the day as well as ventilation by stack effect is maintained in the house without any provision of windows.

Fig. 2: Low cost bungalow

Fig. 3: Brickwork Roof top

Fig. 4: Walls

Fig. 5: Brick Parapet on Terrace

Case Study- 2 of Low Cost Affordable Housing Project

- Place – Inam-Dhamani, Dist.Sangli, Maharashtra
- Date – 22 Feb. 2012
- Owner – Mr. Mali.

Introduction

Site visit to a Brick vaulted house at Dhamani. A bungalow designed based on afforadable housing concepts.

Features

1. Before the expansion of existing bungalow, there was a small old fashioned house at that place in stone masonry.
2. Presently the bungalow is a G+1 structure having ground floor constructed in stone masonry.
3. Ground floor consists of 1 Living room, 1 Kitchen, 2 Bedrooms and 1 Bath, 1 W.C.
4. A Semicircular Arch is provided instead of slab having dimensions 14ft.x 50ft.
5. The total height of the Arch above the ground is 7m. It serves as a common roof for both ground floor and first floor.
6. The Arch is constructed in locally available bricks.
7. For bonding purpose regular Cement mortar is used.
8. Steel reinforcement is not used anywhere in the Arch, it is completely made up of bricks.
9. The staircase was constructed using steel and the wooden planks were used for the steps and landing and the staircase occupied a very less space, which gave a good look and at the same time reduced lot of space required for a regular R.C.C.

CONCLUSION

This research study indicates that the low cost housing buildings can be constructed with minimum cost with the help of latest alternative buildings materials like partial or complete replacement of use of natural river sand with foundry waste sand or crushed sand in construction reduced construction cost considerably. The case studies show that with proper architectural planning using semi-circular arch and natural ventilation concepts affordable low cost housing can be constructed with less maintenance cost. Use of hollow concrete blocks instead of burnt bricks helps in economy along with quality and good finish and strength. Bamboo can be used as reinforcement in beams, foundation work etc. Modern construction materials like precast wall panels can be used a partition member to reduce cost. Filler slab technology, mivan shuttering can be used for construction. The low cost and affordable housing projects can be made successful with the help of government subsidy for such construction projects along with smart project planning, management, use of alternative low cost materials specifically locally available and other cost effective techniques. With this strategies the cost reduction can be brought in the range to 25 to 30%

definitely with assurance of good quality and durability of the structure. The case studies show that using arch shaped masonry work, natural ventilation system, wooden light weight staircase etc. low cost housing projects can be done with minimum cost.

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Emerging Drone Technology and Advancements in the Construction Sector: State of Art

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ABSTRACT

New technology, particularly in communication and computer abilities, has aided the construction sector's rapid growth and improvement. We now have a drone as a tool. The drone can now map locations, monitor work in progress, inspect buildings, and detect and diagnose flaws. Previously, the military used it for espionage and cartography. Age and fatigue in infrastructure are significant challenges, particularly for bridges and elevated highways that have limited lifespans. Thus, this study looks at drones as an amazing technique. This concept employs visualization to use drones for structural and construction inspections. Drones may save time and money, increase site safety, take topographic measurements of large areas, and build structures such as bridges, roads, and highways through aerial surveying. Taking real-time aerial photographs of building elements and creating overviews that highlight assets and impediments might help enhance civil engineering. Operators can exchange photos with headquarters, on-site teams, and subcontractors. Online meetings allow planners to discuss project timelines, equipment, and terrain. The adoption of new trends, software, tools, and technologies would improve problem-solving. It enables contractors, building planners, designers, academics, engineers, and architects to improve construction performance and efficiency.

KEYWORDS: *Advance construction software, Construction stages, Construction technology trends, Drone technology, Unmanned Aerial Vehicle (UAV).*

INTRODUCTION

Unmanned aerial vehicles (UAVs) have grown in popularity in the construction sector due to their ability to provide complete views of distant locations and follow developments in real time [1, 2]. Radio waves or optical electronic heads can remotely control these drones, allowing for surveillance and monitoring without the need for a pilot or passengers. They do not need any additional infrastructure and have a quick reaction time for registering and monitoring certain areas or objects. Since drones became commercially available a decade ago, their use in the construction industry has increased by 239 percent. Drones have transformed workplace security, project documentation, surveying, and communication by delivering important information that would otherwise be expensive and time-consuming [3, 4]. We have widely used applications such as site and safety inspection, progress monitoring, damage assessment, and building maintenance. Commercial drones are tiny and affordable, enabling them to perform jobs more quickly and cost-effectively than people or manned aircraft. The next generation of drones needs less human interaction, which might reduce workplace dangers [5, 6].

TRADITIONAL METHODS

Surveying

Traditional survey methodologies date back a long time. However, there are several approaches that are quite popular and widely used. Before delving into the operation of UAVs in surveying, let's take a look at the three most frequent survey methodologies.

Scaffolding

Creates a platform from which an asset or location can be inspected from the shortest distance possible. The surveyors can use these platforms multiple times. Scaffolding has many advantages, but there are serious safety issues at work. It is possible for someone to accidentally drop a tool or piece of equipment from a high height. Furthermore, it is extremely risky for scaffolding machinery to break down.

Rope Access Inspection

Although it is safer than scaffolding, rope access inspection is not completely safe. A IRATA-certified rope access technician is in charge of carrying it out. However, no matter how skilled the professional is, there is always the possibility of dropping objects or making a minor error while handling the rope. Moreover, these errors pose a real risk to life during rope access inspection.

Inspection Using Mewp MEWPs

Mobile Elevating Work Platforms (MEWP) offer direct access to problematic site areas, but they are not suitable for all configurations and are expensive, making them unaffordable for many organizations. Despite safety concerns, human error and falling objects still occur.

Disadvantages of Traditional Methods	Advantages of Drones in Construction Technology
Costly	Faster Data Acquisition
Time-consuming	Workers' safety is improved
Require a lot of workforces.	Monitoring of Change
The biggest disadvantage is that you can't guarantee workplace health and safety with conventional methods.	Inspections
No customer focal point	Enhanced Safety and Monitoring
Lack of intuitiveness	Marketing
Lack of coordination	
No easy change	
Risk involvement and challenging development	

Fig. 1. Advantages of Drone Technology and Disadvantages of Traditional Methods

APPLICATIONS OF DRONE TECHNOLOGY IN CIVIL INDUSTRY

Builders use drones to gather real-time project data, improve progress tracking, and detect issues early. Civil engineering also uses them for precise monitoring and mapping of construction sites.

Construction and drone technology

BIM technology aids engineers, architects, and construction professionals in building planning, design, and management, with drone integration potentially enhancing productivity and risk identification.

Choosing a Location

Drone mapping is a remote sensing technology that uses drone data to create 3D maps of survey areas, aiding in planning activities like slope stabilisation and road construction.

Mapping by drone

Photogrammetry and LiDAR are drone mapping technologies used to create 3D models, utilising high-quality camera drones and specialised software for automated processes.

LiDAR

Photogrammetry and LiDAR are drone mapping technologies used to create 3D models, utilising high-quality camera drones and specialised software for automated processes.

Monitoring Progress

Drones enhance real-time project control in construction projects, providing accurate data collection, improved communication, and enabling access and monitoring for designers, engineers, managers, workers, and owners.

Health and Safety at Work

Drone technology can enhance the construction industry by providing real-time data, reducing accidents, and enabling direct monitoring of sites. It can also assist with driverless dozers, reducing the need for workers and safety personnel.

Photographing and monitoring the infrastructure

Drones offer cost-effective, cost-effective, and enhanced safety in infrastructure inspections, minimising risky activities and improving damage detection, evaluation, and restoration accuracy.

Detection of Damage

Disaster response uses drones for aerial imagery, hazard mapping, and building access, enabling efficient data collection, resource distribution, and risk-free radiation emissions monitoring.

Increasing construction site safety

Drone surveys improve construction site security by preventing trespassing, theft, and fire hazards, as well as providing audit trails. They monitor site entry and exit, reducing theft and equipment safety.

Problems Related to Traffic

Drones provide a low-cost aerial view during traffic surveillance, which involves monitoring vehicles in transportation networks. Drones can simulate traffic, prevent avalanches, and evaluate road surface conditions, collecting data for a quick response to transportation operations.

Risk and Safety Management

Unmanned aerial vehicles (UAVs) are crucial for construction sites due to their ability to maintain safe distances from risky areas like hazardous structures, fire hazards, or leaks. In the UK, drones can improve worker safety and risk management by capturing images from various angles and observing the entire scene in three dimensions. They can also save money, make tasks easier to reach, and enhance efficiency.

Accessing unsafe and inaccessible areas for the purposes of safety management and survey

Drones enable simple access to inaccessible areas, reducing safety concerns and time. They can examine roof structures from above and below, reducing the risk of accidents and allowing for more efficient risk management.

Goods Transportation

Drones enhance logistics by delivering equipment, goods, and notifications from the air. Their small size and simple control make them faster and safer than site vehicles. They also aid in material transportation, 3D building representation, and volume measurement.

Enhance cooperation

Drones in the construction industry enhance collaboration by collecting on-site data and disseminating it through platforms like BIM 360. This allows engineers, virtual design teams, superintendents, contractors, and owners to compare data, detect discrepancies, and improve project delivery.

To Show the Client the Progress

Drones provide visual data for clients to track construction projects, helping to sell services and keep them updated. They can send survey units, photos, scans, and render elevations in three dimensions for potential customers.

Utilizing mobile 3D mapping for surveying

The use of unmanned aerial vehicles (UAVs) for inspection, surveillance, mapping, and 3D modelling is growing, offering a cost-effective substitute for traditional photogrammetry and opening up new applications in short- and close-range domains.

Examining Assets

Drones can efficiently monitor construction assets through camera technology, enabling volumetric analysis of material stockpiles and tracking equipment location on the jobsite.

Analyses of Volume

Drone technology can efficiently track rule materials on construction sites, allowing for quick volumetric supply analysis. This helps determine the amount of content on hand, enabling efficient ordering and ensuring sufficient supplies for road surfacing and foundation laying tasks.

Tracking of Equipment

Construction sites require efficient transportation of equipment, posing a risk of human error. Drones can help manage this by quickly conducting flyovers to identify out-of-place and rented equipment, avoiding costly extension fees and ensuring timely completion of mission-critical tasks.

Fixed-Wing Drones
Multirotor Drones
Quadcopters
Hexacopters and Octocopters
Single-Rotor and Coaxial Drones
Hybrid VTOL Drones
Nano Drones
Fixed-Wing Vertical Take-off and Landing (VTOL) Drones
Solar-Powered Drones
Autonomous Drones
Fixed-Wing Vertical Take-off and Landing (VTOL) Drones

Fig. 2. Types of Drones

AI IN DRONE TECHNOLOGY CONSTRUCTION INDUSTRY

Artificial Intelligence (AI) is playing a crucial role in advancing drone technology within the construction industry, offering innovative solutions that enhance efficiency, accuracy, and overall project management. As AI continues to evolve, its integration with drone technology in the construction industry will likely lead to increasingly sophisticated applications. The combination of AI's analytical capabilities with the agility and versatility of drones is set to redefine construction practices, offering a future where projects are not only completed more efficiently but also with enhanced precision and safety.

CONCLUSION

Experts predict that drones will revolutionize the construction sector by reducing costs, increasing productivity, improving safety, and improving reporting accuracy. Drone technology will progress, making them smaller, lighter, more effective, and less costly. The construction sector is adjusting to technological learning curves by providing stakeholders with detailed, accurate, and geographical data. Drones may enhance survey accuracy, boost production and communication efficiency, and help with digital documentation. Thermography, modelling, delivery, site inspection, safety, and surveying are other areas where they find application. In the future, AI-powered drones will become available. Large engineering businesses are increasingly deploying drones in dangerous and unorthodox environments, and the construction sector appreciates their mobility and efficiency.

FUTURE SCOPE

Drone technology is set to revolutionise the construction industry by automating surveys, mapping sites, providing real-time insights, and improving site security. The integration of advanced sensors, artificial intelligence, and autonomous capabilities will make these devices indispensable tools for streamlining processes, reducing costs, and enhancing safety standards.

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Creating a Cleaning System with the Least Amount of Water Wasted for Small Overhead Water Tanks

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ABSTRACT

The development of an automated system for cleaning and filtering water tanks. This work addresses theproblem of lowering the turbidity of water by using filter media composed of non-biodegradable material.Materials that are not biodegradable were utilized, including human hair and plastic scrubbers. This is aclever and practical way to save maintenance expenses and simplify the cleaning of above tanks. The prototype has been built and has small, cylindrical water tanks fitted with a mechanical cleaning mechanism. There is only one simple centrifugal force mechanism in the mechanical system. The motorshaft is connected to a long, vertical arm that has two brushes and reaches to the water tank's deepestpoint, where the brushes make contact with the tank's inner walls. The cylindrical water tank's internalwalls are cleaned while the shaft spins in response to the power source with the help of a gear motor. Theprimary objective of this project is to minimize the amount of labor required from humans, save time, and shield workers from toxins that could be harmful to their health when they enter a water tank to clean it.

KEYWORDS: *Automated system, amount of labor required, centrifugal force mechanism, gear motor,non-biodegradable material.*

INTRODUCTION

Water is the most valuable resource on Earth. Water is essential to human health and life. Water is used by people for many different daily tasks. Water is used, for instance, in homes for drinking, cooking, bathing, and washing. Regular cleaning schedules and inspections are required to ensure the cleanliness of water tanks in residential areas and high-rise buildings. During these repair processes, there is a possibility of harm to both the consumers and the water operator's employees. There are times when cleaning syntax tanks requires the use of chemicals, which could waste water, increase maintenance expenses, and have a negative impact on public health. The risks connected with human examination can be avoided by using a filter system, which can also replace cleaning methods that include chemicals. The idea is to design a system that filters and recycles water with the least amount of water consumption. When the system is prepared for cleaning, the filtering process will start. This is a clever and useful way to reduce maintenance costs and simplify cleaning duties. This system'sfilters are made from readily available resources locally, like spent human hair and plastic scrubbers. This process is repeated until the turbidity of the water drops. A motor is used to pump the water through a filter and connect it to a tank in order to reduce the turbidity of the water. This process is carried out again and again. In the case that the filter becomes congested, the rear wash mechanism employs the same motor to clean it. Installing an automated water filtration system could help preserve India's water resources while also helping customers, concessionaires, and water operator's check their supplies. In today's world, cleaning the walls of the tank is a tedious process. Seventy one percent of the Indian population uses syntax tanks with a capacity of 500 lights or more. But cleaning these tanks is tedious as they are different in size, shape and height. To overcome this issue, we developed an automation system to clean the tank wall efficiently and safely. The mechanical framework consists of a bar attached to the arms and brushes at the closure points. The two arms are connected to the bar by a nut. The post can be pivoted to move the arms everywhere. The closeout can be turned with the help of D.C. The manual has been organized as an aid for people who will work and follow your tank cleaning machines. The water tank cleaner was used for cleaning the water tanks by using turning brushes. It was more powerful and protection than the traditional methods. This technique is able to clean water tanks in less time and human effort. The tank cleaning framework model is cleaning the tanks therefore making the activity simple to use.

LITERATURE REVIEW

Noorjannah Ibrahim (2016). This work presents the building of an automated water tank filtration system and a water turbidity investigation using a light-dependent resistor (LDR) as the sensing unit. An Arduino Uno microcontroller, a micro pump, a sensor device, and a water filter are the parts of the system. Determining the water's turbidity value and assessing the LDR sensing unit's ability to detect changes in water are the main objectives of this work. This investigation also addressed the function of the microcontroller in controlling the filtration system. For the turbidity tests, two different flow regimes were used: undisturbed flow and continuous flow. The LDR measurements will be impacted by these variables. The results show that in order to maintain a constant turbidity value in a continuous flow, a longer time lapse between LDR observations is required. The findings indicate that LDR sensing and a microcontroller may be used to create a system that measures the turbidity of water in tanks as well as other water resources like rivers, lakes, treatment facilities, etc. Installing and integrating an automated water filtration system into a customer's smart home system may make it easier for them to monitor their water tanks.

G. BHASKAR (2019-20) The purpose of this project is to create a mechanical system for cleaning a cylindrical domestic water tank. A component of the mechanical system is a fundamental centrifugal force mechanism. The left-hand fleming rule, which converts fundamental electric energy into rotational energy, is the foundation of this mechanism's operation. The cylindrical water tank's interior walls are cleaned as the power source and gear motor help the motor shaft spin. The motor shaft is connected to a long, vertical arm with two PVC brushes that extends to the end of the inner tank layer, making contact with the inner walls of the tank through the brushes.

Shubham Shrivastav (2019) have added to the "Round and hollow Water Tank Cleaner Plan and Improvement" project. Make a mechanical system, as he would see it, to clean a private tube shaped water tank. Two components are utilized in this framework: a four-bar linkage bar system and a rack and pinion gear instrument. The round and hollow water tank's internal walls are cleaned by a rack and pinion. In this framework, fundamental electric energy is changed into rotational energy utilizing the left-hand Fleming rule. The shaft of the DC engine is associated with an upward arm with, and the brushes are joined to the internal mass of the aquarium. At the point when the power is turned on, the shaft is pivoted by an equipped engine, for example, a stuff engine. This is the point of this task is to lessen human exertion and time and stay away from compound consequences for the strength of individuals who enter the aquarium for the end goal of cleaning. The aquarium cleaning technique, which cleans within the aquarium, is more successful and more secure than conventional strategies. This strategy permits you to clean your aquarium quicker than expected. High level model softank cleaning frameworks clean the tank and make the processuser-accommodating.

SCOPE OF THE PROJECT

One of the most essential basic needs without which life cannot even be considered—is water. Every person drinks about 100 gallons (or 455 liters) of water each day, according to a survey. Water is used for cleaning, drinking, mopping, brushing, and other home tasks. Water is thus kept in overhead water tanks in a cylindrical shape to ensure a steady supply for our daily needs. Over time, these tanks accumulate dirt. Within the tank, sediment algae proliferate and scale begins to accumulate on the walls. Algae Bloom is the term for the extremely dangerous algae that grows in water. Because of these contaminants, water cannot be used. In addition to affecting the liver and nervous system, eating or drinking water tainted with alga can cause a host of other illnesses. Algae and sediments accumulate on the water tank's walls, ceiling, and floor, and bacterial infections can also happen, necessitating routine tank cleaning. The water is contaminated by this deposition and becomes unsafe to drink. Over time, bacteria and algae in this water grow and reproduce, contaminating it and possibly causing illness to humans. Therefore, it is crucial to clean your water tank. 1. A small working prototype of the cleaning mechanism for the circular tank's walls was created for this project. 2. In addition, there is a tiny filter unit where human hair waste is kept.

OBJECTIVES OF THE PROJECT

The proposed study aimed to achieve the following goals:

1. To design a prototype that can effectively clean the walls of a circular tank.
2. To set up the filter unit by utilizing plastic polymer scrubber and human hair as filter media. to filter the murky water left over after the water tank has been cleaned.3.To as certain the system's backwashing cycle.

METHODOLOGY

The following approach was used in the study:

1. A 300 m m long, 100 mm diameter PVC pipe was used to create the prototype, which was then attached to pipes used for water circulation using reducers.
2. Plastic polymer medium and waste human hair was used as filter media to assess the in line filter's performance. The primary evaluation parameter was the turbidity of the water.
3. Create a system that removes turbidity from cleaning tank water so that it can be circulated again.
4. Using turbidity break through to calculate the backwashing cycle.
5. A proto type was made out of 450 m m of 12m m diameter PVC pipe, to which two arms were fastened with brushes.
6. The PVC pipe is rotated by a 12Vgear motor.

The Model for Cleaning Inward Surface of Water Tank

A jazzed up plan of the model has been made. An electronic tank cleaning machine is a machine used to clean the above tanks such those found to store the water. Tanks ought to be cleaned occasionally considering various elements.

3 D Model of the Cleaning Machine

The water tank can be consequently cleaned, which sets aside time and cash. Huge water tanks put in structures, and apartment buildings make the best contender for robotized tank cleaning. Nowadays, experts and organizations that utilization programmed tank tidying devices appear at their entry ways prepared to clean the water tanks in a brief time frame. Hardware for programmed tank cleaning has the advantage of saving you time. Moreover, you can disinfect the water tank without going within it. Programmed tank cleaning hardware suppliers normally give an exhibit of their merchandise with the goal that clients can pick the suitable cleaning answer for the tank. Picking the right tank purifying technique cleaning is made compelling by the spout. The purging is finished and the chlorine test shows no residuals. Cleaning above water tanks is important to forestall waterborne ailments, skin conditions, hostile scents, unfortunate preferences, and uncommon varieties. Utilizing pivoting brushes, the water tank cleaner was utilized to clean the water holders. In contrast with the conventional methods, this one was both more productive and secure. This method can clean water holders all the more rapidly and with less assets. The tanks are being cleaned with a high level tank cleaning gadget, which makes the interaction easy to understand. A machine called a robotized tank clothes washer is utilized to clean above tanks, similar to the ones used to hold water. Tanks should be cleaned sometimes for various purposes. The essential legitimization for cleaning the tank is to forestall contagious development. Thus, successive upkeep or tank reviews are required. Mechanized tank purging hardware works much the same way to a wall more clean. A D.C engine of around 12Vwhich runs at 70 rpm. The brushes are associated with PVC pipes. After the total arrangement, the engine pivots and the brushes turn at the outer layer of the tank.

Channel Media Utilized for Filtration

In this channel plastic polymer medium (scrubbers) and waste human hairs are utilized to filtrate the turbid water. Scrubbers trap suspended particles by direct contact with water. Basic arrangements of wet plastic polymer are utilized. The stream decreasing valve might be utilized for managing the water stream conditions. Additionally the additional t-segment to diminish the additional water pressure was given to keep up with fitting the stream rate. Exceptionally high water stream rate can influence the channel media and won't eliminate the turbidity upto beneficial proficiency.

Procedure Adopted

In this cleaning framework the plastic polymer and waste human hair blend are utilized to eliminate the turbidity of water. At the point when engine is turned over the bay line which is furnished with t-area and valves it inspires the water from tank then it goes through channel media. Channel media comprise of 3 layers. Base layer comprise of plastic polymer, center layer comprise of waste human hair and to player comprise of plastic polymer. Separated water through channel media is again gone through outlet line to the tank. For this filtration interaction stream pace of the water is kept up with by 15 lit/min by utilizing valve and area. Motivation behind controlling stream rate is, when high stream rate is there in framework turbidity isn't eliminated. It discarded with speed and slide over the channel media.

CONCLUSION

The accompanying ends are drawn in light of the examination and translation of the outcomes got.

1) Using pivoting brushes, the water tank cleaner was utilized to clean the water holders. Contrasted with conventional methods, this approach is more productive and secure also. The high level tank cleaning framework

utilized by this procedure can clean water tanks with less time and human exertion, making the cycle easier to understand. The functioning model is promising both with regards to conferring neatness sand keeping away from overabundance labor supply.

2) The necessary endeavors in the even to manual cleaning can be disposed of.

3) The water squandered during the most common way of cleaning can be separated utilizing the little channel unit, which can be utilized form on-consumable purposes.

Waste materials like human hair and plastic polymer scrubber can be utilized as a media of channel.

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Assessing Seismic Performance of G+4 Buildings in Seismic Zone III through ETABS Analysis: Exploring Configurational Variations

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ABSTRACT

Modern building development and design predominantly prioritise architectural aesthetics and preferences. Many buildings adopt square or rectangular designs, often with non-parallel x and y coordinates. The susceptibility of building configurations to earthquake damage is increasing, with slender ratios posing a significant concern. This article aims to conduct a comparative exploration of the dynamic behaviour of structures within seismic zone III, characterized by medium soil conditions and diverse structural layouts. This studies the 4-floor building of height fifteen meters located in zone 3 of the seismic zone. Thus, the study aims to assess the performance of G+4 storey buildings in earthquake zone III with medium soil conditions. Each frame is subjected to identical gravity loading during analysis, and seismic analysis employs the response spectrum method. The outcomes are evaluated using ETABS software for comparison.

KEYWORDS: *Analysis, Design, Dynamic response, Gravity loading and response spectrum.*

INTRODUCTION

The majority of buildings in India is low-rise constructions. The population of most major cities is growing these days as a result of increased migration towards urban areas. To accommodate the growing population on the restricted land, construction heights are becoming a medium for high-rise structures. The art and science of creating a functional, elegant, long-lasting structure with economy and grace is known as structural planning and design. In addition to creativity and innovative thinking, a solid understanding of structural engineering science is necessary for the entire structural planning and designing process. This includes familiarity with applicable design rules and bylaws as well as practical details supported by real-world experience.

ETABS 2016 has compatibility which extends to steel, concrete, wood, aluminium, and cold-formed steel materials. The software encompasses a comprehensive suite of features, facilitating tasks from design and analysis to model creation, result visualization, and validation.

The contents of ETABS 2016 are as follows: The Graphical User Interface of Etabs 2016: It is employed to create the model, which the Etabs 2016 engine may subsequently be used to assess. The results can also be shown graphically using the Graphical User Interface once analysis and design are finished. The analysis and design engine for ETABS 2016.

For a structural engineer to perform a thorough analysis, it is essential to gather information regarding structural loads, geometry, material properties and support conditions typically, this analysis yields data such as displacements, stresses, and support reactions. Subsequently, this data is compared against standards that define failure conditions.

The following are the research objectives:

1. Employing the response spectrum method for dynamic analysis, the G+4 story building is assessed utilizing ETABS 2016 software in accordance with IS456: Design of Concrete Structure.
2. To Utilize software tools, referring IS 1893 : Part 1 which gives Guidelines for crafting earthquake-resistant structures for the G+4 storey building.
3. Conducting a comparative analysis of diverse parameters across Zone III regions.
4. The research objective involves quantifying earthquake-induced displacement

METHODOLOGY THEORETICAL FORMATIONS

This parametric research title presents a thorough analysis of the high-rise structure's design utilizing IS codes. Research on reinforced concrete structures has been conducted. Indian Standard with Response Spectrum Method has been used to analyze each of the aforementioned structures. Additionally, studies on the cost- effectiveness of structures have solely looked at material costs.

Table 1: Building Characteristics Overview

Sr. No	Factors	Data
1	Material	Reinforcement Fe-415 Mpa and Fe-500 Mpa
		Concrete grade M25
2	Ductility Class	IS1893:2016 SMRF
3	Masonry density	20KN / M^3
4	Model To Be Design	G+4 story
5	Height Of Each Story	3.0m
6	Ground Story Height	1.2 m
7	Slab Thickness	150mm
8	Poisson's Ratio	Steel- 0.2 & Concrete- 0.15
9	Seismic Zone for IS1893:2016	III
10	Concrete density	25KN / M^3
11	Importance Factor	1.0
12	Earthquake Load	As Per IS 1893-2016
13	Floor Finish	1KN/M^2
14	Live Load	2KN/M^2
15	Code Adopted	IS456:2000, IS1893:2016
16	RRF	5
17	Column Size	450x230, 530x230 & 600x230
18	Size Of Beam	450x230, 380x230, 300x230
19	Foundation Soil	Medium

Types of Loads

1. DL: Load due to permanent or fixed elements.
2. LL: Load due to variable or moving elements.
3. EQ: Load induced by seismic activity.

Combination of loads

A) 1.5DL + 1.5LL

B) 1.2DL + 1.2LL + 1.2EQ

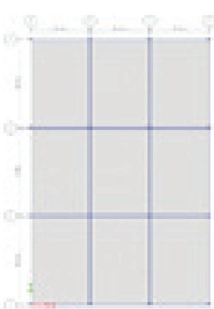
C) 1.2DL + 1.2LL - 1.2EQ

D) 1.2DL + 1.2LL + 1.2EQ

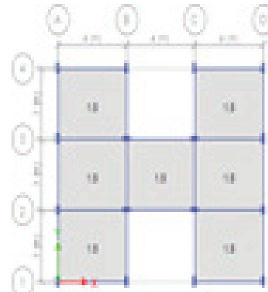
E) 1.2DL + 1.2LL - 1.2EQ

F) 0.9DL ± 1.5EQ

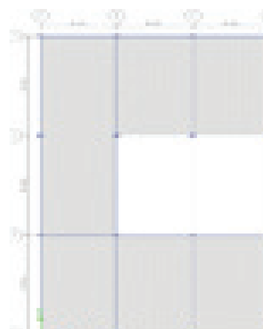
Model Screenshot



A. Shape - Rectangle



B. Shape - H



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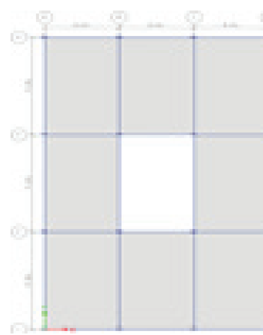

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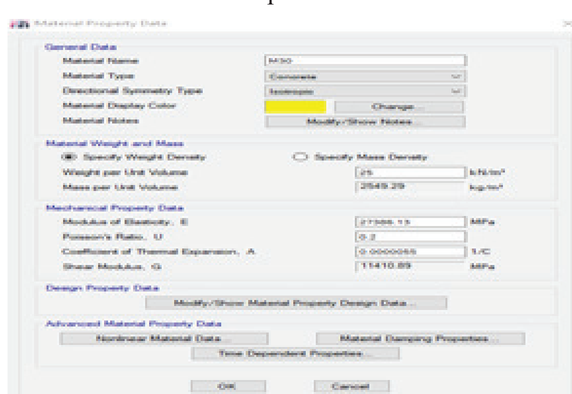
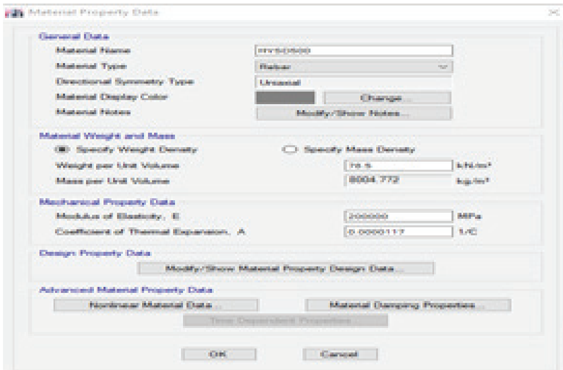
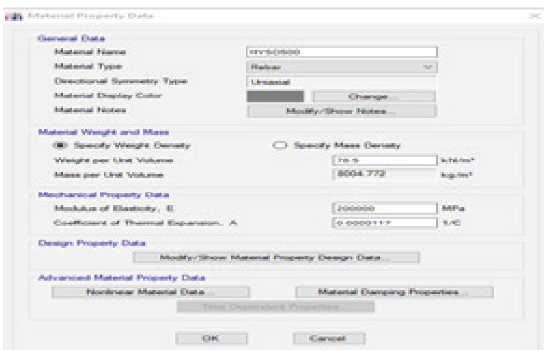


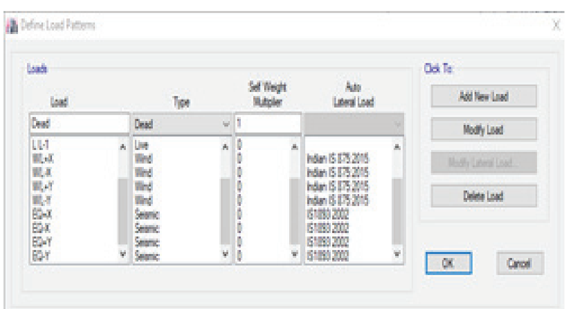
Grade of Concrete Define



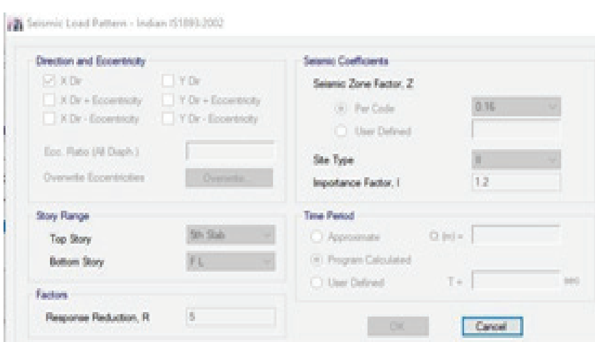
Grade of Steel Define



Mass Source Define



Load Pattern Define



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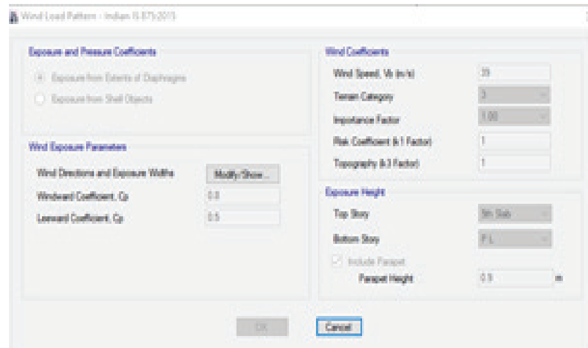
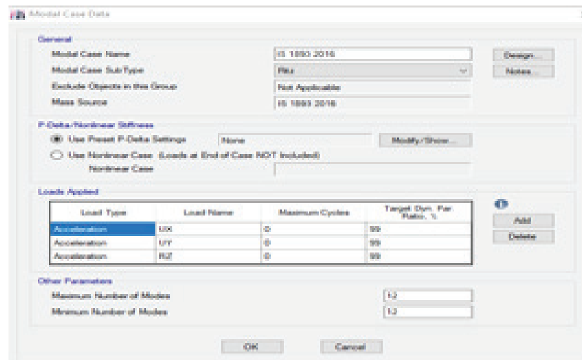
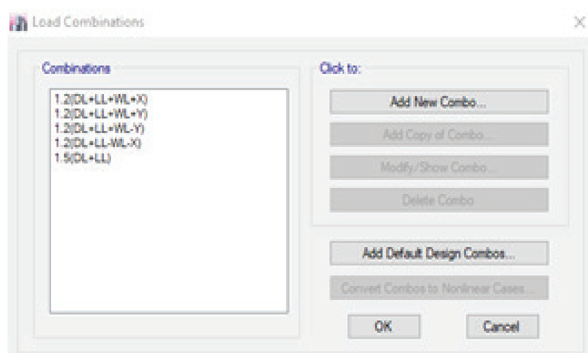


Wind Load Define



Modal Case Define

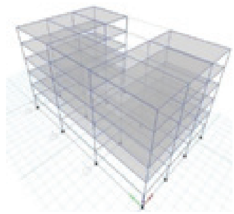


Load Combinations Define

D Models

3D Rectangular Model

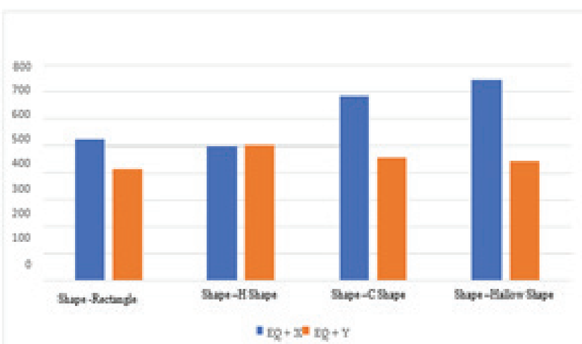
3d H- shape Model



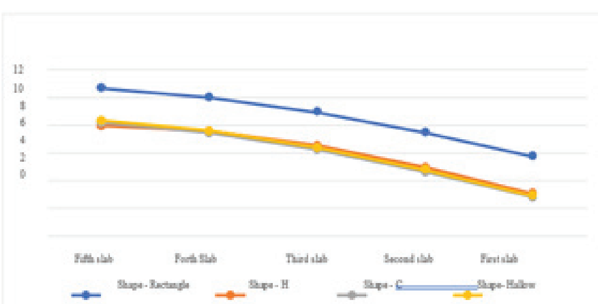
3d C-Shape Model

Hollow Shape Model

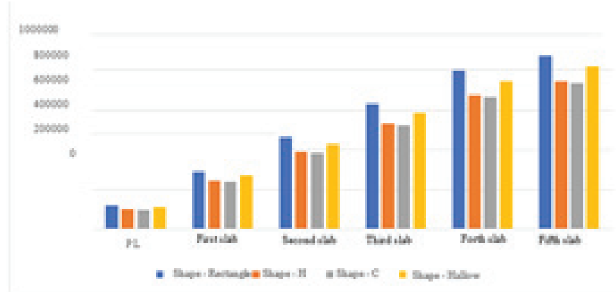
RESULT AND DISCUSSIONS



Graph 1: Base Shear Comparison Across Building Shapes



Graph 2: Story Drift Comparison across Building Shapes



Graph 3: Comparative Analysis of Story Moment Across Various Building Shapes

CONCLUSIONS

This research investigates the comparative analysis of a reinforced concrete composite (RCC) structure featuring different building configurations, such as rectangular, H-shaped, C-shaped, and hollow shapes, comprising a G+4 story building. The analysis considers structures situated in medium soil conditions within earthquake zone III, and subsequent results are contrasted. Various structural attributes, including base shear, story drift, reactions, and moments, are used. Following are Analysis-Derived conclusions.

1. An investigation of an RCC structure situated in seismic zone III with medium soil conditions and featuring diverse structural configurations, such as rectangular, H-shaped, C-shaped, and hollow designs. Relative to a hollow-shaped building, base shear along X-direction experiences elevations of 5%, 30%, and 41.4% for the H-shaped structure.
2. The results show that the base shear variation increases in rectangular, C-shaped, and hollow buildings compared to H-shaped buildings. This means that the self-weight of these shapes is maximum in rectangular, C-shaped, and hollow buildings, making H-shaped structures more cost-effective than other types of buildings.
3. When comparing story drift in rectangular buildings to H-shaped, C-shaped, and hollow-shaped buildings, the drift in the rectangular buildings is 35% higher than in the H-shaped, C-shaped, and hollow- shaped buildings, but both buildings perform well overall in terms of story drift.

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Domestic Wastewater Management System in India: A Review

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ABSTRACT

India uses a multimodal approach to domestic wastewater treatment that includes community involvement, infrastructure development, and legislative frameworks. India, whose population is expected to grow to over 1.3 billion people, has enormous problems with its household wastewater, which are made worse by the country's rapid industrialization and urbanization. The purpose of this study is to examine the problems and existing circumstances surrounding the development of the residential wastewater management system in India. This review paper provides an in-depth analysis of domestic wastewater treatment in India. Critical literature is presented in order to understand the quantity of domestic wastewater treatment systems that are accessible in India. It also highlights a comparative analysis of the domestic wastewater treatment systems that are now in use such as decentralised wastewater treatment systems (DEWATS), which includes membrane bioreactors (MBR), constructed wetlands (CW), anaerobic baffle wall reactors (ABWR), septic tanks (ST), Rotating Biological Contactors (RBCs), Sequential Batch reactors (SBCs), biogas digesters (BD), etc. In order to accomplish the intended results, further work is required to solve issues and carry out the domestic wastewater management system's installation.

KEYWORDS: *Decentralised wastewater treatment systems (DEWATs), Household wastewater, Industrialization and Urbanization.*

INTRODUCTION

Water is widely recognised as "the elixir of life" and an essential resource for household, industrial and agricultural uses. It is also true, though, that our access to clean freshwater is restricted. Reusing treated wastewater has become more popular as a result of the global shortage of water. Over the past century, the amount of water used worldwide has increased six times and it will continue to rise at a modest pace of 1% year. Furthermore, the problem of water security has been made worse by changes in rainfall patterns, a fast growing population, urbanisation, and industry [1].

India has seen rapid industrialization and urbanisation, which has accelerated the nation's economic growth. Water management hasn't, however, kept up with the demand for water or the production of wastewater. There is a significant discrepancy in the amount of wastewater generated and installed treatment capacity, and the current sewage network and wastewater treatment plant (WWTP) infrastructure is insufficient for the population of India. The Central Pollution Control Board (CPCB) estimates that India's metropolitan centres generate 72,368 MLD of sewage annually, of which only 37% can be treated by the country's current treatment capacity. Wastewater treatment is absent from the majority of rural and peri-urban regions [2].

In India, domestic wastewater treatment is a critical component of water management strategies aimed at preserving public health and environmental integrity. With rapid urbanization and industrialization, the volume of wastewater generated from households has surged, posing significant challenges to water resources and sanitation infrastructure. Domestic wastewater typically contains a complex mixture of organic matter, nutrients, pathogens, and pollutants, necessitating comprehensive treatment processes. Wastewater treatment facilities across the country employ a combination of physical, chemical, and biological treatment methods. These processes include preliminary screening and grit removal, primary sedimentation, biological secondary treatment (such as activated sludge or trickling filters), and tertiary treatment for further purification. Efforts are made to ensure compliance with national and local wastewater discharge standards, although challenges remain in terms of infrastructure development, operation, and maintenance. Furthermore, sludge management and disposal present additional complexities, requiring proper handling and treatment to minimize environmental risks. Despite these challenges, ongoing research, technological innovations, and policy initiatives are driving advancements in domestic wastewater treatment practices, with an increasing focus on resource recovery, water reuse, and sustainable management approaches tailored to the diverse socio-economic and environmental contexts of India. The researchers claim that either a decentralised or centralised approach is used to treat wastewater. A decentralised wastewater treatment (DEWATs) is preferable since it is more convenient, economical, and needs fewer upkeep and operation costs.

Following are some commonly used DEWATs for domestic wastewater treatment: Membrane bioreactors (MBR), constructed wetlands (CW), anaerobic baffle wall reactors (ABWR), septic tank (ST), rotating biological contactors (RBCs), sequential batch reactors (SBCs), biogas digesters (BD), etc.

Membrane Bioractors (MBR)

With a number of benefits over traditional treatment techniques, Membrane Bioreactor (MBR) technology is a cutting-edge alternative to treating wastewater at home. MBR creates a small and effective method for removing pollutants from wastewater by combining membrane filtration with biological treatment techniques. Mature Biological Reactors (MBRs) have been popular in India for treating household wastewater because they generate high-quality wastewater that can be recycled, which helps to alleviate water scarcity and encourages sustainable water management techniques [3].

Constructed Wetland (CW)

In India, constructed wetlands, or CWs, have become a popular and eco-friendly method of treating domestic wastewater. They provide a long-term solution by using the body's natural processes to clean wastewater. Wastewater is routed through designed wetland cells filled with carefully chosen vegetation, such as emergent plants like reeds, cattails, or bulrushes, in a constructed wetland system. Contaminants and pollutants are eliminated when the wastewater passes through the wetland due to a variety of physical, chemical, and biological processes [4].

Anaerobic Baffle Wall Reactor (ABWR)

An effective method for treating residential wastewater in India is the Anaerobic Baffle Wall Reactor (ABWR), a specialised type of anaerobic treatment technology. Because ABWRs are built to effectively remove organic pollutants and create biogas in an oxygen-free atmosphere, they are especially well-suited for areas with limited energy and resource availability. This novel reactor design is made up of many chambers or compartments divided by baffle walls. This creates a hydraulic flow pattern that encourages the anaerobic breakdown of organic materials by certain microbes [5].

Septic tank (ST)

In both rural and urban regions, septic tanks are a popular and extensively utilised on-site wastewater treatment method for household sewage. These subterranean facilities effectively purify wastewater before it is released back into the environment despite their straightforward construction. Septic tanks are essential for handling domestic waste in India, especially in places where centralised sewage systems are unreliable or unfeasible [6].

Rotating biological contactors (RBCs)

Domestic wastewater is treated using a sort of fixed-film biological wastewater treatment technology called rotating biological contactors (RBCs). A slow-rotating horizontal shaft holds a number of closely spaced, parallel discs or media in RBC systems. The wastewater passes over the revolving discs, causing a biofilm of microorganisms to form on their surfaces. These microorganisms break down and digest the organic contaminants in the wastewater [7].

Sequential batch reactors (SBCs)

The extremely effective and adaptable Sequential Batch Reactor (SBR) biological treatment technique is used to treat domestic wastewater. An automated sequencing system controls the batch operations of loading, reaction, settling, decanting, and idle phases that wastewater goes through in a single reactor tank throughout an SBR system's treatment. High-quality effluent may be produced with flexibility by optimising treatment parameters thanks to this cyclic operation [8].

Biogas digesters (BD)

Innovative devices called biogas digesters (BD) are used to treat household wastewater and produce biogas, a renewable energy source, all at the same time. These digesters clean wastewater and generate biogas by means of anaerobic digestion, a biological process in which microorganisms break down organic matter in the absence of oxygen. The majority of India has embraced these DEWATs. DEWATs are utilised in accordance with the site circumstances and environment appropriateness. Comparing DEWAT systems is challenging since each system is specifically designed for a different type of wastewater treatment. The results of the study indicate that CW is a better way to treat domestic wastewater since it uses less energy, takes up less space to construct, and is a practical and affordable solution. In the next chapter, the detailed literature for the information provided above is explained.

LITERATURE REVIEW

Koul B et. al. (2022) reviewed that the fast urbanisation and population growth would exhaust clean water supplies by 2050. When selecting a technique for domestic wastewater treatment (DWWT), factors such as the type of waste, its concentration, heterogeneity level, and percentage of clean-up required, as well as the practicability, efficiency, operational challenges, environmental impact, and treatment costs, must all be taken into account. The functions of traditional approaches in DWWT are the main topic of this review, together with their benefits, drawbacks, and potential future applications.

Vijayanandan, Arya et. al. (2023) states that the selection of treatment technology is critical in achieving the required quality of treated wastewater. Technology upgrades are required considering the increase in wastewater generation and the occurrence of toxic and contaminants in wastewater. It is best to prevent the entry of untreated industrial effluent into the municipal sewage system. Fit-for-purpose treatment plans are required, not end-of-pipe ones. Regarding wastewater reuse, there are no precise regulations or requirements. Decentralized and on-site treatment systems must be promoted in peri urban and rural areas as short-term pollution control measures. Moreover, most of the popular DEWATS focuses on wastewater reuse and resource recovery.

Bilad, M.R. (2017) studied MBR as an advanced wastewater treatment technology for both residential and commercial applications. This paper review's goal is to give an overview of MBR technology and its applications in wastewater treatment. It covers talks about the basic, central issues (membrane fouling), the most recent successful development strategy (dynamic filtration systems), and the future course of MBR research. There is also a discussion of MBR membranes and the connection between membrane characteristics and MBR performance. Dynamic filtering systems, one of the most promising MBR technologies particularly designed to handle membrane fouling, are also included in this review. Last but not least, a strategy for resolving MBRs' difficulties as well as current findings and advancements are discussed.

Kumar S and Dutta V. (2019) studied constructed wetlands (CWs) are considered as green and sustainable techniques which require lower energy input, less operational and maintenance cost and provide critical ecological benefits such as wildlife habitat, aquaculture, groundwater recharge, flood control, recreational uses, and add aesthetic value. The evaluation of CW as a sustainable solution for the removal of heavy metals, organic matter, and nutrients from home wastewater is provided in this review study. A brief overview of CW and its components is given first, and then therapeutic methods, key ingredients in the treatment process, and overall efficacy are described. Lastly, the challenges and consequences of ecological issues on their long-term operations are emphasised.

Saif, Yasmin et. al. (2021) studied the effectiveness of a four-chambered anaerobic baffled reactor (ABR) as a sustainable and affordable technique of removing pathogens and organic pollutants from domestic wastewater under various environmental circumstances was investigated. Analysis of the chemical oxygen demand (COD), total nitrogen, sulfate and phosphate load, and total coliform removal for 2 years of operation, 2015 and 2017, showed a COD of 46%, sulfate load of 28%, phosphate load of 51% and total nitrogen of 28% for 2015, compared to a COD of 48%, sulfate load of 44%, phosphate load of 58% and total nitrogen of 31% for 2017. The ABR's overall effectiveness rose in the summer, especially in terms of pathogen elimination, which was noticeably more effective in the summers of both years. Overall, it was discovered that the ABR could reliably treat primary wastewater; nevertheless, prior to water reuse or ultimate release, tertiary effluent treatment was still necessary.

Nasr et. al. (2015) presented the treatment of domestic wastewater using conventional, single-baffle, two-baffle, and packed-type septic tanks. Three hydraulic retention times (HRTs), ranging from 24 to 72 hours, were used to continually feed domestic wastewater into the septic tanks. Nearly equal amounts of volatile organic materials were present in the sludge on average. The order of when to desludge a septic tank at each HRT was found to be conventional > single-baffle > packed-type > two-baffle. The two-baffle or packed-type septic tank is seen to be a feasible option for the on-site decentralised treatment of high-strength residential wastewater, especially in rural communities, based on the obtained findings.

Waqas et. al. (2021) examined the biological performance of RBC, which is utilised to treat synthetic home wastewater at high hydraulic and organic loading rates. According to the findings, the RBC was able to obtain treatment efficiencies of 70.2%, 95.2%, 70%, and 78.9% for COD, ammonium, TN, and turbidity, respectively. The presence of nitrifying bacteria, which actively break down the nitrogen compounds through the nitrification process, is indicated by the effective nitrogen removal and elevated nitrate content. For decentralised applications, this system is a good substitute for treating wastewater from both homes and businesses.

Mahvi, A. H. (2008) evaluated a modified activated sludge technique using a sequencing batch reactor to treat wastewater from industries and municipalities. This paper also states that SBR resulted in higher percentage removal of biochemical oxygen demand (BOD), chemical oxygen demand (COD), total nitrogen, total phosphorous etc.

Noyola, Adalberto et. al. (2006) studied BD as a promising approach towards domestic wastewater treatment. There are a fair number of treatment technology choices available for biogas cleaning and odour control. Technical, financial, environmental, and safety considerations should all be taken into account when selecting a certain technology. Technically speaking, factors like pollutant properties (composition, concentration, reactivity, solubility, and biodegradability) and stream variables (flow, temperature, and humidity) must be assessed. The majority of small anaerobic municipal treatment facilities vent their biogas, which releases pollutants from the water into the environment and adds to the inventory of greenhouse gases. Given the simplicity of this technology and the need to address anaerobic treatment alternatives, biological processes, such as compost biofilters, should be developed for the removal of methane prior to biogas venting in order to address this issue.

LITERATURE SUMMARY

There are several different domestic wastewater treatment systems available, as may be seen from the literature mentioned above. These solutions are available for treating domestic wastewater according to the efficiency, cost-effectiveness, and site circumstances. Despite studying DEWAT's approach extensively, no researcher standardised the process. A few numbers of researchers present a comparative analysis of the current DEWAT systems.

CONCLUSION

The implementation of decentralised wastewater treatment systems (DEWATS) in India has considerable potential in mitigating the obstacles related to the management of domestic wastewater. DEWATS have a number of benefits, including as affordability, flexibility in responding to changing demographic and geographic conditions and environmental sustainability. Communities may lessen the strain on centralised systems, lessen water body pollution, and enhance public health results by decentralising wastewater treatment. But for DEWATS to be successfully adopted in India, a coordinated effort from a range of stakeholders including local communities, NGOs, government agencies, and business partners is needed. It is recommended that this endeavour include policy support, capacity building, technical help, and awareness campaigns to guarantee the efficient deployment and upkeep of DEWATS infrastructure. Furthermore, long-term sustainability depends on incorporating DEWATS into more comprehensive urban planning and development initiatives. In conclusion, adopting decentralised wastewater treatment systems in India is a vital step in the direction of attaining equitable and sustainable development objectives. India can improve water security, safeguard public health, and foster environmental resilience in all of its communities by utilising DEWATS to its fullest potential.

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Using Common European Framework of Reference for Languages (CEFR) in Curriculum and Assessment Design

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ABSTRACT

After gaining experience of teaching Communication Skills to Engineering Courses in the whole tenure of University syllabi, many observations were gathered regarding planning and execution of the said syllabi. Professional courses like Engineering and Management need communication skills and ELT centered subjects specifically as they complement the employability of their students. The aim of this research was to present a possible EFL curriculum and assessment design in line with the principles on the CEFR (Common European Framework of Reference for Languages). According to the findings of the research, it was pointed out that to be able to communicate the development of four language skills are necessary for language learners. It will be better if there is consistency of content for learning and teaching these skills with real life situations. Accordingly, the employment of communicative language teaching methods, strategies, and techniques, and the use of alternative testing and assessment should be taken into consideration in the process of designing and developing key components of a CEFR-based English Language curriculum for foreign learners.

KEYWORDS: *CEFR, Basic linguistic skills, Assessment, Curriculum, Fluency, Descriptors.*

INTRODUCTION

For the systematic assessment of the proficiency levels of the students of the languages, the Common European Framework of Reference for Languages (CEFR) is used extensively. Whether you're learning a new language or seeking to prove your language proficiency, understanding CEFR levels is essential. The Council of Europe created this widely used framework to impart 'a common basis for the elaboration of language syllabuses, curriculum guidelines, examinations, textbooks, etc. …'1. Its main purpose was to support "transparency and coherence" in language teaching by serving as a planning tool. The CEFR is very useful for faculty and students concerned with teaching and learning of English language especially in the following three areas.

Language Teaching and Acquisition: The CEFR defines certain language skills at various competency levels, providing a clear road map for both teachers and language learners. It supports students in setting objectives, monitoring their development, and selecting relevant readings and courses. The framework can be used by educators to create tests, organize classes, and modify instructions to fit the requirements of students.

Curriculum Development: A framework for creating language syllabi that adhere to globally accepted standards is provided by the CEFR. It helps educational institutions create logical language curricula, set learning objectives, and make sure that students with varying levels of proficiency fulfill those objectives.

Language Tests and their Assessment: The CEFR is frequently used in language tests and their assessments. Language competencies can be measured accurately and consistently through the examinations and assessments based on this framework. The test setters can take help of CEFR levels in comprehending the results and deciding on their language abilities.

The Council of Europe released the CEFR in 2001 as a framework that outlines language learners' proficiency in spoken language, reading, writing, and listening at six reference levels.

These six levels are named as follows:

Table 1. Language Competency Levels

Proficiency Level	What it indicates
C2	mastery in the language
C1	effective operational proficiency
B2	considerable proficiency

B1	ability for independent use of the language
A2	low to middle level proficiency
A1	basic use proficiency

We know that the CEFR is not prepared for any specific language or context. It is not intended to constitute a curriculum or a list of learning objectives, nor does it seek to cover every aspect of language, such as vocabulary, grammar rules, or syntax. Users must modify how they utilize it to suit the language they are using and the situation they are in. The freshly admitted engineers, who come from a variety of backgrounds and speak different languages, provide the current context. Since it is anticipated of these students to become more proficient in English for communication, the curriculum is developed to strengthen the LSRW abilities that they will require. They must acquire a variety of skills, including general and specifically communicative language skills. By using the CEFR levels for their first evaluation of language competency, they were able to identify the main areas that needed improvement as a group and specifically designed language lab exercises. It was beneficial for both the teachers as well as students because they can predict the desired changes in their attributed roles. The CEFR integrated two recently developed language learning approaches like the functional approach and the communicative approach. It has been proved as a very effective tool for the agreement of various stakeholders regarding the standards in language qualifications. These stakeholders include students, teachers, board of studies, examination bodies, and administration. The CEFR is flexible enough to adapt to new developments in teaching and learning and to be age-relevant.

CEFR provides a model of language use which is called as the action-oriented approach. This model is in short:

"Language use, embracing language learning, comprises the actions performed by persons who as individuals and as social agents develop a range of competences, both general and in particular communicative language competences"[2].

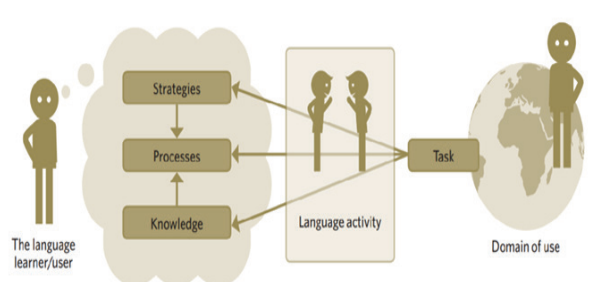

Fig. 1. CEFR's model of language use and learning[3]

The figure depicts a language user whose developmental competence reflects different cognitive processes, strategies and knowledge. The figure places language activity at centre in this model. Language ability is concrete performance in speaking, writing, reading or listening (real world or classroom experience). By observing this activity, teachers can provide students with useful formative feedback, which in turn leads to learning of user.

USING THE CEFR IN CURRICULUM DESIGN

The CEFR has become very important means in the framing the design of curricula and syllabuses of various languages. In practice, the CEFR can provide a direct tool for enhancing teaching and learning. Teaching of any language including English can be integrated with the CEFR in the following ways:

1. Adapting the CEFR for matching the context
2. Concentrating on the learning outcomes
3. Focusing on applied communication
4. Attaining good language learning skills

Adapting the CEFR for matching the context

A context of language teaching and learning has its own specific aims and objectives. The CEFR reveals the comparative advantages and disadvantages of these contexts clearly.

Learning objective of the desired curriculum should be context specific like:

- The students will learn to read newspapers, follow radio, TV and internet media critically and with understanding.
- The students will be able to form and exchange viewpoints on personal and academic issues in the domain of their specialization.

Concentrating on the learning outcomes

Outcomes divide a high-level goal into smaller learning units. They are useful for organizing teaching learning activities. The results are different as per the learning intentions. For example, in relation to the objective "Students learn to critically listen to radio and television", the following results can be expected.

Language outcomes:

- To learn words and expressions of specific news topic
- To separate fact and interpretation in newspaper articles.

Language-learning outcomes

- To grasp nuances of new words.

Outcomes Beyond Language:

- To build inter and intra personal skills like confidence, motivation and cultural enrichment.

Process outcomes, (related with developing knowledge, attitudes and skills needed for the context. For instance,

- Investigation, understanding, discussion, interpretation, co-operation.

Focusing on applied communication

Some well-planned communication activities can be prescribed in the direction of applied communication among the learners like: Listening comprehension, audio-visual literacy, reading comprehension, spoken and written interaction, Verbal and written correspondence etc.

Attaining good language learning skills

The above focus can be made more skills specific through prescribing activities and tasks aiming at development of language learning skills. These activities include Vocabulary Development, understanding announcements and instructions, listening to Radio and audio recordings, conversation, normal discussion, Correspondence etc.

DESIGNING ASSESSMENTS LINKED TO THE CEFR

The curriculum as well as assessment designers should set the target proficiency level as propounded in CEFR. It will be a systematic procedure, then to include the relevant study elements for the said courses. They can distribute these level targets semester wise or class wise further.

Descriptors as suggested in CEFR play decisive role in the formation of language curriculum as well as assessments under them. These descriptors are nothing but the series of statements about what a learner can do at each level of CEFR. Prescribing relevant descriptors for the suggested activities under proficiency levels will provide for the framer of the language tests a clear plan of what and how to evaluate the oral and written assignments. For example, the specific descriptors for prescribing modules for developing listening skills in the language will be as follows:

CEFR Listening Descriptors Overall oral comprehension	
Proficiency Level	
C2	Easy understanding of any language virtually whether face to face or broadcast, in natural speed.
C1	Maintaining extended discourse on abstract and complex topics Recognizing a wide range of idioms, phrases and spoken diction
B2	Understanding accepted language or a common variety in any form. Understanding technical discussions in their field of specialisation.
B1	Understanding factual information about common or job-related topics Understanding the main points made in accepted language or a common variety esp. short narratives
A2	Understanding for meeting needs of a concrete type, provided speakers speak clearly and slowly. Understanding phrases and expressions related to areas of priority e.g. very basic personal and family information, shopping, locations, employment etc.
A1	Following language spoken in slow and clear manner, with due pauses for guessing meaning. Recognizing concrete information like places and times about familiar topics
A0	Understanding short, simple questions and statements, provided they are delivered slowly and clearly with by visuals or manual gestures Identifying familiar words or signs, if they are commonly known Recognizing numbers, prices, dates and days of the week

By finding the necessary levels and descriptions in the CEFR, the syllabi makers can then indicate the level of language proficiency students are expected to achieve to get the learning outcomes. the levels actually achieved by students can be assessed with the help of CEFR-related performance examples. As we have taken only listening skills for the sake of example here, we have to see how comprehensive this process is. It is observed that about 50 to 80% of a person's time in everyday communication is for listening. Buck

(2001) noted that "listening comprehension is a process, a very complex process, and if we want to measure it, we must first understand how that process works" (p.1). Valette (1977) described a set of complex cognitive skills included in the seemingly natural process of listening.4 Following the n Bloom´s indicated certain skills required for comprehension of listening like language awareness, mechanical skills, message transfer, communication and criticism. Richards (1983) noted 33 skills for listening conversations and 18 for listening related with academics.5 While framing syllabi, the designers must think of other language skills with this much precision and accuracy. Linked with the CEFR levels, then, the teachers will be able to guide students towards an internationally recognized language qualifications. If assessed through the systematic CEFR mechanism, the students will understand the expectations of examiners and syllabus setters for them. This helps them know their achievements concretely and not just in terms of grades and marks.

CONCLUSION

So, these kinds of thoughtful arrangements can be done in case of the remaining language skills like speaking, reading and writing before setting curriculum and its assessments. They will surely go beyond the mechanical structure of language learning syllabi and examination systems.

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Analyzing Medicinal Plants Enhanced with Minerals: Exploring Anti-Inflammatory Attributes and Therapeutic Advantages

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ABSTRACT

This research paper investigates mineral-enriched medicinal plants, emphasizing their anti-inflammatory potential, nutrient profiles, and therapeutic effects. As natural healing sources gain recognition, understanding the relationship between minerals, bioactive compounds, and pharmacological activities is crucial. The study uses a holistic approach, integrating botanical, chemical, and pharmacological analyses to explore the multifaceted properties of these plants. We aim to uncover the anti-inflammatory mechanisms and applications of these plants in treating inflammation through rigorous experiments. Additionally, the nutrient profile analysis highlights the role of minerals in promoting health. The methodology includes collecting diverse plant samples, extracting bioactive compounds, and assessing anti-inflammatory activities through in vitro and in vivo assays.

KEYWORDS: *Medicinal plants, Anti-inflammatory, Nutrient profiles, Minerals, Therapeutic effects.*

INTRODUCTION

The therapeutic potential of medicinal plants, has been acknowledged across diverse cultures for centuries [1], with these botanical wonders serving as reservoirs of bioactive compounds with profound healing properties [2]. In recent times, there has been a paradigm shift towards natural remedies,driven by a global quest for sustainable and holistic healthcare solutions. Among the myriad of bioactive constituents found in medicinal plants [2], minerals emerge as key players not only in nutritional contexts but also as potential contributors to their pharmacological activities [3]. This research embarks on a holistic inquiry into mineral-enriched medicinal plants, aiming to unravel their anti-inflammatory potential, and scrutinize their therapeutic effects.

The rising prevalence of inflammatory disorders and the limitations associated with conventional pharmaceutical interventions underscore the urgency to explore alternative sources of anti-inflammatory agents[4,5]. Medicinal plants like, Turmeric (Curcuma longa) Fig. 1, Ginseng (Panax ginseng) Fig. 2, Aloe Vera (Aloebarbadensis miller) Fig. 3, Ginkgo Biloba (Ginkgo biloba) Fig. 4, Echinacea (Echinacea purpurea) Fig. 5, Neem (Azadirachta indica) Fig. 6, Garlic (Allium sativum) Fig.7, Cinnamon (Cinnamomum verum) Fig. 8, Ginger (Zingiber officinale) Fig. 9, Chamomile (Matricaria chamomilla) etc., with their rich chemical diversity, offer a promising avenue for discovering compounds that can modulate inflammatory responses effectively. This study focuses on a subset of medicinal plants distinguished by their mineral enrichment [6], hypothesizing that the presence of specific minerals may contribute synergistically to the anti-inflammatory properties of these botanicals [7-9]. In the context of this investigation, the term "mineral- enriched" encompasses a spectrum of essential elements such as magnesium, zinc, copper, and selenium, known physiological processes [10,11]. While the nutritional significance of these minerals is well-established [12], their potential pharmacological implications within the matrix of medicinal plants remain an exciting frontier [13,14]. The research design integrates a multidisciplinary approach, merging elements of botany, chemistry, and pharmacology. Carefully selected medicinal plant samples will undergo rigorous extraction processes, enabling the isolation and characterization of bioactive compounds. Simultaneously, cutting-edge analytical techniques, including chromatography and spectroscopy, will be employed to quantify and identify the mineral content of these plants [15,16,17]. The anti-inflammatory potential will be assessed through a series of in vitro and in vivo experiments [18,19].

MEDICINAL PLANTS

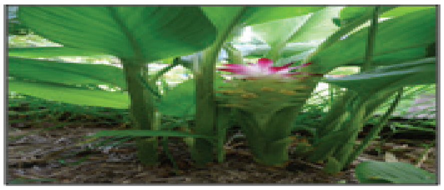

Fig. 1: Curcuma longa

Fig.2.Panax ginseng

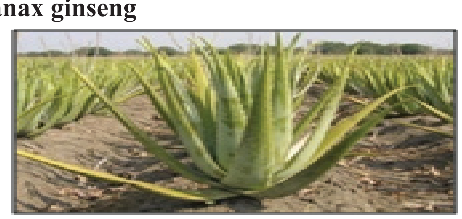

Fig. 3. Aloe barbadensis miller

Fig. 4. Ginkgo Biloba

Fig. 5. Echinacea purpurea

Fig. 6.Azadirachta indica

Fig. 7. Allium sativum

Fig. 8.Cinnamomum veru

Fig. 9.Zingiber officinale

MINERAL-ENRICHED MEDICINAL PLANTS

These diverse medicinal plants are not only esteemed for their bioactive compounds but are also rich sources of essential minerals that contribute to their therapeutic properties [20]. Turmeric, renowned for curcumin, contains minerals such as manganese, iron, and potassium, supporting its anti-inflammatory prowess[21]. Ginseng, a staple in Eastern medicine, is rich in minerals like zinc, potassium etc., enhancing its adaptogenic qualities [22]. Aloe vera, cherished for its soothing properties, contains essential minerals including zinc, magnesium, calcium etc., aiding in wound healing and anti-inflammatory effects [23]. like manganese and calcium, contributing to its antioxidant and anti- inflammatory properties [30]. Ginger, revered for anti-nausea effects, contains minerals such as K, Mn [31-34] etc. Peppermint, with antimicrobial properties [35-37], contains minerals like potassium and magnesium [35- 37]. Lavender, recognized for anxiolytic effects [37], magnesium[38] etc. Holy Basil, an adaptogen in Ayurveda [39], harbors minerals including K, Ca[33] etc., Rosemary, valued for cognitive benefits [40],contains minerals like Fe, Ca [41-43].

NUTRIENT PROFILES OF THE MEDICINAL PLANTS

The nutrient profiles of selected medicinal plants reveal a diverse range of essential compounds [44,49]. Turmeric (Fig.

1) is rich in curcumin, known for its anti-inflammatory and antioxidant properties [46,51]. Ginseng (Fig. 2) is highlighted for its adaptogenic qualities, enhancing vitality and stress resilience [22,47,52]. Aloe Vera (Fig. 3) contains Ca, Mg, Zn, Se, and copper, supporting its anti-inflammatory and wound-healing benefits [46,47,48]. Ginkgo Biloba (Fig. 4) offers cognitive and vasodilatory benefits due to flavonoids and terpenoids. Echinacea (Fig. 5) is rich in iron, copper, zinc, and selenium, which support its immune-boosting properties. Neem (Fig. 6) contains Ca, P, Fe, thiamine, and riboflavin, contributing to its antibacterial and anti-inflammatory effects. Garlic (Fig. 7) features selenium and sulfur compounds beneficial for cardiovascular and immune health. Cinnamon (Fig. 8) contains manganese, iron, and calcium, essential for bone health and metabolism [49,50,51]. Ginger (Fig. 9) is known for its anti- nausea and anti-inflammatory effects, with vitamins and minerals like vitamin C, B6, potassium, magnesium, and manganese [52,53]. Chamomile has calming properties and contains calcium, magnesium, potassium, and phosphorus, supporting bone health and cellular functions [54,55]. Peppermint aids digestion and offers antimicrobial benefits with calcium, magnesium, potassium, and copper [56-57]. Holy Basil is nutrient-rich with calcium, iron, zinc, copper, and selenium, supporting its adaptogenic and stress-relief benefits [58-60].

CONCLUSION

This study explores mineral-enriched medicinal plants, highlighting their anti-inflammatory potential, nutrient profiles, and therapeutic effects, which hold significant implications for health and well-being. Plants like turmeric, ginseng, and aloe vera exemplify their versatility in addressing various health conditions, showcasing properties like anti-inflammatory, antioxidant, adaptogenic, and cognitive benefits. The findings underscore the importance of minerals, bioactive compounds, and traditional wisdom in these plants, positioning them as valuable natural remedies and sources of nutraceuticals. The research advocates for a multidisciplinary approach to fully unlock these plant's potential, blending tradition with modern applications for a holistic and sustainable health future.

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Impact of Entrepreneurship Skill on SHG Group under RSETI Training : Field based Study

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ABSTRACT

This study examines how entrepreneurship skills affect SHG (Self Help Group) groups in Kolhapur District receiving RSETI (Rural Self Employment Training Institute) training. A study on the rate of settlement, the amount of time needed to create the enterprise, and the role played by RSETI in assisting the trained candidates in the settlement process will be helpful in determining the effects of RSETI trainings on the beneficiaries of the Kolhapur district. The majority of respondents were already involved in entrepreneurial activities before to the training program, and only a small percentage of the beneficiaries started new businesses after receiving training from RSETI, according to the report. For this study, the investigator's focus has been on SHG members. The study's objectives are to examine the RSETI-provided entrepreneurial skills and the effects such skills have on SHG groups.

KEYWORDS: *Entrepreneurship skills, RSETI, Self employment, SHG.*

INTRODUCTION

Introduction: Kolhapur, located in Maharashtra, India, is a well-established literal and artificial megacity. In Kolhapur, there are numerous self-help groups led by both masculine and feminine individuals from all backgrounds. However, a closer examination reveals that the majority of SHG operators are women (mostly housewives). These women are not just from the rural areas; they also come from the cities. [2],[3]. The Kolhapur quarter needs RSETI's task and efficacy in helping SHG members develop their entrepreneurial skills, and SHG members are crucial in helping them understand the importance of commission. SHG empowers women to unleash their potential and gives them the self-assurance they need to overcome obstacles more skillfully through business. In order to achieve social advancement, it has also given women financial independence.[2]

RSETI is an initiative of the Ministry of Rural growth (MoRD) to establish specialized structures in every region of the nation for the purpose of educating and skill-upgrading pastoral young with an eye on the growth of entrepreneurship. Banks oversee RSETIs with active support from the Indian government and state governments. Multiple skill development trainings, including soft skill training for pastoral youth, are provided to RSETI. The study was carried out in the Maharashtran Kolhapur regions.[4],[5].

OBJECTIVE OF RESEARCH STUDY

- To study the impact of RSETI training in establishment of an enterprise
- To study the Entrepreneurship skills provided by

  RSETI
- To Study outcome of RSETI's through Rural Development.

REVIEW OF RELATED RESEARCH

In 2018, Dr. Shalini Devi Empowering women in India is a difficult endeavor since it requires us to face the reality that discrimination based on gender has been practised for thousands of years in many different forms. Things won't change overnight, and that is something we have to accept. No amount of time or effort will make the hatred disappear; it won't go away with half-hearted attempts. [4].

A. Sudhakar, Dr. K. Ramakrishna In 2015, the SHG's contribution to the emancipation of rural women is a revolution unto itself, and its members have surely benefited greatly from it. The women members of SHG have been able to speak up on any platform—from within the family to the larger community. They now know how to acquire and manage financial resources more sensibly. Due to their long history of subjugation, the illiterate members of the SHG have managed to rise in status within their families and defy patriarchal norms. [5]

N. Rajendhiran, Dr. Prof. P. Masiyamoorthy 2016: It might be argued that we are in a better position now that women are participating in the field of entrepreneurship at a significant rate and that global and economic initiatives are being made to increase women's involvement in the enterprise sector. Women have currently shattered the male monopoly and demonstrated that they are not less valuable than males. This business can be launched for the least amount of money and can grow as needed. [6].

RESEARCH GAP

Numerous studies have examined the effects of entrepreneurial skills on Self-Help Groups (SHGs) receiving RSETI Training in the Kolhapur District. [2] Based on a thorough assessment of the literature, it has been determined that no research has been done on the influence of entrepreneurs in Kolhapur quarter under RSETI on this particular subject in the state of Maharashtra.[3]

METHODOLOGY

The information obtained from primary sources— interactions with the SHG group—forms the basis of the current investigation. The study was carried out in the deliberately chosen Kolhapur district of the state of Maharashtra. The study mostly uses the secondary data that are available. [1]

ROLE OF RSETI IN KOLHAPUR DISTRICT

RSETI : The Severance Problem is one of the largest issues facing our nation. RSETI is working sincerely to train unemployed youngsters in Kolhapur quarter in the trade of their choosing for FREE, so they can become employable and have a stable source of income. [3]

Under the auspices of the Ministry of Rural Development (MoRD), Government of India, a public post called the National Centre for Excellence of RSETIs (NACER)" has been established in Bangalore to oversee RSETI performance. Additionally, NACER grades all RSETIs annually throughout India, allocating grades such as A, B, C, and D based on performance and structural validity.[4]

Sr.No.	Training Programs	During 2021-22			Since inception*			Cumulative %of Settlement
		A	B	C	A	B	C	
	Agri. EDP:							
1	Dairy Farming	4	134	61	59	1984	1634	82.36
2	Goat Farming	1	30	23	3	95	79	83.15
3	Sheep Rearing	—	—	—	2	71	52	73.23
4	Poultry	—	—	—	1	21	6	28.57
5	Vegetable Nursery Management	—	—	—	1	43	42	97.67
	Product EDP:							
1	Women's Tailor	1	35	36	42	1290	1056	81.86
2	Food Processing & Bakery Products	—	—	—	2	50	40	80
3	Mfg of Paper Bags/Envelops/Files	3	91	94	15	478	391	81.8
4	Bamboo Articles	—	—	—	2	80	49	61.25
5	Papad Making	—	—	—	1	23	17	73.91
6	Chikki & Papad Making	—	—	—	1	37	29	78.38
7	Papad, Pickle and Masala Powder	1	32	21	9	275	212	77.09
8	Cloth Bag Making	-	-	-	2	40	35	87.5
9	Homemade Agarbatti Maker	1	34	20	1	34	20	58.82
	Process EDP:							
1	LMV	—	—	—	2	55	28	50.9
2	Beauty Parlor Management	1	28	—	5	129	78	60.47
3	Fast Food Stall Udyami	—	—	13	2	55	29	52.72
	General EDP							
1	EDP to BC/BF on Financial Inclusion	—	—	—	1	44	44	100
2	KMCPMEGP Module I	—	—	—	12	86	84	97.67
3	KMCPMEGP Module II	—	—	—	9	193	188	97.41
4	EDP for PMEGP Beneficiaries	—	—	—	21	691	592	85.67
5	Training Programme on Financial Literacy for FL	-	—	15	2	57	47	82.46
6	BC Sakhi	—	—	22	1	29	22	75.86
7	General EDP	7	202	213	28	960	787	81.97
8	Entrepreneurship Development	1	35	24	1	35	24	68.57
	Programme (EDP) for Micro Entrepreneurs							
	Total for Self Emp. Prog	**20**	**621**	**542**	**225**	**6855**	**5585**	**76.37**
	Wage Emp. Prog							
	NIL	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	Grand Total for Self/Wage Emp. Prog.	**20**	**621**	**542**	**225**	**6855**	**5585**	**81.47**

*A=No. of Batches, B= No. of Candidates, C= No. of Candidates Settled (Source : BOI Star RSETI 2021-22)

For two years following training, RSETI offers the trained candidates handholding support and encouragement to launch their own microbusiness. 5585 of the 6855 trainees who have been enrolled since the program's start have settled in. Of them, 2660 trainees are placed through self-investment, 2895 trainees are placed through the use of financial aid from different district banks and financial organizations, and 30 trainees are placed through salary employment. As of March 31, 2022, the cumulative credit linkage ratio is 52.11%, while the cumulative settlement ratio is 81.47 percent. [2], [3].

Training calendar for FY 2021-22

In order to train 700 rurally unemployed youngsters, BOI STAR KOLHAPUR RSETI created a calendar of training programs for FY 2021–2022. The program would consist of 23 sessions. In light of Covid-19 phase 2, MoRD updated the RSETI goals. As a result, RSETI has taught 621 candidates through 20 training programs, compared to the goal of 550 candidates through 18 training programs. [1]

Composition of Training Programs for FY 2021-22: MoRD, Govt. of India has advised to conduct training programs under categories such as Agriculture, Product, Process, General EDP and Skill up gradation.

Sr. No.	Category	Examples	No. Of Batches to be conducted	No. of Candidates to be Trained	Actual Batches conducted	Actual candidates trained
1	Agriculture	Dairy, Sheep Rearing, Vegetable Nursery Management and Cultivation etc.	6	200	5	164
2	Product	Dress Designing, Papad, pickle & Masala Powder making, Cloth Bag Making etc.	7	185	6	192
3	Process	LMV Driving, Beauty Parlor Management etc.	1	35	1	28
4	General EDP	EDP to BC/BF on Financial Inclusion, EDP to PMEGP beneficiaries etc.	4	130	8	237
		Total	18	550	20	621

Source : BOI Star RSETI Annual report 2021-22

SUCCESSFUL STORIES

1. Mrs. Megha R. Tupe Kolhapur - Training Programme: Papad, Pickle & Masala Powder Making Batch No. 213/2021-22, Activity started: Pickle making - Mrs. Megha R. Tupe from Karvir Kolhapur, her husband has News Paper agency. The agency was doing well. But due to the sudden downfall of Corona situation, the current agency was lost and as a result had to close. When the financial crisis came, Megha Tupe realized that the crisis would not go well without doing some work. So she and her husband decided to start a breakfast center. For this, she took training from a chef and started a breakfast center. Eventually Mess also started. After gaining experience in both the breakfast center and the mess, they decided to do something on their own, and decided to make and sell pickles but the expected sales did not happen. There were reactions from some people about changing the taste of pickles and at that time she felt the need for training. She soon got this opportunity through RSETI Kolhapur through self-help group. Megha Tupe took admission in pickle training. She learned to make different types of papad, pickles and spices, and training in subjects such as entrepreneurial skills, communication skills, marketing and time management increased their entrepreneurship. After training, she started making fresh pickles and selling them. At the same time, she used her communication skills to do good marketing, which led to good sales of pickles. Today, she have developed a brand of pickles with name ‘Prerana Pickles’. She earn Rs 7,000 to Rs 9,000 per month from this business. The credit for the success goes to the training at RSETI. [1]

2. Smt. Pooja P. Gaikwad. Gagan Bavda Dist. Kolhapur Training Programme: Homemade Agarbatti maker Batch No. 208/2021-22, Activity started: Making Homemade Agarbatti

Pooja P. Gaikwad from gaganbawda works for five thousand rupees/month in the company of making shevaya. She have a daughter who is studying in12th and a son who is currently in 10th. The full worship of these two child is on the shoulders of her alone. Because of her husband’s contraception ten years ago. In order to run the house, she had to work in the factory of making shevaya. She had to carry out this responsibility of educating the children properly. She sincerely wanted to live with self-respect. But she found it very difficult to balance both household expenses and children’s education, and one thing she realized was that just doing a job would not work. She also got the confidence that she can do business. She received in-depth training in different types of Incense Stick, types of making them, sales marketing. During the training, RSETI Kolhapur visited a successful entrepreneur incense stick factory. So she got the motivation to buy raw materials and sell the finished goods in the shops in and around her village. Gradually the demand increased. Her son helps her with her work when he has the time.

Today, she earn about Rs.6000/- to Rs.8000/- per month from this business. They are very happy that we were able to start our own business. Her dream is to make her own brand of incense stick by working harder in the future. She thanked RSETI for providing her with a lasting tool to shape her children’s future. [1]

SETTLEMENT OF ENTREPRENEURS AFTER RSETI TRAINING

As previously stated, the secondary source indicates that thousands of young people have received training and jobs under the RSETI banner. Several authors have reported success stories from the vibrant country corridor, including Chatterjee and Rao (2016), Rao and Chatterjee (2016), Velu (2016), and Chatterjee (2017). The young people who began Micro Enterprises after receiving training from RSETI make between Rs 5,000 and Rs 30,000 a month. Many people’s monthly wages have surpassed Rs 50,000 (NACER, 2017). [3].[4].

CONCLUSION

RSETI provides various entrepreneurship training to Entrepreneurs. With the help of these training programs impact to improve women's behavior in society for communication skills, marketing skills, Soft Skills Development skills, financial skills etc. Numerous successful entrepreneurs imbibed specialized chops and soft chops at RSETIs and proved themselves as an achiever[11]. From this study the experimenter will be suitable to find out how after forming SHGs have bought changes in the provident as well as social status of the women[12]. Since this study will be concentrated substantially on women commission, the women working in SHGs will be canvassed and asked questions about how and why they chose to form the group and in what way they've served and whether forming this group have made them more independent.

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A Review Paper on Integration of PV Solar Systems with STATCOM for Reactive Power Compensation in Grid

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ABSTRACT

The integration of photovoltaic (PV) solar systems into the grid presents both opportunities and challenges for power system stability, reliability and improvement in power quality. While PV systems contribute clean and renewable energy, they also introduce fluctuations in power generation due to changes in solar irradiance. These fluctuations can impact grid stability and voltage regulation, particularly concerning reactive power compensation. This review paper explores the application of Static Synchronous Compensator (STATCOM) as a solution to compensate the reactive power in PV solar systems. By STATCOM capabilities, PV solar systems can contribute to better voltage regulation, power quality improvement, and overall grid flexibility. Addressing challenges and advancing research in this area will further accelerate the adoption and deployment of PV solar systems with STATCOM for grid applications.

KEYWORDS: *Photovoltaic (PV), STATCOM, Reactive power flow, Grid, Power quality.*

INTRODUCTION

The rapid growth of renewable energy sources, particularly PV solar systems, has significantly transformed the landscape of power generation worldwide. While PV systems offer numerous environmental and economic benefits, their intermittent nature poses challenges for grid stability and power quality. One such challenge is the need for reactive power compensation to maintain voltage stability and regulate power flow within the grid. This paper examines the integration of STATCOM with PV solar systems to resolve the challenges and improve the grid's dependability and effectiveness.

Reactive Power Compensation in PV Solar Systems

The voltage levels varies because of reactive power flow and affects stability of power systems. In PV solar systems, variations in solar irradiance and system operating conditions can lead to fluctuations in reactive power output. These fluctuations can adversely affect voltage regulation and grid stability, particularly during periods of high solar penetration. Therefore, effective reactive power compensation mechanisms are crucial for mitigating impacts and maintaining grid reliability.

Static Synchronous Compensator (STATCOM)

A STATCOM is one of the key and major component from FACT device family, the voltage regulation and reactive power compensation are two important roles for the adaptable and effective STATCOM in power systems. In order to control voltage levels and enhance power quality, it operates by injecting or absorbing reactive power into the grid to regulate voltage levels and improve power quality. STATCOMs are based on voltage source converter (VSC) technology, offering fast response times and precise control over reactive power output. These characteristics make STATCOM an ideal solution for addressing the dynamic and transient nature of reactive power fluctuations in PV solar systems.

Benefits of STATCOM Integration with PV Solar Systems

Integrating STATCOM with PV solar systems offers several benefits for grid stability and power quality. Firstly, STATCOM provides rapid and accurate reactive power compensation, helping to mitigate voltage fluctuations caused by variations in solar irradiance. Secondly, STATCOM enhances grid stability by improving voltage regulation and damping oscillations in the system. Additionally, STATCOM facilitates seamless integration of PV solar systems into the grid, enabling increased renewable energy penetration while maintaining grid reliability and performance.

Challenges and Implementation Considerations

Despite its numerous benefits, the integration of STATCOM with PV solar systems presents several challenges and implementation considerations. These include cost considerations, grid compatibility, control and coordination issues, and system integration complexities. Addressing these challenges requires careful planning, coordination, and collaboration among stakeholders, including utilities, grid operators, and equipment manufacturers.

LITERATURE REVIEW

Harsha et al. [1] explored Integration of Static Synchronous Compensator (STATCOM) technology with photovoltaic (PV) solar systems for reactive power compensation in the grid. They highlighted the importance of this integration in enhancing grid stability and improving power quality. Bayod-Rujula et al. [2] investigated the impact of PV solar systems on voltage stability and proposed a STATCOM- based solution to mitigate the effects. Their study emphasized the role of STATCOM in enhancing grid resilience to fluctuations caused by renewable energy sources. Ghosh et al. [3] discussed the enhancement of grid stability with STATCOM-supported PV solar systems. They provided insights into the effectiveness of STATCOM in stabilizing grid voltage and improving power quality under varying operating conditions. Chen et al. [4] proposed an optimal control strategy for STATCOM-supported PV systems to enhance reactive power compensation. Their research focused on optimizing the operation of STATCOM to achieve efficient grid integration of solar energy. Singh et al. [5] PV system in grid to compensate reactive power using STATCOM with adaptive control. They emphasized the importance of adaptive control techniques in optimizing the performance of STATCOM for grid stability enhancement. Zhang et al. [6] developed a modeling and control framework for a PV system in grid with STATCOM to enhance compensation of reactive power. Their study provided valuable insights into the control strategies for effective integration of PV systems with STATCOM. Feng et al. [7] conducted an impact analysis of grid-connected PV systems on voltage stability and reactive power compensation using STATCOM. Their research highlighted the significance of STATCOM in mitigating voltage fluctuations and improving power quality in PV-integrated grids. Das et al. [8] proposed an optimization-based control strategy for PV system in grid with STATCOM for compensating reactive power. Their study focused on optimizing the control parameters of STATCOM to achieve optimal grid performance. Chakraborty et al. [9] performed dynamic modeling and PV system in grid with STATCOM was analyzed. Their research provided insights into the dynamic behavior and performance characteristics of PV systems with STATCOM under different operating conditions. Singh et al. [10] investigated coordinated control strategies for PV systems and STATCOM to achieve reactive power compensation and voltage regulation. Their study highlighted importance and coordination between PV systems and STATCOM for grid stability enhancement. Sharma et al. [11] explored dynamic stability betterment of power systems by injecting PV with STATCOM supported solar farms. Their research focused on the role of STATCOM-supported solar farms in improving dynamic stability in PV-integrated grids. Chandra et al. [12] studied the ideal placement and rating of STATCOM in order to improve voltage stability in PV- integrated distribution systems. Their research provided guidelines for the optimal deployment of STATCOM in distribution systems with PV integration Pham et al. [13] investigated the PV solar system integration with STATCOM to compensate reactive power in microgrids. Their study focused on the application of STATCOM in microgrid environments to enhance grid stability and power quality. Mandal et al. [14] proposed a coordinated control strategy for PV systems and STATCOM to enhance grid stability through reactive power compensation. Their research emphasized the importance of coordination between renewable energy sources and grid-support devices for effective grid integration. Singh et al. [15] provided a comprehensive review of PV system integration with STATCOM for compensation of reactive power in the grid. Their review synthesized existing research and highlighted the potential benefits and challenges of this integration approach. Rajiv K Verma et al. [16-20] research work analyzed and claimed that with integrating PV solar systems into the grid, issues such as voltage fluctuations (poor voltage regulations), power quality degradation, reactive power imbalance with low lagging power factor can be improved upto some extent in day time during the day when sun shines by generating active power by means of PV system and during dark time inverter capacity with control system can fully be utilized. Hingorani, Narain G., and Laszlo Gyugyi.[21] gives a definitive guidance to Flexible AC Transmission Systems (FACTS) technology, offering insights into the concepts, principles, and applications of Flexible AC Transmission Systems devices in power systems in "Understanding FACTS". This book covers a wide range of FACTS controllers, including SVCs, STATCOMs, and UPFCs, and discusses their roles in improving power system stability, control, and efficiency. Miller, T. J. [22] provides a comprehensive overview of control techniques of reactive power along with their applications in electric power systems in "Reactive Power Control in Electrical Systems". The book covers topics such as reactive power generation, transmission, and utilization, along with various methods for controlling reactive power flow to maintain system voltage stability.

FUTURE SCOPE

A several areas need a further research and development in PV solar systems with STATCOM Advanced Control Strategies: Subsequent investigations can concentrate on the advancement of sophisticated control approaches, like machine learning-based methods and predictive control, to maximize reactive power compensation and improve grid stability. Hardware-in-the-Loop (HIL) Testing: HIL testing can be employed to validate control algorithms and assess their performance in real-time grid conditions, facilitating the transition from simulation studies to practical implementation. Grid Interconnection Standards: Standardization of grid interconnection requirements and regulations for PV-STATCOM systems can streamline the integration process and ensure interoperability with existing grid infrastructure. Hybrid Energy Systems: Integration of PV solar systems with other sources of renewable energy, energy storage devices, and Technology for the demand side management can further enhance grid stability and reliability. Cost-Effectiveness Analysis: Economic analysis and optimization techniques can be employed to assess the cost-effectiveness of PV-STATCOM integration and identify optimal deployment strategies for different grid scenarios.

CONCLUSION

The integration of photovoltaic (PV) solar systems with Static Synchronous Compensator (STATCOM) technology offers a promising solution to address reactive power issues, enhanced grid stability in modern power systems, improved voltage regulation, better and improved power factor. Through a comprehensive review of recent research and practical applications, this review has brought attention to the significance of integrating PV solar systems with STATCOM for reactive power compensation in the grid.

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Solar Farm Innovator: Revolutionizing Agriculture with Solar-Powered Cultivation

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ABSTRACT

This paper presents the concept of a solar-based cultivator, which is a sustainable and efficient agricultural tool that utilizes solar energy to power its operations. The solar-based cultivator is an innovative approach to traditional agricultural practices that are often reliant on fossil fuels, which are not only expensive but also contribute to environmental pollution. The solar-based cultivator employs solar panels to convert solar energy into electricity to power its various operations, including tilling, sowing, and harvesting. This paper examines the potential benefits of the solar-based cultivator, including increased efficiency, reduced costs, and improved sustainability, while also discussing the potential challenges associated with its implementation. The purpose of this paper to suggested that solar-based cultivator is a promising method that has the potential to revolutionize agricultural practices, especially in regions with high solar irradiation.

KEYWORDS: *MMPT, Solar energy, Agriculture, PWM, Converter.*

INTRODUCTION

Solar energy has emerged as a prominent and widely accessible renewable energy source. Its abundance and clean nature make it an appealing option for meeting global energy requirements. Ongoing research and development have led to innovative advancements in solar panel technology, including minimum cost, flats solar panels, thin film technology and concentrator systems shaping the future of solar energy utilization. The implementation of maximum power point trackers significantly improves the efficiency of solar panels by enabling them to operate at their maximum power output. The "Perturb and Observe" algorithm and the use of DC and DC Converter, specifically "BUCK" converter, are proposed as effective approaches for designing MPPT systems. Additionally, a microcontroller-based charge controller is commonly used in photovoltaic generation systems to maintain proper battery charging voltage and prevent overcharging. These intelligent control systems contribute to overall system efficiency. A reliable PV charge controller is crucial for achieving optimal performance in PV battery charging systems.

LITERATURE REVIEW

The advanced perturbation and observation (P and O) method is suggested in this study as a way to precisely track a solar PV panel's highest power point. Continuous operation at the MPP is necessary to maximise power capture because to a non-linear V-I characteristic of solar PV cells that is impacted by environmental conditions like as temperature and light intensity. The suggested P and O algorithm incorporates the measurement of short-circuit current prior to each perturbation and observation stage to overcome frequent difficulties in standard P and O algorithm. An enhanced P and O algorithm is superior at tracking the maximum power points of solar PV panels, as shown by simulation results contrasting the proposed algorithm with the conventional P and O algorithm under varied atmospheric circumstances.

PROPOSED WORK

Purpose

With the use of a maximum power point tracking system, the proposed study intends to develop a unique and reasonably priced microcontroller for solar photovoltaic systems. The goal is to guarantee MPP's optimal performance under a variety of environmental circumstances. To effectively regulate the flow of power from the PV panels, the system uses the perturbation and observation MPPT algorithm. This procedure is carried out by a PIC microcontroller using voltage and current data from the PV panel. A proposed system offers a practical and affordable solution for achieving maximum power extraction from solar panels, enhancing overall system efficiency and performance.

Methodology: Block diagram for tracker unit

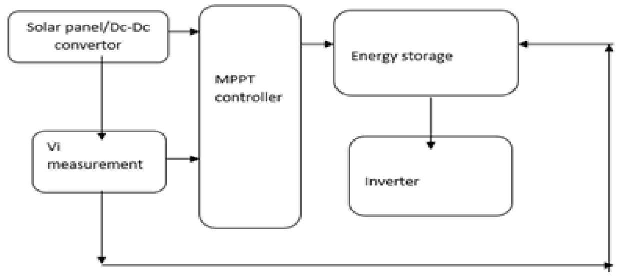

Fig. 1 Block diagram of tracker unit

Microcontroller unit

The integration of a microcontroller equipped with two four-PWM mode impulses and eight-bit analog- to-digital converters in an MPPT control circuit offers several significant advantages. The microprocessor effectively regulates the boost converter, optimizing power transfer in the system. By leveraging the A/D port, the microcontroller accurately reads the current and voltage from the solar panel, allowing for determination of their output power. Simultaneously, it measures the current and voltage on a battery side, enabling calculation of powers and facilitating appropriate signal control transmission to the controller and boost converter. This mechanism effectively adjusts the converter duty cycle, enabling precise control of the DC-to-DC conversion process by increasing, reducing, or turning off the converter as required. The microcontroller's exceptional performance, features, and low battery consumption make it an ideal choice for implementing MPPT control circuits. Its ability to efficiently monitor and regulate power flow ensures optimal energy extraction from the solar panels, contributing to increased overall system efficiency. Furthermore, the control circuit's ability to evaluate the before and after modifications PV output power to DC-to-DC converter control signal's duty ratio is crucial. Anticipating a consistent oscillation built into the program, this evaluation allows for continuous fine- tuning of the system to achieve the MPP under variable conditions. In summary, integration of this microcontroller within the MPPT control circuit offers a robust solution for optimizing power transfer in solar energy systems. Its performance, features, and efficient power management make it well-suited for the task at hand, while the control circuit's evaluation capabilities ensure ongoing adjustments for MPP tracking.

Boost converter

When considering DC-DC converters, various topologies are available, and one commonly used design is the buck converter. This topology is particularly popular in battery-powered applications due to its ability to adjust the output voltage level in relation to the input voltage. DC/DC power converters play a crucial role in photovoltaic (PV) systems, where their primary objective is to transfer the peak amount of electrical and power to the load. This is achieved through control actions implemented in the converter. The specific structure of the converter is selected based on the desired load requirements. In this context, we have highlighted the significance of the boost converter, also referred to as a step-up DC/DC converter. For applications like MPPT in particular, this kind of converter is relevant as it enables regulation input of the voltage at optimum power point and facilitates for load matching optimal transfer of power. By utilizing the same converter, MPPT ensures efficient power extraction from the PV system.

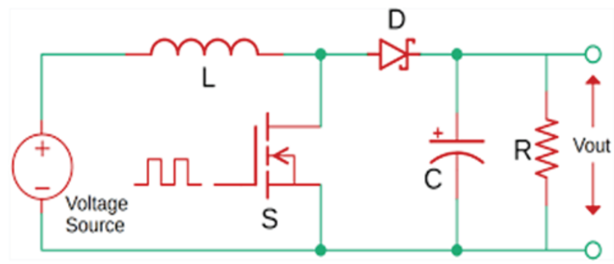

Fig. 2 Circuit diagram of boost converter

Maximum Power Transfer Technique (MPPT)

The solar power efficiency is about 30%. The output power of a solar panel can be optimised using MPPT techniques, increasing overall efficiency. The Maximum Power Transfer method highlights the importance of matching the source impedance and load impedance to achieve the highest output power in a circuit. In the context of solar panels, a buck converter is commonly employed on the source side to increase the voltage of output. Power transfer efficiency can be improved by appropriately matching the source and load impedances by dynamically changing the buck converter cycle of duty with a signal of PWM-Pulse Width Modulation. Several MPPT methods have been proposed, each with its own strengths and limitations. Two often used techniques are the (P and O) perturb and observe approach and the incremental conductance (INC) method. The (P and O) algorithm is employed in proposed system due of its popularity and ease of use. It is also fairly priced. The P&O technique involves the controller adjusting the voltage from the solar array by a small amount and measuring the resulting power. If the power is raised, additional adjustments are made in the same way. When the power rise stops, the maximum power point (MPP) is reached.

Objective of research study

The major objective of this work is to build a solar charger that is highly efficient in recharging batteries while minimising energy loss and successfully coping with voltage changes in the solar panel.

P and O- Perturb and Observe

Algorithms for maximum power point tracking (MPPT) are crucial for maximising the energy produced by solar panels by calculating power, measuring voltage and current, and identifying the perfect power point. Because it is so easy to implement, Perturb and Observe (P&O), one of the many viable algorithms is frequently used. The P&O algorithm adjusts the operating point of the solar panel and tracks the resulting change in power. It is a straightforward technique that adjusts the operating point to the power shift direction. While P&O is easy to implement and widely used, it may exhibit oscillations around the maximum power point and might not provide the highest accuracy compared to other methods.

Motor

The motor described is commonly utilized in applications such as car wipers and as a worm drive motor. Its design features precise tolerances, ensuring zero backlash and a smooth operation of both the motor and gearbox.

PV Cell Panel

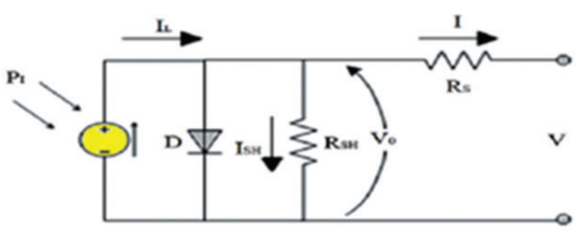

Fig. 3: Circuit of PV cell

Fig 3 shows the diode and current source which are connected across the circuit. PV cell array is connected by number of solar cells in parallel and series. PV cell panel specification as per the following.

$$n_s = \frac{V_{DC}}{V_{OC}} \tag{1}$$

$$n_p = \frac{P_{max}/V_{DC}}{I_{mp}} \tag{2}$$

MPPT -Maximum Power Point Tracking

By employing the MPPT method, the efficiency of PV panels can be significantly enhanced. In this case, we are utilizing the perturbation and observation MPPT technique.

Boost Converter for MPPT

Figure 3.6.1 shows the simulation model of converter DC-DC. To stabilize the input voltage input capacitor is necessary, as the maximum current of the supply must be accounted for. The specification of the inductor is a crucial factor determined by the following equation,

$$L_{MIN} = V_{IN} * \frac{V_{OUT} - V_{IN}}{\Delta I_L * f_s * V_{OUT}} \tag{3}$$

The buck/boost converter was chosen as the DC/DC converter for this project because it modifies the input voltage dependent on the duty cycle. In the simulation, a duty cycle preset of 50% is used, resulting in a half output voltage from the buck converter.

CONSTRUCTION

The cultivator's framework is constructed using 4cm x 4cm iron rods, providing durability and stability for farming operations. The entire iron structure is supported by four wheels, with two sets of wheels utilized for easy movement in the farm. The front wheels have a diameter of 16 inches, while the rear wheels have a diameter of 12 inches. The iron structure is designed in the shape of a square, which not only helps manage the weight but also provides balance for the cultivator during farming activities. Within the square structure, components such as the battery and control system unit are housed, contributing to the overall functionality of the cultivator. At the rear of the square structure, four ploughing teeth are attached to facilitate ploughing action. Each ploughing tooth has a length of 8 inches and is connected to an 18-inch vertical rod. This design allows for adjustable height of the ploughing structure, offering convenience and flexibility in adapting to different farming needs.

Fig. 4: Solar cultivator

RESULTS

This paper aimed to create and produce the cultivator that addresses ecological concerns and the needs of an aging society in the context of agricultural practices, particularly in areas like India where agriculture is of utmost importance. This paper has shown utility of practical in the development of a small-sized electric power cultivator suitable for household gardening. The study explored two different charging methods: voltage charging and constant current, also the combination of solar cells and capacitors.

APPLICATIONS AND UTILISATION

1. It is suitable for small-scale cultivation purposes, such as weeding and spraying operations. This can efficiently work on small fields and garden areas, making it ideal for maintaining and cultivating crops in limited spaces.
2. The specially designed blades of the cultivator facilitate the shifting of soft loamy soil towards the base of plants as the machine moves forward. This creates bridge-like patterns that are crucial for cultivating specific crops like sweet potatoes.

CONCLUSION

This study has demonstrated the feasibility and potential benefits of the proposed electric farming tractor. The project utilizes mature and PV cell panels, electric motors and batteries minimizing compatibility issues and ensuring real-world applicability. From a financial perspective, the project shows promise for profitability under certain conditions. Moreover, the project aligns with EU environmental standards and goals by addressing the environmental degradation caused by traditional farming practices. The combination of technologies used in the project has shown reliability, although some drawbacks, such as unreliable battery technology, have been identified. used in this study.

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Smart Industrial Panel for Control of Induction Motor in Textile Industry

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ABSTRACT

In an age where technological progress is revolutionizing industries, automation stands out as a crucial driver of efficiency and productivity. This paper introduces an innovative solution tailored specifically for the textile sector: the Smart Industrial Panel, meticulously crafted for precise control of induction motors. Induction motors, renowned for their versatility and widespread use in textile operations, take center stage in our study. Through the utilization of simulation tools such as SIMULINK/ MATLAB, we conduct in-depth defect analysis to uncover potential vulnerabilities including undervoltage, overload, and mechanical irregularities such as vibration and temperature fluctuations.

This paper deals with the implementation of a comprehensive protection system, seamlessly integrating traditional methods with IoT capabilities. This approach empowers users with both automatic and manual control options, ensuring optimal motor performance while fortifying machinery against unforeseen challenges. By bridging the gap between cutting-edge technology and industrial requirements, our Smart Industrial Panel signifies a transformative shift towards enhanced efficiency and resilience within the textile sector.

KEYWORDS: *SIMULINK, Textile machine, Motor faults, Internet of Things (IoT), Controlling and monitoring.*

INTRODUCTION

The number of inductive, capacitive, and resistive loads is enormous. The most popular and commonly used inductive loads for a variety of industrial applications are AC and DC motors. Due to their desirable properties, which include heavy-duty construction, low maintenance and operation costs, high starting torque, high efficiency, and reliability, industries mostly utilize induction machines, i.e., single-phase induction motors for home use and three-phase IMs [1-2-3].

In addition, a variety of issues might arise with motors, such as vibration, cooling, heating, bearing problems, rotor problems, stator problems, and winding problems [4-5]. In this circumstance, monitoring is required to prevent any loss because a tiny fault might result in a large engine loss and financial loss to the industry [6]. Numerous methods have been employed to regulate and observe engine performance. In many applications, the Internet of Things has revolutionized global operations, including electrical and mechanical problems. Because machines communicate with each other, the Internet of Things is essential.

Machine type issues as well as the need for machine- to-machine communication highlight current considerations [4]. To make an operation intelligent and enable communication between various pieces of equipment without requiring independent configuration, the Internet of Things (IOT) serves as a link between them. The term "Internet of Things" (IOT) describes the process of connecting various objects and giving them intelligence to make them intelligent. It makes it possible for actual devices to independently configure themselves and communicate with one another [2]. Kevin Ashton initially referred to the worldwide network as the "Internet of Things" (IOT) in 1999 [4]. With the help of the Internet of Things (or "IOT"), we are now accustomed to using it in our daily lives to detect, trace, address, and measure items via wireless networks, WANs, RFID, and other means [3–2].

Operating the loads in both directions manually and using IOT is the aim of this article. Since we have Wi-Fi access from any place, we can use the automated control system, which is more comfortable and efficient. Since no physical labor is required to operate the system, it operates quickly and easily. Manual system operation is a simple process if an issue prevents the automatic system from functioning. Our attention is directed towards irregularities related to temperature and vibration in the three-phase induction motor. Figure 1 provides a flowchart of the entire paper.

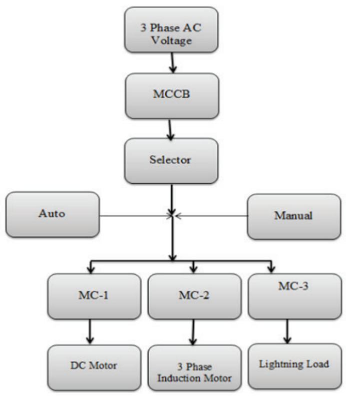

Fig. 1: Flow Chart

PROPOSED SENSORS AND EQUIPMENTS

This study uses both manual and Internet of Things (IOT) inductive loads, which are referred to as linear fluorescent lamps (LFLs). The operation of induc- tive loads under both normal and pathological settings has been our recent focus. Both motors are operated, controlled, and protected by the equipment listed below. MCB, Magnetic Contactor, Selector Switch, Toggle switch, Pilot Devices, CT, Single- Phase Transformer, Diode Bridge, Hz Meter, Node MCU /ELCB, Relay Bunch, Temperature sensor, Vi- bration Sensor, AC three phase motor.

METHODOLOGY

The two primary components of the technique are hardware and software. We simulated several errors in the software and examined the outcomes. We have designed a control panel as the hardware component to manage the motor's operation.

Software Components

Undervoltage, uneven supply, single-phase, overload, interturn faults, and earth faults are among the several fault types that can impair the performance of induction motors. The two most important ones are undervoltage and overload, which can cause the motor to produce excessive heat and endanger the structural integrity and performance of the machine. We use MATLAB to simulate under voltage and overload circumstances to address these problems, as shown in Figures 03(a) and (b) of our work. The examination of these models provides a significant understanding of how these errors affect motor behaviour, highlighting the necessity of putting preventative measures in place to guard against such abnormalities and guarantee optimal motor function.

Hardware Components

This study's methodology clarifies the complex connections among the equipment that is suggested to monitor and control the functioning of DC motors and three-phase induction motors, both manually and via the Internet of Things (IoT). The method provides effective control over loads like DC motors, linear fluorescent lamps (LFL), and induction motors (IM) by using two separate wiring schemes, one for power distribution and the other for control. The selector switch is an essential part of the control system that allows users to smoothly transition between manual and IoT-driven operation modes. Additionally, the Multisim-created circuit diagram in Figure 04 offers a thorough visual representation of the system architecture, demonstrating the integration of diverse loads and equipment. The noticeable addition of a tiny circuit breaker (MCB), which guards against short circuit faults, increases system reliability. To track significant motor health indicators, the control panel assembly also includes temperature and vibration sensors.

Our commitment to ensuring the highest possible mo- tor performance and lifetime is demonstrated by this comprehensive approach. All things considered, tem- perature and vibration monitoring is given top priority for increased operational efficiency and failure preven- tion, and the smart control panel methodology—which is shown in Figure 02—provides a clear and easy-to- use framework for effectively supervising motor oper- ations.

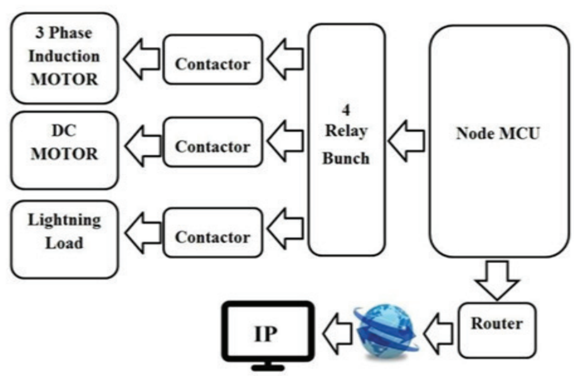

Fig. 2: Block diagram

RESULTS

As we have worked on software and hardware. The first part describes the results of MATLAB software and the second part for hardware.

Software Components Results

First, the results on the undervoltage fault condition in the three-phase induction motor were taken from the simulation displayed in Figure 03(a) to Figure 03(c).

This analysis demonstrates the significant impact of voltage fluctuations on motor performance. When volt- age drops suddenly, notable changes occur in key mo- tor parameters such as motor speed and current, partic- ularly evident during undervoltage conditions. These alterations not only compromise motor efficiency but also elevate the risk of overheating, a critical concern that can potentially lead to motor failure or even burnout. Therefore, safeguarding against such abnor- malities is paramount to ensure the longevity and relia- bility of the motor. Furthermore, our investigation also delves into the effects of overload conditions, a preva--lent issue encountered in motor operations. Through simulations, we observe distinct variations in motor pa- rameters including speed, voltage, and current profiles, as depicted in Figures 03(a) to 03(c). These results un- derscore the detrimental consequences of overload con- ditions on motor performance, highlighting the urgency of implementing protective measures to mitigate risks and preserve motor integrity.

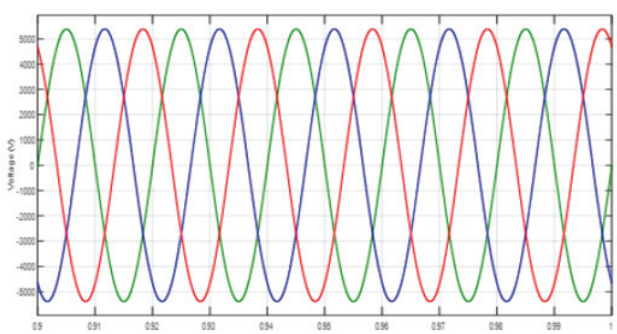

Fig. 3a: Three phase voltage input to induction motor

In conclusion, our findings emphasize the critical importance of proactive measures to safeguard against voltage fluctuations and overload conditions, both of which pose significant threats to motor functionality and longevity. By comprehensively understanding the implications of these abnormalities, we can effectively devise strategies to protect motors from poten- tial damage, thereby ensuring sustained opera- tional efficiency and minimizing downtime in in- dustrial settings.

Hardware Component Results

In summary, our project successfully installed and integrated equipment into the control panel, ensuring secure and efficient operation. External pilot devices and measurement tools provide real-time monitor- ing of voltage, current, and frequency for load bal- ancing assessment. The selector switch offers manual or IoT-based control, while toggle switches activate

loads as required. With its IoT integration, our smart control panel effectively detects and ad- dresses both electrical and mechanical faults in in- duction motors. From short circuits to overheating, and from friction to vibration, our panel incorporates temperature and vibration sensors to trigger alarms when necessary. Leveraging IoT capabilities, users can remotely monitor and manage motor health, ensuring prompt intervention and maintenance as needed. Figure 04 displays the findings from both sensors.

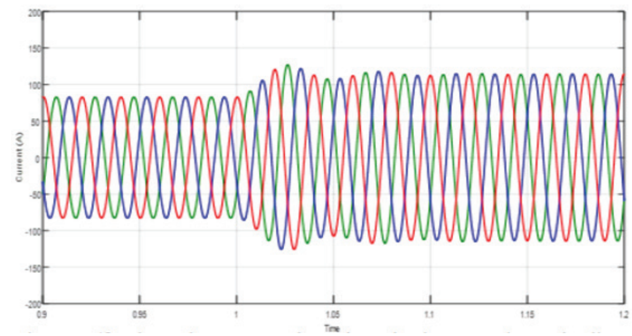

Fig. 3b: Three-phase current drawn by induction motor in overloading condition

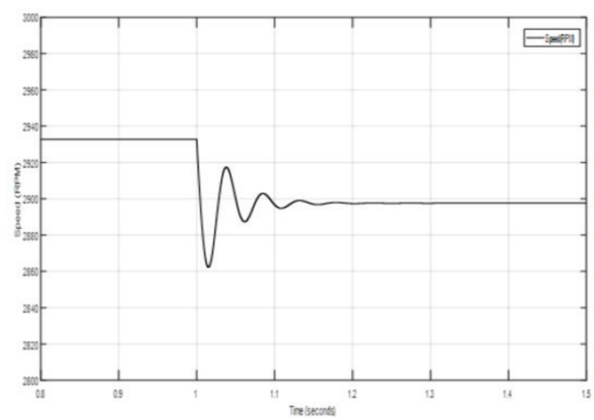

Fig. 3c: Motor speed subjected to overload (1 sec)

CONCLUSION

In the textile industry, where the reliance on inductive loads is paramount for processes like spinning, weaving, and carding, the need for intelligent systems is undeniable. Enter the intelligent panel, a ground- breaking solution designed to seamlessly operate loads manually or through IoT. The IoT control system offers unparalleled efficiency and convenience, accessible from anywhere via Wi-Fi. This translates to a smoother, faster operation without the need for physical pres- ence, thus reducing labour costs and elevating system intelligence.

However, acknowledging the importance of redundancy, the manual operation system serves as a reliable backup. In cases where technical issues disrupt automatic operations, manual control steps in seamlessly. Beyond convenience, the smart panel excels in protection and control. It empowers users to remotely address electrical or mechanical failures via IoT, ensuring swift intervention. Notably, electrical faults such as undervoltage and overload in three-phase induction motors are meticulously accounted for using SIMULINK /MATLAB simulations.

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A Literature Review on Applications of Laplace Transform in Engineering

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ABSTRACT

Knowledge of Mathematics is very essential in daily existence. Researchers in various disciplines use various mathematical tools, models and techniques to validate and substantiate their work. In recent years, the knowledge of integral transforms is essential to engineers and scientists. Among these, Laplace transform plays as a powerful tool to give the solution for solving differential equations and analyzing dynamic systems. This study examined a number of research publications and examined how academics employed the Laplace transform as a tool to address their research issues. This paper demonstrates adaptability and effectiveness of Laplace transform in problem solving and designing efficient systems within the domain of engineering.

KEYWORDS: *Applications, Differential equation, Laplace transform, Inverse laplace transform.*

INTRODUCTION

Laplace transform originated to solve problems in electrical engineering by Oliver Heaviside, an English engineer from the operational methods. The French Mathematician Pierre-Simon Laplace while developing the theory of probability used such transform earlier. It changes a time function into a real or complex variable. It is employed in the solution of system of simultaneous, ordinary and partial differential equations. Its versatility extends across various domains, including control engineering, signal processing, electrical engineering, optics, probability theory etc. [1 Laplace transform is a mathematical operation applied to a function of t defined for all positives values of t. In mathematical terms, the Laplace Transform of f(t), denoted as L{f(t)} or F(s), is expressed as

$$L\{f(t)\} = F(s) = \int_0^\infty e^{-st} f(t)dt$$

Here S is a complex parameter. The inverse Laplace transform L^(-1) serves to revert the transformed function F(s) back to original form f(t), thus:

$L^{-1}\{F(s)\} = f(t)$

In this context, f(t) is recognized as inverse Laplace transform of F(s).

INVESTIGATIONS OF LAPLACE TRANSFORMS APPLICATIONS

In this investigations, various research papers analysis was done in view of the diverse applications of the Laplace Transform and how researchers from different disciplines used this mathematical tool to address their respective research problems [19]. Below, we are providing an overview of our findings where Laplace Transform was utilized: In electric machine, Laplace transform is employed to address differential equations associated with frequency domain and transient responses analysis. Metwally, [2] had applied Laplace transform technique for modeling the transient response of electric machines. For finding, the transfer function, which describes its input-output relationship under impulse excitation of electrical machine, the Laplace transform utilized. He had provided a mathematical framework for simulating and analyzing the impulse response of electric machines. While designing controls for power system and analyzing complex behavior of stressed power system, involve nonlinear differential equation. Hasan shanechi, N. Pariz and E. Vaahedi, [3] used Laplace transformation to solve system of nonlinear differential equations. In this paper, Laplace transform utilized for comprehensive analysis of large-scale power systems with nonlinear characteristics, leading to valuable insights for system design, operation, and control. Siriya Skolthanarat, [4] discussed Laplace transform uses for system modeling, stability analysis and control design. The study would make easier to analyze frequency response and transient behaviour- two critical aspects of system performance assessment- by utilizing Laplace methods. In order to simplify analysis and design procedures, Laplace transform helps translate differential equations into the frequency domain. In order to comprehend the dynamic behaviour and maximise the functioning of the suggested HVDC system, this mathematical tool most certainly played a crucial role. All things considered, Skolthanarat's work provides important insights into the performance and design of HVDC technologies, illustrating the usefulness of the Laplace transform in these fields. Peter Lloyd woodfield, [5] used Laplace Transform to get transient analytical solutions for the motion of vibrating cylinders. The differential equations describing the motion of the cylinder can be transformed into Laplace domain by using Laplace transforms, which makes analysis easier. A through comprehension of the transient behaviour of vibrating cylinders under fluid flow circumstances is made possible by this mathematical method, especially in the stokes regime where viscous forces predominate. By offering analytical insights into the dynamic response of vibrating cylinders, Woodfield's study advances our understanding of fluid structure interaction and improves our ability to forecast outcomes for engineering applications. Shu-Nan et al. [6] used Laplace Transform to derive classical variational principles. Laplace transform is applied to hyperbolic and parabolic heat conduction models. Equations for parabolic heat conduction for different models are transformed into linear variational equations using Laplace Transform technique. This work improves the accuracy and efficiency of heat conduction modelling by using Laplace transform. The significance of Laplace transforms in developing theoretical and computational approaches for researching heat transfer process is highlighted by the work. K. Daneshjou et al. [7] investigate the dynamic behavior of the structure using the inverse Laplace transform technique. They deftly examine the response of the fluid -filled FGM cylinder with a rigid core to transient loads, providing insight into its mechanical characteristic in different scenarios. This work provides the effectiveness of Laplace transform in clarifying the complex dynamics of composite structures. Hodasaleh, et al., [8] Laplace transform was utilized to solve heat transfer problems. Heat transfer problems are usually described by non linear differential equations and solved by using Laplace transform. This indicates Laplace transform technique is useful in modeling fluid flow and heat transfer problems. Thus, Laplace transform is applied in solving transient and time dependent equations, fluid-solid interactions and boundary value problems. Ayush Bhandari, Yonjna C. Elder,[9] developed a comprehensive FRI framework applicable to a wide range of transformations that include Fourier, Laplace,Fresnel, fractional Fourier, Bargmann and Gauss Weirstrass transforms, among others. They offer a comprehensive mathematical framework for characterizing signals with finite innovation rates by incorporating the concepts of Laplace transform. This method makes it easier to use effective signal processing techniques, which makes it possible to accurately reconstruct and analyse complex data streams. Jing Huang et al., [10] addressed the difficulty of proper modelling using Laplace transform techniques, concentrating on the distinctive dynamics of these fibres. They provide a through theoretical framework for understanding the complex behaviour of microstructure fibres through exacting mathematical deviations. The fast variable field in microstructure fibres is described by a transient non linear equation that is established and solved by applying Laplace transformation and Volterra series integration. X. Zheng et al., [11] proposes a novel unilateral nuclear magnetic resonance (NMR) technique to measure the state of insulator aging. A unilateral NMR sensor was created especially to determine an insulator's transverse time. By using inverse Laplace Transform, one -dimensional T2 distribution for each layer was obtained. Laplace transform is often used to analyze and model the behavior of dynamic systems. In the case of the NMR sensor, it might be utilized to model the response of the system to different inputs or conditions. This modeling could aid in understanding the aging process of silicone rubber insulators and how it affects NMR signals. Tania Bakhos et al., [12] presents a quick approach for handling inverse issues involving parabolic partial differential equations. Faster processing is made possible by the use of Laplace transforms, which offer a strong mathematical framework for converting PDE-based inverse problems into algebraic equations. W. K. Zahra, et al.,[13] suggest solution for fractional order electrical circuits utilizing the Laplace transform and a non-standard finite difference method. They create a strict mathematical framework for dissecting these circuits and reveal details about their dynamics and behaviour by utilizing the Laplace transform. Sunil Kumar et al., [14] use Laplace transform techniques to provide an analytical solution to Abel integral problem that they encountered in astrophysics. This work addresses a basic issue in astrophysical modeling and shows how useful Laplace transforms are for solving these kinds of equations. They provide a methodical solution to Abel integral equation by utilizing Laplace transform techniques, which sheds light on astrophysical occurrences. Sumit Gupta et al., [15] offer a novel solution to convection-diffusion problems. To obtain analytical solution, they integrate the Laplace transform technique with homotopy perturbation. They give scientists and engineers a strong toolkit to precisely analyse and forecast the behaviour of convective-diffusive systems by combining the Laplace transform approach with homotopy perturbation. This creative method shows how integrating several mathematical techniques can be useful in solving complex fluid mechanics issues and analytical methods in engineering. M. F. Lumentut et al., [16] implemented Laplace transform techniques for formulating dynamic equations. This resulted in a formula for multifrequency response that harvest power. They offer insights into the design and optimization of such structures for effective energy harvesting applications by utilizing rigorous mathematical analysis. This investigation makes a substantial contribution to the field of energy harvesting technology. Lei Wang et al.,[17] provide a mathematical approach to modelling and analyzing pressure transient occurrences in these reservoirs by utilizing Laplace transform finite difference technique. With this approach, reservoir behaviour may be accurately predicted and useful insights for production strategy optimization are obtained. By demonstrating the efficiency of Laplace transform techniques in reservoir engineering applications, the work advances our knowledge of coalbed methane reservoirs. M. F. Lumentut et al., [18] focused on the utilization of Laplace transform to derive electromechanical response function which explains how the device reacts to changing mechanical and electrical loads over a range of frequencies in the context of electromechanical piezoelectric power harvester. This is especially helpful for figuring out how these devices behaves in various operating environments and for maximizing their efficiency.

CONCLUSION

From the Literature review, we observe that Laplace Transform is very useful in electrical, mechanical, control systems and signal processing domains It is used as a indispensable tool for engineers and scientists to simplify complex mathematical models and facilitate system analysis and design. By applying Laplace Transform-based techniques, engineers can effectively optimize system performance, deal with dynamic system problems and advance technological innovation in various engineering fields.

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On a Certain Subclass of Univalent Function Associated with Mittag-Leffler Function

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ABSTRACT

Within this current document, we introduced a subclass of univalent and analytical functions defined by differential operator associated to Mittag-Leffler function and among other findings we have the results like, coefficient estimates, growth and distortion theorem, radii of starlikeness, convexity and close to convexity for the class $T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,A,B)$.

2000 AMS Subject Classification: 30C45, 30C50

KEYWORDS: *Hadamard product, Analytic function, Starlike functions, Univalent and Mittag-Leffler function.*

INTRODUCTION

Let a represent the class of the following analytic functions:

$$f(z) = z + \sum_{n=2}^{\infty} a_n z^n \tag{1}$$

within the unit disk with normalization $f(0)=0,\ f'(0)=1$. The subclass

of a consisting of functions of the type (1) that are univalent in U.

Also let be the subclass of consists of functions of the form

$$f(z) = z - \sum_{n=2}^{\infty} a_n z^n, \quad a_n \geq 0, \quad z \in U \tag{2}$$

which was introduced and studied by Silverman [9].

Now. If $g(z) \in A$ has the form

$$g(z) = z + \sum_{n=2}^{\infty} b_n z^n, \tag{3}$$

the definition of the convolution (Hadamard Product) of f and g is *f** given by

$$(f*g)(z) = (g*f) = z + \sum_{n=2}^{\infty} a_n b_n z^n, \quad z \in U \tag{4}$$

Mittag-Leffler introduced The Mittag-Leffler function $E_{\nu}(z)$ [7] and Wiman studied its generalization $E_{\nu,\tau}(z)$ [14] given by

$$E_{\nu}(z) = \sum_{n=0}^{\infty} \frac{z^n}{\Gamma(\nu n + 1)}$$

$$E_{\nu,\tau}(z) = \sum_{n=0}^{\infty} \frac{z^n}{\Gamma(\nu n + \tau)}$$

whereas $\nu, \tau \in$ £, $\mathrm{Re}(\nu) > 0,$ and $\mathrm{Re}(\tau) > 0.$

Srinivasulu defined the function $Q_{\nu,\tau}(z)$ [13]

$$Q_{\nu,\tau}(z) = z\,\Gamma(\tau)\,E_{\nu,\tau}(z), \tag{5}$$

and further "the differential operator $D_\lambda^m(\nu,\tau) f(z) : A \to A$ studied by Srinivasulu [13]
And given by

$$D_\lambda^0(\nu,\tau)\ f(z) \equiv f(z) * Q_{\nu,\tau}\ (z)$$

$$D_\lambda^1(\nu,\tau)\ f(z) \equiv (1-\lambda) f(z) * Q_{\nu,\tau}(z) + \lambda z \left(f(z) * Q_{\nu,\tau}(z)\right)'$$

$$D_\lambda^m(\nu,\tau)\ f(z) \equiv D_\lambda^1\left(D_\lambda^{m-1}(\nu,\tau)\ f(z)\right).$$

Seeing that is simple if *f(z)* is provided by the equation (1.2), then the definition of the operator D_λ^m take the form

$$D_\lambda^m(\nu,\tau) f(z) = z - \sum_{n=2}^{\infty} \phi_n^m(\lambda,\nu,\tau) a_n z^n$$

where

$$\phi_n^m(\lambda,\nu,\tau) = \frac{\Gamma(\tau)}{\Gamma(\nu(n-1)+\tau)}\left[\lambda(n-1)+1\right]^m$$

With the operator in this paper, we define the new class as follows

Definition 1.1: From equation (1) the function *f(z)* is in the class $S_\lambda^m(\nu,\tau,\alpha,\beta,\gamma,N,S)$, if it makes the inequality satisfied

$$\left|\frac{\left[D_\lambda^m(\nu,\tau) f(z)\right]' - 1}{(S-N)\gamma\left\{\left[D_\lambda^m(\nu,\tau) f(z)\right]' - \alpha\right\} + N\left\{\left[D_\lambda^m(\nu,\tau) f(z)\right]' - 1\right\}}\right| < \beta \tag{6}$$

whereas

$\nu,\tau \in \mathbb{C}$, $\mathrm{Re}(\nu) > 0$, and $\mathrm{Re}(\tau) > 0$, $0 \le \lambda,\beta,\gamma \le 1, 0 \le \alpha < 1, 0 < S \le 1, -1 \le N < S \le 1.$

Further we define $T_\lambda^m(\nu,\tau,\alpha,\beta,\gamma,N,S) \equiv S_\lambda^m(\nu,\tau,\alpha,\beta,\gamma,N,S) \cap T.$

We see that, such classes were studied extensively by Owa [1], Aghalary [2], Aouf and Cho [3], Aouf et.al [4] and others [5], [6], [8], [9], [10], [11], [12].

MAIN RESULTS

Theorem 2.1: A function with the form (1.1), *f(z)* belongs to the class $S_\lambda^m(\nu,\tau,\alpha,\beta,\gamma,N,S)$ if

$$\sum_{n=2}^{\infty} n\,\phi_n^m(\lambda,\nu,\tau)\left\{1+\beta\left[(S-N)\gamma+N\right]\right\} a_n \le (S-N)\beta\gamma(1-\alpha)$$

$\nu,\tau \in \mathbb{C}, Re(\nu) > 0,$and $Re(\tau) > 0, 0 \le \lambda,\beta,\gamma \le 1, 0 \le \alpha < 1, 0 < S \le 1, -1 \le N < S \le 1.$

Proof: Considering that, the inequality holds true and let $|z| = 1$ from (1.6), we get

$$\left|\left[D_\lambda^m(\nu,\tau) f(z)\right]' - 1\right| - \beta\left|(S-N)\gamma\left\{\left[D_\lambda^m(\nu,\tau) f(z)\right]' - \alpha\right\} + N\left\{\left[D_\lambda^m(\nu,\tau) f(z)\right]' - 1\right\}\right|$$

$$= \left|-\sum_{n=2}^{\infty} n\,\phi_n^m(\lambda,\nu,\tau) a_n z^{n-1}\right|$$

$$-\beta\left|\left[(S-N)\gamma(1-\alpha) - (S-N)\gamma\sum_{n=2}^{\infty} n\,\phi_n^m(\lambda,\nu,\tau) a_n z^{n-1}\right] - N\sum_{n=2}^{\infty} n\phi_n^m(\lambda,\nu,\tau) a_n z^{n-1}\right|.$$

$$\le \sum_{n=2}^{\infty} n\phi_n^m(\lambda,\nu,\tau)|a_n| - (S-N)\beta\gamma(1-\alpha) + \beta\left[(S-N)\gamma+N\right]\sum_{n=2}^{\infty} n\phi_n^m(\lambda,\nu,\tau)|a_n|.$$

$$= \sum_{n=2}^{\infty}\left\{1+\beta\left[(S-N)\gamma+N\right]\right\} n\phi_n^m(\lambda,\nu,\tau)|a_n| - (S-N)\beta\gamma(1-\alpha) \le 0.$$

Theorem 2.2: A function with the form (1.2), *f(z)* belongs to class $T_\lambda^m(\nu,\tau,\alpha,\beta,\gamma,N,S)$, if and only if,

$$\sum_{n=2}^{\infty} n\phi_n^m(\lambda,\nu,\tau)\left\{1+\beta\left[(S-N)\gamma+N\right]\right\} a_n \le (S-N)\beta\gamma(1-\alpha) \tag{7}$$

$\nu,\tau \in \mathbb{C}, Re(\nu) > 0$,and $Re(\tau) > 0, 0 \le \lambda,\beta,\gamma \le 1, 0 \le \alpha < 1, 0 < S \le 1, -1 \le N < S \le 1.$

Proof: By Theorem 2.1, we need to prove the necessary condition.

Assume that *f(z)* belong to the class then we have

$$\left|\frac{\left[D_\lambda^m(\nu,\tau) f(z)\right]' - 1}{(S-N)\gamma\left\{\left[D_\lambda^m(\nu,\tau) f(z)\right]' - \alpha\right\} + N\left\{\left[D_\lambda^m(\nu,\tau) f(z)\right]' - 1\right\}}\right| < \beta$$

$$\left|\frac{-\sum_{n=2}^{\infty} n\phi_n^m(\lambda,\nu,\tau) a_n z^{n-1}}{\left[(S-N)\gamma(1-\alpha) - \left[(S-N)\gamma+N\right]\sum_{n=2}^{\infty} n\phi_n^m(\lambda,\nu,\tau) a_n z^{n-1}\right]}\right| < \beta$$

Since

$\mathrm{Re}(z) \le |z|.$

$$\mathrm{Re}\left\{\frac{-\sum_{n=2}^{\infty} n\phi_n^m(\lambda,\nu,\tau) a_n z^{n-1}}{\left[(S-N)\gamma(1-\alpha) - \left[(S-N)\gamma+N\right]\sum_{n=2}^{\infty} n\phi_n^m(\lambda,\nu,\tau) a_n z^{n-1}\right]}\right\} < \beta. \tag{8}$$

Now, selecting the values of z on the real axis, now we assure that $\left[D_\lambda^m(\nu,\tau)\right]'$ is real.

From equation (2.2) and as $z \to 1$ through real axis, we get

$$\sum_{n=2}^{\infty} n\,\phi_n^m(\lambda,\nu,\tau) a_n \le (S-N)\beta\gamma(1-\alpha) - \beta\left[(S-N)\gamma+N\right] n\phi_n^m(\lambda,\nu,\tau) a_n$$

which implies the proof of inequality (7)."

Corollary 2.1: If $f(z)\in T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$, if and only if,

$$a_n \le \frac{(S-N)\beta\gamma(1-\alpha)}{n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)} \tag{9}$$

where the function holds the equality for

$$f(z)=z-\frac{(S-N)\beta\gamma(1-\alpha)}{n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}z^n \tag{10}$$

Theorem 2.3: Let $f_1(z)=z$ and

$$f(z)=z-\frac{(S-N)\beta\gamma(1-\alpha)}{n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}z^n, \tag{11}$$

which implies that $f(z)\in T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$, if and only if it can be expressed as

$$f(z)=\sum_{n=1}^{\infty}\Psi_n f_n(z),\quad \Psi_n\ge 0,\quad \sum_{n=1}^{\infty}\Psi_n=1.$$

Proof: Suppose $f(z)$ can be written as in (2.5), then

$$f(z)\square z-\sum_{n=2}^{\infty}\Psi_n\frac{(S-N)\beta\gamma(1-\alpha)}{n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}z^n.$$

Now,

$$\sum_{n=2}^{\infty}\Psi_n\frac{(S-N)\beta\gamma(1-\alpha)^n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}{(S-N)\beta\gamma(1-\alpha)^n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}=\sum_{n=2}^{\infty}\Psi_n=1-\Psi_1\le 1.$$

Thus $f(z)\in T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$.

Conversely, let us assume that $f(z)\in T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$, then by (2.3), we get

$$\Psi_n=\frac{n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}{(S-N)\beta\gamma(1-\alpha)}a_n,\quad n\ge 2, \text{ and}$$

$$\Psi_1\square 1-\sum_{n=2}^{\infty}\Psi_n,$$

Then we get $f(z)=\sum_{n=1}^{\infty}\Psi_n f_n(z)$

Theorem 2.4: The class $T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$ is convex set.

Proof: "Consider,

$$f_j(z)\square z-\sum_{n=2}^{\infty}a_{n,j}z^n,\quad a_{n,j}\ge 0,\quad j=1,2$$

belongs to class $T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$. It is adequate to show that function $h(z)$ given by

$$h(z)\square \xi f_1(z)+(1-\xi)f_2(z),\quad 0\le\xi\le 1$$

is belonging to the class $T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$. We get

$$h(z)\square z-\sum_{n=2}^{\infty}[\xi a_{n,1}+(1-\xi)a_{n,2}]z^n.$$

Now from Theorem 2.2, we get

$$\sum_{n=2}^{\infty}n\phi_n^m(\lambda,\nu,\tau)a_n\{1+\beta[(S-N)\gamma+N]\}\xi a_{n,1}$$
$$+\sum_{n=2}^{\infty}n\phi_n^m(\lambda,\nu,\tau)a_n\{1+\beta[(S-N)\gamma+N]\}(1-\xi)a_{n,2}$$
$$\le\xi(S-N)\beta\gamma(1-\alpha)+(1-\xi)(S-N)\beta\gamma(1-\alpha)$$
$$\le(S-N)\beta\gamma(1-\alpha)$$

which gives us $h(z)\in T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$. Therefore $T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$ is convex set.

We will now get the classes close to convexity and starlikeness radii for $T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$."

Theorem 2.5: A function with the form (1.2), $f(z)$ belongs to class $T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$ then $f(z)$ is close to convex of order Ω, $(0\le\Omega<1)$ in the disc $|z|<r_1$.

Whereas,

$$r_1\square\inf_{n\ge 2}\left\{\frac{(1-\Omega)\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}{(S-N)\beta\gamma(1-\alpha)}\right\}^{\frac{1}{n-1}}.$$

For extremal function $f(z)$ is given by (2.4) the result is sharp.

Proof: Given, $f(z)\in T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$ and $f(z)$ *is close to convex of order* Ω

We have got

$$|f'(z)-1|<(1-\Omega).$$

Consider, the equation (2.6) left-hand side

$$|f'(z)-1|\square\sum_{n=2}^{\infty}n\,a_n|z|^{n-1}.$$

This equation is bounded above by $(1-\Omega)$

$$\sum_{n=2}^{\infty}\frac{n}{(1-\Omega)}a_n|z|^{n-1}\le 1. \tag{12}$$

But, $f(z)\in T_{\lambda}^{m}(\nu,\tau,\alpha,\beta,\gamma,N,S)$ if and only if.

$$\sum_{n=2}^{\infty}\frac{n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}{(S-N)\beta\gamma(1-\alpha)}a_n\le 1.$$

Thus equation (2.6) is true, if

$$\frac{n}{(1-\Omega)}|z|^{n-1}\le\frac{n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}{(S-N)\beta\gamma(1-\alpha)}.$$

Or equivalently

$$|z|\le\left\{\frac{(1-\Omega)\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}{(S-N)\beta\gamma(1-\alpha)}\right\}^{\frac{1}{n-1}}.$$

Therefore, the proof of Theorem (2.5).

Theorem 2.6: Let the function with the form (1.2), *f(z)* belongs to the class $T_\lambda^m(\nu,\tau,\alpha,\beta,\gamma,N,S)$ then *f(z)* is starlike of order Ω, $(0\le\Omega<1)$. in the disc $|z|<r_2$.
Whereas,

$$r_2=\inf_{n\ge2}\left\{\frac{(1-\Omega)n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}{(n-\Omega)(S-N)\beta\gamma(1-\alpha)}\right\}^{\frac{1}{n-1}}.$$

For "extremal function *f(z)*" is given by (2.4) the result is sharp.

Proof: Given, $f(z)\in T_\lambda^m(\nu,\tau,\alpha,\beta,\gamma,N,S)$ and $f(z)$ *is starlike of order* Ω

We have

$$\left|\frac{zf'(z)}{f(z)}-1\right|<(1-\Omega). \tag{2.7}$$

"consider, the equation (2.7) left-hand side

$$\left|\frac{zf'(z)}{f(z)}-1\right|\le\frac{\sum_{n=2}^{\infty}(n-1)\,a_n|z|^{n-1}}{1-\sum_{n=2}^{\infty}a_n|z|^{n-1}}.$$

This equation is bounded above by $(1-\Omega)$

$$\sum_{n=2}^{\infty}\frac{(n-\Omega)}{(1-\Omega)}a_n\,|z|^{n-1}\le1.$$

But, $f(z)\in T_\lambda^m(\nu,\tau,\alpha,\beta,\gamma,N,S)$ if and only if

$$\sum_{n=2}^{\infty}\frac{n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}{(S-N)\beta\gamma(1-\alpha)}a_n\le1.$$

Thus equation (2.7) is true if

$$\frac{(n-\Omega)}{(1-\Omega)}|z|^{n-1}\le\frac{n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}{(S-N)\beta\gamma(1-\alpha)}.$$

Or equivalently

$$|z|\le\left\{\frac{(1-\Omega)n\{1+\beta[(S-N)\gamma+N]\}\phi_n^m(\lambda,\nu,\tau)}{(n-\Omega)(S-N)\beta\gamma(1-\alpha)}\right\}.$$

The proof of Theorem (2.6 is complete."

CONCLUSION

In this article, we introduced new differential operator associated Mittag-Leffler function on a subclass of univalent and analytical functions and we obtained a various important property which including coefficient estimates, growth and distortion theorem, radii of starlikeness, convexity. and. close to convexity for the class $T_\lambda^m(\nu,\tau,\alpha,\beta,\gamma,N,S)$. Our results are in line with those in earlier works related to the field of geometric function theory.

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Revolutionary Approach: Harnessing Human Waste for Sustainable Fertilizer Production

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ABSTRACT

This study proposes a novel approach to fertilizer production by integrating partially degradable human feces into the design of a comprehensive fertilizer plant. The utilization of human waste as a resource for fertilizer production offers a sustainable solution to waste management and addresses the increasing demand for fertilizers in agriculture. The design process involves careful consideration of treatment methods to ensure the safe and efficient conversion of human feces into high-quality fertilizer products. Key aspects of the design include waste collection, treatment,and processing techniques, as well as quality control measures to meet regulatory standards. By harnessing the nutrient-rich content of human feces, this innovative fertilizer plant aims to contribute to environmental sustainability while providing a valuable resource for agricultural productivity.

KEYWORDS: *Agricultural productivity, Comprehensive fertilizer plant, Human excreta, Nutrient rich resource utilization.*

INTRODUCTION

In India, between 40 and 60 percent of all solid waste streams are composed of organic waste. Straw, animal dung,and organic waste leftover from the processing of other agricultural products are used as raw materials in the line that turns organic waste into fertilizer. Then, these materials are transformed into organic fertilizer by microbial fermentation, deodorization, and maturation. A workable solution for managing human waste production and producing beneficial fertilizer products simultaneously is to use degradable human waste. The use of human waste as fertilizer has several advantages. First of all, by providing a sustainable way to handle human waste, it lessens the burden on landfills and conventional wastewater treatment systems. Second, it allows for the recovery of essential nutrients that are essential to plant growth, such as nitrogen, potassium, and phosphate that are found in excrement. Thirdly, by reducing the demand for synthetic fertilizers and the harm they cause to the environment during production and use, it aids in closing the nutrient loop.

There are a number of benefits to using human waste as fertilizer. First of all, it relieves the strain on landfills and traditional wastewater treatment systems by offering a sustainable method of handling human waste. Second, intakes it possible to recover vital nutrients like potassium, phosphate, and nitrogen found in feces, nutrients that are critical to plant growth. Thirdly, it helps close the nutrient loop by lowering the need for synthetic fertilizers and the environmental damage that comes with using and producing them.

LITERATURE REVIEW

Arvind Kumar Shukla Approximately 50% of Indians are employed in agriculture. Fertilizer is one of the most important commodities required in India to boost agricultural productivity and farmers' income. India is the top country in the South Asian Association of Regional Cooperation (SAARC) and the second most fertilized country globally. Degradation of the environment and climate change have been brought on by a buildup of fertilizer nutrients in the soil and/or leakage into the environment as a result of reduced utilization of applied fertilizers. This can be caused by utilizing fertilizer nutrients excessively or improperly, applying them unevenly, or just applying secondary and micronutrients carelessly. Unbalanced fertilizer usage has cumulative negative effects that exacerbate soil and air pollution, endanger human health and biodiversity, and eutrophicate aquatic systems. Higher total N2O emissions and low Nusage efficiency (15–30%) are closely connected with higher fertilizer-N consumption.

[1] Franziska Hafner Recycling nutrients is necessary to close nutrient loops in a circular economy. By replacing mineral fertilizers with bio-based recycling fertilizers derived

from locally available resources, such human excreta, environmentally friendly food production may be promoted. Three creative and safe recycling methods were evaluated in a field test to learn more about the nitrogen content and potential as fertilizer of human waste. The effects of one fecal compost and two nitrified urine fertilizers (NUFs) were compared with those of commercial organic fertilizer vinasse.. The marketable yield was higher when fecal compost and a NUF were combined than when compost was used alone. While applying NUF and compost togethermay have reduced crop yields in the short term, over time it may have raised soil carbon levels and supported the production of climate-friendly food.[2] B. Moya two of the biggest worldwide issues are expanding access to safely managed sanitation facilities and producing food sustainably to attain food security. Creating safe, nutrient-rich soil amendments and treating human excreta are two efficient ways to incentivize addressing these two issues. This study assessed the acceptance of fertilizers made from human excreta in the local market and examined their quality. The three fertilizers differed in afew ways: compost had more concentrated nutrients (23 g/kg) than vermicompost (11 g/kg), and the mineralization stages varied between the two, but crop yield was unaffected. The results of the field tests and the interviews point to a strong possibility fortuning human excreta into fertilizers that benefit crops and can be used in the neighborhood market. [3] Mariya E. Kelova Acknowledging the importance of human waste creates new avenues for resolving issues with sustainable fertilizer supplies and nutrient management in the future. Low-tech recycling is made possible by dry on-site sanitation systems' high nutrient concentration and limited trash output. The finished product can significantly improve the local agro-ecological system. Thus,the aim of this study was to evaluate and compare the potential as a fertilizer and nutritional value of different organic amendments made from human excreta. Nine amendments were previously obtained by fermenting or composting human excreta from dry toilets at temperatures of 7, 20, or 38degrees, and then vermicomposting the result. We evaluated the fertilizer potential of the amendments using a pot experiment with barley and a soil incubation study to determine nitrogen and phosphorus mineralization. Since all additions to nitrogen had a slow rate of nitrogen mineralization, the yield was based on the amount of accessible nitrogen. The method of treatment had a significant impact on the amount of nitrogen that was available; amendments obtained by active composting at 38°C had significantly higher amounts of total and mineral nitrogen than those that were fermented or composted at 7°C and 20°C. These findings provide insight into how treatment methods impact nitrogen availability and progress the assessment of the agronomic value of products from on- site dry sanitation systems. [4] J. Nagy Numerous, environmental issues are brought about by flush toilet- based water infrastructure, which manages both grey water and backwater simultaneously. Among these, the loss of important organic material and the nutritional value of human excreta that is, urine andfeces is not yet stressed enough. Grey water and human excreta must be collected separately in order to be used for agricultural purposes. Research mostly focuses on treating and using urine for agricultural applications because it includes the majority of the nutrients found in human excreta. We studied the information found in the literature regarding the nutritional makeup of human waste. In any case, given the yearly loss of soil mass and fertility on Earth, as well as the expense, material, and energy requirements of fertilizer manufacture and consumption, more extensive agricultural use of human excreta is required in the future. [5]Helvi Heinonen- Tanski Composting the faces and urine possibly combined with kitchen and garden waste will eliminate any odor and ensure acceptable hygiene. Compost is an extremely beneficial slow- release fertilizer and soil enhancer. [7] Prithvi Simha A human fertilizer and soil enhancer. [7] Prithvi Simha A human excreta-based bio economy is a set of sustainable, circular practices that promote closed-loop resource and nutrient flows from sanitation to agriculture. A quantitative recovery of urea from human urine might allow for the production of approximately 4.5 kg of urea per person per year.[8] E. Andersson Urine fertilisation is considered a low- risk, low-cost method that can significantly boost yields. This suggests that urine fertilisation can play a key role in promoting food security and income, particularly for individuals with limited alternatives for managing soil nutrients. [9]

OBJECTIVES

The objectives are stated below

1. To create the comprehensive model's component parts.
2. To determine the economy that the system needs.
3. To examine the all-inclusive elements.
4. To boost rural areas' economies

MATERIAL USED

Constituents of the system

Toilet- A toilet is a fixture of sanitary equipment used to hold and collect human waste and urine. Septic tank (sewage-disposal tank)-gather fecal sludge

Composting pit

A compost pit is a pit created to produce manures and fertile materials by disposing of decomposing biodegradable materials.

Mixing tank- A mixing tank is a machine container used to combine different ingredient

Materials used for fertilizer production by using human waste

Human waste

The solid or semi-solid remnants of food that were not able to be broken down or absorbed in the human small intestine but were instead further broken down by bacteria in the large intestine are known as human feces. The human waste that we gathered from a university campus. The excrement was roughly a year old.

Soil

Soil microbes play a crucial role in the degradation process. When used as a filler material, it also improves product efficiency and reduces odor. Soil is composed of four elements: water, air, and organic matter, which make up 25%, 5%, and 25% of mineral matter, respectively.

Organic waste

Enormous amounts of food are thrown in the trash. We could make use of all the food waste and turn it into manure that can be used as organic compost. Food waste is the primary source of natural materials, making it an exceptional soil treatment agent. Eggshells, cereals,veggies, natural products, and espresso channels can all be used to treat soil. Natural materials found in food waste can be used to treat the soil and create manure. It makes sense to use natural waste as natural manure, such as tannery slime, which has a high natural matter, N, and P content, to improve soil fertility in semi- bone-dry soils and to remediate abandoned mine sites./

Sawdust

A waste product or by-product of woodworking processes like sawing, sanding, milling, planning, and routing is sawdust. It is made up of tiny wood fragments. We gathered saw dust from the nearby saw mill shop.

Vermicompost

Vermicompost, also known as vermi-compost, is a mixture of decomposing vegetable or food waste, bedding materials, and vermicast that is produced by utilizing different species of worms, primarily red wigglers, white worms, and other earthworms,. The raising of worms for this purpose is known as vermiculture, and this process is known as vermicomposting. The optimal combination for earthworm biomass growth soil, vermicompost, feces, and vermi compost bottom to top layers, suggesting that the soil layer plays a beneficial function in earthworm biomass growth.[6]

Press mud

Large amounts of sugarcane waste are accumulated in India, where most of the material is not being used productively. However, these waste products have a lot of potential when combined with agricultural soil to create organic fertilizer, which has several advantages and can enhance soil health and agronomic productivity overtime.

METHODOLOGY

- A reviews of the literature and a site visit pertaining to organic fertilizer.
- A tour to agriculture colleges to gather information about the use of human faces.
- Examination of all-inclusive units and system components.
- Choose the materials for the suggested model.
- Quality Assurance: In order to guarantee the safety and efficacy of the product, samples are examined for pathogens, nutrients, and other pollutants.
- Utilization and Distribution:
- Environmental Monitoring

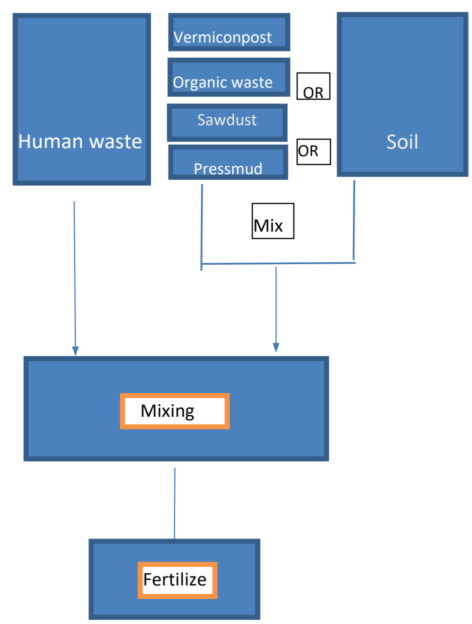

Fig. 1: Proposed diagram of making fertilizer using human waste

CONCLUSION

The process of turning human waste into fertilizer,offers a viable path towards sustainable farming. This fertilizer is superior to chemical fertilizers in that they recycle nutrients from waste streams back into the soil, providing a number of advantages. These advantages include supplying vital nutrients for plant growth, enhancing the health and structure of the soil with organic matter, lowering dependency on chemical fertilizers, and giving an affordable and sustainable waste disposal option. In order to fully realize the potential of this sustainable agricultural resource, human waste offers a promising substitute for chemical fertilizers. However, its successful implementation depends on cautious management, strict adherence to regulations, and cooperation between legislators, researchers, farmers, and the general public.

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Study on Numerical Analysis

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ABSTRACT

Numerical analysis plays a crucial role in solving mathematical problems across diverse disciplines, ranging from engineering to finance. This review paper provides a comprehensive overview of recent advancements, challenges and applications in numerical analysis. Beginning with an exploration of historical developments we trace the evolution of numerical methods and discuss their foundational principles. Subsequently we develop into key numerical techniques, including finite difference, finite element, spectral and Monte Carlo methods, elucidating their strengths and limitations. The review then highlights recent advancements such as high order methods, adaptive algorithms, machine learning integration, along with the challenges of stability, convergences and computational. We aim to provide a comprehensive resource for researchers, practitioners and students interested in the dynamic field of numerical analysis.

KEYWORDS: *Numerical analysis, Applications, Finite difference methods, Finite element methods, Monte Carlo method.*

INTRODUCTION

Numerical analysis is a branch of mathematics that deals with the development and use of algorithms to solve mathematical problems, particularly those involving continuous functions, complex systems, the use of computers to perform mathematical computations and simulations. The field of numerical analysis is incredibly broad, encompassing a wide range of topics such as linear algebra, optimization, differential equations and statistics. Numerical analysis has applications in a variety of fields such as physics, engineering, economics, finance and biomedical. [1] In this review paper, we will discuss some of the key concepts and techniques in numerical analysis, including interpolation, numerical integration, and numerical solutions to differential equations. [1]

INTERPOLATION

Interpolation is a technique used to estimate the value of a function at a point between known data points. The most common form of interpolation is polynomial interpolation, where a polynomial function is fit to the known data points. The polynomial is chosen so that it passes through all the data points and provides a smooth curve that can be used to estimate values at intermediate points. [2]

NUMERICAL SOLUTIONS TO DIFFERENTIAL EQUATIONS

One essential tool for modeling a variety of physical events is the differential equation. But a lot of differential problems require numerical solutions since they cannot be solved analytically. Differential equations can be solved numerically using spectral, finite difference, and finite element methods.. These methods involve discretizing the differential equation and solving the resulting system of equations using matrix methods. [2]

Applications of Numerical Analysis in biomedical and other

Numerical analysis has a wide range of applications in various fields, including engineering, physics, finance and biology. In engineering, numerical analysis is used to model the behavior of complex systems such as aircraft, bridges and buildings.

In physics, numerical analysis is used to simulate the behavior of particles in a system and to model the behavior of materials under different conditions. In finance, numerical analysis is used to model the behavior of financial markets and to value complex financial instruments such as options and derivatives. In biology, numerical analysis is used to model the behavior of cells and to simulate the spread of infectious diseases. [3]

Modeling Biological Processes: Numerical analysis enables the development of mathematical models to simulate and understand various biological processes, such as gene expression, protein folding, cell signaling, and physiological systems. These models help researchers gain insights into the underlying mechanisms governing biological phenomena. [3]

Biomedical Imaging and Visualization: Numerical algorithms are instrumental in processing and analyzing biomedical imaging data obtained from techniques such as MRI, CT scans, PET scans and microscopy. Image reconstruction, segmentation, registration and feature extraction are essential tasks that rely heavily on numerical methods for accurate and efficient analysis.[3]

Biomechanics and Computational Fluid Dynamics: Numerical simulations play a vital role in studying the mechanical behavior of biological structures and fluid dynamics within the human body. Applications include analyzing blood flow in arteries, modeling tissue deformation and predicting the performance of medical devices such as stents and prosthetic implants. [3]

Statistical Analysis of Clinical Data: In clinical research, numerical techniques are used for statistical analysis of patient data to identify patterns, correlations and trends.

Techniques such as regression analysis, survival analysis and machine learning algorithms help in predicting patient outcomes, optimizing treatment strategies and identifying biomarkers for disease diagnosis and prognosis.

NUMERICAL METHODS

Algorithms known as numerical methods are employed to solve mathematical puzzles that are beyond the scope of analysis. Using a series of basic mathematical operations, these methods approximate the answer to a problem. Some of the commonly used numerical methods include:

Newton-Raphson method: The Newton-Raphson method is used to find the roots of a function. It is an iterative method that starts with an initial guess and then improves the guess until the root is found. [4]

Finite Difference Method (FDM)

Accuracy: Finite difference methods can provide high accuracy, especially when using fine discretization. However accuracy may degrade near discontinuities or singularities.

Comparison: FDM is relatively simple to implement and computationally efficient for problems with regular geometries. However, it may struggle with complex geometries and boundary conditions. [4]

Finite Element Method (FEM)

Accuracy: FEM can achieve high accuracy, particularly with adaptive mesh refinement and higher-order elements. Accuracy depends on factors such as element size, element order, and solution smoothness.

Comparison: FEM is versatile and suitable for problems with irregular geometries, complex boundary conditions, and heterogeneous materials. It is widely used in structural analysis, fluid dynamics, and electromagnetics. [4]

Finite Volume Method (FVM)

Accuracy: FVM can provide accurate solutions, particularly for conservation laws and problems involving fluid flow and heat transfer. Accuracy depends on the choice of discretization schemes.

Comparison: FVM is well-suited for problems involving conservation principles and flux balance. It is widely used in computational fluid dynamics (CFD) and heat transfer simulations.

Boundary Element Method (BEM)

Accuracy: BEM typically provides accurate solutions for problems with surfaces or boundaries, as it directly discretizes the boundary rather than the domain interior.

Comparison: BEM is advantageous for problems with infinite or large domains, as it reduces the computational domain to the boundary only. It is commonly used in potential flow problems, acoustics, and electromagnetic field analysis. [4]

Monte Carlo Method

Accuracy: Monte Carlo methods provide approximate solutions with a known level of statistical uncertainty. Accuracy improves with the number of samples but may require a large number of iterations for complex problems.

Comparison: Monte Carlo methods are powerful for solving problems with high dimensionality, nonlinearities. They are extensively used in finance, physics and optimization. [4]

Optimization Methods (e.g., Gradient Descent, Newton's Method):

APPLICATIONS OF NUMERICAL ANALYSIS

Numerical analysis has applications in a wide range of fields. Some of the common applications include: Solving differential equations: Differential equations are used to describe the behavior of systems in physics, engineering and finance. Numerical methods such as the finite difference method and the Runge-Kutta method are used to solve these equations.

Engineering and Manufacturing: Numerical analysis is extensively used in engineering and manufacturing industries for designing, simulating, and optimizing complex systems and processes. It aids in structural analysis, finite element analysis (FEA), computational fluid dynamics (CFD), optimization of product designs, and predicting the behavior of materials under different conditions. [5]

Aerospace and Defense: In the aerospace and defense sectors, numerical analysis plays a critical role in designing aircraft, missiles, spacecraft, and defense systems.

Finance and Economics: Numerical methods are widely employed in finance and economics for risk assessment, portfolio optimization, pricing of financial derivatives, and analyzing economic models. Techniques such as Monte Carlo simulations, finite difference methods, and optimization algorithms are used to model and analyze financial markets, investment strategies, and economic policies. [5]

Healthcare and Biomedical Sciences: In healthcare and biomedical sciences, numerical analysis is utilized for medical imaging, computational modeling of physiological systems, drug discovery, and treatment optimization. It aids in image reconstruction, analysis of biological data, simulation of drug interactions, and personalized medicine approaches. [3]Energy and Environment: Numerical analysis contributes to the energy and environmental sectors by optimizing energy production processes, modeling climate change impacts, and designing sustainable infrastructure.[5] Transportation and Urban Planning: In transportation and urban planning, numerical analysis helps optimize traffic flow, design transportation networks and evaluate the impact of infrastructure projects. It aids in traffic simulation, route optimization, urban sprawl analysis and public transportation planning.

Manufacturing and Supply Chain Management : In manufacturing and supply chain management, numerical analysis assists in production planning, inventory optimization, scheduling and logistics management. It is used to optimize manufacturing processes, minimize production costs and improve supply chain efficiency. [1]

OPTIMIZE SOLUTION NUMERICALLY

Optimizing a solution numerically involves finding the values of certain parameters that minimize or maximize an objective function, subject to constraints. Here's a general approach to optimizing a solution numerically:

Define the Objective Function: Clearly define the objective function that you want to optimize. This function represents the quantity you want to minimize or maximize. It could be a cost function, an error metric, or any other performance measure.

Define the Objective Function: Clearly define the objective function that you want to optimize. This function represents the quantity you want to minimize or maximize. It could be a cost function, an error metric, or any other performance measure. [6]

Identify Decision Variables: Identify the decision variables that affect the objective function. These are the parameters whose values you can adjust to optimize the solution. Define the bounds and constraints for each decision variable, if any.

Choose an Optimization Algorithm : Select an appropriate optimization algorithm based on the characteristics of your objective function and constraints. Common optimization algorithms include gradient-based methods (e.g., gradient descent, Newton's method), derivative- free methods (e.g., genetic algorithms, particle swarm optimization), and metaheuristic algorithms (e.g., simulated annealing, ant colony optimization).

Implement the Optimization Algorithm: Implement the chosen optimization algorithm using a programming language or optimization software. Ensure that the implementation correctly handles constraints and bounds on decision variables. [6]

Specify Convergence Criteria: Define convergence criteria to determine when the optimization process should stop. This could be based on the change in objective function value, the change in decision variable values, or the number of iterations. [6]

Perform Optimization: Run the optimization algorithm using the defined objective function, decision variables, and constraints. Monitor the optimization process to ensure it progresses smoothly and converges to a satisfactory solution. Evaluate the Solution: Once the optimization process is complete, evaluate the optimized solution. Check if it meets the desired performance criteria and satisfies any constraints. [6]

Iterate if Necessary: If the optimized solution does not meet the desired criteria or if you need to explore alternative solutions, iterate the optimization process. Adjust the optimization parameters, such as the algorithm settings or initial guess values, and repeat steps 4-7 until a satisfactory solution is obtained. [6]

Document and Interpret Results: Document the optimization process, including the chosen algorithm, parameters, and final solution. Interpret the results to gain insights into the optimized solution's behavior and performance. [6]

Validate and Verify: Validate the optimized solution through testing and validation procedures, comparing it with experimental data or known solutions if available. Verify that the optimized solution meets the requirements and objectives of the problem. [6] However, keep in mind that the success of the optimization process depends on various factors including problem complexity, algorithm choice and computational resources available.

DATA ANALYSIS

Data analysis involves using statistical methods to analyze and interpret data. Numerical methods such as regression analysis and principal component analysis are used in data analysis.

CONCLUSION

Numerical analysis is an essential tool for solving complex mathematical problems in a wide range of fields. Numerical methods are used to solve mathematical problems that cannot be solved analytically. The field continues to evolve rapidly, with new techniques and algorithms being developed to tackle increasingly complex problems .These methods involve approximating the solution of a problem using a sequence of simple mathematical operations. Some of the common applications of numerical analysis include solving differential equations, optimization, data analysis. Numerical analysis will continue to be an important field as computers become more powerful and new applications emerge.

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Use of AI Tools in Engineering Education Pedagogy

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ABSTRACT

This paper is a systematic analysis of the use of AI tools in engineering education curricula. We discuss the several ways that artificial intelligence (AI) tools are being applied to improve teaching and learning experiences in all engineering fields. We are also considering the challenges and opportunities that will arise in the future with the implementation of AI tools in engineering education curricula.

KEYWORDS: *AI tools, Education, Engineering, Learning outcomes, Skills.*

INTRODUCTION

The technical world of today is changing quickly, and engineers must be more creative, innovative, and adept at solving problems. It is becoming more and more important to give engineering students the knowledge and abilities they need to succeed in this fast- paced environment as businesses adopt developments in artificial intelligence (AI) and associated technologies. Realizing this need, academics and researchers have resorted to enhancing learning outcomes and better preparing students for the problems of the future by incorporating AI tools into engineering education methodology.

TRADITIONAL ENGINEERING EDUCATION PEDAGOGY

The concept of "Traditional Engineering Education Pedagogy" covers the methods and approaches used in engineering education in a traditional classroom environment. It involves all of the teaching techniques, curriculum planning, evaluation techniques, and general learning environment used in engineering education. Educators in traditional engineering education use the following pedagogy.

Lecture-Based Instruction: Lectures are a fundamental component of traditional engineering education. In this method, teachers deliver content through spoken presentations to large groups of students [8].

Laboratory Work: Laboratory sessions complement theoretical learning by providing hands-on experience with engineering concepts and tools.[8].

Problem-Solving Exercises: Problem-solving is a main aspect of engineering education methodology. Educator assign homework assignments, problem sets, and exercises to challenge learner to apply their understanding and analytical abilities to solve engineering problems. [8].

Project-Based Learning: Project-based learning involves learner working collaboratively on engineering projects. It requires them to design, build, and test solutions to real-world problems. [8].

Assessments: Traditional engineering education uses various assessment methods to evaluate learner learning and achievement. These may include quizzes, exams, lab reports, presentations, and project evaluations.[8].

IMPORTANCE OF AI INTEGRATION IN ENGINEERING EDUCATIONS

The use of Artificial Intelligence (AI) into engineering education pedagogy addresses several key needs and opportunities within the field:

Enhancing Learning Outcomes: AI tools can personalize learning skills by adapting instruction to singular student needs, choice, and learning styles. [1,2].

Fostering Problem-Solving Skills: AI-driven simulations and virtual environments offerlearners with chances to involve in authentic problem-solving scenarios, allowing them to apply theoretical knowledge to practical challenges. [1,2].

Promoting Experiential Learning: AI technologies, such as virtual reality (VR) and augmented reality (AR), enable immersive education experiences that simulate real-world engineering environments [1,2].

Supporting Adaptive Assessment: AI-powered assessment tools can analyse student performance data in real-time, allowing instructors to identify areas of strength and weakness more effectively. [1, 2].

Facilitating Collaborative Learning: AI tools facilitate collaborative learning experiences by enabling online collaboration platforms, virtual classrooms, and peer-to-peer learning networks. [1,2].

Preparing for Industry Demands: By exposing students to AI technologies and applications, educators can better prepare them for careers in fields such as data science, machine learning, robotics, and automation [1,2].

Cultivating Innovation and Creativity: AI tools encourage experimentation, exploration, and innovation in engineering education. Students can use AI algorithms to analyse large datasets, design intelligent systems, and develop novel solutions to complex problems, fostering creativity and entrepreneurship [1,2] .

Addressing Global Challenges: By using AI into engineering education, educators can empower learners to apply their abilities and information towards solving real-world problems and making positive social impacts[1,2].

SPECIFIC AI TOOLS BEING USED IN ENGINEERING EDUCATION

Several specific AI tools are being used in engineering education to enhance teaching and learning experiences. Some common AI tools used in engineering education include.

Intelligent Tutoring Systems (ITS): ITSs use AI systems such as machine learning and natural language processing to provide modified instruction and feedback to learners like Adaptive Learning Platforms Chat bots, Automated Grading Systems, Virtual Classroom Platform [3,4].

Virtual Reality (VR) and Augmented Reality (AR): VR and AR technologies generate immersive learning atmospheres where students can explore complex engineering concepts and scenarios. [3, 4].

Simulation Software: AI-powered simulation software enables students to simulate real-world engineering processes, experiments, and scenarios in a virtual environment. [3, 4].

Machine Learning Platforms: Machine learning platforms provide students with hands-on experience in developing and deploying machine learning algorithms for engineering applications. [3,4].

Natural Language Processing (NLP) Tools: NLP tools analyse and process natural language data, enabling students to interact with educational materials through voice commands, text input, and chatbots. [3, 4].

Data Analytics and Visualization Tools: Data analytics and visualization tools allow learners to explore and analyse engineering datasets, visualizing trends, patterns, and insights. [3, 4].

Collaborative Learning Platforms: Collaborative learning platforms leverage AI to facilitate online collaboration, teamwork, and knowledge sharing among students. [3, 4].

Robotics Kits and Programming Environments: Robotics kits and programming environments enable students to design, build, and program robots for various engineering applications. [3,4].

EFFECTIVENESS OF AI TOOLS IN ENHANCING LEARNING OUTCOMES:

The helpfulness of AI tools in enhancing learning conclusions in engineering education has been demonstrated through various studies and implementations.

Personalized Learning: AI-powered adaptive knowledge systems can tailor instruction to separate learner needs, preferences, plus learning styles. By analysing student performance data and providing targeted recommendations, these systems help students focus on areas where they need improvement, leading to better understanding and mastery of engineering concepts [4,5].

Improved Engagement: AI-enhanced learning experiences, such as virtual reality simulations and interactive tutorials, increase student engagement and motivation. These immersive and interactive environments capture students' interest and curiosity, encouraging active participation and exploration of engineering concepts [4, 5].

Enhanced Problem-Solving Skills: AI tools enable learners to involve in authentic problem-solving scenarios, allowing them to apply theoretical information to real-world challenges. [4, 5].

Immediate Feedback: AI-driven assessment tools provide students with immediate comment on their performance, allowing them to detect misconceptions, errors, and areas for progress in real-time. [4, 5].

Data-Driven Insights: AI algorithms analyse large datasets of student interactions and learning behaviour's, providing instructors with valuable insights into student learning patterns, misconceptions, and progress. [4,5].

Enhanced Collaboration: AI tools facilitate collaborative learning experiences by providing online platforms for communication, teamwork, and knowledge sharing among students. [4,5].

Accessibility and Inclusivity: AI tools can address accessibility barriers and support diverse learners by providing alternative modalities for accessing instructional materials and interacting with content. [4,5].

Preparation for Industry Demands: Exposure to AI technologies in engineering education prepares students for careers in industries where AI is increasingly prevalent, such as data science, machine learning, robotics, and automation. [4,5].

CHALLENGES TO USE OF AI TOOLS IN ENGINEERING EDUCATION

While the use of AI tools in engineering education offers numerous benefits, it also presents several challenges. Here are some crucial challenges to use of AI tools in engineering educations.

Access and Infrastructure: Many educational institutions may lack the necessary infrastructure and resources to support the use of AI tools. [5-7].

Cost: Implementing AI tools often requires significant financial investment, including the purchase of software licenses, development of custom applications, and training of faculty and staff [5-7].

Faculty Training: Educators may lack the essential expertise then training to successfully integrate AI tools into their teaching practices. [5-7].

Curriculum Integration: Integrating AI tools into existing engineering curricula requires careful planning and coordination. [5-7].

Moral and Confidentiality Concerns: The use of AI tools increases ethical concerns connected to data privacy, algorithmic bias, and the liable use of technology. [5-7].

Algorithmic Transparency and Interpretability: AI algorithms can be difficult and opaque, making it difficult for learners to know how decisions are made. [5-7].

Equity and Inclusivity: There is a risk that AI tools may exacerbate existing inequalities in access to education and exacerbate disparities among students from diverse backgrounds. [5-7].

Evaluation and Assessment: Measuring the efficacy of AI tools in attractive learning effects requires robust evaluation frameworks and assessment methods [5-7].

Technological Limitations: AI technologies may have limitations and constraints that affect their effectiveness in educational settings. [5-7].

Resistance to Change: Resistance to change from stakeholders, including faculty, administrators, and students, can impede the adoption of AI tools in engineering education. [5-7].

CONCLUSION

In conclusion, the use of Artificial Intelligence (AI) tools in engineering education pedagogy grips great promise for changing teaching and learning skills, making learners for the challenges of a rapidly developing technological landscape, and advancing the field of engineering education.

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BHARATI VIDYAPEETH'S COLLEGE OF ENGINEERING KOLHAPUR

Accredited by NAAC with 'A+' Grade

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2.	Computer Science & Engineering	06
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