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Editorial

Blockchain Technology: From a concept in IT circles, blockchain technology has developed into a potential game-changer for many aspects of our daily life. Blockchain was initially developed to serve the digital currency Bitcoin, but its applications have since grown significantly. Because of its capacity to improve process security, transparency, and efficiency, it is currently being investigated in industries such as finance, healthcare, supply chains, and even the arts.

Fundamentally, blockchain is a digital method of securely storing data for all parties. Blockchain manages and records data using a network of computers rather than a single, central location, such as a bank or business. We refer to this as a distributed ledger. The term "blockchain" comes from the fact that each block of information is connected to the block that came before it, forming a chain. Its design makes it nearly impossible to remove or alter data once it has been added, which helps to prevent fraud.

Although blockchain has numerous advantages, it is not flawless. Some blockchain systems, for instance, consume a lot of electricity, which is not favourable for the environment. Privacy problems are also present. Blockchain raises concerns regarding the use and storage of personal data because its records are so permanent. Furthermore, because blockchain technology is so new, there aren't many regulations currently, which worries some individuals, particularly when it comes to applications in industries like finance.

There are many exciting possibilities for blockchain technology as it develops, but there are also some significant obstacles to be addressed. Although it might change the way we think about security and trust in digital environments, it's crucial to maintain realism and take into account its pros and cons.

New Delhi **Editor**

31st October 2024

Amrutvahini Sheti & Shikshan Vikas Sanstha's

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Machine Learning Solutions for Cyberbullying Detection: A Review of Recent Advances

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ABSTRACT

Bullying is harmful behavior by others that causes physical, mental, or social harm to someone. Cyberbullying, sometimes referred to as online bullying, is a virtual type of bullying or harassment that can take the shape of text or images. Detecting cyberbullying is crucial in today's environment due to its increasing frequency and negative impact on mental health. The purpose of this literature study is to examine the use of machine learning techniques for cyberbullying detection. With the exponential rise of online communication platforms, the need for automated detection methods has grown more apparent. This paper conducts a systematic assessment of recent literature to investigate various techniques, datasets, and evaluation criteria used in cyberbullying detection studies. We examine the strengths and limits of various machine learning techniques and provide comparative analysis and future directions for improving the machine learning algorithms.

KEYWORDS: *Machine learning, Cyberbullying, Hate speech, Personal assaults.*

INTRODUCTION

Social media has transformed communication by allowing for open and honest debates among community members who share ideas, views, and facts. The government, businesses, and consumers may all benefit from the insights gleaned from social media platforms for research and decision-making [1, 2]. Cyberbullying (CB) involves manipulating, belittling, and targeting individuals through negative online messages and postings. [3] The term "cyberbullying" refers to the practice of harassing, threatening, or otherwise embarrassing another person or group via the use of improper textual or multimedia messages sent over the Internet, mobile devices, or other forms of electronic communication.[4]. The person who engages in such behavior is commonly referred to as a "bully," while the person who is targeted is known as a "victim." The expression "cyberbullying" was first utilized in 2003 by Canadian anti-bullying activist and educator Bill Belsey to describe the repeated use of negative actions by at least one individuals to embarrass, harass, upset, or hurt another person through electronic means [4]. This includes sharing videos, audios, images, and similar content through chat rooms, instant messaging, cell phones, and email.. Recent research has found numerous typical forms of harassment in the digital domain. Figure 1 shows many forms of cyberbullying that occur on social media platforms.

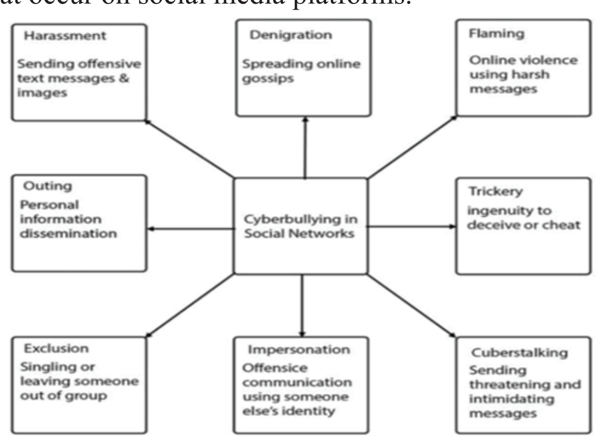

Fig. 1. Several forms of cyberbullying on social media platforms

Cyberbullying occurs persistently, 24 hours every day, seven days per week, making adolescents feel continually exposed because messages and remarks might arrive suddenly and at any moment. This ongoing exposure has a significant psychological influence on youths [5]. The anonymity provided by the Internet exacerbates this problem, as victims may be unaware of their bullies' identities, heightening their dread [6]. Emotional abuse, unlike physical assault, can have long-term implications on mental health. Subsequently, our goal is to explore cyberbullying as a method of suppressing adolescent personalities and to develop cyberbullying preventive techniques utilizing machine learning (ML). This encompasses a number of goals, such as researching different types of cyberbullying in online content, finding approaches to naturally recognize cyberbullying and distinguish disdain discourse, investigating datasets that can be utilized to prepare AI models to identify cyberbullying, and evaluating existing methods while predicting their future trends.

The rest of the paper is coordinated as segment II gives deep literature survey of on state of art systems. Section III discusses pros and cons of state of art systems and finds research gaps. Section IV concludes the paper and provide future research direction.

LITERATURE SURVEY

Authors in [7] propose an innovative unsupervised method for cyberbullying model development, integrating traditional textual features with novel "social features". Their approach categorizes features into Syntactic, Semantic, Sentimental, and Social categories. To categorize the Formspring dataset, they use k-means clustering using a Growing Hierarchical Self Organizing Map (GHSOM) network that has 50 × 50 neurons and 20 elements as info. This approach outperforms earlier techniques. Furthermore, they put their model through its paces on the YouTube dataset using three separate ML models: Naive Bayes Classifier, Decision Tree Classifier (C4.5), and Support Vector Machine (SVM) with a Linear Kernel. The YouTube dataset shows less precise clustering accuracy for hate postings compared to Formspring, which suggests that there are differences in textual analysis and syntactical aspects across platforms. While their hybrid approach demonstrates weaknesses on the Twitter dataset, it presents potential for improvement and constructive application in mitigating cyberbullying issues.

Another technique for identifying cyberbullying via web-based entertainment destinations is recommended [8]. It utilizes the BERT model with a solitary straight brain network layer as a classifier. An astounding 98% and 96% accuracy rate, respectively, were achieved by their model when prepared and tried on the Formspring discussion dataset and the Wikipedia dataset. As compared to the Formspring dataset, Wikipedia performs better since its size is higher, which means that oversampling is not necessary.

The authors of [9] propose a system that uses Supervised categorization Machine Learning techniques to identify and stop Twitter users from being exploited online. They evaluate Naive Bayes and Support Vector Machine using datasets collected from the live Twitter API. The outcomes show that the Support Vector Machine method is better than Naive Bayes, with an accuracy of around 71.25 percent.

The goal of the machine learning algorithm proposed in [10] is to reduce instances of cyberbullying by sifting through picture memes for text. They compare the findings from the YouTube database with those from pre-existing Form datasets in order to determine how well three machine learning algorithms—Uninformed Bayes, Support Vector Machine, and convolutional neural network—perform. Notably, Naive Bayes excels in four categories, while SVM demonstrates efficacy in gender-based analyses.

The significance of recognizing varied offenders is shown in a thorough examination of Twitter cyberbullying that is presented in [11]. To help direct future studies in Cyberbullying Detection using Machine Learning, they lay out concrete procedures for creating efficient apps that identify cyberbullying, talk about data classification trends, and provide case studies.

The authors of [12] describe the steps used to create a model for detecting cyberbullying by combining NLP and ML. Using Twitter data as training, their Spanish cyberbullying prevention system (SPC) reaches an accuracy level of up to 93%. Further improvement in accuracy and possible use in various languages may be achieved via the use of stemming and lemmatization methods in natural language processing.

Researchers in [13] elaborate on hate speech discovery on Twitter employing a profound convolutional brain organization and different AI calculations. Despite challenges with uneven data distribution, Support Vector Machine emerges as the best model, achieving 53% hate speech tweet prediction in a 3:1 dataset. Future improvements may involve expanding the current database for enhanced accuracy

Authors in [14] propose a system for double characterization of cyberbullying using Convolutional Neural Network (CNN) and Keras. Their approach, achieving an 87% accuracy rate on Twitter and YouTube data, emphasizes the potential of deep learning-based models to identify digital harassment episodes effectively. The developers of [15] created a new query language and social network paradigm called Green Ship to fight cyberbullying. By restricting access to harmful information and recognizing various types of friendships on Facebook, Green Ship promotes user safety and privacy. In [16] focus on removing offensive comments on social networks and classify observations into offensive, hate speech, or neutral categories using machine learning models. With an accuracy exceeding 93%, their model utilizes Latent Semantic Analysis and standard feature extraction methods for efficient classification and analysis.

In their study, the scientists found that AdaBoost was the most accurate in classifying posts as either cyberbullying or not. Many support vector machine (SVM) models were said to have been merged for this, although the prediction rate was lower than before. They concluded that the Random Forest model's high recall metric made it the best choice for cyberbullying detection. On data from YouTube comments categorized by three cyberbullying subjects — sexuality, prejudice, and intelligence level — the creators of [18] analyzed numerous regular AI models, including J48, SVM, and JRIP. Both multiclass models that learn from all labels and binary models that focus on certain labels were developed by them. In terms of accurately categorizing each cyberbullying topic's labels, their results showed that individual-label binary classification models performed better than multiclass models.

The authors of [19] were forerunners when it came to developing methods for automated detection of cyberbullying. Using supervised learning and a linear kernel Support Vector Machine (SVM), they were able to categorize messages about online provocation from three distinct virtual entertainment locales: Kongregate, Slashdot, and MySpace. Their approach included enhancing TFIDF with sentiment, contextual, and similarity components; this enabled it to identify abusive postings, especially those mimicking chat-style discussions. Using training time and prediction performance as metrics, the authors of [20] compared and contrasted many cyberbullying detection methods. They found that random forests required the most time to train, whereas multinomial naive Bayes models were the fastest. Logistic Regression outperformed competing models in terms of prediction ability and prediction time, especially on bigger datasets.

In their study, the researchers [21] examined the significance of key factors in the Random Forest model for cyberbullying post detection using the Gini index. Random Forest's capacity to average trees with randomly chosen feature subsets during classification, thereby reducing overfitting, was a deciding factor for certain studies that used it. [22][23].

Cyberbullying communications sent via the anonymous question and answer site Formspring.me were detected by the authors of [24] using a number of models, such as Support Vector Machine with Sequential Minimal Optimization (SVM with SMO), tree-based JRIP, tree-based J48, and Instance-Based Learner (IBK).

Research [25] investigates the linguistic features of cyberbullying in two stages: first assessment of harmfulness and author role categorization, followed by fine-grained text category identification. An experimental binary classifier recognizes bullying posts, with extra classifiers for each category. Bag-of-words and polarity features help with automated cyberbullying detection, which uses supervised learning and complex contextual embedding techniques.

The three sub-models that make up the ensemble model from the original authors [26]—the Outer Model, which distinguishes between bullying and defending, the Bullying Model, which identifies 'Harasser' or 'Bystander assistant,' and the Defending

Model, which categorizes 'Victim' or 'Bystander defender'—are further expanded to detect offensive language. Regarding the accuracy of bystander helper classification, the 'defending model' performs better than the 'bullying model.'

[27] finds instances of cyberbullying by analyzing comments on Facebook. Preprocessing and feature extraction identify linguistic aspects, followed by the LSA technique and random forest algorithm, to detect bullying terms and categorize shortened text and emoticons. Although no particular categories for Bystander Detection have been established, the objective is to enhance bystander intervention.

In [28], a Dutch and English corpus is annotated and examined for cyberbullying. Feature extraction incorporates a variety of linguistic aspects, while binary classification studies using a linear kernel SVM. Multiclass classification techniques and text classification experiments using pre-trained models such as BERT and RoBERT a are also used. The authors of [29] go into the job of overall vibes in toxic Twitter conversations, specifically looking at how onlookers and the tone of first remarks add to the spread of harmful behavior. They highlight the significance of societal standards in predicting how people will behave online and how they will respond to vulgar or abusive language.

As of now no literature is available specific for cyberbullying detection using quantum computing. Cyberbullying detection using quantum-inspired machine learning, which enhances traditional ML algorithms with the concepts of Quantum Computing (QC), is still in its beginning phases.

A quantum-inspired binary classifier (QIBC) was introduced by the authors (41) to enhance decision-making. This classifier makes use of the superposition principle of quantum mechanics and decision theory.. It achieves high F-measure, recall, and precision similar to KNN and SVM. In (42) presented the Helstrom Quantum Centroid (HQC), a binary classifier based on density matrices, which outperforms classical models in a variety of datasets. In (43) developed a quantum support vector machine (SVM) algorithm for exponential speedup in classification tasks. Authors in (44) presented the Quantum Nearest Mean Classifier (QNMC), which performs better than classical models in medical datasets, particularly cancer data.

COMPARATIVE ANALYSIS

Table 1: Comparative Analysis of State of Art system

Data Source	Classifier	Method	Accuracy
ASKfm [25]	Binary Classifier	SVM	78.50%
ASKfm [26]	Binary Classifier	Ensemble model	84%
Facebook [27]	Random Forest	Feature extraction for latent semantic analysis	70%
ASKfm [28]	Linear classification, Classifiers for voting and cascading	Multiple regression, SGD BL, Logistic regression, Passive-Aggressive, and Support Vector Machines	55.19%
Twitter [29]	-	Models for linear and multivariate regression as well as the Poisson regression	-

Table 2: Machine Learning Algorithms Analysis

Techniques	Data Set	Findings
Topic modeling using Snowball sampling and Latent Dirichlet Allocation, NB[30]	Important cyberbullying-related words from Ask.fm; Unstructured data from user profiles	This method improved the classifier's ability to automatically identify different types of conversation..
Bayes, Bayes expectation maximization, DT, Multivariate LogR, MaxE, Winnow2, BoW[31]	15,979 tweets from Twitter; 11,304 annotated Comments from Wikipedia Talk pages	Word unigrams, when used to logistic regression, outperformed the highest-scoring feature collection in the Twitter dataset..

NB, SVM[32]	91,431 tweets	We provide a solution that uses SVM and Naive Bayes to identify and prevent cyberbullying.
CNN, NB[33]	1,578,627 tweets from Twitter; 18,554 users from Formspring.me	Datasets that were obtained were used to assess the accuracy of CNN and Naïve Bayes.
NB, kNN, DT, SVM[34]	Random tweets collected via a customized Python crawler	Less user involvement observed in indirect cyberbullying compared to direct cyberbullying.
RF[35]	6,594 raw comments	Model demonstrated 2% improvement in precision over the next best score.
LSTM+2D TF-IDF, CNN +2D TF-IDF, SVM, logistic regression, CNN +EMBEDDING, LSTM+ EMBEDDING [36]	Random aggressive comments from Twitter	An enhancement to CNNs via the use of 2-dimensional tf-idf characteristics.
MR[37]	Questionnaire for a 256-person online survey about demographics, interests, knowledge, and behavior in relation to current events	Study examining participants' intent to comment uncivilly, hindering productive public discussion.
LogR[38]	Twitter datasets: December 2008–January 2009: 977k English tweets; December 2015: 1 million English tweets	Results revealed aggressive users smile less and appear unhappy in their profile pictures.
LogR, SVM, RF, Gradient Boost[39]	Data with 2,235 samples	Random Forest and Logistic Regression fared better than SVM and Gradient Boosting.
CNN, LSTM[40]	Data with 8,815 comments, including 2,818 labeled as cyberbullying	In comparison to existing machine learning approaches, the suggested hybrid architecture of character-level CNN and word-level LSTM outperformed the competition.

DISCUSSION

Although it finds major research gaps, the literature analysis covers current improvements in cyberbullying detection using machine learning. These include insufficient research into cyberbullying detection in languages other than English, discrepancies in algorithm performance across datasets, and a lack of uniform evaluation metrics. Future study should concentrate on multilingual detection, using future technologies such as deep learning, and exploring socio-psychological ramifications. Real-time detection systems and interdisciplinary research are also required to advance the topic efficiently.

CONCLUSION

The current study presents a thorough literature assessment on cyberbullying detection using machine learning algorithms. The detrimental effects of cyberbullying are unmistakable, with many young individuals experiencing bullying online, often resulting in tragic outcomes like suicides, depression, and psychological trauma. Despite significant advances, there are still study gaps, such as little investigation into multilingual detection, classification of roles in cyberbullying incidents and the socio-psychological effects of cyberbullying. Future study directions should promote interdisciplinary studies, include emerging technologies such as deep learning, and focus on building strong, real-world solutions to lessen the negative consequences of cyberbullying on individuals and communities.

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A Survey of Machine Learning Techniques for Churn Prediction in Telecommunications

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ABSTRACT

In the telecommunications industry, where customer acquisition is often more expensive than retention, accurately predicting churn customer defection is critical for business success. Large volumes of data are generated daily, making it crucial for customer relationship management (CRM) analysts to leverage churn prediction models to identify at-risk customers and understand their behavior patterns within potentially noisy data. This paper proposes a data driven approach to churn prediction. By prioritizing data cleaning to ensure the quality and accuracy of information, the model can generate reliable predictions. Employing classification and feature integration techniques, the model not only identifies customers at risk of churn but also sheds light on the factors contributing to customer churn in the telecom sector. This approach empowers businesses of all sizes to proactively address customer concerns and implement effective retention strategies, ultimately safeguarding their bottom line. This system first classifiers churn data using classification algorithms, in which the Random Forest algorithm is performed well with an accuracy of 93.5%. Then data is sent to CRM to take essential measures accordingly by companies to retain the customers, in this churn customers data is categorizing based on churn and retained CRM by offering certain offers for churning customers. In this paper, machine Learning algorithms used such as Random Forest, Logistical, SVM, Logit Boost, Gradient Boost algorithms for predicting churn customers accuracy. Here Random Forest is best algorithm that gives high accuracy according to test data as well as train data.

KEYWORDS: *Churn prediction, Machine learning algorithms, CRM, Telecom sector, SVM, Random forest.*

INTRODUCTION

Within the telecommunications industry, characterized by high competition and commoditization of services, customer churn represents a significant financial burden [1]. Customer churn refers to the phenomenon of subscribers discontinuing service and migrating to competitors [2]. Predicting churn empowers telecom companies to proactively identify customers exhibiting behaviors indicative of departure. This foresight enables the development of targeted customer retention strategies, such as personalized service plans or exclusive offers [1, 2]. By implementing these interventions, telecom companies can mitigate customer dissatisfaction, safeguard recurring revenue streams, and foster long-term customer loyalty, ultimately ensuring their continued success in a competitive marketplace.

In the fiercely competitive world of telecommunications, customer churn, the rate at which subscribers disconnect service and switch to competitors, stands as a significant financial hurdle. This customer attrition directly cuts into revenue streams built on monthly subscriptions, data plans, and other valuable services [3]. Moreover, telecom companies face a harsh reality: acquiring new customers is considerably more expensive than retaining existing ones. The financial toll of churn extends beyond lost revenue; a high churn rate can also damage a company's brand image, making it more difficult to attract new customers in the future. Therefore, the ability to accurately predict churn and proactively address its root causes becomes paramount for telecommunication companies [4]. By wielding this power of prediction, they can implement targeted retention strategies, such as personalized service plans or exclusive offers, that mitigate customer dissatisfaction and foster loyalty. Ultimately, this proactive approach safeguards recurring revenue streams, cultivates a loyal customer base, and positions the company for sustained success in a competitive marketplace.

Customer churn, the loss of subscribers, poses a significant financial challenge for telecommunication companies. Machine learning techniques offer promising solutions for predicting churn, allowing companies to proactively target at-risk customers with retention strategies. Among these techniques, Random Forests have emerged as a powerful tool due to their ability to handle complex data and achieve high accuracy. By constructing an ensemble of multiple decision trees, Random Forests mitigate overfitting and enhance the generalizability of the churn prediction model. This characteristic is particularly valuable in the telecom industry, where customer behavior can be highly nuanced and influenced by various factors. Consequently, Random Forests offers a compelling approach for telecom companies seeking to develop robust and accurate churn prediction models.

Churn prediction in the telecommunications industry plays a crucial role in subscriber retention and revenue generation. Decision trees offer a valuable tool for this task due to their inherent interpretability. By constructing a tree-like structure where each branch represents a specific customer characteristic, decision trees provide clear insights into the factors influencing churn. This transparency allows telecom companies to not only identify customers at risk of leaving but also understand the key reasons behind their potential churn. Armed with such knowledge, companies can tailor targeted retention strategies that address the specific needs and concerns of at-risk customers. While other machine learning models might achieve higher accuracy, decision trees offer a valuable balance between performance and interpretability, making them a compelling choice for churn prediction in the telecom sector [5,6].

Objectives and Scope of Survey Paper: Churn Prediction in Telecom

This survey paper aims to provide a comprehensive overview of the current research landscape in churn prediction for the telecommunications sector.

Objectives

- To explore the historical development and evolution of churn prediction techniques within the telecom industry.
- To analyze and categorize existing research based on the data sources, machine learning algorithms, and evaluation metrics employed.

Scope

This survey paper will focus on churn prediction research specifically within the telecommunications sector. The scope will encompass various machine learning algorithms, data preprocessing techniques, and evaluation metrics used in this domain [5]. While briefly touching upon emerging trends like deep learning, the primary focus will be on established and well-documented techniques. The paper will exclude churn prediction research in other industries such as banking or retail.

LITERATURE SURVEY

Prior research by Figalist et al. (2018) in “Customer Churn Prediction Analysis” explores the design, applications, and challenges of churn prediction models. Their work emphasizes the importance of customer segmentation for effective prediction. They propose a method for creating customer and user maps based on “customer categories” to ensure the model captures all critical factors influencing churn, potentially leading to more accurate predictions [1].

Pallav Routh presents an operational approach in a clear survival forest framework that effectively identifies churn risks and establishes the correlation between risks and customer behavior. Unlike current methods, this model does not rely on a specific functional form to describe the relationship between risk and behavior, nor does it make fundamentally different assumptions, both of which limit its performance [2].

Malak Fraihat proposes a powerful churn prediction technique called the Selection Ensemble Model (SEM). This method carefully selects a combination of machine learning models to contribute to the final prediction, resulting in a highly accurate forecast [3].

Deepak Gupta and colleagues explore the effectiveness of over 100 different classification algorithms for predicting customer churn in a telecommunications company. Their analysis incorporates a wide range of well-established classifiers from various machine learning families [4].

S.W. Kim proposes a churn prediction model that leverages both customer segmentation and aggregation strategies. This approach allows for targeted identification of at-risk customers and the factors contributing to churn within a specific industry. The model employs a feature selection technique based on benefit statistics and qualification ratings, resulting in a Random Forest classifier with improved churn prediction accuracy [5].

According to Asmin Alev Aktaş, a customer data structure is created to organize customer-related information. This structure is then leveraged by a long-term memory model to analyze complex customer segments. The performance of this model is subsequently compared to traditional classification methods [6].

The Churn Prediction Model using Machine Learning Methods in the Telecom Sector, as presented by Yogi Reddy Maramreddy and Pagalla Bhavani Shankar , demonstrated the effectiveness of machine learning algorithms such as Random Forest, Logistic Regression, and Support Vector Machine in predicting customer churn. The Random Forest algorithm emerged as the best-performing model with a high accuracy rate of 93.5%, showcasing its potential for accurate churn predictions [7].

Karanovic et al. delved into the use of a CNN neural network for churn prediction, achieving an impressive accuracy of 98.85%. However, concerns were raised regarding the small dataset and missing features, potentially impacting the model's performance. Esteves et al. 3 explored five machine learning algorithms, with Random Forest outperforming others with 95% accuracy, 99% AUC, and 99% sensitivity, showcasing the significance of data mining techniques in churn prediction [8].

Jain et al. conducted an experimental study using Logistic Regression and Logit Boost techniques, achieving high accuracies of 85.2385% and 85.1785%, respectively [9].

Lalwani et al. applied ensemble learning techniques like Xgboost and AdaBoost, obtaining accuracies of 81.71% and 80.8%, with Xgboost leading in performance [10].

Esteves et al. explored five machine learning algorithms, with Random Forest outperforming others with 95% accuracy, 99% AUC, and 99% sensitivity, showcasing the significance of data mining techniques in churn prediction [11].

The literature survey on churn prediction in the telecom industry reveals a diverse range of advanced models and techniques aimed at enhancing the accuracy and efficiency of churn prediction systems. Studies such as the Customer Churn Prediction Analysis, the State-of-the-Art Churn Prediction Model, and the Selection Ensemble Model showcase the importance of leveraging machine learning algorithms, deep neural models, and ensemble techniques to predict customer churn effectively. Results from segmentation-based models and performance evaluations of classifiers demonstrate promising outcomes in improving churn prediction accuracy. These findings underscore the significance of proactive churn management strategies in telecom companies, emphasizing the need for robust predictive models that can leverage advanced technologies to forecast customer churn accurately and efficiently [12].

Freund and Schapire introduced the concept of boosting, which has become a cornerstone technique in machine learning. Their work shed light on how boosting algorithms can be strategically incorporated into the learning process to significantly enhance the accuracy and robustness of machine learning models. This innovation has had a profound impact on various machine learning applications, allowing them to tackle complex problems with greater efficiency and reliability [13].

Hong and Weiss delved into the cutting-edge advancements in data mining methods used for predictive purposes. Their analysis sheds light on the ongoing evolution of machine learning techniques, providing valuable insights that can propel the field forward. This newfound knowledge has the potential to empower researchers and practitioners to develop even more sophisticated and effective machine learning algorithms capable of tackling increasingly complex challenges [14].

Customer churn prediction is a prime example of a domain within data mining that grapples with imbalanced datasets. In this context, Chawla's (2005) research stands out for providing valuable insights into effective techniques that can mitigate the challenges posed by imbalanced data. By addressing these challenges, machine learning models become more adept at identifying customers at risk of churn, enabling businesses to implement targeted interventions and ultimately improve customer retention rates [15].

Kiss and Bichler (2008) delve into the concept of identifying influential customers within a network. This approach goes beyond simply understanding individual customer behavior. By pinpointing influential customers, businesses can gain valuable insights into the social dynamics at play within their customer base. These dynamics can significantly impact customer behavior, including purchase decisions and the likelihood of churn. Identifying influential customers allows businesses to tailor their marketing strategies and retention efforts more effectively. By understanding who influences whom, companies can target their messaging to reach not only individual customers but also leverage the power of social influence within the network. This can lead to a more holistic understanding of customer behavior, ultimately improving churn prediction models and customer retention rates [16].

In a 2012 study, researchers investigated predicting customer churn in the telecommunications industry. They utilized two machine learning methods, Random Forest and KNN, to analyze customer data. To compensate for an uneven distribution of data points (churning vs. non-churning customers), they employed a technique called Particle Swarm Optimization to reduce the size of the majority class. Additionally, they implemented feature reduction methods including Principal Component Analysis (PCA), F-score, Fisher's ratio, and Minimum Redundancy Maximum Relevance to optimize the data for model training. The effectiveness of these methods was evaluated using metrics like Area Under the Curve (AUC), sensitivity, and specificity. Their simulations yielded positive results in predicting customer churn [22].

A 2018 study by Khan investigated customer churn in telecom using a combined model (ensemble model). To improve the model's focus on relevant features, they employed a technique that prioritizes features with strong relationships to the target variable (churn) while minimizing redundancy. This resulted in a more streamlined feature set. The ensemble approach involved training multiple individual models (classifiers) and then combining their predictions for a final outcome. Random Forest, Rotation Forest, and KNN algorithms were used as the base classifiers, with their final predictions determined by majority vote. The model's effectiveness was assessed using various metrics, including Area Under the Curve (AUC), sensitivity, specificity, and Q-statistic. These results indicated that the ensemble model achieved a high level of accuracy in predicting customer churn [17].

A 2012 study by Lee explored a genetic algorithm approach to predicting customer churn for retention purposes. Their method involved generating multiple programs for each customer category (churner vs. non-churner) using the Adaboost technique. Predictions were made by selecting the program with the highest output from a weighted sum of all program outputs within a category. To evaluate the accuracy of this approach, the study employed a 10-fold cross-validation process. This resulted in an Area Under the Curve (AUC) score of 0.89, indicating a good level of prediction performance [18].

In a 2010 study, Basiri et al. proposed a novel method for combining predictions from multiple machine learning models (classifiers) to improve overall accuracy. This hybrid approach utilized the Ordered Weighted Average (OWA) technique to merge the outputs from each classifier. Their study employed two popular ensemble learning methods, bagging and boosting, to train the individual classifiers. Additionally, they incorporated the LOLIMOT algorithm, which learns models using varying numbers of significant features. The results showed that this hybrid approach achieved superior performance compared to some established classification algorithms [19].

The summary of the literature survey is summarized in table 1.

Table 1: Summary of Literature Survey

Ref	Methodology	Findings
[1]	Customer segmentation	Emphasizes the importance of customer segmentation for churn prediction, proposes method for creating customer maps based on "customer categories"
[2]	Survival forest framework	Establishes correlation between churn risks and customer behavior without relying on specific functional forms, achieves effective churn risk identification
[3]	Selection Ensemble Model (SEM)	Uses a combination of machine learning models for highly accurate churn prediction
[4]	Classification algorithms	Explores over 100 classification algorithms for churn prediction in telecom, incorporates a wide range of classifiers
[5]	Customer segmentation and aggregation	Leverages segmentation and aggregation strategies for targeted identification of at-risk customers, employs feature selection technique for improved accuracy
[6]	Long-term memory model	Organizes customer data structure for analysis, compares performance with traditional classification methods
[7]	Machine learning algorithms	Demonstrates effectiveness of Random Forest, Logistic Regression, and Support Vector Machine in predicting churn, Random Forest performs best with 93.5% accuracy
[8]	CNN neural network	Achieves 98.85% accuracy for churn prediction, highlights concerns regarding small dataset and missing features
[11]	Machine learning algorithms	Random Forest outperforms others with 95% accuracy, 99% AUC, and 99% sensitivity, emphasizes significance of data mining techniques
[9]	Logistic Regression and Logit Boost techniques	Achieves high accuracies of 85.2385% and 85.1785% respectively
[10]	Ensemble learning techniques	Xgboost and AdaBoost achieve accuracies of 81.71% and 80.8% respectively, Xgboost performs better
[13]	Boosting techniques	Introduces boosting concept, enhances accuracy and robustness of machine learning models
[14]	Data mining advancements	Highlights advancements in data mining techniques for predictive purposes, provides insights for future developments
[15]	Techniques for imbalanced datasets	Addresses challenges posed by imbalanced datasets in churn prediction, improves model performance
[16]	Identifying influential customers	Identifies influential customers within networks, allows for targeted marketing and retention strategies
[22]	Random Forest, KNN, Particle Swarm Optimization	Utilizes machine learning methods and optimization techniques for churn prediction in telecom, achieves positive results
[17]	Ensemble model	Combines Random Forest, Rotation Forest, and KNN algorithms for accurate churn prediction

[18]	Genetic algorithm approach	Uses Adaboost and genetic algorithms for churn prediction, achieves good prediction performance
[19]	Hybrid ensemble approach	Combines predictions from multiple classifiers using OWA technique, achieves superior performance compared to individual classifiers

PROPOSED WORK

Our study focused on applying machine learning algorithms, including Random Forest, Decision trees, and Support Vector Machines (SVM), to a dataset specific to the telecom sector. These algorithms analyse various customer attributes to generate churn probability predictions [20].

The overall process encompasses several key steps: data pre-processing (data cleaning and filtering), customer segmentation based on predicted churn risk, and churn rate calculation (percentage of customers predicted to churn and those predicted to remain). Customer Relationship Management (CRM) systems can then leverage this data to implement targeted interventions and retention offers, ultimately enhancing customer lifetime value [32].

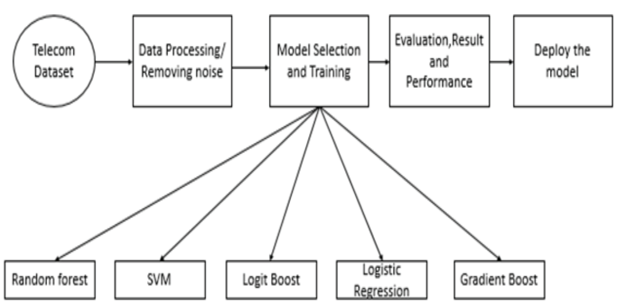

Fig. 1. System Architecture churn prediction model

Methodology

Data pre-processing is essential for building accurate models. It cleanses data like a filter, removing inconsistencies that skew results [18]. Feature engineering and selection techniques further refine the data, focusing on the most predictive factors. This yields benefits beyond model accuracy[33]. CRM systems can leverage this process to:

1. Boost agent productivity by pinpointing at-risk customers.
2. Personalize promotions for targeted customer segments.
3. Optimize marketing campaigns for better ROI.

Data: The foundation for this analysis is a customer dataset sourced from IBM. This sample comprises 7,043 data points across 21 features, capturing:

Service subscriptions: Details on phone plans (including multi-line options), internet access, various online protection and support services (security, device protection, backup, technical support), and entertainment subscriptions (TV and movie streaming).

Account details: Customer tenure, contract type, preferred payment method, paperless billing status, monthly charges, and total costs.

Customer demographics: Age range, gender, partnership status, and number of dependents.

Training: During the training phase, meticulous attention was given to data preparation, commencing with thorough data cleaning and pre-processing steps, including outlier identification and removal, [21] normalization to ensure consistent scaling, label encoding for categorical features, and the potential utilization of Principal Component Analysis (PCA) for dimensionality reduction when deemed necessary. Moreover, feature engineering techniques were extensively explored, alongside the employment of selection methods to pinpoint the most pertinent features crucial for optimizing model performance [22].

Discussion

Table. 2 Accuracy table

Ref.	Algorithm	Accuracy
[7]	Random Forest	93.5
[10]	SVM	89.6
[12]	Logistic regression	85.2
[9]	Logit boost	81.5
[23]	GradientBoost	80.41

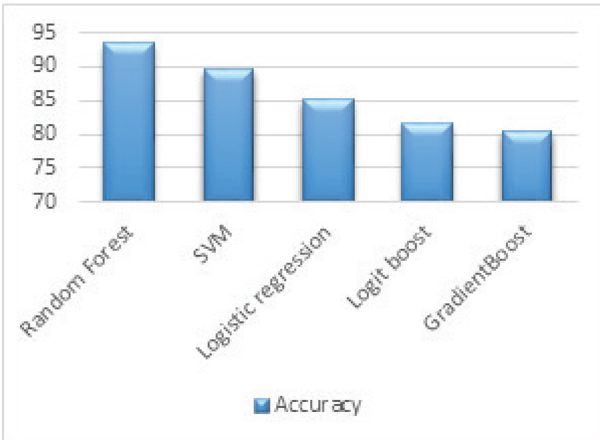

Figure 1: Graphical Representation of Results obtained

Figure 1 evaluate the several machine learning models on a dataset revealed their classification performance. Random Forest emerged as the leader, achieving an accuracy of 93.5%. This indicates its exceptional ability to accurately predict the classes. Support Vector Machine (SVM) trailed closely behind with a strong performance of 89.6%. Logistic Regression and Logit Boost also delivered respectable accuracies of 85.2% and 81.5%, respectively, demonstrating their competency in data classification. Gradient Boosting yielded a slightly lower accuracy of 80.41%. In conclusion, these findings suggest that Random Forest and SVM are the most effective models for this particular dataset [19]. However, Logistic Regression, Logit Boost, and Gradient Boosting also proved to be viable options.

CONCLUSION AND FUTURE WORK

To gain a comprehensive understanding of customer churn prediction, we began with a thorough review of existing research. This survey process informed the design and development of our model. Our findings demonstrate that the model delivers fast and accurate predictions that align with real-world market conditions. We observed that a customer's recent behavior can be a strong indicator of future churn. By analyzing customer data specific to the telecom industry, our model effectively predicts churn risk. This empowers companies to proactively address customer needs and ultimately retain valuable customers. Retention is significantly more cost-effective than customer acquisition, enabling telecom companies to improve profitability.

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Plant Leaf Species and Disease Prediction Using Advanced Image Processing & Deep Learning Model

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ABSTRACT

Typically, farmers look to agriculture as one of their main sources of income, and the Indian economy is heavily dependent on agriculture's expansion and improvement for higher output. We all know that farmers have faced a number of ongoing difficulties throughout the years, such as identifying new plant species while cultivating them and dealing with various plant illnesses. Farmers lack the knowledge necessary to grow new plants and recognize diseases that are affecting plant growth. Today's farming industry needs computerized imaging innovation. It can aid in the early identification and classification of leaf plant diseases by agriculturalists. There are a few different types of infections in the agricultural sector that might assault and manifest themselves through the leaf. It will be highly beneficial for the end users to conserve their plants and take the required steps to avoid the illness's future spread if the disease is predicted in the early stages. It is quite challenging to spot the disease in its early stages and take the appropriate precautions with that plant or crop. In some instances, we are able to detect the disease from the physical changes that have occurred on the outside of the plants, but in other instances, we are unable to do so. This inspired to create the current programme, which makes use of deep learning theory and image processing to try and identify the disease that is affecting those plants. Here, we attempt to create the suggested application using the VGG19 model. We tested our suggested model through a number of trials on the PlantVillage dataset, and we were able to identify the plant species and accompanying disease with an accuracy of 91.79%.

KEYWORDS: *PlantVillage, Dataset, Agriculturalist, Image classification, Disease prediction.*

INTRODUCTION

The economic sector has always been supported globally by the agricultural sector. Plant scraping frequency varies from time to time. Farmers are facing a lot of problems while cultivating because of several crop diseases and especially the women farmers [1] who don't have more knowledge. This is not only in India but also the same problem in north Asia, Africa and America [2],[3] .A decline in crop production will result from the disease's impact on leaf plants. Early leaf plant disease identification and classification are crucial for agriculturists. Normally for identifying diseases on plants, the leaves play a main role for classifying the healthy plant and infected plant easily. Some plant diseases have the potential to result in enormous losses in terms of money, society, and the environment. Early disease detection through the use of digital image processing is crucial for timely and accurate treatment (A. & L. N., 2017)[4]. Agriculturists can use this to determine the disease's type and to produce some early decisions. Agriculturists can use this information to analyse the disease's type and make quick decisions about it. In this paper, several types of image processing methods for plant disease detection are discussed. The first unit provides an overview of leaf disease detection. The procedures of image processing are made clear in Unit 2 before a quick literature review of all the authors' methods is presented in Unit 3. A review table is provided in Unit 4 to provide rapid details on the methods and findings of all authors across all papers.

In the agricultural industry, [9] it is very important to monitor on crop health and disease for the successful growth of crops on the farm. This necessitates a lot of work and remarkable processing time. The location of the leaf plant sickness can be the target of the picture management method. The pre-processed photograph will improve the quality of the image. Image processing analysis will produce excellent results. It involves picture augmentation, picture segmentation, and colour space alteration. The leaves, stem, and fruits [5] are typically where the infection's negative consequences are visible. The plant's leaf may display an infection signal. Image processing is the process of enhancing an image such that the results are better suited for a certain use.

Pre-processing [6] an image entails enhancing edges, improving image differentiation, or brightening an image while removing noise, as well as sharpening or de-blurring an out-of-focus image. The process of generating an image has been successful in recognising a variety of leaf plant diseases, including those that impact the borders of the leaf and stem, the form of the afflicted area, the colour of the affected area, the separation of the image's layers, and image segmentation.

LITERATURE SURVEY

This section will discuss about some preliminary research that was carried out by several authors on this appropriate work and we are going to take some important articles into consideration and further extend our work.

Detect and classify the plant diseases using Image Processing Software.

Authors : T. Sinshaw, et al.

In this paper [7] the author mainly discussed four processes that the researcher focuses on are: One process is how to create an alternate color for the RGB leaf image, this is possible by applying a colour space modification on the RGB leaf. In the second process they targeted on segmenting the image using some well known clustering algorithm like K-Means. In the next process how to extract the objects texture features from the segmented image.

Finally constructing an effective method to identify and categorize plant diseases as result outcome.

Detect and classify the Disease on the Plant.

Authors: O.S.Android, et al.

In this article [8] the author mainly concentrated on the potential factors which affect the plant parts such as leaves, stems, lesions, and fruits. In general if any plant leaf is effected with any disease there will be some sign of altering colour and revealing the dots on it. There are a number of procedures necessary, including identification and training in image processing. For this to identify the first stage involves resizing the obtained image and utilising segmentation technique to transform it to HSI colour space format. Next the HSI colour space will use for extracting some useful features and then we try to apply ANN finally to figure out the disease which is present on that plant. But the author failed to achieve more accuracy by using ANN.

Developing software that automatically identifies and categorises plant diseases

Authors: You meo et al.

In this article [9] the author mainly concentrated on proposed techniques which contain numerous processes, such as image clustering, pixel matching and neural classifier using a network. The suggested strategy is a good one. It greatly aids in a quick computational analysis for the proper detection of leaf diseases. But the authors found this automatic identification and classification are not applied on all types of plants.

Leaf Disease Identification & Grading Using Digital Image Processing and ML.

Authors: A.Rastogi, et al.

In this article [10] the author mainly discussed about two-phase system that was suggested. In the primary stage the leaf identification is done and pre-processing of leaf to extract the main features. In the next stage we try to apply ML and DIP for grading the leaves which are healthy and infected. Here the DIP is used to figure out which portion of leaf is effected and damaged.

PRIMITIVE METHODS

The primitive system includes normally two types of systems: one built using K-Means clustering, which provides the highest correlation or homogeneity at 83.2%, and the other using KNN classifier with weighted parzen window method to pre-process the images. By using the first system we can achieve the maximum accuracy of upto 90% for just top twelve categories of plant diseases. One limitation of the current system is that it is less accurate and will not function well for more than 12 categories. Also some other limitations are present in primitive methods such as:

1) More time delay to find out the disease of any plant for more categories.

2) There is no prevention technique

3) The primitive system failed to identify early prediction.

CURRENT SYSTEM

In this current work, we are choosing 15 categories and working to increase the validity accuracy in order to address the drawbacks of the current system. model application is described below. We used the data set from Kaggle for this project, and I'll provide the URL to it below: https://www.kaggle.com/datasets/emmarex/plant disease We are extracting the file after downloading the data. We are iterating through each and every image present in each of the 15 folders and using the computer vision (cv2) library to resize all of the images to 84*84*3 size where 3 represents three channels and 84*84 is the height and width of the Image and we are storing all of the images. In this data set, we have

15 different categories of plant diseases corresponding to tomato and potato plants. With the aid of the Matplotlib and Seaborn libraries, we first display images with their category names at random before normalising all of the image pixel values to a lower scale. Next, we build the VGG19 advanced convolution neural network after dividing the data into training and test sets. Finally, we ran the model and achieved validation accuracy of 91.7% on the validation data for 15 different categories.

Some of the advantages of using current system is as follows:

1) By using our proposed VGG19 model we can easily classify on more categories and we can get accurate result for large dataset.

2) The proposed application is going to extract more than 15 categories of plant diseases where the existing systems failed to do.

3) Result from using VGG19 we can achieve almost 91.7 % of accuracy in plant leaf disease detection, which is not yet implemented so far by any one.

PROPOSED ALGORITHMS

In this section we discuss the proposed algorithms which were used in our proposed application. They are as follows:

1) VGG-19 Model

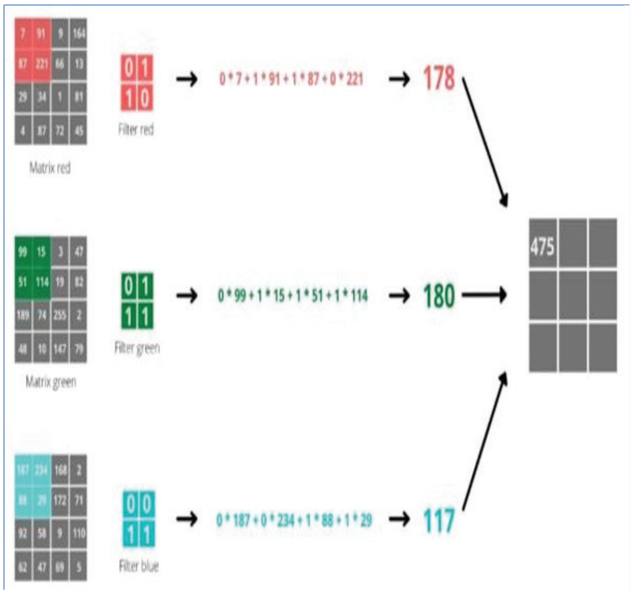
2) ConvNet

Now let us discuss the overview.

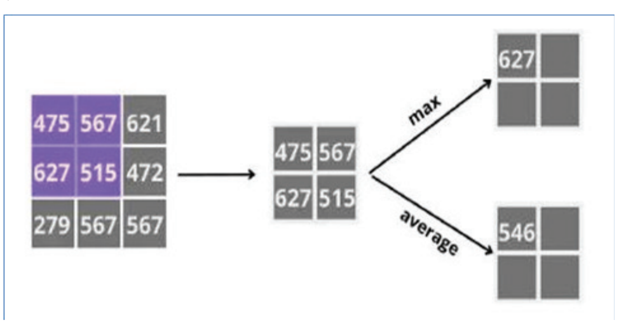
1) ConvNet

Convolutional neural networks (CNN or ConvNet) are a sub class used in several applications of voice recognition and image processing. We can achieve high dimensionality of images with very less error rate and loss. As this proposed work is more depend on crop images, these CNNs are mostly used for this purpose. As we are going to identify the plant diseases then from leaf we need to use digital image processing technique and hence we use CNN or ConvNet which is best used in image processing applications.

In general the RGB image is converted into matrix format and those values are stored as per the corresponding cells. The RGB range will be always between 0 to 255 and the plant leaves will have different shades. Hence based on their exact color and features the RGB matrix is mapped.



Here the maxpooling layer plays a main role which uses the 3x3 convolution layer input matrix and works to further reduce the dimensionality while retaining the key aspects of the image. We split the input into all conceivable partial 2x2 matrices in order to produce a 2x2 matrix as the layer's output, then we look for the highest value in each of these fields. This will be the value in the output matrix's field. Instead of using a max-pooling layer, we would compute the average of the four fields if we were to utilise the average pooling layer[11].

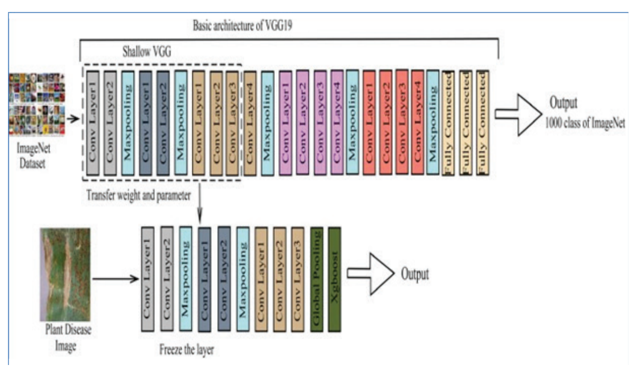


After MaxPooling layer is applied the image will be converted into max and average blocks. Next the fully connected layer has completed the task we set out to complete with the entire image in the beginning. For each entry in the smaller 2x2 matrix, we build a neuron, and we link that neuron to every other neuron in the following layer. This provides us a lot fewer dimensions and uses less training resources. Once the result is found the iteration will be stopped and training is completed.

VGG-19 Model

Once the image processing technique is completed on input images ,now we try to apply the VGG-19 model on that processed images and finally try to find out the disease of that plant based on leafs [12].

A variation of the VGG model called VGG19 has 19 layers in total (16 layers are convolution layers, 3 layers are fully connected layer, 5 layers are MaxPool layers and 1 layer is of SoftMax layer). VGG16 and VGG19 are generally relatively comparable, with the exception of the difference in the number of layers; in fact, VGG19 provides greater accuracy than VGG16 because it has more hidden layers. In the suggested application, we used VGG 19 on the provided dataset to achieve an accuracy of 78% across 50 iterations. By applying VGG-19 on the input dataset which we collected from KAGGLE, we finally achieved 91.7 5 accuracy on more than 15 several categories of plants.



From the above figure we can clearly see how the VGG-19 is applied on the sample plant dataset and how we can achieve the accurate result.

EXPERIMENTAL RESULTS

Here we are using Python as programming language for implementing the application and for this we use google collab platform to store the information and execute the project.

Load Dataset

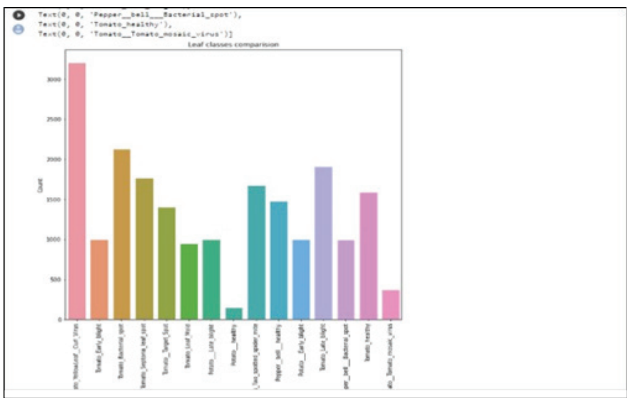
KAGGLE/Plant Disease Dataset

Here we load the plant disease dataset from kaggle and try to apply our models to check the performance of our proposed models.

Extract Categories from Dataset

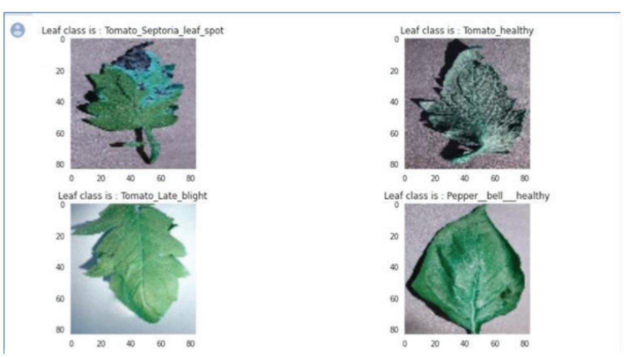
```
total 2.0M
drwxr-xr-x 2 root root  96K Apr 13 15:05 Pepper__bell___Bacterial_spot
drwxr-xr-x 2 root root 140K Apr 13 15:05 Pepper__bell___healthy
drwxr-xr-x 2 root root  96K Apr 13 15:05 Potato___Early_blight
drwxr-xr-x 2 root root 100K Apr 13 15:05 Potato___Late_blight
drwxr-xr-x 2 root root  16K Apr 13 15:05 Potato___healthy
drwxr-xr-x 2 root root 220K Apr 13 15:05 Tomato_Bacterial_spot
drwxr-xr-x 2 root root  96K Apr 13 15:05 Tomato_Early_blight
drwxr-xr-x 2 root root 176K Apr 13 15:05 Tomato_Late_blight
drwxr-xr-x 2 root root 100K Apr 13 15:05 Tomato_Leaf_Mold
drwxr-xr-x 2 root root 172K Apr 13 15:05 Tomato_Septoria_leaf_spot
drwxr-xr-x 2 root root 160K Apr 13 15:05 Tomato_Spider_mites_Two_spotted_spider_mite
drwxr-xr-x 2 root root 136K Apr 13 15:05 Tomato__Target_Spot
drwxr-xr-x 2 root root 316K Apr 13 15:05 Tomato__Tomato_YellowLeaf__Curl_Virus
drwxr-xr-x 2 root root  40K Apr 13 15:05 Tomato__Tomato_mosaic_virus
drwxr-xr-x 2 root root 152K Apr 13 15:05 Tomato_healthy
```

Plot Sample Graph from the Categories



From the above window we can clearly see almost all the categories are mapped into bar chart.

Label the Input



From the above window we can clearly see all the images are labelled with names.

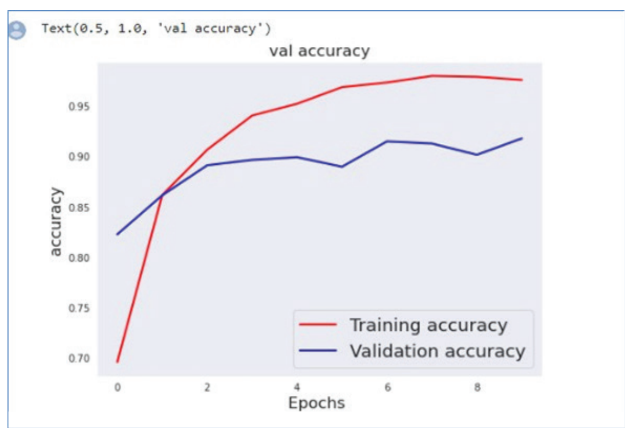
Apply VGG-19 Model

```python
from tensorflow.keras.applications.vgg19 import VGG19
vgg = VGG19(input_shape=(img_size,img_size,3), include_top=False, weights="imagenet")

for layer in vgg.layers[:19]:
      layer.trainable = False

model2=Sequential()
model2.add(vgg)
model2.add(MaxPool2D((2,2),strides=(2,2)))
model2.add(Flatten())
model2.add(Dense(len(class_names),activation='softmax'))
model2.compile(optimizer='adam',loss='categorical_crossentropy',metrics=['accuracy'])
model2.summary()
```

From the above window we can clearly see Vgg-19 model is applied and now we can see the accuracy of our given model in below window.

Training and Testing Accuracy

```
history2=model2.fit(X_train,y_train,validation_data=(X_test,y_test),epochs=10,batch_size=batch_size)

Epoch 1/10
258/258 [==============================] - 61s 193ms/step - loss: 0.9486 - accuracy: 0.6961 - val_loss: 0.5111 - val_accuracy: 0.8227
Epoch 2/10
258/258 [==============================] - 47s 182ms/step - loss: 0.3989 - accuracy: 0.8617 - val_loss: 0.3940 - val_accuracy: 0.8614
Epoch 3/10
258/258 [==============================] - 47s 182ms/step - loss: 0.2636 - accuracy: 0.9067 - val_loss: 0.3257 - val_accuracy: 0.8912
Epoch 4/10
258/258 [==============================] - 47s 182ms/step - loss: 0.1776 - accuracy: 0.9406 - val_loss: 0.3060 - val_accuracy: 0.8966
Epoch 5/10
258/258 [==============================] - 47s 182ms/step - loss: 0.1348 - accuracy: 0.9523 - val_loss: 0.3154 - val_accuracy: 0.8992
Epoch 6/10
258/258 [==============================] - 47s 182ms/step - loss: 0.0898 - accuracy: 0.9687 - val_loss: 0.3962 - val_accuracy: 0.8898
Epoch 7/10
258/258 [==============================] - 47s 182ms/step - loss: 0.0773 - accuracy: 0.9733 - val_loss: 0.2996 - val_accuracy: 0.9150
Epoch 8/10
258/258 [==============================] - 47s 182ms/step - loss: 0.0596 - accuracy: 0.9799 - val_loss: 0.3216 - val_accuracy: 0.9128
Epoch 9/10
258/258 [==============================] - 47s 182ms/step - loss: 0.0593 - accuracy: 0.9790 - val_loss: 0.3921 - val_accuracy: 0.9016
Epoch 10/10
258/258 [==============================] - 47s 182ms/step - loss: 0.0729 - accuracy: 0.9760 - val_loss: 0.3051 - val_accuracy: 0.9179
```



From the above window we can clearly see Vgg-19 model is achieved an accuracy of 91.7 % at 258 epochs. We can see the same in validation graph corresponding to training accuracy.

CONCLUSION

In this current work, we concentrated on image classification and clustering. The benefit of using an image processing technique for identifying the plants infection at the starting stages, so that farmers can easily take decision about how to safeguard a crucial evacuation from the illness on the leaf spreading to other takeoffs.

The specific researcher incorrectly identified and categorised plant diseases using various techniques and frameworks. Our proposed VGG-19 model achieved more than 91 percent of accuracy in order to identify the plant diseases on almost 15 different categories. The methods outlined in this paper help expedite processes and provide positive outcomes.

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Automatic Aerobridge Language System

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ABSTRACT

Effective communication is paramount in air traffic control (ATC) to ensure the safety and efficiency of aviation operations. However, language barriers can pose significant challenges, especially in multicultural environments. The AeroBridge Language System offers a promising solution by providing real-time language translation capabilities for ATC personnel and storing the conversations in a database which can be used for later use. This paper explores the implementation and use of the AeroBridge Language System in ATC communication, highlighting its impact on enhancing communication between pilots, air traffic controllers, and ground staff speaking different languages. The system's ability to facilitate clear and accurate communication in diverse linguistic environments is a crucial step towards improving safety and efficiency in air traffic management. The research investigates the integration of the AeroBridge Language System into existing ATC communication systems, evaluating its effectiveness in improving communication clarity and reducing misunderstandings. Furthermore, the paper discusses the challenges and considerations in deploying such a system in ATC environments, including reliability and regulatory compliance.

Overall, the AeroBridge Language System shows great potential in revolutionizing ATC communication, paving the way for safer and more efficient aviation operations globally.

KEYWORDS: *Air traffic control (ATC), Language barriers, Real-time translation, AeroBridge language system (ABLS), Aviation safety.*

INTRODUCTION

In today's globalized world, effective communication is essential for collaboration and understanding across diverse cultures and languages. This is particularly true in air traffic control (ATC), where clear and accurate communication is crucial for ensuring the safety and efficiency of aviation operations. However, language barriers can pose significant challenges in ATC environments, where personnel often need to communicate with pilots, air traffic controllers, and ground staff who speak different languages. The AeroBridge Language System is a cutting- edge solution designed to overcome these challenges by providing real-time language translation capabilities for ATC communication.

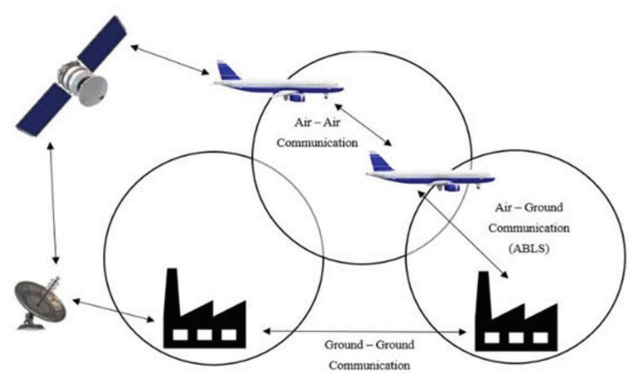

Fig. 1 Communication Flow

Purpose and Scope

The primary purpose of the AeroBridge Language System is to improve communication clarity and efficiency in ATC operations. By providing real-time translation capabilities, the system aims to reduce misunderstandings and improve situational awareness among ATC personnel, pilots, and ground staff. The system's scope extends to various communication scenarios in ATC, including radio communication between pilots and controllers, as well as verbal interactions between controllers and ground staff. Additionally, the system can be used in training environments to help ATC personnel practice communication in different languages.

Objectives

The main objectives of the AeroBridge Language System project are to:

- Enhance communication clarity and accuracy in ATC operations.
- Improve situational awareness among ATC personnel, pilots, and ground staff.
- Reduce language barriers and misunderstandings in multicultural ATC environments.
- Provide a user-friendly and intuitive interface for seamless communication across languages.
- Explore the feasibility and effectiveness of using real-time language translation in ATC communication.

SIGNIFICANCE

The AeroBridge Language System has the potential to revolutionize communication in ATC environments, making air travel safer and more efficient. By enabling effective communication across language barriers, the system can help reduce the risk of miscommunication and errors, ultimately enhancing aviation safety. Furthermore, the system's user-friendly interface and advanced features make it a valuable tool for improving communication in diverse and multicultural ATC settings. Overall, the AeroBridge Language System represents a significant advancement in ATC communication technology, with far- reaching implications for the aviation industry.

METHODOLOGY

This research will begin with a comprehensive analysis of communication requirements in air traffic control (ATC) environments, focusing on identifying the key challenges and language barriers faced by ATC personnel, pilots, and ground staff. Based on the findings from the requirement analysis, the AeroBridge Language System will be designed to address these challenges, with a particular emphasis on facilitating real-time multilingual communication. The system architecture will be developed to integrate advanced speech recognition and translation technologies, enabling seamless communication across languages in ATC environments.

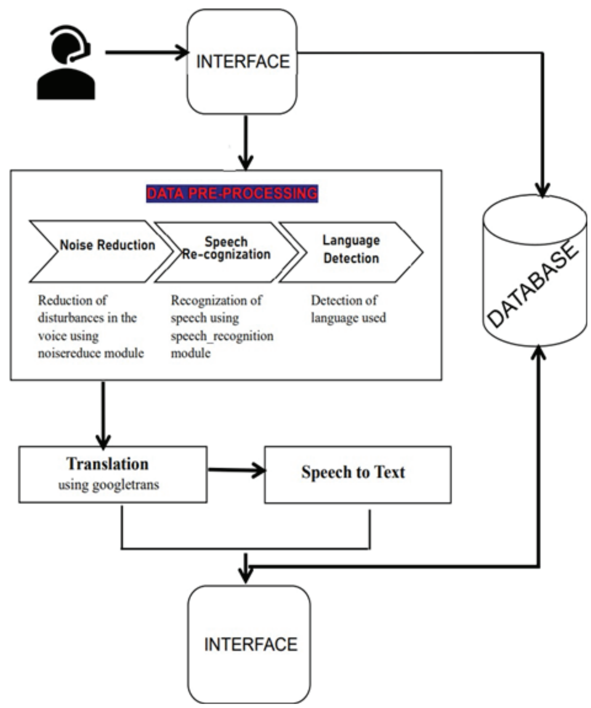

Fig. 2. AeroBridge Language

IMPLEMENTATION:

Following the design phase, the AeroBridge Language System will be implemented using suitable programming languages and frameworks. Special attention will be paid to ensuring the system's capability to accurately recognize and translate speech in multiple languages. Integration with existing ATC communication systems will also be a critical aspect of the implementation process to ensure compatibility and seamless operation. Extensive testing of the AeroBridge Language System will be conducted in simulated ATC environments to evaluate its accuracy, reliability, and performance under various conditions and scenarios. User feedback will be gathered from ATC personnel, pilots, and ground staff who use the system to assess its usability, user-friendliness, and effectiveness in facilitating communication across language barriers. Performance evaluation will be based on predefined metrics such as speech recognition accuracy, translation accuracy, response time, and system uptime. The research will also include a comparative analysis between the AeroBridge Language System and traditional communication methods in ATC to highlight the advantages and limitations of the system. Validation of the system's effectiveness in improving communication clarity and efficiency in ATC environments will be conducted, along with an assessment of its impact on reducing language barriers and enhancing situational awareness

RESULTS& DISCUSSION

System Performance

The AeroBridge Language System demonstrated high accuracy in speech recognition and translation, with an average accuracy rate of over 93% in recognizing operations. The system's ability to provide real- time translation was particularly beneficial in emergency situations, where clear and concise communication is critical.

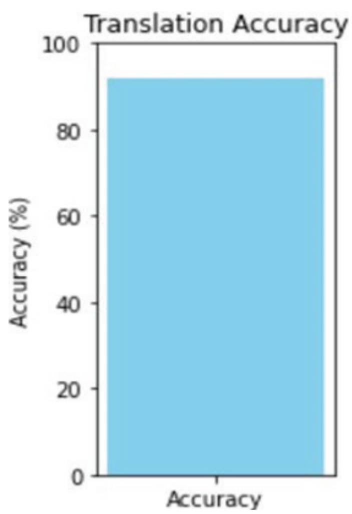

Fig. 3. Accuracy of Translation

Comparison with Traditional Methods

In comparison to traditional communication methods in ATC, such as using a common aviation language or relying on interpreters, the AeroBridge Language System offered several advantages. The system was faster, more accurate, and more reliable than traditional methods, allowing for quicker decision-making and response times. Additionally, the system's user-friendly interface and intuitive design made it easier for personnel to adopt and use effectively.

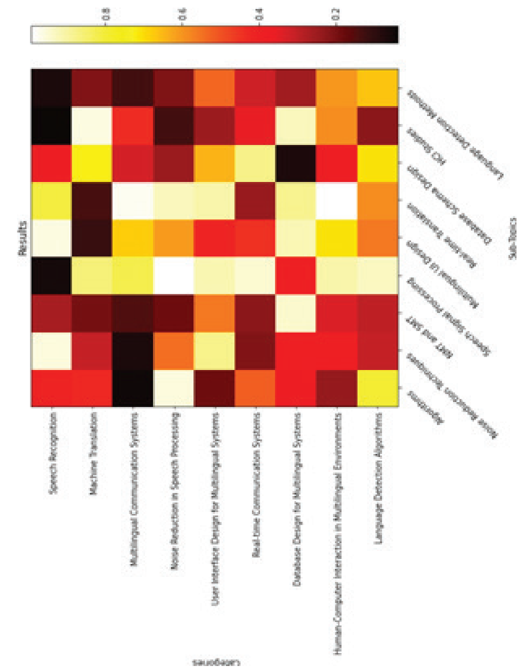

Fig. 4. Comparison of ABLS with Traditional ATC Systems

FUTURE ENHANCEMENTS

While the AeroBridge Language System showed great promise in enhancing communication in ATC environments, there are several areas for future improvement. These include further enhancing the system's accuracy and reliability, expanding language support, and integrating additional features such as voice commands and automated translations. Additionally, future research could explore the integration of the system with other aviation technologies, such as automated aircraft systems, to further improve safety and efficiency in air traffic management.

CONCLUSION

In conclusion, the AeroBridge Language System represents a significant advancement in ATC communication technology, offering a practical and effective solution to language barriers in aviation. The system's high accuracy, user-friendly interface, and positive impact on communication make it a valuable tool for enhancing safety and efficiency in air traffic management. Further research and development of the system could lead to even greater improvements in communication and collaboration in the aviation industry.

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E-Healthcare Infrastructure using SAAS Tool for Healthcare

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ABSTRACT

In the Healthcare industry, more and more cutting edge technologies are introduced to improve the quality of healthcare provided, the quality of service provided and efficiency of day to day operations. For instance, a patient's medical records and basic information are handled by the hospital information management system; their identity (ID) can be swiftly scanned or entered using a wrist one-dimensional QR Code; and so forth. While information technology is convenient, it also has certain security drawbacks in a number of common scenarios due to immature technology or management vulnerabilities. Examples of these include the ease with which patient wrist IDs can be forged, the X-ray transparency that compromises user privacy, the lack of strict control over access to view medical privacy records, infusion confirmation without technical authentication, and so forth. The security concerns are examined in more detail below. Healthcare applications are considered as promising fields for wireless networks. Patient mobility, energy-efficient routing, and dependable patient communication are some of the current themes in healthcare research. On the other hand, if new technologies are implemented in healthcare applications without taking security into account, patient information and privacy are put at risk. Furthermore, an individual's physiological statistics are quite sensitive. This paper's primary accomplishment is the secure distribution of patient data across data servers and the use of cryptosystems to do statistical analysis on the data without jeopardizing patient privacy and store data in Quick Response Code which help to access patients information in case of emergency at hospital and Insurance department.

KEYWORDS: *Electronic health card, Health card, Healthcare, Health information, QR code.*

INTRODUCTION

Many developing nations are having trouble providing improved healthcare to their rural and distant populations. One of the main problems facing India's healthcare industry is that it requires improvisation and advanced technology, which makes it more crucial than ever. The introduction of technology has brought about a transformation in the health field. One such example is the creation of the Electronic Health Card, which is becoming a more crucial instrument in the healthcare system. An Electronic Health Card is a secure, portable, and easy-to-use device that stores a patient's medical information and makes it accessible to authorized healthcare providers in real- time. The Electronic Health Card is designed to store a variety of medical information, including personal information, medical history, lab results, medications, and immunizations. The Electronic Health Card will also provide patients with greater control over their medical information, allowing them to carry their medical history with them at all times. An increasing number of information technologies are being used in medical administration and healthcare research to increase productivity. A wrist one-dimensional QR code is used to read or input a patient's identity (ID), for example, and the hospital information management system handles the patient's basic information and medical care. Information technology makes life easier, but it also has certain security drawbacks in a number of common situations due to underdeveloped technology, design or management flaws. Some examples include: user privacy being compromised by transparent health records; access to view medical privacy records not being strictly controlled; infusion confirmation lacking technical authentication; patient identification easily forged; inconvenient payment methods; and so on. The system's primary goal is to make information immediately accessible in an emergency. Users will be able to view the specifics of the individual in need of medical care. The person's information, including his most recent medical records and personal information, is provided by the system. Through this intuitive and user-friendly interface, you can take charge of your health and actively participate in your area, all while ensuring the privacy and security of your sensitive data. For healthcare professionals, the Health Card streamlines the process of accessing patient information and fosters efficient collaboration. Doctors can use their personalized login credentials to access the dedicated doctor portal on our website. Once logged in, they can quickly retrieve patient records by scanning the patient's Health Card QR code or searching by patient ID. The doctor portal provides a comprehensive overview of each patient's medical history, allowing physicians to make informed decisions based on accurate and up-to-date information. It also facilitates secure communication channels between doctors and patients, enabling seamless exchange of messages, test results, and treatment plans. With the Health Card, doctors can streamline administrative tasks and focus more on delivering personalized, high-quality care. The QR code embedded in the Health Card serves as a powerful tool for research and analysis. Researchers and scholars can leverage this technology to access patient profiles for authorized studies and clinical trials. By scanning the QR code, researchers are directed to the patient's profile page, which offers a comprehensive overview of their health data, contributing to the advancement of medical knowledge and the development of evidence-based practices.

LITERATURE SURVEY

After studying a few research papers based on Electronic Health Card, we were able to observe and analyze some points, few of them are mentioned ahead. These research works have been mainly carried out in European countries [1][3]. These projects aim to improvise the connection between the mobile citizens of Europe and the national health care systems using advanced smart card technology [3]. Some of the projects have implemented a user-friendly chat-box to create a more healthy relationship between doctors and their patients [4]. Several electronic health cards have introduced highly secured encryption of data using encryption keys and digital signature keys which are stored on the system and are utilized to exchange secure and authorized data between clients and database servers[1][2][4][6]. Due to advancement in technology many health agencies have also launched an electronic health card with unique features like storage where one can store nominal of their own premium insurance [5][8][9]. Instead of single-server-environment-based authentication system there has been an introduction of mutual authentication and key agreement scheme for a multi-medical server environment[6].Many papers have concluded that The use of an electronic health card will have several advantages, such as less administrative and paper processes, lower costs, fewer medical errors, more accurate case follow-up, patient information integrity, the removal of the problem of readable prescriptions, etc[1][7][8][9]. At present, the use of smart cards has become a daily necessity in the community such as identity cards, electronic money, attendance, health insurance, and other needs [5][8][9].

METHODOLOGY

The methodology of our project goes as follows: We conducted a literature review to gather information about the already launched similar projects in the health industry. We studied different research papers and developed unique ideas and designs to be implemented in our project, E-Healthcare Infrastructure Using SAAS Tool for HealthCare (wellNexa). We conducted extensive field surveys, interviewing Doctors and Medical Practitioners from solo practitioners to medium and large scale hospitals. We analyzed the work and feedback from interviews and decided to add a unique feature to our project. We have added a QR scanner and a unique identity number which helps in accessing the information on the health card. We worked on developing a front-end and a back-end for the website of our project. This website can help us access health cards. The front-end has been developed using languages like HTML, CSS and JavaScript. We have been working on the back-end using SQL and Xampp for creating a database. We are in the process of deploying our website using repositories on GitHub.

Characterization: WellNexa is a website UI with multiple portals; one for the patient, one for the doctor, one for the pharmacist, one for insurance agent, etc. The patient module consists of a Dashboard page where all the basic info of the patient is shown and can be accessed by scanning the qr code present on the health card. Since anyone can scan the qr code we have displayed only the basic information in it. For other details we have made a pin authentication where he can access past OPDs and other medical records. The website includes a user interface for accessing patient information and a database to store and retrieve medical records. The website has highly secured encryption and authentication protocols which are used to ensure the protection of patient data. The website is patient centric as well as doctor centric, we have a patient login where he can check his prescriptions, book an appointment and order medicine from any nearby pharmacy. We also have a doctor login where a doctor can check a patient's data by searching for a patient ID. A doctor can also access the OPD section and fill an OPD form for a patient.

Algorithms used in our Project wellNexa: We've implemented a number of different algorithms in our project to ensure the integrity and security of the users' data stored in our systems.

- MD5: This hashing algorithm is used to generate a hash of all login credentials (both patients and doctors), user data which include patients' health records, doctors' records, doctors' notes, case files, etc. This algorithm is used to ensure the integrity of the data stored.
- AES: This encryption algorithm is used to encrypt both the original data and the hash generated during the previous step by MD5. Data is encrypted to ensure the privacy and confidentiality of data and prevent unauthorized access by malicious actors.
- Reed-Solomon Method: Used in generating QR codes printed on health cards. A QR code generating client is used who makes use of Reed-Solomon error correction method to generate working and personalized QR codes.

Mathematical Model

System Description:

Let W be the whole system which consists of Input = U, E, C, T, M, N, Y.

Let u is the set of number of users. U= u_1, u_2, ..., u_n.

E : encryption key.

T : text message in M. M: cipher-text in set C

N: signature for sending messages. Y: collection of symptoms.

Functions

QREnc ():a QR encoding algorithm that generates a QR code from a string S in N.

QRDec (): an algorithm for decoding QR codes that yields a string S in N after receiving a code

Procedure

Protocol for generating OTP for Authentication with Random Strings:

Step 1: The user initiates a connection with the server and transmits his/her ID..

Step 2: The server checks the ID to retrieve the users.

Step 3: The user is prompted to enter the string by a QR code that appears.

Step 4: The user decrypts the QR code. Since the random string is encrypted, he/she can only view the OTP string on her smartphone and enter the OTP using a physical keyboard in the terminal.

Step 5: The server validates the result and sends it back if it matches what it sent earlier, at which point the user is authorized. The user is rejected otherwise. Any string of letters or numbers that is four characters or longer, depending on the appropriate security level, is considered an OTP in this protocol.

Protocol for Authentication

Step1: The user connects to the server and sends her ID.

Step2: The server checks the received ID from the database. In order to obtain, the server randomly arranges the keyboard and encrypts it using the public key.

Step 3: After that, a QR encoder is used to get the ciphertext. Step 4: A blank keyboard and a QR code are shown on the user's terminal. The user is unable to enter her password because there is no alphabet on the display keyboard.

Step 5: The user opens her smartphone app, which decodes the QR code first. The smartphone application then decrypts the ciphertext.

Step 6: The user can click the appropriate button to enter a password when they see the blank keyboard with the QR code displayed on it via a smartphone application. The blank keyboard displays alphanumeric characters. The user views the keyboard layout on her smartphone and enters her password on the terminal screen. The terminal simply recognizes which buttons are pressed; it is unaware of the password. The terminal sends the identities of the buttons that the user has clicked to the server.

Step 7: The server verifies that the right buttons have been pressed in order to determine whether the password is correct. We need to talk about and clarify a few of the technical problems with the two protocols that we discussed in the earlier parts. We go into detail in this part on how to deal with a number of concerns pertaining to our protocols, including transaction verification, session hijacking, and transaction security.

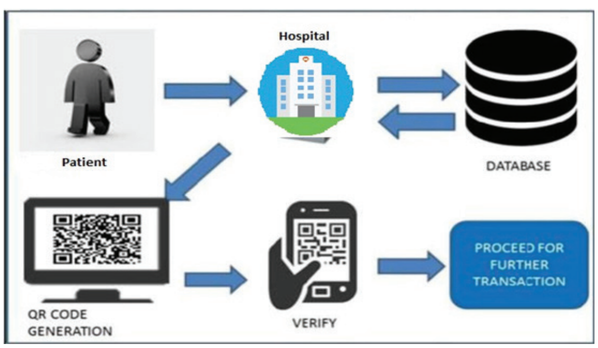

Fig. 1. Proposed System Architecture

Showcasing basic working of the web application

In a Developed Country	In a Developing Country
Focuses on improving EHR access and patient identification.	Designed to provide healthcare to underserved populations.
Aims to streamline administrative processes	Targets financial inclusion and equitable healthcare access.
Enhances personalized care and treatment plans based on patient medical history.	Employs health cards as proof of insurance coverage or eligibility for subsidized services.
Enables quick retrieval of patient information during emergencies for efficient decision-making.	Enhances patient identification to ensure accurate delivery of services.
Supports public health management through data tracking and contact tracing.	Facilitates targeted healthcare interventions for specific health issues prevalent in the region.
Improves overall healthcare delivery and patient experience.	Strengthens healthcare infrastructure and capacity in underserved areas.

Fig. 2. Comparison (Literature Survey)

Highlighting differences in existing infrastructure in developed and developing countries

RESULTS AND DISCUSSIONS

wellNexa, an electronic health card has served its purpose appropriately. It has helped to create a better connection between a patient and his doctor, it acts like a bridge between them. It has become simpler for the hospitals to access the information, data and past records of a patient. Using the health card will lead to advancement in not only the health industry but also in technology and economy. This has proven beneficial also for the patients as they can access their health information from anywhere anytime easily. The health card includes security and protection of users data and information therefore they can have their privacy protected. Doctors using the health card can save their time by directly accessing the patient record by scanning the QR code or entering the unique patient ID instead of opening and reading past records. It has also helped to store the Vaccination records very easily in the form of a checklist. wellNexa has been really helpful and reliable in the health industry. Some of the major discussions are Seamless Transfer of Medical Information: 1. When a patient is transferred from one healthcare facility to another, health cards can ensure a smooth transition of medical information.

2. For instance, if a patient needs to visit a specialist or is admitted to a hospital, their health card can be used to quickly access their medical records, enabling the healthcare provider to have a comprehensive understanding of the patient's health history, previous treatments, and medications.

Emergency Situations

Health cards are particularly valuable during emergencies when immediate medical attention is required and paramedics and emergency responders can quickly access vital information from the patient's health card, such as allergies, pre- existing conditions, and medication details. This information helps in making critical decisions and delivering appropriate and timely care, potentially saving lives.

Public Health Management

Health cards can play a crucial role in managing public health initiatives such as vaccination programs and disease surveillance. By linking individuals' health cards to their immunization records, authorities can efficiently track vaccination rates, identify vulnerable populations, and take appropriate measures to prevent the spread of diseases and can also aid in contact tracing during outbreaks, enabling timely interventions to control the transmission of infectious diseases.

Observations

1. Improved Doctor-Patient Relationship: The electronic health card, like wellNexa, facilitates a stronger connection between patients and healthcare providers by streamlining access to medical records. This enhanced connectivity fosters better communication and understanding between doctors and patients, ultimately leading to improved healthcare outcomes.
2. Enhanced Efficiency for Hospitals: The implementation of electronic health cards simplifies the process for hospitals to retrieve and manage patient information and past records. This efficiency not only benefits healthcare providers by saving time but also contributes to overall advancements in the health industry, technology, and the economy.
3. Convenience for Patients: Patients experience increased convenience and accessibility to their health information through electronic health cards. They can access their medical records anytime, anywhere, empowering them to take a more active role in managing their health.
4. Privacy and Security: Electronic health cards prioritize the security and protection of users' data and information, ensuring patient privacy is safeguarded. This instills trust and confidence in patients, encouraging them to embrace and utilize the technology.
5. Time-saving for Healthcare Professionals: Doctors can save valuable time by quickly accessing patient records through electronic health cards, either by scanning QR codes or entering unique patient IDs. This streamlined process allows healthcare professionals to focus more on patient care and less on administrative tasks.
6. Seamless Transfer of Medical Information: Electronic health cards facilitate the seamless transfer of medical information when patients are transferred between healthcare facilities. This ensures continuity of care and enables healthcare providers to make informed decisions based on comprehensive patient health histories.
7. Critical Role in Emergency Situations: Electronic health cards are particularly valuable during emergencies, providing paramedics and emergency responders with vital patient information such as allergies, pre-existing conditions, and medication details. This enables timely and appropriate medical interventions, potentially saving lives.
8. Public Health Management: Health cards can contribute significantly to public health management initiatives, such as vaccination programs and disease surveillance. By linking health cards to immunization records, authorities can track vaccination rates and identify vulnerable populations, aiding in disease prevention and control efforts.

Overall, electronic health cards like wellNexa offer numerous benefits to both healthcare providers and patients, ranging from improved efficiency and convenience to enhanced patient safety and public health management.

Working Modules

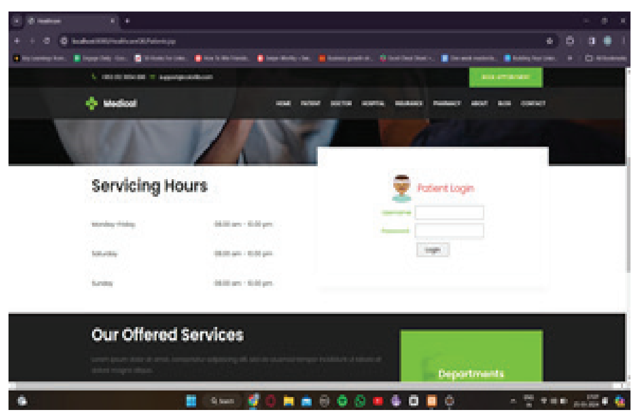

Fig. 3. Patient Login Page

Shows the interface when a user tries to log into their profile

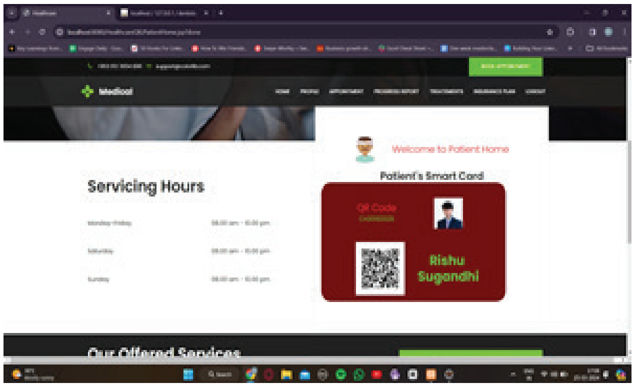

Fig. 4. Generated QR Codes

Exhibits the smart ID and the QR code that is generated for the patient (health card)

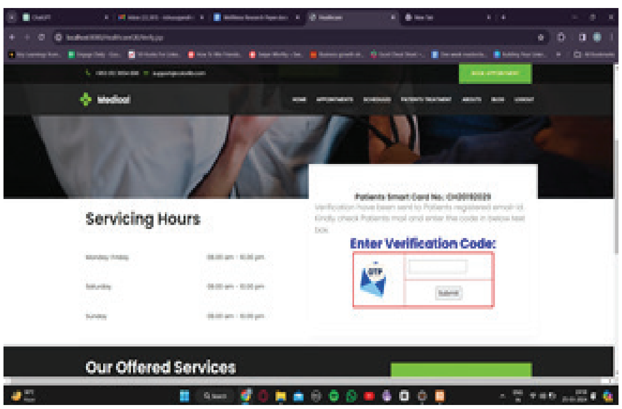

Fig. 5. The Verification Page

Shows the necessary verification process where the user has to input an OTP sent to their registered mobile number or mail ID

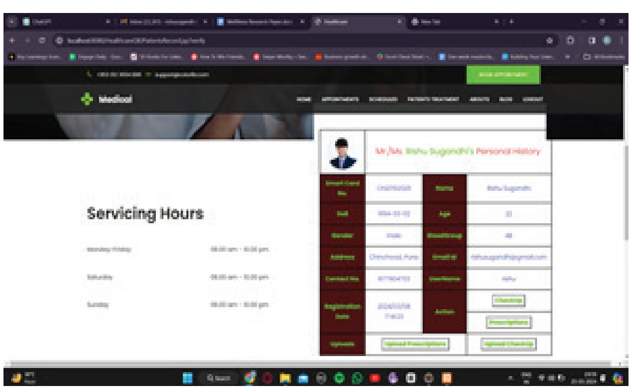

Fig. 6. Patient History Interface

Displays the medical history of the patient, medical records, past prescriptions, scans, x-rays, etc.

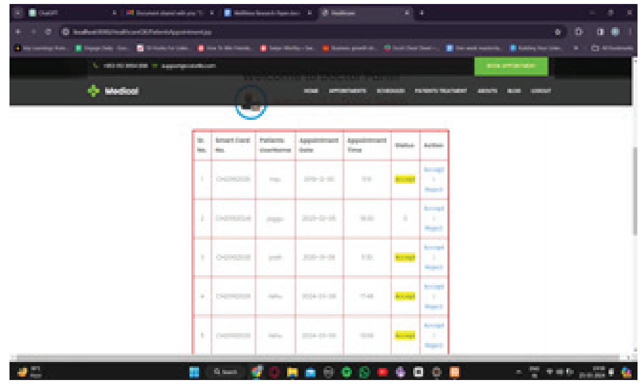

Fig. 7. Doctor Appointment Details

Exhibits appointment records, appointment requests to the doctor made by patients essential to the healthcare sector.

ACKNOWLEDGEMENT

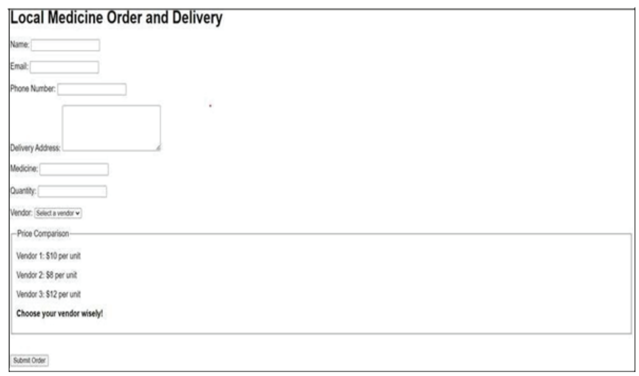

Fig. 8. Medicine ordering interface

Displays pharmacy module UI to order medicines and other equipment.

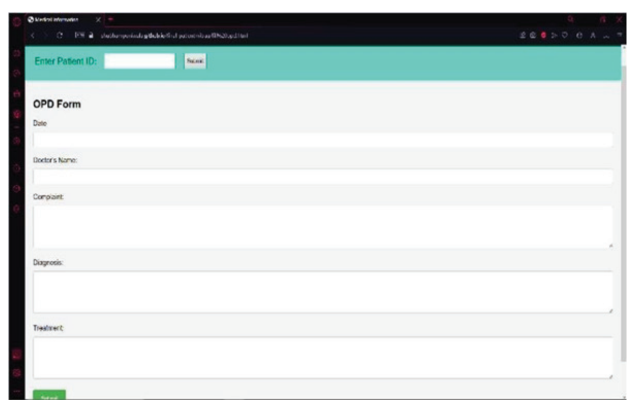

Fig. 9. OPD form that the doctor will be filling

Form, the attending doctor will be filling in during an ongoing checkup in real time which gets added to the patient medical record.

CONCLUSIONS

WellNexa is a project which will bring changes and improvement in the health sector. The platform serves a bridge between a patient and his doctor. This implementation of health cards enhances accessibility, improves patient care, and streamlines medical record management. It's not only beneficial to doctor's but also to patient's. This efficient and secure health card system ensures quick retrieval of patient information, facilitating informed medical decisions and minimizing errors. When people realize the benefits of the proposed Electronic Health Card system and the necessity of technology for improving India's current healthcare system, the system is likely to be successful. Patients are empowered to actively participate in their own health management through the centralization of medical records that guarantees security and privacy and the use of QR code technology, which facilitates seamless healthcare delivery. Health cards have a bright future ahead of them because of technological advancements, and they will always be essential to the healthcare sector.

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Banquet Hall Management Systems Streamlining Event Operations in the Hospitality Industry

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ABSTRACT

Android apps and products have come a long way. This article presents an application developed u sing the Android platform and whose data source is Firebase; The application will use current important features of Android devices such as WIFI, mobile data and GPS. This application requires the user to log in under certain conditions, otherwise the information will be displayed without a registration form. Statistics on page clicks and counts will be generated in the Firebase app of your Google account. Additionally, the end user application does not require any special features to run; only network connection, GPS and user account are required. Services will be displayed based on the user's location and preferences. Since almost all services are offered online, here is an application through which users can book dining tables online

KEYWORDS: *Android operating system, Mobiles, Database.*

INTRODUCTION

The hospitality industry thrives on seamless experiences and banquet halls play a crucial role in facilitating wide range of events. From weddings and conferences to corporate meetings and social gatherings, managing these spaces efficiently is essential to ensure customer satisfaction and business growth. This is where banquet hall management systems (BHMS) come into play. A BHMS is a software application designed to streamline all aspects of banquet hall operations. It acts as a centralized platform for managing bookings, reservations, event details, catering services, staff scheduling, and financial transactions [1]. By automating these processes, BHMS offer numerous benefits to both banquet hall owners and event organizers. Key functionalities of a BHMS: o Event Booking and Scheduling: BHMS provide a user-friendly interface for managing event inquiries, bookings, and cancellations. Real-time calendar availability ensures no double bookings, while customizable scheduling allows for time slots and setup requirements. Customer Relationship Management (CRM): The system stores customer details, preferences, and event history, facilitating targeted communication and personalized service. This fosters stronger client relationships and increases the likelihood of repeat business. Catering Management: BHMS integrate with catering services, allowing for menu selection, order placement, and cost tracking. They may also manage vendor inventory and facilitate communication with catering partners [1][6]. Staff Management: BHMS enable efficient staff scheduling based on event needs and staff availability. Tasks can be assigned, communication channels established, and payroll data can be integrated for streamlined workforce management [6]. Financial Management: BHMS handle invoices, payments, and deposits, providing real-time insights into revenue and expenses. The system can generate reports on event profitability and identify areas for cost optimization. Inventory

Management: BHMS track banquet hall equipment, furniture, and supplies. This ensures availability for events and allows for proactive maintenance scheduling to avoid last minute disruptions. Reporting and Analytics: BHMS generate comprehensive reports on booking trends, customer preferences, revenue streams, and operational efficiency. These insights enable data-driven decision making and continuous improvement within the banquet hall operations. Benefits of using a BHMS: Increased Efficiency: BHMS automate manual tasks, saving time and reducing errors. Staff can focus on providing exceptional customer service. Improved Communication: The system facilitates seamless communication between staff, clients, and vendors, ensuring everyone is on the same page. o Enhanced Customer Experience: A BHMS allows for personalized service, efficient event planning, and streamlined execution, leading to higher customer satisfaction[2]. Data-driven Decision Making: BHMS provide valuable insights that can be used to optimize pricing strategies, marketing efforts, and resource allocation. Increased Revenue: Streamlined processes and improved efficiency lead to higher booking rates, operational cost savings, and ultimately, increased revenue[5]. The use of BHMS is becoming increasingly prevalent in the hospitality industry as banquet halls strive to meet the evolving needs of event organizers and provide a competitive edge[3][5][6]. As technology continues to develop, BHMS functionalities can be expected to further expand, incorporating features such as mobile apps for on the-go management, integration with online booking platforms, and advanced analytics for deeper business insights. By implementing a BHMS, banquet halls can significantly enhance their operational efficiency, customer satisfaction, and overall profitability. This research paper will delve deeper into the specific functionalities of BHMS, explore various software options available, and analyze the return on investment (ROI) associated with their adoption [4].

LITERATURE REVIEW

Banquet Hall Reservation The current system for managing banquet halls is inefficient, it requires customers to visit each hall before booking. The proposed system aims to improve efficiency by dividing halls into smaller areas, allowing multiple guests to use same hall. The system provides services like location, available dates, amenities, parking layout, catering facilities, & payment management ,reducing the workload of suppliers and improving service quality. The system manages the reservation process, with an admin managing new halls & updating available details. Users can book halls by entering their username and password, and the booked halls disappear once free. The proposed banquet hall reservation system offers a centralized platform for booking with features like location details, amenities, and catering. It aims to improve efficiency by dividing halls and allowing multiple bookings. However, dividing halls might create noise or visual distractions, and the system lacks functionalities like real-time availability, cancellation policies, and user interface refinements. Improvements can include floor plan views, time slot bookings, online payments, communication tools, and a comprehensive cancellation policy [1]. Design and Implementation of an Android Application for Booking Banquet Halls and Other Services In the 21st century, the hall booking sector faces challenges due to reliance on word of mouth and a lack of better options. A mobile application has been developed to address these issues by providing precise information about halls, locations, prices, dates, florists, decorators, and other services. The application allows users to view ratings, schedules, and price listings based on service quality. Users can also book specific slots for the hall and choose from variety of online food ordering options. IT also allows users to view ratings, reviews, and feedback from previous customers, ensuring transparency and display of service quality. The app aims to save time &effort by providing accurate information about halls caterers, florists, and other services[2]. Web-based venue booking system In a 2016 IEEE paper, LinhDuc Tran, Alex Stojcevski, The Banquet Management System project aims to and Thanh Chi Pham discussed the need for an develop robust and user-friendly software solution automated hall booking system. Meeting rooms are that will revolutionize the way events are managed essential for sharing knowledge and making and executed within our Organization. important decisions, but traditional scheduling software often underutilizes them. This study aims to The scope of this system encompasses the address this issue by proposing a smart meeting following key elements: room management system with real-time occupancy 1)User Authentication and Authorization: detection. This system would support ad-hoc 2)Event Management: meetings and maximize utilization, as traditional 3)Resource Management: scheduling software struggles to find unoccupied 4) Guest Management: rooms, especially when located in different buildings. 5) Inventory Management. A 2016 IEEE paper by LinhDuc Tran et al. proposes a Banquet Management System to revolutionize event management. This user-friendly software focuses on automating hall booking, a common pain point in traditional scheduling systems that underutilize meeting rooms. Their system tackles this by offering real-time occupancy detection to optimize room usage, particularly for ad-hoc meetings which traditional software struggles with[3]. This comprehensive guide provides insights into the management of festivals and special events, covering various aspects such as planning, marketing, operations, and risk management [7]. The paper discusses the development of a web-based integrated service management system aimed at enhancing service quality and revenue generation at UNY Sports Hall, providing valuable insights into leveraging technology for service improvement [8]. In [9] study focuses on a web-based application for managing rental buildings and event equipment at the Arcadia Function Hall, offering insights into the use of technology for efficient management in the event industry. The research explores the strategic implications of service attributes in wedding banquet halls for market competition and risk management, shedding light on factors influencing competitiveness and risk mitigation in this sector[10]. This paper presents a n multiple-criteria decision-making model for evaluating wedding banquet halls, providing a systematic approach for decision-making in selecting banquet venues based on various criteria[11]. Focusing on digitalization, this study discusses the impact and benefits of digitizing banquet hall bookings, highlighting the advantages of using technology to streamline the booking process and improve customer experience[12].

PROPOSED SYSTEM ARCHITECTURE

Fig 1 represents different modules of BHMS which is Web-based platform for managing banquet hall reservations, bookings, & event logistics.

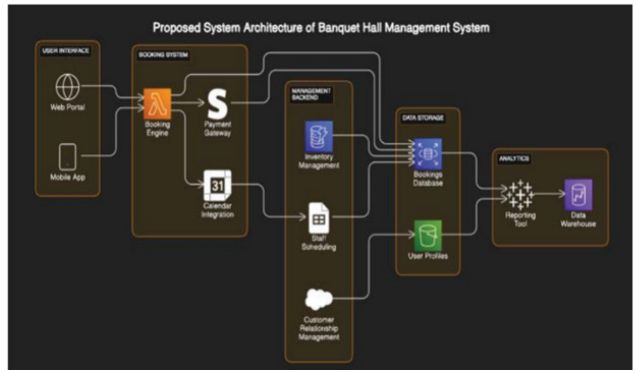

Fig. 1 Banquet Hall Management System (BHMS) Architecture

- User Authentication Module: Allow users to register and log in.
- Admin Module: Manage user roles and permissions.
- Banquet Hall Management Module: Add, update, or remove details of banquet
- Event Management Module: Allow customers to specify event details
- Booking Module: Allow customers to browse available banquet halls based on their requirements
- Staff Management Module: Add, update, or remove staff details.
- Customer Feedback Module: Collect feedback from customers after events.

BHMS ALGORITHM

User Management

Hall Management

Function: Add new halls, edit existing hall details (capacity, amenities, price)

Input: Hall details (name, capacity, amenities, price)

Output: Updated hall information in the system

Event Booking

Function: Allow users to search for available halls based on their event details (date, time, attendees).

Input: Search criteria (date, time, attendees)

Output: List of available halls that meet user requirements

Sub-Function: Check calendar for availability (date, time slot) for chosen hall.

Input: Hall ID, date, desired time slot

Output: Confirmation of availability or conflict notification

Sub-Function: Book the chosen hall upon confirmation.

Input: User ID, Hall ID, Event details (date, time, attendees)

Output: Confirmation of booking and update calendar availability

Event Management

Function: Allow users to view and manage their booked events.

Input: User ID (to retrieve booked events)

Output: List of booked events with details (hall, date, time)

Sub-Function: Edit booked event details (date, time, attendees - subject to availability).

Input: Event ID, new event details

Output: Updated event details or conflict notification if changes clash with existing bookings

Sub-Function: Cancel booked event.

Input: Event ID

Output: Cancellation confirmation and update calendar availability

Reporting: Function: Generate reports on various aspects of the system.

Input: Report type (e.g., bookings by month, revenue by hall)

Output: Detailed reports with relevant data visualizations

RESULTS & DISCUSSION

The Banquet Hall Management System (BHMS) is a comprehensive web-based platform designed to streamline the process of managing banquet hall reservations, bookings, and event logistics. Through the integration of several modules, including User Authentication, Admin, Banquet Hall Management, Event Management, Booking, Staff Management, and Customer Feedback, the BHMS aims to provide an efficient experience for users and administrators alike.

User Authentication Module: This module ensures secure access control by enabling users to register and log in securely. Its implementation enhances system security and personalization for users.

Admin Module: Empowering administrators to manage user roles and permissions effectively, this module enhances overall system security and management by providing control over access to system functionalities.

Banquet Hall Management Module :Allowing administrators to add, update, or remove details of banquet halls, this module ensures the availability of accurate and up-to-date information for customers, thereby improving their booking experience.

Event Management Module :Customers can specify event details through this module, facilitating personalized event planning and enhancing customer satisfaction by providing flexibility in event customization.

Booking Module : Customers can browse available banquet halls based on their requirements using this module. Its user-friendly interface enhances the booking experience by simplifying the search and booking process.

Staff Management Module: This module facilitates the management of staff details, ensuring efficient staffing for events and contributing to smooth event execution and customer satisfaction.

Customer Feedback Module: Collecting feedback from customers post-event, this module provides valuable insights for service improvement. By capturing customer feedback, administrators can identify areas for improvement and enhance service quality.

BHMS Algorithm: The BHMS Algorithm outlines the system's functionalities, including User Management, Hall Management, Event Booking, Event Management, and Reporting. By providing a structured approach to managing banquet hall reservations and event logistics, the algorithm ensures the efficient operation of the BHMS.

Discussion: The BHMS offers a robust and user-friendly platform for managing banquet hall reservations and event logistics. Through the integration of various modules and functionalities, the system enhances efficiency, security, and customer satisfaction. However, ongoing research and development are necessary to address potential limitations and further enhance system capabilities.

CONCLUSION

In conclusion, Banquet Hall Management Systems (BHMS) have transformed event management by automating tasks, fostering communication, and providing valuable data. BHMS empower both banquet halls and event organizers to operate efficiently, deliver exceptional service, and make data-driven decisions, ultimately leading to a brighter future for the event industry.

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AgriChain: Reinventing Agriculture with Blockchain and Supply Chain Integration

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ABSTRACT

Fairness and a lack of transparency in the supply chain are issues that farmers specifically encounter in the agriculture business. Farmers currently face difficulties with opaque pricing, delayed payments, and authenticity verification procedures. Blockchain technology can be a significant factor in the current digital era in preserving supply chain transparency and traceability. Transparency in the supply chain makes farmers feel more trusted and easily accountable. Product tracking is made simple by blockchain technology. A decentralized system like blockchain can satisfy all parties participating in the process and is transparent to all parties. It improves the relationship between agronomists and stakeholders. The two main benefits of applying blockchain technology to supply chain management are security and traceability. This paper exhaustively presents a decentralized blockchain hung traceability that enables erecting blocks for farming. In addition to helping farmers achieve more financial security, a transparent procedure also promotes reliability and accountability among suppliers. This paper provides an overview of blockchain technology, followed by a study on supply chains and the various applications of blockchain technology by supply chain researchers. In conclusion, the experimental setup and tools are discussed along with algorithms.

KEYWORDS: *Hyperledger, Smart-contracts, Supply chain management.*

INTRODUCTION

Technology breakthroughs have caused a revolutionary change in agriculture in recent years. Blockchain integration with agricultural supply chains is one such invention that has attracted a lot of interest. Originally developed as the foundational technology for cryptocurrencies such as Bitcoin, blockchain has become an effective means of improving efficiency, traceability, and transparency in a number of other sectors. Within the agricultural sector, where intricate supply networks and worries regarding food safety and genuineness are common, blockchain technology offers a potentially effective way to tackle enduring issues.

Throughout the economy, supply chain management is a crucial commercial procedure. Supply chain management, also known as SCM, is the process of overseeing the entire production flow of a good, from raw materials to the delivery of the finished product to the customer.

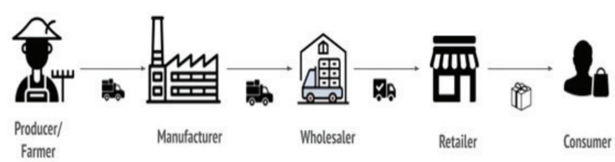

Fig.1 Supply chain management in Agriculture

To address the complicated agricultural difficulties, cutting-edge technologies are being developed; the most recent of them is blockchain. Supply chain management is the application of blockchain technology that is most visible. Blockchain provides a plethora of choices for shipment data. We can track the supply of our goods by integrating Blockchain technology with the Internet of

Things (IoT). The soil quality and current temperature of the location from which the product is being transported are provided by the IoT.

Blockchain technology allows us to preserve tamper-proof records, provide security, and eliminate the need for third parties to act as middlemen in transactions by acting as a public ledger via a distributed network or for all information management, including verification, validation, etc. It primarily lowers transaction costs while simultaneously raising product quality. The usage of cryptography in this case fosters user trust, which increases demand for the product. The crypto currency industry uses encryption techniques to verify users and blocks. Accordingly, every block in our blockchain has transactional data as well as other information. The chain contains the ledger that dates back to the creation of the genesis block. Here, a hash value serves as a reference between each block and the one before it.

Peer-to-peer networks aid in the validation of new users and transactions. The consensus mechanism generates challenges for users to complete; if the challenges are genuine, they are then verified and added to the block.

These shortcomings can be addressed by blockchain technology through tracking, security, efficiency, and transparency through smart contracts that activate automatically when certain criteria are met. The function of middlemen in a blockchain-based network is either completely eliminated or significantly diminished by smart contracts. A smart contract is a type of digital contract that takes action on its own in a network when certain circumstances are fulfilled. When the terms of the contract are met, these self-executing code-based contracts enable agreed-upon actions (like payments) to happen spontaneously, instantly, and without the need for a mediator. Third-party representatives are not necessary because of smart contracts. This saves a significant amount of time, energy, and money. Additionally, no one is used to facilitate transactions, and there is no possibility of fraud or user error. A smart contract makes a supply chain more effective, transparent, and traceable, making it more flexible in fostering stronger bonds between the participants. Every single smart contract has a 20-byte unique address assigned to it. Once a contract is deployed into the Blockchain, it cannot be altered; users may only send transactions to the contract's address. Every consensus node in the network will then carry out this transaction in order to come to an agreement on its outcome.

LITERATURE REVIEW

The architecture by Adil El Mane [1] aims to secure farmers' storage, requiring rules for modification of agriculture data, and automates procedures using smart contracts, connecting traditional farm systems with blockchain for a seamless agri-supply chain.

Affaf Shahid [2] proposes a blockchain-based Agri-Food supply chain solution, focusing on traceability, trading, delivery, and reputation. The system maintains credibility, quality ratings, and immutability of transactions. Smart contracts are used, and simulations show a specific gas requirement for deployment and execution.

The case study illustrates both the challenges associated with implementing blockchain technology in the food supply chain and its potential benefits in reducing waste and enhancing safety throughout the global food chain[3].

Khan, H. H proposed that during the COVID-19 pandemic, blockchain technology can improve agricultural business enterprises by building trust, streamlining processes, and resolving issues faster. It can also enhance supply chains, improve business relationships, and ensure food safety and freshness. Responses were collected, out of which 23% of respondents adopted blockchain for value chains and new business models, while 23% cited security as a key reason.[4]

An approachable blockchain-based agricultural supply chain management platform is presented with the goal of improving product quality and transparency. It makes assets traceable along the whole supply chain and lessens the likelihood that farmers will be taken advantage of by dishonest middlemen. This approach also prevents false price inflation that is intended to support the dishonest profit of intermediaries[5].

A smart farming organization that is dependable, self-managing, and ecologically conscious can be established with blockchain technology. Agri Block IT creates transparent, reliable, and auditable data for agri-food traceability by fusing blockchain technology with IoT. By doing away with middlemen and central processing facilities, the Ethereum blockchain and smart contracts facilitate the tracing of transactions across farming streams[6].

[7] presents a cutting-edge blockchain strategy that optimizes supply chains by doing away with middlemen and using a multi-agent system with smart contracts. Strong security features of the model enable shipping tracking, transaction proof-keeping, and product origin verification. Agents check terms and conditions and levy penalties or fines for violations.

The research analyzes mutual share, the demand curve, and the advertising budget by applying a suggested model to five real-world scenarios. In addition to offering managerial insights for maximizing profit through collaborative and digital marketing tactics, it highlights web design components for digital marketing in global supply chain management[8].

This article explores the theoretical and practical applications of blockchain technology in smart farming, food supply chains, agricultural insurance, and agricultural product transactions. We also talk about how difficult it is to keep track of small holder farmers' transactions and build the ecosystem needed to use blockchain technology for the food and agriculture industries[9].

Kramer MP proposes that selecting a particular blockchain technology platform type (BCTPT) and its associated coordination mechanisms is crucial to the intended use case's financial performance, the supply chain network's effective management, and ultimately the selection of the digital business model[10].

Blockchain technology is being utilized more and more to automate administrative procedures, decrease human intervention, and improve transparency in a variety of industries, including logistics. The public's desire for openness and transparency in logistical procedures could propel independent, publicly accessible Blockchain networks to prominence[11].

In order to boost their reputation and get additional advantages, producers and processors using blockchain technology ought to control the traceability expenses. Supply chain representatives should be encouraged to take part in traceability by the government by creating a strong system of rewards and penalties[12].

Kaja.Sai Sree Neeraj finds that blockchain holds great promise for a transparent food supply chain. Numerous efforts pertaining to different food items and food-related matters are now underway, but there are still a lot of obstacles and difficulties that prevent blockchain from becoming more widely accepted among farmers and agricultural systems[13]

KEY CONCEPTS

The decentralized peer-to-peer ledger concept was first introduced by Satoshi Nakamoto in 2008. Blockchain has been effectively used in the financial sector, such as Bitcoin, and it has generated a lot of interest in a number of other fields, such as voting, supply chain management, hospitality management, and property management. Three key components make up the core technology of blockchain: decentralization, smart contracts, and decentralization.

Decentralization

Decentralization addresses information inequality by facilitating direct interactions between verified users, ensuring equal power and access to records. Because all product information is recorded, manufacturers can monitor suppliers and consumers can verify the legitimacy and quality of the product, which is very useful in the agriculture food supply chain. Decentralization mitigates information inequality and centralized power by enabling direct transactions between verified users within the network. Users can access the entire transaction history, retain copies of documents, and evaluate transactions with the same power.

Security

Blockchain consensus mechanism ensures data security in agriculture's food supply chain management, reducing hacking risks and disruptions due to decentralization and a single point of failure.

Immutability

Blockchain features' immutability ensures authentic records, eliminating human intervention, proving accountabilities, and eliminating intermediaries for organic, halal, and fair products, boosting customer confidence.

Smart contract

Blockchain features' immutability ensures authentic records, eliminating human intervention, proving accountabilities, and eliminating intermediaries for organic, halal, and fair products, boosting customer confidence.

Traceability

Traceability is the use of recorded identities to map an entity's location and history. Food traceability involves capturing, storing, and transmitting information about food at every supply chain level for safety and quality inspection. Accurate records enhance traceability, speed up recalls, and help businesses make better decisions. Traceability encourages sustainability, builds trust, and motivates vendors to deliver high-quality goods. Conventional traceability solutions rely on inefficient, time-consuming methods, while DNA-based methods, barcodes, smart tags, RFID, and WSN can increase efficiency but may be costly.

Blockchain technology presents itself as the ideal means of achieving effective traceability. Tian (2016) proposed a conceptual framework combining blockchain with IoT and listed its benefits, which include efficiency & transparency[14].

SYSTEM ARCHITECTURE & WORKING

Product owner (Farmer) stores complete details about the product on blockchain-Using the blockchain network's mobile app or central site, a farmer can store all the information about cultivated crops, including their origin, type, sowing method, storage details, and more.

- Information that farmers store may be available to all parties connected in the blockchain system network.
- Farmers can also upload photos of their food crops, which are then processed by companies or refineries using AI and machine learning algorithms to determine the crop's quality.
- While storing the data on the blockchain network, the rules integrated into the chaincode guarantee compliance.

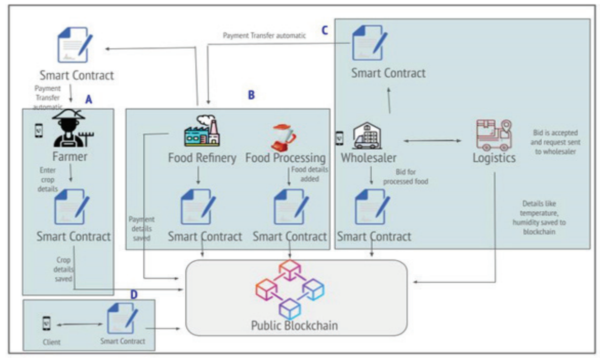

Fig. 2. System Architecture

Processing done by food processing companies

- After receiving food crops from the farmers, refineries or food processing companies can bid for the crops through chaincode.
- When a bid is accepted, they could start processing & save the details related to the refining of crops on the blockchain system.

Wholesalers bid on processed products with smart contracts

- Refining or food processing enterprises may put the processed items up for bid after processing the food products or merchandise.
- Wholesalers may begin using the chaincode to place bids.
- Food processing companies will provide processed food to wholesalers after their bid acceptance has been granted.
- Transporting the processed food product or item through IoT-enabled vehicles could help to keep the food items safe under the preferred temperature.

Consumers can verify quality with transparency

- The blockchain system allows for the digital linking of various details, including farm origin details, batch numbers, transportation details, manufacturing and processing data, storage temperature, expiration details, and other details, to food products or goods.
- Every network stakeholder will verify the detailed information that was saved throughout the transaction.

- After every block has been validated, it is appended to the transaction chain. A permanent, unchangeable record will be produced as a result.
- By going backward in the supply chain, the end user can guarantee food safety.
- There can never be a compromise in the quality of food products or items when various stakeholders have access to all relevant information at any point in time.

Tracing Product Algorithm

Input

Producer: P

Product Name: α

Id:i

Price: ε

Quantity: Δ

Output: Product distribution starting

Algorithm:

```
function initDistri(P, α, i,  ε, Δ):
setInitiationDate(currentTimestamp())
setName(α)
setID(i)
setPrice(ε)
setQuantity(Δ)
        emit
DistributionInitiate(Producer)
```

Violation Algorithm

Input

violationType: μ

Category: κ

Output: Emitting Violation Condition

Algorithm

```
function emitViolation(μ, κ):
      if μ == "Temperature":
            if κ == 1:
               setTempCondition("Over")
               Set μ="Temperature"
                    emit TemperatureViolation("over the threshold")
            else if κ == 0:
                    setTempCondition("Under")
                    Set μ="Temperature"
                    emit TemperatureViolation("under the threshold")
            else if κ == 2:
               setTempCondition("Optimum")
               Set  μ="Non"
               emit TemperatureViolation("optimum")
            else:
               // Do Nothing
         else:
            // Do Nothing
```

Same conditions are considered for humidity and light exposure.

CONCLUSION

As today's need for security and traceability in supply chain management the system is implemented with blockchain technology. Decentralized blockchain is implemented which leads to transparency in the system leading to improving quality of product. As transparency is maintained by blockchain, the product owner or farmers get fair prices for the product. Using blockchain also enables traceability, throughout the chain from farmer to consumer the system keeps track of product. Use of blockchain enables traceability of the asset. From the farmer to the buyer , throughout the availability chain, the system will keep the track of the asset. While initiating distribution of product by product owner or farmer the system stores time stamp, product name, id, price and quantity on a block.

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Approach for Car Variety Plate Reputation for Automated Toll Tax Collection

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ABSTRACT

The utilization of computerized wide variety plate recognition with OpenCV technology is a form of photo processing. Its primary objective is to create an efficient system for automatically identifying legal number plates. This system is specifically designed for the entrance of the University Campus to enhance security measures. Through advanced methods, the system can accurately capture the image of a moving vehicle and extract its number plate information. Image and video segmentation techniques are utilized to isolate the number plate area in the image. The system then employs an optical character recognition method to recognize the characters on the number plate. This data is stored in a database along with other relevant information such as the time, frequency, and toll amount. The implementation of technologies such as CNN, Tensor flow, and Image AI has allowed for the successful simulation and performance testing of the system on real images and videos. Additionally, the system also records and stores vehicle information such as passing time, date, and toll amount in the database for record-keeping purposes. A functional prototype of the system has been developed and tested, utilizing both hardware and software components. The results of the test demonstrate the system's capability to accurately detect and recognize number plates in real images and videos.

KEYWORDS: *ANPR, person Segmentation, Convolutional Neural Networks, side Detection, registration code Extraction, Morphology, OCR.*

INTRODUCTION

The proposed Gadget is a smart toll collection system that aims to eliminate the lengthy queues of automobiles at toll booths. It utilizes IoT and deep learning techniques for automated vehicle identification and toll tax collection. Each vehicle owner is provided with an E-wallet, which can be topped up from any bank account. Whenever a transaction is made, the system automatically deducts the tax amount from the available wallet balance. In case the owner fails to pay the deducted amount within the given time, a penalty will be imposed.

The system comprises a plate detection stage, which is responsible for predicting the presence and position of plates in a given image. The image is normalized based on predetermined values to ensure accurate detection. Optical character recognition (OCR) technology is used to recognize and convert machine-printed or handwritten text in scanned documents and images into editable form. This system primarily focuses on detecting and storing the number plates of various vehicles in a database.

The project was developed to address the difficulties faced by the security staff in recording the number of vehicles entering the campus. In some instances, the staff may fail to record the information due to poor vision, lighting conditions, or difficulty in interpretation. This may not seem like a major issue, but in high-security areas where there is a need for strict scrutiny, such failures can lead to serious security breaches.

Image pre-processing plays a crucial role in the effectiveness of any image analysis system. Without proper pre-processing, the accuracy of the recognition process can be compromised. Therefore, the proposed system ensures that proper pre-processing techniques are employed to improve the accuracy of number plate detection.

LITERATURE REVIEW

According to Soomro, Shoaib Rehman et al [1], their aim was to create a green system for vehicle number plate recognition and automated toll tax collection. The system first detects the vehicle and captures a front view image. The number plate is then localized and the characters are segmented. It is designed to work with grayscale images, allowing it to detect number plates regardless of their color. Many scientific organizations became interested in this technology after the development of digital cameras and faster processing speeds in the 1990s. Vehicle number plate recognition (VNR) is an image processing technology that extracts license plate numbers from digital images. The template matching approach is used for recognition. The resulting number is compared with a database of all registered vehicles to determine the vehicle type and toll tax to be charged. The system then opens road barriers and generates toll tax receipts. The vehicle's information, including passing time, date, and toll amount, is stored in a database for record-keeping.

In their research, Saiyadi, Parviz et.al [2] aimed to implement an algorithm using the Sobel Operator to detect vertical edges in the vehicle plate image and extract the plate by comparing histograms and using morphological operators. They also designed and implemented a system to accurately locate and classify the numbers and letters on the plate. Time analysis is crucial in plate recognition systems and is based on various techniques, making it highly relevant in practical applications. The authors attempted to use a combination of edge detection methods, histogram analysis, and morphological operators to improve the accuracy of their system. The operation was completed quickly with minimal processing time. [3] A simple and efficient method based on morphological operations and Sobel edge detection is used for segmentation of letters and numbers on the number plate. After reducing noise from the input image, histogram equalization is applied to improve contrast in the binarized image. The focus is on two steps: locating the number plate and segmenting the numbers and letters. Number plate recognition systems have various modern applications, such as visitor management, stolen car tracing, automatic digital toll collection systems, and more. [4] The LPR method consists of two main modules: one for locating the license plate and one for classifying the license number. The former uses fuzzy techniques to extract license plates from an input image, while the latter uses neural networks to identify the numbers on the plate. Soft computing techniques are used to compensate for uncertainties caused by noise, measurement errors, and imperfect processing. While the algorithm in this study is designed for one specific country, it can easily be extended to work with number plates from other countries. According to [5], a novel approach for number plate identification is proposed, which involves a series of image manipulations. Four algorithms are used for plate detection. Traditional image processing techniques are also applied for plate localization. To successfully extract information from license plates, a combination of techniques such as image enhancement, unsharp masking, edge detection, filtering, and analysis of current components are utilized. The system takes in a digital image, captured by high-speed rotor or digital cameras, and converts it to grayscale using the NTSC standard. In [6], the ALPR utilizes either color, black and white, or infrared cameras to capture images. The quality of these images plays a crucial role in the overall success of the ALPR. As a real-world application, the ALPR must efficiently and accurately process license plates under various environmental conditions, including indoor and outdoor settings, day or night. It also needs to be adaptable to handle plates from different countries, provinces, or states, which may have different colors, languages, and fonts. Additionally, some plates may have a solid color background, while others may have background images. These plates can also be partially obscured by dirt, lighting, or towing accessories on the vehicle. In this paper, we provide a comprehensive overview of various techniques used in ALPR.

RESEARCH METHODOLOGY

The main component of the database system is the essential database, which contains information on all registered vehicles and their owners. Whenever a registered vehicle goes through a toll plaza, the toll amount is automatically deducted from the user's linked wallet and the database is immediately updated with this information. The system also sends an SMS notification to the user to keep them informed.

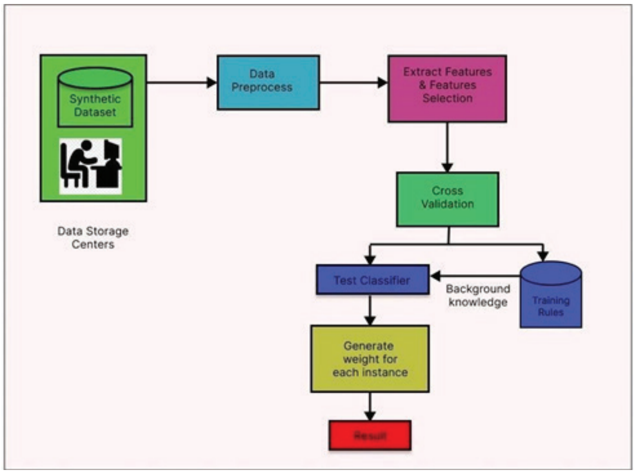

Fig. 1. System Architecture of Proposed System

IMPLEMENTATION PROCESS

- In the base device, a simple approach is supplied for a computerized wide variety Plate Recognition (ANPR) device, which can be used in many applications for the automatic recognition of automobile quantity plates.
- A simple set of rules is designed which can help to understand a wide variety of plates of automobiles and the usage of pictures taken by using the camera.
- The five essential components of the variety plate algorithm, including image acquisition, pre-processing, part detection and segmentation, feature extraction, and use of appropriate ML algorithms, have contributed to its widespread usage.
- In order to implement an automated number plate recognition system for incoming vehicles at toll plazas, a device using IoT and Deep Learning (DL) techniques will be established.
- Initially, the device utilizes a pair of digital cameras (one on the left and one on the right) in a designated area to capture continuous video footage of outbound vehicles.
- Exceptional photo frames are created from the steaming data and then transmitted to CNN.
- The master cloud database is used by CNN to identify and retrieve vehicle type information from images that contain diversity.
- Based on the type of vehicle, it produces an automated tax invoice for the specific car and transmits it to the transaction web server.
- Server robotically triggers the technique and deducts balance from pockets.

ALGORITHM DETAILS

Input: TestDBLits[] test file containing many tests, showing data generated by the TrainDBLits[] training phase, starting from Th.

Description: Whenever the weight of the HashMap violates the threshold value.

Step 1: Use the following equation for each reading and each test.

Step 2: Remove all features as electronic or neuron components using the equation below. Extracted_FeatureSetx[t…….n]= (m) Extracted_FeatureSetx[t] carries the function vectors of the corresponding domains.

Step 3: The following equation is used for each study. Extracted_FeatureSetx[t……n] = (m) Extracted_FeatureSetx[t] carries feature vectors of names.

Step 5: Now map out all the assessments identified for each training session.

Step 6: go back

RESULTS AND DISCUSSION

The artwork produced using this machine can only be evaluated by comparing it to systems designed to solve a shared issue for the end user.

Table 1. A thorough examination of all current systems and proposed systems in the available literature.

Method	Total Samples	Predicted Samples	Accuracy
Automatic License License Agreement Use Extraction Function [16]	500	424	84.8%

Automated car range Plate popularity the use of established factors[17]	150	138	92%
Automobile number Plate popularity machine: A Literature overview and Implementation of the use of Template Matching [18]	Unknown	Unknown	80.8%
Computerized range Plate popularity by using the use of Matlab [19]	20	18	90.00%
Proposed	105	102	99%

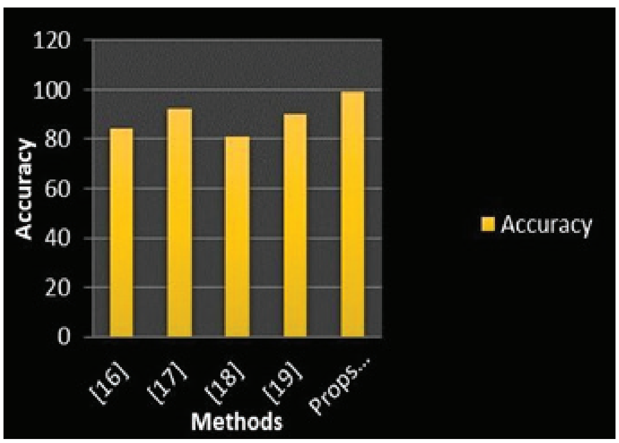

Fig. 2. Accuracy of the proposed system

CONCLUSION

This image describes an automatic reputation recording tool built entirely on CNN's learning about synthetic images. Define and modify a CNN model to solve additional problems related to plate and behavior analysis. These networks are trained on fake data to prevent global snapshot disclosures from being hit hard. We compared our tool to a real image dataset by considering the pattern of commercial images in a small medicinal plant dataset. Our predicted effects for tests display that it's far possible to gain precision and not forget performances over precision even as training the system over completely artificial pix. computerized license plate reputation is a huge discipline that can be carried out with the use of many distinctive algorithms and strategies. each approach has its very own advantages and drawbacks. Our preprocessing steps include RGB to grayscale conversion, noise removal, and image binarization. The domain name is extracted using Sobel's edge detection algorithm. People are grouped using horizontal scans and used as input for the CNN so you can identify the correct men or women. Training our body with the help of artificial equipment makes our body safer and more efficient at understanding good signals. automated toll collection device is person pleasant.

- It could reduce traffic congestion at toll plazas which leads to avoiding gasoline loss.
- It may remove all risks of contemporary guide toll series machines like time and human efforts.
- It does now not require any tag handiest required best first-class digicam.

FUTURE WORK

In our gadget, the toll charge is carried out mechanically method the toll amount is deducted from the person's pockets. The equal idea can be used to enhance vehicle parking and safety machines. From the future perspective, police need to join this tool to eliminate various penalties like challan, drunk driving, not wearing helmet, not wearing seat, speeding and other penalties.

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LibChain – Library Management System using Blockchain

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ABSTRACT

Blockchain technology is widely used in various industries, including finance, healthcare, and supply chain management, due to its ability to securely verify and store transaction records in a decentralized and time-stamped manner. In this article, focus on user-to-user communication using blockchain. This article also introduce a new library management system using blockchain, called libchain, which is designed to be more user-friendly, time-saving, and secure. One of the most promising use cases of blockchain in libraries is user-to-user communication and to create a secure and decentralized communication channel between users, eliminating the need for intermediaries. Libchain uses smart contracts to automate the lending and borrowing of books, reducing human interaction and making the process more efficient.

KEYWORDS: *Blockchain technology, Decentralize, Smart contracts, Time-stamp, LibChain, Secure, User-friendly, Time-saving.*

INTRODUCTION

The library management system is an integral part of every educational institution, and traditional library management systems have several limitations, including security issues, centralized control, and lack of transparency. This article provides insight into how blockchain technology works and examines its innovative current and future uses in various branches of libraries.

By implementing blockchain technology, libraries can overcome these limitations and provide a more efficient and reliable system for managing their resources. Blockchain-based library management systems offer features such as decentralized control, immutability, transparency, and enhanced security. Each block in the chain contains a unique cryptographic hash that links it to the previous block, forming an immutable record of all transactions that have taken place on the network. This innovative approach provides a way to create a tamper-proof record of every transaction in the library, making it easier to track the movement of books, documents, and other resources [1].

This system can also help to streamline the borrowing and returning of books and other resources, allowing patrons to access these materials more easily. Additionally, blockchain technology can facilitate the tracking of overdue books and fines, making the management of these processes more efficient.

MOTIVATION

The motivation behind a blockchain-based library management system is to provide a more secure, transparent, and efficient way to manage library resources. Traditional library management systems are often centralized, with a single authority controlling access to the system and maintaining the database of all transactions. This can lead to issues such as data manipulation, system downtime, and security breaches. By utilizing blockchain technology, a decentralized system can be created where multiple parties participate in the network and maintain a shared ledger of all transactions. This provides a higher degree of security and transparency, as all transactions are recorded on an immutable ledger that is resistant to tampering or manipulation. Additionally, the use of smart contracts can automate many aspects of library management, such as book borrowing and returning, reducing the workload on librarians and increasing efficiency. A blockchain-based library management system has the potential to revolutionize the way libraries are managed and provide a more secure, transparent, and efficient system for library users and administrators alike.

RELATED WORK

Traditional library management system

A traditional library management system (LMS) is a software application designed to automate the day-to-day operations of a library. The main objective of a library management system is to manage the library's resources efficiently, including books, journals, multimedia items, and other materials. Traditional library management systems usually run on a local server and require on - premise hardware and software installation. However, with the rise of cloud-based solutions, many libraries are now transitioning to web-based LMS, which offer greater flexibility, accessibility, and cost-effectiveness[2].

Benefits

1) Efficient management of library resources, including books, general and multimedia items.
2) Automation of issuing and returning of materials, introducing manual workloads for librarians.
3) Accurate inventory control through cataloging making it easier to locate material and track their uses.

Disadvantage

1) Traditional LMSs are only accessible within the library premises.
2) The traditional LMSs require significant upfront investment of installation and staff training.

Centralized library management system

A centralized library management system is a software application that enables the management of multiple libraries from a central location. The system is designed to manage the operations of libraries that are part of a larger organization, such as a university system or a consortium of libraries[3].

Benefits

1) Improved resource sharing among libraries.
2) Consistent policies and procedures across all locations.
3) Greater scalability to accommodate new libraries.

Disadvantages

1) High initial cost for implementation.
2) Complex implementation process.
3) Dependence on central system for library management.

Decentralized library management system

Decentralized library management system (DLM) allows multiple libraries to manage their collections independently while sharing certain resources and services. Each library maintains its own catalog and services, while also sharing resources such as interlibrary loan and electronic resources. This system can take many forms and is particularly useful for smaller libraries. Examples of DLMs include the Orbis Cascade Alliance, the Council of Atlantic University Libraries, and the Virtual Library of Virginia. These consortia offer shared services while maintaining local control for each library[4].

Benefits

1) Local control over collections and services.
2) Resource sharing for wider access to materials.
3) Collaboration for greater efficiencies and cost savings.
4) Cost-effective approach through resource sharing and efficiency gains.

Disadvantages

1) Decentralized library management systems can be complex to manage, especially in larger consortia or networks.
2) Integration issues can arise when multiple libraries use different systems and processes, which can lead to challenges in sharing resources and services.

Decentralized LMS using Blockchain

This specifically focuses on the potential application of blockchain technology in decentralized library management systems, discussing the benefits and challenges of using this technology in this context. It also delves into the potential of blockchain for creating a decentralized lending platform and cataloging system, which were not discussed in the previous paragraphs. Additionally, it highlights the importance of data privacy and security concerns when implementing a blockchain-based library management system[5].

Benefits

1) Blockchain technology in decentralized library management provides high security.
2) Libraries can maintain local control while sharing resources through decentralization.
3) Decentralization with blockchain can improve efficiency and reduce costs.

Disadvantages

1) Technical expertise needed
2) Data privacy and security concerns
3) Interoperability challenges

Adoption challenges

Peer to peer Decentralized Library Management System

Decentralized library management systems using blockchain can provide secure and efficient management of collections and services. Smart contracts could automate lending and decentralized cataloging can increase access to resources. Transparency and cost reduction are benefits, but technical expertise and data privacy are challenges. Careful consideration is necessary before implementation in a library setting[6].

Benefits

1) Decentralization allows local control and resource sharing.
2) Reduces costs and automates processes.
3) Provides a tamper-proof and verifiable record of all transactions.
4) Enables sharing of data and resources between different library management systems.

Disadvantage

1) Technical expertise and infrastructure
2) Data privacy and security
3) Interoperability challenges
4) Adoption challenges.

PROPOSED SYSTEM

The proposed system is a library management system that uses blockchain technology for secure and reliable access and book information storage, enabling users to search for and borrow books shown in figure 1. User to user transfer module uses secure and reliable user communication to facilitate book exchanges between library users, with each exchange transaction recorded on the blockchain network.

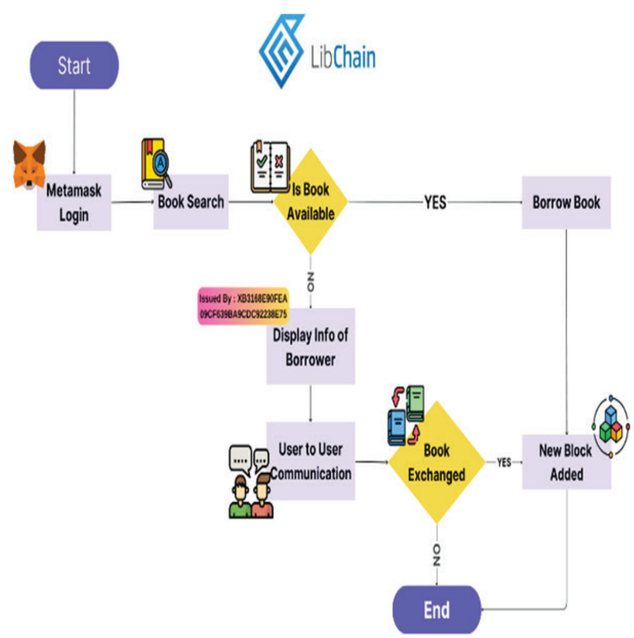

Fig. 1. Proposed System Architecture of LibChain

IMPLEMENTATION AND DISCUSSION

Metamask Login

The program requires the user to have a Metamask Wallet account by which users can use the LibChaindecentralised system. This account is used to access all the modules. LibChain uses Metamask wallet login for secure authentication and authorization. Users and administrators must have a Metamask wallet installed on their device to access the system. This provides a high level of security by requiring authentication using private keys stored on their device. It also eliminates the need for a centralized authentication service vulnerable to hacking. Metamask wallet login offers a seamless and user-friendly experience as users and administrators can authenticate using a familiar tool. This ensures a smooth and secure user experience for the library management system.

Add Books

The user inputs the book name and author name, and after the necessary processing, the book is added to the network. The book add module is designed to allow the system administrator to add book information, including the book name and author, to the blockchain network. The module is built on top of the Ethereum blockchain using the Polygon test network, which offers fast and low-cost transactions. When the administrator adds a new book to the system, a smart contract is triggered, which creates a new block on the blockchain network. The block contains the book information, along with a unique identifier that can be used to retrieve the book information from the blockchain.

The book add module is implemented using Solidity, a programming language that is used to write smart contracts on the Ethereum blockchain[10]. The module is integrated into the library management system using ether.js, a JavaScript library that allows the system to interact with the blockchain network. When the administrator adds a new book to the system, the book information is sent to the smart contract using ether.js, which then creates a new block on the blockchain network. The book information is stored in the block as a transaction, which can be viewed by anyone on the network.

In the Polygon Test Network, the book add module was tested on the Polygon test network[11] on the Ethereum blockchain shown in figure 2. The system administrator added several books to the system, and the book information was successfully added to the blockchain network as a transaction.

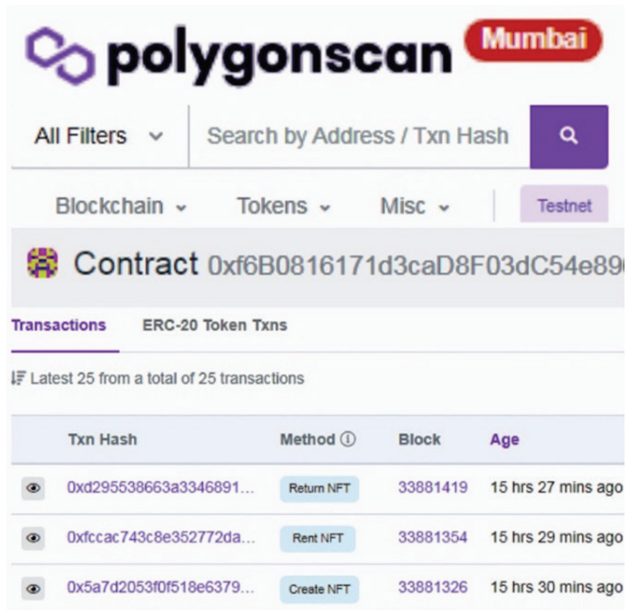

Fig. 2. Polygon test-network (Created Blocks)

The transactions were visible on the blockchain explorer, allowing anyone to view the book information. The book information was retrieved from the blockchain using the unique transaction identifier, and the information was found to be correct and unchanged.

View Book Details Module

The system takes a book ID as input and processes the information. Once completed, the relevant book details are displayed as output..The book display module is designed to display book information, including the book name, author, availability status, and issuer metamask address, on the user interface when the user inputs the book ID.

The user can take the book ID from the book list interface where users will be able to see all the books in the network.

The book display module was tested by users who input the book ID and verified that the book information was displayed correctly on the user interface. The transactions and book information were visible on the

Polygon test network, allowing anyone to view the book information. The book information was retrieved from the blockchain using the unique transaction identifier, and the information was found to be correct and unchanged.

Issue and Return Book

This program takes a book ID as input and displays the relevant book information after processing. The output includes essential details about the book. The admin enters the book ID and the user's Metamask address to issue a book to the user. The system checks if the book is available on the network, and if so, assigns it to the user. When the user returns the book, the admin enters the book ID to mark it as returned. The book is then available again for other users to borrow. To test this module, you can use the book detail module to view the current status of the book. If the book is available, the admin can issue it to a user. Then, you can check the book detail module again to confirm that the book is now assigned to the user. When the user returns the book, the admin can mark it as returned, and the book should become available again for other users to borrow. It's important to note that this system relies on the availability of the book on the network. If the book is not available, the system will not be able to assign it to the user. Additionally, Blockchain technology can provide benefits such as increased transparency, security, and immutability of data. By using a blockchain-based system, it may be possible to create a more secure and efficient system for managing book borrowing and returns.

User to User Book Transfer Module

To transfer a book to a user, provide the book ID and the user's Metamask address as input. Once the process is complete, the book will be successfully transferred to the user. The user-to-user book transfer module is a key feature of the system, enabling users to transfer books directly to each other. To transfer a book, a user enters the recipient's Metamask address and the book ID. The system then uses smart contract logic to verify the availability of the book and transfer ownership to the recipient. The transfer is recorded on the blockchain network, providing a transparent and immutable record of the transaction.

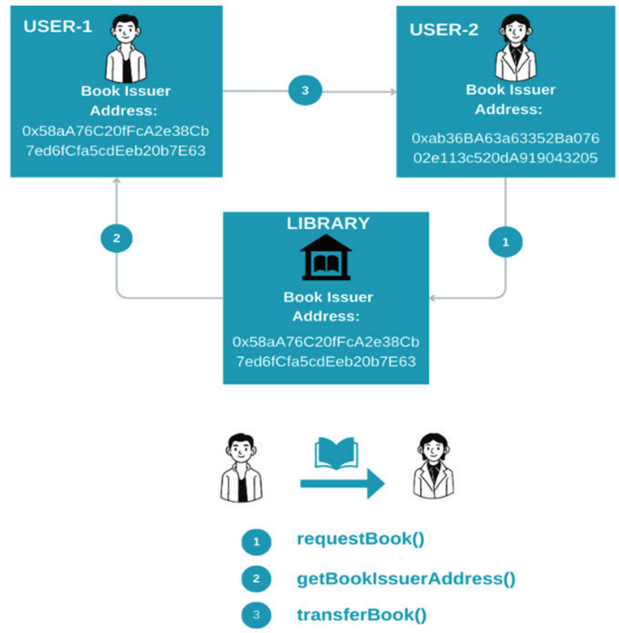

Fig. 3. User-to-user book transfer architecture

The blockchain-based library management system with user-to-user book transfer module demonstrates the potential of blockchain technology for creating more efficient and secure library management systems shown in figure 3. The user-to-user book transfer module provides a convenient and decentralised way for users to transfer books to each other, reducing the reliance on centralised library management systems.

To test this module, you can use the book detail module to view the current status of the book. you can check the book detail module to confirm that the book is now assigned to the recipient.

CONCLUSION

The use of blockchain technology in the proposed library management system offers several benefits. Firstly, it provides a secure and transparent platform for managing library transactions, making it difficult for unauthorized users to manipulate data or gain access to the system. Additionally, the use of metamask for user login and Matic as a currency adds an extra layer of security to the system. Furthermore, the integration of Polygon scan network for creating new blocks about book information and user-to-user book transfers adds efficiency and ease to the system. The decentralization of the network ensures that users can make transactions without the need for intermediaries, which saves time and reduces transaction costs.

The use of smart contracts in our proposed blockchain-based library management system is a crucial component that enables the system to automate library transactions, improve efficiency,Smart contracts also eliminate the need for intermediaries. Finally, the proposed system's ability to be used in pandemic situations like Covid-19 provides a solution to the challenges faced by traditional library systems in times of social distancing and remote working.

FUTURE SCOPE

The current system has been developed for the college-level library, but the future scope involves expanding the system to connect all regional libraries together. This will allow for the sharing of resources and a more comprehensive view of available resources. The expansion will require the development of a network protocol and new smart contracts. Connecting regional libraries will lead to cost savings, increased resource access, and collaboration opportunities for innovations.

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Handwritten Mathematical Symbol Recognition using Convolutional Natural Networks

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ABSTRACT

Handwritten mathematical symbol recognition is crucial for digitizing handwritten notes and aiding visually impaired individuals. This paper proposes a recognition system combining pre-classification and elastic matching to enhance speed and accuracy. We introduce a pruning strategy based on character features to reduce computational complexity and analyze their impact. Experimental results demonstrate improved speed and accuracy without sacrificing performance.

KEYWORDS: *Handwritten mathematical symbols identification, Pattern recognition, Convolutional neural networks.*

INTRODUCTION

The handwriting used in mathematics differs greatly from other handwriting styles. Initially, the range of potential inputs The vast symbolography originates from multiple alphabets and sources. About 2000 symbols would need to be distinguished for the document to be a complete recognizer for all math. Several of these symbols are remarkably similar, and they usually consist of numerous strokes arranged in an arbitrary order, unlike Asian languages which have large symbol sets. Second, intricate Two-dimensional rules that are context-sensitive can be used to take advantage of the spatial relationship between symbols. Third, large operators, like square roots, fractions, and matrix brackets, may be written in mathematical handwriting. Mathematical handwriting resembles a blend of writing and painting due to its arrangement and grouping. Naturally, extraction of features is crucial for handwriting recognition [2], and the majority of acknowledgers currently in use.

For people to solve the data entry problem great effort to develop many methods based on keyboards. But, because keyboard input disrupts one's stream of thought, one would prefer to utilize pens and paper rather than a keyboard when concentrating while typing. As a result, an increasing number of people are investigating pen input techniques. Systems have been created and numerous study reports have been published in the past ten years.

RELATED WORKS

A large public file of handwritten data was missing formulas and this made it difficult to compare some of these methods.

In this piece of work we present extensive experimentation using the latest CROHME dataset competition [4] to deliver equivalent outcomes. since the development of recurrent neural networks (RNNs), [1] demonstrated to perform better in this job than Hidden Markov Models (HMM), we employed them as our classifier.[9] We provide the results of our trials with offline functionality, online features, and their combinations. The findings show the superiority of offline features over internet features. and that using them together greatly raises the recognition rate. In light of the recognizing challenges and the necessity of mathematics in today's technology, a system with enhanced handwritten text recognition algorithm mathematical equations must be introduced.

It could aid in the visually challenged man's ability to read mathematical notation and allow for the efficient digitization of handwritten math documents. The identification of handwritten mathematical symbols, numbers, and equations has been the focus of decades of study. but there are still numerous obstacles to overcome in this field of study. Processing comes in two types: online and offline. A mathematical equation is processed once it is formed in online processing, and it is processed again after it is created in offline recognition math.

In fact, mathematical equations must be transformed to digital format for documentation in all sectors of engineering and technology. A mathematical expression is composed of different symbols and integers, and letters, each of which has a distinct meaning. Certain types of unique properties must be extracted from complex equations. Specific functions in the proposed system, such as variance, mean, skew, and standard deviation, must be taken into consideration. Common types in the existing system functions, Several factors were taken into account, including the centroid, area, thickness, thinness, number of items counted, line width, and ratio of height to width. Edge detection in segmentation, followed by morphological surgery, is being explored.

The Handwritten mathematical symbol recognition there are some common techniques are used,

1. CNNs, or convolutional neural networks
2. SVMs, or support vector machines
3. Markov Hidden Models (HMMs)
4. Neural Networks with Recurrence
5. Memory for Long Short Term (LSTM)
6. Forests Random Networks
7. The K-Nearest Neighbours (KNN)
8. decision tree
9. GBMs, or gradient boosting machines
10. Analysis of Principal Components (PCA)

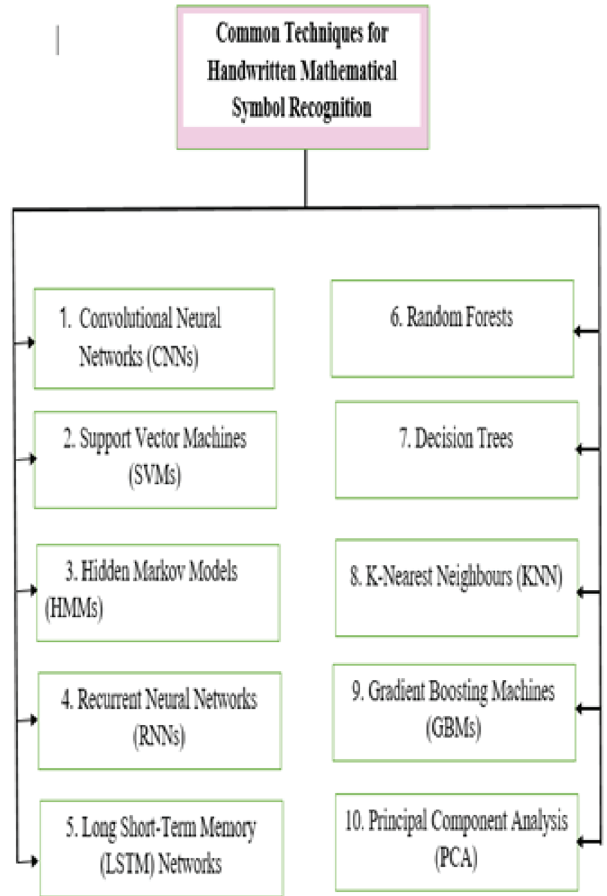

Fig. 1. Techniques for Handwritten mathematical symbol recognition

ACCEPTANCE OF HANDWRITTEN MATHEMATICAL SYMBOLS

The following fundamental concept has greatly aided us in handwritten mathematical symbol recognition: symbol most likely belongs to either symbols that most closely resemble him or members of the same class as the family. Thus, the idea of closeness or degree of membership needs to be modeled. We considered extracting endpoints for each mathematical symbol from the skeleton in order to accomplish this. We can reduce the number of symbols that can be identified by classifying them based on how many endpoints are extracted from each skeleton by using this strategic decision, which yields Zero Endpoint, One Endpoint, Two Endpoint, Three Endpoint, Four Endpoint, Five Endpoint, Six Endpoint, and Eight Endpoint are the eight classes. of course, The overall number of intriguing symbols is much greater than the number of symbols in each class combined. Given that identification rates differ based on the descriptors and recognizers we display in the upcoming section, this technique made it easy to recognize the symbols, saving vital time while we carried out our program. In order to carry out this plan, we pre-processed our photos using a variety of methods, including transformation, normalization, filtering, and thinning, to make it easier to extract their endpoints.

Recognition of handwritten mathematical symbols have focused on various approaches to address the challenges associated with this task.

1. Template Matching Techniques: Early works utilized template matching techniques where handwritten symbols are compared against predefined templates. These methods often suffer from limitations in handling variations in handwriting styles and symbol deformations.

2. Feature-Based Methods: Many researchers have explored feature-based methods, where handcrafted features such as curvature, stroke direction, and intersection points are extracted from the symbols and used for recognition. These methods often require extensive feature engineering and may struggle with complex symbols.

3. Machine Learning Approaches: With recent developments, machine learning methods like deep learning have been used to recognize handwritten symbols. In order to increase recognition accuracy, Neural networks using convolutional (CNNs) and recurrent (RNNs) architectures have shown encouraging results in learning discriminative features straight from raw input data.

4. Combination of Techniques: Some studies have proposed hybrid approaches that combine the strengths of different techniques. For example, a system may use a template matching approach for initial classification followed by a machine learning-based refinement step.

5. Evaluation Metrics: Additionally, research in this area has also focused on developing appropriate evaluation measures for evaluating how well recognition systems work. Measures like accuracy, precision, recall, and F1 score are frequently employed to assess how well recognition algorithms work.

SYSTEM ARCHITECTURE AND METHODOLOGY

Architecture of the Symbol Recognizer

The global architecture of a symbol recognizer typically involves several key components working together to recognize handwritten text accurately and quickly Below is a summary of the typical architecture:

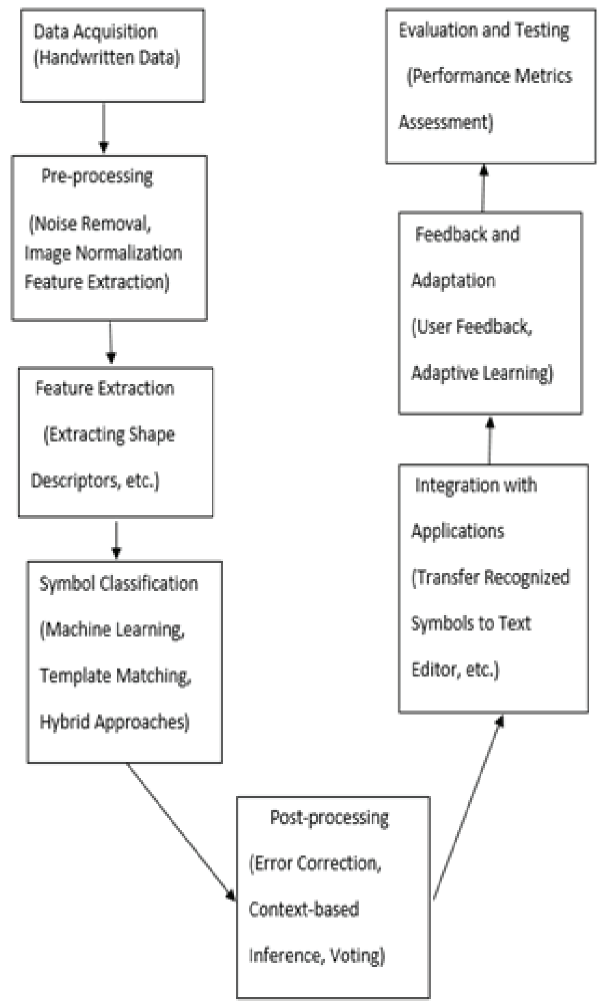

Fig. 2. Architecture of the Symbol Recognizer

1. Data Acquisition: The process starts with acquiring handwritten symbol data, which may include images or digitized samples of handwritten symbols. This data serves as the input to the recognition system.

We used a tablet PC to fill out a questionnaire in order to gather data. There were several formulas and 227 symbols in the questionnaire. Ten digits, Greek letters, capital and lowercase letters, mathematical operators, and various arrows were among the individual symbols. The information gathered for every symbol includes time stamps, pen pressure, pen up/down events, and x and y coordinates. The trace coordinates were likewise captured when the user lifted the pen, provided that it was still detectable. Whether the pen touched the writing surface or not, every movement was tracked as a "Stroke." Each pair of x, y coordinates has a pressure value that ranges from 0 to 255 in units that depend on the device. The start time is included in the time stamp.

2. Pre-processing: Before recognition, the acquired data often undergoes pre-processing steps to enhance quality and usability. Pre-processing techniques include image normalization, binarization, and noise reduction, and resizing to prepare the data for further processing.

A number of pre-processing procedures were carried out, such as size normalization, resampling, smoothing, and the selective cutting of the head and tail of strokes. The average of each of the three consecutive points is calculated during the smoothing process, and it is used in place of the midpoint. Errors are typically seen in the initial and last few points, and they typically have an impact on the recognition outcomes. Therefore, we cut off each stroke's head and tail. We compute the angles between the first five locations before slicing the head. In the event that the angles significantly alter (we found that an angle of 90 degrees works well), the appropriate points are chopped. The angles for slicing the tail follow the same guidelines. Re-sampling was utilized to decrease the quantity of data, and size normalization was carried out to eliminate the symbol.

3. Feature extraction: To obtain discriminative information for symbol recognition, pertinent features are retrieved from the pre-processed data at this stage. Features may include shape descriptors, curvature, stroke direction, intensity gradients, or other characteristics that can help distinguish between different symbols. Although many recognizers have acknowledged the value of feature extraction, choosing the most pertinent features is still mostly ad hoc, with researchers always searching for the best features. Angle and angle difference were employed by H. Winkler in HMM-based recognition [9]. In addition, he combined the real strokes with concealed stroke information. He used the information indicating whether the current point is part of an integrated hidden stroke or a stroke itself, excluding the angle feature.

4. Symbol Classification: The extracted features are fed into a classification algorithm or model that maps them to specific symbol classes. This classification step may involve various techniques such as template matching, machine learning methods (including SVM and neural networks),or hybrid approaches combining multiple methods.

5. Post-processing: After classification, The recognition results can be improved by using post-processing techniques. and improve accuracy. This may include rectification of errors, context-based inference, or voting schemes to handle ambiguous cases or correct misclassifications.

6. Integration with Applications: The recognized symbols are then integrated into the broader context of the application or system in which the recognizer operates. This could involve transferring the recognized symbols to a text editor, mathematical expression interpreter, or any other software component that utilizes the recognized symbols for further processing or display.

7. Feedback and Adaptation: In some cases, the recognition system may incorporate mechanisms for user feedback or adaptive learning. This allows the system to improve over time by learning from user interactions and continuously updating its recognition models based on new data.

8. Evaluation and Testing: Finally, the performance of the symbol recognizer is evaluated through rigorous testing using benchmark datasets or real-world scenarios. Performance measures including recall, accuracy, precision, and processing speed are used to evaluate how well the recognition system works.

Convolutional Neural Networks (CNNs), a class of deep learning algorithm well-known for their performance in image identification tasks, are a key component of the suggested methodology. The steps in the methodology are as follows:

Compiling a dataset of handwritten mathematical symbols for assessment and training.

Preprocessing: The process of preparing a dataset for training by applying methods including augmentation, scaling, and normalization.

CNN Architecture: Creating a convolutional, pooling, and fully connected layer CNN architecture specifically for the job of handwritten symbol identification.

Training: Using the proper loss functions, optimization techniques, and hyper parameters, train the CNN model using the prepared dataset.

Evaluation: Assessing the correctness and performance of the trained model using a different validation dataset.

Segmentation: Generally, functional and structural analysis is applied. Edge detection has been used in segmentation, followed by morphological operations. Component separation, thickness, thinness, and bounding box as a graphical function have all been taken into consideration.

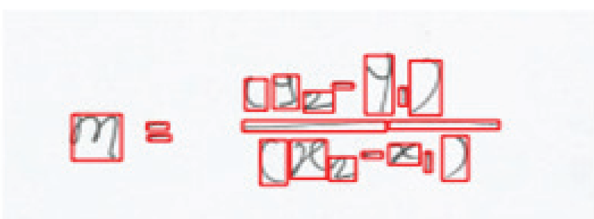

Fig. 3. Segmentation of slope of line

Fig. 4. Segmentation of Law of Gravity

The special math symbols ∞, ∫, and λ are accessible and effectively recognized in complex equations.

Figures 3 and 4, respectively, show how the law of gravity and the slope of the line are segmented. Figure 2 illustrates the neural network architecture, which consists of 10 nodes at the input layer, 2 hidden layers, and 1 output layer with 10 nodes. Figure 5 displays the neural network's best training performance, which is 0.99918 at epoch 219. Figure 5 displays the neural network's training state plot with gradient 0.13125 at epoch 219 and learning rate 6.5793 at epoch 219, and Figure 4 displays the training regression plot with R = 0.99918.

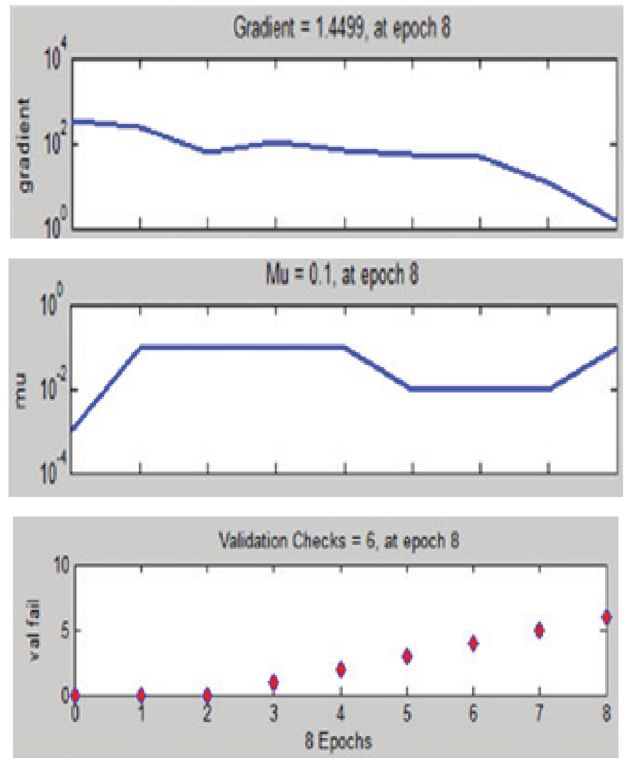

Fig. 5. Neural Network Training state

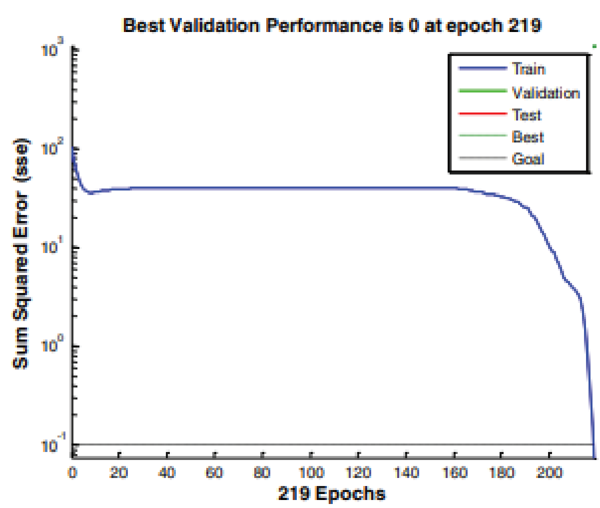

Fig. 6. Neural Network Training Performances

Convolutional Neural Networks (CNNs)

Handwritten Mathematical Symbol Recognition (HMSR) has been completely transformed by Convolutional Neural Networks (CNNs), which offer an efficient and potent way to automatically identify symbols from handwritten input. The following is a thorough explanation of how CNNs are used in HMSR:

Image Preparation

Digital tools such as scanners and cameras are used to take pictures of the handwritten symbols.Pre-processing methods can be used on the pictures to improve their quality and create a uniform file format. Resizing, normalization, noise reduction, and binarization are a few examples of these. Rotation, scaling, and translation are examples of data augmentation techniques that can be applied to improve the CNN model's resilience and diversity within the dataset.

Architecture Model

Convolutional, pooling, and fully linked layers are among the layers that make up a CNN. By applying filters, or kernels, to the input images, convolutional layers use convolution operations to extract local features. These filters record patterns at various spatial scales, such as corners, edges, and textures. In order to decrease the spatial dimensions and computational complexity of the feature maps derived from the convolutional layers, pooling layers down sample them. Max pooling and average pooling are two common pooling methods. High-level features that the convolutional layers taught them are integrated by fully connected layers, which then use these features to do categorization. These layers generate probability distributions across the classes using methods such as softmax activation.

Instruction

Handwritten symbol labeled datasets are used to train the CNN model. Every image in the dataset has a ground truth label that corresponds to the image's symbol. The model learns to reduce the discrepancy between predicted symbols and ground truth labels by optimizing its parameters (weights and biases) during training. Usually, gradient-based optimization methods like Adam or stochastic gradient descent (SGD) are used for this kind of optimization. The difference between the ground truth labels and the predicted symbol probabilities is measured by the training loss function. For multi-class classification tasks, categorical cross-entropy is a common loss function.

Assessment and Validation

A different validation dataset is used to evaluate the CNN model's performance once it has been trained. Evaluation criteria that quantify the model's performance in identifying handwritten symbols include accuracy, precision, recall, and F1-score. Confusion matrices and precision-recall curves are two tools that can be used to further examine the model's performance and identify its advantages and disadvantages.

Adjusting and Streamlining

To increase recognition accuracy even further, fine-tuning strategies like altering hyper parameters, changing the architecture, or utilizing transfer learning from pre-trained models may be used, depending on how well the original model performs.

Over fitting can be avoided and generalization to new data can be enhanced by using strategies like batch normalization and regularization (such as dropout).

Implementation

When the CNN model performs well enough, it can be used to recognize handwritten mathematical symbols in practical applications. This could entail incorporating the model into embedded systems, mobile apps, or software programs that need to recognize symbols.

CONCLUSIONS AND FUTURE WORK

Handwritten Mathematical Symbol Recognition using Convolutional Neural Networks is a promising area of research with significant potential applications. By leveraging CNNs and advanced techniques, we can achieve accurate and robust recognition of handwritten symbols, paving the way for enhanced digital education, document processing, and automated grading systems.

Although one of the modified versions of SSD showed a significant improvement in mean Average Precision (mAP) compared to the original, there is still ample room for further enhancement. Particularly, similar symbols continue to cause confusion, leading SSD to misclassify them. To address this issue, we aim to leverage additional data to improve classification accuracy. Additionally, while the recognition of small symbols has been achieved, our parser struggles to handle all cases. It performs well in generating LaTeX strings from Mathematical Expressions (MEs) with clear baselines and unambiguous symbols. However, we have yet to integrate semantic analysis into the structural analysis phase. For instance, when presented with an input image containing the equation: "x + y = z", SSD might recognize it as "x [y = z", resulting in our parser generating "x [y" as the output. Integrating semantic analysis into the system could help mitigate such issues. This aspect remains a focus of our future work.

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Disaster Management: Mobilizing Safety During Calamity

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ABSTRACT

Natural disasters are a big threat to people's lives, causing a lot of harm. One major problem in dealing with disasters is that there's often a communication issue between people stuck in dangerous situations and the teams trying to rescue them. This lack of communication makes it hard for rescuers to do their job quickly and effectively because they don't know how many people are trapped or where they are. On top of that, many people in disaster-prone areas don't know how to prepare for emergencies, making the impact of disasters even worse. To address these challenges, this paper describes a system, which includes all in one mobile application for diverse civilians which offers user-friendly interface, operability throughout India, anti-disaster literacy with multi-language feature for a broader audience, and track, store & keep appending their live locations in secure database after some interval of time. Additionally, a machine learning based system which will count trapped civilians' frequency and mark hotspot (disaster prone) regions using civilian's live locations & past stored locations. This project aims to rescue trapped civilians in disaster and also improve how communities get ready for and respond to disasters.

KEYWORDS: *GPS, Mobile application, Machine learning, K-Means algorithm, Disaster management.*

INTRODUCTION

Natural disasters, encompassing events such as floods, cyclones, earthquakes, landslides, and droughts, continue to pose significant threats to human lives and communities worldwide. When it comes to the number of fatalities caused by natural disasters in India, earthquakes rank first with 33%, followed by floods (32%), cyclones (32%), landslides (2%) and droughts (1%) [1]. These devastating occurrences not only claim lives but also leave a trail of destruction and disarray in their wake.

In India, where natural disasters are common, the problem is made worse because many people don't know much about how to deal with them. About 35% of the population in India doesn't have enough knowledge about natural disasters like preventions, precautions, how to seek help, whom to contact, and what immediate actions to take in the event of a natural disaster, etc. This makes the disasters even harder to handle because communities aren't ready to respond well.

Additionally, India's varied scenery brings in people from other countries as immigrants, tourists, and residents who might not know much about the specific dangers of natural disasters in the area. Because they aren't aware, they're not ready for these disasters. This shows why there's a need for a thorough plan for handling disasters that goes beyond just where you are and what language you speak.

One of the critical challenges faced during such disasters is the communication gap between individuals trapped in affected areas and the rescue teams tasked with their evacuation and assistance. Rescue teams sometimes don't have enough information regarding how many and at what regions the people are affected, which makes it harder for them to get ready and act fast. This communication breakdown can severely hamper rescue efforts, as the absence of real-time information on the number and locations of trapped individuals complicates the planning and execution of rescue operations.

To address these challenges and reduce the devastating impact of natural disasters, this paper introduces a practical and inclusive disaster management system. The proposed system includes a user-friendly mobile application designed for civilians, ensuring operability throughout India, anti-disaster literacy with multi-language support, real-time alert notifications, and the ability to track and store live locations securely or simply S.O.S feature [2]. Additionally, the integration of a machine learning-based system aims to provide real-time insights, counting the frequency of trapped civilians and identifying hotspot regions prone to disasters. This project strives to save human lives and enhance the resilience of communities in the face of natural calamities.

LITERATURE SURVEY

While surveying and researching the existing mobile applications, we came across the following applications that were similar to our device like the IOWA Legal Aid [3], FDAS-Disaster Management System [3], Relief Central [3], Family Disaster Manager [3] and Disaster Preparedness by OXFAM [3]. We found that some had very poor application interfaces, some were not reliable and most all of these applications are not operated centrally hence there are no multi-language feature, moreover the use of locations of trapped people to estimate exact frequency of people trapped in a calamity for better preparedness of rescue team. Owing to all situations, there are apps that can help in emergency situations, but there is still a need to design a model that is beneficial for rescue teams, multi-language support, central based, and has a better user interface.

During natural calamities, the use of an SOS [2] (emergency) system can be instrumental in saving lives and coordinating timely assistance. When disaster strikes, individuals may find themselves trapped or in urgent need of help due to injuries, structural damage, or dangerous conditions. In such situations, activating an SOS alert through a mobile application can rapidly notify nearby responders and authorities, enabling swift rescue operations. This real-time communication helps bridge the gap between those in distress and rescue teams, ensuring that resources are efficiently deployed to affected areas. The SOS feature provides a critical lifeline during emergencies, facilitating faster response times and potentially minimizing casualties by expediting the delivery of aid and support to those in need.

The K-Means clustering algorithm [4] is used for data clustering and analysis, offering significant utility across various domains. Its importance lies in its simplicity, efficiency, and effectiveness in partitioning data into distinct clusters based on similarity measures. One of the key advantages of K-Means is its computational efficiency, allowing it to handle large datasets with relative ease. Moreover, its unsupervised nature makes it versatile for a wide range of applications, where the underlying structure of the data is not explicitly known. In disaster management and response systems, K-Means plays a pivotal role in identifying hotspot locations and patterns of activity, aiding in the allocation of resources and formulation of response strategies. Furthermore, the interpretability of K-Means clusters facilitates the extraction of meaningful insights from data, enhancing decision-making processes. Despite its simplicity, K-Means remains a robust and widely used clustering algorithm, making it an indispensable tool in data analysis and pattern recognition tasks.

RELATED WORK

Use Case

The primary actors involved in the use case are trapped individuals and rescue teams. For trapped individuals, the application offers a lifeline during distressing situations. Upon registering within the app, individuals provide essential details such as their name, contact information, and current location. This registration process ensures that their information is securely stored and readily accessible to rescue teams. The application leverages GPS technology to continuously track and update the location of trapped individuals, creating a dynamic record that informs rescue operations.

Communication lies at the heart of the application's functionality. Trapped individuals can generate distress signals through the app's interface as shown in Figure "1". These real-time notifications enable rescue teams to promptly initiate response efforts with the trapped individuals to gather additional information. Civilians can retrieve region-specific disaster information, including preventive measures and precautions, thereby enhancing their safety and resilience.

For rescue teams, the application serves as a comprehensive platform for coordinating and executing rescue operations.

A notable feature of the application is its integration of machine learning model, which contribute to estimating the approximate number of trapped individuals along with displaying hotspot regions based on their GPS locations. This innovative approach augments the capabilities of rescue teams, offering a data-driven perspective that facilitates more informed and effective response strategies.

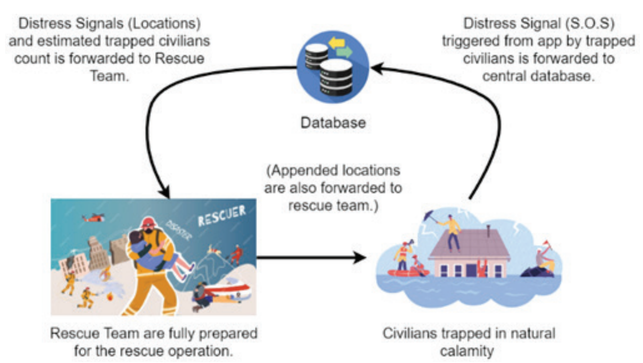

Fig. 1. Basic working of the idea

Proposed system includes

The flow of the described project involves a sequence of interconnected steps aimed at enhancing disaster preparedness and response through a mobile application with GPS tracking and machine learning support.

Real-time Location Tracking: Upon registration, users activate the GPS [5] location tracking feature in the app, which continuously monitors their location through GPS technology, providing real-time updates on their geographical coordinates.

Multi-Language Support: Utilizing multi-language capabilities, the app ensures the delivery of information in the user's chosen language, facilitating access to disaster-related content in a language that individuals find comfortable. This feature enhances accessibility for users from diverse linguistic backgrounds, promoting inclusivity and effective communication [6] during critical situations.

Machine Learning Model Integration: The application seamlessly incorporates a machine learning model that has undergone specialized training to provide estimates of the approximate number of individuals in distress, utilizing GPS location data. This model operates in real-time, continuously analyzing incoming location data and adjusting its estimations to align with the dynamically changing circumstances during a disaster.

Emergency Alerts and Notifications: The app proactively sends emergency alerts and notifications to users based on their real-time location and the detected type of disaster. These notifications may encompass evacuation alerts, safety instructions, and other crucial information designed to guide users through the emergency.

User Education and Preparedness: Serving as an educational platform, the app provides information about the specific disaster, its characteristics, and the most effective preventive measures and precautions.

Machine learning model

This project includes a machine learning model, based on their historical location data it provides analysis of hotspot locations and trapped civilians predicted count.

Identifying hotspot locations of civilians trapped in natural calamity.

The model employs the K-Means [4] clustering algorithm which is a popular unsupervised machine learning technique that partitions data into distinct clusters based on similarity measures. The primary objective of this model is to analyze the latest stored location data of users and identify regions that exhibit a concentration of individuals affected by a particular disaster, thereby pinpointing hotspot locations.

The foundation of this machine learning model lies in the extensive dataset comprising the historical stored locations of users collected at 15-minute intervals. Each data point within this dataset represents the location of an individual user at a specific timestamp. For our project, we made our own dataset for the machine learning model because we couldn't find one online.

The figure "2" below shows the dataset we're using in this project.

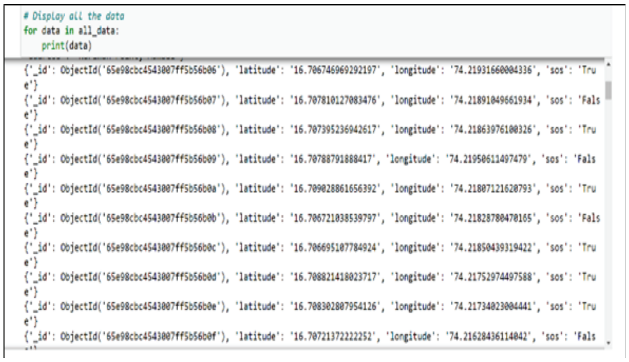

Fig. 2 Synthetic dataset of user's historical locations

In the context of the project, the algorithm [7] works by grouping together user locations that are close in proximity, thereby identifying regions with a higher density of trapped individuals.

Determining Optimal Clusters with the Elbow Method

To operationalize the insights derived from the Elbow method and enhance the performance of the K-Means algorithm [4], the identified optimal number of clusters [8] is set as a hyperparameter for the algorithm. By specifying this hyperparameter, the K-Means algorithm tailors its clustering process to align with the identified structure of the data, resulting in cluster centers that encapsulate the inherent patterns and distributions of the user location data related to natural calamities. In this mode, the number of clusters is set to 4 as shown in Figure "3".

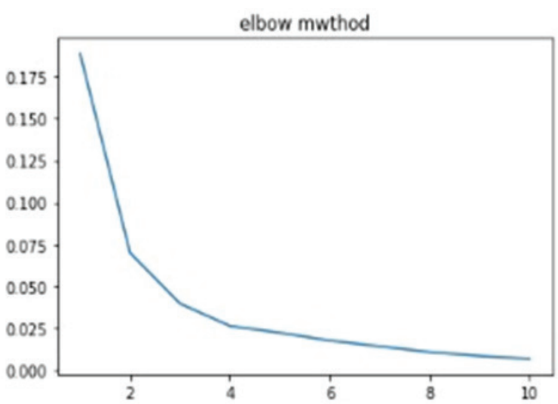

Fig. 3. Elbow method determining optimum number of clusters

Producing Cluster Centers

Upon setting the optimal number of clusters as a hyperparameter, the K-Means [9] algorithm proceeds to generate cluster centers representative of the identified hotspot locations. These cluster centers serve as focal points within the geographical landscape, encapsulating regions with a heightened concentration of affected individuals. By analyzing the proximity of user locations to these cluster centers, the algorithm facilitates the identification and visualization of areas most severely impacted by natural calamities, thereby guiding rescue and response efforts more effectively.

$$d = \sqrt{[(x2 - x1)^2 + (y2 - y1)^2]} \tag{1}$$

Euclidean distance formula to find distance between two points.

$$ci = \frac{1}{|S_i|} \cdot \sum_{x_i \in S_i} x_i \tag{2}$$

Formula to find new centroid from clustered group of points.

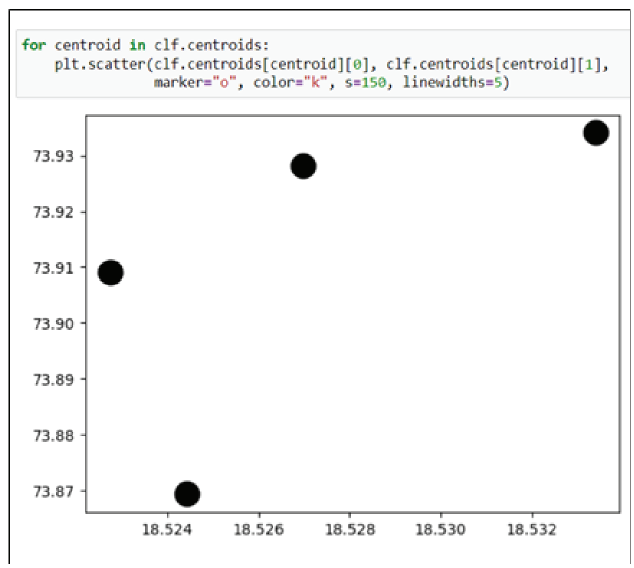

Fig. 4. Centroid points are plotted

The algorithm calculates the mean point (centroid) for each cluster as shown in Figure "4". These centroid coordinates represent the estimated hotspot locations.

Trapped Civilian Frequency model

This method is used to estimate the number of people trapped in specific areas during disasters. Users send their location data through the app, which we analyze and store over various time periods. By averaging the number of people seen in particular "hotspot" locations over time, we get a typical count of individuals expected there. When determining the final estimate, we compare this average count with the latest data point. If the current count is higher than the average, we display the current count; otherwise, we show the mean of both the average and current counts.

By considering the hotspot generated from the K-Means model, this model performs analysis over a certain time-frame to provide a generalized count of civilians visiting in that hotspot area. For instance, K-means model provides a hotspot location as Pune. Thereafter, this model analyzes historical civilian's location data which is stored in the database for different time-frames such as weekly. From this analysis the model will generate an estimated average count of civilians at that given hotspot location with respect to particular time frames. This will help to predict current civilian's count during calamity in those regions.

METHODOLOGY

The system architecture comprises two main entities, namely mobile application, and machine learning model. In which, mobile application is used by end users through which we can track user's live location using GPS [5]. This location is used to rescue trapped users in any calamity by the rescue team. Also, send preventions and precautions according to the user's location about calamities which are prone to occur in that region.

The mobile application tracks and appends the user's location in the database at the interval of every 15 minutes. One of the primary motivations behind this 15-minute interval tracking is to mitigate the impact of network outages, unexpected natural calamities, disruptions that may occur during a natural disaster or other emergency situations. In such critical scenarios, maintaining a continuous and accurate record of the user's location becomes paramount.

By capturing and storing location data at frequent intervals, the application ensures that even if a network outage occurs, the most recent location of the user is still accessible. This "last known location" data can be instrumental for rescue teams, providing them with crucial insights to initiate or adjust rescue operations, even in the absence of real-time connectivity.

By capturing the user's location every 15 minutes, the application aims to create a comprehensive and up-to-date record of the user's movements and whereabouts. This periodic tracking enables the application to provide timely and relevant information, such as real-time updates on the user's location during a natural disaster or calamity. It also facilitates the efficient coordination of rescue and response efforts, as rescue teams can access accurate and recent location data to guide their operations.

In mobile application, an S.O.S[2] button is provided through which the users can generate distress signals which will be stored in the database. These signals are forwarded to the rescue team along with location's that lie in that particular region by the admin to save the civilians from the disaster. Also, the trapped civilians count which is predicted by a machine learning model is also forwarded to the rescue team by central admin. All the user's general information like names and phone numbers are stored in the database.

Below is the explanation of the system architecture as shown in Figure "5":

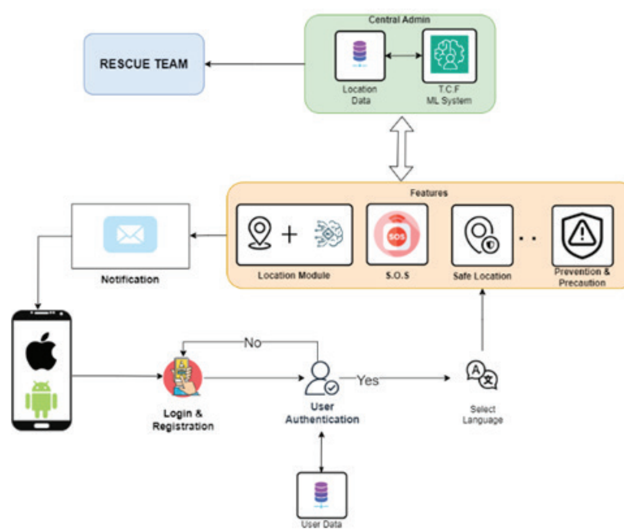

Fig. 5. System Architecture

Mobile App Frontend: The user interacts with the system through the mobile application. The app provides features such as real-time location tracking, disaster alerts, and preventative information. It's designed to be user-friendly and multilingual.

User Data: It includes location and general information about the user, which is collected and stored securely in the database.

Central Administration: This component is responsible for monitoring and coordinating disaster response efforts. It includes:

1. Machine learning model to predict the trapped civilians count using stored user's locations and display hotspot locations.
2. Analyzing incoming data to make informed decisions regarding resource allocation and response strategies.
3. Facilitating communication between the admin team and rescue teams.

Rescue Teams: These are the on-ground personnel responsible for rescue operations. They receive location data and instructions from the central administration and use it to perform rescue operations efficiently.

Language Support: Language support modules enable the app to present information in multiple regional languages based on user preferences.

Push Notifications: The app uses push notifications to alert users to disaster warnings, updates, and preventative information.

RESULT

The results of our project showcase a comprehensive journey through various stages of user interaction and system functionalities. Figure "6" depicts the seamless process of requesting location access, essential for the accurate functioning of the application. Upon successful login, users are greeted with Figure "7", the intuitive home page of the application, providing easy access to essential features. Additionally, Figures "8" highlight the provision of specific preventions and precautions for natural disasters in particular regions. Figure "9" and Figure "10" showcase the application's inclusivity by offering translations into Hindi and German languages, ensuring accessibility to a wider audience. As depicted in Figure "11", users can send an S.O.S signal. Furthermore, Figures "12" provide predicted count of trapped civilians in Pune, also Figure "13" and "14" provide critical insights into hotspot locations and live locations of trapped civilians in regions such as Pune and Kolhapur, aiding rescue teams in optimizing their response strategies effectively. These results collectively demonstrate the robustness and efficacy of our disaster response system in safeguarding lives during emergencies.

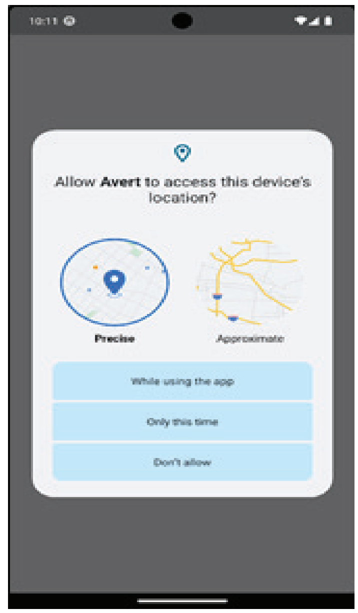

Fig. 6. Requesting location access

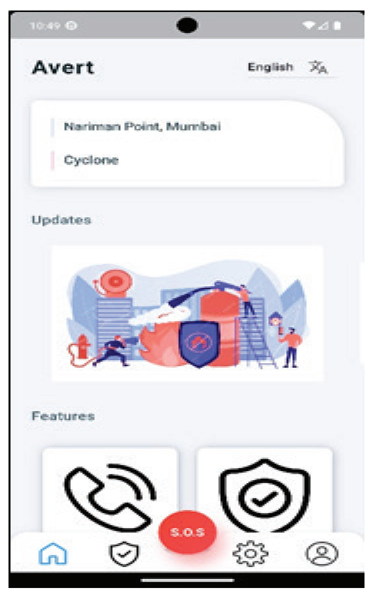

Fig. 7. Home Page

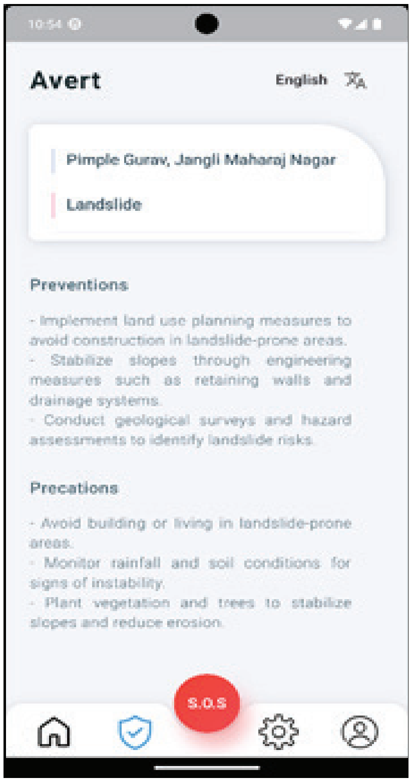

Fig. 8. Preventions & Precautions for Landslide in Pune

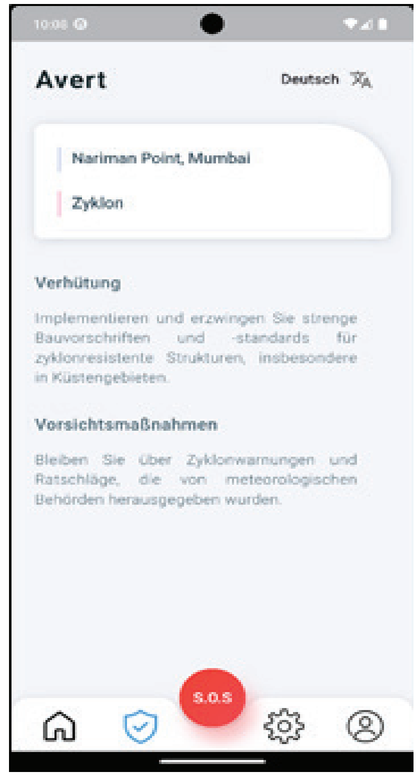

Fig. 10. Translated to German language

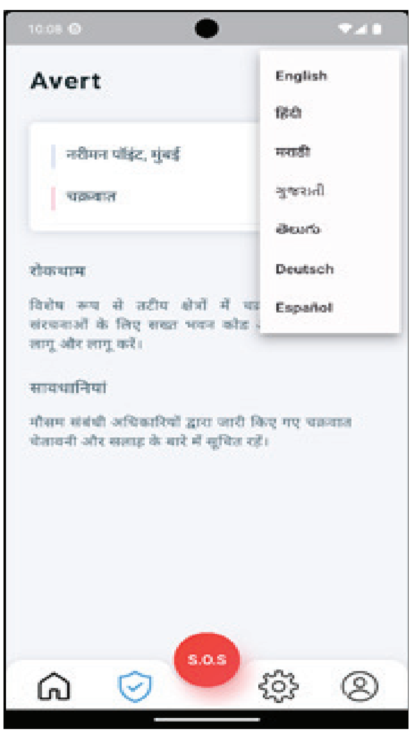

Fig. 9. Translated to Hindi language

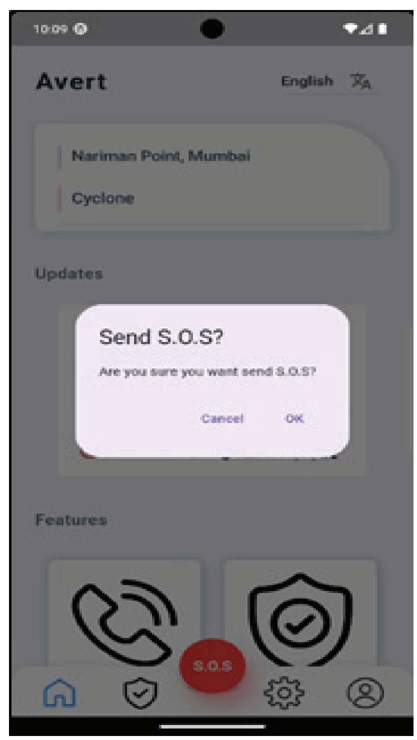

Fig. 11. Confirmation to send S.O.S signal

Fig. 12. Hotspot locations and predicted count of trapped civilians, Pune Region

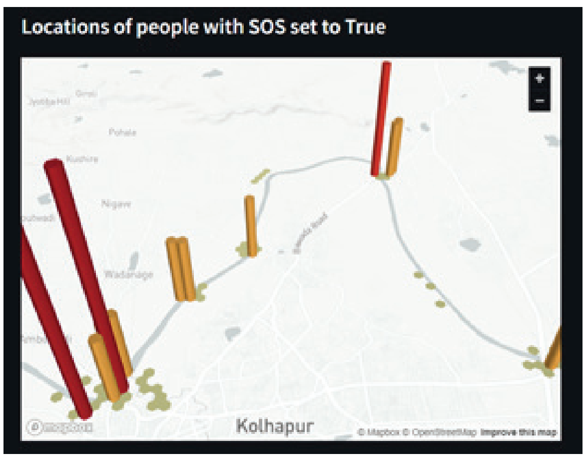

Fig. 13. Displaying civilians' location who triggered S.O.S

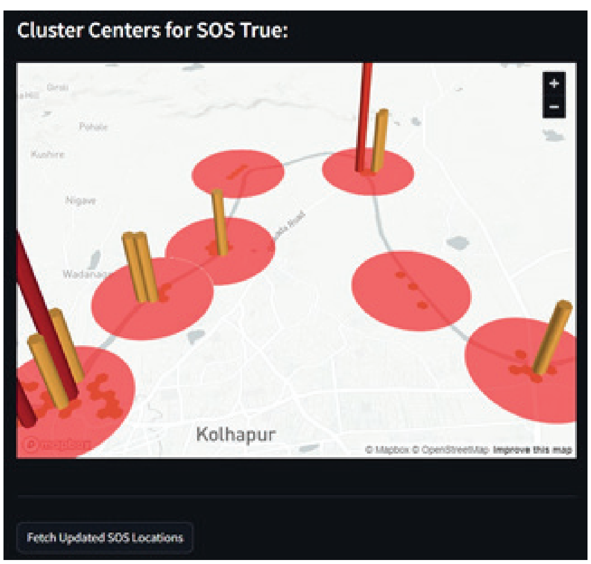

Fig. 14. Displaying hotspot region which is sent to rescue team

FUTURE SCOPE

We hope to improve our project in the future by utilizing the information gathered from the smartphone application, where civilian locations are continuously added to a database. Over time, when we gather a sizable amount of location data, we hope to use big data analytic tools to draw insightful conclusions. This involves estimating civilian counts with greater accuracy and projecting their future movements based on their present positions. In particular, we intend to use Recurrent Neural Networks (RNN) for predictive analysis, which will allow us to estimate the likely next destination of people, even in situations when internet connectivity is restricted or nonexistent. Rescue teams might benefit greatly from this update by being able to concentrate their efforts in areas where civilians are most likely to be found, which would enable more effective and efficient response plans.

CONCLUSION

In conclusion, our project envisions a robust and proactive approach to disaster management that leverages cutting-edge technology to save lives and reduce the devastating impact of natural disasters. By addressing the critical issues of communication gaps, lack of awareness, and unpreparedness, our mobile application offers a multifaceted solution that benefits both the public and rescue teams.

In a world where natural disasters continue to pose significant threats to communities worldwide, our project represents a proactive and innovative step toward disaster resilience. By equipping individuals and rescue teams with the tools they need to navigate these challenging circumstances, we strive to reduce casualties, minimize property damage, and ultimately save lives.

As we move forward with the development and implementation of this disaster preparedness mobile application, we remain dedicated to the fundamental goal of making our communities safer and more resilient in the face of adversity. With ongoing research, development, and collaboration, we have the potential to transform the way we respond to natural disasters, creating a safer and more secure future for all.

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A Location-aware Voice Assistant for Seamless Navigation

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ABSTRACT

In today's digital age, the proliferation of smartphones and computers has led to the digitization of nearly all tasks, revolutionizing the way we operate. With the advent of voice assistant technology, performing tasks has become even more seamless, as we can now accomplish them simply by speaking commands. There is a growing anticipation that voice assistant robots will eventually supplant traditional computers and smartphones. While virtual and voice assistants like Google, Siri, Jarvis, and Cortana have greatly simplified day-to-day tasks [2], they often lack detailed information about specific locations or organizations. To address these limitations there is need of a system aimed at providing comprehensive assistance to users, particularly when navigating unfamiliar places. The proposed system allows users to pose questions via voice commands and receive responses tailored to their inquiries. Additionally, it offers graphical results such as floor maps and interior building layouts when necessary.

Operating on voice input, the proposed system delivers output through voice, text, or multimedia formats, with the primary goal of providing instant and accurate assistance to users. Upon receiving voice input via a microphone (either Bluetooth or wired), the system converts it into computer-understandable language and matches user queries with the database to provide relevant answers. Powered by natural language processing algorithms, system effectively engages in communication with users, offering a user-friendly interface and executing tasks based on predefined commands. Ultimately, the voice assistant robot is designed to streamline various tasks and enhance user experience in navigating complex environments.

KEYWORDS: *Voice assistant, Virtual assistant, Natural language processing, Artificial iintelligence.*

INTRODUCTION

In today's rapidly advancing technological landscape, the quest for smart solutions to everyday tasks is paramount. In this modern era, convenience, comfort, and minimizing manpower are key considerations in problem-solving. One common challenge is obtaining accurate information about unfamiliar locations when visiting for the first time. In such situations, the Voice Assistant Robot emerges as an ideal solution.

This assistant robot efficiently addresses the needs of individuals by providing precise answers to their queries and assisting them in accessing relevant data. Utilizing voice input, the robot processes inquiries and retrieves information from a meticulously managed database, ensuring accuracy and reliability. Additionally, it can present responses in various formats, including text and multimedia, enhancing user interaction.

Moreover, the system supports multiple languages, including English, Marathi, and Hindi, enabling seamless communication for users of diverse linguistic backgrounds. Furthermore, the mobility feature allows users to transfer the robot between locations via a mobile phone, facilitating its use across different premises with minimal effort.

BACKGROUND AND RELATED WORK

Virtual voice Assistants played a vital role in various domains like Home Automation [1], Autonomous Vehicle controlling, Voice based Assistive Technologies or Voice Controlled Devices [7], for elderly people [9], Education [6], [8] etc. The work is done in virtual voice assistants internationally as well as nationally. Below is the detailing of the pathway in this domain.

In April 2011, Apple unveiled Siri [3], followed by Google's introduction of Google Now in July 2012. Microsoft entered the fray with Cortana in April 2013. November 2014 saw Amazon's debut of Alexa and the Amazon Echo. The Echo officially launched in the US on June 23, 2015, with the introduction of Alexa Skill set shortly after on June 25. In March 2016, Amazon expanded its Echo lineup with the Echo Dot and Amazon Tap. May 2016 marked the introduction of Google Assistant. Amazon brought the Echo to the UK and Germany on September 28, 2016. Google followed suit with the launch of Google Home and the Google Pixel smartphone on November 4, 2016. Chinese manufacturer LingLong entered the market with the Echo competitor DingDong on November 28. Samsung joined the virtual assistant race with Bixby in March 2017. Google Home expanded to the UK on April 6 and to Canada on June 26. With the abundance of digital assistants available, users may wonder which one to choose. However, there is currently a lack of empirical data regarding customer satisfaction with these assistants. To bridge this gap, a study was undertaken employing PLS-SEM to analyze 244 survey responses. The majority of respondents were Siri users (72%), while other digital assistants (28%) were also represented in the sample. [5].

The popularity of voice assistants is on the rise among users in India, and the country is actively keeping pace with global trends both in adoption and development of such technologies [4]. Leveraging advancements in Machine Learning, Artificial Intelligence, and Neural Networks, numerous Indian startups are offering voice and language services in a variety of non-English languages. Table below is a compilation of several Indian startups and companies that are actively competing in this sector on the global stage.

Table 1. Few Indian Startups in Voice Assistant Domain

Sr No	Lab/ Company	Product	Details
1	Manthan	Maya	Crafted with the objective of assisting businesses in comprehending not only daily sales within the nationwide retail chain but also offering insights into potential improvements based on seasonal trends, MAYA by Manthan is a versatile tool. It possesses the capability to address a myriad of inquiries, spanning from broad and open-ended to precise and voice-commanded queries.
2	Ixigo	Tara	This system enables users to access optimal travel deals from the website, facilitate ticket bookings, and recommend destinations based on their previous visits.
3	Reliance Jio	Hello Jio	This voice assistant facilitates access to functionalities within the MyJio app, accommodating both Hindi and English languages. Users can utilize it for tasks like mobile recharges, bill payments, music playback, movie browsing, making calls, and more.
4	Yatra	Yuva	The company is poised to introduce a personalized touch to enhance customer experiences. Their vision includes expanding onto various platforms like Alexa, Google Home, WhatsApp, and others to broaden their reach and accessibility.

PROPOSED SYSTEM

Figure 1 illustrates the core system architecture of a voice assistant, highlighting key modules: speech recognition, NLP, Dialogue Management, and text-to-speech. The process initiates by analysing user commands via microphone input. Speech recognition converts the audio to text, which is then processed to determine the command's nature. The processor invokes relevant scripts for execution and determines the output format—voice, text, or multimedia. Challenges such as background noise and pitch variations in human speech can affect speech recognition accuracy but can be mitigated through electronic filtering devices.

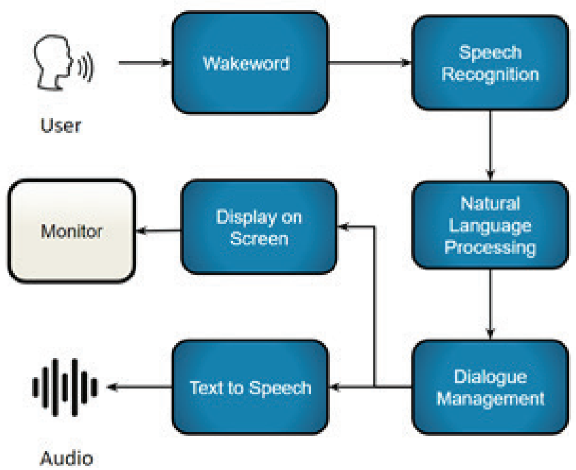

Fig. 1. System Architecture of Location-aware Voice Assistant

The system uses wake word as well as following different modules.

- Wake word: Proposed system utilizes a wake word to activate. A Wake word detector constantly listens for the specific word or phrase to trigger the assistant. Alternatively, users can activate the assistant by pressing a push-to-talk button.
- Automatic Speech Recognition (ASR): This module converts spoken audio from the user into a textual transcription.
- Natural Language Understanding (NLU): NLU analyzes the transcription to discern the user's intention. It also comprehends that users may phrase requests differently while conveying the same meaning.
- Dialogue Manager (DM): The Dialogue Manager (DM) determines the appropriate response to the user, manages the conversation flow, and decides on any necessary actions.
- Text to Speech (TTS): TTS module generates the voice output of the assistant.

CONCLUSION

The proposed system addresses the challenge of accessing accurate information about unfamiliar locations. It accepts voice commands as input and utilizes Speech recognition, NLP, and Speech-to-text conversion to manage voice output. The system incorporates a dialog manager to present multimedia content such as videos, images, navigation guidance, or directions to specific indoor locations. Additionally, it supports regional languages like Marathi and Hindi, catering to the needs of illiterate individuals. This solution streamlines organizational efficiency by guiding visitors without the need for human assistance. With minor database adjustments, the system can be deployed across various public venues such as malls, schools, colleges, railway stations, and airports. Future enhancements may include storing visitor data, including photographs, contact information, and email addresses, and facilitating the transmission of necessary information to visitors via email or SMS.

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Decentralized Crowdfunding on the Ethereum Blockchain: Building a Web 3.0 DApp with MetaMask Integration and Smart Contracts

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ABSTRACT

Blockchain technology has enabled decentralized crowdfunding, which signifies a change of paradigm in the way money is raised through trustless, transparent, and censorship - resistant transactions. This paper outlines how we designed and then implemented a decentralized application (DApp) for crowdfunding on Ethereum blockchain. The DApp leverages smart contracts and MetaMask integration to offer a smooth user experience that is secure and unchangeable. With the proposed DApp, project creators may deploy smart contracts to create fundraising campaigns with defined goals of funding, durations, and reward structures. Contributors use a user- friendly interface provided by the DApp while employing MetaMask for secure wallet management as well as transaction signing.

The progress of an entire fundraise—collection plus distribution of funds plus rewarding people—can be automated via smart contracts. This also makes it possible for them to operate without intermediaries hence transparency prevails. The most crucial features of this DApp are the decentralized reputation system used to evaluate project creator's credibility, automatic execution of fundraising milestones according to predefined conditions and tracking campaign progress in seconds rather than weeks or months like other legacy systems would do. Additionally, thanks to MetaMask integration, users no longer have to worry about incorporating themselves into this system since all technical complexities can be hidden through an abstraction layer provided by MetaMask.

KEYWORDS: *Blockchain technology, Decentralization, Smart contracts, Ethereum, MetaMask, Interoperability.*

INTRODUCTION

Blockchains are digital systems that ditch the middleman (like a bank) and spread information across a network. Using unbreakable codes, transactions are securely locked into blocks, then chained together for everyone to see. This creates a tamper-proof, transparent system for tracking anything of value.

Many problems with philanthropy have been identified [1]. Donations of goods and cash are made during a natural or man-made disaster.

On the other hand, the day-to-day management of charitable funds is unclear. Because of these circumstances, there was a decline in both the willingness to donate and the quantity given. Online crowdfunding has become a popular way for internet users to contribute to public welfare activities. Crowdfunding is the process of using a selected platform to raise a given amount of money in roughly the required quantity from a large (manageable) group of netizens known as the crowd to support a project (company), medical emergency, cause, loan, or financial necessity [2]. Online platforms like Twitch and Kickstarter let people raise money based on their reputation. But blockchain is a whole new way of using the internet.

More specifically, the blockchain has brought about a fundamental shift in our understanding of money, trust in communication, and even the concept of digital democracy. Several of the tenets of the "hyper-connected and trusted world" concept were already gaining traction, but the blockchain—thanks to smart contracts—has given them the tools to be quickly put into practice without the assistance of a third party. As a result, the Blockchain has made it possible for technology to construct decentralized currencies and smart contracts—digital contracts that can execute themselves—quite quickly. Furthermore, the Smart Property—intelligent assets that can be managed online—is based on the Blockchain [4].

In this paper, we introduce CrowdFund, a social networking platform built on top of Ethereum that enables users to fundraise for other users through a simple web Dapp.

CrowdFund makes it easy for anyone with a project to raise money from the public by utilizing smart contracts. The term "something" in this line implies that anyone can utilize the CrowdFund website to publicize and promote any kind of financial need, loan, project, business, or emergency. Smart contracts are used by CrowdFund, a decentralized internet platform, to manage and control money.

LITERATURE REVIEW

Numerous studies have been done on the topic, examining various aspects of crowdfunding platforms based on blockchain technology, from their advantages and disadvantages to their effects on the financial sector and the regulatory challenges they face[4]. Several research studies have examined the impact of blockchain-based crowdfunding platforms on the financial industry. The results of these research have demonstrated that the application of blockchain-focused crowdfunding platforms can significantly improve small enterprises' and startups' chances of obtaining finance, hence advancing economic growth.

Additionally, by using blockchain technology in crowdfunding operations, middlemen' participation in fundraising operations may be reduced, which lowers associated costs and improves competence.

The product team and the backers always have a trusting relationship, according to the body of extant literature on crowdfunding sites. Our investigation of crowdfunding platforms revealed that there is always a trusting relationship between the product team and its fans [4]. This was found in the body of current literature.

This traditional funding method, where investors give money to startups, is now being combined with new ideas like blockchain technology, which is getting popular worldwide [5].

Some even consider crowdfunding to be the radical substitute for venture capital funding. This has the effect of drawing in a new audience for atypical fundraising endeavours.

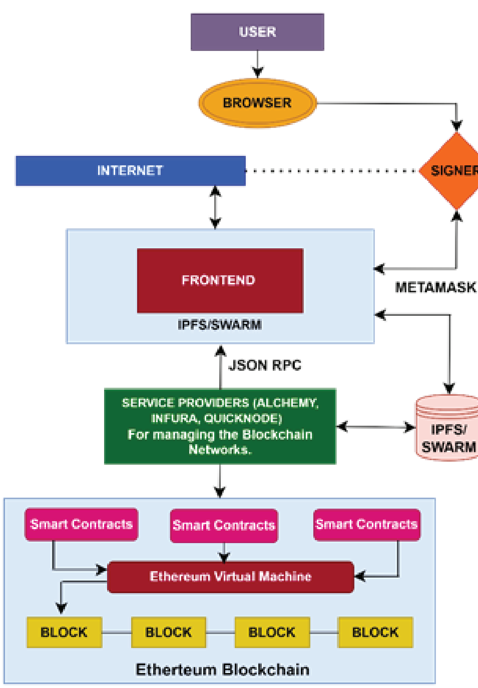

Fig. 1. Architecture Diagram

METHODOLOGY

1. Establish Project Objectives: You're crowdfunding DApp project should have well-defined goals and objectives. Determine the problem that must be solved, the target audience that it wants to reach, and the desired outcome.
2. Conduct Market Research: To obtain knowledge about the current crowdfunding environment, conduct market research. Determine rivals and comprehend the requirements and inclinations of users. Your project's concept will be improved and made more unique in the market with the aid of this research.
3. Deciding on a blockchain platform for the crowdfunding DApp requires a delicate balance between four key factors. Transaction fees, a major concern, might be lower on platforms like TRON compared to Ethereum. Scalability, crucial for handling a large user base, could be better on EOS. Security, paramount for user trust, is a strong point for Ethereum's established network. Finally, developer support, ensuring access to skilled programmers, is more readily available with Ethereum's larger community.
4. Design User Interface (UI): Make wireframes and a user-friendly interface for your crowdfunding DApp. Focus on functionality, style, and ease of use. Ensure a smooth experience for project developers and backers alike [5].
5. Create the smart contract or smart contracts that will govern the crowdfunding procedure in step five. Smart contracts are self-executing bits of code that define a campaign's rules and logic on the blockchain. Carry out tasks including project ideation, finance approval, prizes for backers, and funding disbursement.
6. Put Front-End Development into Practice: Use web technologies like HTML, CSS, and JavaScript to create the front end of your crowdfunding DApp. To provide a seamless user experience, incorporate smart contract functionality into the UI design.
7. Web3 Platform Selection: Pick an appropriate blockchain platform: When choosing the blockchain platform for crowdfunding, consider elements like transaction costs, scalability, community support, and the number of current users [6].
8. Launch and Management of Campaigns: Establish the campaign's parameters: Establish the campaign's duration, financing goal, and any stretch or milestone objectives. Contributions could be made easier by allowing people to contribute cryptocurrency to the smart contract address to participate. Campaign progress should be tracked, including the amount of funding collected and the frequency of updates sent to the community.
9. Ongoing Enhancement: Examine the outcomes: Analyse the crowdfunding campaign's effectiveness and note any shortcomings. Iterative development: Modify the DApp and crowdfunding procedure as needed for upcoming campaigns based on user input and lessons learned.
10. Ongoing Community Involvement: Continue to communicate: Even after the crowdfunding campaign is over, stay in contact with the community by sharing updates on the status of the project and its milestones. Collect input: Seek input from the community to resolve issues and implement changes.

SMART CONTRACTS

In crowdfunding, smart contracts act like a secure vault for the money. The money only gets released to the startup when certain goals are met, like raising a specific amount or reaching certain progress points in their project. This protects investors by making sure their money is only used for what they intended.[7].This approach reduces risk for investors, making them more likely to invest in promising startups with the potential for good returns.

Crowdfunding just got more transparent! Special programs called "smart contracts" track every penny going in and out.These records are stored on a super secure online system, like a public ledger everyone can see, so there's no hiding where the money goes.

In short, studies show that crowdfunding platforms built on blockchain technology offer significant benefits compared to traditional options. Enhanced efficiency, security, and openness in the crowdfunding process are some of these benefits [8]. Further investigation is necessary to assess the wider influence of these platforms on the financial sector and to develop a thorough regulatory structure that promotes their continuous progress and uptake.

BLOCKCHAIN DIAGRAM

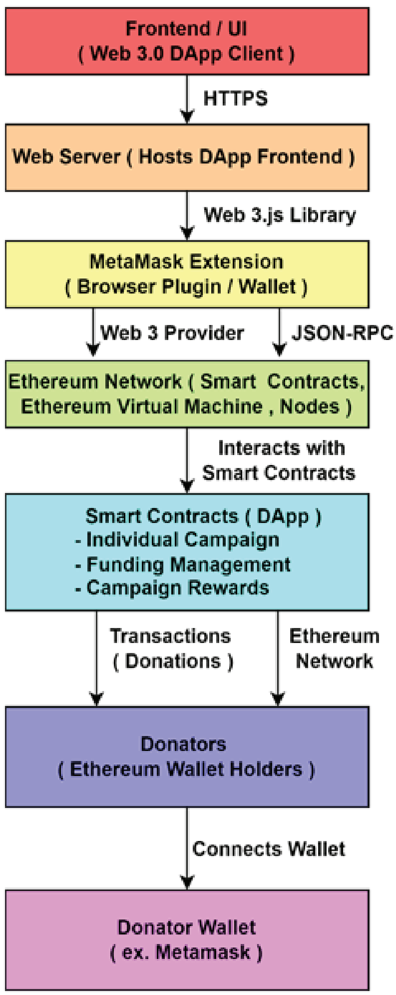

Fig. 2. Proposed System Diagram

DEPLOYMENT

Solidity language support is available in VSCode code editor, and smart contracts compile to produce two objects: ABI and bytecode. When deployed to the Ethereum network, the bytecode records the contract address, which is the smart contract's address. ABI is essential for understanding a smart contract's functionality, as it is difficult to understand only by looking at its bytecode. ABI communicates with the deployed smart contract by building EVM bytecode and using ABI to hash the function.

The node module "solc" is installed to compile a solidity file in node.js, which yields the ABI and bytecode. The Web3 library allows applications to connect to the Ethereum network, with different providers serving as conduits between the Web3 library and the network.

Security and public and private keys are not required when a contract is implemented in a local network, as there is no need for ether. However, in Ethereum Main network or public test networks, accounts must have some ether (wei) to deploy the contract, and public and private keys are needed to unlock the accounts. Real ether is used by the main network for deployment, manipulation, and contract interaction. Smart contract development for Ethereum utilizes testnets for deployment and functionality verification prior to mainnet launch. Fictitious Ether (ETH) facilitates testing within these testnets, replicating real-world conditions without the risk associated with actual funds.

DECENTRALIZED CROWDFUNDING OVER THE YEARS

In projects without a central authority, founders can build trust with contributors by making everything open and accountable, thanks to the special features of the public record-keeping system they use. This method makes use of MetaMask wallets and smart contracts to enable safe and long-term funding via Web 3.0 DApps. By doing so, reliance on centralized platforms is eliminated, promoting transactions that are immune to censorship.

By doing away with middlemen, blockchain technology allows project creators to interact directly with contributors while upholding integrity during the whole fundraising process. Ethereum's powerful smart contract features enable automated goal fulfillment, money collection, and reward distribution [9].

Decentralized reputation systems are a notable innovation that guarantee donors make well-informed judgments by utilizing blockchain data to assess past performance. By using smart contracts to automate fundraising milestones, efficiency may be increased and human error can be decreased.

Distributed crowdsourcing DApps improve accountability and transparency by giving stakeholders real-time campaign progress tracking. Innovative incentive and reward systems can be made possible by expanding fundraising potential through the integration of decentralized finance (DeFi) protocols into DApps [10]. Through DApps and smart contracts, Ethereum's blockchain provides a transparent and safe alternative to crowdfunding. Because it makes transactions censorship-resistant and trustless possible, this upends established platforms. However, to make decentralized crowdfunding a practical financing option, cooperation is needed to overcome security and regulatory obstacles.

The blockchain of Ethereum enables a new crowdfunding age. DApps and smart contracts provide censorship-free, safe, and transparent fundraising. This upends established paradigms, democratizing financial access and encouraging creativity in the digital economy.

CROWDFUNDING OVER THE YEARS

Crowdfunding gained popularity through websites like Indiegogo and Kickstarter, but it has since spread to other platforms and industries [11], taking advantage of technological improvements and shifts in consumer behavior.

When crowdfunding first started out, its focus was on artistic endeavors like movies, albums, and art installations. These platforms gave creators the chance to present their concepts to a worldwide audience and earn money through pledges based on rewards, pre-orders, or donations. Independent creators now have an option to establish funding methods, democratizing the process, and enabling them to realize their ideas without the interference of conventional gatekeepers.

As crowdfunding gained popularity, it expanded to include other industries, such as business, technology, and social concerns. The emergence of platforms such as GoFundMe allowed people to raise money for charity causes [12], personal necessities, medical bills, and disaster relief. This growth demonstrated the flexibility of crowdsourcing as a tool for community-driven projects as well as business endeavors.

Concurrently, the emergence of blockchain technology brought forward the notion of decentralized crowdfunding, which employs smart contracts and cryptocurrencies to facilitate transparent and trustless fundraising initiatives. Decentralized applications (DApps) for crowdfunding were made possible by platforms such as Ethereum, allowing projects to raise money through token sales or initial coin offers (ICOs). Regulators and investors were watching this model more closely because it presented security dangers and regulatory issues in addition to new fundraising and investment options.

With the introduction of new models and platforms, crowdfunding has continued to develop in recent years. While equity crowdfunding is still becoming more and more popular to finance startups and small businesses, reward-based crowdfunding is still popular for creative initiatives and product launches. Crowdfunding platforms that accept donations have also become more widespread, aiding in the fundraising of philanthropic causes and social impact projects.

Furthermore, social media and digital marketing tactics are becoming more and more incorporated with crowdfunding, giving creators the opportunity to use their online networks and interact with backers instantly [13]. The emergence of specialist platforms and crowdfunding aggregators has expanded the diversity of the crowdfunding ecosystem by providing customized solutions for groups and sectors.

Crowdfunding can further democratize access to capital and promote innovation in the global economy through tokenization, decentralized finance (DeFi), and other developing trends.

TYPES OF CROWDFUNDING

Various models can be applied to crowdfunding, depending on the type of contributions and anticipated returns. These include:

Donation-Based Crowdfunding: Under this model, donors give money to a project, person, or cause without anticipating receiving anything in return. Donation-based crowdfunding is frequently used by nonprofits, relief operations for natural disasters, and individual fundraising campaigns [14].

Reward-Based Crowdfunding: Under this paradigm, contributors receive material or intangible benefits in return for their money. Incentives may include first dibs on merchandise, invitation-only events, or acknowledgment in the project credits. This is how most crowdfunding sites, such as Indiegogo and Kickstarter, function.

Equity-Based Crowdfunding: In return for their monetary contributions, investors can purchase ownership holdings in a business or project through equity crowdfunding. Equity crowdsourcing makes investment opportunities available to a wider range of investors, including those who are not accredited, in contrast to traditional venture capital or angel investing.

Peer-to-peer lending using debt-based crowdfunding: Debt-based crowdfunding, also referred to as peer-to-peer lending, is people or companies taking out loans from a group of lenders. Investors may receive a financial return on their investment as borrowers repay the loans with interest over time [15].

Important Crowdfunding Players

Creators/Entrepreneurs: The main motivation behind crowdfunding campaigns is people or organizations looking for capital for their endeavors or ideas. It is the responsibility of creators to craft persuasive proposals, establish financial targets, and keep their word to supporters.

Backers/Investors: People who make financial contributions to crowdfunding projects are referred to as backers, investors, or supporters. Depending on the crowdfunding approach, backers may receive reimbursement, stock, or perks in exchange [16].

Advantages of Donor Funding

Access to Capital: By giving inventors, artists, and business owners a different way to raise money outside of conventional channels, crowdfunding democratizes access to capital.

Market Validation: Before devoting a substantial amount of time and money to their ideas, entrepreneurs can assess market demand and validate their concepts through crowdfunding [17]. A successful crowdsourcing effort can draw more interest from investors or customers and serves as proof of concept.

Community involvement: Among backers who have a similar interest in or passion for the project, crowdfunding promotes community involvement and a sense of belonging [18].

CROWDFUNDING DURING COVID-19 PANDEMIC

Globally, the COVID-19 epidemic has presented hitherto unheard-of difficulties for people, companies, and communities. Crowdfunding has become an effective means of generating money, addressing immediate needs, and organizing support during social unrest and economic turmoil. This thorough research looks at opportunities, problems, and trends in this changing environment as it investigates how the COVID-19 pandemic has affected crowdfunding initiatives [19].

The emergence of crowdfunding campaigns for COVID-19. Crowdfunding websites became popular as the epidemic expanded around the world and people and organizations started using them to support different COVID-19-related projects. These initiatives ranged from community relief projects meant to give necessary goods and assistance to people in need to medical fundraising for those fighting the illness. Crowdfunding projects for COVID-19 included a variety of activities, such as:

-COVID-19 patients' medical costs, including as prescription drugs, hospital bills, and treatment expenditures.

-Resources for mental health, nutrition, and personal protective equipment (PPE) for front-line healthcare personnel.

-Community relief initiatives, such as food distribution, housing aid, and assistance for low- income and elderly families and other vulnerable groups.

-Investigation and creation of COVID-19 vaccinations, therapies, and diagnostic instruments.

Effect on Conventional Fundraising Techniques like live events, galas, and charity auctions were interrupted by the COVID-19 pandemic, which compelled organizations to change and become more inventive. Many nonprofits and charity groups moved their fundraising efforts online, using crowdfunding platforms to reach contributors and supporters remotely, in response to social distancing tactics and lockdowns. Despite these obstacles, a lot of groups were able to contact donors and generate money throughout the epidemic by successfully utilizing peer-to-peer fundraising, digital storytelling, and social networking [19].

ACKNOWLEDGEMENTS

Before launching a crowdfunding campaign, project creators and investors should carefully weigh the many advantages and disadvantages of crowdfunding.

Benefits of crowdsourcing

Funds Access: Through crowdfunding, producers can obtain funds without depending on conventional financing sources like banks or venture capitalists. Small enterprises and individuals can now directly raise money for their ideas or endeavors from a wide range of possible backers thanks to the democratization of funding.

Community Involvement: Because backers of crowdfunding projects develop an emotional stake in the project's success, it encourages community involvement and engagement. A devoted consumer base or fan base may result from backers' continued support and lobbying because of this sense of ownership [20].

In conclusion, crowdsourcing has several advantages, such as market validation, financial availability, and community involvement, but it also has drawbacks, including resource requirements, competition, and failure risk.

FUTURE SCOPE

With Web 3.0 DApps that integrate with MetaMask and smart contracts, decentralized crowdfunding on the Ethereum blockchain has enormous potential to revolutionize and innovate the fundraising industry. We can expect notable developments in the following areas [21]:

Enhanced Availability: A wider audience will be able to utilize decentralized crowdfunding as blockchain technology advances and user interfaces get more intuitive. The integration of MetaMask streamlines the onboarding procedure, enabling users to engage with DApps without requiring a deep understanding of blockchain technology.

Global Reach: Through decentralized crowdfunding, backers, and creators from across the world can take part in fundraising campaigns, regardless of where they live. This worldwide reach creates new chances for international cooperation and investment, promoting a more inclusive and linked crowdfunding economy.

Increased Security and Openness: The Ethereum blockchain's smart contracts offer unmatched security and transparency, lowering the possibility of fraud, manipulation, and corruption in crowdfunding initiatives. The integrity of the fundraising process is maintained by decentralized consensus methods, while immutable transaction logs guarantee accountability.

Interoperability and Standards: Making connections between various decentralized crowdfunding platforms and other blockchain- based apps will be easier with the help of standardization initiatives and interoperability protocols. Greater liquidity throughout decentralized financial ecosystems, interoperable tokens, and cross-platform crowdfunding campaigns will all be made possible by this interoperability.

In summary, technological breakthroughs, legislative clarity, and user adoption will drive the growth and innovation of decentralized crowdfunding on the Ethereum blockchain in the future. Through the utilization of Web 3.0 principles, integration with MetaMask, and smart contracts, decentralized crowdfunding DApps will significantly contribute to democratizing capital access, promoting creativity, and revolutionizing the worldwide fundraising scene.

RESULTS

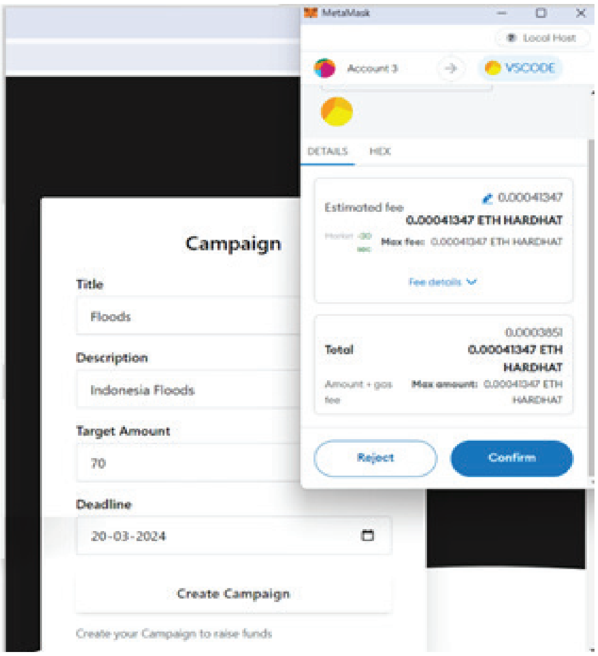

Fig. 3. Transferring cryptocurrency on a blockchain network

CONCLUSION

Testing and building new alternative architectures that demonstrate the idea behind providing innovative solutions is essential as the world moves toward Web 3.0 and decentralized systems to address common issues. Given that current crowdfunding solutions are developed and managed by middlemen corporations that have a part in many campaign aspects, an alternate approach based on a peer-to-peer network managing campaign transactions appears feasible. This study investigates ways to do away with middlemen in a crowdfunding business use case. This program also assists in eliminating any danger to the private information of campaign creators and contributors. The use of the consensus protocol is a relatively new technology that enhances the security of this decentralized application and helps deter financial fraud and other illicit activities. Smart contracts, which were developed for the crowdfunding DAPP application and deployed on the Ethereum blockchain, were used to achieve this. They control how the transaction is carried out. It is because of this engagement that users may design and fund campaigns that appeal to them. Crowdfunding platforms enable campaign designers and contributors to efficiently execute their intended actions. The Ethereum blockchain has great security, but its main drawback is the very high gas costs associated with each transaction. Numerous additional blockchains, including the Ethereum- based Binance Smart chain (BSC), are arising despite the high gas prices. Campaign designers are still working on the Ethereum blockchain because they don't want to jeopardize data security and privacy. The creator of Ethereum, Vitalik Buterin, has released several updates and enhancements for the platform, such as Ethereum 2.0 and EIP 1559, which aim to lower gas costs for Ethereum users while also increasing the scalability of the blockchain.

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Machine Learning techniques for Crop Prediction and Leaf Disease Detection

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ABSTRACT

Agriculture as an occupation is backbone for many countries which have been supporting farmers. For decades, farmers have used specific pattern for farming but the changing climate is encouraging the farmers to rethink the pattern established by their forefathers. With progress in computer field and machine learning new techniques are emerging for farming. With same in view the system is proposed for leaf disease detection with prediction of crop which can be planted in specific type of soil and crop yield prediction help of artificial Intelligence algorithm. The system supports two different architectures for detection of leaf disease and prediction of crop. Artificial Intelligence algorithm techniques quantifies the crop yield prediction depending on Variables such as meteorological conditions, soil composition, and moisture levels. The image processing is used for leaf disease detection and remedies suggestion for removal of same. The application is established after careful analysis for both machine learning techniques and image processing algorithms which gives the results for disease detected leaves of tomato, grapes,etc. Based on the outcome of this research model we were able to predict different type of crops through the humidity, temperature and moisture content of soil. Through the comparative analysis on the parameters of accuracy Naïve base, RF, XG Boost models provides 99% , SVM provides 98%, Logistic Regression provides 96.5% and decision tree provides 95.5% accuracy.

KEYWORDS: *Agriculture, Leafdisease, Forecasting yield, Artificial intelligence algorithms, Image processing.*

INTRODUCTION

For centuries agriculture has been the main source to provide food and raw materials to many people across globe. The production and outcome from it is changing since the climatic change around the world. The production is declining and not meeting the need of growing population. The farmers are facing problem with declining crop production as well the income they earn from it. The farmers are not able to deal with changing environment , disturbed rainfall and the crop are diseased to give low yield. They lack knowledge for the good production of crop. The ignorance towards new techniques and disapproval for adaptation for same causes more problem.

Thus, emerging field of technology help for this crisis faced by farmers. They provide information to the farmers for good farming so that they can produce good and more yeild. With machine learning techniques the weather conditions can be predicted. The image processing techniques help in image perspective. The following objective is to provide a system that provides farmers with the necessary information in the selection process. The technology of information is widely used in several sectors globally in contemporary civilization. Data mining refers to the process of extracting and analyzing relevant information from a dataset in order to address the agricultural issues mentioned above. Examine historical crop patterns and depict them using statistical analysis. Analyse agricultural productivity and identify strategies to enhance crop output. A product is recommended for all types of soil. Help farmers choose crops. The information given on appropriate fertilizer and the methods of irrigating the selected crops. The motive of data is to consider only the data that is required from big data. Actually, this is the process of getting necessary knowledge from many documents.

The paper represents a system where crop is predicted depending on soil, weather conditions, temperature. The crop yield is predicted to ensure market requirement and the leaf images of plant are used to predict the disease and remedial suggestion to farmer to remove the same.

The paper is structured to present The execution of leaf disease identification alongside scrutiny of previously employed methods. Section I provides a detailed introduction, while Section II presents an overview of systems commonly utilized by agronomists. Section III outlines the framework designed for predicting crop outcomes and identifying leaf diseases, accompanied by a consideration of approach. Section IV presents the results and analysis of the implementation.

REVIEW OF LITERATURE

The literature survey for system is done through aspects of crop prediction, crop yield prediction, data mining techniques used in system as well the leaf disease detection with latest trends taken into consideration

Crop Prediction

In [4]cultivation, classification of data is used to analyze diverse biological and lifeless components. A An issue often encountered by landowners in India is their inability to choose the right crop according to the needs of the soil. As a result, their production faced serious problems. The farmer's problem is solved with preciseness of crop yield. Site specific crop management is a present day agricultural technology that make use scientific data collected from properties of ground, ground type, plant information and recommends suitable crops that the farmer does not have This reduces product selection errors and increases profitability. This work addresses the aforementioned difficulty. solved by proposing a common model that uses majority voting method using random trees,KNN, Naive Bayes and Chi- square as learners to reach consensus on the accuracy and Crop performance for given location.

India [5] relies heavily on farming and farming-related industries as the primary source of income for its people. The country's main economy revolves around agriculture.. It is also a country where major disasters such as rain or floods destroy crops. This situation caused farmers to suffer huge economic losses and caused farmers to commit suicide. Pre-harvest crop forecasting, farmers' and government agencies' decision on storage, marketing, price support, minimum transportation quantity, import/export, etc. It can help you make appropriate plans such as: Predicting crop yield is primarily based on the quality of ground and its various properties. It requires examining large amounts of data regarding many variables such as. Since crop forecasting involves large amounts of data, this forecast becomes an ideal candidate for data mining. We extract information data through D.M.. This article presents research on various methods for calculating crop yield. The success of any product assumption depends on how many features are extracted and how well the distribution is used. This article presents results from various algorithms used for crop prediction by different authors, as well as their accuracy and agreement.

Recommendation of fertilizer

The optimal approach for planting is using formulae to compute the precise quantities of different nutrients required throughout the duration of the growth period. selecting the appropriate fertilizer, and scheduling fertilization time. The key to whether it can be widely used lies in whether the system's parameters can readily adjust to accommodate local cultivation methods. To help solve these problems, it is necessary to have knowledge about the infrastructure and its applications. This article first uses the object-oriented approach to decompose the model to meet the requirements of system programming. Organizations are split into following groups: non-owners and employees, and are used to transform materials used in composting into software system products.

The proposed application utilizes the ResNet50 transfer learning model as its core to differentiate between healthy and infected leaves and categorize the specific disease type. Its aim is to assist farmers in conserving resources and mitigating economic losses by early detection of plant diseases and administering suitable treatments [11].

Disease Detections

The prototype[12] has been operational for three months and has demonstrated strong performance, enduring diverse weather conditions without rusting. The proposed plant disease prediction framework has achieved an impressive accuracy rate of 99.24%.

Seven distinct classifiers were evaluated, revealing that the support vector machine (SVM) classifier attained the highest classification accuracy of 94.65%. The models were trained and tested on a dataset comprising 619 images[13].

The region growing method [14] is employed to address cluttered background challenges by interactively selecting growing seeds in real-field settings. Precision is utilized to calculate the performance measure, resulting in an average segmentation accuracy of 94%.

We select a set of measurement-based features representing the blobs, which are further filtered based on their impact on the model's performance through a wrapper-based feature selection algorithm, crafted with a hybrid metaheuristic approach. These selected features serve as inputs for an artificial neural network (ANN). Our methodology is contrasted with an alternative approach employing well- known CNN models[15].

The information that needs to run the model is then divided into different kinds according to its role and represented according to various rules stored in relational data. Finally, the decision-making engine is designed to use them. It is actually a special computer used to control the local environment and display the rules in the form of some ideas and make suggestions.[1]

The presented method introduces groundbreaking approach, marking the first of its kind, aimed at effectively detecting and categorizing 4 diseases found in potato leaves. Evaluation of the algorithm's performance in tests resulted in an impressive accuracy rate of 97.2%. Several tests have been carried out to confirm that, in comparison to current standards, our suggested approach shows higher accuracy and consistency in the identification and categorization of potato illnesses.

Table 1: Literature Review

Sr. no	Title	Year	Technology	Limitation
1	Forecasting Crop Yields via a Deep Reinforcement Learning Model for Sustainability Agrarian Application	2022	Reinforcement Learning	Crop Damage is not Detected
2	System for agriculture recommendation using data mining	2021	The system will extracting databases for crop selection when farmer required.	IoT platform is used but prediction with machine learning for crop yield is not done.
3	IoT based smart agriculture system for grapes	2020	The data acquired from sensors gives the condition at field like temperature, moisture in soil, leaf wetness and humidity.	IoT platform is used but prediction with machine learning for crop yield is not done.
4	Smart crop and fertilizer prediction system	2019	N, P, K prediction from humidity, electric conductivity (EC), ph and temperature.	Features such as soil type is not included. Crop damage is not detected.

METHODOLOGY

The system is designed to detect the batch to be planted in soil and farm output depending on npk value of soil and weather, humidity of the specific place. Fig1 is architecture diagram for farm presaging and farm yield presaging. The machine learning concept of relearning is used for crop prediction.

The past data is used for training the model. The query data is input and preprocessed. When classification is applied for data with help of SVM, the crop is predicted while when regression is used on preprocessed data the yield is predicted. The system first determined the crop and then the image processing approach is used to detect the disease for plant through image of leaf.

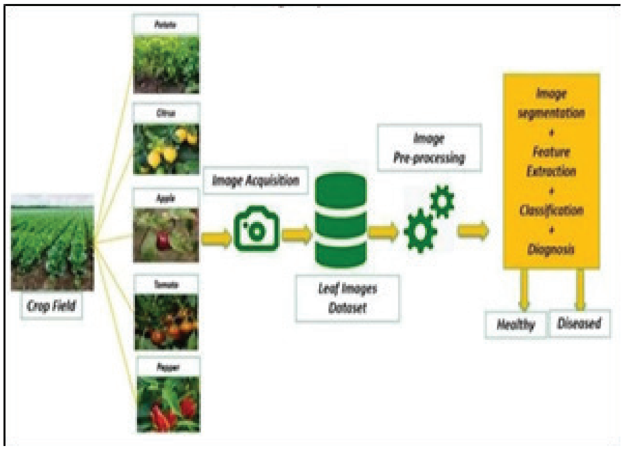

Fig. 1. Overall structure of system

System Design for Crop Prediction

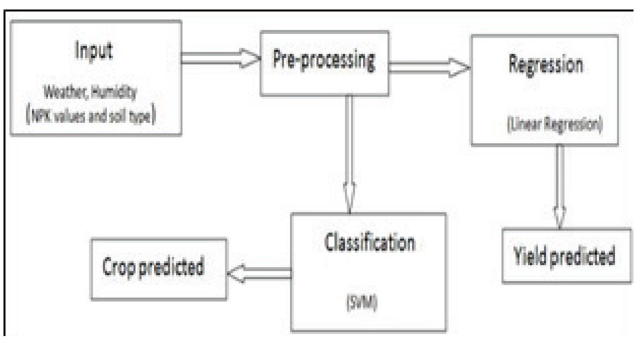

Fig. 2. Crop Prediction System Design

In the system main elements are depicted in Figure 2:

- Pre-processing: The dataset undergoes pre-processing techniques aimed at converting basic information into a practical and effective format.
- Regression: Utilizing regression as the modeling approach.
- Farm Prediction: Training the model with data to predict crop yields.
- Classification: Employing SVM for classification purposes.
- Crop Prediction: Utilizing the model to predict the type of crop.

System Design for Leaf disease detection

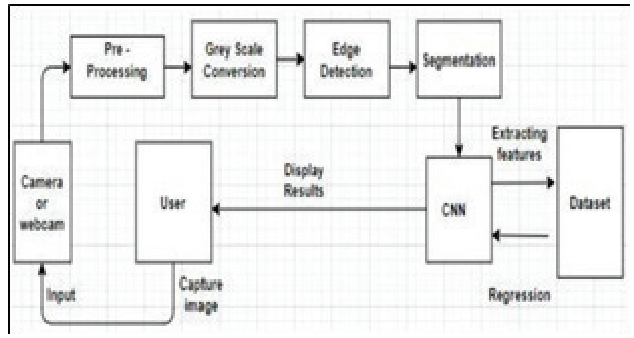

Fig. 3. Leaf Disease Detection

In the system primary elements are, as illustrated in Figure 3, include:

- Image Capture: Capturing the image of leaf.
- Pre-processing: Employing pre-processing techniques on the dataset to convert data into information.
- Greyscale Metamorphosis: The image is then transformed into grayscale.
- Detection of Edge: Detecting edges within the image.
- Classification: Segmenting or classifying the image.
- Detection of Disease: Detecting diseases within the segmented image.

Algorithm used in system

S.V.M.

Utilizing SVM, a ML technique, data can be separated by maximizing the margin between categories. This algorithm helps with the categorization of written feedback using collected data.

Given a dataset D, token semantics, and feedbacks, the desired output is: Classifying Applications

First, we iterate through each feedback ID in dataset D:

Next, we need to extract the necessary features and save them in vector x for the feedback ID.

Step 3: Add the characteristics from the feedback ID to vector x.

Step 4: Terminate the loop.

Step 5: Iterate through each element to vector x:

Step 6: Obtain the initial feature and assign it to ‘b’, while assigning the remaining features to ‘w’.

Step 7: Compute h(w, b)(x) as g(z), where z is obtained by evaluating (w^T x + b).

Step 8: In the case where z is less than or equal to zero,

Step 9: Set g(z) equal to 1.

Step 10: Otherwise, set g(z) to -1. Step 11: Terminate the program if the specified condition is met.

CNN

First, the system is given a dataset that includes images along with corresponding captions.

Step 2: Using a convolutional neural network, the system acts as an encoder to extract image features ‘f’ pixel by pixel.

Step 3: Index factorization is used to process the extracted pixels, resulting in a matrix of size m x n.

Step 4: Conducting max pooling on the matrix involves selecting the maximum value and reinstating it within the matrix.

Step 5: Normalization is performed to convert any negative values to zero.

Step 6: Negative values are set to 0 using Rectified Linear Units (ReLU), effectively converting them to 0.

Step 7: The layers that are obscured get values for input from the visible layers and then assign weights based on the calculated maximum probability.

RESULTS AND ANALYSIS

The system is implemented to give results for crop prediction, crop yield prediction . the fertilizer are suggested for the specific crop and leaf disease is detected step by step to solution for improve health of crop and leaf thus increasing the productivity.

The evaluation of results is done in four parts the first images are for web application for the system. The later part if crop prediction where the values are input and the system predicts the crop to be planted for those specific NPK values. The third part is for crop yield prediction with fertilizer suggestion. The next part is for leaf disease detection with proper care suggestion for leaves and plants

Web Application Screenshots

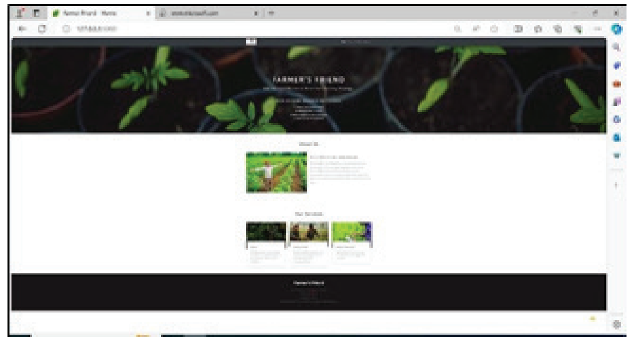

Fig. 4. Web application Homepage

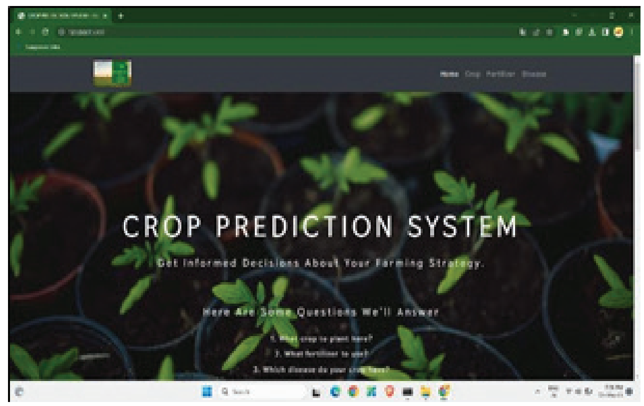

Fig. 5. Web application Homepage

Fig.4 and Fig.5 represent the application for system which has dashboard to take input for both parts of system. It takes input values for crop prediction and input image for leaf disease detection.

Crop Prediction

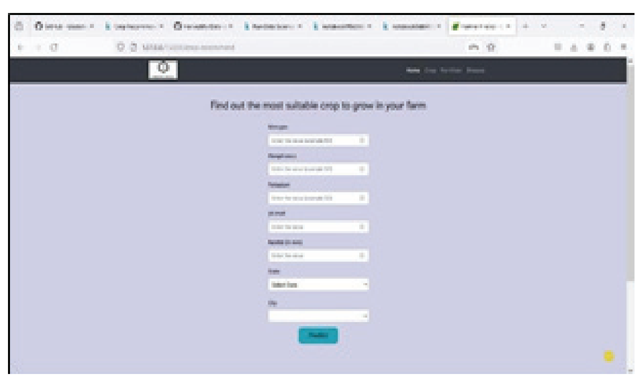

Fig. 6. Input for Crop Prediction

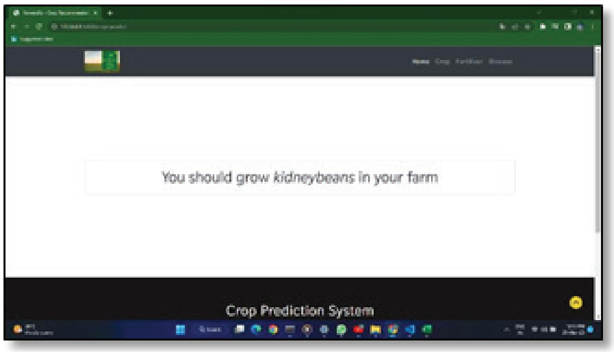

Fig. 7. Output for Crop Prediction

Fig 6 and Fig 7 shows the crop prediction implementation in system where the input values of NPK are giving as shown in Fig6 and output for crop is predicted as shown in Fig 7 .

Fertilizer suggestion

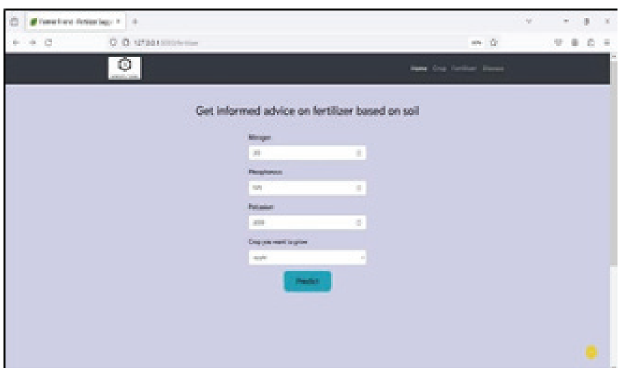

Fig. 8. Input for fertilizer suggestion

Fig. 9. Output for fertilizer suggestion

Fig8 and Fig 9 are the implementation for fertilizer suggestion with given inputs as shown in fig 8 and output for the fertilizer suggested as shown in Fig 9.

Leaf Disease Detection

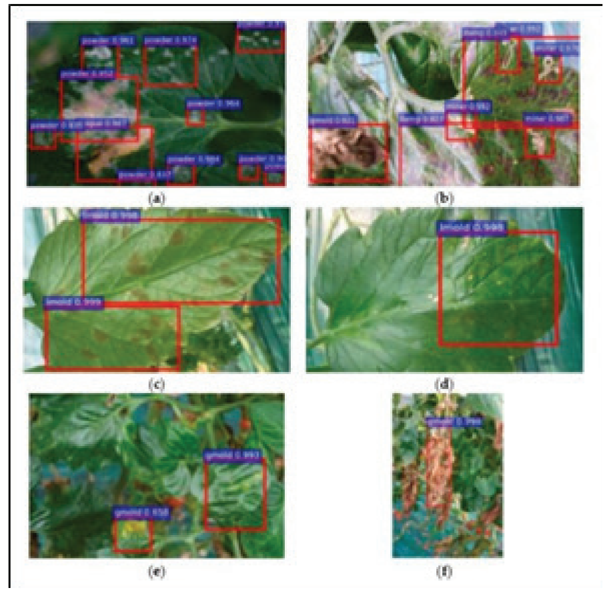

Fig. 10. Leaf disease detection Process

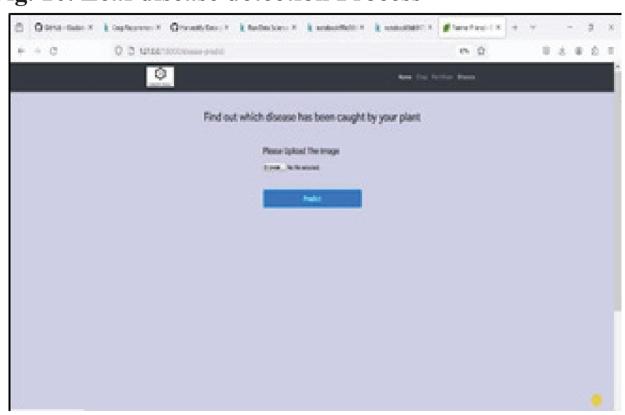

Fig. 11. Leaf Disease Detection : Browse Image to Upload

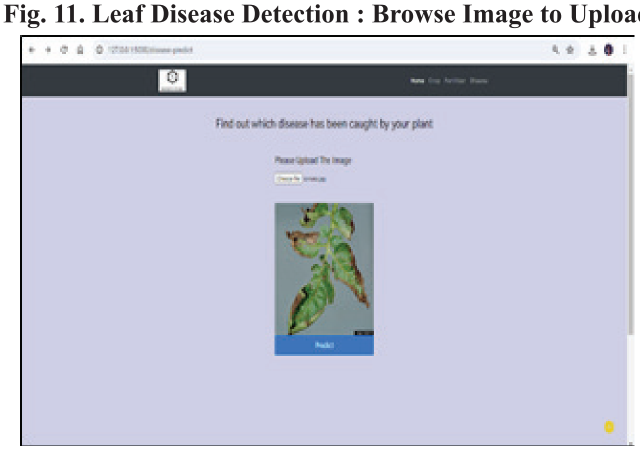

Fig. 12. Leaf Disease Detection : Tomato leaf Image Uploaded

Fig. 13. Leaf Disease Detection : Tomato leaf disease detected

The fig. 10 gives the overall process of leaf disease detection. The fig 11, 12 upload the image while fig 13 enlist the disease and gives details and suggestion to remove it.

Algorithm and Other Factors Analysis

The system implemented the algorithm for crop prediction. Different algorithm were implemented for crop prediction. The fig 14 shows the graph for the algorithms used for crop prediction the SVM shows more accuracy and is used in system for prediction while CNN used for leaf disease detection.

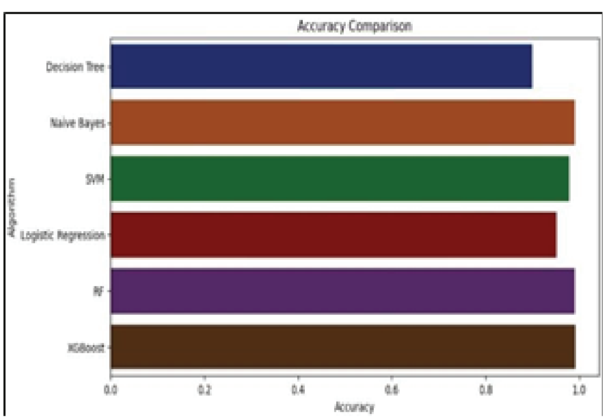

Fig. 14. Algorithm Analysis

Through the comparative analysis on the parameters of accuracy Naïve base, RF, XGBoost models provides 99% , SVM provides 98%, Logistic Regression provides 96.5% and decision tree provides 95.5% accuracy.

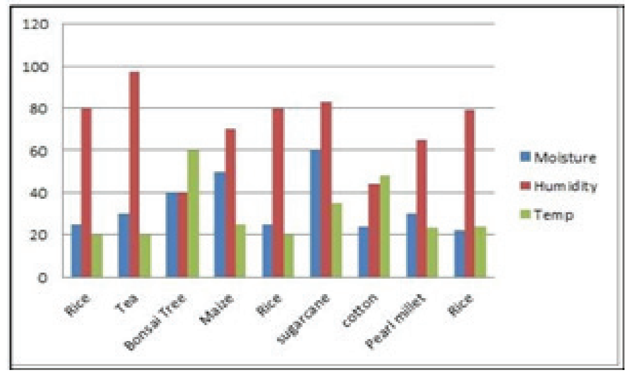

Fig. 15. Moisture Humidity and Temp Analysis

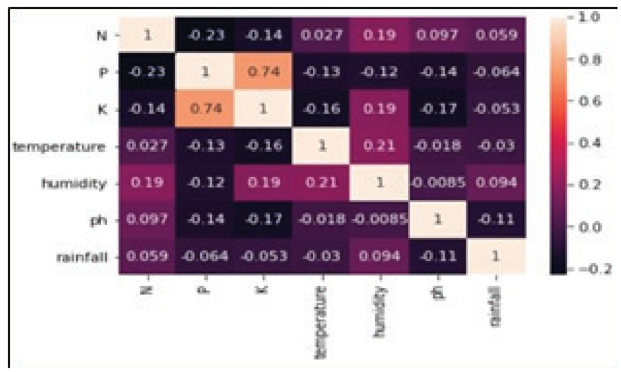

Fig. 16. Moisture Humidity, pH and Rainfall Temp Analysis

The Fig 15 and Fig16 gives the analysis with temperature and humidity . the analysis also covers rainfall and ph. factor for specific crop to be grown.

CONCLUSION

In system, Crop forecast and crop yield forecast will ensure crop yield. The method will undergo training on standardized data profile values for NPK and the kind of soil needed for successful cultivation. Real data including Potassium(K), Phosphorous(P), Nitrogen(N) levels and soil types will be used to test the system. Rice yield prediction using regression analysis and artificial intelligence algorithm. To verify the correctness of the information, we tested the method for predicting the crops to be planted and the yield from the new crop. In order to determine which new crop should be planted, we evaluate the data set used for training with the test dataset. Imaging is used to detect leaf diseases.

Through the comparative analysis on the parameters of accuracy Naïve base, RF, XGBoost models provides

99% , SVM provides 98%, Logistic Regression provides 96.5% and decision tree provides 95.5% accuracy.

The system can be enhanced by creating an android app which will be of ease of use for farmers where they can know about the crop yield, as leaf disease, prevention for same as well market value for the product.

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Insights into Tomorrow's Weather: A Cloud-Integrated IoT Weather Monitoring Solution Tailored for Smart City for Environmental Data Analysis Using Flutter

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ABSTRACT

In our rapidly evolving world, staying abreast of local weather conditions and seamlessly disseminating this crucial data worldwide is paramount. Leveraging cutting-edge technology, this innovative device presents a pioneering approach to monitoring weather patterns and distributing data across the globe. At the heart of this groundbreaking solution lies Internet of Things (IoT) technology, a sophisticated framework that interconnects diverse elements within a network, bridging geographical boundaries and enabling ubiquitous access to real-time weather information. The robust infrastructure of our system facilitates the seamless retrieval of data from any location on the planet, empowering users to monitor weather conditions remotely with unparalleled ease and efficiency. Traditional methods of weather monitoring depend on cables and simplistic devices and often face limitations in comprehensively assessing environmental parameters, particularly in cultivating zones. Our solution addresses this challenge by integrating advanced sensors capable of monitoring and scrutinizing environmental constraints remotely. Central to our discussion are the DHT11 Humidity and Rain sensor, FC37, and Temperature Sensor, each playing a pivotal role in gathering accurate environmental data. By harnessing these sensor technologies, our system delivers comprehensive insights into environmental conditions, enhancing decision-making processes in various domains, from agriculture to urban planning. In the context of smart cities, where efficient resource management and environmental sustainability are paramount, our cloud-integrated IoT weather monitoring solution emerges as a transformative tool. By providing real-time environmental data analysis tailored to the unique needs of smart urban environments, our solution empowers city planners, policymakers, and stakeholders to make informed decisions that drive sustainable development and enhance the quality of life for residents.

KEYWORDS: *Temperature sensor, Humidity sensor, IoT, Raindrop sensor, Nodemcu, Gas sensor, Soil moisture sensor.*

INTRODUCTION

The evolution of (IoT) the Internet of Things represents a significant milestone in the post-Internet era, ushering in a new wave of technological innovation and economic growth. At its core, IoT serves as a sophisticated framework that seamlessly connects all facets of our physical environment to the digital realm of the Internet. Its overarching objective is to facilitate the exchange and transmission of data through standardized protocols, enabling a higher level of interconnectedness and automation. IoT transcends traditional boundaries, enabling communication not only between humans but also between humans and devices, and even between devices themselves. This integrated system imagines a future where ordinary items, enhanced with microcontrollers, digital communication interfaces, and smart display systems, interact with each other and users. This convergence blurs the boundaries between the physical and digital realms. “The study of open-source hardware like Arduino plays a vital role in the design and development of applications based on IoT as well as based on cloud. Arduino with various sensors supports rapid development and flexibility for the addition/deletion of sensors.[9] ” Furthermore, through facilitating effortless access and connectivity with a wide range of devices such as household appliances, surveillance cameras, environmental sensors, actuators, displays, vehicles, and beyond, IoT lays the groundwork for creating inventive applications that capitalize on its extensive capabilities and diverse data generated by these interconnected entities. This interconnectedness enhances operational efficiency and enables novel insights and capabilities across various domains, from smart homes and cities to industrial automation and environmental monitoring. In the context of contemporary technological advancements, there is a significant emphasis on controlling and monitoring various activities to address human needs and challenges more dynamically. This progress is characterized by a relentless pursuit of efficiency in sensing and controlling diverse operations across different domains. Effective environmental monitoring systems have emerged as a crucial imperative for overseeing and assessing environmental conditions, especially when they exceed recommended thresholds or pose risks to human health and safety. As objects within the environment become increasingly equipped with sensor devices, microcontrollers, and advanced software applications, they transition into self-aware Additionally, within these intelligent environments, there are self-monitoring entities often referred to as smart environments alerts and warnings are automatically triggered in response to specific events or anomalies, enhancing situational awareness and responsiveness. “The recent environmental monitoring systems[11–14] are based on the sensors, such as temperature, humidity, and pressure sensors. Some of these sensors can support different environmental conditions. But, others require specific conditions. These sensors can capture the corresponding physical or chemical weather values and convert them to an electric signal. Hence, the captured values are transferred as electric signal to an electronic card. The last one is able to understand the received signals and give its respected value to each one. [1] “Smart environmental monitoring systems these entities play a pivotal role in detecting and mitigating the impacts of environmental changes on various organisms., including humans, animals, and plants. By integrating information from sensor devices into the environment, these systems enhance its intelligence and adaptability for diverse purposes, ranging from resource management and conservation to disaster prevention and response. The development of diverse monitoring systems tailored to specific needs and contexts underscores the importance of technological innovation in addressing complex societal challenges and advancing human well-being. These monitoring systems encompass a wide range of applications, including custom detection-based systems and spatial processes estimate frameworks, each designed to fulfill specific objectives and requirements. Against this backdrop, the main goal of this paper is to devise and execute a proficient monitoring system customized for smart cities, utilizing the potential of IoT and cloud computing technologies. Particularly, the proposed system targets remote monitoring and management of essential environmental parameters like temperature, humidity, rainfall, and atmospheric pressure, utilizing a cloud-integrated IoT platform. By collecting and analyzing real-time data from the sensor devices deployed across urban environments, the system provides actionable insights and early warnings to stakeholders, enabling informed decision-making and proactive intervention. Furthermore, the system offers seamless integration with existing infrastructure and communication networks, ensuring interoperability and scalability across different urban settings.

LITERATURE SURVEY

The table provided illustrates the Literature Survey, encompassing highly cited papers from 2021 to 2014. Recognizing the evolution of methodologies over time, along with their respective constraints, is crucial in this context.

Table 1. Literature survey

Sr. No.	Year	Title	Method/Algorithm used	Limitations of Existing Methodology
1.	2021	IoT Based Data Logger for Weather Monitoring Using Arduino-Based Wireless Sensor Networks with Remote Graphical Applications and Alerts	This study is an implementation of a system for monitoring environmental parameters using IoT. In this paper, they proposed an automatic weather monitoring system that uses Arduino.	A great deal of research work should be done to make sure they use as few components as possible to make sure it is cost-effective and should add a mobile app instead of using web-based monitoring.
2.	2017	Internet of Things-Based Weather Monitoring System	The paper focused on the utilization of environmental sensors to collect various parameters including temperature, pressure, humidity, rainfall, and light intensity. Incorporation of an LDR sensor. Employing an SMS alert system based on sensor values exceeding predefined thresholds.	The method relies on sensor technology, which may have limitations in accuracy and reliability, especially in extreme weather conditions or harsh environments. Additionally, the reliance on SMS alerts may be subject to network connectivity issues or delays.
3.	2017	Economical Live Weather Monitoring System with OLED Display	Utilization of ESP8266-EX microcontroller-based WeMos D1 board to fetch data from the cloud. Integration of an OLED display to showcase real-time weather conditions.	While the system provides real-time weather data and aims to address challenges faced by farmers and industries, it may have limitations in terms of scalability and coverage, particularly in remote or underdeveloped areas with limited access to cloud infrastructure.
4.	2019	Weather Monitoring and Prediction System for Day-to-Day Planning	Integration of sensor data, bus mobility, and deep learning technology. Utilization of a two-stage weather management system with friction model and local information processing.	Despite its predictive capabilities, the system may face challenges related to data accuracy and reliability, particularly in dynamically changing weather conditions. Moreover, the implementation of deep learning models may require significant computational resources and expertise.
5.	2017	IoT-Based Weather Monitoring System for Climate Change Observation	Utilization of swarm algorithm to enhance accuracy in climate data collection. Integration of IoT technology to transmit data to an Android mobile application through an API key.	While the project aims to provide accurate and efficient weather information, it may encounter challenges related to data synchronization, network connectivity, and scalability, especially when dealing with large volumes of sensor data in real-time.

PROPOSED METHODOLOGY

The proposed approach to developing a Cost-Effective Weather Monitoring System for Smart Cities entails a methodical framework tailored to address the unique requirements and challenges of urban environments. Here's a structured plan to guide the implementation process:

Clarify Objectives and Specifications

Begin by defining the objectives and specifications of the weather monitoring system tailored for smart cities. Identify key parameters for observation, including temperature, humidity, air quality, precipitation, and other relevant meteorological variables. Customize the system to align with the unique requirements and characteristics of urban environments, taking into account factors such as population density, infrastructure availability, and environmental considerations.

Site Evaluation and Sensor Selection:

Conduct a comprehensive assessment of potential monitoring locations within the city to ensure optimal coverage and data accuracy. Select appropriate sensor technologies capable of capturing the identified parameters effectively. Consider factors such as sensor accuracy, reliability, power efficiency, and compatibility with urban infrastructure.

Cloud Integration and Data Management

Integrate the monitoring system with cloud-based platforms for centralized data storage, processing, and analysis. Leverage scalable cloud services like AWS, Azure, or Google Cloud to handle large volumes of sensor data effectively. Employ rigorous data management protocols to uphold data integrity, security, and availability for stakeholders and decision-makers.

Data Analytics and Insights Generation

Apply advanced data analytics techniques to extract actionable insights from the collected sensor data. Employ algorithms for predictive modeling, trend analysis, and anomaly detection to identify patterns and correlations in urban weather patterns. Generate meaningful insights to support informed decision-making and urban planning initiatives.

Automation and Decision Support

Integrate automation capabilities into the monitoring system to enable proactive responses to weather-related events and emergencies. Implement intelligent algorithms and decision support systems to provide timely alerts, recommendations, and adaptive responses based on real-time data analysis. Enhance system resilience and responsiveness through continuous optimization and refinement.

Evaluation and Validation

Execute comprehensive testing procedures to assess the functionality and reliability of the entire system in various conditions, including controlled environments and real-world agricultural settings. Validate the system's performance against predefined benchmarks and objectives, iteratively refining and adjusting as needed to optimize functionality and accuracy.

Continuous Monitoring and Enhancement

Establish robust monitoring mechanisms to continuously track the system's performance and operational metrics over time. Solicit feedback from users and stakeholders to identify areas for enhancement and refinement. Implement iterative updates and improvements to enhance system functionality, responsiveness, and adaptability.

User Interface

Flutter Mobile App: Users can remotely monitor the environment using a dedicated mobile application.

Alerts: In case of critical conditions (e.g., for extreme temperature or Gas leakage), the app will alert the user see Fig. 1.1.

Security

Incorporate security protocols to safeguard the system against unauthorized entry and potential cybersecurity risks. The ThinkSpeak server furnishes a token that serves as authentication for accessing the API to retrieve data. It adds another level of security. The token is only provided to authorized users.

Real-time Data Visualization

Users can effortlessly monitor current weather conditions with visually appealing charts and graphs, providing intuitive insights into ongoing weather patterns:

Comprehensive Historical Data Analysis

Our system meticulously stores historical data, empowering users to delve deep into past trends and patterns, facilitating informed decision-making and trend analysis.

Robust User Authentication Mechanism

Security is paramount, and our mobile application implements robust user authentication protocols, ensuring secure access to the weather monitoring system, and safeguarding sensitive data from unauthorized access.

Data Collection Streamlining

The NodeMCU efficiently collects data from interconnected sensors at predefined intervals, ensuring consistent and accurate data acquisition.

Seamless Data Transmission

Leveraging the MQTT protocol, collected data is seamlessly transmitted to the cloud server, facilitating swift and reliable communication.

Mobile Application Integration

Users gain convenient access to weather data through our feature-rich Flutter mobile application, establishing seamless communication with the cloud server for real-time updates and data retrieval.

MODULE ARCHITECTURE

In conclusion, the utilization of a weather monitoring system integrated with NODEMCU and multiple sensors, alongside a Flutter application, represents a significant advancement in weather forecasting and monitoring see Fig. This innovative approach offers real-time data collection and analysis, enabling more accurate weather predictions and proactive decision-making for various applications. While challenges such as data accuracy and system reliability persists, the integration of advanced technologies like NODEMCU and Flutter demonstrates the promising potential for enhancing weather monitoring capabilities and improving overall forecasting accuracy.

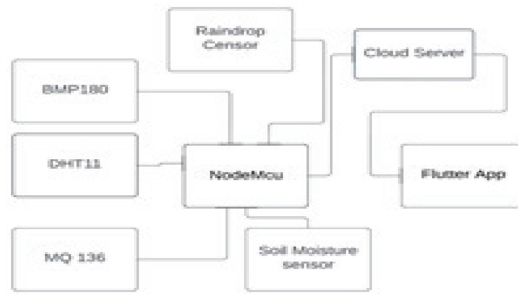

Fig. 1: Module Architecture

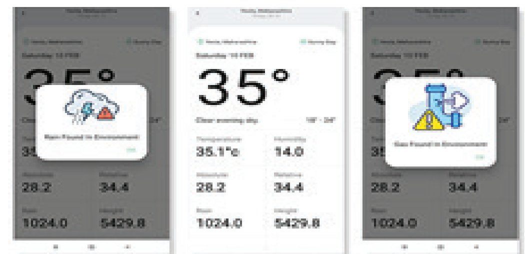

Fig. 1.1: Flutter App

The Module Includes the following components

NodeMcu: Utilizes ESP8266, Lua scripting, Wi-Fi connectivity, 32-bit MCU, GPIOs, ADC, UART, SPI, I2C, compact design, ideal for IoT prototyping.

Soil Moisture Sensor: Measures soil moisture, analog output, corrosion-resistant probe, 3.3V-5V, for agriculture, irrigation, Arduino compatible, easy integration, long-lasting.

Rain Sensor: Detects rainfall, digital output, adjustable sensitivity, weather monitoring, Arduino compatible, simple interface, reliable, durable, suitable for smart agriculture.

BMP180 Sensor: Barometric pressure, temperature sensor, I2C interface, high precision, low power consumption, for altitude, weather monitoring, Arduino compatible, accurate.

DHT11: Digital temperature, humidity sensor, single-bus interface, cost-effective, highly reliable, for climate monitoring, Arduino compatible, user-friendly, perfect for home automation.

Gas Sensor MQ136: Detects H_2S gas, high sensitivity, analog output, stable performance, environmental monitoring, safety applications, Arduino compatible, reliable, and precise measurements.

IMPLEMENTATION

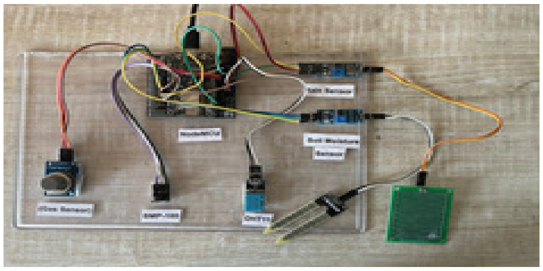

Fig. 2: Project Sensors Connecting to NodeMcu

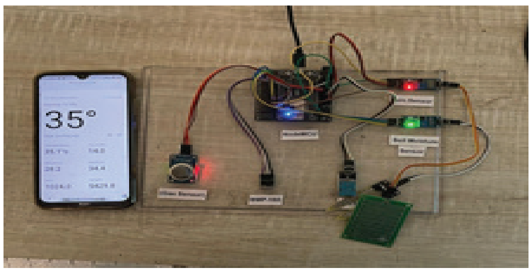

Fig. 3: The project turned on with Flutter app

RESULT

When assessing the outcomes of the implemented WiFi-based weather monitoring station, the analysis encompasses several key aspects:

Effectiveness of Monitoring and Control

Assess the system's effectiveness in monitoring and regulating weather conditions, including temperature, humidity, air pressure, and precipitation levels, utilizing WiFi connectivity.

Optimization of Resources

Assess the system's ability to optimize resource utilization, including water and energy, through data-driven insights and automated adjustments facilitated by WiFi-enabled sensors and actuators.

Impact on Environmental Conditions

Examine the system's influence on maintaining optimal environmental conditions conducive to plant growth, agricultural productivity, and overall sustainability within smart cities.

Data Accuracy and Consistency

Verify the accuracy and consistency of sensor data collected by the monitoring station over WiFi connections to ensure reliable decision-making and analysis.

Remote Monitoring and Control

Evaluate the efficiency and responsiveness of remote monitoring and control features enabled by WiFi connectivity, allowing users to access and manage the station's operations from anywhere with internet access.

Alerting Mechanisms

Assess the effectiveness of the system's alerting mechanisms in promptly notifying users about critical weather events, anomalies, or system issues, leveraging WiFi-based communication channels.

Energy Consumption and Sustainability

Analyze the energy consumption patterns of the monitoring station, considering power requirements and exploring opportunities for sustainable energy usage and operational efficiency enhancements within smart city environments.

Fig. 4: Absolute Pressure: This graph exhibits absolute pressure data, pivotal for altitude calculations and weather predictions, sourced from the BMP180 sensor.

Fig. 5: Relative Pressure: Depicting variations in relative pressure, essential for weather forecasting and trend analysis, obtained from the BMP180 sensor.

Fig. 6: Height: Illustrating changes in altitude, crucial for aviation and outdoor activity planning, calculated from barometric pressure data captured by the BMP180 sensor.

Fig. 7: Rain: Showing rainfall intensity or presence, significant for agricultural planning and flood prediction, detected by the rain sensor.

Fig. 8: Soil Moisture: Displays soil moisture levels, vital for irrigation scheduling and plant health monitoring, obtained using a soil moisture sensor.

Fig. 9: Humidity: Illustrates humidity levels, important for assessing comfort levels and preventing mold growth, measured by the DHT11 sensor.

Fig. 10: Temperature: Represents temperature fluctuations, fundamental for climate analysis and

system monitoring, recorded by the DHT11 sensor.

Fig. 11: Gas Presence: Indicates the presence of specific gases such as H2S, crucial for environmental monitoring and safety, detected by the MQ136 gas sensor.

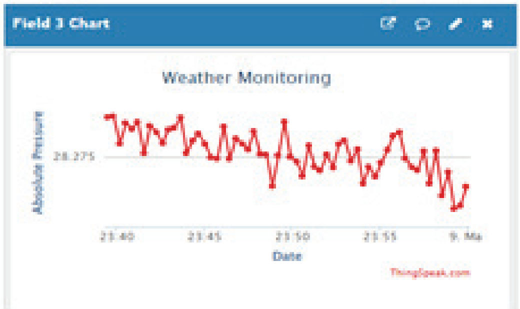

Fig. 4: Absolute Pressure

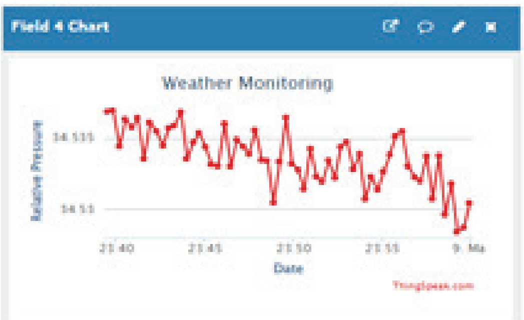

Fig. 5: Relative Pressure

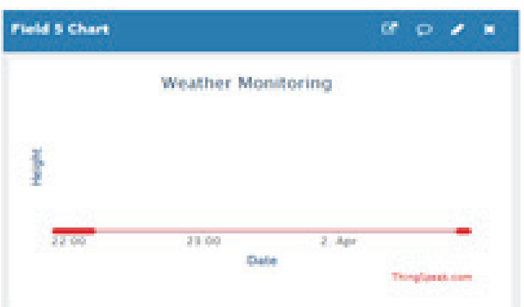

Fig. 6: Height

Fig. 7: Rain

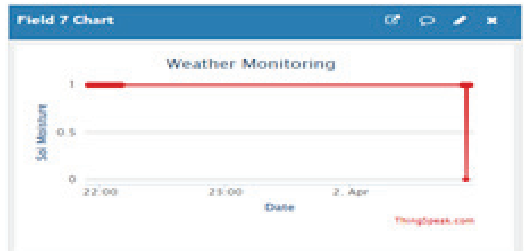

Fig.8: Soil Moisture

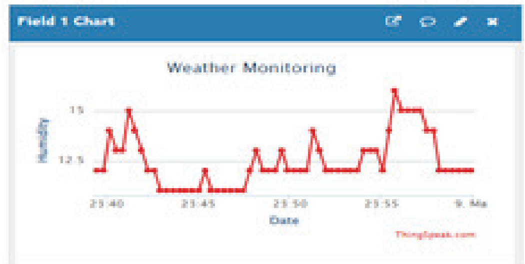

Fig. 9: Humidity

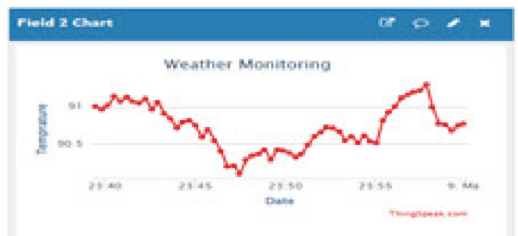

Fig. 10: Temperature

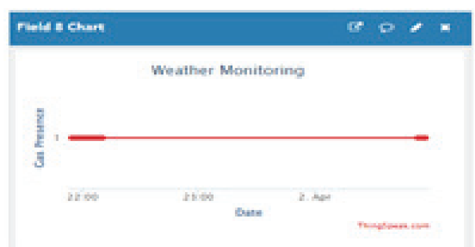

Fig. 11: Gas Presence

CONCLUSION

In conclusion, our cost-effective weather monitoring station for smart cities offers a groundbreaking solution to address the growing need for efficient environmental monitoring. By integrating multiple sensors and a user-friendly Flutter app, we provide real-time data on key weather parameters. This system not only improves the precision and dependability of weather data but also notably diminishes expenses and human involvement in contrast to conventional monitoring approaches.. With remote access to data via the app, city managers and residents can make informed decisions to improve safety, optimize resource allocation, and enhance overall urban resilience. By leveraging modern technology and innovative design, our solution contributes to the creation of smarter, more sustainable cities, ultimately benefiting communities and stakeholders alike.

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Smart IoT based Management for Greenhouse Farming for Controlled Environments

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ABSTRACT

The concept of smart agriculture is gaining prominence due to the capabilities of IoT sensors to gather information about agricultural fields and subsequently respond based on human input. This study focuses mostly on enhancing existing agricultural methods through the utilisation of contemporary technologies to achieve higher crop productivity. This study presents a prototype of an intelligent greenhouse, which enables farmers to automate farm operations and reduce the need for manual monitoring. A greenhouse, as an enclosed structure, provides protection to plants against severe weather conditions such as wind, hailstorms, UV radiation, and infestations by insects and pests. A proposal has been made to create a Smart Agriculture System that utilises the benefits of advanced technologies such as ARDUINO, Internet of Things (IoT), Wireless Sensor Network, and Machine Learning. The objective of the project is to utilise emerging technologies, specifically the Internet of Things (IoT) and smart agriculture, through automation. Monitoring environmental conditions is crucial for enhancing the productivity of high-performing crops. This study presents the construction of a system capable of monitoring temperature, humidity, wetness, leaf detection, and providing farmers with updated news through our web application.

Plant disease is a significant impediment to farmers' ability to maximise their profits from their harvest. This issue can be mitigated if the farmers diligently observe their crops from the initial planting phase till the final harvesting phase. This approach may be effective for small-scale farms, but it could become a laborious undertaking when applied to larger farms. The suggested technology will offer an enhanced and efficient method for farmers to oversee their crops. This system offers a disease classification function that will be trained using a Machine Learning methodology. Upon completion of the classification process, it will provide the resulting classification. Subsequently, a Web application will extract the data from the trained model. If a disease is detected, the findings will provide the percentage confidence that the plants on the farm are affected.

KEYWORDS: *Internet of Things (IoT), Smart agriculture utilising IoT, Soil moisture sensor, Photocell sensor, Air quality sensor.*

INTRODUCTION

Smart Farming is an agricultural management concept that utilises advanced technology to enhance the quantity and quality of agricultural products. Modern farmers have the ability to utilise advanced technologies like as GPS, soil scanning, data management, and Internet of Things. The user's text is "[2]". The objective of smart agriculture research is to establish a decision-making support system for farm management. Smart agriculture recognises the need to tackle the challenges posed by population expansion, climate change, and labour in a technologically advanced manner. This includes employing technology for tasks such as planting, watering, monitoring crop health, and harvesting. An Internet of Things (IoT)-based smart agriculture system is developed to monitor the crop field using various sensors such as light, humidity, temperature, and soil moisture. Additionally, it automates the irrigation system. In the agricultural environment, the term "Internet of Things" (IOT) refers to the utilisation of sensors, cameras, and other devices to convert all aspects and activities of farming into data. Smart agriculture is necessary for the expansion and development of the agricultural sector as it has the potential to significantly reduce the adverse environmental impacts associated with conventional farming practices. Smart cities utilise Internet of Things (IoT) devices, such as interconnected sensors, lights, and metres, to gather and analyse data. Subsequently, the cities utilise this data to enhance infrastructure, public utilities, services, and other related aspects. The user's text is "[3]." Farmers often struggle to comprehend technical terminology and the practical use of technology, which may often be a financially burdensome endeavour.

The Internet of Things (IoT) is currently and will continue to be a significant force in all industries, affecting the lives of individuals by imbuing intelligence into everything. It is a collection of diverse devices that form an autonomous network capable of organising itself. The advancements in Smart Farming, utilising Internet of Things (IoT), are revolutionising traditional agricultural practices. These innovations not only optimise farming processes but also make them cost-effective for farmers, while minimising crop wastage. The objective is to present a tool that can produce notifications for farmers across many platforms. The device will provide real-time data on temperature, humidity, soil moisture, UV index, and IR from the farmland. This data will enable farmers to make informed decisions and implement smart farming practices, resulting in increased crop yields and resource conservation, specifically water and fertilisers. The device described in this paper utilises an ESP32s Node MCU, a breadboard, a DHT11 Temperature and Humidity Sensor, a Soil Moisture Sensor, a SI1145 Digital UV Index / IR / Visible Light Sensor, jumper wires, LEDs, and allows for real-time data monitoring on the serial monitor and Blynk mobile application. This will enable farmers to effectively manage their crops using modern agricultural techniques.

Plants have become indispensable in our daily lives due to their capacity to provide food and protect us from detrimental radiation. The presence of plants is necessary for the sustenance of life on earth and the protection of the ozone layer, as they serve as a filter for UV radiation. The tomato is a significant agricultural crop and a widely consumed edible plant. Annually, the global consumption of tomatoes amounts to over 160 million tonnes. Tobacco cultivation plays a substantial role in alleviating poverty and is considered the primary source of income for rural people. Tomatoes, being one of the most nutrient-dense crops globally, significantly impact the agricultural sector due to their extensive production and cultivation. Tomatoes possess pharmacological properties that can aid in the prevention of several ailments such as high blood pressure, Hepatitis, and gum haemorrhage, in addition to being rich in nutrients. Tomatoes are highly sought for due to their widespread usage. Statistics indicate that small farmers contribute to over 80% of agricultural production, with about 50% of their crops being lost due to diseases and pests. Tomato development is mostly influenced by diseases and parasitic insects, hence it is imperative to do research on crop disease diagnostics. Manually detecting pests and pathogens is both inefficient and expensive. Hence, it is imperative to furnish farmers with automated, AI solutions that are based on picture analysis. Image-based computer vision applications rely on imaging to detect sickness, since it offers a dependable method of detection thanks to the presence of appropriate software packages or tools. They utilise advanced picture identification technology to process photos, resulting in improved image recognition efficacy, reduced expenses, and increased recognition precision. Although plants are essential for survival, they still encounter numerous obstacles. An accurate and prompt diagnosis reduces the likelihood of causing harm to the environment. Without a systematic approach to identifying illnesses, the product suffers in terms of both quality and quantity. This has an additional detrimental effect on a nation's economy. The Food and Agriculture Organisation of the United Nations (FAO) states that agricultural production has to increase by 70% by 2050 to meet global food demands.

On the other hand, the use of chemical disease prevention techniques such as fungicides and bactericides has a harmful impact on the agricultural environment. Consequently, the agroecosystem necessitates prompt and precise disease classification and detection technologies. Advanced disease detection systems for tomato plants can be developed using state-of-the-art technologies such as image processing and neural networks. Consequently, stress can lead to a 50% decline in agricultural productivity.

In the current agricultural system, crop monitoring is conducted using Arduino boards and GSM technology. In this setup, Arduino boards function as microcontrollers rather than servers. Therefore, to address these characteristics, Arduino Nano boards or Renesas microcontrollers are integrated with the current version of aurdino, which functions as both a microcontroller and a server. The primary characteristic of this system is its low installation cost and numerous benefits. One can remotely access and manage the agricultural system using a laptop, cell phone, or PC.

The proposed algorithmic application utilises advanced machine learning methodologies and cutting-edge picture recognition software to accurately detect and categorise various diseases. Before conducting photo pre-processing, acquire and record the contaminated area. Subsequently, collect the fragments, identify the affected area, and perform a process of extracting certain characteristics. This article provides a comprehensive guide on how to accurately detect and recognise plant diseases.

PROBLEM DESCRIPTION

Conventional agriculture and its accompanying industries are unable to meet the requirements of modern agriculture, which calls for productive, high-quality, and efficient output. To accurately determine the maximum production and ideal crop for a particular piece of land, it is essential to update current techniques and utilise information technology and data gathered over an extended period. The precision agriculture movement is characterised by the widespread use of mobile devices, reliable and affordable satellite technology for imaging and location services, and high-speed internet connectivity. Precision agriculture is a widely recognised IoT use in the agricultural business, and numerous organisations are implementing this approach on a global scale. Soil sensors that collect information on soil nutrient levels, pest presence, moisture levels, and other parameters can be utilised to systematically enhance agricultural productivity.

Greenhouse farming is a technology that enhances the yield of fruits, vegetables, and other products. Environmental factors in greenhouses are regulated either through manual intervention or by employing a proportional control system. The implementation of IoT applications in greenhouse technology can greatly enhance the efficiency and convenience of farmers' labour, providing them with significant benefits. Plant disease detection is a technique used to identify diseases that harm plants. This aids farmers in identifying and implementing the essential measures to treat the disease. Deep learning aids in precisely identifying diseases.

TOOLS AND TECHNOLOGY

Arduino Integrated Development Environment (IDE) : Creating code and uploading it to the board is a straightforward process using the free and open-source Arduino Software (IDE). This programme is compatible with any Arduino device.

Bylnk : Blynk is a mobile IoT platform designed for iOS and Android smartphones. It enables remote control of Arduino, Raspberry Pi, and Arduino devices via the Internet.

Anaconda: Anaconda is a software package that includes the Python and R programming languages. It is specifically designed for scientific computing and has the goal of making it easier to manage and distribute software packages.

A breadboard is an electronic gadget utilised for the purpose of testing electrical circuits. Instead of employing solder as a means of connecting wires and components together, as is often done on a full or printed circuit board, an alternative method involves affixing them into the holes of the breadboard using adhesive. The device features internal metal strips that facilitate their connection, allowing for effortless removal or relocation during circuit testing.

- The breadboard typically features rows and columns of perforations that are commonly designated with alphanumeric labels.

- All components will be interconnected in a linear arrangement, with each component assigned a unique number. The only exception is the breadboard, which features a central strip. Under those circumstances, the metal fractures, resulting in the division of the row into two distinct connections, with one on each side.
- The central bar is especially advantageous for interconnecting integrated circuits (ICs) due to its ability to facilitate pin connections on both sides without any overlapping connections. Typically, wires with a gauge of 22 or 24 are the most suitable for filling holes in the breadboard.

IMPLEMENTATION

The DHT11 is an inexpensive, entry-level digital temperature and humidity sensor, depicted in Figure 1.3. An electrical phenomena humidity sensor and thermal resistor are utilised to monitor nearby air conditions and produce a digital signal on the information pin. It is straightforward to use, but it requires careful timing to retrieve data. The temperature range for measurement is -40 to +125 degrees Celsius with an accuracy of ±0. The DHT11 has a temperature range of zero to fifty degrees Celsius with an accuracy of +-2 degrees, while the precision of the other device is five degrees.

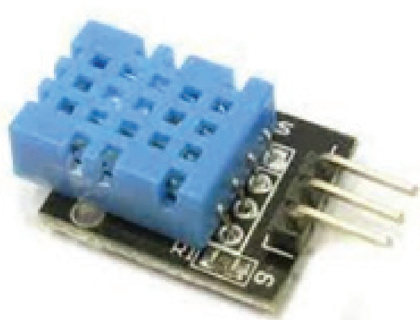

Fig. 1. DHT11 temperature sensor

Soil moisture sensors quantify the moisture content in the soil. Soil moisture affects the microwave radiation that is reflected, and this radiation is utilised for remote sensing in hydrology and agriculture. Agriculturists or horticulturists have the option to utilise portable screening machines. Soil moisture sensors facilitate effective irrigation management. Effective irrigation management leads to improved crop quality, reduced resource use, and enhanced financial gains. Soil moisture sensors aid irrigators in comprehending the conditions within the middle region of the crop.The user's text is enclosed in tags.

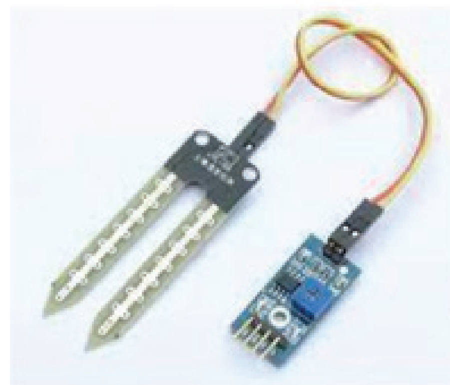

Fig. 2. Soil moisture Sensors

Photo sensors utilise light to quantify the characteristics of the soil. They are deployed on satellites, drones, or robots to ascertain soil composition, organic matter, and soil moisture levels. The user's text is "[12]".

Fig. 3. Photo Sensor

The MQ135 Gas Sensor is a module that provides both digital and analogue output to measure air quality. The MQ135 gas sensor utilises SnO_2 as its sensitive material, which exhibits poor conductivity when exposed to pure air. As the concentration of the desired flammable gas increases, the conductivity of the sensor also increases. The MQ135 gas sensor exhibits a heightened sensitivity towards ammonia, sulphur, and benzene vapours. It is also responsive to fumes and other harmful gases. It is cost-effective and adaptable for a wide range of uses. The user's text is "[13]". These devices are utilised to detect hazardous gases in the environment, including as ammonia, aromatics, sulphur, benzene vapour, and other noxious gases or fumes. Concentration range tested: 10 to 1000 parts per million (ppm) Submit an application to.

Fig. 4. MQ135 Gas Sensor

The implementation of Agri-IoT is used to manage the operational processes involved in agricultural product processing. Firstly, it is necessary to address the issue of context-based online processing and distribution collaborative scheduling for agricultural products under the Internet of Things (IoT). The timely processing and delivery of agricultural goods require close cooperation between every stage of the process. The scheduled objects display a state that is both continuous and dynamic. The fundamental challenge of online intelligent collaborative optimisation lies in transforming the stages of selection, processing, categorization, packing, and distribution into a seamless and intelligent workflow within the framework of the Internet of Things (IoT). However, it is essential to optimise the organisational architecture of agricultural product processing. Agri-IoT's superior intelligence enhances the operational efficiency of the agricultural supply chain and decreases labour expenses. An effective business process necessitates a high level of resilience and a low level of risk. The expectation is to establish a trade-off between different parts and ultimately propose an appropriate organisational architecture. Managing the sale and post-sale service of agricultural products using Agri-IoT technology. The main objective is to investigate quality management and traceability techniques for the complete life cycle of agricultural products. Initially, it is necessary to customise a food quality and safety management system that relies on monitoring data within the framework of Agri-IoT to align with the specific attributes of the agricultural product supply chain. Furthermore, presenting marketing strategies for agricultural products inside the framework of the Internet of Things (IoT) holds significant worth. When building marketing models, it is important to take into account the present sales status of agricultural products and the characteristics of Agri-IoT.

CONCLUSION

The developed automated Smart Agriculture system effectively minimises the time and resources needed for manual operation. This system utilises Internet of Things technologies. The technology also assesses soil moisture and water levels in fields. We employ air quality monitors and photo sensors. This system functions optimally under ideal settings, however enhancements can be made to address suboptimal conditions such as inadequate illumination or lighting. The sensors and microcontrollers of all three Nodes have been successfully connected to the raspberry pi, enabling wireless communication between the different Nodes. Empirical evidence and experimental trials confirm that the project offers comprehensive resolutions to field operations, irrigation challenges, and storage issues through the use of a remotely operated robot, an intelligent irrigation system, and an advanced warehouse management system, respectively. The Plant disease detection system aids farmers in identifying plants that are infected by bacteria. It provides precise results with a percentage indicating the level of accuracy. Deploying such a technology in the agricultural sector can certainly enhance crop yield and overall productivity.

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IoT based Milk Adulteration Detection System using Nano Sensor Technology

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ABSTRACT

Milk adulteration poses a global challenge and societal issue, affecting both less developed and more advanced nations. The risk is particularly pronounced in developing countries due to inadequate monitoring and policy frameworks. Milk, a crucial nutritional source for a significant portion of the global population, faces contamination with various adulterants such as starch, sucrose, urea, formaldehyde, detergent, etc. This not only affects the quality of milk but also poses several health risks for users. In the proposed system the use of the Internet of Things (IoT) with Machine Learning (ML) can help predict and detect milk adulterants in real-time thereby informing dairy processors about the quality of milk during intake to the plant from dairy farms. The Edge-ML-based architecture allows the implementation of milk adulteration detection techniques in dairy processing, hence providing real-time monitoring of milk quality. The milk monitoring identification/checking framework utilizes sensors like pH, temperature, MQ2 Gas sensor, etc. In the real-time detection of milk adulterants, this proposed system implemented using Raspberry pi 3 microcontroller programmed with neural network classifier for low cost and accurate milk adulteration testing.

This research work involves the design and development of a low-cost, portable, ML-based, non-destructive sensor based system that can be used to detect the milk adulterant in real-time. The sensor system is connected to the internet via the developed IoT application module, which displays the detected adulterant results in a Thing Speak cloud platform. This IoT application enables the adulterant detected results published on the internet immediately in the form of graph and the information is stored in Excel sheet.

KEYWORDS: *IoT, Machine learning, Milk adulteration, Sensors, Algorithm, Analytics.*

INTRODUCTION

Milk is often hailed as the 'ideal food' due to its rich content of essential nutrients crucial for both infants and adults. It provides proteins, minerals, health-promoting vitamins, and energy-supplying lactose and milk fat. Despite its nutritional benefits, global concerns regarding milk adulteration escalated following the melamine contamination scandal in Chinese infant milk products. Unfortunately, milk adulteration is widespread worldwide, particularly in developing and underdeveloped countries, where inadequate monitoring and weak law enforcement prevail, leading to ethical, economic, and health-related consequences. Apart from the ethical and economical issue, it also creates health diseases. Most of the times, the adulteration is intended to make greater profit, but sometimes it may be due to the lack of proper awareness. The reasons behind it may include- perishable nature of milk, demand and supply gap, low purchasing capability of customer and lack of suitable adulterant detection methods. Chemical adulterants are used for different purposes but it lead to affect the quality of milk. The common adulterants are sugar, water, salt, starch, chlorine, hydrated lime, sodium carbonate, formalin, sodium bicarbonate, ammonium sulphate, H2O2 and non-milk proteins etc. To meet the shortage of milk, some people are preparing synthetic milk by mixing urea, caustic soda, refined oil and common detergents which has poisonous effect. Hence, the current review highlights the milk adulterants, their detection and their hazards on health of consumers[1],[2].

Milk, constituting about 87% water and containing essential elements such as proteins, fats, lipids, lactose, vitamins, minerals, and enzymes, is a highly nutritious beverage, particularly beneficial for the well-being of young individuals [3]. Its rich nutritional profile makes it beneficial for the good health of young infants. It's essential to note that adding chemical agents to milk for different reasons can pose serious health risks and ethical concerns. Adulterants are added for enhancing the flavor, shelf life, consistency, or thickness. The widespread issue of milk adulteration poses a substantial threat, particularly in developing countries like India. In 2016, a comprehensive nationwide survey conducted by the Food Safety and Standards Authority of India (FSSAI) highlighted the severity of the problem, revealing that approximately 68.7% of milk and its derivatives were contaminated with harmful substances[4]. This pervasive adulteration not only compromises the nutritional integrity of the milk but also presents potential health risks[5].

The system incorporates a robust hardware setup, featuring nano sensors interfaced with Raspberry Pi 3 microcontroller, enabling the acquisition of precise data regarding the milk's composition. The data is transmitted to a centralized cloud platform through IoT connectivity, facilitating efficient storage, analysis, and real-time monitoring[6]. The core of the system lies in its machine learning component, where a sophisticated model is trained using a diverse dataset of milk samples[4]. This model learns to distinguish between pure and adulterated milk based on the unique patterns detected by the nano-sensors. The trained model is deployed for continuous monitoring, ensuring prompt identification of any adulteration attempts. To enhance user accessibility, a user-friendly interface, be it a web as well as message based mobile application, is developed for real-time monitoring and control. In case of detection of adulteration, an alert system is integrated to notify relevant stakeholders, enabling swift intervention and preventive measures[6].

IoT (Internet of Things) based detection of milk adulterants using nano-sensor technology is a cutting-edge approach that combines modern technology with the food industry. This system involves the use of small, sensitive nano-sensors that can detect various adulterants in milk such as water, chemicals, or other contaminants[7]. These sensors are connected to the internet, forming an IoT network that can transmit real-time data to a central monitoring system. This enables timely detection of adulteration and ensures the quality and safety of milk products[8].

DESIGN AND DEVELOPMENT

The block diagram of the proposed milk testing equipment is shown in Fig. 1. The IoT-based detection system for milk adulterants incorporates a pH sensor, Temperature sensor, and MQ-135 gas sensor to detect acidity, Temperature, and the presence of harmful gases, respectively.

A historical dataset comprising labeled samples of both pure and adulterated milk was utilized to train the machine learning model. Data collected from sensors and the CSV dataset undergo pre-processing. It clean and normalize data, label samples as pure or adulterated.

It identify and select relevant features like temperature, pH level, gas levels, and other critical factors affecting milk quality from the dataset. The extracted features are then passed to the neural network for classification. Neural network learns from the data and predicts pure or adulterated milk. The collected data and result is then transmitted and stored on ThingSpeak, an IoT platform for real-time monitoring. It upload sensor readings and classification results[13].

Raspberry Pi acts as a central processing unit. In this project we are using Raspberry Pi 3since it supports a variety of open-source software and libraries, making it easier to implement machine learning models and integrate them into the system. Each sensor is connected to a microcontroller Raspberry Pi which processes the sensor readings. The microcontroller then transmits the processed data to Thing Speak for visualization using Wi-Fi or other connectivity options. The ThingSpeak is the open-source platform integrated with MATLAB analytics enables user to aggregate, visualize, and analyze live real-time data streams in the cloud[4]. It offers instant visualizations of data posted by your devices or equipment allowing for the execution of MATLAB code withinin the ThingSpeak platform. This facilitates and perform online analysis and processing of the incoming data, enhancing efficiency and enabling live insights[7]. It also executes the machine learning model for classification. Power supply Provides continuous power to the Raspberry Pi and connected sensors for uninterrupted operation. Users can interact with the system through users interface. Views real-time and historical data as well as receive alerts and notifications through buzzer and SMS in case of detected adulteration.

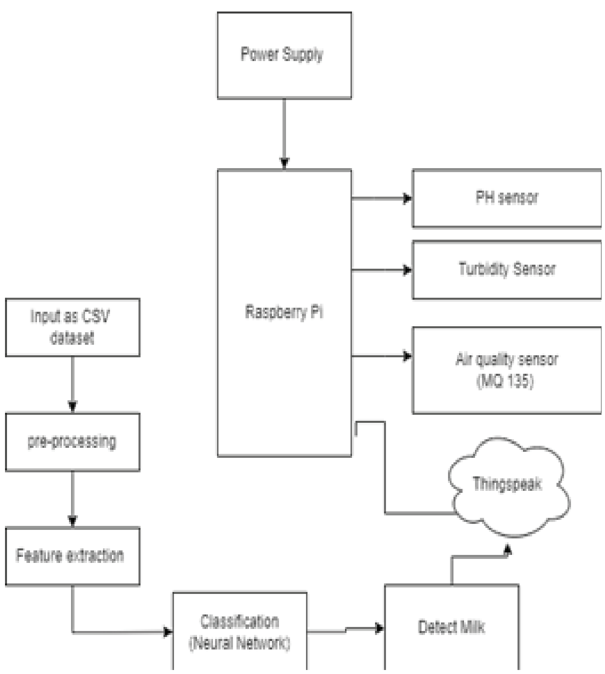

Fig. 1: Block diagram of Milk Adulteration Detection System

SYSTEM INTEGRATION

Nano sensor Technology- Investigated methods to enhance the sensitivity and selectivity of nano-sensors for detecting a wider range of milk adulterants and contaminants. This involves optimizing sensor materials, surface functionalization, or exploring new nano materials[10].

Researched on the development of nano-sensors capable of simultaneously detecting multiple parameters in milk, such as fat content, protein content, lactose, urea, detergent and the presence of specific contaminants[12]. Through this process pH sensor, Gas sensor, temperature sensor, etc. are more suitable for detection of adulterants.

Integration of IoT Technology-The system leverages IoT technology, creating a network of interconnected devices (nano sensors) that communicate and share data seamlessly. This interconnectedness enables a comprehensive and real-time approach to monitoring milk quality[13].

Cloud Computing and Storage-Thing Speak is the open IoT cloud platform serves as the repository for the collected data. It offers users to aggregate, visualize, and analyze real-time data streams in the cloud[13]. It facilitates efficient storage, analysis, and management of the vast amount of information generated by the nano-sensors.

Alert System-In the event of detecting adulteration, an integrated alert system notifies relevant stakeholders[11]. This ensures prompt intervention and preventive measures to uphold the quality and safety standards of the milk supply chain. In this system alerts are sent through SMS, as well as buzzer is implemented in the system to ensure timely responses.

Machine Learning- Machine Learning algorithms play a crucial role in the identification and extraction of relevant features from the sensor data. Fig.2 shows the Machine Learning algorithm of the proposed system. Researchers can experiment with different feature extraction techniques to enhance the discriminatory power of the system, capturing essential information from pH, temperature, and gas sensor readings.

Milk datasets may often be imbalanced, with fewer instances of adulterated samples[15]. ML algorithms can be tailored to handle imbalanced data through methods like oversampling, under sampling, or advanced techniques such as Synthetic Minority Over-sampling Technique (SMOTE) to ensure fair representation of both classes[13]. ML algorithms enable the system to perform real-time monitoring by continuously analyzing incoming sensor data.

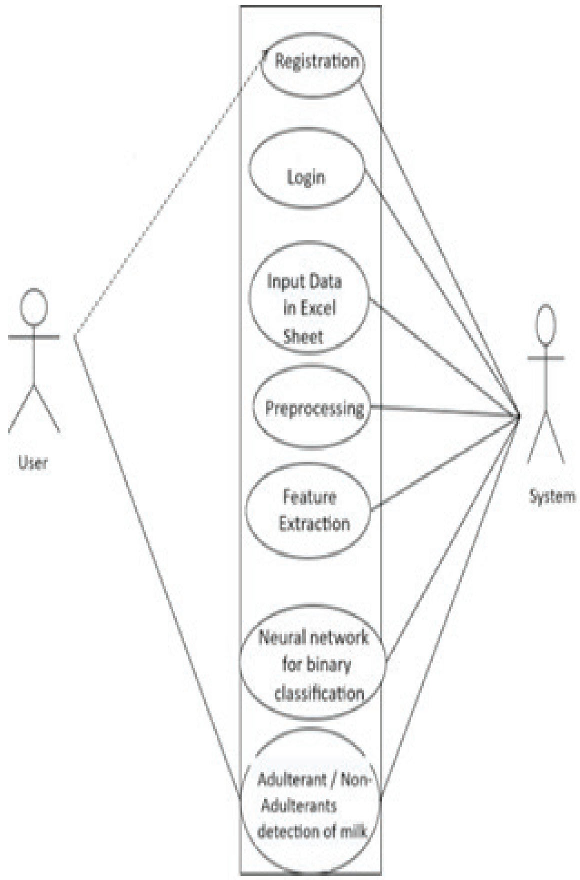

Fig. 2: Machine learning Algorithm

Step I: Data Acquisition

Identify the data source, which is an Excel sheet in this case.

Read the data from the Excel sheet into your machine learning environment using libraries like pandas in Python.

Step II: Preprocessing

TensorFlow ecosystem is used for preprocessing data and Handling missing values, outliers, and inconsistencies in the data collected from the excel sheet result. It converts categorical variables into numerical representations through techniques like one-hot encoding. Normalize or standardize numerical features to bring them to a similar scale.

Step III: Model Selection

A Convolution Neural Network is used for the classification task. Here binary classification is achieved by single-output neural network with a sigmoid activation function in the output layer. According to the samples Decision of choosing the number of hidden layers and neurons per layer is based on the data collected, complexity of the problem and computational resources.

Step IV: Model Training

Spliting the preprocessed data into training and testing sets.

Initialize the neural network model. Training the model using the training data. This involves forward propagation to compute predictions, calculating the loss function, and back propagation to update the model parameters (weights and biases) using optimization algorithms of gradient descent.

Step V: Model Evaluation

Evaluating the trained model's performance using the testing data. Calculating metrics such as accuracy, precision, recall, F1-score, and confusion matrix to assess the model's effectiveness in classification.

Step VI : Deployment

Deploying the trained model for real-world use, which could involve integrating it into an application, serving it as an API, or deploying it as a web service by ensure that the deployment environment is compatible with the model and can handle the required computational resources.

Step VII: Monitoring and Maintenance

Continuously monitor the deployed model's performance and retrain/update it as needed to maintain its effectiveness. Handling any changes in data distribution or model requirements by adapting the model accordingly.

By following these steps, Machine Learning algorithm can effectively build, train, and classify the quality of milk.

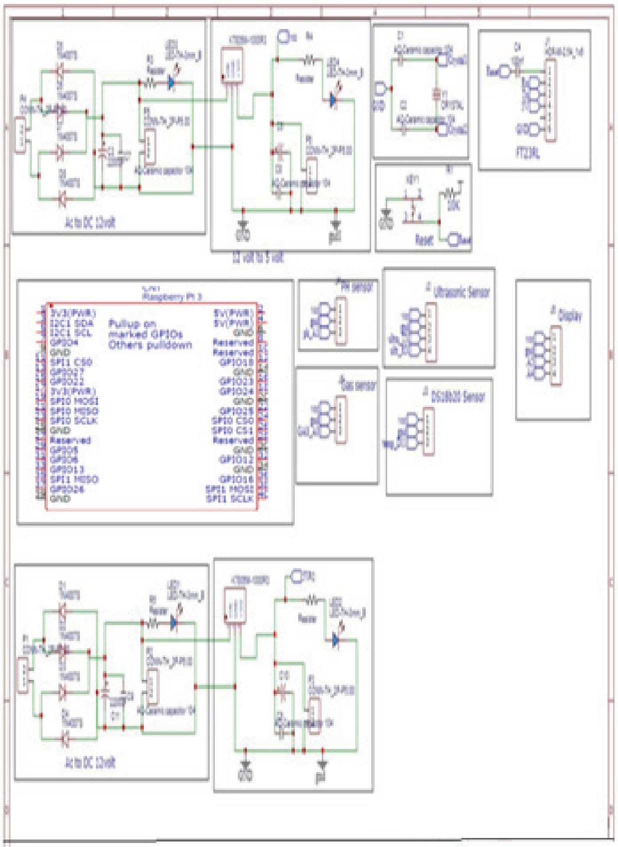

Fig. 3 Circuit Diagram of the proposed system

Prototype of designed system is shown in fig.4.

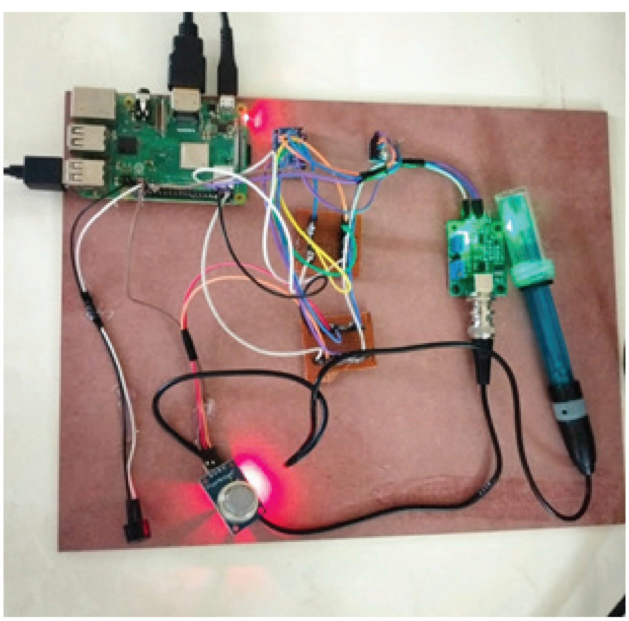

Fig. 4: Prototype of Milk Adulteration Detection System

RESULTS AND DISCUSSION

The pH sensor chart on Thing Speak displays the acidity or alkalinity levels of the milk over time. It provides insights into the variations in pH, which is a crucial parameter for assessing milk quality[9]. Anomalies or sudden shifts in pH trends could indicate potential adulteration or contamination, prompting further investigation.

Fig. 5: Testing pH of Milk through pH sensor

The normal pH value of milk lies between 6.5 to 7. When some adulterants are added in the milk its pH value changes due to which we can get clarity adulteration in milk[16].

Resullt of milk sample after testing pH of milk sample is shown below fig. 7. It displays the pH of different milk samples on the screen which gives clarity of acidity or alkalinity of milk.

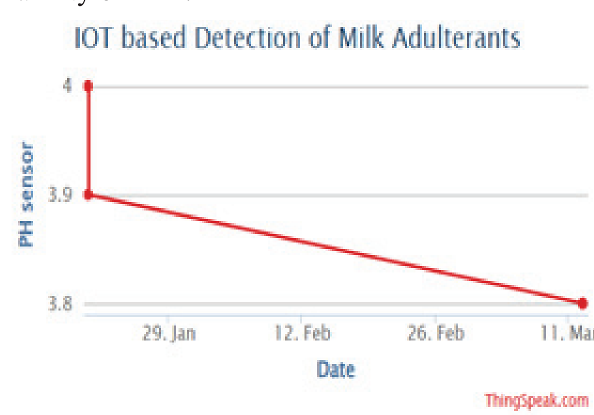

Fig. 6: pH sensor output chart

The gas sensor chart illustrates the concentrations of gases or contaminants detected in the milk. This information is vital for identifying any harmful substances that may have been introduced[3]. Sudden spikes or unusual patterns in gas concentrations can serve as indicators of potential adulteration or contamination, guiding the system to flag such instances[15].

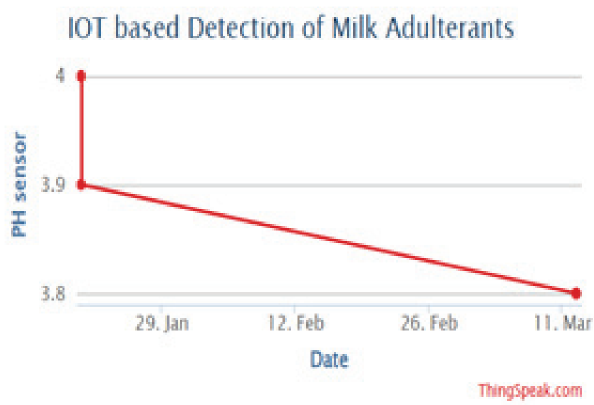

Fig. 7: Gas sensor output chart

The Temperature sensor chart showcases the temperature variations in the milk samples recorded over time. Monitoring temperature is essential for ensuring the freshness and safety of milk[16]. Any deviations from the expected temperature range might signal improper storage conditions or adulteration attempts, leading to timely corrective action[18].

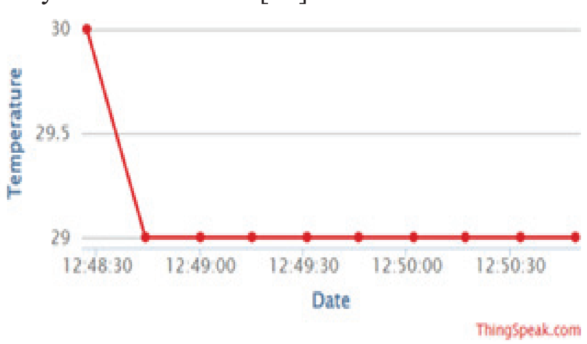

Fig. 8: Temperature sensor output chart

These sensors, when integrated into the IoT system, can provide real-time data that is transmitted to a central server for analysis. Machine learning algorithms can then be trained to interpret the sensor data and identify patterns indicative of milk adulteration[13]. For example, changes in pH levels, unusual temperature fluctuations, or the presence of specific gases beyond acceptable limits could trigger alerts or further investigation.

Grade A milk go through careful production, processing and packaging in order to ensure the safety of the consumers. Typically, raw milk is pasteurized using either by low temperature pasteurization, where the milk is heated to 1450F or higher for at least 30 minutes, or by high-temperature pasteurization, where the milk is heated to 1610F or higher for at least 15 seconds and then quickly cooled. Pasteurization destroys harmful bacteria, thereby extending the shelf life of milk and promising its safety for consumption. Nevertheless, pasteurized milk can easily spoil and could cause food borne illness(food poisoning) if not properly preserved and handled. Refrigeration is the single most important factor in maintaining the safety of milk[14] in industries as well as home use. By law, Grade A milk must be stored at a temperature of 45 °F or below to prevent bacterial growth. Bacteria in milk will grow minimally below 45 °F. However, temperatures well below 40 °F are necessary to protect the milk's quality. This temperature control is essential throughout the entire milk supply chain, including warehousing, distribution, delivery and storage, to uphold the integrity and safety of the milk.

Infants, pregnant women, the elderly and the individuals with chronic illness such as those undergoing cancer treatments and individuals with AIDS, diabetes or kidney disease are particularly vulnerable to serious illness due to consuming any unsafe food and contaminated milk. These caregivers and those individuals who care for them must handle milk with extra caution and safely[16].

Fresh milk is primarily categorized by its fat content, the amount of butterfat, etc. aiming to provide clarity to consumers regarding the distinctions between different types of milk. In November 1997, the FDA introduced a new rule for milk labeling assist consumers in clarifying the difference between 1- and 2-percent milk and to emphasize the fact that skim milk is fat-free. According to the new rule, 2-percent milk is termed as reduced fat; 1-percent milk is termed as low-fat; additionally, skim milk is now called as fat-free or non-fat, despite the possibility of containing up to 0.5 grams of fat in a one cup serving[19]. Hence it is essential to maintain the temperature of milk to keep it fresh and maintain its quality.

In this experimental project we are using Contactless temperature sensors, also known as non-contact or infrared temperature sensors, use infrared technology to measure the temperature of an object without physically touching it. The sensor needs to be calibrated based on the characteristics of the milk. Calibration ensures that the readings correspond accurately to the actual temperature of the milk as shown in fig 8.Using contactless temperature sensors in checking the temperature of milk offers advantages such as speed, non-invasiveness, and the ability to monitor temperature without physically interacting with the milk.

As milk spoils, it undergoes chemical changes that release specific gases or volatile compounds. Gas sensors can detect these changes and identify the presence of spoilage-related gases, such as ammonia, amines, or fatty acids. Early detection of spoilage can help prevent the distribution of spoiled milk products[3].Gas sensors can be employed in storage facilities, transport containers, or processing plants to monitor the environment around milk. Changes in temperature, humidity, or the presence of specific gases can be indicative of conditions that may affect the quality of the milk[12].

Gas sensor is integrated into an IoT-based system for centralized monitoring. The data collected by gas sensors can be transmitted to a central server or processing unit, such as a Raspberry Pi, where machine learning algorithms can analyze the information and identify patterns associated with poor milk quality. Thing Speak is an IoT (Internet of Things) platform that allows users to collect, analyze, and visualize data from their connected devices. When data is collected and stored on ThingSpeak, users often want to export or view the data in various formats, including Excel. The collected data is stored in Excel sheet as shown in fig. 10. Field1 stores the data of pH sensor readings, field2 stores data of temperature sensor and field3 stores the data of gas sensor.

Test Date	Time	Entry ID	pH Level	Temp ©	Gas Sensor	Remark
17-01-24	12:48	1	6.8	28	1	Good
17-01-24	12:50	2	3.5	27	0	Bad
17-01-24	12:52	3	3.7	29	0	Bad
17-01-24	12:54	4	3.8	28	0	Bad
17-01-24	12:56	5	4.1	30	1	Good
17-01-24	12:58	6	6.5	28	1	Good
17-01-24	1:00	7	6.2	38	1	Good
17-01-24	1:02	8	3.9	32	0	Bad
17-01-24	1:04	9	7.8	28	0	Bad

Fig. 9: Sensor Output Result

CONCLUSION

In conclusion, the development of an IoT-based Milk Adulteration Detection system represents a noteworthy advancement in ensuring the safety and integrity of the milk supply chain. By leveraging Nano-sensors with its high sensitivity and accuracy, combined with the power of IoT connectivity and ML algorithms, this system offers real-time monitoring and analysis of milk quality. The accuracy of the machine learning model is about 95 – 98%. Through continuous surveillance and rapid detection of adulterants, stakeholders can take timely corrective actions to prevent contaminated milk from reaching consumers, thereby safeguarding public health. Furthermore the implementation of this technology contributes to enhancing consumers trust, promoting transparency in the dairy industry, and mitigating economic losses associated with adulteration incidents. As further research and development continue to refine and optimize this system, its potential for widespread adoption holds promise for creating a safer and more reliable milk supply chain ecosystem.

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Noise Reduction in RPE-LTP Speech Coding using DCT, DFT and DWT Techniques

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ABSTRACT

The determination of signal processing algorithms in speech coding require the selection of performance parameters as per the application. Along with bit rate and computational complexity, the list of other important performance parameters includes Signal To Noise Ratio (SNR), Mean Square Error (MSE), Mean Opinion Score (MOS) and Perceptual Evaluation of Speech Quality(PESQ) to reflect the quality of recovered speech signal. In this paper, these quality measures are considered for the quality assessment after applying energy detection using Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) for noise reduction in RPE-LTP speech coding. It is found that objective quality measures and subjective testing both are useful means of signal quality assessment in performance. The Proposed noise reduction techniques have shown remarkable quality improvement whereas DCT outperforms.

KEYWORDS: *Energy detection, Discrete Fourier Transform(DFT), Discrete Cosine Transform (DCT), Discrete wavelet transform (DWT), Thresholding.*

INTRODUCTION

The world in and out is full of one common signal, noise. There are numerous types of sound signal sources around us which we may or may not hear. The signals which get mixed with desired signal is easily carry forwarded for the processing and becomes companion of it. At the destination side when it appears with the signal of our interest called desired signal then its presence is realized. This signal is nothing but noise, the unwanted signal. The noise signal may get mixed with the desired signal at any stage of signal processing system. Hence it is very important to keep monitoring, recognizing and if found then deal with it at every stage of signal processing [1][2][3]. The noise signal origin may be near or distant. It may get cancelled before reaching to the system. Some noise component however, may reach or get generated in the system itself. If the energy of noise signal is poor then it may get suppressed in the process flow. But high energy noise signal which may ruin the communication system must be filtered out[4][5].

LITERATURE SURVEY

The survey of existing speech coding techniques and noise reduction efforts taken in past have been presented in the survey.

RPE-LTP encoder

The block schematic of the RPE-LTP encoder is shown in fig.1. The input speech is segmented in the frames 160 signal samples in each. These samples are then forwarded to LP analysis Filter to determine the short term analysis filter parameters called coefficients. The process from segmentation to Coefficients is called as LPC analysis. Simultaneously, the 160 sample frame is filtered by using these parameters through autocorrelation operation to produce the short term residual signal. These filter parameters called as reflection coefficients are transformed to Log Area Ratios[6][7].The 160 samples of short term residual signals are shortened into 4 sub-frames with 40 samples per frame for block wise processing. First, the estimation of LTP lag and LTP gain parameters of the long term analysis filter by using current block or 40 and remaining 120 short term residual samples is completed and updated in the LTP analysis block.The estimated short term residual signal and 40 LT residual signal samples are subtracted to get Long Term residual signal samples. These 40 long term residual samples block is given to the Regular Pulse Excitation analysis for compression by representing 1sub-sequences in just 13 pulses function of the algorithm[8][9]. The frame of 13 pulses from RPE is encoded using Adaptive Pulse Code Modulation (APCM). The reconstructed short term residual signal is obtained by adding 40 quantized samples of the long term residual and 40 samples of the quantized version of the long term residual signal. The reconstructed signal block is used by LP section for estimation of next sub-block.

The RPE-LTP coding technique is sufficient enough to handle the interference because of in speech signal or internally generated noise. The coding technique is based on prediction and estimation keeps the gap towards quality performance.

The research has been done for the reduction of noise signal pre or post and in the coding process of many coders of speech signal. However there is always scope of improvement and hence the paper presents the noise reduction by using Discrete Fourier Transform (DFT), Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) for noise reduction in RPE-LTP speech coding[10][11]. The objective of Noise Reduction in Speech Processing is to test the well-known techniques in novel manner for enhancement of the qualitative performance of speech coder.

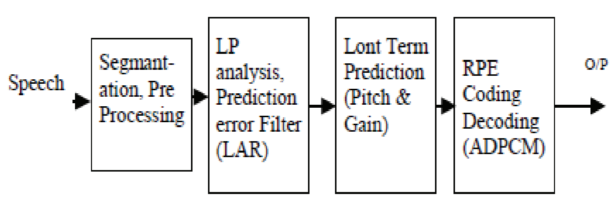


Fig. 1: Block Diagram of RPE-LTP Speech Coder

Discrete Fourier Transform (DFT)

Fourier series and Fourier transform tools are used to analyze continuous signals. DFT is the modified version of FT which is used for discrete data i.e. sampled signal. Formula for discrete time Fourier Transform is given by eqn. 1

$$(\omega)= \sum_{-\infty}^{\infty} f(k).e^{-j\omega k}(k), \qquad k \in Z \qquad (1)$$

F(ω) is a Fourier series expansion of f(k) speech samples. The function, F(ω) is “2π” periodic function[3]. DFT yields frequency content of the discrete signal and the high frequency noise component can be filtered out from speech signal from the spectral output of DFT operation.

Discrete Cosine Transform

DCT is one of the most preferred tools as it has unique energy compaction property. This is very useful for removal of noise signal content process. By using DCT, the energy of speech samples identified and based on energy level of the samples it will become easy to find the high energy and low energy samples [12]. It would be well assumed that the low energy samples are noise signal samples and can be separated out by retaining high energy samples as they are speech signal samples. Hence it is possible to concentrate on few coefficients by easy way removal of noise [13].

More the less, DCT has higher spectral resolution as compare to other similar transforms e.g. If the window size is N indicated the same number of spectral components which are real and possess binary phase value. The noise changes phase of the signal which is an indicator that if phase change is seen then it is sure a noise. This shows a better degree of noise detection because only noise can change the sign of the coefficient [14].

Hence, even though the high energy coefficient is seen with phase change then it will surely be a noise signal.

The Discrete Cosine Transform consider frequency component and separate it out as per sign and magnitude of the component. The sign portion has either positive or negative components and the magnitude collects only higher energy value components. This makes the task of separating out the noise frequency component which are obviously low in magnitude [15][16]. Thereafter the magnitude and sign group components are recombined to obtain the optimal quality speech reconstructed using a similar scheme as here above.

Discrete Wavelet Transform (DWT)

The discrete wavelet transform supports the compute/analyze/process the signal on computers. The Discrete Wavelet Transform (DWT) provides the sequence of signal samples in the form of orthonormal coefficients sequence by shifting and scaling operation. It is one of the fastest and numerically stable algorithms used for sequence analysis and synthesis. To find out discrete wavelet transform of any signal f(t), we need basis functions [4].

If the scaling function is represented by ∅ (t) and wavelet function by ψ(t).

The scaling function ∅(t)∈V0 is the set of functions consisting where V0 is space of functions.

All scaling functions are obtained from basis function by translation and dilation process.

In similar fashion, wavelet function works. The wavelet basis function is called as "mother wavelet" and all other functions derived from mother wavelet are termed as child functions or child wavelets obtained after translation and dilation operation.[17].

$$\psi_{j,k}(t) = 2^{j/2}\, \psi\,(2^{j}\, t-k) \tag{2}$$

The DWT is a multistage decomposition process using filter banks in the form of tree structure. At each branch of tree, the input signal is filtered through a low pass and high pass filter at a time. The alternate signal samples are selected and the process is called as down sampling by a factor of two. The output of low pass filter output is coarser information and output of high pass filter delivers detail component [18][19]. In DWT tree format, the Output of previous stage is supplied as an input to next stage to finally end up with low frequency resolution and detail coefficients sequence.

METHODOLOGY

The proposed noise reduction technique for RPE-LTP is shown in fig.2 by using any of three transform techniques.

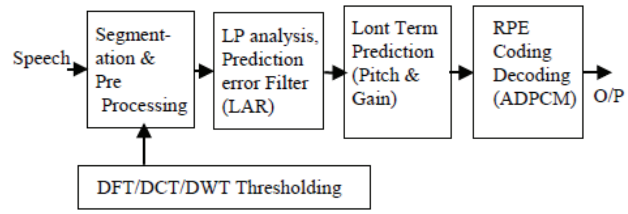


Fig. 2: Block diagram for Noise Reduction Technique in RPE-LTP

Methodology for Using Discrete Fourier Transform

Step 1: The speech signal is sampled at 8 KHz frequency with 20 ms frame duration. Then Discrete Fourier Transform is applied to each segment separately. The DFT coefficients with frequency higher than 4KHz (by considering Noise signal with higher frequencies) are replaced by zero.

Step 2: In this step, signal is forwarded to RPE-LTP coding section.

Methodology for Using Discrete Cosine Transform

Step 1: The speech signal is sampled at 8 KHz frequency for 20 ms frame. Then Daubechies wavelet is selected with 5 as decomposition level speech signal.

Step 2: Apply Thresholding

Global thresholding has been applied in the proposed coder. The threshold value is taken as the average of all wavelet coefficients in one frame/segment. The coefficients with lower value than threshold are replaced by zero.

Step 3: In this step, signal is forwarded to RPE-LTP coding section.

In DCT,

$$Cu = \sum_{x=0}^{N-1} f(x) COS\left(\frac{\pi\,(2x+1)u}{2N}\right), \quad u = 0, 1, 2, N-1 \tag{3}$$

Where, $\alpha_u = \{\sqrt{\frac{1}{N}} \;\; for\ u = 0 \;\; and \sqrt{\frac{2}{N}} \;\; for\ u \neq 0$

$$\text{we get, } C_0 = \sqrt{\frac{1}{N}} \;\; \sum_{x=0}^{N-1} f(x) \tag{4}$$

C_0 is the average value of the sequence [8]. All the waveforms are orthonormal and the cosine function. All the basis functions are unique from other basis functions. [13]. The basis functions are then multiplied with the sample sequence to reduce the mathematical computation overhead and hence to improve the computation efficiency.

The high value coefficients of DCT holds more information as compare to low value coefficients. Hence lower value coefficients are rejected from the further opeartions.

Methodology for Using Discrete Wavelet Transform

Step 1: The sampling frequency used to sample the speech signal is 8 KHz for 20 ms frame. Then Daubechies Wavelet is selected as mother wavelet as mother wavelet because Daubechies Wavelet is the orthogonal and compactly supported wavelet. Then the signal decomposed upto level 5 for the given speech segment.

Step 2: Apply Thresholding

Global thresholding has been applied in the proposed coder. The threshold value is taken as the average of all wavelet coefficients in one frame/segment. The coefficients with lower value than threshold are replaced by zero.

Step 3: In this step, signal is forwarded to RPE-LTP coding section.

RESULTS AND DISCUSSIONS

The proposed techniques algorithm has been implemented and simulated in MATLAB environment. The comparison between the input and output signals is done on the basis of quality measures such as SNR, MSE, PESQ and Subjective test given in Table 1 and the comparison of output speech signal(green color) and original signal(red color) is shown in fig.3.

Signal To Noise Ratio (SNR)

Signal-to-noise ratio spells all about the strength of the desired signal as compared to the unwanted signal. The higher value of SNR means a clearer transmission of better technical quality.

$$SNR = \frac{[MSE(output\_speech) - MSE(input\ Speech\ Signal)]}{MSE(Input\ Speech\ Signal)} \quad (5)$$

$$SNR\ in\ db = 10 * \log_{10}(SNR) \quad (6)$$

Perceptual Evaluation of Speech Quality(PESQ): It is the test that compares the output speech to the original one to create an objective indicator of the actual signal being heard. The accuracy of the method is more reliable as compare to the subjective test. Its range is from 0.5 to 4.5 reflecting quality with higher scores.

Subjective Test: This is the most popular speech quality measurement method. This test considers the feedback on original and reconstructed signal given by the subjects which is expressed in terms of Mean Opinion Score (MOS). The process followed was as per the recommandations by ITU- P.800 on English speech samples in English with the judgment scale from Bad to Excellent (1 to 5).

Mean Square Error (MSE): The Mean Square Error (MSE) is the major performance metric in the speech processing applications. It identifies the level of error between two signals such as original and reconstructed speech signals. Consider that,

A= (Ai | i = 1, 2, 3, 4, 5 … i) and

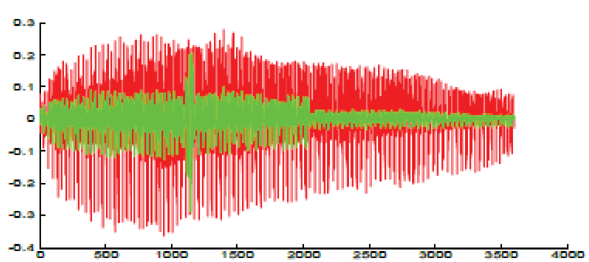
B= (Bi | i = 1, 2, 3, 4, 5 … i)

be the two signals where N is number of samples, Ai and Bi are the i^{th} sample value of A and B samples. The MSE is determined by,

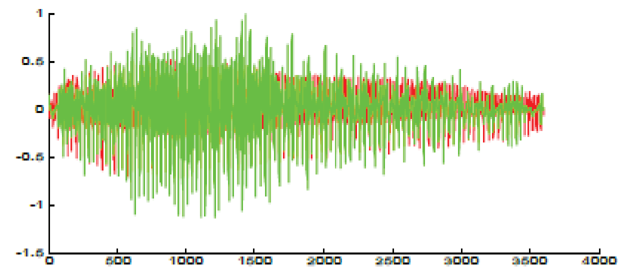
$$MSE\ (x, y) = \frac{1}{N} \sum_{i=1}^{N} (A_i - B_i)^2 \quad (7)$$

Table 1. Qualitative performance of RPE-LTP under DFT/DCT/DWT Techniques

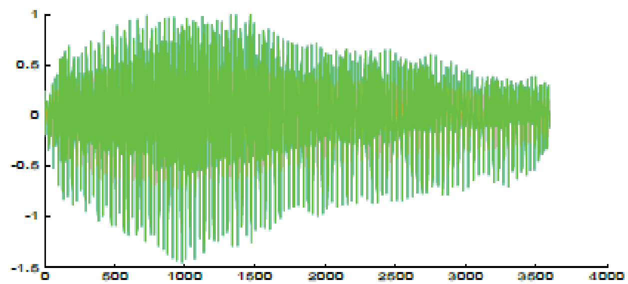
Parameters / Technique	*SNR dB*	*PESQ*	*MSE*	*MOS*
RPE-LTP Without noise reduction	*3.00*	*2.7*	*0.679*	*3.0*
DFT	*3.02*	*2.8*	*0.8430*	*3.1*
DCT	*7.89*	*4.2*	*0.0467*	*4.2*
DWT	*10.46*	*4.6*	*0.0023*	*4.7*



(a)



(b)



(c)

Fig. 3 Comparison of Original input and Output with DCT Noise

Reduction Technique (a) DFT (b) DCT (c) DWT Red-Original and Green is signal recovered after filteration techniques.

The Signal to Noise Ration at higher side indicates better quality. There is gradual increase in SNR observed in all four techniques and SNR of DWT is highest of all. The perceptual Evaluation of Speech Quality index is expected above 3.5 and as per the results obtained, DCT and DWT techniques meet the condition. The Mean Square Error value indicates erroronious contents and hence better to be as minimum as possible. The lowest MSE is shown by DWT technique. Similarly, the last test was opted for acceptance in the form of MOS through public opinionfor the recovered signal and in the MOS test (about 24 opinions) also DWT has received highest score(the acceptable score is above 4.5). The Comparison of all mentioned techniques shows the best performance was given by DWT for noise reduction in RPE-LTP speech coding. In fig.3, it seems that the noisy signal in red colour is decreasing from fig 3(a) to fig 3(b) and original speech signal content in green colour is increasing. Hence, from the performance parameters and speech signal graph the best performance is of DWT technique.

CONCLUSIONS

The proposal of noise reduction techniques at the stage of segmentation has shown improvement in the quality measures of RPE-LTP coder. All the three techniques are performing well

but, the discrete Wavelet Transform has shown best enhancement of quality measures. In future, by employing DWT and DCT techniques together, the performance of speech coder in noisy environment may be evaluated.

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B-A TM: Biometric Automated Teller Machine Verification System

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ABSTRACT

Biometric authentication systems, which are being employed more widely across major implementations, leverage an individual's fingerprints and face traits. Even though there are several available facial recognition technologies. More studies ought to uncover elements that enhance accuracy and efficiency. Both fingerprint and facial recognition play a significant role in the identification process since, in contrast to certain other biometric techniques, they do not require human help. This explains why biometric identification technologies have been receiving so much attention, as well as demonstrating the enormous potential to develop far stronger protection for such Simulated ATM operations. Thus, an efficient framework for biometric verification on virtual ATMs using fingerprint and facial recognition has been presented for this purpose. The framework that is being described makes use of OTP authentication, channel-boosted convolutional neural networks, live streaming, and regions of interest. Long-term experiments have been used to measure the framework, yielding results that are highly comforting.

KEYWORDS: *Biometric automated teller machine, One time password, Face recognition, Fingerprint recognition, Channel boosted convolutional neural networks.*

INTRODUCTION

The internet has become increasingly accessible with the widespread use of smartphones and the growing popularity of online connectivity. There has been a significant increase in the popularity of smartphones in recent decades, leading to a surge in the development of new smartphone applications and software programmers. Here, a cutting-edge biometrics ATM technology utilizing advanced machine vision and facial recognition technology is revolutionizing productivity. Facial recognition is a reliable method for personal identification and verification, thanks to its unique and stable features that are inherent to the human body. Facial recognition is widely embraced, seen as positive, reliable, and secure when compared to other methods.

India has witnessed the introduction of various types of equipment due to technological advancements, all aimed at enhancing customer satisfaction. The ATM was a revolutionary addition to the banking industry, making transactions more efficient for financial institutions. With the introduction of ATMs, customers gained the ability to carry out financial transactions on their own. At first, only a specific bank's customers had access to an ATM for money transfers. However, over time, all ATMs became interconnected, allowing customers from any bank to use any ATM they preferred. Thanks to this, customers of other banks were still able to conveniently use the ATMs of different banks for making deposits, withdrawals, and wire transfers.

Facial detection comes so naturally to us humans that even newborns have the ability to distinguish between family members and friends. However, face detection poses a challenge for computers. Just like a data scientist, the automated face identification system creates an extracted feature by labeling the locations of facial landmarks such as the eyeballs, eyebrows, chin, and more. To identify faces, it measures the Euclidean distance between the extracted features from different photos. Many methods use feature maps of different dimensions to analyze the architectural aspects of facial photographs in a large database. Similar to a data scientist, some face recognition methods streamline the categorization process by treating the face region as a junction and representing it in a lower dimensional environment derived from the input images' multidimensional space.

Facial identification has been extensively researched over the past several years and is widely regarded as a highly reliable method for establishing a person's identification. Face recognition from photographs is a widely explored field in biometrics. One of the valuable applications of facial recognition and identification technologies is the evaluation of images for interpretation. Various professionals, including mental health experts, neuroscientists, and machine learning specialists, have shown a keen interest in facial recognition software. This is because advancements in this field could potentially shed light on the workings of the human brain. Even with the widespread use of biometric identification methods such as fingerprint and retinal scanners, they still require human verification. However, it is not required when using face images for person authentication. Facial recognition technology is essential for establishing a person's identity, as it doesn't require human cooperation like other biometric approaches.

An-Ping Song et al. [1], compiled a novel collection of similar face datasets (SFD) and proposed a resilient face identification technique that integrates both internal and external facial aspects. The author's method effectively enhances face matching accuracy and provides a fine-grained recognition effect by integrating both external and internal features. The author's approach enhances the efficacy of face feature extraction in the conventional face recognition model, while preserving the benefits of the original deep CNN model. This addresses the issue of recognition accuracy that arises from traditional methods when dealing with highly similar face images. There is an inherent correlation between the similarity of two face photos and their identification accuracy. This relationship will be further investigated in future research. One significant limitation associated with the incorporation of internal and external characteristics for finegrained face recognition is the introduction of supplementary parameters into the model, hence augmenting the training complexity.

Dailé Osorio-Roig et al. [2], address the ongoing difficulty of developing large-scale facial identification systems that effectively safeguard the privacy of the individuals involved. In the realm of safeguarding privacy, numerous template protection strategies have been previously put out. Nevertheless, it seems that these approaches are not appropriate for the purpose of indexing, which involves reducing effort, in biometric identification systems. They have been employed in identification systems that conduct thorough searches, resulting in a decrease in computing efficiency. In this study, the author presents a face identification system that aims to preserve anonymity. The system use a hash look-up table based on Product Quantization to index and retrieve protected face templates. The facial templates are safeguarded using fully homomorphic encryption techniques, ensuring a robust level of privacy protection for the participants involved.

M. Vasanthi et al. [3], conducted studies using three distinct facial image benchmark datasets: GT, LFW, and Pointing '04. In addition to the utilization of benchmark datasets, the author has developed a novel dataset comprising celebrities, which was subsequently exposed to experimental scrutiny. The method that was suggested yielded mean precision scores of 95.27%, 94.20%, 96.19%, and

96.05 for the GT, LFW, Pointing '04, and author's datasets, consecutively. Furthermore, the F-score was computed for the aforementioned datasets and subsequently compared to the established methodologies. The results of the comparison analysis indicate that the proposed methodology exhibits a level of comparability with the already employed methodologies. The suggested methodology integrates geometrical feature points with low-level visual features, which contributes to the superior precision scores achieved by the proposed method in comparison to previous methods.

This research paper is divided into five sections: Section 2 analyzes the relevant literature; Section 3 describes the research methodology; Section 4 talks about the experimental evaluations; and Section 5 concludes with recommendations for future research.

LITERATURE SURVEY

Shilpa Sethi et al. [4], introduces a deep learning-based methodology for the identification of facial masks in public settings, with the aim of mitigating the transmission of the Coronavirus within the community. The technique suggested in this study effectively addresses occlusions in challenging scenarios by employing a combination of single and two-stage detectors during the pre-processing stage. The ensemble approach not only enhances accuracy but also significantly improves detection speed. Moreover, the utilization of transfer learning on pretrained models, along with thorough experimentation on an impartial dataset, yielded a system that is both extremely resilient and cost-effective. By breaking mask standards, the identification of faces enhances the system's utility for public benefits. Ultimately, this finding presents intriguing prospects for future researchers. The suggested technique is compatible with high-resolution video surveillance cameras and can be applied to other applications, not just mask identification. Additionally, the model has the potential to be expanded in order to identify facial landmarks when wearing a facemask for biometric applications.

N. Kiruthiga et al. [5], elucidate the contemporary world, characterized by the rapid advancement of technology and the emergence of new eras of scientific breakthroughs. Consequently, there is a growing demand for security across all domains. Currently, the use of vehicles is an essential requirement for individuals. Concurrently, safeguarding the vehicle against theft is also crucial. Conventional vehicle security systems rely on numerous sensors and are also expensive. Once the car is stolen, there are no further options or alternatives available to assist the owner in locating it. The primary objective of this study is to safeguard the vehicle from illegal entry by employing a rapid, user-friendly, transparent, dependable, and cost-effective fingerprint recognition technology. This car security system utilizes Global System for Mobile (GSM) communication technology to inform the owner about the vehicle's state. Vehicle entry is permitted contingent upon the individual's certification. Alternatively, an SMS will be dispatched to the owner, resulting in the immobilization of the engine.

Pranav KB et al. [6], This paper presents a proposal for the construction and assessment of a real-time facial recognition system utilizing Convolutional Neural Networks. The evaluation of the suggested system and CNN architecture involves the adjustment of several parameters of the CNN in order to improve the accuracy of the system's recognition. The suggested system achieves a maximum recognition accuracy of 98.75% and 98.00% while utilizing AT&T and real-time inputs, respectively. The proposed study has the potential to be readily applied to a range of consumer applications, including but not limited to face detection- based home automation, device control, attendance systems, and intruder detection.

Wang Yao et al. [7], outlines the difficulty of achieving strong authentication for low-power consumer devices that lack a keyboard. The advent of low-power neural accelerator hardware, along with advancements in neural facial recognition algorithms, has facilitated the development of enabling technologies for low-power, on-device facial identification. This study investigates various methodologies to evaluate the resilience of Arcface, a cutting-edge facial recognition (FR) technique, in the context of end-to-end applications. The author's focus lies on the two more demanding cases for FR, namely severe lighting conditions and facial position. The utilization of GAN-based re-lighting and pose approaches is employed to investigate the impact on FR performance, primarily due to the limited availability of extensive multiple-identity datasets. The aforementioned findings are additionally corroborated using the most reliable multi-identity datasets, namely MultiPIE and BIWI.

Hangaragi et al. [8], conducted experiments on face identification and recognition using a dataset consisting of 1700 photos. These images were selected from a combination of the LWF dataset and real-time acquired photographs. The purpose of face mesh is to recreate the entire face by utilizing facial landmarks. The accuracy of face reconstruction is computed using the BU3DFE dataset from various perspectives. The task of detecting and recognizing nonfrontal human faces from various age groups and racial backgrounds has been successfully achieved. The evaluation of face recognition accuracy in relation to the current methodologies has been successfully conducted. The accuracy of the model achieved in the experiments done under different constraints is 94.23%.

Jianghan Mao et al. [9], The author of this work presents an innovative technique for conducting voice command fingerprinting attacks. The model employed by the author utilizes a highly robust adaptive and dilated ResNet architecture, together with an attention-based BiGRU, as its underlying infrastructure. The overall model effectively integrates the geographical and temporal attributes of encrypted communication. In the context of a closed-world scenario, the model developed by the author demonstrates superior performance compared to other contemporary voice command fingerprinting models, attaining an accuracy rate exceeding 93%. The author also does experiments on openworld scenarios and proves that their model can accurately differentiate the voice instructions that are of interest to the attacker. The author demonstrates the applicability of their concept to several domains of fingerprinting, including website fingerprinting. In summary, the author's study uncovers the security vulnerabilities associated with encrypted data in smart speakers, and their model can be cited in relevant domains.

Huy H. Nguyen et al. [10], Face authentication has gained significant popularity, particularly on mobile devices, as a preferred method of authentication over traditional methods such as personal identification numbers or unlock patterns, mostly due to its inherent simplicity. Consequently, it has emerged as an enticing objective for malicious actors employing a presentation attack. Facial photos or videos of the victim are commonly employed in conventional presentation attacks. The existence of master faces, which are faces that match several enrolled templates in facial recognition systems, has been demonstrated in prior research. The presence of these master faces enhances the potential for presentation attacks. This work presents a comprehensive investigation on latent variable evolution (LVE), a widely employed technique for generating master faces. The LVE method was executed across multiple scenarios and with multiple databases and/or face recognition systems in order to ascertain the characteristics of master faces and elucidate the circumstances under which robust master faces can be produced.

Proposed by Marcus Smith et al. [11], Biometric face recognition is an artificial intelligence system that use automatic facial feature comparison to identify unknown suspects from images and closed circuit video. It is commonly employed by law enforcement agencies. The capacity of artificial intelligence is quickly growing and holds significant potential for crime resolution. Nevertheless, this technology also entails substantial privacy and ethical considerations that necessitate legal frameworks and regulatory measures. This article explores the emergence of biometric facial recognition, its present-day uses, and the legal advancements around it. Additionally, it undertakes an ethical evaluation of the ethical concerns that come from this technology.

M. Vasanth et al. [12], put forward The ARBBPNN method was devised to address the growing need for non-touch biometric technologies, specifically face recognition, in response to the anticipated surge in demand resulting from the epidemic. COVID-19. Public and private organizations that employ biometric-based attendance systems are increasingly adopting touch-based approaches, such as fingerprint recognition, as an alternative. The proposed method combines hand-crafted and DNN features to achieve a high level of accuracy in face detection while minimizing computing requirements. The findings produced are equivalent to the most advanced methods currently available.

The fingerprint presented by Hoshang Kolivand et al. [13], has gained significant popularity in several biometric applications. Several well-established studies have been conducted on image enhancement techniques to enhance the quality of fingerprint images. Nevertheless, the generation of substandard photos as a result of the existence of scars continues to pose a significant obstacle in the field of biometrics. The presence of scars results in the impairment of fingerprint minutiae information as a consequence of fractured ridges, hence diminishing the precision of identification. This study devised a method for enhancing pictures in order to enhance the quality of scarred fingerprint photographs and achieve precise extraction of minutiae.

According to Ayman Iskandar et al. [14], humans are characterized by their walking patterns. Various methodologies, such as the utilization of diverse sensor technologies, have been employed to establish walking patterns as biometric indicators. The utilization of footstep recognition in various security applications, such as access management in protected areas or providing an additional layer of biometric verification for secure entry into limited territories, can be achieved through the examination of the distinctive characteristics of an individual's footsteps. The author has put forth a proposal for biometric systems that aim to verify and identify individuals by utilizing spatial foot pressure images obtained from piezoelectric sensors. This proposal is based on the Swansea Foot Biometric Database, which comprises 19,980 footstep signals collected from 127 users. It is worth noting that this database is the most prominent open-source repository for footstep recognition.

Hoai Nam Vu et al. [15], The author has proposed a methodology that integrates deep learning models with Local Binary Pattern (LBP) features inside a cohesive framework for the purpose of identifying masked faces. The approach being presented employs deep models for the purpose of face detection. It involves the extraction of facial features, which are then merged with LBP features obtained from the eyes and eyebrows. An empirical investigation is undertaken to validate the proposed methodology. The evaluation results have shown that the proposed method outperforms several state-of-the-art face recognition methods, such as Dlib and InsightFace, on both the published Essex dataset and the author's self-collected dataset COMASK20.

PROPOSED MODEL

The image above illustrates the suggested methodology for implementing a Cardless bio-metric ATM system that incorporates biometric authentication, specifically face and fingerprint verification. The subsequent section provides a detailed explanation of the processes undertaken to establish this system.

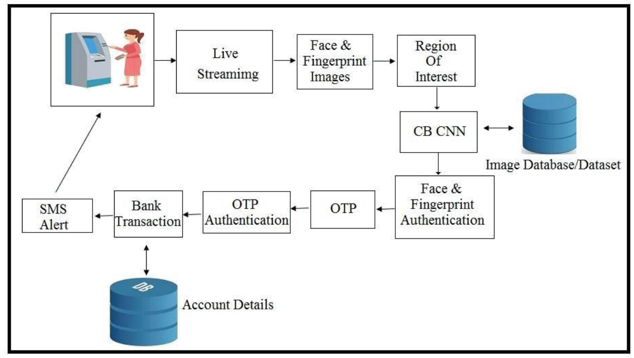

Fig. 1: Proposed Methodology

Step 1: User Interface — An interactive user interface has been implemented utilizing the swings framework on the Java programming language in order to showcase our methods. The development of a user-friendly interface has facilitated the execution of bank transactions by customers. The interface that has been established and designed serves to facilitate the process of user registration on the platform. This is achieved by gathering a range of qualities and information from users, including their name, date of birth, and mobile number. Additionally, the interface incorporates user authentication components such as facial recognition and fingerprint recognition.

The user's face attributes, obtained from their facial image upon registration, are stored with their fingerprints. These attributes are advantageous for the implementation of the virtual ATM methodology, which aims to authenticate customers by analyzing their face features and fingerprints. The unique users' collected attributes are categorized and saved in an image database, which will be employed in subsequent stages to train our deep learning model.

Step 2: Training the CB-CNN model – In the second step, the CB-CNN model is trained. The user's facial and fingerprint photos have played a vital role in training the chosen deep learning model for this application. The CB-CNN model is being used to train and recognize users based on their faces and fingerprints.

Channel Boosted Convolutional Neural Networks (CBCNN) represent a notable advancement compared to conventional Convolutional Neural Networks (CNNs). A boosted color channel was employed in the implementation of the CB-CNN model, in contrast to the traditional CNN which does not include any boosted channels. The introduction of boosted channels in the CB-CNN approach significantly enhances recognition accuracy compared to the classic CNN.

The TensorFlow library includes a Sequential class that facilitates the creation of sequential neural network designs. In the initial phase of the CB-CNN Design, a convolution layer is incorporated, consisting of 32 3x3 kernels and the Rectified Linear Unit (ReLU) activation function. This layer is specifically allocated for images of the appropriate dimensions. The sole function of this layer is to guarantee uniformity in the size of the photos. Subsequently, a Convolution layer is implemented, consisting of 64 3 x 3 kernels with ReLU activation. A maxpooling layer has been designed with a dropout regularity of 25% and a dimensions of 2 by 2 units.

The size of each of the 128 kernels is 3 by 3, which is attributed to the inclusion of additional fully connected layers. For this purpose, we have employed a specialized activation function known as the Rectified Linear Unit (ReLU) activation function. The size of the maximum pooling layer has been specified as 2x2. Upon the completion of the third layer, the final layer is executed using 128 3x3 kernels and the Rectified Linear Unit (ReLU) activation function. A second Max pooling layer is incorporated, with the dropout rate set at 25% and the dimensions maintained at 2 x 2.

Once the training process of the neural network is concluded, it undergoes flattening using the flatten method. This involves the application of a dense layer with a size of 1024 and the ReLU activation function. At the termination point of the convolutional neural network, it is necessary to employ a dropout ratio of 50. Subsequently, a dense layer has been employed, consisting of seven classes, each representing the seven users being utilized for the purpose of illustrating this process.

The Adam optimizer is commonly used to enhance the outcome by doing 500 epochs for all user attributes, such as face and fingerprints, while the player is still in the learning phase. After the completion of the training step, the model proceeds to import the acquired data from an H5 file and subsequently utilizes it in the testing phase. Figure 2 illustrates the architecture of the Channel Boosted – Convolutional Neural Network.

Table 1: Convolution Neural Network Architecture

Layer	Activation
CONV 2D 32 X 3 X 3	Relu
CONV 2D 64 X 3 X 3	Relu
MaxPooling2D 2 X 2	
Dropout 0.25	
CONV 2D 128 X 3 X 3	Relu
MaxPooling2D 2 X 2	
CONV 2D 128 X 3 X 3	Relu
MaxPooling2D 2 X 2	
Dropout 0.25	
Flatten	
Dense 1024	Relu
Dropout 0.25	
Dense 7	Softmax
Adam Optimizer	

Step 3: User Authentication and Transaction Completion – In order to authenticate the user and complete the transaction, the trained model that was obtained in the previous phase is being used. In order to verify their identity, the registered user interacts with the virtual ATM to submit the necessary information, including their fingerprint and face. For the purpose of authentication, the system takes pictures of the user's face and fingerprints, which it then passes to the following modules.

The system uses the photographs after first putting them through an evaluation process to determine their region of interest. For the trained model's assessment, the region of interest separates the facial region and the fingerprints. After that, the photos are fed into a trained model, which uses the collected fingerprint and face photographs to authenticate the individual.

A One Time Password, or OTP, is generated and emailed to the user after the user has been validated. It is necessary to authenticate this OTP before completing the transaction. The bank transaction starts as soon as the OTP is validated, and the system helps the user complete the bank transaction quickly.

RESULTS AND DISCUSSIONS

The deployed method for the Biometric ATM involves utilizing both facial and fingerprint characteristics of the user. The approach has already been embraced by both the Python and Java programming languages, utilizing the Spyder and NetBeans integrated development environments, respectively. The software was developed inside both of these specific environments. To execute the essential jobs of deep learning, the strategy necessitates the utilization of the OpenCV, TensorFlow, and Keras frameworks. The optimal configuration for testing the upcoming implementation was found to be a laptop equipped with an Intel Core i5 CPU, 8 GB of memory, and 1 TB of storage capacity.

The efficiency of the suggested technique must be taken into account when measuring the accuracy of face and fingerprint detection. One can utilize error to determine the degree of trustworthiness of a technique; generally speaking, the lesser the error, the more reliable the technique. The root mean square error measure can be used to do a trustworthy error analysis.

Performance Evaluation based on RMSE

One of the best performance metrics for determining the degree of variation among a group of related features is the Root Mean Square Error. Two metrics will be used to assess the proposed method: the proportion of correctly identified fingerprints and the proportion of mistakenly identified fingerprints. For your convenience in calculating the RMSE, Equation 1 is provided here.

$$RMSE_{fo} = [\sum_{i=1}^{N} (z_{fi} - z_{oi})^2 / N]^{1/2}$$

Where,

∑ - Summation

(Zfi - Zoi) 2 - Differences Squared for the fingerprints identified correctly and fingerprints identified incorrectly N

- Number of conducted Experiments.

By applying the deployed method to several fingerprint recognition repetitions, we calculate the relative mean square error, or RMSE, values. To guarantee accuracy, fingerprint recognition is verified ten times. The identification result of the suggested method is saved following each acquisition session. After that, an RMSE evaluation is performed using the data. These RMSE values are obtained by carefully calculating the results shown in table 1 and presenting them below.

Table 2. RMSE measurements tabulated

S no.	Number of Iterations	Correctly identified Fingerprints	Incorrectly identified Fingerprints	MSE
1	10	9	1	1
2	10	8	2	4
3	10	9	1	1
4	10	7	3	9
5	10	10	0	0

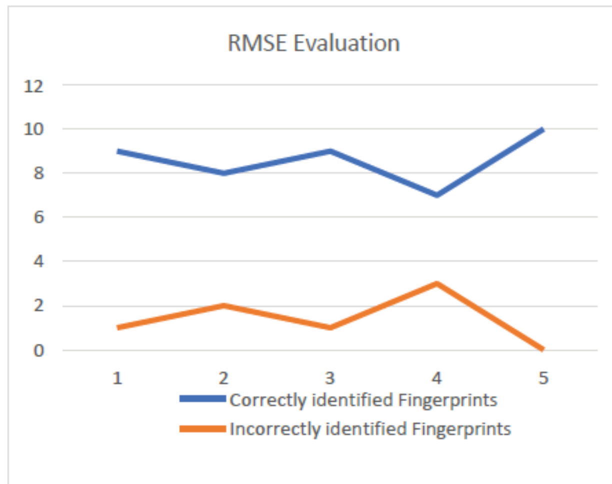

Fig. 2: RMSE outcomes

We are using the findings for the RMSE measurements and identification effectiveness found in the previously supplied table 1 to create the diagram in figure 3 above. The technique designed to achieve an extremely low mistake rate of 1.732 for fingerprint recognition is shown in the table and graph that follow.

Performance Evaluation based on Precision and Recall

Precision and recall metrics are quite valuable for evaluating the level of completeness in executing a certain module of the paradigm. The aforementioned measurements are examined within the broader context of our methodology. The concept of relative correctness is determined by the precision of a module, encompassing its reliability throughout a broad spectrum.

The precision of this method was assessed by comparing the count of accurate identifiers with the overall count of tests. However, the inclusion of memory requirements serves as a valuable supplement to the evaluation of accuracy when assessing the overall reliability of the CB-CNN component.

This is because precise monitoring alone is insufficient.

The determination of recall in this method involves comparing the proportion of correct identifications against the proportion of wrong identifications. To quantitatively assess this argument, the subsequent equations are presented.

The visual representation of Precision and Recall is as follows:

A = This represents the quantity of precise facial identifications.

B= This represents the quantity of erroneous facial identifications.

C= This represents the quantity of precise facial identifications that have not been completed.

So, precision can be defined as

Precision = (A / (A+ B)) 100 Recall = (B / (B+ C)) 100

Table 3 below displays the experimental results using the previously indicated formula. Using these statistical factors, the representation shown in figure 4 can be produced.

Table 3: Precision and Recall Measurement Table

No. of Iterations	Accurate Face identifications (X)	Inaccurate Face identifications (Y)	Accurate Face Identifications not done (Z)	Precision	Recall
10	10	0	0	100	100
20	17	2	2	89.47368	89.47368
30	27	2	2	93.10345	93.10345
40	35	3	3	92.10526	92.10526
50	44	5	2	89.79592	95.65217

Figure 3: Comparison of Precision and Recall

This graph displays the performance of the CB-CNN over a wide range of trial counts and shows that it can accurately distinguish faces based on the input data. The method's reliability is demonstrated by the very high accuracy and recall rates of 92.89% and 94.06%, respectively. For the first time that this technique has been used, these statistics are rather significant, and the success that has been attained is commendable.

CONCLUSION AND FUTURE SCOPE

This research article presents a detailed explanation of the suggested approach for the implementation of a Cardless Virtual ATM system that integrates biometric identification techniques, such as face and fingerprint authentication. The proposed methodology utilizes an automated teller machine (ATM) in combination with a camera to record the user's realtime video feed. The real- time transmission of the ATM camera's live feed allows for the quick capturing of the user's face and fingerprints by the system. The photographs undergo a transformation and are then shown in the next stage to evaluate the region of interest. The process of isolating the facial features and the exact area within the image that encompasses the face is attributed to the region of interest. The inputs of the Channel Boosted Convolutional Neural Networks are subsequently linked to a database including user facial and fingerprint images. Subsequently, the CBCNN methodology employs the photographs saved in the database to authenticate the user's identification. Following this, a One Time Password is transmitted to the cellphone number linked to the registered user. Following this, the user enters the OneTime Password (OTP), which undergoes verification and confers authorization to conduct the bank transaction at the automated teller machine (ATM). Subsequently, a pertinent notification is transmitted to the subscriber by SMS. The technique's performance has been comprehensively evaluated using measures such as Root Mean Square Error (RMSE), Precision, and Recall, resulting in highly dependable measurements.

In future generations, a Reinforcement Learning model can be used to accurately detect the aging face.

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Smart Crop Prediction and Fertilizer Recommendation using Machine Learning

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ABSTRACT

In the era of modern agriculture, the convergence of the Internet of Things (IOT), Machine Learning (ML), and real-time data visualization technologies is revolutionizing farming practices. Our project demonstrates this transformation by employing Internet of Things (IOT) sensors such as temperature, humidity, and moisture sensors also N,P, and K values in agricultural fields. Data collected from these sensors is transmitted via NodeMCU, a low-cost open-source IOT platform, and displayed on Thing Speak-a cloud- based IOT platform. The data collected from the IOT sensors provides real-time insights into the environmental conditions of the field. This information is combined with historical data and processed through a Gaussian Naive Bayes (GNB) Machine Learning algorithm. GNB is an expert at handling multivariate data and is employed to predict crop growth patterns and yields with remarkable accuracy. Furthermore, our project integrates crop prediction and fertilizer recommendation system that takes into account soil conditions, and environmental factors. This recommendation system empowers farmers to make informed decisions about fertilizer application, reducing waste and environmental impact. The collaboration between IOT, GNB-based ML, and NodeMCU for data transmission and Thing Speak for real-time data display is at the forefront of precision agriculture. It equips farmers with the tools to monitor, analyze, and optimize farming practices in an efficient, cost-effective, and environmentally responsible manner. This project not only enhances crop productivity but also represents a pivotal step towards sustainable agriculture. Bridging the gap between traditional farming and advanced technology, it finds the way for a future where data- driven insights drive agriculture toward greater efficiency and sustainability. Precision agriculture, driven by IOT and ML, is the key to meeting the ever- growing global food demand while protecting our environment. In summary, our project serves as a prime example of how innovative technology can be implemented to create a more productive and responsible agricultural future, boosted by the integration of a kaggle dataset for crop prediction and fertilizer recommendations. The evaluation of our proposed solution further validates its effectiveness, with the GNB model exhibiting exceptional accuracy, achieving 99% accuracy in training and 96% accuracy in testing datasets.

KEYWORDS: *NodeMCU, Thing dpeak, Naïve bayes, Soli PH sensor, Humidity sensor, Temperature sensor.*

INTRODUCTION

In traditional agriculture, the effective use of crop fertilizers stands as a big challenge. Traditional methods of fertilizer application often led to undesirable outcomes, with farmers frequently facing the problem of overuse or underuse. These results in reduced crop yields, increased production costs, and adverse environmental effects, collectively reducing the sector's sustainability and efficiency. This is due to the absence of precise, data-driven approaches for crop prediction and fertilizer management. An immediate challenge calls for an inventive remedy that effectively integrates two forefront technologies: Machine Learning (ML) methods and the Internet of Things (IOT). This innovative solution aims to predict and enhance crop selection and fertilizer usage with high precision. Within the realm of IOT, it encompasses a network comprising various objects integrated into devices, sensors, machinery, software, and human interaction via the internet, facilitating seamless communication, information exchange, and interaction, thereby bridging the gap between physical and virtual domains.

RELATED WORK

A. A. Khan et al. [1] the authors have implemented a method for Providing fertilizer guidance utilizing the fusion of machine learning techniques and Internet of Things (IOT) technology.. In this paper, they used the NPK sensor as an IOT part to collect data from the field for recommendation purposes and then this data is transferred to a machine learning model for fertilizer prediction where we used a support vector machine (SVM) algorithm.

V. K. Quy et al. [2] This study offers an overview of IOT solutions and explores their integration potential within the realm of smart agriculture. To fulfill this aim, the authors delve into envisioning IOT-enabled smart agricultural ecosystems, scrutinizing their architectural components such as IOT devices, communication technologies, big data storage, and processing. Furthermore, the paper examines the applications and developmental trajectory of these ecosystems, while also shedding light on emerging trends and opportunities within IOT applications for smart agriculture. Additionally, it highlights unresolved issues and challenges associated with deploying IOT applications in this agricultural domain.

Devdatta A. Bondre, Mr. Santosh Mahagaonkar [3] The primary emphasis of the paper lies in crafting a predictive model designed to forecast crop yields for future use. It provides a concise examination of utilizing machine learning methodologies for predicting crop yield outcomes.

A. Rahman et al. [4] This paper reviews IoT technologies for advanced monitoring and control in agriculture, aiming to comprehensively evaluate smart agricultural practices. It explores IoT applications, benefits, challenges, and potential solutions within the agricultural domain. The focus is on optimizing crop yield and efficiency by leveraging existing techniques such as water and pesticide management, irrigation practices, crop monitoring, and fertilizer application.

J Madhuri and M Indiramma [5] propose an Artificial Neural Network (ANN) driven crop recommendation system that considers climatic conditions, soil type, and crop attributes. This recommendation system holds significant promise in crop planning, boasting an impressive 96% accuracy rate in predicting suitable crop types. In addition to facilitating smart irrigation and disease forecasting, the integration of IOT and machine learning is pivotal for accurately mapping soil attributes.

S.Pudumalar et al. [6] Precision agriculture employs contemporary farming methods that leverage research findings on soil characteristics, soil types, and crop yield data to recommend suitable crops based on specific site conditions. This approach minimizes the risk of selecting inappropriate crops and enhances overall productivity.

Ravesa Akhter et al.[7] The IoT-enabled system integrates wireless sensors to monitor crop conditions, analyzed via a web app using data mining. Mobile app notifies farmers about soil moisture, and recommends watering, based on optimal conditions like 29–30°C temperature and 72–81% humidity for high yields. This dynamic approach ensures crops receive tailored care, fostering increased productivity and quality in agriculture.

S. Sundaresan et al.[8] IoT and machine learning unite to curtail annual crop losses, notably in India surpassing $11 billion, through a comprehensive system integrating crop selection, autonomous watering, and fertilizer recommendations. The paper highlights successful simulations of crop recommendation, automatic irrigation, and fertilizer suggestion systems, underscoring their potential to mitigate losses caused by adverse atmospheric conditions.

Aman Kumar Dewangan et al.[9] IoT and cloud tech are vital for improving agriculture amidst growing demand.

AI enhances data-driven decisions, utilizing public datasets for crop optimization. Precision farming, with soil and seed analysis, is empowered by blockchain for efficient distribution. Streamlined IoT solutions offer monitoring and analytical capabilities, aiding logistics and productivity.

PROPOSED SYSTEM

The proposed system consists of two interconnected components: an Internet of Things (IOT) sensor network for continuous data collection and a Machine Learning (ML) application for precise crop prediction and fertilizer recommendations in agriculture. Utilizing sensors installed across fields, the IOT segment monitors critical elements such as soil moisture, nutrient status, and meteorological parameters. This information is then relayed to a central hub, where it merges with weather predictions and soil analysis results, culminating in a comprehensive dataset. The ML application, designed for user accessibility, forms the core of the system. Farmers can input specific details such as N, P, K values, and IOT sensor data. Utilizing historical data and advanced ML algorithms, the application generates tailored crop and fertilizer recommendations. The ultimate aim of this proposed system is to revolutionize crop prediction and fertilizer management in agriculture. By bridging the gap between IOT technology and ML-driven decision support, it provides an integrated approach to optimize fertilizer usage and to help to plant the right crop in the farm. This innovation enhances crop yields, reduces costs, and fosters sustainable agricultural practices, addressing critical global challenges.

Internet of Things for Crop Prediction and Fertilizer Recommendation

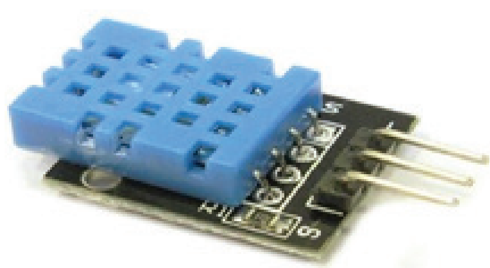

Fig. 1: DHT11 (Temperature & Humidity Sensor)

The DHT11 sensor, known for its affordability, is widely employed to gauge temperature and humidity levels. Deployed in crop fields, the DHT11 aids in monitoring environmental conditions crucial for crop growth, particularly temperature and humidity. This gathered data plays a vital role in evaluating the microclimate suitability for various crops, thereby aiding in informed decision- making regarding crop cultivation.

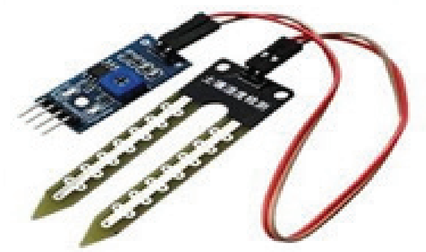

Fig. 2: Soil moisture sensor

A moisture sensor is a tool utilized to gauge the moisture levels in a substance, commonly soil or air. It functions by detecting alterations in electrical conductivity or capacitance triggered by moisture fluctuations. Typically comprising two electrodes, the sensor measures the resistance or capacitance between them. As moisture content increases, resistance decreases or capacitance rises.

Machine Learning Model for Crop Prediction and Fertilizer Recommendation

Data Input

This block is responsible for acquiring the dataset from Kaggle. The dataset likely contains historical agricultural data, including information about Environmental conditions, Soil pH and Soil nutrients. Data from this block is sent to the next block for crop prediction processing.

Crop Prediction

In this block, the dataset is used to train a machine-learning model for crop prediction. This model is based on Gaussian Naive Bayes (GNB) algorithm. Crop prediction involves using historical data to predict the most likely crop that will thrive in specific environmental conditions. The predicted crop information is then passed to the next block for further processing.

Data Preprocessing

Before the data can be used for model training, it must be preprocessed. Preprocessing can involve tasks like data cleaning, handling missing values, and scaling features. Feature extraction may also occur in this block, where relevant features from the dataset are selected for training the model.

Model Training

In this block, the preprocessed data is used to train the machine learning model. The use of Gaussian Naive Bayes (GNB), which is particularly effective for multivariate data. During training, the model learns the relationships between environmental factors and crop outcomes.

GNB (Gaussian Naïve Bayes)

The Naïve Bayes algorithm, a supervised learning method, relies on the Bayes theorem to address classification tasks, particularly suited for high-dimensional datasets such as text classification. Renowned for its simplicity and effectiveness, the Naïve Bayes Classifier facilitates the rapid development of machine learning models capable of swift predictions. Operating as a probabilistic classifier, it derives predictions from object probabilities. Its primary advantage lies in its simplicity and potency, offering a straightforward implementation and quick real-time predictions. Consequently, it stands as a preferred choice for solving real-world problems, adept at responding promptly to user queries.

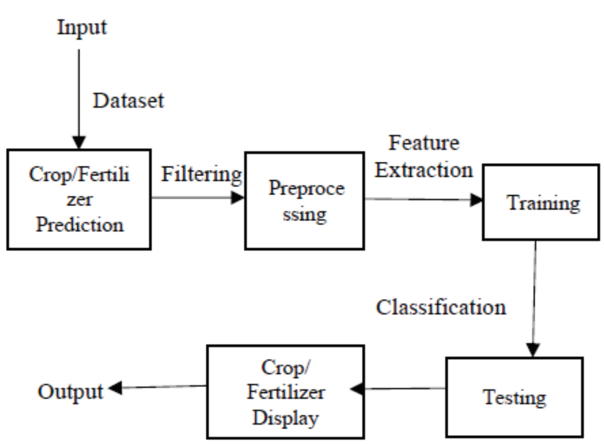

Fig. 3: GNB Working Flow

In the context of crop classification and fertilizer recommendation, we have three classes of crops: Class K (e.g., crops that require high levels of potassium), Class N (e.g., crops that require high levels of nitrogen), and Class P (e.g., crops that require high levels of phosphorus). We'll also consider the following environmental variables: rainfall, pH level, humidity, and temperature.

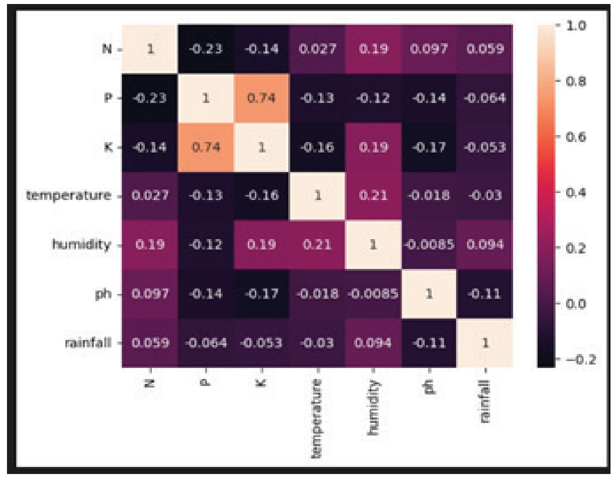

Fig. 4: Confusion matrix of GNB Algorithm

METHODOLOGY

1. Data Collection Using IOT Sensors.
2. NodeMCU Data Transmission.
3. Data Storage and Visualization with Thing Speak.
4. Data Preprocessing.
5. Integration with GNB Algorithm.
6. Crop Prediction.
7. Fertilizer Recommendation.
8. User Interface for Farmers.

Guassian Naïve Bayes Construction

Bayes theorem is a formula that offers a conditional probability of an event A taking happening given another event B has previously happened. Its mathematical formula is as follows

$$P(A|B) = \frac{P(B|A).P(A)}{P(B)}$$

Where,

- A and B are two events
- P(A|B) is the probability of event A provided event B has already happened.
- P(B|A) is the probability of event B provided event

A has already happened.

- P(A) is the independent probability of A
- P(B) is the independent probability of B

Now, this Bayes theorem can be used to generate the following classification model –

$$P(y|X) = \frac{P(X|y).P(X)}{P(y)}$$

Where

- X = x1,x2,x3,.. xN are list of independent predictors. y is the class label
- P(y|X) is the probability of label y given the predictors X

The above equation may be extended as follows:

$$P(y|x1, x2, x3..xN) = \frac{P(x1|y).P(x2|y).P(x3|y)\ldots P(xN|y).P(y)}{P(x1).P(x2).P(x3)\ldots P(xN)}$$

SYSTEM ARCHITECTURE

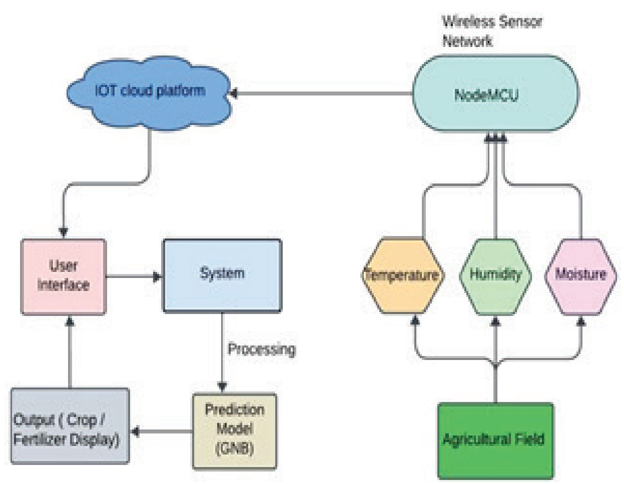

Fig 5. Architecture Diagram of Fertilizer Recommendation and Crop Prediction System

This fertilizer recommendation and crop prediction system combines sensor technology with machine learning to empower farmers. A network of wireless sensors collects data like temperature, humidity, and moisture from the field. This data is then transmitted to the cloud via an open-source IOT platform. By analyzing this data using a machine learning model, the system can predict optimal crop yields and recommend the most suitable fertilizer for specific conditions. This information is then presented to the user through a user interface, enabling farmers to make informed decisions for better agricultural outcomes.

RESULTS

A crop prediction and fertilizer recommendation system based on IOT (Internet of Things) and ML (Machine Learning) provides real-time, data-driven guidance for applying the right type of crops and amount of fertilizer to crops. It optimizes fertilization by considering soil conditions, weather data, crop type, and environmental factors. The result increased crop yields, reduced fertilizer waste, and improved resource efficiency.

Datasets

Dig into our Kaggle dataset tailored for crop prediction and fertilizer recommendations using cutting-edge machine learning algorithms. Gain granular insights into optimal planting times, crop varieties, and nutrient requirements for your specific soil and climate conditions. Revolutionize your farming strategy with personalized recommendations, maximizing yields while minimizing environmental impact.

Outcomes

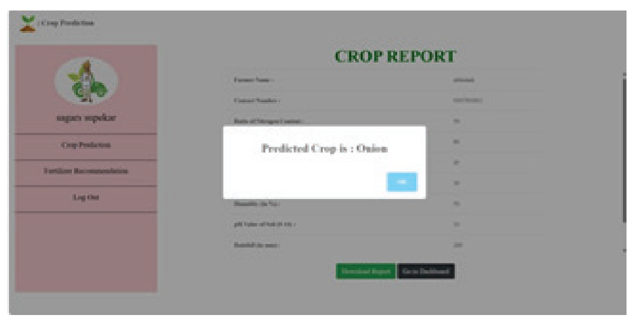

Fig 6. crop prediction based on different environmental factors

Fig 7. Fertilizer recommendation based on different environmental factors

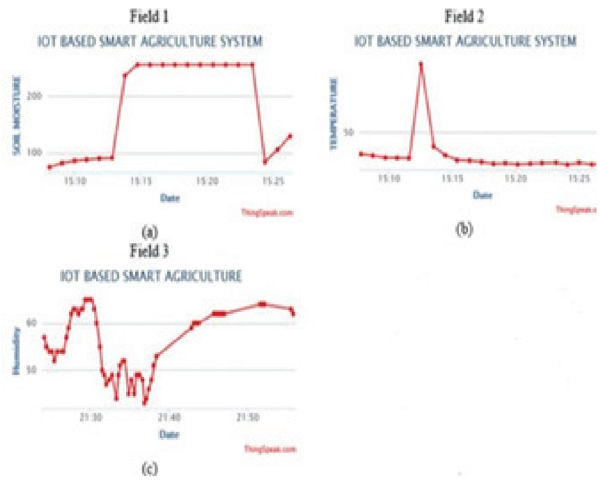

Fig 8. Thing Speak dashboard sensor readings

Performance Evaluation

Table 1. Algorithm Performance Comparison

	Applied Algorithm			
No. of Sample Inputs	**Proposed Methods**	**Existing Methods**		
	GNB	**RF**	**SVM**	KNN
	Accuracy (Percentage)			
10 - 100	99%	95%	95%	90%
101 - 400	98%	91%	90%	87%
401 - 1100	96%	85%	87%	83%
1101 - 2200	93%	80%	85%	80%
Average Accuracy	97 %	88%	90%	85%

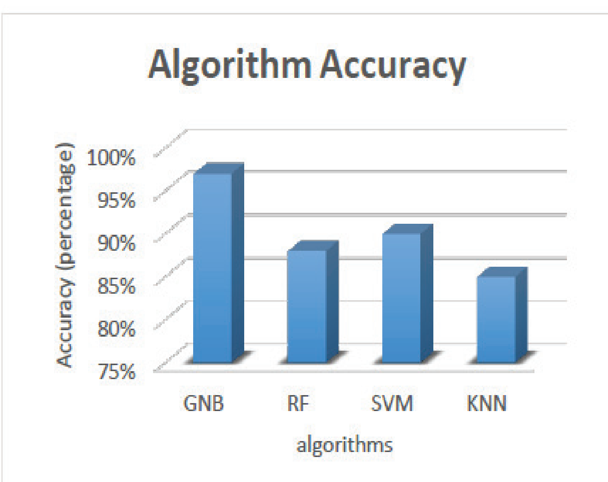

Fig 9. Algorithm Performance Comparison

CONCLUSION

In conclusion, our project on "Smart prediction of crop and fertilizer recommendation using GNB Algorithm, IOT Sensors, NodeMCU, and Thing Speak" represents a significant leap forward in the jump of sustainable and efficient farming practices. By seamlessly integrating IOT sensors, the GNB machine learning algorithm, NodeMCU for data transmission, and Thing Speak for real-time data display, we have provided farmers with a powerful toolkit for informed decision-making. This toolkit not only enhances crop productivity but also significantly reduces resource wastage and minimizes the environmental impact associated with excessive fertilizer use. The project's fusion of data collection, analysis, and visualization technologies reflects a harmonious blend of tradition and innovation in agriculture. It points the way towards a future where data- driven insights empower farmers to optimize their practices, ultimately meeting the growing global food demand while safeguarding our environment. In essence, precision agriculture, as exemplified by our project, underscores the importance of responsible and efficient farming. It showcases how the collaboration of IOT and ML technologies can transform the agricultural landscape, making it more sustainable, productive, and environmentally conscious. As we move forward, this project provides a compelling vision of the role technology can play in shaping the future of agriculture.

FUTURE SCOPE

- Enhance the system to be scalable and adaptable to different agricultural settings and regions, considering variations in climate, soil types, and crop varieties.
- Implementation of automated irrigation systems and drone technology for precise and targeted application of fertilizers and pesticides, further optimizing resource usage.
- Expansion of machine learning algorithms to incorporate deep learning models for more intricate analysis and prediction of crop growth patterns.
- Embracing sustainable farming practices such as regenerative agriculture and agroforestry, leveraging IoT and ML technologies to promote

biodiversity and ecosystem resilience while maximizing agricultural productivity.

ACKNOWLEDGMENT

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AEROLENS: Military Aircraft Detection using Deep Learning

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ABSTRACT

"Deep learning" is a branch of machine learning that uses multi-layered neural networks to learn data representations. It enables computers to automatically learn from data without explicit programming, allowing them to perform tasks such as image and speech recognition, natural language processing, object detection and decision-making. In our pursuit of enhancing the swift and accurate identification of flying objects, we propose the implementation of a specialized computer system, specifically a Convolutional Neural Network (CNN), renowned for its proficiency in image analysis. This strategic integration holds the promise of significantly improving the recognition capabilities in the vast expanse of the sky. The main aim is to develop an Aerial Target Recognition System that utilizes Artificial Intelligence (AI) alongside a Convolutional Neural Network (CNN) for accurate target identification in the sky. This innovation equips decision- makers with the necessary tools to make informed choices and respond swiftly, ultimately making our airspace safer for everyone. In our future work, we plan to use our Aerolens to detect numerous aircraft entering our airspace at the same time.

KEYWORDS: *Military, YOLO (You Only Look Once), Computer vision, EO.*

INTRODUCTION

Identifying aerial threats requires a smart approach that can quickly recognize objects in the sky. One of the methods is using an Electro Optical (EO) device for detection. The process of identification is time critical as it involves decision making for initiating further appropriate course of action. Therefore, a requirement to make available an Aerial Target Recognition System based on inputs from devices by utilizing AI which will provide instantaneous target recognition and identity of the aerial object. So, the proposed project introduces a groundbreaking shift in this conventional aircraft tracking approach by leveraging the capabilities of deep learning technology. The envisioned transformation entails the seamless integration of real-time tracking mechanisms fueled by live camera feeds.

The significance of this paradigm shift extends beyond immediate operational gains. The streamlined deployment of anti-aircraft guns, facilitated by autonomous tracking and targeting, ensures a more proactive defence strategy. The system becomes inherently capable of responding swiftly to emerging threats, providing a critical advantage in safeguarding national airspace. The system has the ability to learn and adapt over time using past data, which helps it get better at identifying and tracking various types of aircraft. This learning feature ensures that our air defence stays ahead in innovation, allowing it to keep up with the constantly evolving aerial technologies.

Additionally, the integration of deep learning brings forth a highly advantageous trait: adaptability. This signifies that our system possesses the capability to learn and improve over time by analysing historical data, thereby continuously enhancing its accuracy in identifying and monitoring various aircraft profiles. This adaptability proves to be indispensable as it positions our air defence system as a trailblazer in innovation, allowing it to remain synchronized with the swiftly evolving landscape of aerial technologies. Consequently, this ensures that our defence infrastructure retains its agility and effectiveness in countering emerging threats, thereby bolstering the overall security of our airspace.

This research paper is dedicated to the creation of an autonomous tracking system, which means a system that can work by itself without human intervention. We're focusing on using a sophisticated technology called deep learning to make this system intelligent and efficient. Our goal is not just to develop any tracking system, but to pioneer a solution that originates from our own country. We want to address the current challenges faced in tracking and monitoring, while also incorporating the latest advancements in technology. As we delve deeper into the project, we realize that our efforts extend beyond mere technological advancement. We're deeply committed to enhancing the operational efficiency and strategic capabilities of the Indian Army's air defence setup. This means not only improving the technology but also ensuring it fits seamlessly into the existing defence infrastructure. Ultimately, our comprehensive approach is aimed at not just filling the existing gaps but also positioning India as a frontrunner in the realm of cutting-edge defence technologies.

LITERATURE SURVEY

Fengcheng Ji, Dongping Ming, Beichen Zeng,Jiawei Yu, Yuanzhao Qing, Tongyao Du (2021) " Aircraft Detection in High Spatial Resolution Remote Sensing Images Combining Multi Angle Features Driven". In this paper the Model achieved an average precision on public and private datasets, respectively, which is higher than that of the Faster R-CNN. [1]

Zhi-Ze Wu, Shou-Hong Wan, Xiao-Feng Wang, Ming Tan (2020) "A benchmark data set for aircraft type recognition from remote sensing images". In this paper, Performance analysis of aircraft type recognition and deep learning approaches on the MTARSI dataset is done. [2]

Dillon Reis, Jordan Kupec, Jacqueline Hong (2023) " Real- Time Flying Object Detection with YOLOv8". This paper proposes a generalized model for real-time detection of flying objects that can be used for transfer learning and further research, as well as a refined model that is ready for implementation. [3]

Patchigolla Sampath, Shaik Haseeb, Are Jaideep (2023) "Revolutionizing Military Surveillance Advanced Deep Learning Techniques for Aircraft Detection". Results from six distinct picture classification models—ResNet50, VGG19, Xception, MobileNetV2, InceptionResNetV2, and DenseNet—are presented in this study. [4]

Hongliang Zhu, Hoseung Lung, and Nang Lin (2020) "Carrier-based Aircraft Detection on Flight Deck of Aircraft." In this paper method achieved an average detection good accuracy in the real reconnaissance images of the aircraft carrier with carrier-based aircraft on the flight deck. [5]

PROPOSE SYSTEM

In our Aero-lens (shown in figure I) device, we're employing high-definition cameras to spot airplanes in the sky instantly. These cameras capture details such as flags, symbols, and aircraft numbers for accurate detection. This means we're not just looking for planes, but also gathering specific information that helps us identify them correctly.

The system architecture comprises three distinct models. In the initial phase, "Process A" assumes the pivotal role of responsively acquiring inputs from diverse channels. It meticulously pre-processes and transforms the images into a predefined format. Subsequently, the processed data is seamlessly forwarded to "Process B", which undertakes the critical task of detecting aircraft within the images.

This involves the precise delineation of bounding boxes around identified aircraft, thereby encapsulating their spatial coordinates. The meticulously computed box coordinates are then transmitted to "Process C" for further analysis and action.

In our device, we're using something called a frame splitter. It does exactly what it sounds like: it breaks down a video of an aircraft into smaller parts called frames. Imagine if you had a 10-second video of a plane flying by. The frame splitter would divide this video into 10 separate pictures, each capturing a moment from that

10-second video. This helps us analyse each moment more closely and accurately.

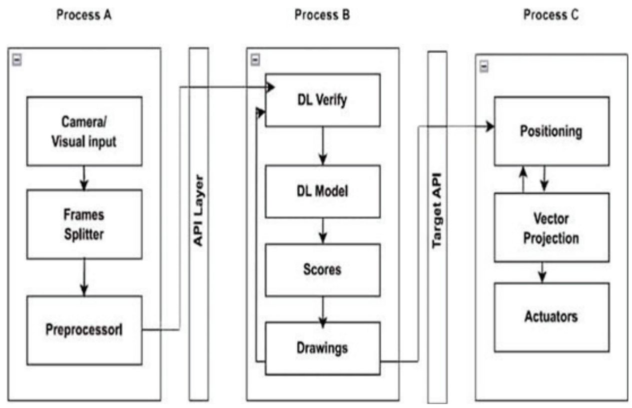

Fig. 1: System Architecture

During the preprocessing stage, we're adjusting the size of the images we capture of military aircraft. We make them all the same size, specifically 640 by 640 pixels. This makes it easier for our system to analyse and compare the images effectively. By standardizing the size, we ensure consistency in our data processing, which helps improve the accuracy of our detection and recognition processes.

In this Areo-lens we are using YOLO model, is a popular object detection algorithm in the field of computer vision. It's a deep learning model that can detect and locate objects within an image or a video frame in real-time. Unlike traditional object detection algorithms that require multiple passes through an image, YOLO processes the entire image in one go.

We're figuring out how accurate our system is at identifying aircraft. We do this by comparing the information we get from the images we capture to the data we already have in our project's dataset.

So, if our system captures an image of an aircraft, we check if it matches the information we already know about that aircraft from our dataset. This helps us understand how well our system is performing and if it's correctly recognizing the aircraft it sees. In our project, we have actuators that control the movement of cameras.

When system recognizes an aircraft in the air, these actuators turn the cameras towards it. This movement is carefully calculated using a technique called matrix OpenCV calibration. Essentially, this means we use a method to accurately adjust the position of the cameras based on mathematical calculations. So, when our system detects an aircraft, the actuators make sure the cameras focus on it correctly, helping us get clear and accurate images.

DATASET

The purpose of this dataset is to identify military aircraft objects. Images of military aircraft in various settings and circumstances are included. Its annotations are extremely accurate, providing more precise bounding boxes than are usually present in datasets of a comparable nature. More precise detection models can be trained thanks to this precision. The collection includes 47 distinct types of military aircraft, some of which have been combined into a single class along with their variants. [6]

The classes that are offered are as follows: A-10, A-400M, AG-600, AV-8B, B-1, B-2, B-52, Be-200, C-130, C-17, C-2, C-5, E-2, E-7, EF-2000, F-117, F-14, F-15, F-16, F/A-18, F-22, F-35, F-4, J-10, J-20, JAS-39, KC-135, MQ-9, Mig-31, Mirage2000, P-3, RQ-4, Rafale, SR-71, XB-70, YF-23, Tu- 160, Tu-95, U-2, US-2, V-22, Vulcan, Su-24, Su-25, Su-34, Su-57, Tornado, and so on. Figures II and III depict airplanes from each class of aircraft that were utilized to train the deep learning model.

Fig. 2: Dataset Images

Fig. 3: Dataset Images

YOLO MODEL

In our military aircraft detection model, we're using YOLO model, It's a smart computer program that's trained to quickly find and recognize military aircraft in images or videos using deep learning technology. Imagine it as a super-fast detective that can scan an entire picture or video at once and instantly identify any aircraft it sees. This makes our model really efficient and reliable for spotting military aircraft in different situations, which is crucial for defence and security purposes.

[7] So, by using the YOLO model, we're making our military aircraft detection system smarter and more effective at keeping our airspace safe.

Because military aircraft have so many different features, it can be difficult to identify and locate them using surveillance data—images or videos—collected by sensors or cameras. Effective military surveillance and defense demand the development of precise detection systems for such aircraft. [8]

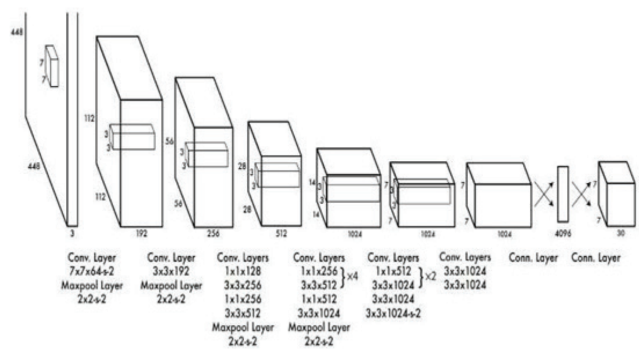

Fig. 4: Yolo Architecture [9]

A type of deep learning technique called YOLO models has proven remarkably effective in a number of computer vision applications, such as segmentation, classification, and object detection. These models are very good at automatically identifying and extracting relevant features from the input data such that manual feature extraction techniques are not necessary. When it comes to identifying military aircraft, YOLO models can be trained to identify distinguishing characteristics from a large collection of annotated photos or videos. These characteristics include contours, edges, coatings, and designs unique to different kinds of military aircraft [4]. After being trained, the YOLO model can forecast the probability of aircraft presence in each zone by utilizing methods like region proposal or sliding window to evaluate fresh surveillance data.

Furthermore, YOLO models can function effectively in real- time applications because to optimization techniques like acceleration, quantization, and network pruning. To put it briefly, YOLO models are very good at identifying military aircraft because they can learn from large datasets, can adapt to different kinds of aircraft, and can perform quickly in real- world scenarios.

TRAINING OF MODEL

We use method known as transfer learning in YOLO involves leveraging pre-trained models on large datasets to improve the performance of YOLO on specific tasks or domains with limited data. By fine-tuning a per-trained YOLO model on a target dataset, it can adapt its knowledge and features to improve object detection accuracy for the specific task at hand. We use the predefined weight which is yolov8n.pt.

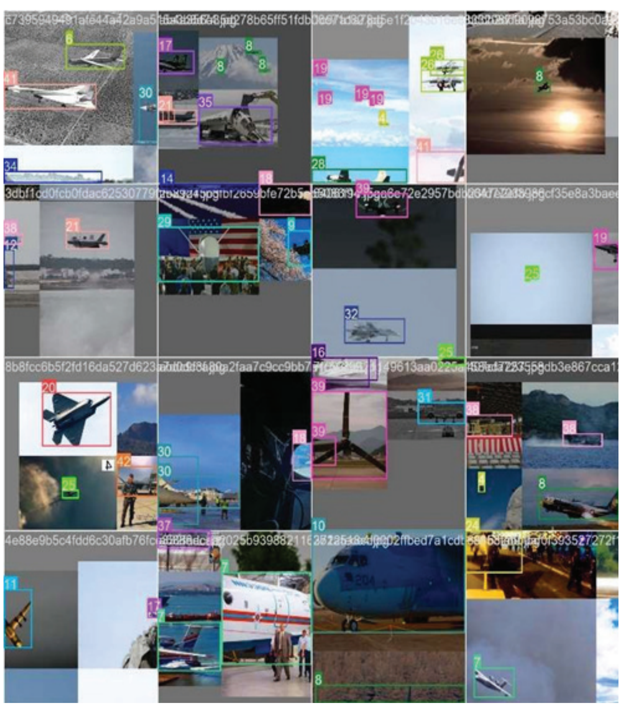

Fig. 5: Training Batch Sample

Yolo with the help of its provided robust utility script train.py which is responsible for training the YOLO model with custom dataset as in this our case is military aircraft dataset as discussed in earlier section. The train.py takes care of all the fail cases such as saving the trained model weights at some time interval, It maintains two weights files best.pt and last.pt where first are the weights which has best performance in current training session and latter is the last trained epoch weights, in the case of an failure of training due to any reason the script can resume the training from the last trained epoch.

The training is done in batches of images and for our case we have kept the batch size 12 as shown in below image.

Hyper parameter set for model to train are shown in table 1.

Hyperparameter	Value
Lr0	0.01
Lrf	0.01
Momentum	0.937
Weight_decay	3.0
Warmup_decay	0.0005
Warmup_ephocs	3.0
Warmup_momentum	0.8
Warmup_bias_lr	0.1
Box	0.05
Cls	0.5
Scale	0.5
Cls_pw	1.0
Obj	1
Obj_pw	1.0
Iou_t	0.2
Anchor_t	4.0
Fl_gamma	0.0
Translate	0.1
Shear	0.0
Perpective	0.0
Flipud	0.0
Fliplr	0.5
Mosaic	1.0
Mixup	0.0

The hyperparameters show in table I are default used to train the YOLO model for dataset shown in section V, if the results need to be replicated then these hyperparameter are recommended.

HARDWARE USED

The results achieved for yolo model after training it on hardware shown in table II, please note the hardware is not mandatory, we can use more powerful hardware with different CUDA versions.

Table 2:

Hardware	Capacity/Type/Name
GPU	Nvidia MX450 2GB GDDR4
RAM	16GB (GDDR4) 4267Mz
OS	Windows 11 (22H2)
CPU	I7-1165G7

The total training time we required after using hardware (ref table II) we took 24 x 7 = 160 hours (1 week) of time for training 110 epochs.

RESULTS

After training 110 epochs as described in section IX, we got the following results and for summary confusion matrix is shown in figure VI and various curves F1, Precision Recall, recall confidence, these results are produced after using hyperparameter shown in Table I, these results only show the performance of the model when an image is given as input, these results does not include model realtime performance over video from the webcam is used.

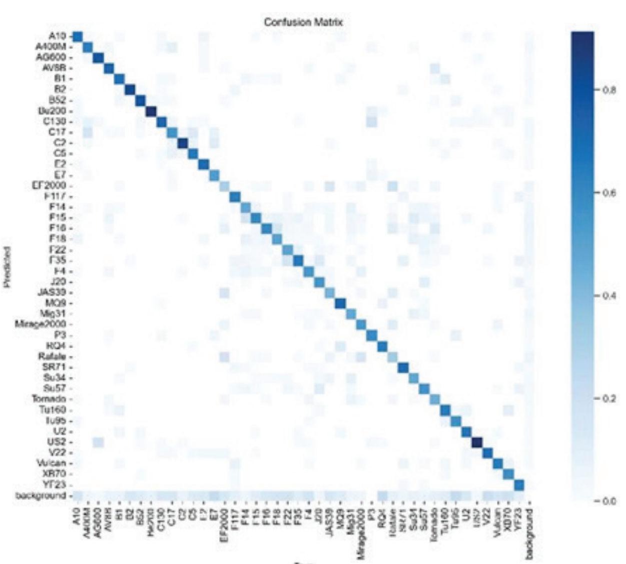

Fig. 6: Confusion Matrix

A table that displays the counts of true positive, true negative, false positive, and false negative predictions is called a confusion matrix, and it is used to assess how well a classification model is performing.

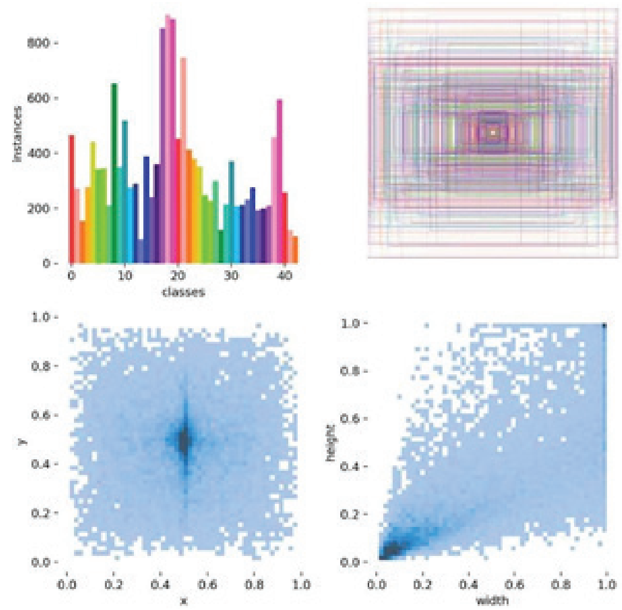

Fig. 7: Labels

The above figure VII shows the information about the attributes of the labels such as how many images are associated with each class and shows the image width and height and it also shows the center x and y of the aircraft in the images.

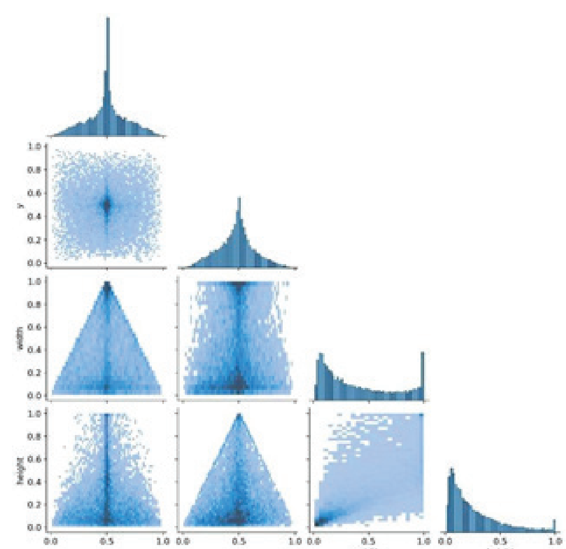

Fig. 8: Label Correlation

Label correlation refers to the degree of association or relationship between different labels or categories in a dataset. It assesses how closely related or dependent the labels are on each other, which can be important for tasks such as multi-label classification or understanding the underlying structure of the data.

The F1 curve, as seen in figure IX, illustrates how the F1 score varies for various thresholds used in binary classification models. The trade-off between recall and precision at different thresholds is made easier to see by plotting the F1 score versus the decision threshold.

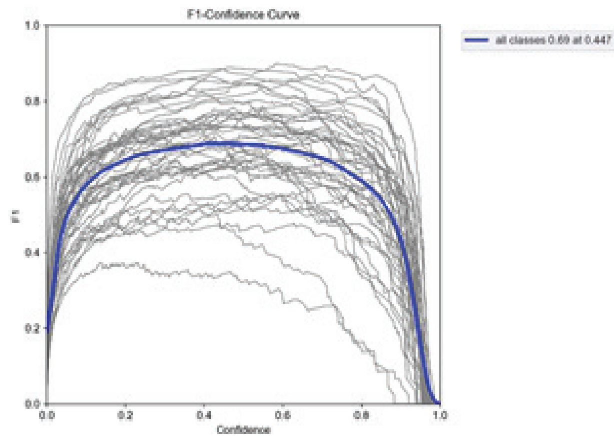

Fig. 9: F1 Curve

The precision-confidence curve shows how a model's precision changes as the prediction's confidence threshold varies. It aids in evaluating how a classification model's confidence and precision are traded off.

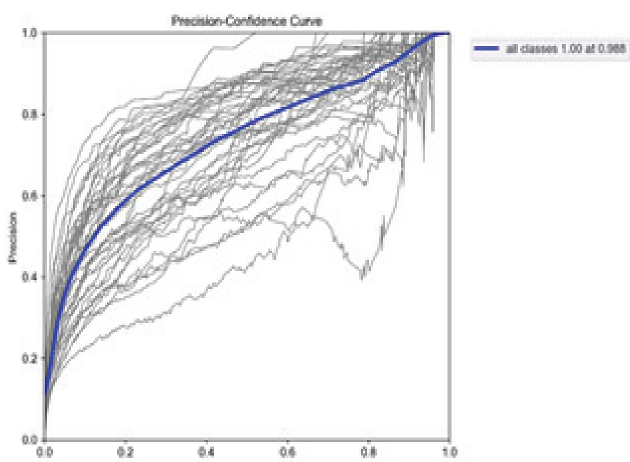

Fig. 10: Precision Confidence Curve

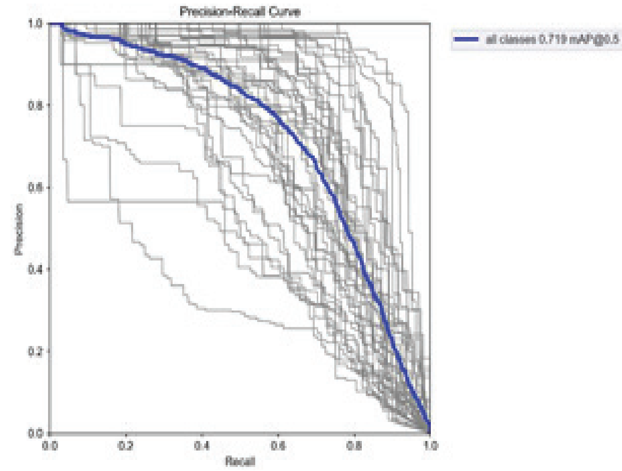

Fig. 11: Precision Recall Curve

A graphical depiction of the trade-off between precision and recall for various binary classification model thresholds is called the precision-recall curve. It aids in assessing how well the model performs at different categorization certainty levels.

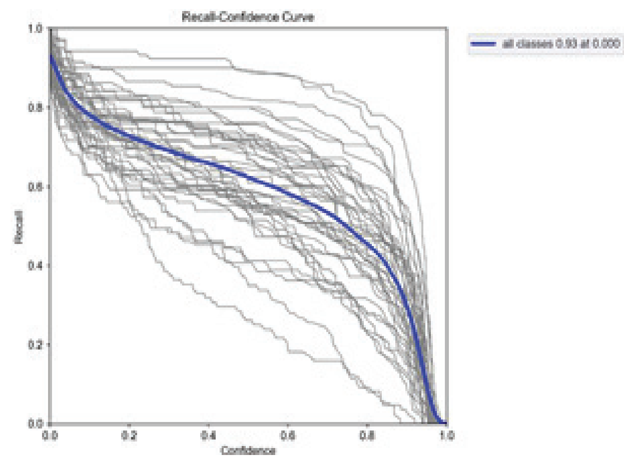

Fig. 12: Recall Confidence Curve

The recall-confidence curve shows how the recall of a model changes with varying confidence thresholds for predictions.

It helps understand how the model's recall performance varies as the confidence in its prediction's changes.

The combined results are shown here, including training, validation losses, and a number of other metrics including recall, accuracy, mAP0.5, mAP_0.5:0.95, train/box, train/object, train/class, validation/box, validation/object, and validation/class losses.

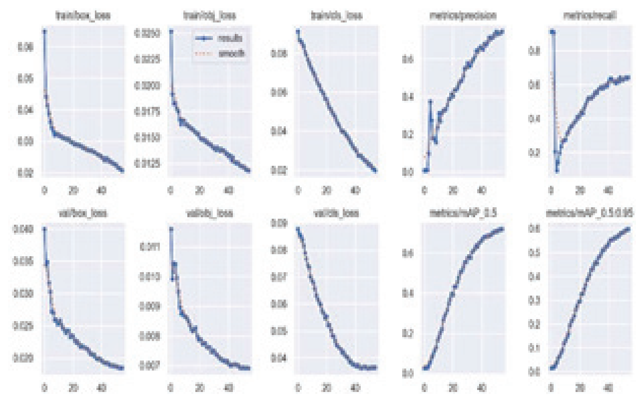

Fig 13: Train/Validation Losses

These are the results which we got after using transfer learning of YOLO model with its pre-defined weights yolov8n.pt.

Parameter	0.74
Precision	0.7
Recall	0.6
mAP 0.5:0.95	0.03
Class loss(validation)	0.007
Box Loss(validation)	

CONCLUSION

In conclusion, by Utilizing Aerolense enables real-time detection and tracking of military aircraft, leveraging the rapid inference capabilities of the YOLO deep learning model, renowned for its single-shot object detection. And YOLO also offer a great ecosystem for training and testing the trained models by using transfer learning. Aerolense can help in detection and tracking of the military aircraft simpler and fast by leveraging high performance compute capability of the GPUs. With the hardware used in table II we achieved the precision of 0.74 which has future scope of improvement. We can use aerolens where there is need for automated targeting system which should work on camera or visual feeds which has biggest application in military air defense. It will help to make the existing systems more reliable.

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Churn Prediction in Telecom Sector using NLP and ML

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ABSTRACT

Our study aims to create a strong churn prediction tool for telecom companies by combining machine learning (ML) especially the powerful XGBoost algorithm and natural language processing (NLP) together. Churn simply means when customers stop using a service or product, which is a big problem for the telecom industry. Customer churn badly affects the revenue of the company and customer loyalty. In today's fast-paced telecom world, accurately guessing when churn might happen is crucial for companies to keep customers and stay profitable. By using NLP and ML, especially XGBoost, our objective is to predict churn accurately, helping companies keep customers happy and their businesses healthy. Our tests show promising results, proving the effectiveness of our tool in reducing churn and building better customer relationships.

KEYWORDS: *Machine Learning (ML), Churn prediction, Telecom industry, Natural Language Processing (NLP), XGBoost algorithm.*

INTRODUCTION

In any industry, customers are esteemed as the most valuable asset, as corporate profitability is often directly tied to customer numbers. The telecommunications industry encompasses businesses facilitating global communication through wired or wireless connections, spanning phone, Internet, or both mediums. These companies construct the infrastructure facilitating data transmission worldwide in text, audio, or video formats. This industry's numerous companies comprise internet service providers, cable, satellite, and landline or wireless phone operators. While wired communication is gradually advancing to wireless connections, the number of cellular users expands on a regular basis. Despite the prevalence of wireless communication, customers are divided into post-paid and pre-paid categories based on subscription payment methods, with a range of service options available. The overarching goal of telecommunications firms remains revenue growth and survival in a fiercely competitive landscape [3].

Customer churn, denoting a significant portion of clients dissatisfied with a telecom company's services, occurs when customers depart for another service provider. This migration of customers results in service provider changes, impacting profit margins for companies. Churn prediction systems are instrumental in mitigating this issue by pre-emptively addressing customer loss.

Various factors contribute to churn, including inadequate network infrastructure, costly services, ineffective strategies, and subpar consumer experiences. Prepaid customers, unbound to a specific company, can terminate services at any time, exacerbating churn rates. Additionally, churn detrimentally affects a company's reputation and brand value. Loyal customers, significant revenue generators, may be inclined to switch providers if dissatisfied, prompting telecom companies to reevaluate policies to prevent revenue loss.

In today's digital age, virtually every business maintains a website to promote, expand, and engage with clientele. Websites serve as platforms for customers to provide feedback and reviews, invaluable for service enhancement. However, traditional churn prediction systems predominantly rely on machine learning and historical customer data analysis. Integrating customer feedback analysis through natural language processing (NLP) can offer deeper insights into customer sentiments.

Customer relationship management (CRM) analysts prioritize forecasting customer churn and identifying underlying causes to retain current clientele. Timely marketing initiatives targeting at-risk customers are vital for churn reduction. Accurate churn prediction techniques are imperative for effective CRM strategies; inaccurate predictions hinder proactive campaign execution. The integration of advanced analytics and machine learning models enhances the precision of these predictions, allowing for the customization of retention strategies tailored to individual customer profiles.

Overview of Machine Learning

Machine learning (ML) techniques are revolutionizing churn prediction in the telecommunications industry. By harnessing vast datasets comprising customer demographics, usage patterns, and interactions, ML models offer invaluable predictive capabilities. Through sophisticated preprocessing and feature engineering, raw data is transformed into actionable insights, enabling the identification of at-risk customers. ML algorithms, ranging from logistic regression to ensemble methods like random forests and gradient boosting, are meticulously trained and optimized to achieve optimal performance. Evaluation metrics such as accuracy and AUC-ROC provide valuable feedback on model effectiveness. Once deployed, these models facilitate proactive customer retention strategies, ensuring telecom companies can anticipate and address churn effectively. In summary, ML-driven churn prediction empowers telecom providers with the foresight needed to maintain customer satisfaction and business success [9].

Overview of Natural Language Processing

Natural Language Processing (NLP) techniques are increasingly vital in enhancing churn prediction strategies within the telecommunications sector. By leveraging textual data from customer feedback, reviews, and interactions, NLP enables a deeper understanding of customer sentiment and preferences. Through text preprocessing methods such as tokenization and sentiment analysis, unstructured text data is transformed into structured information, enriching the predictive capabilities of churn prediction models. NLP techniques also facilitate topic modelling, allowing telecom companies to identify recurring themes and issues driving customer dissatisfaction. By integrating NLP insights with machine learning algorithms, telecom providers can develop more nuanced and effective customer retention strategies. In essence, NLP empowers telecom companies to extract actionable insights from textual data, ultimately improving customer satisfaction and reducing churn rates.

Objectives:

- To develop a Churn Prediction Model that identifies customers at risk of churning.
- To predict the factors that cause churn.
- To improve customer satisfaction by focusing on areas where improvement is required.

LITERATURE SURVEY

Chen Zhue et al. The MIPCA-XGBoost method for telecom customer churn prediction achieves high accuracy through mutual information feature selection. It recommends that restrictions including the effect of instant messaging programs and the requirement for data from various operators be addressed in future studies. Creating categorization models for turnover patterns and taking customer interactions into account are some of the suggested directions. These results provide guidance for improving retention tactics and expanding the field of churn prediction research [1].

Sarkaft Saleh et al. The telecom industry's churn analysis and retention tactics underscore the need for innovative techniques that go beyond price competitiveness in light of market saturation. Key variables impacting churn in Denmark and the USA are identified using five MLAs, highlighting the need of enhancing service quality and upgrading subscription plans. The findings indicate that age is a key predictor of churn, which highlights the need to take into account cultural variation and diversify churn analysis methods in order to improve comprehension and retention initiatives [2].

Sylvester Igbo et al. The study creates a methodology for predicting loss of customers in the telecom sector using machine learning. The optimal regression model for forecasting customer switching across telecom providers is found by comparing many of them. Among the models are the Random Forest Repressor, Artificial Neural Network, Lasso Regression, Elastic Net Regression, Polynomial Regression, Support Vector Regression, and Stochastic Gradient Descent. Evaluation metrics include Cross-Validation, R2, RMSE, MAE, and MSE. The results indicate that the Lasso Regression model is the most successful in predicting customer turnover, since it minimizes loss functions and achieves optimal fit on observed data [3].

Sharmila K. Wagh et al. Recognizing that customer turnover is inevitable, the proposed system makes use of machine learning algorithms to estimate telecom client churn and build retention measures. By using a random forest classifier, the system is able to anticipate churn well. The significance of comprehending survival curves in churn prediction is emphasized by the integration of survival analysis using a Cox Proportional Hazard model. Emphasis is placed on minimizing customer effort to enhance retention rates [4].

Mr. Abhinav Sudhir Thorat et al. In the telecom sector, the Random Forest model is a strong machine learning method for forecasting client loss. The model finds important elements in churn prediction and correctly identifies consumers who are at danger of leaving. With its excellent recall and forecast accuracy, it offers telecom firms a solid and dependable tool. Furthermore, the model pinpoints critical elements in churn prediction, which helps businesses better understand attrition dynamics and tailor their customer service approaches. [5].

Samah Wael Fujo et al. Utilizing a Deep-BP-ANN model to predict loss of customers in the telecom sector and evaluating its effectiveness with four machine learning approaches yields encouraging outcomes. On the IBM Telco and Cell2Cell datasets, the DeepBP-ANN model performs better than other classifiers in terms of accuracy, precision, recall, and F1-Score. It does this by using Lasso regularization for feature selection and the XG Boost method for feature significance identification. The model's efficacy is enhanced by balancing approaches like ROS and Activity regularization, and performance is further improved by adjusting parameters like the number of neurons and epochs. The suggested approach outperforms previous research in terms of findings, demonstrating its efficacy in precisely forecasting client attrition [6].

Denisa MELIAN et al. In the telecom industry, predicting customer attrition entails using five statistical techniques to examine consumer behavior. The main goal is to increase churn prediction performance and efficiency in order to foresee and stop client loss. Even with problems like low AUC values, decision trees show promise as a substantial predictor, as "MonthsO" is the main indication that affects churn in all approaches. While Balanced Random Forest emphasizes "MonthsO" and "MinC" in finding churners, Random Forest emphasizes "MinC" as a crucial component. Furthermore, according to PSM, "MonthsO," "Invoice," and "Tenure" are important factors that influence turnover. Subsequent investigations will broaden the dataset to encompass prepaid consumers, highlighting the pivotal function of "MonthsO" in forecasting customer attrition in the telephone industry [7].

Glory Sam et al. Six machine learning algorithms are evaluated in a proposed customer churn prediction model: Random Forest, Decision Trees, K-Nearest Neighbour, Support Vector Machine, Logistic Regression, and XGBoost. According to experimental data, XGBoost outperformed other algorithms, with Random Forest and Decision Trees coming in second and third. These results highlight how well sophisticated machine learning methods like XGBoost can forecast customer attrition, underscoring the necessity of ongoing innovation to handle the complexity of the market [8].

V. Kavitha et al. The three tree-based algorithms that are most useful in these kinds of applications are Random Forest, XGBoost, and Logistic Regression. These methods improve prediction accuracy. Enabling targeted retention efforts and accurate prediction of prospective churners are made possible by leveraging data from customer service plans. With Random Forest producing the best accuracy of all the approaches tested, the suggested churn model performs better than the others [9].

Pan Tang et al. To predict loss of clients in telecommunications firms, a prediction model combines XGBoost and K-Means clustering. This method shows better precision and overall generalization ability while keeping high efficiency when compared to other models like decision trees. As a result, the model has a wide range of applications in telecom customer churn prediction, providing both computational economy and enhanced predictive performance [10].

PROPOSED SYSTEM

System Architecture

Fig. 1: System Architecture

Using a dataset from the telecom sector that includes structured customer data such as customer ID, tenure, marital status, and more, the study first uses this data. The basis for forecasting churn behaviour is this dataset. To complement the structured dataset, unstructured data is also gathered in the form of consumer reviews. To make sure the dataset is suitable for predictive modelling and of high quality, data cleaning is started. Only pertinent properties are kept after feature selection and data normalization is used to normalize the numerical feature scale. To effectively train the model, the dataset must be prepared using these methods.

The gathered feedback data is subjected to Natural Language Processing (NLP) using instruments such as the Sentiment Intensity Analyzer (SIA) after data cleansing. Based on consumer feedback, this natural language processing produces sentiment scores that indicate customer satisfaction levels. In order to improve feature sets for predictive modelling, these sentiment scores offer extra insights into customer sentiment that are subsequently combined with structured customer data.

The XGBoost technique is used by the study for model creation after the dataset has been produced. Because of its efficiency in managing structured data and ability to support more features from sentiment analysis, XGBoost is selected. Here, the sentiment score that was calculated serves as an extra layer. To precisely assess model performance, the dataset is divided into training and testing sets. As the model is being trained, XGBoost picks up on the underlying patterns in the training data [10].

When the model training is finished, evaluation metrics including accuracy, precision, recall, and F1 score are used to evaluate the predicted performance. These measurements shed light on how well the model predicts churn behaviour. By employing a thorough methodology that incorporates sentiment analysis and structured data, the research seeks to offer telecom firms practical insights to improve business outcomes and maximize client retention tactics.

Dataset

We selected a telecom company dataset, which is available on Kaggle.com, for predicting churn customers because it includes data on both churn and non-churn customers. The dataset is publicly accessible on Kaggle as the Telco Customer Churn dataset. It contains about 21 features and 7043 rows, with the class label “churn” set to either “yes” or “no”. The final defined attribute, represented as a numeric value, such as 0 or 1, is the class label.

(https://www.kaggle.com/datasets/blastchar/telco-customer-churn/data)

Table 1. Dataset Description Table

Sr. no	Features	Feature Description
1	customer ID	Customer ID
2	gender	male or female (M, F)
3	Senior Citizen	Whether customer is Senior Citizen (0,1)
4	Partner	Does customer have partner (Yes, No)
5	Dependants	Customer dependents (Yes, No)
6	tenure	Tenure in months (0 - 72)
7	Phone Service	Customer has a phone service (Yes, No)
8	Multiple Lines	Customer uses multiple lines (Yes, No, No phone service)
9	Internet Service	Internet service provider (DSL, Fiber optic, No)
10	Online Security	Customer has online security or not (Yes, No, No internet service)
11	Online Backup	Customer has online backup or not (Yes, No, No internet service)
12	Device Protection	Customer has device protection or not (Yes, No, No internet service)
13	Tech Support	Tech support for customer (Yes, No, No internet service)
14	Streaming TV	streaming TV (Yes, No, No internet service)
15	Streaming Movies	Customer has streaming movies or not (Yes, No, No internet service)
16	Contract	The contract term of the customer (Month-to-month, One year, Two year)
17	Paperless Billing	Customer has paperless billing or not (Yes, No)
18	Payment Method	Payment method (Mailed check, electronic check, Credit card, Bank transfer (automatic))
19	Monthly Charges	Monthly amount charged (18.3 – 119)
20	Total Charges	Total amount charged (18.8 - 8680)
21	Churn	(Yes, No)

Data Preprocessing

Data preparation is crucial to ensure that the data is clean, consistent, and suitable for machine learning models. It involves a series of systematic steps, including addressing missing values, standardizing data, encoding categorical variables, and eliminating noise or outliers. The dataset to be used consists of 7043 rows and 21 columns. The first step of preprocessing involves searching for null values within the dataset and filling them. Features like ‘MonthlyCharges’ and ‘TotalCharges’ are converted to numeric values to handle errors and fill the missing values.

The dataset consists of various categorical variables such as ‘Gender’, ‘Partner’, ‘Dependents’, ‘PhoneService’, ‘MultipleLines’, ‘InternetService’, etc., which are to be converted into numerical format using one-hot encoding for further processing and model training. To obtain dummy values for the categorical variables, a new column for each unique value in the categorical columns is created. The first dummy column for each category is dropped to avoid redundancy and multicollinearity. The target column ‘Churn’ contains categorical data which is to be converted into binary numerical labels 0 and 1.

Feature Selection

Building predictive models requires carefully selecting a subset of important features. Features such as ‘CustomerID’ that have no impact on the model’s prediction are filtered out. The target column ‘Churn’ is dropped for the purpose of model training.

Data Analysis

The key to predicting customer churn lies in uncovering hidden patterns within their data. This study adopts a unique approach by integrating two methodologies: ML and NLP.

In our data analysis, we delve into various aspects of customer behaviour to pinpoint potential indicators of churn. Initially, we investigate the relationship between a customer’s tenure and their propensity to churn. Subsequently, we explore how different usage patterns, such as phone line or internet service subscriptions, impact churn rates. Additionally, we examine the influence of billing preferences, such as paperless billing and payment methods, on churn behaviour. Moreover, we delve into demographic factors like age, gender, and geographical location to understand their contribution to churn. Lastly, we analyse the correlation between monthly spending habits and customer churn. Through the use of charts, graphs, and statistical methods, our objective is to uncover any discernible connections between these factors and customer attrition, thereby identifying the most significant predictors of churn.

To gain insights into these relationships, we employ a correlation matrix to visualize the strength of connections between various customer features. This visualization aids in identifying initial patterns, such as whether senior citizens with high spending habits (MonthlyCharges) tend to exhibit greater retention. Additionally, we delve deeper into the analysis by exploring how factors like contract duration and customer service interactions impact churn rates. This comprehensive examination allows us to uncover nuanced insights and refine our churn prediction model further.

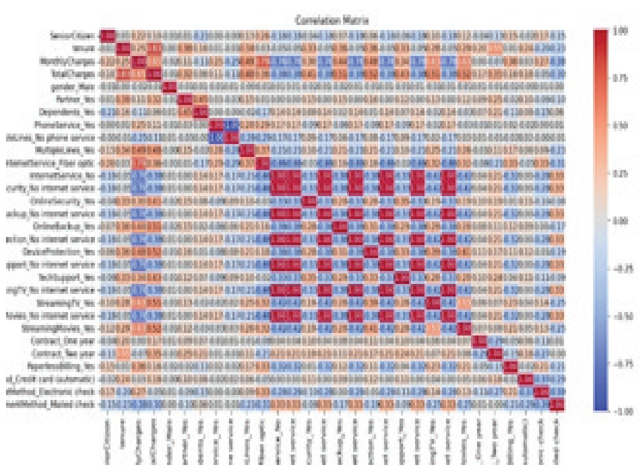

Fig. 2: Correlation Matrix

MODEL BUILDING

ML Model

Random Forest

The Random Forest machine learning technique generates many decision trees and aggregates their forecasts to arrive at a final prediction. Decisions are made by each decision tree in the forest using a random subset of characteristics once it has been trained on a portion of the data. Random Forest is able to manage complicated interactions in the data and produce reliable forecasts by combining the predictions of several trees. It has a reputation for being extremely accurate and capable of handling big datasets with plenty of attributes [5].

Logistic Regression

Logistic Regression is a statistical tool mainly used for tasks where we need to classify things into two groups for example, the model may examine past customer data, including payment details, use trends, demographics, and customer service exchanges. It works by looking at the information we have and calculating the chances of something belonging to one group or the other. These chances are turned into probabilities, which tell us how likely it is for each data point to belong to each group. The tool then figures out which factors influence these probabilities the most and adjusts them to make the predictions as accurate as possible. Once it's trained, it can take new information and predict which group each new data point belongs to, based on the probabilities it calculated

XGBoost

The gradient boosting algorithm's advanced version, known as XGBoost, has become popular for its excellent accuracy and performance in predictive modeling applications. It builds a sequence of decision trees one after the other, each one learning from the errors of the one preceding it. XGBoost decreases the discrepancy between the expected and actual results by employing a gradient boosting strategy to enhance the learning process.

Objective Function: The objective function in XGBoost combines the loss function with regularization terms. It's formulated as:

$$\text{Objective} = \sum(\text{Loss}(y_i, \hat{y}_i)) + \sum(\Omega(f_k))$$

Where:

- $\text{Loss}(y_i, \hat{y}_i)$: Loss function measuring the difference between predicted ($\hat{y}_i$) and actual (y_i) values.

- Ω(f_k):regularization word for every tree in the group.

Because XGBoost can effectively handle huge datasets with high dimensionality, it is thought to be the best model for churn prediction. Because it can automatically manage feature engineering, feature selection, and missing values, it is appropriate for complicated real-world datasets that are frequently used in churn prediction tasks. Regularization strategies are also used by XGBoost to avoid overfitting and ensure the model's applicability to fresh data. Because of its speed and scalability, it can handle large volumes of data rapidly, which makes it the perfect option for real-time applications like telecom churn prediction. Furthermore, XGBoost offers comprehensible outcomes, enabling analysts to understand the elements causing churn and extract useful information for maintaining clients tactics.

NLP Model

Natural Language Processing (NLP) can be used as a additional layer as it does analysis on customer feedback for churn prediction. NLP can be used to determine the sentiment of customer feedback. Positive sentiments might indicate satisfaction, while negative sentiments could signal dissatisfaction or intention to churn. The sentiment analysis is done with the use of Sentiment Intensity Analyzer (SIA). The Sentiment Intensity Analyzer (SIA) is a tool within the TextBlob library in python. It's specifically designed to analyse the sentiment of text data. Unlike other sentiment analysis tools that simply categorize text as positive, negative, or neutral, SIA provides a more nuanced analysis by calculating a sentiment score. These scores reflect the positive or negative connotation of each word.

SIA doesn't use pre-trained data in the same way as some machine learning models. SIA relies on a pre-built lexicon containing words with associated sentiment scores. The sentiment lexicon is itself pre-trained. This lexicon is a large list of words with pre-assigned sentiment scores.

SIA generates a compound score that reflects the general emotions of the piece of text. The "compound" score in the lexicon, represents the overall sentiment polarity (positive, negative, or neutral). This score normally varies from -1 (very negative) to +1 (highly positive), with zero representing neutrality. SIA is relatively easy to use. Hence, Sentiment analysis with SIA is fast and efficient.

RESULT & ANALYSIS

We conducted an analysis and comparative study of the churn prediction problem, where customers are churning from one service to another. Through this, we aimed to identify which parameters affect customer churn and to find solutions to mitigate this problem using machine learning techniques, algorithms, and Natural Language Processing (NLP). We utilized various algorithms for this comparative study, such as XGBoost (Extreme Gradient Boosting), Random Forest, Decision Tree, and Logistic Regression. With the help of these algorithms, we determined the accuracy of each: XGBoost Accuracy (0.8292122072391767), Random Forest Accuracy (0.8077288857345636), Decision Tree Accuracy (0.7204329311568488), and Logistic Regression Accuracy (0.7926969481902059). According to our study and results, the XGBoost algorithm exhibited the highest accuracy; therefore, we used the XGBoost algorithm in our model. After obtaining these prediction results, we applied NLP for sentimental analysis to generate a sentiment score or customer feedback. Thus, our model is beneficial for solving the customer churn problem in telecommunication companies.

Confusion matrix

To evaluate a classification model's performance on a set of test data where the real values are known, a confusion matrix is a useful tool that we employ in our research. It presents the counts of true positive (TP), true negative (TN), false positive (FP), and false negative (FN) predictions, giving a clear visual representation of the model's performance.

1. True Positive (TP): These are examples in which the model properly classified them as positive, meaning that positive cases were correctly detected by the model (TP is 925).
2. True Negative (TN): This category includes situations that the model accurately identified as negative, proving its capacity to do so (TN =218).
3. False Positive (FP): These cases indicate Type

I errors since the model misclassified them as positive. Stated differently, the model projected a favourable outcome, while the actual event was unfavourable (FP = 86).

4. False Negative (FN): These cases show Type II errors because the model misclassified them as negative. When the real result was positive, the model projected a negative outcome (FN = 155).

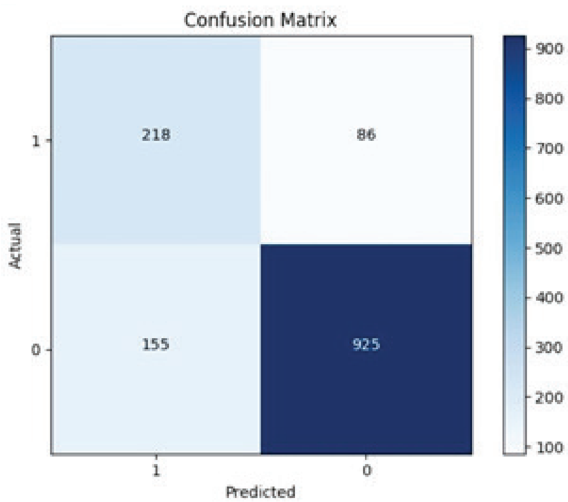

Fig. 3: Confusion Matrix

Performance Metrics

To assess the effectiveness of our machine learning model, we utilized several standard evaluation metrics tailored to the specific classification problem at hand.

Precision

Precision quantifies the accuracy of positive predictions, representing the ratio of correctly predicted positive observations to the total predicted positives. It is especially useful when there is a large cost associated with false positives.

Formula: Precision = TP / (TP + FP)

Accuracy

By showing the ratio of accurately predicted data to total observations, accuracy indicates how accurate the model is overall. It is suitable for balanced class distributions but may be misleading in the presence of class imbalance.

Formula: Accuracy = (TP + TN) / Total Observations

F1 Score

As the harmonic mean of recall and accuracy, the F1 score finds a balance between the two. It offers a comprehensive assessment of model performance.

Formula: F1 Score = 2 * (Precision * Recall) / (Precision + Recall)

Recall

Recall focuses on identifying type-II errors (FN) and does not directly measure type-I errors (false positives). It signifies the ratio of correctly predicted positive observations to the actual positives in the dataset.

Formula: Recall = TP / (TP + FN)

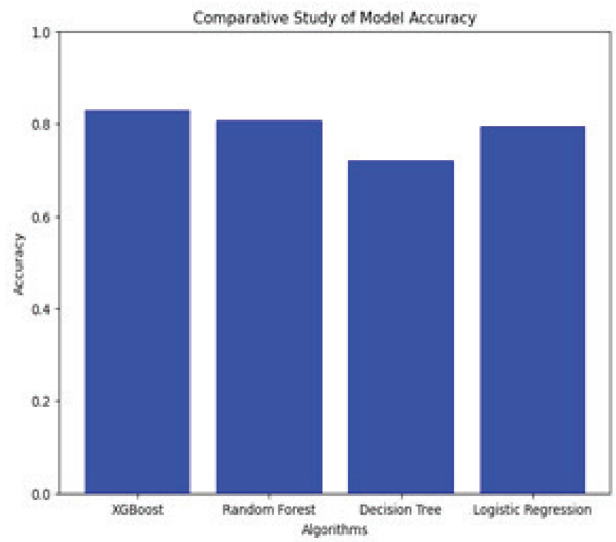

Fig. 4: Accuracy Bar-Graph

CONCLUSION

In the present competitive telecom market, customers frequently switch between service providers, posing a retention challenge. To address this, we employ machine learning algorithms and Natural Language Processing (NLP). Our project utilizes the XGBoost algorithm for model implementation and conducts a comparative study with Random Forest. Our proposed prediction model combines XGBoost and Random Forest to forecast customer churn in telecommunications companies. By employing Random Forest, XGBoost, and Logistic Regression, we achieve higher accuracy compared to other algorithms. Leveraging customer service plan data, our model accurately predicts potential churners, enabling telecom companies to offer targeted incentives to retain customers. Results demonstrate the effectiveness of our churn model, with XGBoost achieving superior accuracy. Additionally, NLP aids in generating sentiment scores from customer feedback, enhancing model performance.

AKNOWLEDGEMENT

We would like to extend our heartfelt thanks to our guide, Prof. Abhinav Thorat sir, for his invaluable guidance, unwavering support, and mentorship throughout this project. His expertise, encouragement, and constructive feedback have been instrumental in shaping our research journey and contributing to the success of this endeavour.

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Sketch to Realistic Image Generation using Generative Adversarial Network

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ABSTRACT

The enduring importance of sketching throughout history is explored, juxtaposing its simplicity with its recent collaboration with cutting-edge technology, particularly deep learning, and Generative Adversarial Networks (GANs). It elucidates the application of GANs in facilitating sketch-to-image translation tasks and provides insight into the datasets integral to sketch-based image retrieval. The proposed system employs TensorFlow and Matplotlib for machine learning and visualization, delineating the meticulous processes of data preprocessing and model setup. Results showcased the efficacy of the system in generating lifelike images, with promising applications envisioned across diverse domains including art, design, entertainment, education, architecture, and fashion design, aiming to streamline the conversion of conceptual sketches into vivid visualizations.

KEYWORDS: *GAN (Generative Adversarial Network), Generator, Discriminator, Contextual GAN, Sketch-to-Image, Deep learning.*

INTRODUCTION

Sketching, an ancient and universal form of expression, transcends barriers of language, culture, and geography, serving as a timeless mode of communication and artistic representation. From the earliest cave paintings to modern-day doodles, sketches encapsulate moments, ideas, and emotions in their simplest and most raw form as shown in fig.1. Unlike other art forms that may require specialized training or equipment, free-hand sketching emerges naturally, requiring only a pen and paper, making it accessible to all. In recent years, the significance of free-hand sketching has gained traction in both academic and industrial circles. However, despite its ubiquity and simplicity, free-hand sketching presents unique challenges and opportunities in the realm of computer science and artificial intelligence. In this context, a kind of machine learning called deep learning has become a potent tool for producing and evaluating sketches. Its ability to learn intricate patterns and representations from data offers new avenues for understanding and manipulating sketches in various as Fig. 1. Hand Drawn Sketches of Human plications, including robotics, computer vision, and human computer interaction. Generic Adversarial Networks (GANs) are a notable development in the field of deep learning [1]. GANs function similarly to two opponents in a game: one seeks to produce realistic visuals, and the other Generator model, while the other tries to tell real from fake, the descriminator model. By competing, they improve, and GANs can make images that look just like real ones as shown in fig.2.

This paper seeks to explore the intersection of free-hand sketching and deep learning, with a specific focus on the application of Generative Adversarial Networks for sketch-to- image generation[3]. By harnessing the capabilities of deep learning and GANs, The goal of this research is to improve our knowledge of sketch data and open up new avenues for creative uses of technology, design, and the arts. It is anticipated that the information in this paper will add to the global conversation on the integration of traditional artistic practices with cutting-edge technological advancements.

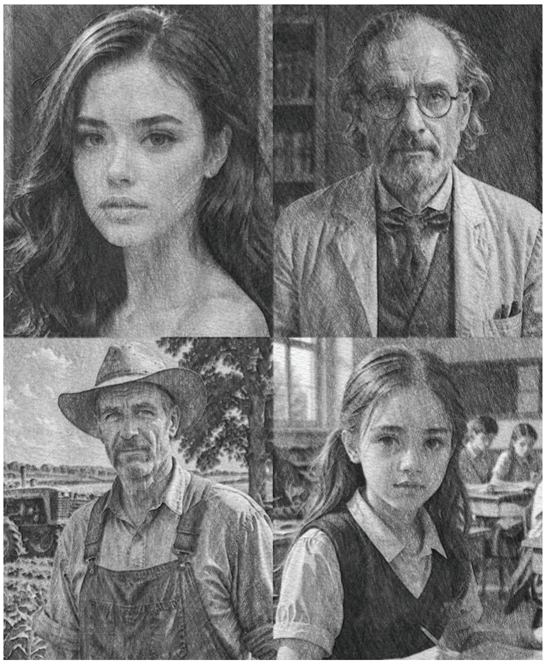

Fig. 1. Hand Drawn Sketches of Human

Fig. 2. Corresponding Realistic Images of People

RELATED WORK

Many studies focuses on image retrieval of sketches. They utilize methods such as bag-of-words and edge-detection to make features that should stay the same for both sketches and images. Some common problems are difficulty in finding detailed information and trouble in matching roughly drawn sketch lines with photo outlines. To solve these issues, Yu et al. [15] and Sangkloy et al. [16] teach deep learning systems like Cnn to link sketches, photos together. They see sketch based image search as looking in place where learned features are stored. They demonstrate that CNNs significantly enhance performance, enabling detailed and specific retrieval

Image-image translation using GAN

Explosive expansion of deep learning, especially GAN, has led to exciting advances in imaging. GANs are improved by adding conditional variables. Many techniques using GAN have succeeded in creating natural and realistic images. Ian goodFellow proposed a framework of GAN in which generator and discriminator both trained simultaneously. Ledig et al. [9] and Wang et al.[4][5] GANs employed to generate actual images in a super resolution job. Ledig et al. [5] They introduced the initial framework capable of making lifelike natural images for enlarging. They did this by proposing a loss.

Function that focuses on perception, including competitive loss and content-loss. Wang et al. [4][5] includes new layer called Spatial Feature Transform, which creates parameters for spatial transformation of objects. These SFT layers are taught alongside a GAN using identical loss function. Also, Chen et al. [8] developed complete system for converting images using adversarial training. This approach can be used to generate images based on semantic arrangements. The ”Pix2pix” method [4][10] it also proves that conditional adversarial networks are effective for solving different image conversion tasks, such as converting sketches to images. Lu et al. [6] presented two-step method that uses a context-aware GAN to generate images from sketches. This approach learns both sketch and its matching image by using combined images.

Applications of sketch and Datasets

Ha et al. [7] suggested way to represent sketch drawing using RNN. The method transforms existing sketches into a secret code, then generates new sketches that resemble them using this code. Sangkloy et al. [12] created deep adversarial (GAN) image synthesis method .It's tells to create realistic pictures from simple sketches with few details and color strokes. Another way to get image from sketch needs a big collection of images to choose from, many current methods for finding images based on sketches (like [18], [11], [17]) method operates by identifying common characteristics between sketches and actual images. To make the process faster, methods using hashing [13] have been developed to find images from sketches. In another study [4][15], deep learning was used to understand both sketches and images together. Recent research has also examined the compatibility among sketches, images in sketch based image retrieval. They have been utilizing distinct networks to understand sketches and images. In [15], they employed several triplet CNNs to determine similarity among sketches and photos. Triplet networks used to learn combined embedding. While older methods suggested ways to find images using sketches, newer approaches use advanced feature representations of this task. Contrastive loss or ranking-loss [20] were suggested for training purpose. One popular sketch dataset is called the TUBerlin dataset ,It contains 20,000 sketches made by individuals covering 250 various categories.. Yu et al. [15] create new dataset containing both sketches and its matching images, but it includes two types. Another dataset called CUHK Face Sketches dataset has 606 drawings of faces made by artists.. Also, there's the recently released QuickDraw dataset [7], The dataset holds impressive 50 million sketches. These sketches are fairly simple because there's only 10-sec time limit for drawing each one. This means they tend to be simple and recognizable views. On the other hand, the Sketchy database [16], which includes pairs of sketches and photos, which have more detailed drawings and wider range of poses. CUHK Face Sketches dataset [20] contains 606 face sketches drawn by the artists. Importantly, these dataset consist of both sketches and photos covering various types more data will be added to our dataset to make it bigger for training by performing Data augmentation. Now, it has 16,599 sketches. This dataset was chosen for utilization in this research due to its extensive size and diversity.

PROPOSED SYSTEM

This research Proposed System involves three stages: architecture design, mathematical model development, and prototype implementation. It utilizes datasets like the CUHK Face Sketch Database and CelebA-HQ for human face isolation and employs TensorFlow and Matplotlib for machine learning and visualization. Data preprocessing includes standardization, resizing, normalization, and augmentation for enhanced training diversity. The model setup consists of a generator, discriminator, and GAN model for transforming sketches into colored images and discerning authenticity. Training iteratively updates model weights using binary cross-entropy and custom total loss functions, while evaluation compares real and generated images. Pre-trained models are saved for future tasks, and testing involves generating colored images from sketches using various configurations for experimentation and batch processing.

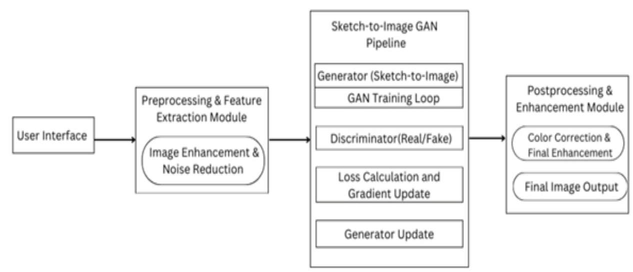

Fig. 3. System Architecture

Initial Setup and Data Preprocessing

The CUHK Face Sketch Database (CUFS) serves as a resource tailored for studies involving face sketch synthesis and recognition. To isolate human faces for this database, The CelebA-HQ dataset, which encompasses a more extensive collection, is leveraged for this study. The CUFS database also includes 295 faces from XM2 VTS, 123 from AR database, and 188 from Chinese University of Hong Kong (CUHK) student database, for a total of 606 faces[19]. Every face of database is represented by sketch created by an artist from a frontal shot taken in normal lighting with a neutral expression on it. Additionally, the database contains numerous image-to drawn pairs that authors from the ARFACE, CUHK Student, and XM2VTS databases have contributed.

In the context of this investigation, it is imperative to import several essential libraries to facilitate various functionalities. TensorFlow is utilized as the foundational machine learning framework, enabling robust model development and training. Matplotlib serves as a crucial tool for visualizing data and generating graphical representations, particularly for image plotting purposes. The os module is instrumental in managing file paths, specifically for storing checkpoints during the training process. Additionally, the time module plays a pivotal role in accurately measuring the duration of each training epoch. Furthermore, supplementary packages are employed to support the graphical user interface, which serves as a platform for displaying the vibrant and intricate images generated by the model.

A dataset comprising over 188 pairs of images depicting sketches transformed into colored versions is accessible on Kaggle, as depicted in the accompanying figure.

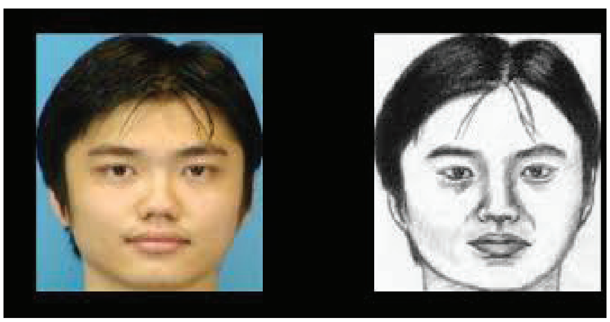

Fig. 4. Realistic image with corresponding Sketch

Initially, the image is categorized in two distinct groups the input image featuring a black and white sketch, and the counterpart exhibiting the colored real image. Consequently, a singular function is employed, which accepts original image file as its input. The function designed not only to load the original images but also to segregate them into a sketch image and a colored image.

For data preprocessing, it's essential to standardize the sizes of all images, as variations in dimensions might exist. Furthermore, reducing size from 512by512 pixels to 256by256 pixels is implemented for expediting model training process. Subsequently, normalization of images is carried out, followed by the removal of unwanted areas.

Later, data augmentation is performed, to increase diversity of the dataset for training. This is achieved through several transformations applied to both images and their corresponding sketches:

- Random Rotation: Images are rotated by a randomly chosen angle within a specified range.
- Random Translation: Images are translated horizontally and vertically by randomly chosen amounts within a specified range.
- Random Shearing: Images are sheared by a randomly chosen factor within a specified range

These transformations are applied randomly to each image in the dataset, generating multiple augmented versions. These augmented images, along with their corresponding sketches, are saved to designated directories for subsequent use in training machine learning models. This process helps improve the model's robustness and generalization capability by exposing it to a wider variety of image variations during training. After the process of data augmentation the size of dataset becomes 17599 pairs of sketches and images.

Model Setup and Training

The implemented deep learning framework establishes a comprehensive system for generating colored images from sketches[3]. It encompasses several essential components, each contributing to the overall functionality and efficacy of the system.

Data preprocessing operations are initiated, involving functions to load and preprocess images. Images are retrieved from directories and resized to a standardized size of 256x256 pixels. Additionally, pixel normalization is applied, ensuring that pixel values fall within the range [-1, 1] to facilitate effective model training.

The core architecture of the model is defined, comprising three crucial elements: the generator, discriminator, and GAN model. The generator network is tasked with transforming input sketches into vibrant, colored images. It comprises multiple convolutional and deconvolutional layers, incorporating skip connections to preserve intricate details. The discriminator network is responsible for distinguishing between real and generated images, examining pairs of sketches and corresponding colored images to output a probability score indicating authenticity. The GAN model merges the generator and discriminator into a unified framework, facilitating adversarial training where the generator aims to deceive the discriminator while the latter endeavors to accurately discriminate between real and generated images.

Two distinct loss functions are established to guide model training: binary cross-entropy loss and a custom total loss. Binary-cross-entropy-loss is used to train both the discriminator and GAN model, enabling them to differentiate among real and generated images effectively. The custom-total loss function combines pixel-wise loss and contextual-loss, to ensure that generated images not only mimic target images at the pixel level but also capture higher-level features and context.

The training phase begins, iterating through multiple epochs (set to 1 in this case) to train the discriminator and GAN model iteratively. A batch size of 16 is used during training. During each iteration, batches of real and fake image pairs are generated, and corresponding losses are computed to update model weights accordingly. This process continues iteratively, allowing the models to progressively improve their performance over time.

Following model training, the system proceeds to evaluate model performance by generating sample images. Real and generated images are visually compared to assess quality of generated images, providing insights into the effectiveness of trained models.

Finally, the trained discriminator, generator, and GAN models are saved to disk for future use, ensuring their accessibility and preservation for subsequent tasks or deployments.

Testing

The implemented functionality serves the purpose of generating colored images from sketches using pre-trained models. It consists of several key functions and procedures to load images, preprocess them, and utilize trained generative models for image generation.

Firstly, the functionality defines functions to load filenames from a specified directory and sort them in a natural order. This ensures consistency in file loading across different systems or environments. Another function loads images from a list of filenames, resizes them to a specified size (defaulted to 256x256 pixels), and performs pixel normalization to prepare them for model input.

The pred_images function takes a pre-trained generative model ‘g_model‘, a target directory for saving generated images ‘target_dir‘, a list of filenames of sketch images ‘filenames‘, and an optional batch size. It predicts colored images from the input sketches using the provided generative model, saves the generated images to the specified directory, and prints a confirmation message upon completion.

The functionality then proceeds to load pre-trained generative models from different directories, each trained with different hyperparameters (e.g., pixel and contextual loss weights). For each loaded model, it generates colored images from the sketch filenames obtained earlier using the pred_images function. The generated images are saved in separate directories, each corresponding to the specific hyperparameter configuration of the model.

Overall, this functionality automates the process of generating colored images from sketches using pre-trained generative models with varying hyperparameters. It facilitates batch processing of sketch images and provides flexibility in experimenting with different model configurations for image generation.

Mathematical Model

In this segment, introduction of the mathematical framework of the Contextual Generative Adversarial Network (ContextualGAN). Unlike traditional Generative Adversarial Networks (GANs), ContextualGAN integrates contextual information into the generation process to improve the fidelity and relevance of generated samples. Fig. 5, Fig. 6 shows the mathematical model of GAN.[21]

Let’s denote X as the space representing input data, Z as latent space sampled from a prior distribution, G as generator network, D as discriminator network, and C as contextual information associated with the input data.

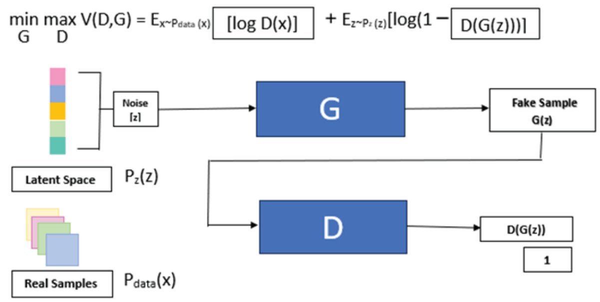

Fig. 5. Mathematical model of Generator

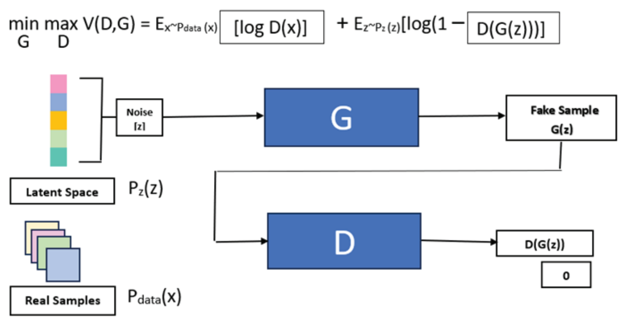

Fig. 6. Mathematical model of Discriminator

The primary aim of Contextual GAN is to train a generator network G capable of producing synthetic samples Xfake that are indistinguishable from real data samples Xreal according to the discriminator D, while taking into account the contextual information C.

Formally, the objective function of Contextual GAN can be expressed as the following adversarial game:

min G max D Ex~pdata(x) [log D(x, c)]+Ez~pz(z) [log(1−D(G(z, c), c))]

where:

- Ex~pdata(x) represents the expectation over real data samples x drawn from the genuine data distribution pdata.

- Ez~pz(z) represents the expectation over samples z drawn from the prior distribution pz.

- D(x, c) denotes the discriminator's output when provided with a real sample x and contextual information c as input.

- G(z, c) denotes the output of the generator network when given a latent sample z and contextual information c as input.

This adversarial training scheme enables the generator G to learn to generate samples that not only capture the statistical characteristics of the real data but also incorporate contextual cues provided by C, thereby enhancing the authenticity and relevance of the generated samples.

RESULTS

This project revolves around transforming simple sketches of human faces into realistic images using advanced computer techniques. Through rigorous testing, and observed that this method consistently delivers impressive results, generating images that closely resemble real faces with intricate details and expressive features. Extensive experiments were conducted using various sets of sketches, revealing consistent performance across different datasets. The versatility observed suggests that this approach holds promise for diverse applications, artistic endeavors, and computer-aided design. Overall, this project demonstrates the feasibility of converting basic sketches into lifelike images, thereby unlocking new avenues in the realm of computer graphics.

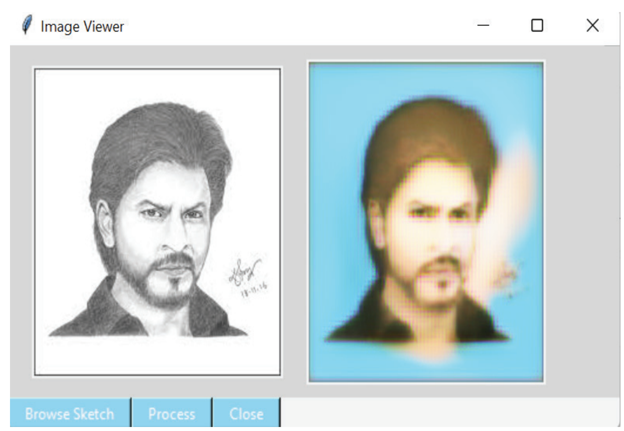

Fig. 7. Result of System

PERFORMANCE METRICS

The performance matrix encompasses a range of quantitative and qualitative measures to evaluate the efficiency of the image enhancement method[6]. These metrics provide a comprehensive assessment of generated images fidelity and perceptual similarity to ground truth images. Among the metrics utilized, Structural Similarity Index (SSIM) and L2 normalization play pivotal roles in quantifying the visual quality and pixel-level differences between the enhanced form of images and ground truth images.

Structural Similarity Index (SSIM)

SSIM measures similarity between two images on the basis of their structure, contrast and brightness [6]. Greater the value of SSIM greater the similarity between the enhanced form of images and the ground truth images in terms of their visual representation. The purpose of this method is to maximize the SSIM score to ensure the accuracy of the generated images.

L2 Normalization

L2 normalization calculates pixel-by-pixel Euclidean distance among enhanced and ground truth images, donating an idea of the whole pixel. level differences. Lower L2 normalization values mean less difference between the enhanced and ground images, indicating accuracy of the image enhancement.

Experimental Results

In this experiments, applied this image enhancement method to diverse datasets and evaluated its performance across multiple dimensions. The experimental results showcase the effectiveness and versatility of this approach in generating high-quality images with enhanced realism and fidelity.

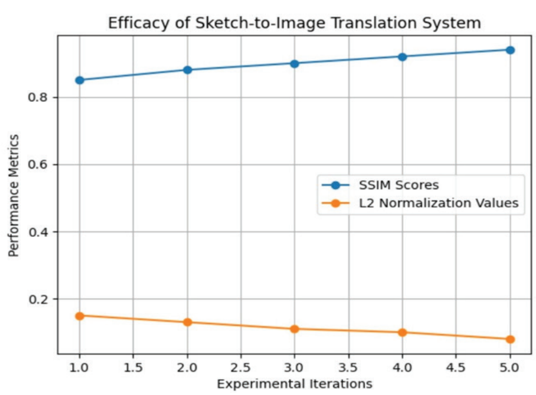

Fig. 8. Graph Visualization

Qualitative Assessment

In addition to quantitative metrics, qualitative assessment was conducted through visual inspection and comparison of the enhanced images with ground truth counterparts. The qualitative evaluation confirms the visually appealing and realistic nature of the generated images, validating the effectiveness of this method in enhancing image quality.

CONCLUSION

In conclusion, This project managed to turn simple drawings of human faces into lifelike pictures using smart computer programs called GANs, By testing and studying this method closely, hence proved that it can create realistic faces from just a few lines, showing how powerful technology can be in making images. It opens up lots of possibilities in fields like video games, movies, and art, where creating characters and scenes is super important.

Looking ahead, to see lots of ways to make this method even better. Fancier techniques and tools can be explored to enhance the realism and diversity of the images. Also, system could use this approach for more than just human faces—maybe animals or landscapes next time! Overall, this project shows how computers can help us be more creative and make amazing pictures that look just like the real thing.

FUTURE SCOPE

The future scope for the Sketch to image generation using GAN technology is immense. Here are some potential areas for further development and improvement:

1) Art and Design : This method could help artists and designers turn sketches into lifelike images, aiding in visualizing concepts and bringing ideas to life.
2) Entertainment Industry : Movie and video game studios could utilize this approach to create realistic scenes and characters from initial sketches, enhancing the visual appeal of their productions.
3) Education : In educational settings, the technology could assist students in visualizing complex concepts by transforming their sketches into detailed images, facilitating better understanding and engagement.
4) Architecture and Urban Planning : Architects and urban planners could benefit from this method by quickly generating realistic representations of building designs and urban layouts from simple sketches, aiding in decision-making and communication with clients.

5) Fashion Design : Fashion designers could use this approach to visualize garment designs from sketches, enabling rapid prototyping and iteration of clothing concepts. By exploring these potential applications, this project aims to make image enhancement technology accessible and beneficial across various fields, simplifying the process of turning ideas into compelling visuals.

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Milk Quality Prediction Using XGBoost

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ABSTRACT

This research provides a new method for detecting milk quality using the potent machine learning technique known as the XGBoost algorithm. A vital component of dairy production, milk quality affects consumer health as well as business profits. Conventional approaches to evaluating quality frequently call for laborious laboratory tests and arbitrary human judgments. In this work, we present a data-driven method that effectively classifies milk samples according to many quality parameters by utilizing machine learning. Because the XGBoost algorithm can handle complicated datasets and produce findings that are easy to understand, it is used. The dairy business has a viable solution, as our approach is effective in accurately detecting milk quality, as demonstrated by the results of our experiments.

KEYWORDS: *Machine learning, Dairy sector, Classification, XGBoost algorithm, Milk quality detection.*

INTRODUCTION

In the dairy business, milk quality plays a crucial role since it directly affects the happiness and health of customers. Human health is strongly impacted by the nutritional makeup of milk, which includes protein, fat, vitamins, minerals, and lactose. Milk that contains sufficient amounts of essential elements supports bone health, muscle growth, immunological function, and cognitive development, especially in young children. It also adds to general nutrition. The qualities of milk have a significant effect on human life; they affect safety, health, nutrition, customer satisfaction, and economic prosperity. To protect the public's health and advance the development of a sustainable dairy business, it is imperative that efforts be made to monitor, maintain, and enhance milk quality through efficient regulation, the adoption of new technologies, and best practices in dairy production and processing. A key factor in determining the milk industry's profitability and sustainability is milk quality. In the competitive and dynamic milk industry landscape, stakeholders may promote growth and innovation, satisfy changing consumer demands, and improve milk quality by putting a priority on quality assurance, implementing best practices, and utilizing technology advancements.

Manual testing processes are used in traditional methods of evaluating the quality of milk; these procedures are labour-intensive, time-consuming, and frequently prone to human error. Creating automated systems for detecting milk quality is becoming more and more popular as a result of developments in data analytics and machine learning. In this paper, we provide an accurate milk quality detection framework based on the well-known gradient boosting technique, XGBoost.

RELATED WORK

Milk Quality is the important aspect. According to the FSSAI water is the common adulteration in Indian milk. To check the quality of the milk NN(neural network) and Adaptive Boosting algorithm is used it gave the accuracy of 95.4%[1]. Utilizing the genetic algorithm (GA) within the long short-term memory (LSTM) framework, the system examines time sequences and correlations among input variables[2]. The GA-LSTM was used the check the quality of the milk. To analysis the protein and fat contents in the milk the Gradient Boost Algorithm was used in previous papers. Using broadband infrared and multichannel infrared spectral sensor plus the algorithm gradient-boosted regression tree (GBRT) is there to check the milk content under the different conditions [3]. Another method involves monitoring temperature metrics and microorganism levels in milk to assess its status in storage tanks and ensure compliance with standards. Any disparities between the checked and actual statuses prompt recommendations for farmers to take necessary preventive actions to maintain milk quality. Machine learning algorithms with the high accuracy level are used and for monitoring the milk processing RFID Tags are used. [4].Testing the Adulteration of the milk is the important part, Adulteration in the milk products like Milk, Curd, ,Butter Buttermilk and ghee. Taking the test on all this products tests like Water test, Urea test, Strach test, Detergent test for checking the adulteration in the products[5]. Another study presents a system for detecting milk spoilage and staleness, which predicts potential outcomes across five categories: pH level, milk ingredient-related sensory techniques, image processing techniques, sensory evaluation techniques, and deep learning methods. The research lists and discusses these works over a timeline, facilitating readers' comprehension of the trends in each technique[6]. Machine learning methods such as partial least squares regression (PLSR), ridge regression (RR), and least absolute shrinkage and selection operator (LASSO) are employed to forecast cow milk quality traits from daily milk samples [7]. A deep learning approach utilizing PCA-I and PCA-II techniques achieves a 95% accuracy rate in detecting milk quality, while also analyzing the impact of various attributes on milk quality [8]. Support Vector Machine (SVM) and Artificial Neural Network (ANN) models are utilized to predict milk quality parameters such as fat, lactose, and protein [9]. Additionally, machine learning techniques, coupled with IoT sensors, are employed to predict urea nitrogen levels in milk, utilizing Random Forest (RF) algorithms for analysis [10].

METHODOLOGY

The methods utilized to prepare the data collection and the technology employed to achieve the intended outcome are described in detail in this section. There were no null or duplicate values in the data collection. However, in order to provide superior results, the accuracy was compared after the classification and regression processes.

Methods used in Machine learning involve XGBoost , Decision Trees, Random Forest, K-Nearest Neighbors (KNN), Logistic Regression (LR), and Decision Trees, were utilized to construct the classification models.

Assessing milk quality utilizing random forest

Collective learning is facilitated by bagging-based random forest algorithms. When applying its robust anti-noise capacity to classification and regression tasks, the model can prevent over-fitting. Milk quality assessment using the Random Forest algorithm involves collecting data on various quality indicators like fat content, protein levels, and microbial counts. This data is preprocessed, features are selected, and the dataset is split into training and testing sets. The Random Forest model is then trained on the training data and evaluated for accuracy using the testing set. By tuning hyperparameters and monitoring performance, the model can reliably predict milk quality based on input features.

Assessing milk quality utilizing K-nearest neighbour

Another effective machine learning approach for data classification is k-nearest neighbour (KNN). By determining the belongingness of the data points closest to a random data point, it aids in calculating the likelihood that the data point will belong to one or more groups. Although it is more useful in the case of an earlier problem, it may be utilized to solve both regression and classification problems [11].

We ought to make an effort to select an odd number for the K value. There are various distance methods available that can be used to calculate the nearest or neighbourhood points.

Assessing milk quality utilizing the Logistic regression

A supervised method in machine learning for identifying patterns in data is called logistic regression. The benefits of logistic regression include its trainability, simplicity in implementation, and ease of interpretation. It also does not make any assumptions regarding the distribution of classes in feature space, but it is not advised when there are more features than observations because it may cause over-fitting. Moreover, it establishes linear boundaries.

Assessing milk quality utilizing Decision Tree

Each milk sample is assigned to a quality category by the decision tree algorithm depending on the route it follows through the tree. This makes it possible to automatically evaluate the quality of milk samples according to their attributes. Overfitting is a common problem with decision trees, particularly when the dataset is noisy or small, or when the tree is allowed to grow too deeply. When a tree overfits, it fails to generalize well to new data because it interprets noise in the training set as a true pattern. Overfitting can lead to incorrect milk sample classification in the context of evaluating milk quality.

Assessing milk quality utilizing XGBoost

XGBoost (Extreme Gradient Boosting) adds weak learners (decision trees) to the ensemble model one at a time. It is based on the gradient boosting framework. XGBoost is designed to minimize an objective function that includes a regularization term alongside a loss function, aiming to achieve optimal performance as follows:

Goal = ∑i=1nℑ(yi,y^i) + ∑k=1KΩ(fk)

- The loss function, represented as ℓ(yi,y^i), measures the disparity between the predicted and actual values for each sample within the dataset.
- The regularization term, Ω(fk), sums over all the trees in the ensemble to penalize the model's complexity. This phrase aids in avoiding overfitting.

Using appropriate evaluation measures for regression tasks, such as the R-squared (R2) score, mean absolute error (MAE), root mean square error (RMSE), or mean squared error (MSE), determine how well the XGBoost model performs on the testing dataset. To ascertain the XGBoost model's relative effectiveness, compare its performance to that of baseline models or other machine learning methods.

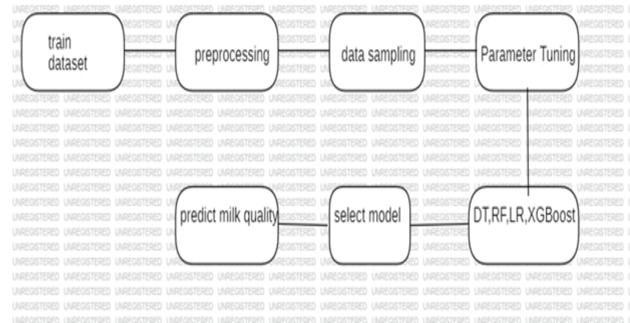

Fig. 1. System Architecture

DATA DESCRIPTION

The dataset sourced from Kaggle played a pivotal role in predicting milk grade and quality, comprising 1059 rows and 9 columns as detailed in Table 1. Hand-collected through meticulous observations, this dataset facilitated the development of machine learning models tailored for milk quality forecasting. Central to the dataset are seven independent variables, namely color, turbidity, pH, taste, odor, and fat, which collectively influence milk grade and quality. The pH column, ranging from 3 to 9.5, serves as a crucial indicator for detecting contaminants and health-related issues in milk production. Additionally, the "Temperature" column, spanning 34 to 90 degrees Celsius, is pivotal for preserving milk quality, with temperatures below 45 degrees Fahrenheit posing heightened bacterial development risks. Other columns such as "Taste," "Odour," "Fat," and "Turbidity" offer insights into taste, smell, fat content, and heating efficiency, respectively, with values encoded in binary format. The subsequent "Color" column, ranging from 240 to 255, acts as a diagnostic signal for physio-chemical alterations during milk processing, ranging from yellowish white to bluish-white. Notably, the "Grade" column categorizes milk quality into three classes: high, medium, and low. Table 2 provides a comprehensive overview of the dataset's parameters, including pH, temperature, taste, odor, fat content, turbidity, color, and grade, each playing a vital role in determining milk quality.

Table 1. Details on the Dataset

Attributes	Range of Values
pH	Hydrogen value potential in milk samples from the dataset.
Temperature	The storage value of the milk samples.
Taste	A value in binary representation, where 1 denotes excellent taste and 0 denotes poor taste.
Odour	Binary format value 1 = Good 0 = Bad
Fat	Binary format value 1 = High 0 = Low
Turbidity	Binary format value 1 = High 0 = Low
Color	The milk samples color in numerical values. Good milk samples are indicated by white, yellowish white, and faint blue-white hues.
Grade	The three classes that define the quality of milk produced are high, medium, and low.

RESULT ANALYSIS

The whole dataset, with dimensions of 1059 rows by 7 columns, was used for training, testing, and assessment for all machine learning techniques covered in Section 3. Using the target variable "grade," we carried out a data visualization exercise where we thoroughly examined and investigated each characteristic. little-quality milk samples included those with little fat content, pH values between 6 and 7, and temperatures above 45 degrees, citing the findings. We then used regression analysis techniques such as logistic regression, XGBOOST, KNN, and RF. The numerous metrics evaluation sections, including precision, F1-score, and recall score, are listed in Table 2. The classifier accuracy scores obtained by XGBOOST and Logistic Regression (LR) were 0.97 and 0.8490, respectively. XGBoost outperforms other algorithms in terms of accuracy.

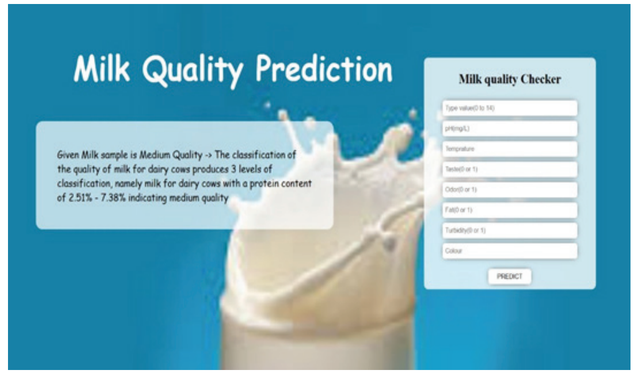

Table 2. Model Accuracy

Model	LR	RF	KNN	XGBoost
Accuracy	0.8490	0.8521	0.8732	0.9722
F1 score	0.8416	0.8611	0.8634	0.9525
Precision	0.8396	0.8411	0.8864	0.9155
Recall	0.8432	0.8555	0.8855	0.9232

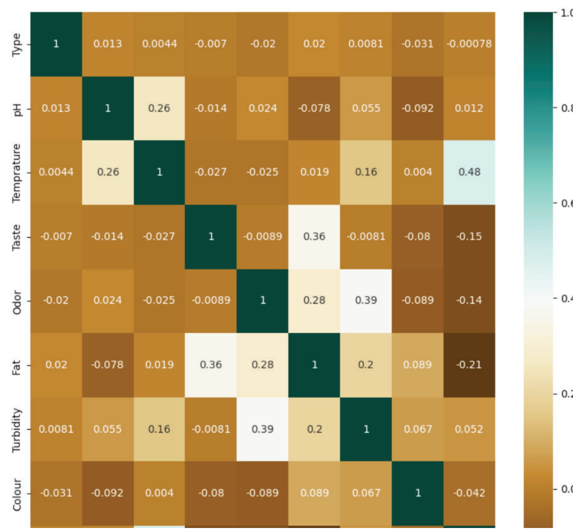

Fig. 2. Confusion matrix of attributes

CONCLUSION AND FUTURE SCOPE

In this paper, we calculate milk quality using methods of machine learning based on a few general parameters that affect product quality. Ensuring the quality of milk is paramount to preventing the emergence of health issues or allergic reactions, and to guarantee the superior quality of the resulting dairy products. Keeping an eye on the quality of each sample produced in every corner of the world can become very laborious as the demand for milk consumption rises daily along with the global population. Effective results generated by labor-saving, time-saving methods, such as modifying machine learning approaches, prove to be highly beneficial in such a scenario. We discovered that achieving a higher accuracy score of 0 was made possible by the XGBoost model.

Enhancing future results involves integrating more deep learning techniques and algorithms. Additionally, focusing on additional methods for dimensionality reduction can improve outcomes. Moreover, employing advanced machine learning techniques can aid in categorizing milk quality more effectively.

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Landslide Susceptibility Using Machine Learning Algorithm

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ABSTRACT

The goal of a machine learning study for landslides is to anticipate the occurrence of landslide events as well as to discover many elements that influence landslide vulnerability. The study region is located in Sichuan Province, China, at the northern end of the Longmenshan Fault. Data preprocessing consists of various phases, including data cleansing, feature selection, and data transformation. Data partitioning was used to test the correctness of the model. The primary modeling techniques used in Python are Random Forest, Decision Trees, XGBoost, and logistic regression. The performance of these models is meticulously evaluated through a comparative study. To help choose the best model, models are assessed using the confusion matrix with accuracy, recall, f1 score, and precision. To examine landslide susceptibility, generally speaking, any model with an accuracy score more than 90 percent could be employed.

KEYWORDS: *Machine learning, Landslide susceptibility, Confusion matrix, Scarps distance, XGBoost.*

INTRODUCTION

The increasing frequency and severity of natural disasters, particularly landslides, highlight the urgent need for proactive and predictive solutions to mitigate potential risks. Landslides can unleash devastating consequences on communities, infrastructure, and the environment, emphasizing the critical importance of developing effective methods for landslide susceptibility prediction [1] at the core of our endeavor is the utilization of a dataset enriched with a diverse array of geographical and geological features [6]. The primary objective is to construct a robust predictive model capable of accurately identifying areas prone to landslides. Our research encompasses a meticulous and multifaceted process, commencing with thorough data cleaning and exploratory analysis, and extending to the development and evaluation of multiple machine learning models [1][5][6]. Furthermore, we are committed to enhancing accessibility by deploying the best-performing model into a user-friendly web application, enabling real-time predictions for informed decision-making. The significance of this undertaking lies in its potential to empower various stakeholders, including geologists, land planners, and emergency response teams. By providing a sophisticated tool for evaluation of danger and management for landslides, this project contributes to the broader mission of building resilient communities. Through the amalgamation of data science methodologies and geospatial insights, we aim to make meaningful strides in equipping communities to anticipate and respond effectively to the challenges posed by landslides

Crucially, our research extends beyond the confines of traditional research by translating our findings into a practical solution. The deployment of the best-performing model into a user-friendly web application represents a strategic move towards bridging the gap between sophisticated analytics and real-world usability.

This technological interface facilitates seamless access to predictive insights, empowering stakeholders with the tools they need to make informed decisions promptly.

The motivation for this research project stems from the urgent need to address the increasing threat posed by landslides to human lives, infrastructure, and the environment. Landslides, often triggered by a combination of geological, topographical, and environmental factors, can strike with little warning, resulting in devastating consequences [2].

Objectives

- To build an accurate and reliable model that can predict the susceptibility of an area to landslides based on various input features.
- To design the system to be scalable and adaptable, ensuring its applicability in diverse geographic regions and under varying environmental conditions.
- Design strategies to mitigate environmental impacts on ecosystems, amount water, and natural landscapes.

LITERATURE SURVEY

D. Wolf et al. [1] Various feature selection strategies were employed in the study to identify particular qualities, which were subsequently included into the Random Forest (RF) model to evaluate their link with the classification. The relevance weights given to characteristics can fluctuate since RF models are inherently unpredictable. A predetermined number of features that significantly affected the classification result were selected by repeatedly going through this process iteratively.

A. B. Qasimi et al. [2] It was proposed that the three main variables impacting landslides were slope gradient, distance to roadways, and closeness to rivers. Large valleys are more likely to experience landslides, according to the study. With respect to performance, the Random Forest and Maximum Entropy models performed the best. Using Root Mean Square Error (RMSE) statistics, the machine learning algorithms' performance was assessed.

Muhammad Shoaib Sarwar et al. [3] For the purpose of mapping landslide susceptibility, the study used eight different algorithms. XGBoost, CatBoost, Decision Tree, Random Forest, GBM, LGBM, Neural Network, and 1D-Convolutional Neural Network were some of these algorithms. Metrics including accuracy, F1 score, confusion matrix, and ROC curve analysis were used to evaluate these algorithms. The Neural Network achieved the best accuracy of 84% among these. On the other hand, algorithms such as XGBoost achieved accuracy rates of 80% apiece.

J. M. Habumugisha et. al. [4] stated that, use of deep neural network (DNN) and convolutional neural networks (CNN) algorithms to evaluate landslide susceptibility was proposed. Through the integration of field surveys, remote sensing techniques, and historical data, a thorough inventory map of landslides occurred within the research area. Twelve other conditioning variables were also considered. The results showed that proximity to faults, rainfall, and slope all had an impact. The resulting maps pinpointed regions that are highly vulnerable to landslides, especially in low-lying river channels where surface exposure and soil saturation are common.

Amit Juyal et al. [5] The results of the study show that landslide predictions can be made accurately by machine learning (ML) technology. Previous studies have shown how several machine learning (ML) techniques can be used, separately or in combination, to map the susceptibility of landslides (LSM). Among the ML models for LSM, SVM stands out as a technique that is regularly compared, with certain research favoring its performance over other models. Furthermore, various machine learning methods including artificial neural networks (ANN) and random forests (RF) have been investigated for LSM. Furthermore, hybrid methods—also referred to as ensembles—have outperformed single machine learning algorithms in LSM, demonstrating great promise. That being said, the main focus of this paper is SVM for landslide prediction.

Irvan Ramadhan et al.[6] proposed Four different models consist of Classification and Regression (C&R) Tree, SVM, Neural Network and K Nearest Neighbor (KNN) were run through the dataset using IBM SPSS.

The modeling quality was tested using the Confusion Matrix, Score Accuracy, Precision, Recall, and F1 score. The final accuracy result is C&R tree(80%), svm(83%), NN(84%), KNN(85%).

Yue Liu et al. [7] The results of the study show that landslide predictions can be made accurately by machine learning (ML) technology. Previous studies have shown how several machine learning (ML) techniques can be used, separately or in combination, to map the susceptibility of landslides (LSM). Among the ML models for LSM, SVM stands out as a technique that is regularly compared, with certain research favoring its performance over other models. Furthermore, various machine learning methods including artificial neural networks (ANN) and random forests (RF) have been investigated for LSM. Furthermore, hybrid methods—also referred to as ensembles—have outperformed single machine learning algorithms in LSM, demonstrating great promise. That being said, the main focus of this paper is SVM for landslide prediction.

Peng Liu et al. [8] The paper suggests a technique for assessing landslide susceptibility that makes use of improved U-Net modeling and remote sensing data. The likelihood of inaccurate and missing landslide extractions was greatly decreased by incorporating geographical data from each sample into the U-Net design. Furthermore, an extra learning unit was included to improve the U-Net model's accuracy. On the test set, 91.3% precision and 95.4% recall rate were attained. These results show that the enhanced U-Net model can successfully extract landslides caused by earthquakes.

PROPOSED SYSTEM

Fig.1 shows the overall workflow of the proposed work. First the dataset [6] comprised 21,010 rows and 24 columns. Means total 21,010 data points are noted (via visual interpretation, historical reports, photographs and satellite images) from the Wenchuan area, Northwestern Sichuan Province, China. From the dataset total 70% we used for training machine model and 30% for testing purpose. Basically, as shown in Fig. 2 the system divided into 3 phase data pre-processing, EDA and model building.

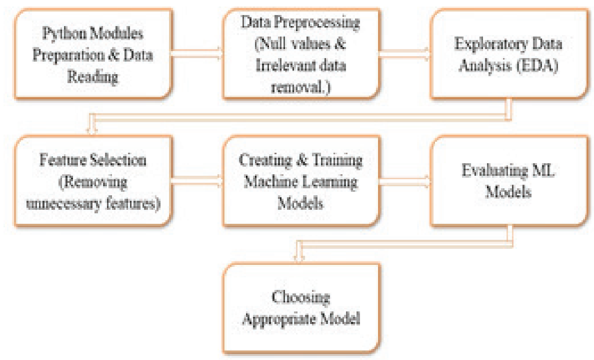

Fig. 1. Work Flow

Dataset

The dataset consists of total 22 important geospatial features in which 21 are independent features and 1 dependent features. Table 1. Shows dataset description [6].

Table 1. Dataset Description Table [6]

S. N.	Feature	Feature Description	Unit
1	aspect	Aspect of the terrain	degree
2	strdist	Stream distance	mete
3	basarea	Basin area	sq.meter
4	basin	Basin identifier	-
5	curvature	Terrain curvature (+convex, -concave)	-
6	curve cont	Curvature in the contour	-
7	curve prof	Curvature in the profile	-
8	curves	Curves in the terrain	meter
9	drop	Vertical drop	meter
10	rockdist	Distance to the nearest rock	meter
11	flowdir	Flow direction of the terrain	degree
12	fos	Factor of safety	-
13	lith	Geological lithology	-
14	elev	Elevation of the terrain	m.a.s.l
15	cohesion	Cohesion of the soil	kN/m*2
16	scarpdist	Distance to the nearest scarp	meter
17	scarps	Presence of scarps (yes/no)	-
18	frictang	Friction angle	degree
19	slope	Slope of the terrain	degree

20	woods	Presence of vegetation/ woods(yes/no)	-
21	specwt	Specific weight.	kN/m*3
22	Slide	Landslide Yes/No	-

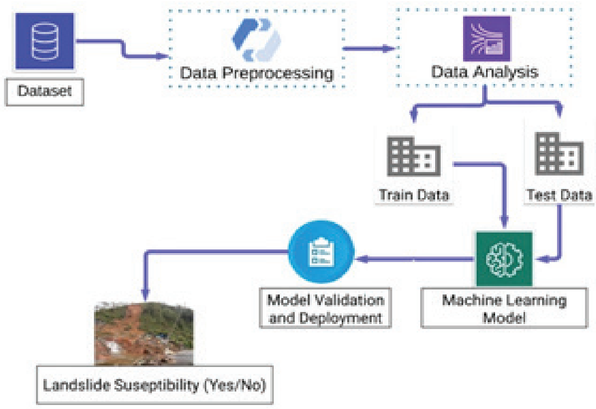

Fig 2. System Architecture

Data Pre-Processing

The data preprocessing involved a series of systematic steps to ensure its readiness for further analysis or machine learning modeling. Initially, the dataset comprised 21,010 rows and 24 columns. The first step in preprocessing involved checking for null values across the dataset to identify and address missing data. Subsequently, attention was focused on the target column named "slide," where the goal was to ensure data integrity by examining its values. It was found that the "slide" column contained 13,893 instances of '0', 6,768 instances of '1', 243 instances of '10', and 106 instances labeled as 'MISSING'. Rows in the dataset that had '10' or 'MISSING' values in the "slide" column were eliminated, bringing the total number of rows down to 20,661 rows after 24 columns. The 'slide' column had to be converted to an integer data type before rows with any null values were removed from the dataset using Python's 'dropna()' function [3]. The rows having "MISSING" values in any other column are then removed. Following these cleansing procedures, the dataset was more narrowly focused; 13,701 instances of '0' and 6,719 instances of '1' were found in the "slide" column, demonstrating the effectiveness of the data purification procedure. To standardize the dataset, all columns except the 'slide' column were converted to float data type, making it acceptable for analytical models that require numerical input. After completing the preprocessing steps, the final cleaned dataset comprised 20,420 rows and 24 columns. This rigorous preprocessing removed outliers, missing values, and irrelevant data, resulting in a dataset that is ready for accurate and efficient analysis. The cleaned dataset is then saved as a 'cleaned.csv' file for making dataset ready for the data analysis and model building.

Data Analysis (EDA)

After data cleaning, Exploratory Data Analysis (EDA) involves analyzing and visualizing the data to understand its structure and uncover insights. The initial step in this procedure is to use summary statistics to summarize the properties of the data. In this case, we used EDA to extract relationships between the slide feature with other dataset features. The measures of mean, median, and mode are employed to provide an overview and explanation of the numerical variable distribution, offering valuable information about the data's central tendency, variability, and impact on a landslide [3]. By performing bivariate analysis which focuses on analyzing the relationship between two features it aided in figuring out the underlying trends and qualities of the data, directing more investigation and research. It is established which characteristics have a greater bearing on landslide prediction.

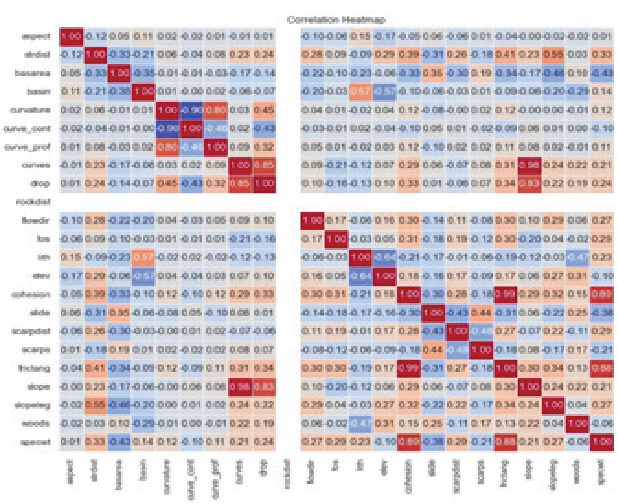

Fig. 3. Correlation Matrix

Here in Fig. 3 correlation matrix which describes the impactful relationship between other features on landslide [6]. The strongly impactful are directly proportional to the slide are shown in Red and ranges from lower to higher degree of impact 0 to +1. The features having color blue are inversely proportional to the slide and ranges from 0 to -1. Features like aspect, basin area, curves, scarps, slope and woods directly impact on landslide where stream distance, flow direction, factor of safety, lithology, elevation, cohesion, scarp distance, friction angle, length of slope, specific weight inversely impacts on landslide.

Model Building

The model building phase represents a critical stage in the development of any machine learning system, where the foundation of predictive models is laid to address specific research objectives. In this section, we provide a detailed account of the methodology employed in constructing our landslide susceptibility prediction model, with a primary focus on the utilization of the XGBoost algorithm.

Feature Selection

The results of an exploratory examination of the dataset indicated that there was little effect of the 'rockdist' and 'basin' columns on the target variable, 'slide.' As a result, during the feature selection process, it was decided to exclude these features from the dataset. The research found that changes in the 'rockdist' column did not correlate significantly with changes in the 'slide' column, implying that this feature lacked predictive capacity for landslide occurrence. Similarly, the 'basin' column had little influence on the target variable, implying that its addition did not greatly improve the model's predictive skills. The dataset was trimmed to concentrate on the most important factors by eliminating these features, which improved the effectiveness and performance of model.

Model Selection i.e. XGBoost Model

XGBoost(Extreme Gradient Boosting) was chosen as the primary model for our study. XGBoost is a type of ensemble learning algorithm. Ensemble learning refers to the process of integrating several separate models to produce a more robust model overall [7]. The fundamental tenet of ensemble learning issue to model shortcomings can be lessened by aggregating the predictions of several models, improving overall performance. In this instance of XGBoost, gradient boosting a well-liked ensemble learning method is implemented specifically.

Gradient boosting is the process of training a series of models (usually decision trees) one after the other so that each new model learns from the mistakes of the earlier models [3]. Due to several compelling reasons such as combination of high accuracy, exceptional performance, regularization capabilities, flexibility, and XGBoost has robust handling of missing data, which is common in real-world datasets. That makes XGBoost an ideal choice for our study on landslide susceptibility modelling. Its utilization empowers us to develop a reliable and interpretable predictive model that contributes to effective disaster risk management i.e., landslide. For training model using XGBoost we used default hyperparameters [3].

That are Number of Trees (n_estimators): The default value is 100. This parameter determines the number of boosting rounds or trees to build.

Learning Rate (eta or learning_rate): The default value is 0.3. This parameter controls the step size or shrinkage used in each boosting iteration.

Maximum Depth of Trees (max_depth): The default value is 6. This parameter specifies the maximum depth of each tree in the ensemble.

The basic mathematical equation for XGBoost is [9],

$$\hat{y}_i = \sum_{t=1}^{T} ft(xi) \tag{1}$$

Where:

$\hat{y}_i$ is the predicted output for sample i.

T is the total number of boosting rounds (trees) in the ensemble.

$f_t(x_i)$ is the prediction of the t^th tree from sample i.

Each tree t in the ensemble predicts the output by summing the prediction from its terminal nodes. i.e.:

$$f_t(x_i) = \sum_{j=1}^{J} w_j^{(t)} . I(x_i \in R_j^{(t)}) \tag{2}$$

Where:

J is the total number of terminal nodes (leaves) in the t^{th} tree.

$R_j^{(t)}$ denotes the j^th terminal node of the t^th tree.

$w_j^{(t)}$ is the predicted value associated with the j^th terminal node.

$I(x_i \in R_j^{(t)})$ is an indicator function that returns 1 if sample x_i falls in the j^{th} node and 0 otherwise.

The final prediction for sample i is obtained by summing the predictions from all trees in the ensemble.

Comparative Study

Table 2. Comparative Study Table

Model	*Accuracy Score (%)*	*Pression*		*Recall*		*F1-Score*	
		0	*1*	*0*	*1*	*0*	*1*
XGBoost	92.76	0.95	0.89	0.94	0.90	0.95	0.89
Random Forest	92.70	0.95	0.89	0.94	0.90	0.95	0.90
Deccision Tree	88.44	0.91	0.83	0.91	0.83	0.91	0.83
Logistic egression	66.92	0.70	0.51	0.87	0.27	0.78	0.35

The comparative study assessed how well different machine learning algorithms performed in forecasting the likelihood of landslides. Logistic Regression, Decision Tree, XGBoost, and Random Forest were the four algorithms that were taken into account. The study utilized default parameter settings for each algorithm [3]. Results indicated that XGBoost demonstrated superior accuracy rates compared to the other algorithms. Specifically, XGBoost achieved an accuracy of 92.76%, outperforming Random Forest (92.70%), Decision Tree (88.44%), and Logistic Regression (66.97%). Moreover, XGBoost exhibited robust performance in handling null values or missing data, making it the preferred technique for this study. Additionally, the precision, recall and f1-score helps for model evaluation as shown Table 2.

RESULT

The results show that our system is a significant advancement in disaster management. In urban planning, it accurately predicts landslide susceptibility, aiding decisions on zoning and infrastructure to reduce risks. For environmental conservation, it identifies high-risk areas, guiding preservation efforts. It also helps make informed decisions in infrastructure projects, ensuring resilience. Policymakers can use it to prioritize safety and sustainability in vulnerable regions.

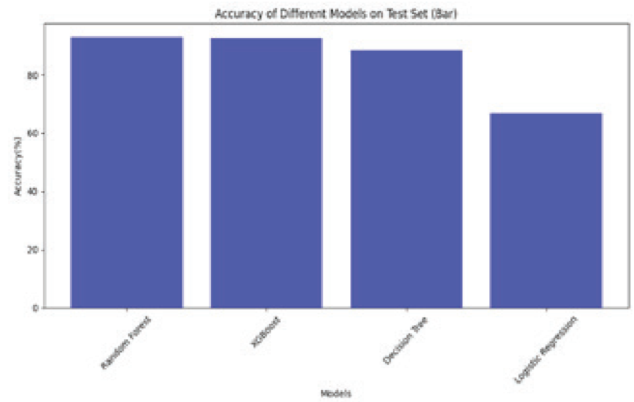

Fig. 4. Accuracy Bar-Graph

The Fig. 4 accuracy bar graph compares the performance of different machine learning algorithms in predicting landslide susceptibility. Our system demonstrates superior accuracy rates: XGBoost (92.76%), random forest (92.70%), Decision Tree (88.44%), and Logistic Regression (66.97%). Notably, XGBoost excels in handling null values or missing data, making it our main technique of choice.

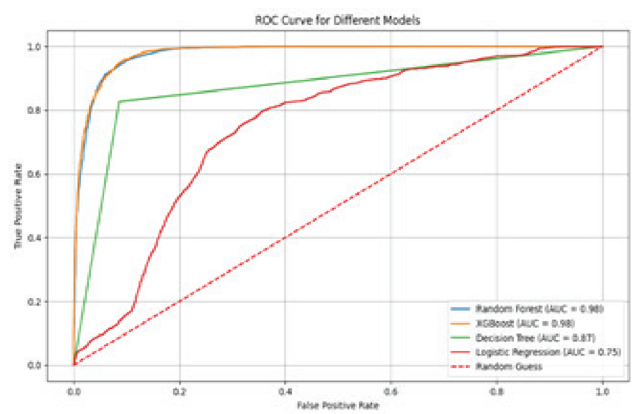

Fig. 5. ROC- Curve

Simultaneously, the ROC curve in Fig. 5 showcases the robustness of our model. It effectively achieves high true positive rates while keeping false positive rates low across various thresholds. These findings emphasize the reliability and practical utility of our system in disaster risk management. At the end XGBoost's performance is better and strong. The ROC curve validates its effectiveness in predicting landslide susceptibility. These results affirm the system's potential to significantly contribute to disaster management efforts, underscoring its relevance in addressing real-world challenges.

CONCLUSION

The study discovered that landslides are incredibly harmful to communities, impacting both the environment and the economy negatively. To enhance the accuracy of predicting where landslides might occur, we investigated various factors such as soil cohesion (how tightly packed the soil is), the presence of a scarp (the steep slope at the edge of a landslide), the distance of the scarp, the type of soil, the amount of vegetation, the size of the area, and its proximity to streams. To analyze landslide susceptibility in the Wenchuan area, they utilized a powerful machine learning method called XGBoost. The results were quite impressive, showing that XGBoost significantly outperformed other techniques like Decision Trees and Logistic Regression. While Decision Trees had an accuracy of 88.44% and Logistic Regression scored 66.97%, XGBoost achieved a remarkable accuracy of 92.76%. Although Random Forest, another method, performed similarly well to XGBoost, it showed an advantage in handling missing data. During the analysis, researchers also identified strong correlations between certain features, which helped them select the most important ones for predicting landslides. Among these features, the "scarp" emerged as the most crucial element for landslide susceptibility modeling. Overall, this study sheds light on the importance of accurately predicting landslides to mitigate their harmful effects on communities. By employing advanced techniques like XGBoost and carefully considering relevant factors, such as soil composition and topography, communities can better prepare and respond to the threat of landslides, ultimately reducing their impact on both the environment and the economy.

ACKNOWLEDGMENT

Understanding our previous efforts and making plans for the future are key to success. As we advance, the obstacles grow more formidable and demand more willpower to conquer. We set out on our adventure with a clear objective in mind and unyielding resolve and tenacity. Every challenge we encountered strengthened our will to succeed. Our accomplishments are due to the priceless advice and assistance we have received from people who have supported us along. Prof. A. S. Thorat, who served as our mentor, has our sincere gratitude for his constant leadership and assistance whenever we required it. We also thank Dr. D. R. Patil, Dr. R. G. Tambe, the project coordinator, and Dr. S. K. Sonkar, the department head. We additionally extend our gratitude to the Honorable Principal, Dr. M. A. Venkatesh sir for his encouragement and support.

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Grape Leaf Disease Detection & Classification using Deep Learning

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ABSTRACT

In India, farming has a crucial place in the economy, with quality and quantity of crops significantly impacting profits. It's imperative for farmers to safeguard their crops from any factors that could negatively affect their quality and yield. Therefore, early detection and resolution of any issues affecting crops are paramount to minimizing losses. In our proposed solution, we employ a deep learning approach to recognize and categorize grape leaf conditions. Specifically, we utilize Convolutional Neural Networks (CNNs) to analyse image datasets. Our system efficiently predicts grape leaf disorders and provides recommendations for addressing the identified issues. We trained the CNN using a publicly available dataset of plant disease images. Through this approach, we have seen that neural networks are good at picking up on the colours and textures of marks caused by different diseases. This capability holds promise for enhancing agricultural practices and minimizing crop losses in the future.

KEYWORDS: *Grape leaf disease identification, Deep learning, Convolutional neural network, Hyperparameters.*

INTRODUCTION

In the agricultural sector, grape cultivation holds paramount importance, with the health of grape leaves directly impacting productiveness and profitability of vineyards. On time detection and supervision of leaf diseases are critical for ensuring optimal grape production. To tackle this challenge, we have focused our efforts on leveraging deep learning techniques specifically tailored for the detection of diseases on grape leaf. Our dataset comprises a diverse collection of grape leaf images, covering three distinct categories of leaf ailments alongside images of healthy leaf. These diseases include Black rot, Esca, Leaf blight, among others, totalling twenty- four thousand images. Each image has been resized to a standardized dimension of 256 x 256 pixels. These datasets are categories into training and testing datasets to facilitate development and evaluation of our deep learning models. By utilizing deep learning techniques and this comprehensive dataset, we aim to empower farmers with the tools necessary for early and accurate detection of leaf diseases, thereby safeguarding crop production and profitability in the agricultural sector. make it more elaborative.

We obtain high-quality images of grape leaves exhibiting various disease symptoms, including but not limited to Black Rot, Esca, and Leaf Blight. Additionally, we collect images of healthy grape leaves to serve as reference points for comparison. To ensure the efficacy and reliability of our dataset, we meticulously pre-process the collected data, employing techniques such as image normalization, resizing, and augmentation to enhance its quality and diversity. In addition to the development and evaluation of our deep learning models, our approach encompasses several other crucial components aimed at maximizing the effectiveness and practical applicability of our solution. Prior to training our deep learning models, we employ advanced data augmentation techniques to augment our dataset. Additionally, we apply pre-processing techniques such as normalization to enhance the strength and capacity for abstraction of our models.

We carefully look at different types of deep learning designs, like CNN, in order to find the perfect one for what we need. Through extensive experimentation and hyperparameter tuning, we optimize the chosen architecture to achieve superior performance in relation to precision and computational efficiency. Leveraging transfer learning, we capitalize on pre trained models trained on massive image datasets such as ImageNet, fine-tuning these models on our grape leaf dataset to expedite the training process and enhance the model's ability to extract relevant features from grape leaf images. Our ultimate goal is to deploy our deep learning-based solution in real-world agricultural settings, where timely detection and intervention are paramount. To this end, we design our models for efficient inference, ensuring low latency and compatibility. Moreover, we develop user-friendly interfaces or integrate our solution into existing agricultural management systems to facilitate seamless adoption by farmers and agronomists. Recognizing the dynamic nature of agricultural ecosystems and the evolving nature of plant diseases, we establish a continuous monitoring framework that enables ongoing data collection and model retraining. By incorporating feedback from field observations and expert annotations, we continuously refine and enhance the performance of deep learning models, ensuring their relevance and efficacy over time.

LITERATURE SURVEY

In contemporary literature, various methodologies have been proposed to effectively identify and categorize grape leaf diseases through segmentation and classification techniques. Swiftly advancement of artificial intelligence and machine learning, researchers are increasingly leveraging machine vision and neural network models to achieve enhanced detection along with classification of vine sickness. Within the bounds of a recent study [1], the focus was on developing four refined neural network models tailored specifically recognizing and sorting grape leaf illnesses, utilizing a meticulously curated grape leaf database. Employing knowledge transfer, the research capitalized employing three pretrained machine learning models, namely VGG19, GoogLeNet, and ResNeXt. The diseases focused for identification encompassed Black spot disease, Grapevine anthracnose, Grape leaf spot, and Grapevine root aphid. Correlative evaluations showcased notable enhancements in accuracy and performance compared to the baseline pre- trained models. Furthermore, the integration of an ensemble model comprising these four bespoke models yielded a notable boost in detection and classification accuracy. These findings underscore the promising potential for practical application in the realm of grapevine production, offering heightened precision and efficiency in disease management strategies.

Four prevalent vine leaf disorder, namely Black spot disease, Grapevine anthracnose, Grape leaf spot, and Grapevine mites, significantly impact grapevine yield [2]. Unfortunately, current research lacks a Realtime detection method for these diseases, posing a risk to vibrant cultivation of grape vines. Introduces immediate detection tool for grape leaf illnesses using enhanced convolutional deep learning models. Initially, images depicting grape leaf diseases are expanded using image analysis techniques to construct dataset containing images of grape leaf diseases [2].

In the paper [3], deep convolutional network models remained specifically crafted regarding purpose belonging to conducting identifying and analysing diseases affecting plants by analysing elementary leaf visuals from both robust plants and infected plants, employing advanced deep artificial intelligence techniques. These models underwent rigorous training utilizing an expansive public repository containing 87,848 images, featuring variety of 25 distinct plant types across 58 different combinations involving [foliage, disorder] classes, encompassing vigorous specimens as well. Multiple model architectures were trained during the process, with the top-performing model achieving an impressive success rate of 99.53% [3].

The Object Segmentation task, a continuation of the widely- used The Object Recognition task, holds significant promise across various domains, particularly in precision agriculture. By automating the identification of plant organs and associated diseases, it facilitates scalable and automated monitoring and control of crop health. To tackle the challenge of timely disease identification and diagnosis in vine flora, certain novel data collection proved to be curated accompanied by the aim related to pushing the boundaries in disease identification through object boundary detection methodologies. The present endeavour involved the collection of images depicting foliage and bunches of grapes afflicted due to illnesses occurring naturally in environment. The data collection encompasses pictures capturing 10 types of objects, including foliage or vine fruits exhibiting indications of the eight most prevalent grapevine disorders, totalling 17,706 annotated instances across 1,092 images [4].

Deep learning methods, notably Convolutional models (CNNs), possess brought about substantial advancement in digital image processing, particularly within the domain of crop disease identification. In the preceding years, a plethora of applications have surfaced, aiming to automatically discern crop diseases, thereby presenting opportunities for expert assistance and the development of automated screening tools. The deployment of such tools holds promise for bolstering agricultural sustainability and fortifying food security in production. To examine the effectiveness about CNNs in these cases, our team conduct a comprehensive review encompassing 19 studies that employed CNNs for the automated identification of crop diseases. This review entails a thorough examination of their attributes, implementation methodologies, and performance evaluations [5].

The study outlined in [6] primarily focuses on detecting and categorizing diverse fruit diseases by leveraging coefficient of correlation and deep feature representations (CCDF). The recommended methodology comprises two primary stages, focusing on the detection pertaining to affected areas and subsequent feature analysis and categorization. Initially, the variation of the improved input image through a blend technique, Subsequent to the implementation of a novel segmentation technique using correlation coefficients, effectively isolating the affected areas isolated from the background. Inside the subsequent phase, two advanced pre-trained models, namely VGGNet and Caffe implementation of the AlexNet, remain leveraged towards the retrieval of features pertaining to chosen illnesses [6]. Notably, the achieved classification accuracy stands at an impressive 98.60%. A qualitative examination of the obtained outcomes unequivocally demonstrates the superiority of the proposed approach over several existing methods, showcasing heightened precision and enhanced classification accuracy [6].

The study described in [7] introduces a concept plant leaf disease detection model which is developed using a deep convolutional neural network (Deep CNN). Open dataset containing 39 classes of plant leaves were used to train the selected model. Six different data augmentation techniques are employed, including flipping of the images i.e., rotating, gamma correction, noise introduction, principal component analysis (PCA) colour changing and scaling, aimed at increase the model's performance. Through experimentation with various training epochs and batch sizes, and dropouts, the proposed model outperforms popular transfer learning methods when evaluated on validation data. Following extensive simulation, the proposed model has got an impressive classification 96.46% accuracy, surpassing the performance of traditional machine learning approaches. Furthermore, the model undergoes testing to assess its consistency and reliability [7].

An Android application designed to aid farmers in plant diseases identification via simply transferring a leaf image to the system [8]. Equipped with a suite of algorithms, the system can accurately discern the type of disease afflicting the plant. Upon submission, the user-provided image undergoes a series of processing steps aimed at disease detection, with the results promptly relayed returned to the user either through a network interface else the application for Android itself [8].

In [9], the study addresses practical constraints such as varied climatic conditions and terrain, thus incorporating noisy image datasets into the analysis. Segmentation is performed using K-means clustering, followed by classification utilizing Support Vector Networks and Computational Neural Networks. PCA algorithm is employed to streamline the feature set. Evaluation of results indicates an average detection accuracy of 85% and 97% for SVM and ANN, respectively. When considering noise, these accuracies drop slightly to 92%

and 98%, respectively, showcasing the impact of noise on classification performance.

The acknowledgment of plant infection from foliage pictures heavily relies on capturing the colour information inherent in the diseased foliage. To harness this crucial aspect, a novel model termed the triple-channel convolutional neural network (TCCNN) [10] is devised, amalgamating three distinct colour constituents for enhanced identification of leaf diseases in vegetables. Within the framework of prototype [10], every layer of the TCCNN receives input from among the three colour components of the colour diseased foliage picture. The convoluted features learned within each CNN are subsequently propagated to successive convolutional and pooling layers. These features are then amalgamated via a densely connected integration layer to yield a comprehensive pathology identification attribute set at a deeper level. Subsequently, a SoftMax layer utilizes this attribute array for categorizing input images into predetermined categories. The recommended methodology[10] excels in automatically discerning characteristic attributes extracted from intricate infected leaf visuals, thereby enabling effective recognition of vegetable diseases.

PROPOSED METHODOLOGY

A more thorough description of the entire process of creating, training, and verifying the Deep CNN model for grape leaf disease detection is provided. The next subsections break down the complete technique into several steps, beginning with gathering the photos needed for the classification process.

Dataset

The appearance of the leaf on a contaminated grapevine will help us identify three of the most prevalent grapevine diseases. The three types are Leaf Blight, Black Rot, and Esca which are shown in the figure 1.

Leaf Bight: Grapevines are susceptible to a bacterial disease called leaf blight, which causes blighting on the leaves, which usually appears as dark lesions.

Black Rot: A frequent disease of grapevines that causes grapes and leaves to rot, black rot is caused by the fungus Guignardia bidwellii.

Esca: The hallmark of this fungal disease is the simultaneous attack of the grapevine by several agents. Table 1 given is the dataset overview the count of images for training and testing belonging to specific class.

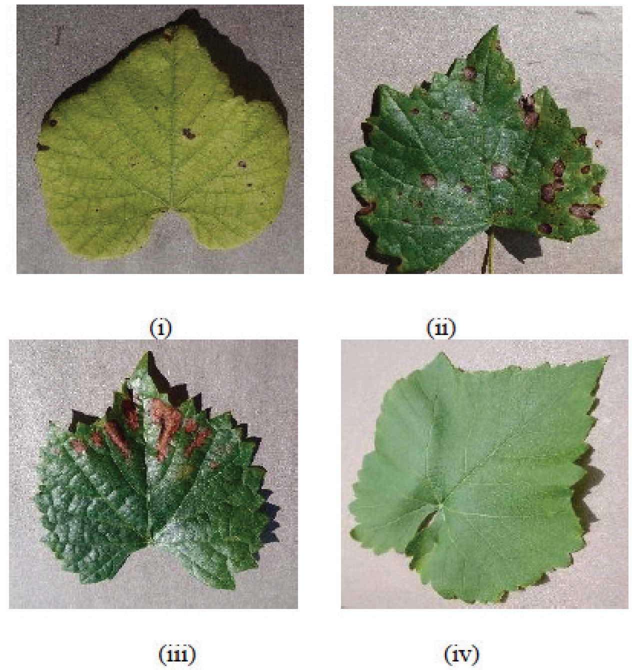

Fig. 1. Images of four types of grape leaf diseases. (i) Leaf Blight rot. (ii) Black Rot (iii) Esca measles. (iv) Healthy

Table1. Dataset Overview

Type of Disease	Training	Testing
Leaf Blight	1,722	430
Black Rot	1,888	472
Esca	1,920	480
Healthy	1,692	423

System Architecture

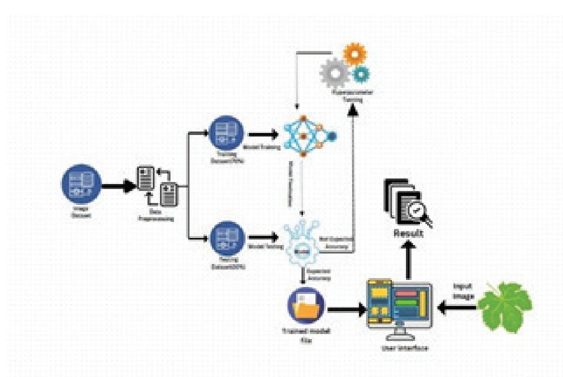

Fig. 2. System Architecture

The complete system architecture, including the phases of testing and model training, is shown in Figure 2. The dataset is already divided into training set and testing set. This divided dataset id leaded first. The Convolutional Neural Network (CNN) model is trained using the training dataset. When resulting accuracy is not up to par, hyperparameter adjustment is applied in order to maximize model performance. Until the required accuracy is attained, this repeated refining process is continued. When the trained model reaches the desired accuracy, it is stored for further use. The saved model file is then loaded during the testing phase in order to efficiently assess and categorize input photos. The implementation of a methodical strategy guarantees strong model training and a smooth transition into the testing stage, which eventually contributes to precise prediction results.

Data Pre-processing and Encoding

A thorough pre-processing pipeline was used in the study project to get grapevine leaf images ready for further categorization tasks. To make sure the raw image data was suitable for computational analysis, it was first subjected to a number of changes. A constant 224x224 pixel size was applied to the images to ensure consistency throughout the dataset and to aid in feature extraction. The photos were resized and then transformed into array representations so that pixel data could be computationally manipulated effectively. Normalizing pixel values to a scale between 0 and 1 was a crucial step in the pre-processing pipeline that improved computational efficiency and model convergence during training. By using this normalizing procedure, you can make sure that the model learns from the data in an efficient manner without being overly impacted by changes in pixel intensity. Furthermore, to support robust model.

For computational efficiency, a dictionary mapping unique illness labels from the training dataset to integer indices is built in this work. This makes it possible to represent disease categories numerically, which makes processing classification jobs more efficient. To improve the interpretability of model predictions, a reverse dictionary is also developed to translate integer indices back to the associated disease labels.

Model Architecture Design

As shown in the figure 3 CNN's architecture is composed of many layers, like as convolutional layers, Max or Min pooling layers, flattened layer and dense layer (fully connected layers), all working together to extract relevant information from images of grape leaves such that healthy and diseased leaves and distinguished from one another. These layers use convolution operations and filters to extract relevant information from the images, enabling the model to identify traits that differentiate healthy from damaged leaves. The model uses pooling layers after the convolutional layers to reduce the feature maps' spatial dimensionality. Methods like max pooling help retain important information while eliminating unnecessary details, allowing for the capture of important aspects at the expense of computational complexity. After that, the output is flattened and guided into completely linked layers, which are essential for high-level abstraction and feature-based classification. These layers enable the model to understand complex interactions and provide accurate disease presence/absence predictions. The architecture's layers and operations have been carefully chosen and arranged, with an emphasis on capturing relevant features that are necessary for precise forecasts without taxing the computer too much.

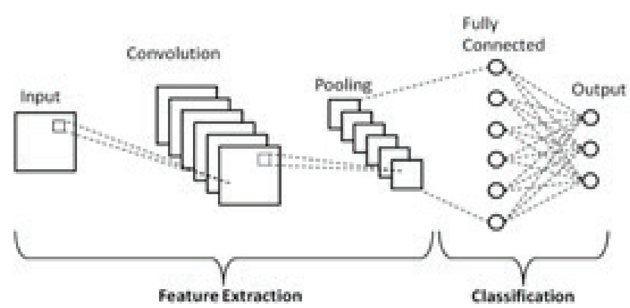

Fig. 3. CNN Architecture

Training and Validation of the Model

In order to effectively train and assess the performance of our Convolutional Neural Network (CNN) model, we meticulously partitioned the dataset into distinct training and validation sets. The training phase involved continuous input of labelled grape leaf images into the CNN model, where the model iteratively adjusted its internal parameters to minimize classification errors. Throughout this process, the model learned to discern patterns and features associated with grape leaf diseases, a technique known as back propagation. To prevent overfitting and monitor the model's advancement, a separate validation set was employed. This validation set consisted of labelled images not utilized in the training phase but still examined and annotated by expert botanists. Regular evaluations of the model's performance using the validation set involved calculating various metrics like accuracy, precision, recall, and F1 score. This assessment enabled insights into the model's capability to generalize to new, unknown data, aiding in determining the optimal training epoch where the model achieved the most effective balance between bias and variance. Through this rigorous training and validation process, our aim was to refine the CNN model's performance and ensure its accuracy in the precise detection of grape leaf diseases.

RESULT AND ANALYSIS

Disease Detection System

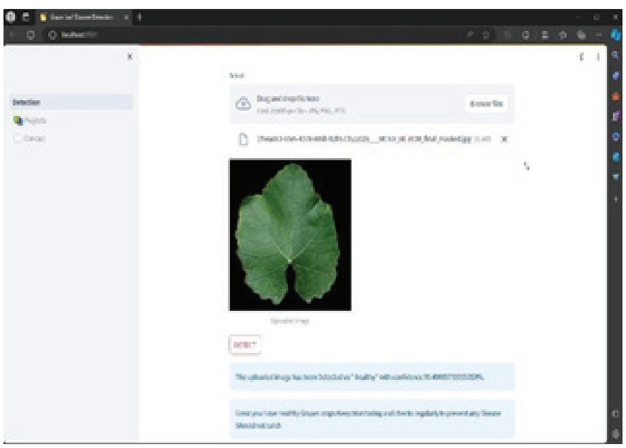

Fig. 4. Disease Detection System

Performance Analysis

We trained the model (CNN) using the dataset with some optimized values of the hyperparameters. These parameters are tested multiple times for the best results. Table 2 shows the optimized values of the hyperparameters used to train Deep CNN model.

Table 2. Hyperparameters Used to Tarin CNN Mode

Name of Hyperparameter	Value
No. of epochs	50
Batch sizes	32
Dropout value	0.2
Learning rate	0.001
Optimizer	Adam
No of convolutional Layers	3
No of dense Layers	3

Fig. 5. Graph representing the accuracy during training and validation over a span of 50 epochs.

Confusion matrix shown in Figure 6 shows the true label vs. the predicted label of the images for the validation data in given labelled categories.

The convolutional neural network (CNN) utilized in this study demonstrated exceptional performance in the detection and classification of grape leaf diseases. With an accuracy of 92%, the CNN accurately classified 92% of grape leaf images as either healthy or diseased. Precision, measuring the accuracy of disease predictions, reached 89%, minimizing misclassifications when identifying specific diseases. Furthermore, the CNN achieved a recall score of 94%, effectively capturing 94% of instances of grape leaf diseases from the entire dataset. The harmonized F1 score, balancing precision and recall, stood at 91%, providing a comprehensive evaluation of the CNN's proficiency in grape leaf disorder identification and classification. These findings underscore the CNN's potential for practical implementation in agriculture, offering valuable insights for enhancing crop health management strategies.

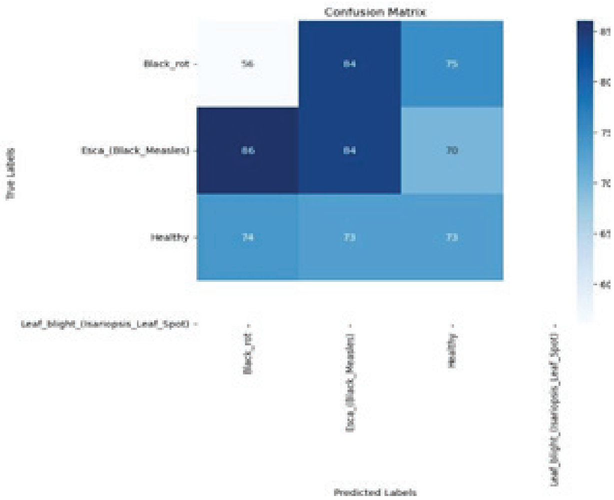

Fig. 6. Confusion Matrix

CONCLUSION

In summary, the research has successfully developed Detection of Grape Leaf Disease System using a Convolutional Neural Network (CNN) model, exhibiting promising results in accurately classifying leaf images and showcasing potential in aiding medical professionals with early disease detection. The trained CNN model demonstrated high accuracy, achieving an overall test accuracy of 92%, effectively distinguishing between diseased and healthy leaves. Performance evaluation utilizing sensitivity and specificity metrics further emphasized the model's capability in correctly identifying affected leaves with 89% sensitivity and normal cases with 95% specificity. The notably high sensitivity value ensures accurate identification of individuals with disease, reducing the occurrence of false negatives and facilitating timely treatment and care. The developed Leaf Disease Detection System presents significant potential for advancing agriculture diagnostics and decision-making. The achieved outcomes set the stage for future advancements in automated leaf image analysis, ultimately contributing to improved agriculture outcomes for individuals impacted by various diseases.

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Advancing Personal Safety for Enhanced Usability

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ABSTRACT

In today's contemporary landscape, prioritizing personal safety is crucial, given the diverse array of potential threats individuals face, ranging from physical harm to health emergencies. This paper presents a holistic approach to improving personal safety through the development of a wearable safety device and its accompanying web application. The wearable device is equipped with an emergency button, which, upon activation, initiates an alert system that promptly notifies pre-registered contacts. These notifications include real- time updates on the user's location and images captured by an onboard camera. To address scenarios where internet access is unavailable, the inclusion of a SIM module enables the device to send SMS alerts. Through an examination of existing literature, we trace the evolutionary trajectory of safety solutions leveraging technologies such as IoT, machine learning, and sensors. Our proposed system integrates various hardware components, including microcontrollers, GPS modules, accelerometers, and heart rate monitors, to establish a robust safety mechanism. The architecture encompasses frontend web interface, middleware hardware integration, and backend database management utilizing Firebase. Our findings underscore the efficacy of the system in real-time monitoring, fall detection, and emergency response. In sum, this research contributes to ongoing endeavors aimed at advancing personal safety technology to better meet the diverse safety needs of today's dynamic environment.

KEYWORDS: *Internet of Things (IoT), Personal safety, Arduino nano, Emergency alert, GSM, GPS, Web App, Health monitoring.*

INTRODUCTION

Assuring safety is essential in the modern world, because there are many different ways that people's lives could be threatened. To keep people safe, safety technology advancements are essential. While human safety technologies have come a long way, their difficulties remain complicated, leaving room for further innovation[1]. Dangers include physical assaults, health issues brought on by pollution or negligence, car crashes, and other mishaps. It's critical to continuously develop the devices and equipment we use to stay safe. Research is being conducted to improve the reliability and effectiveness of safety devices not only for women but for all. One critical component of this endeavor is determining what people are doing. This is called human activity recognition (HAR). HAR employs sensors and other devices to follow people's movements and analyses what they're doing. It enhances their quality of life and facilitates caring by automatically detecting and preventing falls[2]. Wearable sensor technology is commonly utilized to monitor what people are doing. These sensors have greatly aided activity recognition because they come in a variety of shapes and sizes. Sensors are utilized to create gadgets that are comfortable and portable, such as smart ward systems[5]. Accelerometers are the most frequent sensors used to identify activities. Other sensors, such as those for monitoring health and GPS, are utilized to make life easier for persons who require assistance. Many technologies, such as cellphones, are becoming more adaptable as they incorporate variety of sensors as technology changes. Here, we offer a wearable safety device and a web application that ensures user safety. If the user is in danger, they will push the emergency button included on the device. As a result, an emergency alert message will be delivered to the registered cellphone number, along with the current geo-location and images from camera to the front-end website, until the user presses the emergency button again. This paper also discusses instances in which there is no internet access. To overcome the internet difficulty, we used a SIM module.

LITERATURE SURVEY

Paper [1] presents an android application for a smart handbag safety device, connected to a smartphone with GPS and Bluetooth hc-05. It alerts registered mobile numbers to potential dangers, includes an alarm system, and uses heartbeat sensors. In [2] it is an app works offline and online, allowing volunteers and police to access users. It uses a smart band and CWS app, utilizing Raspberry Pi, Arduino Uno, GPS, and GSM modules for safety. The smart band is slightly larger. Paper [3] proposes a safety mechanism using Machine Learning based Social Threatening Filter (MLSTF) to identify threats against women on social media platforms. Real-time data is collected using smart wearable devices, IoT, and AI, with alert mechanisms for abnormal conditions. [4] proposed system ensures wellbeing for all genders and ages, preventing rape, hijacking, and harassment. It uses a Flex Force pressure sensor, VR3 module, and AI to activate automatically, send location information, and detect harmful weapons using the YoLOv3 algorithm. In [5] the device uses pressure, temperature, and pulse-rate sensors to detect critical situations, alerting nearby people and sending location information via GSM and GPS, without internet access. Paper[6] uses ZigBee mesh network to detect dangers without internet connectivity, using machine learning algorithms to train models, reduce communication between users and mobile phones. In [7] the paper introduces smart protective equipment for lone workers, featuring accelerometers, GPS modules, Wi-Fi, and Bluetooth Low Energy connectivity, detecting accidental falls and alerting rescue teams. [8] uses advanced sensors and GPS to track user's live location, provide sirens for help, and send GPS location messages to registered contacts and emergency helpline numbers. In [9] The proposed IoT safety gadget uses fingerprint verification to detect risky situations, notifying authorities and neighbors when a woman is in danger. It also features a shockwave generator, audio recording, group messaging, and a mobile app for safe locations. [10] proposes an IoT device using LoRa wireless network to monitor hazardous environments, alerting users via a web-based application and mobile application for emergency situations.

PROPOSED METHODOLOGY

Architecture and Working

Working of the Project can be explained in three parts Frontend, Middleware & Backend as Fig.1 shown below.

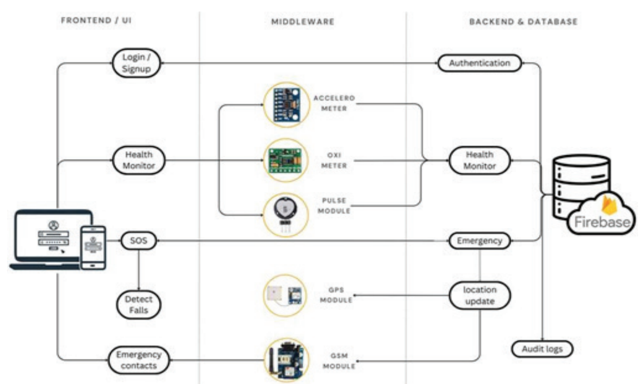

Fig. 1. System Architecture

Frontend

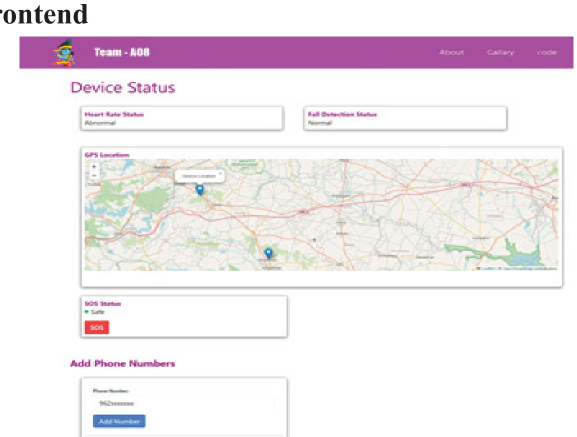

Fig. 2. Frontend web app

It consists of a dedicated web app or website which has some components that have different labels for different modules in a single page. We used HTML, CSS and basic JavaScript for frontend shown in Fig.2.

a. Health Monitor: The website collects and displays real- time data from IoT sensors, such as heart rate and SpO2 levels from pulse module.

b. SOS: it is the label which shows simply the SOS mode is on or off. It triggers using some methods described below.

   • When a person falls down on ground the accelerometer will detect the fall.

   • When the pulse module detect abnormality in the heart rate

   • When the SOS button is pressed from either hardware or website.

c. Detect Falls: Implement a fall detection algorithm that continuously analyses data from accelerometer and shows the person position whether person is standing or lying down. Which also helps in triggering the SOS.

d. Emergency Contacts: The emergency contact can be added so the respective contacts will be notified whenever there is an emergency.

e. Map: The location rendered from GPS shows accurate location using GPS module and thus the location is then shown on map directly.

f. Image: when SOS is pressed a photo would be taken from ESP32CAM which is then sent to firebase and then to the interface.

Middleware

As Fig.1, Middleware refers to software that acts as a bridge between different components or between hardware and software. It facilitates communication, data exchange, and interaction among various devices or between hardware and software applications. Essentially, it enables interoperability and integration within a hardware system, enhancing its functionality and efficiency. The prototypes are shown in Fig.3 and Fig.4. Subsequently, circuit diagram in Fig.8.

List of Material used

1. Arduino Nano: This microcontroller board contains an ATmega328P chip, operating at a clock speed of 16 MHz with 32 KB of flash memory, it provides ample storage for programming code. It also has 2 KB of SRAM for efficient task execution, and operates at 5V.

2. Node-MCU ESP8266: Powered by the ESP8266 chip, this microcontroller board operates at a clock speed of 80 MHz It offers 4 MB of flash memory for storing programs and data. With integrated Wi-Fi (802.11 b/g/n) capability, it operates at 3.3V, ensuring compatibility with low-power requirements.

3. SIM800L Module: The SIM800L Module is a compact Quad-band GSM/GPRS module, supporting frequencies of 850/900/1800/1900 MHz It features a SIM card interface for easy integration with SIM cards. Operating within a power supply range of 3.4V to 4.4V, it facilitates seamless interaction with microcontrollers.

4. MPU650 Accelerometer: This sensor module includes the MPU6050 chip, featuring a 3-axis accelerometer for motion sensing applications. It also integrates a 3-axis gyroscope with selectable ranges in degrees per second. It operates at either 3.3V or 5V.

5. Adafruit TCA9548A 1-to-8 I2C Multiplexer: Acting as a gateway, this multiplexer allows a single I2C bus to communicate with multiple devices simultaneously. Controlled through the I2C interface, it simplifies the management of multiple devices, with an address range from 0x70 to 0x77.

6. MAX30102 Heart-Rate Monitor Module: Specifically designed for monitoring heart rate and blood oxygen levels, this sensor module features both red and infrared LEDs for accurate vital sign measurements. With an I2C interface, it seamlessly integrates with microcontrollers.

7. NEO-6M GPS Module: Built around the u-blox NEO-6M chipset, this high-performance navigation device supports both GPS and GLONASS satellite systems. With a 50- channel GPS receiver, it

captures signals from multiple satellites for enhanced accuracy and stability, operating within a wide voltage range of 3.0V to 5.0V.

8. ESP-32 CAM Module: Powered by the ESP32 dual-core microcontroller, this module includes an OV2640 camera module for capturing JPEG images and streaming video. It operates via external battery, allowing independence from other hardware, and shares data to a website by storing it first on Firebase.

9. 2200mAh 18650 Lithium Ion Battery: This rechargeable cylindrical cell provides a nominal voltage of 3.7 volts. With a capacity of 2200mAh, it can theoretically supply a current of 2200 milliamperes for one hour before full discharge. It is specifically used to power the GSM module.

10. SOS Switch: This switch, when activated, sends out an SOS signal, which could be a distress call in Morse code, indicating an urgent need for assistance via light signals, radio waves, SMS.

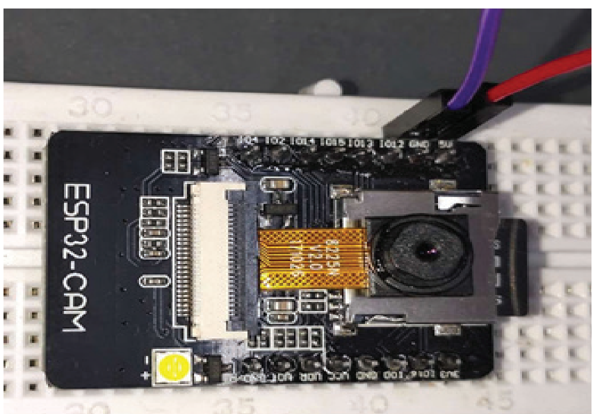

Fig. 3. Prototype-1

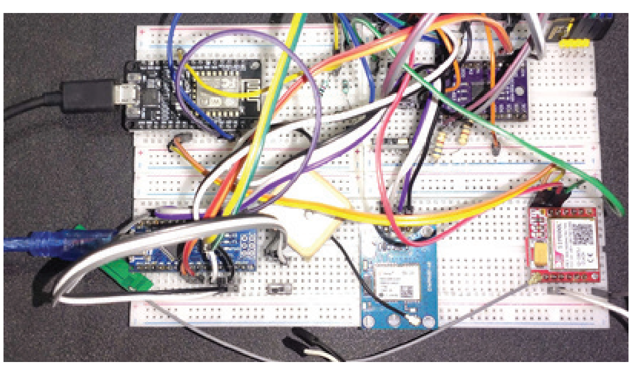

Fig. 4. Prototype-2

Backend

Back end comprises database, authentication, and coding parts. We have used firebase for Authentication, Hosting and as a Database as well. Due to use of firebase the project downtime (optimal performance time) and response time is greatly reduced as compared to others.

a. Face detection: The image captured from the ESP-32 CAM module is stored on Firebase's 'Storage'. It is then processed for face detection using the CascadeClassifier class in OpenCV, and at last it is updated on the website as well. It is a popular computer vision library used for object detection. We used 'haarcascade_frontalface_default.xml', which is a pre-trained cascade classifier file for detecting frontal faces. Pre-trained cascade classifiers are available for various objects such as eyes, full body, etc.

b. Firebase: The app can Authenticate, store and retrieve user's real-time location data in Firebase as per Fig.5, Fig.6 & Fig.7. This allows access to user location and sharing with designated contacts in emergency services. The database can store location updates with timestamps, allowing for tracking of the user's movement.

- Authentication: The user who operates the website is authenticated before further processes like adding emergency contacts, sending messages to them, tracking, etc.

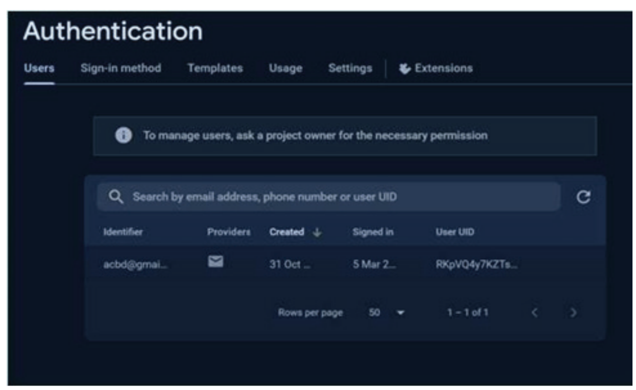

Fig.5 Firebase Authentication

- Storing data: all sensors and modules continuously collecting data from various sources are stored at the firebase directly by embedding a storage link into the microcontroller’s code. It is then accessed to front end via firebase only.

Fig.6 Realtime Database

- Image capturing: ESP 32 CAM captures the image and then send it to firebase which stores it and send it to interface when SOS is triggered.

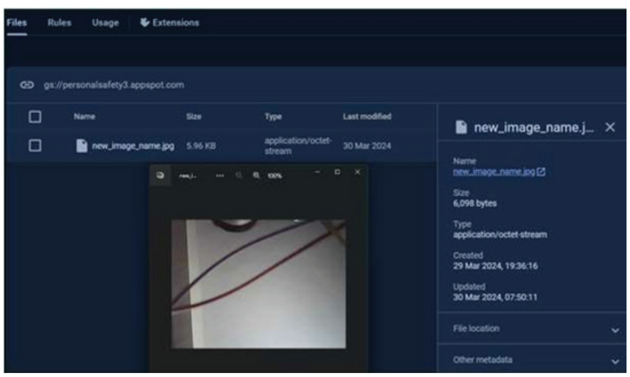

Fig.7 Image Storage

- Location update: The GPS receiver module in a device obtains the user’s current location by receiving signals from multiple GPS satellites, calculating the distance to each satellite based on signal travel time, and using trilateration to determine the user’s position in terms of latitude, longitude, and altitude. This coordinates then converted into a link for ease of access to emergency contact to track the location.

c. Emergency SOS: We have used a sim 800l GSM module for sending SMS to contact persons. It has sim inserted which will need monthly SMS recharge pack. It does not send any data to firebase but works independently and sends SMS directly to respected contacts when triggered and thus a 5v battery is attached to confirm its independence.

TECHNICAL SPECIFICATIONS AND MODELING

Circuit diagram

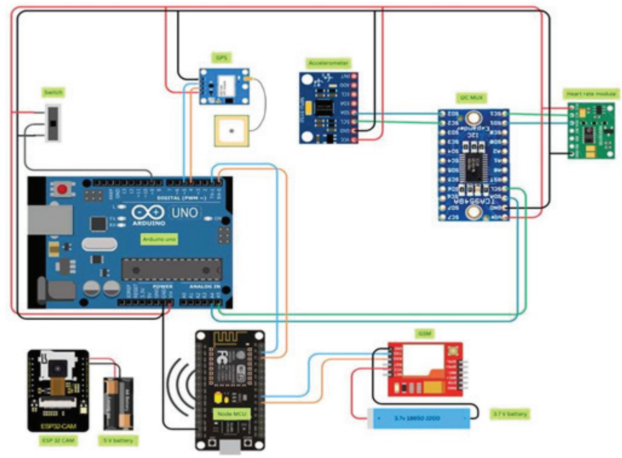

Fig. 8 Circuit Diagram

According to Fig.8 given above, the black wires represent connections to each component’s ground (GND) terminals, providing a common ground reference for all components, essential for effective operation. The red wires represent power connections, linking the batteries’ positive terminals to the relevant power input pins of the components, supplying power to the circuit. Blue wires indicate data connections between components. The connection between the Arduino Uno and the GPS module facilitates data exchange for GPS positioning. The connection between the Arduino Uno and the GSM module enables communication over the GSM network. The connection between the Arduino Uno and the I2C MUX allows the Arduino to control and interact with various I2C devices. The Arduino Uno’s connection to the accelerometer enables data transmission for acceleration measurement. The connection between the Node MCU and the ESP32-CAM suggests that these microcontrollers could exchange data or control one another. The Heart Rate Module’s connection to the Arduino Uno allows for the transmission of heart rate monitoring data. The orange wires represent control connections. The ESP32-CAM is used to take pictures, it is connected to Wi-Fi and supplied with an external 5V battery.

Mathematical model

Let modules be,

- Pulse Module: P
- Accelerometer: A
- SOS Button: B
- GPS Module: G
- GSM Module: M
- ESP32 CAM: C

Let functions be,

- Handling: H
- Data: D
- Logic: L

Arduino Microcontroller:

- Data Processing Unit (DPU):
  Processing function: f_{DPU} (P, A, B, G, M, C)
- Network Interface (N): Network Connection State: N
  Network Connection Handling (H): $H_{network}$ (N, M)
- Sensor Integration: Alert Logic(L):
  Fall Detection: L_{fall} (A)
  Abnormal Health Parameter Detection: L_{health} (P, A)
- Image capturing: L_{image}(C) Firebase Integration(F):
  Firebase Connection State: F
  Firebase Data Transmission: $D_{firebase\_trans}$ (P, A, B, G, M, C)
- Data Transmission via Network:

Data Transmission: $D_{network\_trans}$ (P, A, B, G, M, C)

Firebase Realtime Database:

Data Storage, Retrieval, Synchronization, processing and collection (D):

- Data Storage: D_{store} (P, A, B, G, M)
- Data Retrieval: $D_{retrieve}$ ()
- Synchronization: D_{sync} ()
- Data Processing: D_{web} (P, A, B, G, M, C)
- Data Collection: $D_{collect}$ (P, A, B, G, M, C)

Web Application (W):

- User Interface:
  Display: W_{ui} (P, A, B, G, M, C)
- Backend & Firebase Integration: Backend Data Retrieval: $W_{backend}$ () Firebase Integration: W ($I_{firebase}$ ()) Alert Notification: W_{alert} ()

GSM Module

- Network Connectivity:
  GSM Module State: G_{state}
  Network Connectivity State: N_{state}

Workflow

- Data Processing and Transmission:
  $D_{transmit}$ (P, A, B, G, M, C)
  Processing function: f_{DPU} (P, A, B, G, M, C)
- Firebase Realtime Database:
  Data Handling: $H_{Firebase}$ (P, A, B, G, M, C)
- Web Application:
  Data Handling: H_{web} (P, A, B, G, M, C)

RESULTS AND DISCUSSION

1. A dedicated interface for getting the values and data from database includes several labels for different sensors and modules are heart rate, fall detection, map, SOS alert, an emergency image, and a section to add phone number.
2. Emergency notice: GSM module has 5v battery support to work independently. It sends a SMS with coordinates like Fig.9. System keeps sending that SMS for time interval so it can't be ignored and will get a prior attention & at same time location is updated on website also.

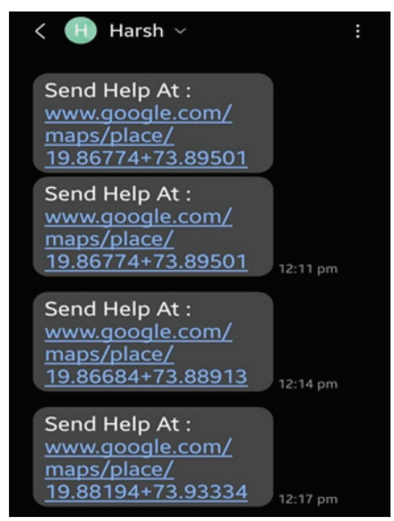

Fig.9 SMS

3. SOS status: It updates the SOS status on website where a SOS button is given to make alert disable. There is another option for SOS as a switch is to enable/disable SOS.

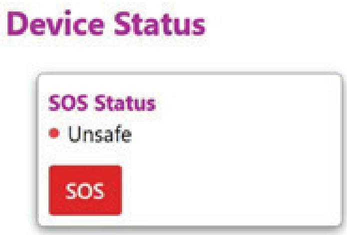

Fig. 10 Status

4. At the same time all other information like fall detection, heart rate and image captured from ESP-32 CAM is updated on website at the time of SOS alert generation process.

Fig. 11 Camera

5. Face detection: We utilized a preprocessed OpenCV class for face detection, which detects faces from captured images and subsequently displays them on the website. The respective result is depicted in Fig. 12.

Fig.12 Face detection

6. Location: It uses a GPS module to show accurate location which is then used for rendering to the front end in map and for sending location in emergency. We have used an API (Leaflet) as it is an open source. A map also shows several location marks which are recent locations shown in Fig.13.

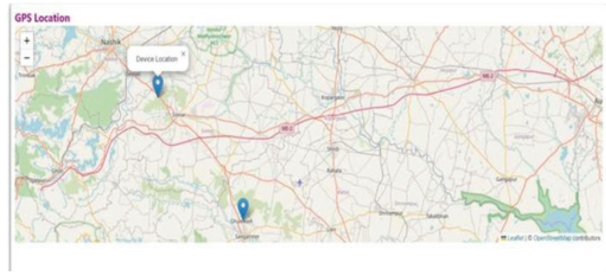

Fig.13 GPS Location

7. Code : We have added a repository link for code and further information:https://github.com/shubhambulkunde/Advancin g-Personal-Safety-Technology-for-Enhanced-Effectiveness- and-Usability

CONCLUSION

Advancements in safety technology, as highlighted in the literature survey, underscore the importance of continuous innovation in ensuring personal safety. The proposed wearable safety device and web application offer effective means of alerting and responding to emergencies, integrating various sensors and modules for comprehensive monitoring.

With support from institutions like Amrutvahini College of Engineering, the project demonstrates the potential for enhanced usability and effectiveness in personal safety solutions.

ACKNOWLEDGMENT

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YouTube Transcript Summarizer Using Machine Learning and Natural Language Processing

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ABSTRACT

This paper is about YouTube Transcript Summarizer Using Machine Learning and Natural Language Processing in which we are creating a system that is summarizing videos from the platform like YouTube. This paper uses Natural Language Processing (NLP) and Machine learning to generate a summarized transcript without missing any key points. The objectives of this research is to condense transcribed text obtained from a provided input video. The proposed methodology entails the retrieval of transcript summary through video id. The constructed model accepts video identifiers as input from users and produces a short transcript summary as output. As per the findings, the output translated text summary was generated more efficiently compared to alternative methodologies.

KEYWORDS: *Summary, YouTube, Transcript.*

INTRODUCTION

It is estimated that YouTube had more than 2.3 billion active users in 2020, and the number has shown a steady annual rise, contrary to the popular belief. Through the channel, there are 500 videos uploaded every minute. Though content is rich, identifying a particular piece of information that is scattered through the long video such as TED talks is still an issue. To cope with this, we are going to apply the Latent Semantic Analysis (LSA) Natural Language Computing (NLC) algorithm. One of the benefits is that the amount of processing power required is reduced, and it also reduces the necessitation of large training datasets. This data means therefore that YouTube is developing markedly and so the need exists thereof for better ways to get around its vast repository of content.

Motivation

The YouTube video transcripts summaries serve the purpose of serving as a scannable overview of the video's content enabling the users to read and get a quick grasp of the video's contents which enhances readability and the user experience. This is particularly useful when there is high pressure for instance at the end of the term when time is a constraint and time efficient revision is essential. The transcript summary is the condensed of the whole transcript that allows users to quickly grasp the major points of video.

Objectives

- To study and analyze machine learning and NLP algorithms.
- To study a summarization algorithm that accurately captures the main points, ideas and context of the video's content.
- To design model to get transcript text based summery of YouTube video.
- To implement proposed algorithms of transcript summarizer.
- To measure and compare proposed system result with existing system results.

LITERATURE SURVEY

This research paper uses extractive techniques to execute video summarization, achieved through the utilization of pipelining techniques to analyze critical segments of the video.

[1] Pipelining is a methodology commonly employed in computer science and data processing, where tasks are broken down into smaller, sequential stages, with the output of one stage serving as the input for the next. This approach enables efficient and streamlined processing, allowing for the analysis of complex data in a systematic manner.[9] This employs the Algebraic Statistical method alongside the MoviePy Library to align video segments with subtitles, thereby generating the summarized text. A notable advantage of this model is its minimal processing power requirement and the absence of necessity for prior training data. In the context of our YouTube transcript summarizer, pipelining is applied to the analysis of video content.

The process begins with the extraction of the video's transcript, which is then passed through a series of stages within the pipeline. These stages encompass various techniques such as speech recognition, text preprocessing, and text summarization. Each stage focuses on a specific aspect of the analysis, progressively refining the data and extracting key information. For instance, the speech recognition stage converts the audio content of the video into text format, enabling further analysis. Subsequently, the text undergoes preprocessing, which may involve tasks such as removing noise, normalizing text, and identifying key entities or keywords. Following preprocessing, the text is subjected to summarization algorithms that identify and extract the critical points and main themes of the video.[2] Moreover, our system goes beyond mere summarization by incorporating a comparison of the similarity between the provided input video and the updated, summarized version.

This comparison provides users with insight into the extent to which the essential content of the video has been retained in the summary, thereby enhancing transparency and confidence in the summarization process. Finally, to ensure the quality and accuracy of the summarized text, our system incorporates mechanisms for evaluating the fidelity of the summary to the original video content.[3] This assessment may involve comparing the summary against the original transcript, evaluating coherence and relevance, and leveraging metrics such as precision and recall. In essence, through the strategic application of pipelining techniques, our system is able to efficiently analyze and summarize YouTube video content, while also providing insights into the similarity between the original and summarized versions, and ensuring the accuracy of the summarized text.[1] An automatic YouTube transcript summarizer is a cutting-edge tool designed to swiftly generate summaries of video content by analyzing the spoken words within the video's transcript.

This innovation is particularly valuable for users seeking to grasp the essence of a video without investing the time to watch it in its entirety. [4] Our project introduces a sophisticated system that leverages machine learning and natural language processing (NLP) methodologies to achieve this task seamlessly. Central to our system's functionality is a machine learning model that has been meticulously trained using state-of-the-art summarization algorithms.[10] This model operates in real-time, analyzing YouTube videos to accurately distill the main points and essential information from their transcripts.

Through the utilization of advanced techniques such as speech recognition, text preprocessing, and text summarization, our system excels in delivering concise and precise summaries. [5]A pivotal component of our methodology is latent semantic analysis (LSA). LSA is a powerful technique within the field of NLP that delves into the latent semantic structure embedded in the word usage across a body of text.[7] By employing LSA, our system uncovers intricate patterns and relationships between words, thereby extracting deeper meaning from the text.

This method is particularly effective in response to user queries, commonly referred to as concept searches. Essentially,[2] LSA enables our system to grasp the contextual nuances and underlying concepts within the transcript, facilitating more accurate and insightful summarizations. Our project represents a fusion of cutting-edge technologies aimed at revolutionizing the way users interact with YouTube content. By harnessing the power of NLP, machine learning, and specifically

LSA, we have developed a system capable of providing users with efficient and comprehensive summaries of YouTube videos, enhancing accessibility and usability in the digital age.

PROPOSED SYSTEM

In the initial phases of the process,[1] the system focuses on data classification, extracting pertinent information from the input video transcripts. Once the transcripts are obtained, the system enters the training phase, where it discerns the tone embedded within the textual content. This model serves as the foundation for generating the final summarized text, integrating insights from the transcripts while ensuring coherence and conciseness in the output.

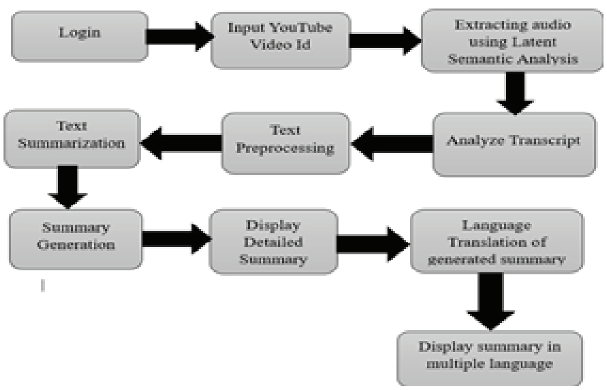

Fig. 1. Process Flow Diagram

By summarizing the video transcripts, each step gears toward the output of an uninterrupted brevity of operation which is concise and digestible by reading which gives the key points. First, the transcript is carefully reviewed and only relevant data is identified, which helps to omit information that is not as important and to add information that is only important in the intended summary. [8] Next the system also determines the mood of the content through the tone which permits it to discern the dominant atmospherics and implications of what is spoken in the video.

These are techniques that tend to simplify the current added- up task into small and few understandable steps as each part contributes to the overall production. The system has a continuous evolution process, including refinement and improvement [6]. Thus, the final output is well structured and is able to successfully summarize the main points of the input content. The process of interacting with AI tools is ongoing which not only helps the tool to reach an improved accuracy level but also ensures that the summaries are easily accessible and digestible by users who demand videos to be summarized quickly and easily.

The system architecture is descripted in below figure.

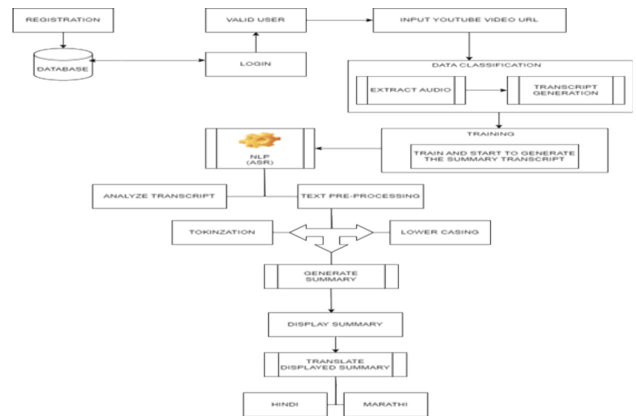

Fig. 2. System Architecture

Methodology

We were reviewing various video summarization approaches, we observed that many require substantial training and execution time. In response, we conducted an evaluation to address this issue. Our solution involves utilizing the transcripts of YouTube videos by fetching them for text summarization, rather than directly processing the video content. This approach aims to streamline the summarization process while maintaining accuracy and efficiency.

1. User Login: Implement functionality for users to register and log in securely to the system.
2. User Authentication: Verify user credentials during login to ensure authorized access.
3. Input Processing: Accept YouTube Vedio's ID as input for further processing.
4. Data Classification: Extract audio and generate a transcript from the input video.
5. Training Process: Train the system using the generated transcript to enhance performance.
6. NLP Algorithm Application: Apply Latent Semantic Analysis (LSA) to extract key sentences from documents.

7. Transcript Analysis: Analyze the generated transcript, including preprocessing steps.
8. Summary Generation: Employ tokenization and lower casing for text preprocessing to create summaries.
9. Summary Display: Showcase the generated summary to users.
10. Multilingual Translation: Enable translation of the displayed summary into multiple languages for accessibility.

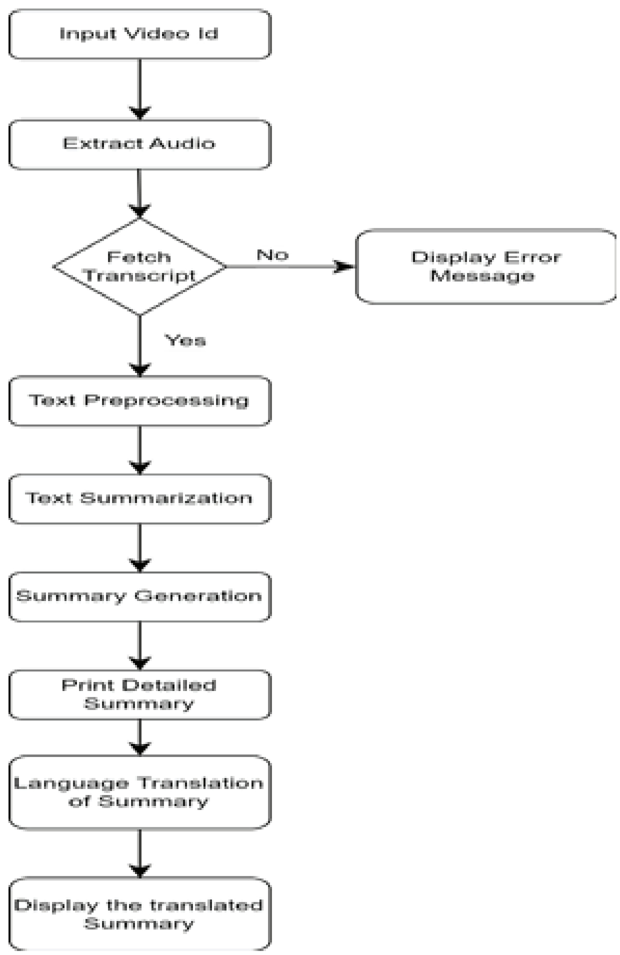

Fig. 3. Process Flowchart

Alogrithm

Module 1: Providing the input video for extracting the necessary transcripts.

Step1: Install tkinter library which is necessary for Graphical User Interface (GUI).

Step 2: Next install youtube_transcript_api to fetch YouTube transcripts of provided video.

Step 3: Import NLTK library for natural language processing tasks.

Step 4: Give YouTube Video id of video to get the summary.

Module 2: Fetching the transcripts of provided input video into a function so that they can be processed for summarization process.

Step 1: Display the input YouTube Video Id with summarize button on GUI.

Step 2: Creating the transcript of a specified video through a function.

transcript = YouTubeTranscript_get_transcript(video_id)

Step 3: Observation of generated transcript along with its contents

full_transcript = ‘ ‘.join([entry[‘text’] for entry in transcript])Step 4: Perform text preprocessing.

Step 5: Perform text Summarization. Step 6: Print the generated summary.

Module 3: Performing language translation on generated summary

Step 1: Firstly, import Translator library of googletrans Step 2: The function used is to translate the language translated = translator.translate(text, dest=target_language)

Step 3: Define the target languages into which the generated summary has to be translated using the following code:

text_to_translate = “Hello, how are you?” target_language = “hi”

target_language2 = “mr”

Step 4: Print the translated summary in multiple specified target language.

Fig. 4. Screenshot of Resulted Output

Requirements

The system undergoes testing with a specific set of inputs to assess its accuracy and functionality. The operational requirements for implementation include transcription, summary transcription, and text analysis. The software prerequisites entail:

1. Programming Language: Python
2. Operating System: Windows 7 or newer
3. Development Environment: Google Colab

Advantages

i. Time-Saving: The software enables viewers to quickly assess the relevance of video content by providing concise summaries, saving time and effort in content consumption.

ii. Content Optimization: Content creators benefit from improved discoverability and a deeper understanding of viewer engagement through keyword extraction and categorization.

iii. Accessibility: The summarization feature enhances accessibility for individuals with hearing impairments, providing closed captions and text-based con tent summaries.

iv. Customization: Users can tailor their summarization preferences and categories, allowing for a personalized and enhanced user experience.

v. Data Insights: The software offers data insights and user feedback through comment analysis, assisting content creators in refining their content and strategy.

Disadvantages

i. Accuracy Constraints: Summarization accuracy depends on the quality of NLP algorithms and speech recognition technology, which may result in occasional inaccuracies.

ii. Language and Dialect Variability: Summarization may be less effective for content in languages or dialects with limited NLP and speech recognition support.

iii. Privacy Concerns: The handling of user-generated content and comments raises privacy and ethical considerations that must be addressed.

CONCLUSIONS AND FUTURE WORK

In conclusion, the "YouTube Transcript Summarizer" project presents a significant advancement in online video content interaction, promising enhanced accessibility, efficiency, and informativeness. Through the utilization of Latent Semantic Analysis (LSA), key sentences are extracted from video transcripts, allowing for concise and relevant summaries. This implementation ensures that users can quickly grasp the essence of video content without having to watch the entire video, thereby saving time and improving the overall viewing experience.

Furthermore, the project's future scope includes potential enhancements such as sentiment analysis, topic modeling, and advanced natural language processing techniques to provide even deeper insights into video content. Additionally, integrating multilingual support and real-time summarization features could further broaden its impact globally. By addressing current digital media needs and continually evolving to meet future demands, this project has the potential to significantly shape the landscape of video content consumption and creation, fostering a more dynamic and engaging online environment.

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Blockchain based Approach for Tracking the Drug Supply Chain

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ABSTRACT

Due to the difficulty in determining whether the medicinal products we purchase are genuine, counterfeit drugs are currently a major issue. Along with that manipulations with medicine's price, content and expiry date are major concerns. Because of the existing setup, it is simple for someone to interfere with the supply chain and escape the surveillance. This study offers a solution that makes use of the robust blockchain technology. Blockchain functions similarly to a digital ledger, securely and irreversibly recording transactions between parties. This makes it ideal for preventing counterfeit medications as well as unauthorized data tampering because it is noticeable, decentralized, and unchangeable. Our proposal is to track medications through the blockchain technology along the supply and demand chain. Through the use of smart contracts, each drug transfer is tracked on the blockchain. In this manner, we are able to track the origin of each medication. Additionally, we created a QR code that customers can scan to view information about the medicine, ownership transfer, price hikes and its origin. After testing, we discovered that our methodology is both safer and more effective than the current one.

KEYWORDS: *Blockchain technology, Transparency, Drug counterfeiting, Smart contracts, Medicine tracking.*

INTRODUCTION

A drug supply chain is the network through which pre- scripted medicines are delivered to patients consisting an intricate network of several individuals consisting of sup- pliers, manufacturers, wholesalers, distributors, pharmacist, patient[1]. Central Drugs Standard Control Organization (CD- SCO) is the national regulatory authority for pharmaceuticals and medical devices in India. In India, the National Pharmaceutical Pricing Authority (NPPA) is in charge of controlling the prices for pharmaceutical goods. It monitors price compliance and takes actions against companies violating pricing regulations. The Indian government has been working on implementing a track and trace system for pharmaceuticals, requiring manufacturers to affix barcodes containing prod- uct information and batch details. This initiative is aimed at reducing the incidence of counterfeit drugs, unauthorized manipulation of medicine descriptions and ensuring the au- thenticity of medicines. The traditional supply chain is based on centralized approach. This methodology is not efficient and there is no pricing transparency[10]. As a result, it is very difficult for the customers to know the accurate value of medicines. There are instances of manipulating the expiry date, contents of medicines to sell the counterfeit drugs due to illegal or unethical practices because of involvement of middlemen[10]. Counterfeit medications pose a significant threat to public health, particularly in underdeveloped nations [6], where approximately 30% of drugs are fake[1]. The World Health Organization (WHO) identifies counterfeit pharmaceuticals as a leading cause of death in these regions[9]. The COVID-19 pandemic raised this issue, providing opportunities for black marketers to exploit the urgent demand for treatments[3]. Global efforts, such as Interpol operations[10], aim to combat the illegal trade of pharmaceuticals, with seizures totaling millions of dollars. Initiatives like the European Union Falsified Medicines Directive (FMD) enforce stricter regulations requiring medicines to have a unique identifier and an anti-tampering device on their packaging.[11]. This data shows that the traditional supply chain has no global ledger which includes the records of all the transactions performed across various participants[11]. Without powerful tracking and verification systems, it's challenging to distinguish genuine medications from counterfeit ones.

Blockchain

The Ethereum blockchain platform enables the development and execution of decentralized applications (DApps) and smart contracts[12]. Smart contracts are self-implementing contracts whose conditions are programmatically defined within the code. These contracts are executed using the Ethereum Virtual Machine (EVM), which is a distributed executable environment[13]. Ether serves as the native cryptocurrency of the Ethereum platform. Transactions on the Ethereum network are confirmed using a consensus mechanism called Proof of Stake (POS)[3]. The computational resources required for tasks on the Ethereum network are measured in units called "gas"[12] with users paying gas fees to miners or validators for transaction processing.

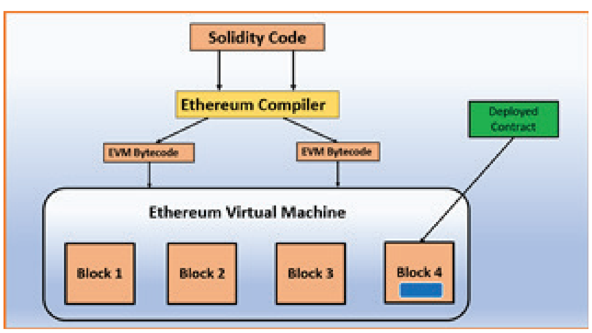

Fig. 1. Ethereum Blockchain

As shown in Fig. 1 Smart contracts are typically developed in higher-level programming languages like Solidity and then translated into bytecode[13] for execution by the EVM. The Ethereum blockchain consists of multiple nodes distributed across the network[11], each maintaining a copy of the ledger and participating in transaction validation and block creation[12].

In supply chain management, blockchain technology offers various benefits such as automating payments, ensuring quality, building trust among participants[11], accelerating data processing, reducing paperwork, and providing real-time visibility[7] into the supply chain process. To overcome the drawback of centralized approach we have developed a decentralized application with the help of configuration provided by React. A private local blockchain offered by Ganache[15] is used to deploy the smart contract. Through Web3.js and the Truffle[14] framework, the decentralized application (DApp) is linked to the blockchain network.

RELATED WORK

Several researchers have explored the potential of combining blockchain technology with the Internet of Things (IoT) across various domains. S. Nanda, S. Panda, and M. Dash addressed challenges within the healthcare supply chain [2], proposing a revolutionary method combining Blockchain and IoT to tackle issues like security threats, lack of transparency, and counterfeit drugs. Amjad Qashlan, Priyadarsi Nanda, Xiangjian He, Manoranjan Mohanty [5] suggested a blockchain-driven solution to enhance data privacy in smart homes, utilizing feature-driven authorization and digital agreements with distributed computing for scalability and robustness. Haya Hasan, Esra Al Hadhrami, Alia AlDhaheri, Khaled Salah, Raja Jayaraman [13] proposed a blockchain-based system for real-time surveillance and management of shipment movements in the distribution chain, utilizing smart contracts within the Ethereum blockchain to regulate communication between senders and receivers. These solutions leverage IoT sensors to monitor shipping conditions such as temperature, location, humidity, pressure, light exposure, and physical integrity, enhancing supply chain transparency and efficiency.

Nowadays, blockchain is also used for improving the transparency of various food supply channels. A. Iftekhar and Xiaohui Cui [7] proposed blockchain-based solutions to enhance transparency and traceability in food supply chains, particularly focusing on COVID-19 risk reduction in imported frozen meat. Their approach involves tamper-proof auditing and integration with

IoT for continuous monitoring of feeding practices and animal breed. Importers can oversee safety measures through live feeds of processing plants and implement rigorous disinfection protocols. Lu Wang, Longqin Xu, Zhiying Zheng, Shuangyin Liu, Xiangtong Li, Liang Cao, Jingbin Li, Chuanheng Sun [8] advocated for a blockchain system to monitor the agrarian chain's process flow, promoting transparency and eliminating data barriers between businesses. They proposed capturing the data about crop environment and yields via the InterPlanetary File System (IPFS) and ensuring information safety by storing IPFS hash codes in smart contracts. This approach aims to mitigate storage concerns and leverage outcomes such as eliminating middlemen and enabling product tracing through QR codes.

Several authors studied and compared the perks and issues of utilizing various freeware blockchain platforms for implementing the Healthcare distribution chain. M. Uddin, K. Salah, R. Jayaraman, S. Pesic, S. Ellahham [6] advocated for Hyperledger Fabric and Besu to address product traceability issues and combat counterfeit medications, focusing on privacy, trust, protection and scalability. Justin Sunny, Naveen Undralla, V. Madhusudanan Pillai [11] highlighted the significance of product tracking and transparency in supply chains across various industries, demonstrating a Proof of Concept using Solidity smart contracts on Microsoft Azure Blockchain Workbench. M. Labaran and M. Hamma-Adama [9] conducted research involving interviews with medical firms and Nigerian pharmacological authorities to assess the feasibility of integrating blockchain into the country's medicinal distribution channel, aiming to mitigate counterfeit drug circulation.

Abirami Raja Santhi and Padmakumar Muthuswamy [3] stated that as traditional factories evolve into large-scale gigafactories, the involvement of multiple intermediaries complicates the supply chain and logistics operations. The findings indicate that blockchain has the potential to revolutionize these functions, rendering them secure, adaptable, trustworthy, and transparent. It suggested that a private or permissioned blockchain is especially well-suited for multi-organizational enterprises such as those in supply chain and logistics, offering enhanced control and security.

S. Soner, R. Litoriya, and P. Pandey [4] discussed the problem of duplicate property register records in government agencies and proposed using blockchain technology as a solution. This study draws attention to the shortcomings of the current manual or partially online registry systems, which lead to a number of issues like unreliability and falsification. They proposed a scheme to use blockchain to automate the management of registration records while maintaining agreement, tamperproof, and openness among participants. This framework's principal elements include fast verification, multi-level authentication, and smart contracts to accelerate processes and follow to legal requirements. The suggested framework is superior in terms of delivering consistent and transparent data across government agencies.

PROPOSED METHODOLOGY

System Architecture

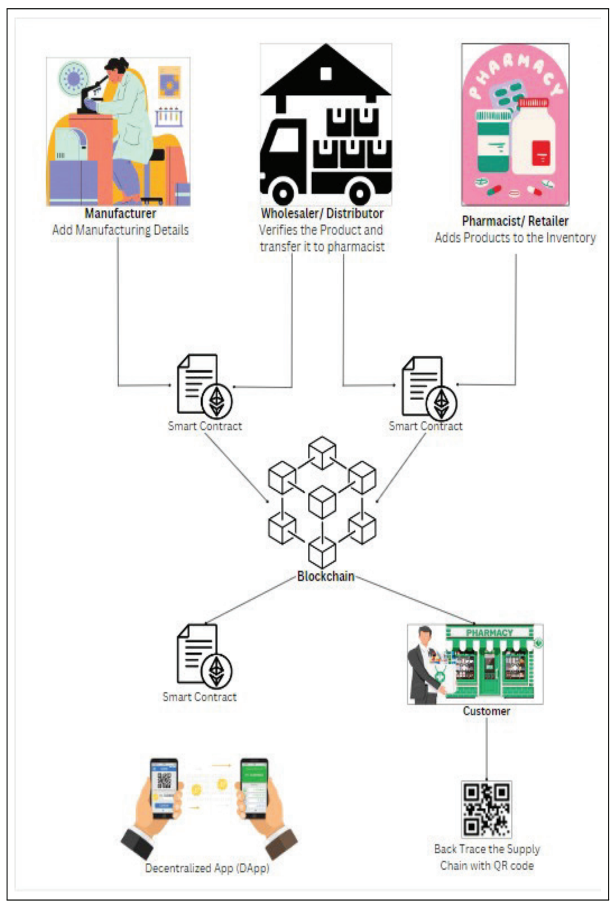

Fig. 2. Overview of demonstrated Architecture

The proposed framework's architecture is shown in Fig. 2.

- Firstly manufacturer adds details about the manufactured medicine including medicine description, quantity, trans- porter's public address and other relevant data in the DApp
- After manufacturing, the medical product is transported via transporter to the wholesaler or distributor who re- quested it. A transaction containing all the details of the shipment is automatically created by the execution of smart contracts.
- Once the transaction is initiated, a metamask notification is prompted on the user's screen which displays estimated gas fee to perform the transaction and total amount of ethers required. Additionally it shows options to either confirm or reject the transaction. After a transaction is submitted to the Ethereum network, Metamask will display a notification indicating whether the transaction was successfully processed or if it failed.
- All the transactions are validated with the help of elliptic curve cryptography. It includes dynamically generating the digital signatures for both the participants (sender, reciever) involved. The digital signature is generated by combining private key of recipient and automatically created product hash address (once the correspomding medicine is added to the blockchain). After successful validation, a new block conatining the transaction's de- tails like transaction hash, sender, recipient, gas limit, gas used, status, timestamp etc. gets added to the blockchain as a result of execution of event txnCreated.
- The pharmacist or retailer receives the product from the wholesaler. They add the product to their inventory, making it available for sale to the patients.
- Customers/Patients play an essential role in this system. They can scan QR codes on product packaging. By doing so, they can backtrace the product's journey through the supply chain.

In this system, smart contracts likely govern the transfer of products and information, ensuring that each step is recorded and verified without the need for a central authority. The DApp helps to know about medicine's origin and effectively monitor the supply chain and enhance the transparency.

Technologies used

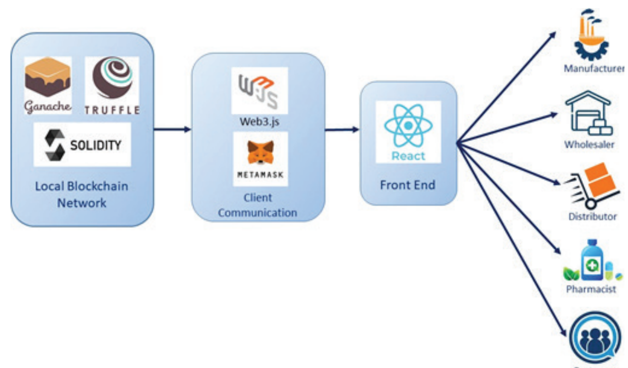

Fig. 3. Technology Ecosystem

1) Ganache: Ganache, a component of the Truffle Suite [14], offers a simulated blockchain environment for local development. Developers can interact with this environment without accessing the live Ethereum network, facilitating test- ing of smart contracts and decentralized applications (DApps). With 10 preloaded accounts, each containing 100 dummy ethers [15], developers can execute transactions, deploy con- tracts, and engage with DApps seamlessly during the develop- ment phase. This controlled environment enhances efficiency and accuracy in blockchain development and testing.
2) Truffle Framework: A widespread Ethereum program- ming platform called Truffle makes creating, evaluating, and implementing DApps and smart contracts easier[14]. It offers a collection of libraries and resources that simplify the Ethereum development workflow. Truffle helps developers organize their Ethereum projects by providing a standardized project struc- ture.
3) Metamask: MetaMask is a well-known digital currency wallet and web-browser plugin that lets users access DApps and connect with the Ethereum blockchain straight from their internet browsers. MetaMask implements the Web3.js JavaScript

library, which allows web applications to interact with the Ethereum blockchain. This integration enables DApps to connect to the user's MetaMask wallet and request per- mission to access their Ethereum accounts, enabling seamless interaction with blockchain-based applications.

4) Front End: For interacting with the DApp and smart contract, the presentation layer provides visual interface. Re- actJS is used for creating interactive webpages. JavaScript is employed to develop the logic responsible for initiating actions within smart contracts.

Implementation

We created a web application for our research to monitor the distribution chain for drugs. Fig. 4 displays how the request-response mechanism in the DApp is executed when the Manufacturer requests a raw material from the Supplier.

The application comprises of various Data Structures, events and functions for accessing the DApp.

Data Structures

- Define Medicine Status enumeration: atManufac- turer, pickedForWholesaler, pickedForDistributor, deliv- eredAtWholesaler, deliveredAtDistributor
- Define struct txns to hold details of a transaction: bytes32 txnHash, address fromAddr, address toAddr, bytes32 prevTxn, uint timestamp
- Define Participant role enumeration: noRole, sup- plier, transporter, manufacturer, wholesaler, distributor
- address[] stakeholders: array containing public key addresses of various stakeholders (manufacturer,retailer etc.)
- medicineDescription: details of the medicine such as medicine contents, price, quantity, expiry date etc.
- uint transporterType: indicates the shipment status of medicinal products from one participant to another. eg. if transporterType == 3 then the shipment is from wholesaler to distributor.

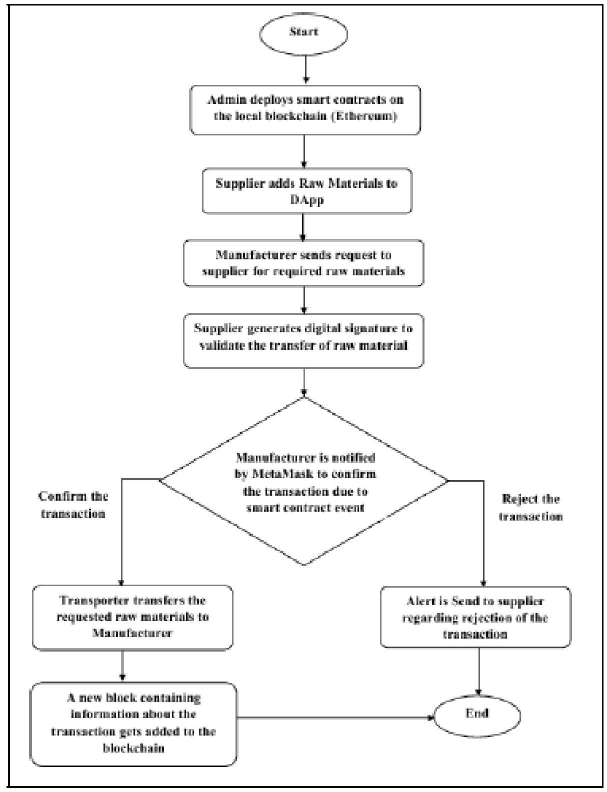

Fig. 4. Flowchart describing the transfer of raw material from Supplier to Manufacturer

Functions

- function registerUser (string name, string[] memory location, unit role, adddress userAddress): using this function the admin adds new stakeholder to the DApp by specifying the new participant's name, location, role and public address.
- function handlePackage (address productAddress, uint transporterType): this method is used to transfer product from one entity to another via transporter by specifying product hash address and transporter type.
- function Creates Medicine (address manufacturer Addr, bytes32 description,address[] memory rawAddr, uint quantity, address[] memory transporterAddr, address recieverAddr, uint RcvrType): manufacturer creates medicine by providing details like description, raw material's hash addresses, quantity, tranporter's public address, reciever's address and type of the reciever.

- function getAllTransactions() public view returns(txns[] memory): using this routine, any stakeholder can access all the details of the transaction by providing it's hash address.
- function getMedicineInfo () public view returns(ad- dress manufacturerAddr, bytes32 description, ad- dress[] memory rawAddr, uint quantity, address[] memory transporterAddr, address distributor, address customer): this function embeds all the details of medicine in the dynamically generated the QR code.

Events

- event txnCreated(bytes32 txnHash, address fromAddr, address toAddr, bytes32 prevTxn, uint timestamp)
- event UserRegister(address address, bytes32 name)
- event sendEvent(address seller, address buyer, address packageAddr, bytes32 signature)
- event receivedEvent(address buyer, address seller, ad- dress packageAddr, bytes32 signature).

Implementation of Digital Signtaure

If a stakeholder or entity 'A' wants to initiate a transaction to transfer a medical product to another stakeholder 'B' then entity 'A' will create a transaction T_x of the event and transmit it to the Ethereum network. Only if found valid by miners, T_x will get added to the blockchain. Adding T_x to the blockchain completes the transaction [12].

To verify the validity of transaction Tx , entity 'A' has to sign Tx using 256 bit private key P^{entity}_{key} along with the hash address Hmedicine of the medicine being requested.

The following equation describes the process of signing the transaction Tx:

$$DSign = F_{sign}(F_{hash}(H_{medicine}), P^{entity}_{key})$$

where,

1. D_{Sign} => generated Digital Signature
2. F_{Sign} => is the cryptographic digital signature algorithm such as RSA

F_{hash} => cryptographic hash function applied on the medicine address to produce fixed-length digest. This ensures that the signature is of a fixed size and is unique to every distinct $H_{medicine}$.

P^{entity}_{key} => is the private key only known to the signer entity.

D_{Sign} requires P entity to generate it and hence user cannot deny (repudiate) having performed a transaction. Furthermore, modifying T_x will cause change in Hmedicine and produce a different D_{Sign} thus, guaranteeing T_x integrity.

RESULTS

Ganache[15] offered a local blockchain on which the smart contracts were implemented. It shows the deployed smart contract along with the gas cost for executing them.

Gas cost for Supply chain smart contract is 1551280. To convert gas cost to Ether, there is a need to divide the gas cost by the current gas price in Gwei. If the gas price is 17 Gwei, then:

Gas cost = 1551280

Gas price = 17 Gwei = 0.000000017 Ether Actual cost in Ether = Gas cost * Gas price

Actual cost in Ether = 1551280 * 0.000000017 = 0.02637456 Ether

Fig. 5 shows a digital signature which is a cryptographic mechanism used to verify the authenticity and integrity of transactions. It is generated with the help of private key associated with the recipient and product address being requested.

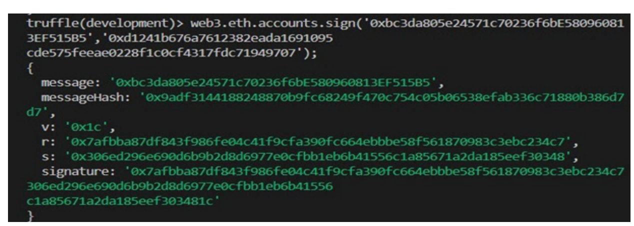

Fig. 5. Digital Signature generation

Fig. 6 displays a summary of the latency as well as throughput of blocks mined on the Ganache blockchain. Each block contains a bundle of transactions and has its own unique identifier called a block number, hash, timestamp, gas limit, gas used, difficulty, and nonce. Additionally, you can view the transactions included in each block and explore their details, such as transaction hash, sender, recipient, gas limit, gas used, and status.

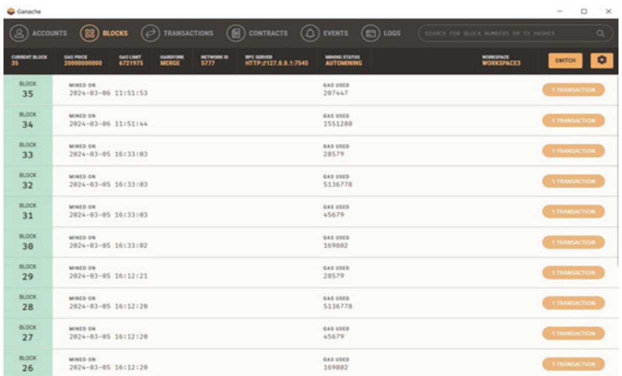

Fig. 6. Analysis of the Ganache GUI local blockchain.

Fig. 7 displays the main GUI of the web based decentralized application(DApp).

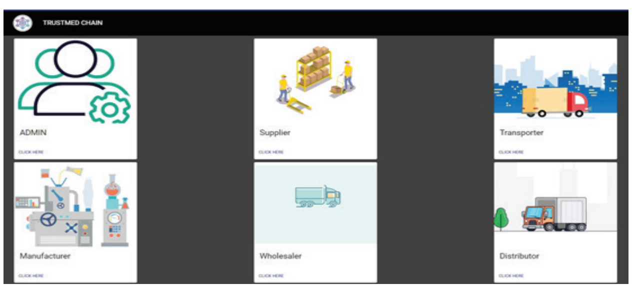

Fig. 7. Home page

The Landing Page shows the cards for each stakeholder containing their respective functionality developed using ReactJS.

A raw material being produced by the chain's Supplier entity is seen in Fig. 8. The supplier must provide information regarding raw material description, quantity and transporter's address.

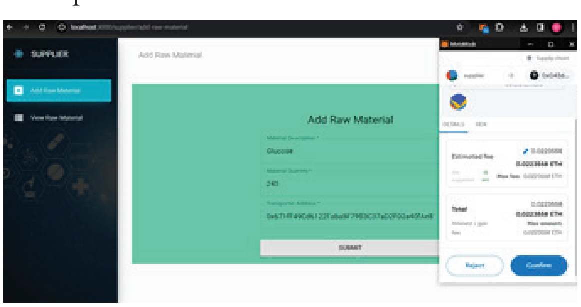

Fig. 8. Creating a Raw material

The raw material is given an address and its information is added to the blockchain. Once the supplier clicks on submit button, metamask notification is popped up due to event request-response mechanism and execution of smart contract. It displays estimated gas fee to perform the transaction and total amount of ethers required.

Fig. 9 displays the final product tracking dashboard. It displays the generated product hash address, medicine name, quantity and dynamically generated QR code in which the medicine description is embedded.

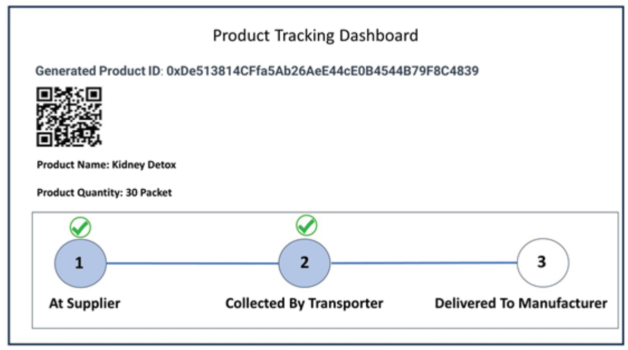

Fig. 9. Generated QR code

Along with this a progress bar showing the movement of medicines along the supply chain is displayed which is helpful for effective tracking. Product ID is a unique identifier generated automatically when the product gets added to the blockchain. The progress bar shown in Fig. 9 indicates that the raw material is being transported from supplier to the intended manufacturer.

Once the QR code is scanned, the medicine information as shown in Fig. 10 is displayed. The description contains important details like medicine name, manufacturing date, expiry date along with the names of stakeholders involved in the process.

Product Details

Medicine name	Kidney detox
Product Address	0x3FC4766b9327AB6a1E867187586251658b03Cbc2
Manufacturer	NUTRICORE BIOSCIENCE PRIVATE LIMITED
Wholesaler	Herbs Nutriproducts Private Limited
Retailer	Herbs Nutriproducts Private Limited
Product Quantity	70 Packetes
Product Price	70 Rs per packet
Generic Name	Kidney Detox
Manufacturing Date	15 July 2010
Expiry Date	15 July 2022

Fig. 10. Display of Medicine details after scanning QR code

The information embedded in the QR Code helps for real-time tracking of the price manipulations taking place while change in ownership occurs in the supply chain and permanently record the transaction events, for adequately monitoring the unethical tampering and take compliance actions if required.

PERFORMANCE METRICS

Here are a few key metrics that can be used to assess the performance of the blockchain-driven system:

1) Transactions per second (TPS) : This metric measures the overall quantity of transactions that the Ethereum network can handle per second [2]. This is the most important metric as it helps to determine the transaction processing speed and efficiency of the network. Throughput = capacity = TPS = (Block size)*(Block Time)

TPS = (Transactions per Block)*(Block per second) So,the average TPS ranges between 0.01 to 0.209. The Ethereum blockchain has a TPS limit of around 15 to 45.

2) Block Time: This metric calculates the time required for creating a block and adding it in the mined blockchain. Typically for the ethereum blockchain, the block time is around 13 to 15 seconds. The faster the block processing time, quicker is the transaction processing, improving the performance and scalability of the ethereum network.

3) Gas Fees: The computing power needed to carry out tasks on the Ethereum platform is calculated in terms of Gas [5]. Individuals are required to spend gas fees since every task or operation uses a particular quantity of gas to compensate miners or validators for processing their transactions. The average gas fee on the ethereum blockchain can range from 50 to 100 gwei the depending on the network congestion. 1 gwei is equal to 0.000000001 ETH. This enhances transaction affordability and accessibility for a wider user base.

CONCLUSION

The study presents a decentralized track-and-trace mechanism through digital contracts and Ethereum technology, which significantly enhances the healthcare delivery chain administration. This solution guarantees the integrity and authenticity of pharmaceutical items while improving transparency and traceability. As a result, there is less chance of fraud, counterfeiting which will lead to accurate data recording. Important parties like manufacturers, distributors, retailers, and customers are integrated into the system architecture via a decentralized application (DApp) interface. End users can easily authenticate products, which is crucial for patient safety. The legality of each event is confirmed via an event request- response mechanism that also records every transaction in real- time on the blockchain. An application that has no central administrator and runs on the Truffle configuration was developed. The smart contract was deployed, tested via a local blockchain provided by Ganache, and web app interaction interface was developed for effective access of medicine information by scanning the generated QR code.

FUTURE SCOPE

The future potential for the blockchain-driven solution is integration with IoT technology. IoT devices can assist to track temperature, humidity, and location in pharmaceutical transport. Integrating IoT data with blockchain ensures instantaneous surveillance and recording of these parameters. The immutable ledger guarantees optimal storage and transport conditions for drugs. This fusion improves medicinal supply chain traceability and visibility.

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Blockchain Enabled Smart Contract Based Ammunition Management System

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ABSTRACT

In today's era, the problem at hand involves the shortcomings of existing ammunition management system in military, which lack an effective means of ensuring transparency, traceability in the distribution and usage of ammunition(weapons). This deficiency results in potential security vulnerabilities, unauthorized access, and difficulties in tracking ammunition. To overcome these issues, the goal is to design and implement a solution that leverages blockchain technology and smart contracts. This research uses blockchain to trace the purchase, sale, and transportation of weapons. With this technology, transaction records are extremely safe and unchangeable. Additionally, we're employing digital agreements known as smart contracts to automatically enforce the guidelines for how these transactions should go. Additionally, a Ethereum platform, Hardhat environment for deployment of smart contracts and a digital wallet known as Metamask are supporting this. All of this lowers the possibility of somebody cheating or breaking into the system without authorization and helps us ensure that weapons transportation is done correctly.

KEYWORDS: *Blockchain, Smart contracts, Metamask, Inventory management, Hardhat, Infura, Consensus, Ethereum, Ammunition, Military.*

INTRODUCTION

Ammunition management is an essential part of security and operational effectiveness in the military, law enforcement, and civilian domains, among other sectors. Traditional ammunition management techniques have faced ongoing difficulties in the past few years, including fraud, mistakes, and a lack of openness. But the rise of cutting-edge technology, including blockchain and smart contracts, offers a viable way to solve these problems and transform ammo management.

Blockchain technology provides a decentralized and unchangeable ledger system. It was first made popular by its ability to support cryptocurrencies like Bitcoin. This ensures the integrity and openness of transactions by making it nearly hard to change or tamper with data once it is recorded on the blockchain. Utilizing blockchain technology reduces the risks associated with fraudulent activities and illegal access by offering a safe and auditable record of all transactions.

Furthermore, by automating and enforcing agreements without the need for middlemen, smart contracts that automatically execute having parameters on the bond explicitly encoded in software—complement blockchain technology. Smart contracts can make it easier to execute transactions in the ammunitions management domain by meeting predetermined criteria including amount, destination, and authorization requirements. Stakeholders can reduce operational inefficiencies and minimize the possibility of human error by using smart contracts to streamline the shipment, inventory, and procurement processes.

This research paper's goal is to investigate how blockchain technology and smart contracts might be integrated within an ammunition management system (AMS). We will examine these technologies' technological foundations as well as real-world uses for improving the security, openness, and effectiveness of ammo management procedures. By means of an extensive analysis of practical applications and case studies, we aim to assess the possible advantages and difficulties linked with implementing blockchain-enabled smart contract-based systems for ammunition management.

Moreover, platforms like Hardhat, Ethereum network, and Metamask make it easier to combine blockchain technology with smart contracts. The Ethereum project development environment Hardhat offers a solid foundation for creating, testing, and implementing smart contracts. The foundation for executing smart contracts and logging transactions on the blockchain is provided by the Ethereum network. With the use of a browser plugin wallet called Metamask, users may communicate with Ethereum-based apps—such as those that employ smart contracts to control ammunition—with ease. This research project aims to improve ammunition management procedures by illuminating the revolutionary potential of these technologies and providing insights into how blockchain and smart contracts can facilitate ammunition transactions that are safer, more transparent, and more effective. With this system can work on immutable ledger to solve the problem.

Additionally, we try to assess the prospects and difficulties related to the adoption of blockchain-enabled smart contract-based munitions management systems by looking at case studies and real-world deployments. Our ultimate objective is to supply information that enables interested parties to make the most use of these technologies, pushing the boundaries of munitions management and making the world a safer and more secure place for everybody.

LITERATURE SURVEY

Ilhaam A. Omar, Raja Ja- yarman (2022). This study offers a thorough cost analysis for different supply chain stakeholder interactions as well as an examination of solutions for various security vulnerabilities. It discussed how important it is for different supply chain stakeholders to share inventory. We've talked about how important information exchange is to managing a profitable and successful[1]

Syarifah Bahiyah Rahayu, Sharmelen A/L Vasanthan (2022). In this research, we show that the application of blockchain technology can significantly increase MSCM Integrity since recorded data is unchangeable. Future research will focus on extending blockchain technology to other military fields including finance and logistics. The results demonstrate that secure communication, integrity, and transparency are made possible by integrating blockchain technology into the MSCM. Blockchain could thereby lessen fraud, enhance party communication, and increase end-to-end tracking transparency in MSCM. When blockchain technology is integrated into Military Supply Chain Management (MSCM), the same advantages may also be realised.[2]

Nicol`o Miottol (2022). This study suggests that blockchain-based registries could gather information on all the documents involved in the manufacture, shipping, storage, and acquisition of armaments and ammunition. By adding a permissioned blockchain to the Organisation for Security and Cooperation in Europe (OSCE) framework for conventional ammunition control, more confidentiality, better monitoring, and data verifiability would be provided, bolstering the OSCE's CAC regimes.[3]

Sharifah Saadiah, Syarifah Bahiyah Rahayu(2021). It is anticipated that the data exchanged in this paper's digital ledger amongst block participants will be more structured, safe, and oriented. The research demonstrates the structure of the consortium blockchain network. It suggests a brand-new military blockchain consortium for defence shipping. In order to accommodate military authorities and suppliers, blockchain layers are developed. The traceability and tracking capabilities in military logistics, such as the transportation and life cycles of military assets, may be strengthened by more research in this field.[4]

Rui Qin, Wenwen Ding, Sangtian Guan (2023). This article explores how decentralised autonomous organisations (DAOs), enabled by blockchain and Web3 technology, are able to reinvent organisational structures, production relations, and resources. Additionally, a closed loop equation, novel function-oriented intelligent algorithms, and a five-layer intelligent architecture are provided. The results demonstrate that secure communication, integrity, and transparency are made possible by integrating blockchain technology.[5]

PROPOSE SYSTEM

Blockchain technology would be used by this system to track and control the supply of ammunition. Ammunition movements would be tracked and recorded automatically using smart contracts. This would make it easier to make sure that ammo is utilised correctly and is always accounted for.

The system would work as follows:

- Smart Contracts with the help of solidity programming is compiled and deployed on the hardhat platform.
- Metamask wallet is used and integrate with Smart Contracts for the connection of wallet for transaction of weapons.
- Hardhat environment connects the etherum network for the blockchain framework to work and have the connection established with local host for the transactions of ammunitions.
- Whenever ammunition is moved, the transaction would be recorded on the blockchain ledger. This would include information about the type and quantity of ammunition, as well as the source and destination of the ammunition.
- Smart contracts could be used to automate certain tasks, such as triggering an automatic resupply order when ammunition levels fall below a certain threshold.

A piece of code designed to run automatically in accordance with the parameters set by network participants. It functions as a virtual agent that validates transactions without requiring assistance from outside parties. Four smart contracts, each centred on a distinct purpose, make up our suggested methodology. While the inventory level contract details the amount of inventory remaining for each provider as well as the product descriptions given by suppliers, the registration contract focuses on registering all network users. Order handling and management are covered under the order management contract, and vendors are ranked according to the quality of their products, the effectiveness of their distribution, and their integrity.[6]

Certain nodes in a distributed system may purposefully (devil nodes) or inadvertently (damaged nodes) turn unreliable. Even when there are faulty nodes in the network, the consensus technique is employed to guarantee data consistency in distributed systems. In this subsection, two popular consensus algorithms are presented. The primary consensus algorithm used on the public blockchain is called Proof of Work. Additionally, the suggested plan will make use of consensus techniques. In Ethereum and Bitcoin, the consensus technique used is called Proof of Stake (PoS).[7]

Numerous advantages would come with this technique. First off, it would make ammo tracking more transparent and accurate. Secondly, it would aid in the prevention of theft and fraud. Thirdly, it would simplify the management of ammunition inventory.

System Architecture

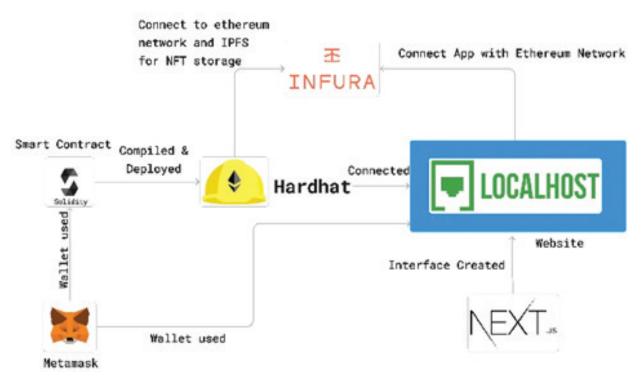

Fig 1. System Architecture

PROPOSED METHODOLOGY

Blockchain can be thought of as a digital ledger that records transactions, much like a spreadsheet or record book. Nevertheless, this ledger is dispersed among a network of computers as opposed to being kept in a single, central location.

Web3, or the decentralised internet is based on decentralised software (dapps) and cryptocurrencies.

But in order to use them, a user interface is necessary.[8] An beautiful, comprehensible, and simple interface is desirable.

MetaMask, a popular cryptocurrency wallet, is one of the key entrance points into Web3, decentralized finance (DeFi), and NFTs, and it does so through browser integration and excellent design.

Infura is an Infrastructure-as-a-Service (IaaS) and Web3 backend provider that offers blockchain developers a range of tools and services. The suite of Infura APIs is part of this. The Infura Web3 service relies heavily on the flagship Infura Ethereum API.

A decentralised blockchain platform is called Ethereum. It makes smart contract creation and deployment possible for developers. Ether (ETH), the native coin of Ethereum, is used to support transactions and provide a proof of stake (PoS) consensus mechanism to encourage network security.[9]

Ethereum is an excellent alternative for your next blockchain project since it provides a flexible and strong framework for developing decentralized applications. Its smart contract functionality allows you to easily develop and execute complicated transactions, as well as automate corporate operations.[10] Furthermore, Ethereum's decentralized infrastructure protects the security and transparency of your data, and its huge and active community offers access to a plethora of tools and knowledge. Using Ethereum for your next blockchain project will help you achieve increased productivity, security, and scalability for your organization.

A digital contract that is signed, saved on a blockchain network, and that goes into automated execution when its terms and conditions are fulfilled is known as a smart contract. Solidity and other blockchain-specific programming languages are used to write the terms and condition.

On the Ethereum blockchain, Hardhat is a development environment that aids developers in the testing, building, deploying, and debugging of dApps. It plays a vital role in helping developers and programmers organize tasks, which is necessary for the creation of dApps and smart contracts. The Hardhat smart contract development environment provides developers with appropriate tools to oversee the development process. Similar to how platforms use an EVM implementation, the network likewise depends on it.[11]

Imported Libraries

```
"dependencies:
   "ethers": "^5.7.2",
   "next": "14.0.4",
   "react": "18.2.0",
   "react-dom": "18.2.0",
   "react-icons": "^4.12.0",
   "web3modal": "^1.9.12"

 "devDependencies":
   "@nomicfoundation/hardhat-toolbox": "^2.0.0",
   "autoprefixer": "^10.4.16",
   "hardhat": "^2.13.0",
   "postcss": "^8.4.32",
   "tailwindcss": "^3.4.0"
```

Fig. 2. Libraries

There are 5 module in our project:

Create Shipment

features that add ammo quantity, delivery location, and other relevant information. Provide input sections where users may enter facts about ammunition, including kind, quantity, delivery date, and destination address. The construction of a new shipment is managed using smart contracts. The frontend application will call and the blockchain will execute these functions. To make transaction signature and blockchain interaction easier, use wallet providers like MetaMask.[12] This guarantees that authorized users may effectively and safely input details like the type of ammunition, how much of it is, and where it will be delivered.

Start Shipment

The "start shipment" function initiates and records a new shipment of ammunition within the system. Authorized users, such as logistics managers or administrators, start the shipment procedure in the system. This includes inputting information about the type and quantity of ammunition, the destination, the recipient, and any other pertinent information. When a smart contract is initiated, it is formed or activated within the blockchain network. This smart contract has specified rules and conditions for the shipping process. The execution of the smart contract adds information about the new shipment to the blockchain.

Connect Wallet

The project aims to allow users to engage smoothly with their MetaMask wallets for tasks including as signing transactions, seeing account balances, and communicating with blockchain-based services. Request access to the user's account. This prompts the user to connect their MetaMask wallet to the program. Retrieve information about the connected MetaMask accounts, such as the current account address. Use the recovered account information to communicate with blockchain-based smart contracts. By integrating MetaMask with the project's wallet module, users may securely engage with blockchain functionality while using their MetaMask wallets, resulting in a familiar and trusted user experience.

Complete Shipment

A shipment's completion entails completing the delivery procedure and updating pertinent blockchain records. The recipient or other authorized staff confirms the delivery once the package arrives at its destination. A digital signature serves as this validation. The shipment's smart contract is activated to carry out predetermined tasks upon delivery confirmation. These actions consist of changing the shipment's status to "completed," noting the delivery time and place, and starting additional procedures like payment and inventory changes. Ammunition was moved from one inventory location to another as part of the shipment; the system changes the inventory records appropriately. This guarantees precise monitoring of ammunition availability and stock levels.[13] Notifications that the shipment has been successfully completed are sent to all parties involved in the process, such as the sender, recipient, and appropriate authorities. These notifications guarantee that all stakeholders are aware of the shipment's status and promote transparency.

Get Shipment

The "GET SHIPMENT" module obtains details regarding a particular cargo and its present state a feature of smart contracts that lets users get shipment details by using parameters or the shipment's unique ID. Users can get shipment information by providing pertinent data, like the shipment ID or destination address, through a querying mechanism included in the smart contract. enabling user identification and smart contract interaction with the usage of MetaMask the frontend elements that enable users to start requests to get shipment details. the error handling procedures to deal with situations in which the shipping information sought is unavailable or cannot be retrieved because of incorrect parameters or other problems. The "GET SHIPMENT" module integrates with the other project modules with ease. Allow other features of the system to call the "GET SHIPMENT" module whenever necessary in order to obtain shipment data for processing.

RESULT AND ANALYSIS

The enhanced accountability and traceability made possible by blockchain technology is one of our study's major findings. The ammunition movement monitoring system (AMS) guarantees transparent and auditable ammunition movements from purchase to usage and maintenance by keeping track of ammunition-related transactions on a decentralised, immutable ledger. [14] Better decision-making is made possible by this improved transparency, which also serves as a deterrent to dishonest practices like theft and unapproved distribution.

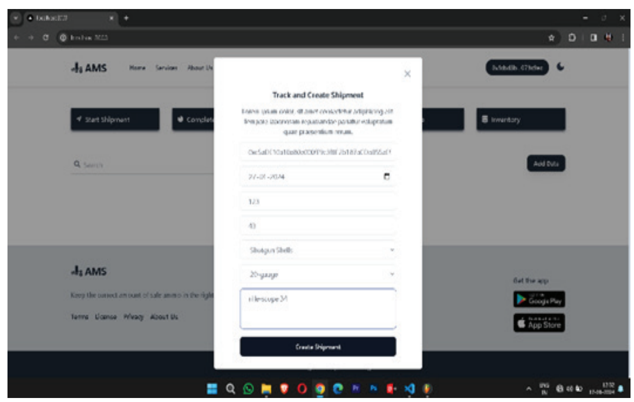

Fig 3. Add Data Section to Proceed Shipment Process

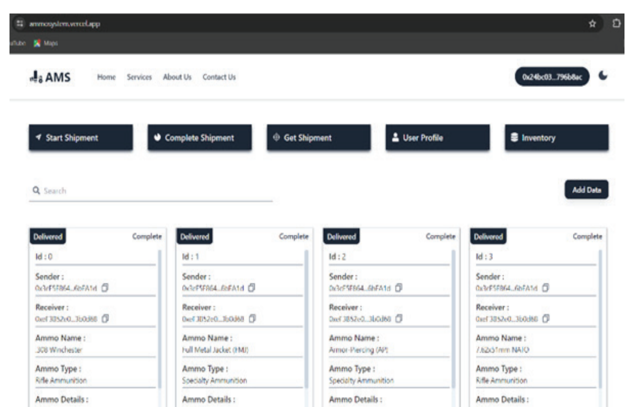

Fig 4. Different Modules for the AMS

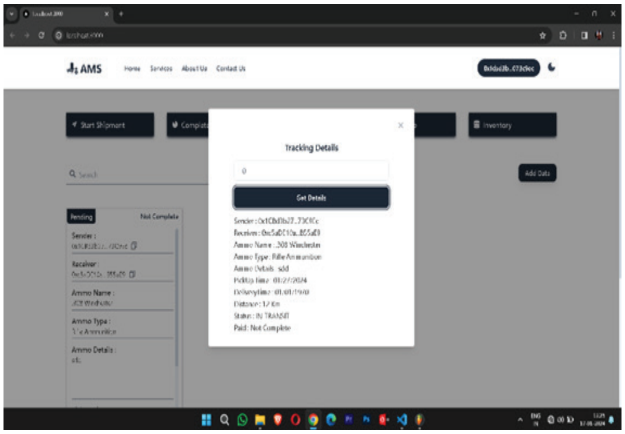

Fig 5. Tracking Details of the Shipment

Home Page

The picture displays the front page of a blockchain-based ammo management system. Envision a safe electronic ledger that records each bullet. This web-based system communicates via a cryptocurrency wallet such as MetaMask. You can start shipments and request or deliver ammo right from the homepage. Additionally, a feature that tracks ongoing shipments and displays their location and status is available. In a similar manner, you can accept shipments and update the system upon delivery. To provide for secure access, users can create profiles.[15] The "Inventory" section is the most fascinating aspect. This implies that the system keeps track of the precise amount of ammo that is available, possibly at various locations. Utilizing the potential of blockchain technology, ammunition may be managed in a transparent and safe manner.

Create Page

This webpage's main objective is to create a fresh shipment. Blockchain technology is a safe way to maintain records, similar to a safe digital ledger that records data. It would be used to monitor the movement and stock of ammo in this scenario. You can enter information about the cargo you're generating on the webpage. There are fields to indicate the kind of ammunition (shotgun shells, for example), the caliber (20-gauge, for example), and the amount (123, for example). The homepage has other buttons that probably let you access other parts of the bigger ammunition management system.

Tracking Details

The ammo management system's tracking component offers thorough information regarding every shipment's path from sender to recipient. Sender and recipient IDs, pick-up and delivery timings, distance travelled, status updates, and payment statuses are all recorded. With the help of this tool, stakeholders may keep an eye on the logistics process in real time, guaranteeing accountability and transparency at every turn. Users may check compliance with rules, follow the flow of munitions, and confirm delivery deadlines by gaining access to this information. Furthermore, the tracking function improves operational effectiveness by spotting possible hold-ups or problems and facilitating prompt fixes.[16] All things considered, it is an indispensable instrument for overseeing and streamlining the logistics of munitions transportation, encouraging safety, dependability, and conformity to regulations all throughout the supply chain.

Algorithm: Ammunition Management System (AMS)

Data Structures

- Define shipment status enumeration: PENDING, IN_TRANSIT, DELIVERED
- sender: address of the sender
- receiver: address of the receiver
- pickupTime: timestamp of when the shipment is picked
- deliveryTime: timestamp of when the shipment is delivered
- distance: distance of the shipment
- price: price of the shipment
- weaponName: name of the weapon being shipped
- weaponType: type of the weapon being shipped
- weaponDetails: details of the weapon being shipped
- status: current status of the shipment (PENDING, IN_TRANSIT, DELIVERED)
- mapping(address => Shipment[]) public shipments to store shipments by sender address

Events

- event ShipmentCreated (package indexed sender, recipient, pickup time, distance, and price in UINT256)
- , string weaponName, string weaponType, string weaponDetails) to indicate a new shipment creation
- event ShipmentInTransit(uint256 pickupTime, address indexed sender, address indexed receiver) to indicate a shipment is in transit
- event ShipmentDelivered(uint256 deliveryTime, address indexed sender, address indexed receiver) to indicate a shipment is delivered
- event ShipmentPaid(uint256 amount, address indexed sender, address indexed receiver) to indicate a shipment is paid for

Functions

Function createShipment:

- address _receiver: address of the receiver
- uint _pickupTime: timestamp of when the shipment is picked up
- uint _distance: distance of the shipment
- uint _price: price of the shipment
- string memory _weaponName: name of the weapon being shipped
- string memory _weaponType: type of the weapon being shipped
- string memory _weaponDetails: details of the weapon being shipped
- Create a new Shipment object with the provided details and status PENDING
- Add the new shipment to the shipments mapping for the sender
- Increment shipmentCount
- Emit a ShipmentCreated event

Function start Shipment

- address _sender: the sender's address
- address _receiver: the receiver's address
- uint256 _index: index of the shipment
- Modifiers: None
- Retrieve the shipment at index _index for sender _sender
- Ensure the receiver matches _receiver and the shipment status is PENDING
- Update the shipment status to IN_TRANSIT
- Emit a ShipmentInTransit event

Function completeShipment

- Parameters
- address _sender: the sender's address
- address _receiver: the receiver's address
- Actions:
- Retrieve the shipment at index _index for sender _sender
- Ensure the receiver matches _receiver, the shipment status is IN_TRANSIT, and the shipment is not already paid
- Update the shipment status to DELIVERED, set delivery Time to current timestamp, and mark the shipment as paid
- Transfer the payment to the sender
- Emit a ShipmentDelivered event and a ShipmentPaid event.

Overall, the analysis and findings of our research highlight how Blockchain Enabled Smart Contract Based Ammunition Management Systems (AMS) have the potential to revolutionise ammunition management procedures by providing increased security, efficiency, and transparency. To overcome implementation obstacles and guarantee the successful use of this technology in actual operational settings, more study and cooperation are nonetheless required.

CONCLUSION

This paper addressed the importance of military weapons management in more conventional and secure way with the use of blockchain technology and it's frameworks. This management system provides accountability between parties primarily through transparency and immutability. Through the use of blockchain technology we had found the best possible solution to reduce the chances of unauthorized access or data leak by providing high end security in management and transportation of weapons and ammunitions from one location to other. The integration of blockchain technology and smart contracts holds immense potential for revolutionizing the management system of various sectors in military. Through our research, we have explored the technical foundations, practical applications, and potential benefits of blockchain-enabled smart contract-based ammunition management system. Our proposed system gives more than 90 % accuracy.

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Cloud-Ed: E-Learning Platform Using Smart Classroom Systems

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ABSTRACT

In recent years especially after COVID-19, importance of E-Learning and Cloud Computing is seen as important for every individual and country's non-stuck growth. New generation students use technology daily. In this digital era, students are surrounded by technologies and consuming media rich content daily. By using such, better learning tools should be provided for learning, to support self-paced, independent, and personalized learning. The explosion of information technology can fulfill those demands. Also, the adoption of cloud services for education will enable institutions to improve quality learning with less infrastructure. Basic objective is to develop and apply E-Learning services. Need to integrate various technologies to accomplish this objective, and this can be efficiently done by following agile methodology and feature driven development. Analyzing the need for cloud computing and going into further detail on the significance of the aspects of e-learning design. As a result, assess the importance of adopting a cloud-based application framework for e-learning platforms, and have extensively investigated the following areas: software engineering methods, architectural design, development resources, and the external interface of the application framework. The implements and discusses the value of utilizing a cloud environment for any institution-based E-learning platform, emphasizing the potential advantages and features it offers in terms of design for professors and students.

KEYWORDS: *E-Learning, Cloud computing, Smart classroom, Dedicated dashboards, Agile development.*

INTRODUCTION

The COVID-19 pandemic underscored the importance of e-learning during periods of lockdown, leading to the emergence of numerous online platforms aimed at aiding students and institutions in accessing and managing educational resources, including virtual classrooms. Simultaneously, cloud computing has made significant strides, becoming the standard for such applications. This advancement has revolutionized traditional e-learning by offering programs that facilitate academic activities within a cloud-based framework [3]. Cloud computing provides robust software support, ample computing resources that can be accessed from any location at any time, catering to the requirements of educational institutions. This transition to cloud computing enhances e-learning performance, particularly for higher education institutions such as colleges and universities [10]. Referred to as a cloud campus, this innovative approach minimizes the necessity for physical infrastructure while providing greater flexibility in technology utilization and a substantial increase in potential to transform education. This paradigm shift promotes innovation and collaboration within learning environments [1].

The usage of e-learning applications has significantly increased considering the recent pandemic, making it a recent change in the education sector. Most e-learning platforms are inexpensive or free, simple to use, and don't present any problems for numerous corporations, educational institutions, and universities have expressed interest in using e-learning applications for their training sessions or to encourage their students to enroll in the platform's numerous courses [12]. Easy to understand information and extra resources included in the program are key components of a successful e-learning application. The real-time usage of e-learning application can be used by colleges so their students can learn virtually smarter [3]. Many schools and universities are using e- learning more and more. Since setting up online learning systems can be expensive, some are turning to cloud computing as a cheaper option. E-learning is like having a super convenient school right at your fingertips, thanks to the internet! It means you can learn stuff from your computer or phone, whenever you want and wherever you are. Whether you're a kid in school or an adult. Cloud computing is like renting space on the internet to store and use programs [9]. It's becoming popular in education because it's affordable and convenient. Lots of educational institutions are now using cloud-based e-learning tools alongside their regular learning systems. This research looks at how well these cloud tools work for e-learning and the advantages they bring to education. The goal is to find the best educational solutions using cloud technology to make learning better for everyone [4].

This study is motivated by the notable influence of emerging technologies on education, especially the transition from traditional offline learning to online platforms [2]. This shift is due to rapid technological advancements, which have fostered the development of innovative learning environments [13]. With the increasing significance of e- learning, there is a natural interest in exploring its integration with another groundbreaking technology: cloud computing. Cloud-based e-learning platforms offer flexibility and customization options, empowering educators to create and deliver content in diverse formats (e.g. text, audio, video) and tailor teaching approaches to accommodate various learning styles. Learners can personalize their learning journeys and access resources at their own pace. The objective is to comprehend the mutual benefits of integrating e-learning and cloud computing [15]. By using these two domains, and detailing the development, significance of e-learning and implementing all the required functionalities, virtual classroom the aim is to enhance quality, accessibility, and efficiency of educational experiences.

LITERATURE SURVEY

The paper titled "Cloud-Based Learning Web Applications on Amazon Web Services" illustrates the extensive utilization of e-learning platforms across various user demographics, emphasizing their cost-effectiveness and user-friendly nature, particularly during transmission. It presents a direct model for virtual learning environments, emphasizing the significance of clear content and supplemental resources for successful e-learning implementations [1].

In "Cloud Based E-Learning," the evolution of cloud computing in contemporary education is explored, showcasing its potential and efficacy. The study advocates for the adoption of cloud-based learning management systems in universities to foster collaborative learning, thereby enhancing educational content and performance. Furthermore, it introduces the utilization of cloud computing technology to facilitate remote access to education and promote student-driven learning. The importance of enhancing the capacity and efficiency of cloud-based e- learning platforms to cater to diverse users and improve educational accessibility is also underscored [2].

"Smart Classroom Service System Design Based on Service Computing System" underscores the criticality of smart classroom design to accommodate changes and advancements. It suggests that integrating information technology into smart classroom design can facilitate adaptation to evolving technological landscapes and support ongoing enhancement and innovation. The report emphasizes the necessity for comprehensive support for smart classroom development to facilitate the integration of various technologies and operations, advocating for continuous research and development to optimize smart classrooms' efficacy in enhancing learning outcomes. Ultimately, the study portrays the potential of service-oriented smart classrooms to supplant traditional teaching methods, creating a dynamic learning tailored to students' needs [3].

"E-learning integrated with cloud computing: A comprehensive examination of trends, obstacles, and prospects" offers an extensive exploration of merging e-learning with cloud computing, stressing the necessity for concentrated research on usability, architecture, performance, and security. Furthermore, it emphasizes the significance of conducting usability tests and refining platform development to enrich user experience and educational achievements, alongside tackling concerns such as data security and privacy within cloud-based e-learning setups, to fully leverage cloud computing's capabilities in educational contexts [5].

In the paper titled "Enhancing e-learning through Cloud Computing: Leveraging the Potential of Cloud-based Platforms," the advantages of employing cloud-based e- learning systems are explored, showcasing their advantages in accessibility, cost-efficiency, and performance compared to conventional systems. The paper proposes the assessment of current tools and the formulation of future e-learning environment frameworks to continue enhancing e-learning experiences [9].

"E-Learning Based on Cloud Computing "It is deeply rooted on the view that, adoption of cloud-based solutions can transform education outcomes and increase access to learning resources. The paper suggests how educational institutions, policy makers, and technology providers should implement and make good use of cloud-based e-learning platforms. The guidelines involve building a strong infrastructure, adopting security best practices, as well as encouraging collaboration among stakeholders [10].

In their paper "Analysis of collaborative and convenient e- learning on cloud computing "Their analysis has emphasized the benefits of using cloud-based solutions to improve collaboration, accessibility, and scalability in e-learning environments. The paper also underscores certain obstacles like security threats and data protection concerns that necessitate a robust infrastructure or effective data management approaches. Furthermore, it delves into implementation tactics and recommended procedures for getting the most out of cloud computing with respect to e- learning [6].

"Research paper on E-Learning Application Design Features using Cloud Computing & Software Engineering Approach" The analysis highlights the impact of cloud technology in improving accessibility, scalability, and collaboration in e- learning platforms. It emphasizes the significance of integrating software engineering principles for the effective development and upkeep of cloud-based e-learning systems. Furthermore, it delves into current studies on optimal strategies and approaches for creating successful e-learning applications using cloud infrastructure [4].

"Agile Software Development: Methodologies and Trends" In this paper, we observed the world of Agile Software Development methodologies and trends. We analyze the evolution of Agile methodologies, such as Scrum, Kanban, and Extreme Programming (XP), focusing on their principles and practices. Survey looks into the current trends of Agile adoption in different industries, addressing challenges and best practices related to Agile implementation. Furthermore, we explore new techniques and tools in Agile software development, offering insights into the future of Agile practices [7].

"Design and Implementation of a Web-based Project Management Information System" They look into different methods, tools, and successful strategies for building efficient PMIS solutions. The study emphasizes the significance of user-focused design principles and usability testing when creating PMIS. It also examines how web technologies can aid in promoting teamwork, communication, and project tracking in educational settings. Furthermore, the paper reviews case studies and real-world research to offer perspectives on the benefits and obstacles of implementing web-based. Incorporating educational goals and encouraging student involvement in project-based learning activities, the research highlights the importance of using technology to enhance project management in educational environments.[11].

METHODOLOGY

It focuses on application development following the agile model, feature driven application development which makes better project visibility and ensures robust software quality throughout the development lifecycle. Moreover, these methods help in building the application continuously, ensuring it meets requirements effectively.

Several conventional software development techniques are available, including the waterfall technique, incremental and iterative approach, spiral approach, evolutionary approach, etc. These methods are often labeled as heavyweight or planned software development methods. They prove highly beneficial for crafting large, intricate software systems as they aid in minimizing ad-hoc development and ensuring the systematic creation of high-quality software that aligns with user requirements within predefined timelines [7]. However, traditional software development approaches entail an intensive process, including:

- Establish a comprehensive project plan beforehand.
- Specifying the software requirements.
- Developing a complete design adheres to the specified requirements.
- Writing software code that meets all defined specifications and guidelines.
- Rigorously testing the software to verify compliance with specifications and design.

Despite the advantages, many projects employing traditional software development methods encounter significant challenges, particularly concerning maintenance and accommodating changes prompted by the user requests. One of the primary issues stems from the potential for substantial modifications triggered by such requests. Consequently, there is a growing need for lightweight software development techniques aimed at expediting the development process and adeptly managing requested changes. Agile software development methods optimize this low-tech approach to software development and lightweight alternatives to address these challenges.

Challenges in Smart Classroom design

While the current research focusing on smart classroom for E-learning activities, have several challenges to propose smart classroom design that can accommodate E-learning [8], the following is the problem formulation of this research:

1) User Interface Design.
2) Real-Time Communication.
3) Content creation and Management.
4) How can a smart classroom service system be assembled by services in the E-learning and smart teaching environments?
5) How is the design of the smart classroom service system evaluated?
6) Strictly follow agile methodology and feature driven development.

Following stages required for pre-application development:

A) Plan- Stating objectives and requirement collection.

B) Design-Modelling and Architecture development.

Objectives and Requirements

Plan: In this stage, the team figures out what needs to be done. Discuss the project goals, objectives and decide1 which tasks are the most important to complete first. It's like making a roadmap for the project.

Objectives:

1) To study and design a user-friendly platform for learners and educators.
2) To design and implement automated online assessment tools for offering feedback.
3) To implement online education module on cloud infrastructure.
4) To give control to individual user to track their progress.

Design and Modelling

Here, the team decides how they're going to do each task. They might sketch out ideas or make plans for how the software or product will look and function. It's like drawing up blueprints for a building.

Architecture

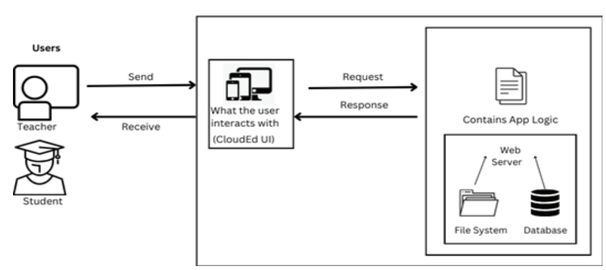

Fig. 1: Architecture of Cloud-Ed

- Users: These represent the application users, in this case a teacher and a student.
- Send Request: This signifies the user's action of initiating interaction with the application.
- Cloud-Ed UI: This likely represents the user interface (UI) of the web application, elements that the user directly interacts with.
- Response: This indicates the application's response to the user's request.
- App Logic: This represents the backend logic of the application that processes user requests and interacts with the data layer.
- Web Server: This refers to the server that hosts the web application and facilitates communication between the user and the application logic.
- File System: This signifies the storage system that holds application files, potentially including user-generated content or system configuration.
- Database: This represents the database that stores the application's data, such as user information or application content.
- Response Handling: Once the back-end processes the request, it sends a response back to the front-end code. The front-end it turn, renders the response and displays it to the user.

IMPLEMENTATION

Implementation in application development refers to the process of translating design specification into functioning software. It involves writing code, configuring databases, integrating APIs, and deploying the application to its environment. Implementation is where the theoretical concepts meet practical execution, requiring meticulous attention to details and adherence to coding standards. Through iterative development cycles, refine and enhance the application, addressing bugs and adding new features until it meets the desired requirements. Implementation involves following stages:

Develop

This is where the actual work happens. The team starts building the software or product according to the plans made. They write code, create designs, and put everything together. It's like constructing a building based on the blueprints. To develop the application:

Technology Stack

- PHP (Hypertext Preprocessor): It is the language used in generating dynamic contents and interacting with the database at the back-end as a server-side scripting language.
- MySQL: It is the relational database management system (RDBMS) used for storing and managing structured data connected with user accounts, courses, content, and interactions.
- HTML (Hypertext Markup Language): This is used to structure the content of web pages, which may include text, pictures, forms, and multimedia.
- CSS (Cascading Style Sheets): These are used to style and format the visual presentation of web pages, and create a consistent and aesthetic look across the platform.
- JavaScript: Implemented for client-side scripting to enhance interactivity and responsiveness, facilitating features such as real-time communication, multimedia playback, and dynamic content updates.
- jQuery : jQuery is an open-source, free software used for simplifying event handling, DOM manipulation and AJAX interactions that enable developers to create high-performance websites by making front- end development more efficient.
- Bootstrap: Utilized as a front-end framework for developing responsive, mobile-first web interfaces, leveraging pre-designed components, layouts, and utilities to streamline UI development.

Implemented Modules in CloudEd:

1) Admin Panel:

- Add Course:
- Add Teacher:

2) Teacher Panel:

- Create or Delete Classrooms
- Approve or reject students.
- Add students to the classroom.
- Upload, view, remark assignment.

- Upload notes or tasks.
- Create meet.
- Class chat.

3) Student Panel:

- Register and login.
- View joined classrooms.
- Upload or view assignment score.
- Class chat.
- Join meet.

Deploy

After creating something, such as software or a product, it's time to make it available for use. In the 'Deploy' stage, the team deploys the finalized version to AWS, enabling access and utilize the product anytime, anywhere.

Team deployed the web application over the AWS by creating ec2 instances. Major steps followed for deployment:

1) Launched an AWS ec2 instance by choosing Ubuntu image that supports PHP, MySQL, and configured security groups to allow SSH (port 22) traffic.
2) Connected to instance via SSH using a tool called PuTTY and created a key-pair of. ppk extension.
3) Installed XAMPP on ec2 Linux virtual machine and granted all required permissions.
4) Uploaded PHP web app using git by cloning a repository from git which was version controlled.
5) Configured Apache phpMyAdmin panel and imported prj_clouded_db.sql database file in virtual XAMPP's MySQL.
6) Tested WebApp.

RESULT AND DISCUSSION

The paper focuses on the response to the evolving landscape of education technology and the challenges posed by the fragmented nature of online learning tools. Revolutionize the educational experience with the development of a Smart Classroom System. The primary objective is to provide a comprehensive, user-friendly platform that centralizes resources, smooth collaboration, and enhances communication between students and teachers.

Features and Modules: The Smart Classroom System encompasses a range of features and modules designed to address the multifaceted needs of both students and teachers. The project's modules include a Homepage for centralized access, Registration and Login modules for user authentication, and dedicated dashboards for both students and teachers. Notable features include real-time communication tools and a user-friendly interface to enhance the overall educational experience. Smart classroom project is like a supercharged tool for students and teachers. Noticing that using lots of different apps for learning can get confusing and overwhelming. So, creating one central hub where everything happens - classes, discussions, assignments, and more. It's like having a virtual classroom that's super easy to use. After successful completion of project is to make learning easier and more fun. Teachers can organize their classes and share stuff with students effortlessly. Students can join in, talk to each other, and learn at their own pace with some cool personalized features. Making sure it's safe and secure too, so everyone can focus on learning without any worries.

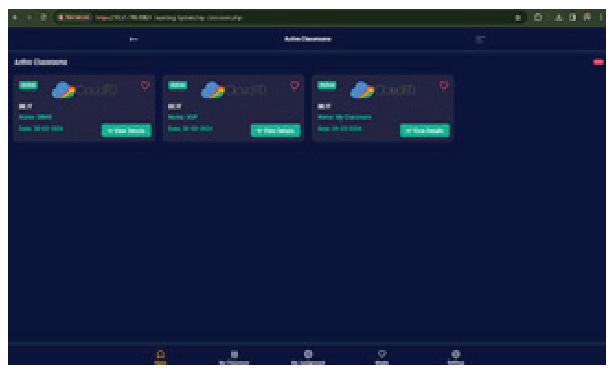

Fig. 2: Student Panel

Fig. 3: Admin Panel

CONCLUSION AND FUTURE SCOPE

The smart classroom system is a revolutionary advancement in the field of educational technology. The paper intended to reimagine the educational experience for both teachers and students. For teachers and students, a like, smart classroom project is an enhanced tool. Instructors can easily plan their lessons and distribute materials to their students. With some awesome personalized features, students can participate, communicate with one another, and learn on their own. For everyone to concentrate on learning without interruption, also ensure that it is safe and secure. It is like bringing the best elements of a traditional classroom into the digital age, simplifying the learning process for all. It is found that learning with a variety of apps can become overwhelming and confusing. Thus, setting up a single, central location for all the activities, including classes, discussions, homework and more. It is like having an extremely user-friendly virtual classroom.

Nowadays AI has entered every domain, similarly AI can be efficiently used in E-Learning. AI based assessments and gamifications features can be developed. Gamification elements, such as badges, leaderboards, points, and rewards, will be used to enhance learner engagement and motivation. Advanced analytics and data-driven insights will enable educators to track learner progress, identify learning trends, and assess the effectiveness of teaching strategies. E-learning platforms will use learning experiences that match each student's strengths, weaknesses, learning pace, and preferences. Adaptive learning technologies will change lapse content and difficulty in real-time using individual learner progress and performance data. Thus, leveraging more and more AI advanced technologies in E-Learning will help in the development of this field.

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Comparative Study of Various Algorithm for Encrypted Negative Password

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ABSTRACT

Cyber Security is an essential field when it is used in password security. passwords that stored in simple databases are prone to hack hence in the field of Cyber Security encryption is used to encoding the passwords that prevents intrusion of password database encryption scrambles the data so that only authorized person or organizations can unscramble it. Many researchers proposed a system that involves fetching the passwords from the system then hashing the password by various hashing algorithms like SHA-1, SHA-2, SHA- 256, SHA-512.Then this hashed password is transformed into Negative database. Then this Negative password is converted into the Encrypted negative password using various symmetric and asymmetric cryptographic algorithms. Authentication involves the same process as registration phase. This multilayer protection model is not easy to crack by any unauthorized person. This system can add on various existing websites easily. The paper includes comparison between various symmetric cryptographic algorithms like AES, DES, 3-DES, Twofish, Blowfish and various Asymmetric cryptographic algorithms like IDEA, RSA, DSA, etc. More robust encryption algorithm gives strong security to system. So, this paper contains comparative study of the various cryptographic algorithms done by various factors. Analysis is done on different parameters to find precise algorithm for system that gives highest security to passwords.

KEYWORDS: *ENP, SHA, RSA, AES, DES.*

INTRODUCTION

In the ever-evolving landscape of cybersecurity, password security remains a critical concern. Traditional methods of storing passwords in plain text databases leave them vulnerable to unauthorized access and data breaches. Where multiple systems are available for the security of the system that contains passwords, captcha, email verification by google, multi factor authentications, etc. but large no of websites are dependent upon one time password protection. We explore a multi-layered security approach where passwords are initially hashed using established algorithms like SHA-256. These hashed values are then transformed into negative representations before employing both symmetric and asymmetric encryption techniques. This dual encryption layer significantly enhances the system's resistance against unauthorized access. The rationale behind this multi-layered approach lies in its inherent complexity. Cracking such a system becomes significantly more challenging for attackers due to the combined strength of hashing and encryption. This research investigates the comparative effectiveness of different cryptographic algorithms in securing the "Negative password" database. The paper meticulously evaluates various algorithms based on crucial factors such as security strength, processing speed, and resource requirements. By conducting this analysis, the study aims to identify the optimal cryptographic algorithm that provides the most robust security for password storage systems while maintaining efficient performance. selecting an appropriate cryptographic algorithm is crucial for maximizing the security and efficiency of a negative password system. This research paper delves into a comparative analysis of prominent cryptographic algorithms, The following sections will explore the strengths and weaknesses of each algorithm, evaluating their suitability for encrypting negative passwords. Performance metrics such as processing speed, key size, and resistance to known attacks will be rigorously analyzed. The research aims to identify the optimal cryptographic algorithm that provides a balance between security and efficiency for a negative password- based user authentication system. Our research contributes to the ongoing pursuit of robust password security by providing a comparative analysis of leading cryptographic algorithms. By analyzing these algorithms through a multi-faceted lens, we aim to equip developers and security professionals with insights to implement the most effective encryption methods for securing user passwords.

Motivation

Recent incidents by hackers, through the brute force or lookup table attacks contains large organization and millions of personal accounts highlights the vulnerability of traditional password base security.

Users are not happy to use complex passwords, but weak passwords are easy to crack by hackers through the brute force or lookup table attacks.

This research is motivated by the potential of negative password systems by continuously analyzing and comparing prominent cryptographic algorithms. Research aims to provide valuable findings for developers and cybersecurity professionals.

The research will contribute to the development of strong negative password systems leading to a more secure digital era for users.

LITERATURE SURVEY

This paper make use of the rivest Shamir and adelman algorithm to overcome from the previous deficiency introduced in the two phases registration phase and authentication phase and it also involve the use of the sha256 algorithm for the hashing purpose and it ensure that the integrity of the user's creditional survives even though hackers get access to database[1]

In comparison of various algorithm for the purpose of negative password we examine multiple algorithm on the basis of various parameters like a performance measure security level computational efficiency In this paper involve the use of rsa algorithm for the negative password it compare the Rsa algorithm with the traditional method of the salting and key stretching which involved the dictionary attack and tell us how rsa algorithm will perform better than all of these techniques in enp[2]

This paper emphasize on the advantages of the asymmetric cryptography in increasing security by removing the necessity to the Revel private keys reducing risk to compromise it also stress on the importance of dynamics salt generation in improving the credential security as well as demonstrated in the proposal system[3]

This research states that the twofish demonstrated superior performance compared to aes and blowfish algorithm in the term of encryption time ,decryption time and the throughput it states how to twofish is better to implement alongside the hmac in securiting the various networking protocol allowing to its efficient encryption and decryption process[4]

This paper comprehensively compare the performance and security aspect of the elliptical curve cryptography algorithm and the rivest Sameer adelman algorithm in the context of the internet of things devices it investigate the several matric such as the memory requirement energy consumption ,key size, signature generation and the provides the valuable insights for the future research[5]

This Paper emphasize on the improving the secure data communication provides a detailed cryptography techniques it introduces Nobel cryptography algorithm and discuss the modern cryptography approaches it evaluate the cryptography algorithm based on the criteria like a level of protection and the complexity[6]

This paper introduced a combined technique of linear authentication and encryption to improve integrity for cloud data managed using Hadoop. It examines the existing vulnerabilities in cloud data storage systems and suggests a more sophisticated method for ensuring data integrity, stability, optimality, and effectiveness [7]

COMPARATIVE STUDY OF VARIOUS ALGORITHMS

Conversion of plain text data into ciphertext called as Encryption and conversion of cipher text data into again plain text is called Decryption. These two methods can be performed by various Algorithms. There are two types of cryptographical algorithms:

1. Symmetrical Cryptographic Algorithm
2. Asymmetrical Cryptographic Algorithm

Symmetric Algorithms

A cryptographic algorithm where the same keys are used for both encryption and decryption processes called Symmetrical Cryptographic Algorithms. It is also known as "shared-key" or "private-key" or "secret key" algorithms. The sender and receiver share a secret key. This key is used to encrypt plaintext into ciphertext and decrypt ciphertext back into plaintext. Since the same key is used for both operations, it's crucial that the key remains secret to ensure the security of the communication. Key exchange protocols or key exchange external algorithms are used to secure transmission of the key like Diffie Hellman algorithm. Symmetric cryptography tends to be computationally efficient compared to asymmetric cryptography because they are suitable for encrypting large volumes of data, we can pass the large amount of input for bulk key generation for bulk data transfers or streaming media. In this algorithms encryption and decryption processes done faster than asymmetric algorithms and also creates the strong cipher text. Key-size is the length of the keys measured in bits used while performing encryption and decryption, it decides the strength and the security level of the algorithms. Longer key sizes typically provide higher levels of security against brute-force attacks, where an attacker tries all possible keys to decrypt the ciphertext. Range of key-size of the symmetric algorithm lies between 128 bits to 256 bits. As it has very small key size so that these algorithms are not achieved higher level of security which achieved by asymmetric cryptographic algorithms.

Symmetric algorithms are often suitable for closed systems, but it depends on the specific requirements and constraints of the system. Closed systems typically refers to environments where limited number of entities are involved for the process of password encryption. The organisational system can be the example of closed system. It have following advantages:

1. Simplicity: Symmetric algorithms are relatively straightforward to implement and require less computational overhead compared to asymmetric algorithms. In a closed system where simplicity is valued, symmetric cryptography can be an attractive choice.

2. Efficiency: Symmetric algorithms are generally more efficient in terms of computational resources and processing speed. Resource utilization is very low. In a closed system where resources may be limited or where real-time processing is required.

3. Key Distribution: Key distribution is very simpler in limited entities and the key can be securely shared among authorized parties within the closed environment.

   Unauthorized access to the key could tamper or compromise the security of the system.

4. Security: While asymmetric algorithms offer higher levels of security due to the use of separate keys for encryption and decryption, symmetric algorithms can still provide adequate security for closed systems, especially if the key is kept secret and securely managed.

   Symmetric algorithms comes with the higher risk of key tampering, If the symmetric key is compromised or tamper by any unauthorised entity then all encrypted communications could be at risk. Proper measures must be in place to protect the confidentiality of the key. These algorithms sometimes fails to provide the main aspects of security that are confidentiality, integrity and authenticity.

Following table shows the comparison between various symmetric algorithms like DES, 3DES, AES, Twofish, Blowfish ,IDEA etc on the basis of different parameters like key-size, rounds for encryption ,block size , security, processing time required for encryption and decryption, throughput, confidentiality, usability and performance.

Table 1: Comparison Of Symmetric Algorithms

Symmetric algorithms	AES(Advanced Encryption Standard)	DES(data Encryption standard)	3-DES	Twofish	Blowfish	IDEA
Key-size	128,192, 256bits	56 bits	168 ,112 bits	128,192,256 bits	32-448 bits	128 bits
Round of encryption	128-10 round 192-12 round 256-14 round	16 rounds	48 rounds	16 rounds	16 rounds	8 round
Block cipher size	128 bits	64 bits	64 bits	128 bits	64bits	16 bits(4 chunks of 4 bits)
Security	Strong	Low secure	Modrate	Highly secured	Less than AES	Sufficient secure(highly secure)
Encryption and decryption processing time	Fast	Slow	Very slow	Less time required	Moderate	Low
Throughput	Low	Low	Low	High	Moderate	Low
Confidentiality	High	Low	Low	High	Low	High
usability	Highly used	Less used	Moderately used	-	-	Highly used
performance	Less compared to twofish	Moderate compare to 3-DES	Good performance than DES	High compared to blowfish and AES	Less as compared to twofish	Good performance

Asymmetric Cryptographic Algorithms

Asymmetric Cryptographic Algorithms employ a pair of public and private keys for encryption and decryption, respectively.

Asymmetric algorithms provide a higher level of security compared to symmetric ones, as the private key remains secret and never needs to be shared. This eliminates the risk of key distribution attacks and enhances the confidentiality of encrypted negative passwords. This is the greatest advantage of asymmetric algorithm over symmetric. Algorithms also uses larger key-size upto 1048 bits or higher hence provide greater amount of security as well as reach at high level of strength. However, asymmetric algorithms are computationally intensive and may introduce latency because of complex computations and resource utilization also high due to this complex operations. Processes of encryption and decryption are get slower because of these complications. Asymmetric algorithms are commonly used in open systems, particularly in scenarios where secure communication and data exchange between parties are essential. An open system typically refers to a computing environment where multiple entities, such as users, devices, or networks, interact with each other over potentially untrusted channels, such as the internet. Here are some examples of open systems where asymmetric algorithms are frequently used:

1. Digital Signatures : Asymmetric algorithms play a crucial role in verifying the authenticity and integrity of digital documents, transactions, and software in open systems. Digital signatures generated using asymmetric cryptography algorithms ensure that messages or documents are not tampered with and originate from trusted sources.
2. Blockchain and Cryptocurrencies: Open distributed ledger systems like blockchain rely heavily on asymmetric cryptography for secure transactions, digital signatures, and ensuring the integrity and immutability of distributed data records. Cryptocurrencies such as Bitcoin and Ethereum use asymmetric algorithms for wallet encryption, transaction signing, and secure peer-to-peer communication
3. Virtual Private Networks: Asymmetric cryptography is commonly employed in VPN technologies to establish secure tunnels over public networks. VPN protocols like IPsec (Internet Protocol Security) and OpenVPN utilize asymmetric algorithms for key exchange and authentication between VPN endpoints, ensuring confidentiality and integrity of data transmitted over open networks.

Asymmetric algorithms are highly used because they are able to provide the high integrity and authenticity in which symmetric algorithms fails. Comparision between various asymmetric algorithms is representated in table below.

Table 2: Comparison Of Asymmetric Algorithms

Asymmetric algorithms	RSA	DSA	ECC
Key-size	512 bit	2048 bits	224 bits
Round for encryption	1	1	1
Security	Encrypted message stored in database.	Original message directly stored in database which is very risky	Encrypted message stored in database
Block-size	**1024**	64	256
Power consumption	High	High	Low
Performance	fast	modrate	Fastest
Key usage for decryption	Private key	Public key	Private key
Key usage for encryption	Public key	Private key	Public key

RESULT

This study gives us a detailed of the qualified and important outcomes in reference to the various encryption algorithms taken under consideration.

Depending upon the comparison done under various terms spread light on which encryption algorithm to choose and which algorithms came forward as the most likely for securing confidential information. Explaining the logic behind the selection by taking in consideration metrics such as security strength, performance, and practical implementation.

Provides direction on how company or developers can be benefited from the unique optimal encryption algorithms to improve the privacy of data management systems. This could add best customes for information handling, collaboration with previous systems, and major challenges to look during implementation.

It also gives us possible domains for further research or studies in the area of encoded adverse data and cyber safety. This can be include studying developing cipher methods, tackling particular weaknesses, or delving into alternative strategies for passcode security beyond encoding.

Analysis done on various algorithms that results

DES: wildly used back then but attackers learns to defeat it. AES: AES considered prone to all kinds of attacks except brute force kinds of attacks.

Blowfish: known for its huge speed and effectiveness but it's available in free public domain

Twofish: as fast as blowfish but uses symmetric key cryptography hence less secure.

All other algorithms also has major advantages but not as compatible as RSA cryptographic algorithm for negative database system.

CONCLUSION

Both symmetric and asymmetric cryptographic algorithms offer unique advantages and challenges in implementing encrypted negative passwords. Symmetric algorithms provide high performance but require robust key management practices to ensure security. On the other hand, asymmetric algorithms offer stronger security guarantees but may require higher computational overhead. The choice between symmetric and asymmetric cryptography depends on the specific requirements of the application, balancing factors such as performance, security, and key management complexity. By understanding the trade-offs between these approaches, cybersecurity practitioners can make informed decisions in designing secure authentication systems based on encrypted negative passwords.

FUTURE WORK

In the Comparative study of various encryption algorithm we have decided to implement rsa algorithm for securing user's creditional in our environment so in future we can make use of them to Develop a robust key management system to securely generate, store, distribute, and rotate RSA keys. It can also contribute by Continuously optimizing the RSA implementation for better performance, especially for large datasets or high-volume transactions.

We can ensure cross-platform compatibility of our rsa implementation by developing libraries, apis, or wrappers that enable seamless integration with various operating systems, programming languages, and environments.

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Vehicle Insurance Fraud Claim Detection Using Machine Learning

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ABSTRACT

Frauds in the car insurance sector are one of the most underrated challenges in case of insurance agencies that unfortunately leads to the financial losses. It also increases the financial burden on insurance policyholders as the losses are often created through increased insurance policies and premiums. This paper describes a powerful technique of Machine learning and its algorithms to find the insurance fraud in insurance claims made. Machine learning, a domain of artificial intelligence, leverages data and experience to predict unseen data. We use the random forest classifier to automate the claims process for car insurance companies. Our objective is to propose a classification methodology that enhances accuracy compared to other fraud detection techniques. The research shows that Random Forest beat in performance all other algorithms compared. Insurance fraud is the act of someone or something making faulty insurance claims to get benefited from the money or some other assets which leads to the financial losses. The several methods for these include Decision Trees, Naive Bayes. An insurance fraud is alleged to have cost over forty billion of dollars in total. Thus claim fraud detection is one of the most difficult problems of the insurance industries.

KEYWORDS: *Machine learning, Classification, Random forest, Artificial intelligence.*

INTRODUCTION

The agreement between an insurer (an organization that provides insurance services) and an insured (the owner of a vehicle) to pay for any costs incurred in the event of an unintentional harm or theft occurrence. Vehicle insurance fraud is when a policyholder attempts to obtain financial benefits by filing fraudulent claims due to property damage or injuries from fictitious accidents, or by demanding payment for past losses or overbilling[1]. Insurance fraud can be done by anyone in the chain of the whole process, including garage mechanics, drivers, police officers which investigates the case, insurance staff involved in case, and others[2]. Vehicle insurance in case of car fraud can be classified into a number of different categories, from straightforward insurance claim file fraud to more sophisticated forms such as staging fraudulent[3].

There is a chance that auto insurance will contain bogus asserts. Less than 3% of car insurance claims are false, according to reports, whereas 21-36% of claims are prosecuted . Automobile insurance fraud cost the US economy $39 billion in 2016, The analysis made from the FBI a well- known US based agency. The majority of insurance claim fraud cases in Indonesia, The Indonesian General Insurance Association (AAUI) claims that involve automotive insurance car insurance fraud can take many different forms, such as fictitious theft reports, overstated claims, staged accidents, and car dumping (leaving a vehicle to be reported stolen).

Machine learning algorithms are created and designed in a way that a dataset collects a necessary information, enabling machines to work with dataset and algorithms to predict results. As such, statistics and data mining are involved[4]. The algorithm's accuracy of prediction enhances with the overall quality and quantity of the dataset it employed. Real- time frauds case finding is achievable using Machine learning[5]. Collecting evidences from available dataset to predict the unique cases from others is the primary objective of fraud detection. Along with Unsupervised technique a supervised classifier is a crafted technique in anomaly detection when the target dataset contain the predicted output is fraud or not-fraud[6]. It may tackle complex issues by building a classifier model from a dataset which is labelled, then using the target feature on given data[7].

An unbalanced dataset is a major problem in machine learning[9]. When Working model uses the dataset which is unbalanced, general problem arises where model being biased towards of majority group and eventually accuracy decreases Consequently, major class data accuracy is excellent but minority class identification performs poorly[10]. The more fairer approach to deal with these issue is work on dataset using technique under sampling and over sampling can be used to modify the data itself and produce a balanced dataset. Taking a random sample of the majority classes is one way to put the under sampling method into practice. By increasing the minority classes during the oversampling process, a balanced data set can be obtained[11].

The aim of the research is to create a automated system which is based on machine learning model used to assess whether an insurance claim is fraud. After evaluating various algorithms, the best model for identifying whether a claim is false or not will be created. This is an effort to influence the insurance companies to create a more specialized model that will integrate more seamlessly with their present infrastructure. The working model should be easy enough to work with huge datasets and complex to achieve the reasonable success rate. The traditional method of finding fraud is based on a manual based on fraud signs. They are thought to have been backed by the fraud selection that was made. The ultimate goal is to not only develop a sophisticated fraud detection model but also to suggest a novel strategy that outperforms current systems and changes to meet newly developing fraud techniques. Our project aims to improve the security and efficiency of the claims processing system, maintain fair premiums, and uphold the trust that is essential to the insurance industry by integrating a user-friendly interface and making artificial intelligence results more relevant.

RELATED WORK

In paper [2] Author uses two main techniques namely normalization of data and Extreme Learning Machine. ELM is a Single hidden Layered Feed-forward network. Nodes are generated randomly weights to these nodes are assigned to the values of edges coming arbitrarily. In ELM performance of model depends on two variables number of nodes in hidden layer and regularization.

Authers of paper [5] uses a basic machine learning approach where a well-defined large dataset plays crucial role various attribute feed to dataset with large no of entries and the classification done using K-means clustering algorithms. Paper [10] works on detecting frauds in automobile sector where it handles the imbalance dataset and detects the fraud in high accuracy applies Synthetic Minority Oversampling Technique (SMOTE) with Support Vector Machine and K- nearest neighbours to find the fraud. A methodical technique utilizing mean-variance effective portfolios have been proposed in [4] for the detection of false claims. The Sharp ratios are calculated in this paper to find instances of insurance claim fraud. The process of estimating these ratios involves concurrently attenuating the variations of risks and increasing the mean of the requested amounts. Using the Support Vector Machine (OCSVM) and k-Reverse Nearest Neighborhood (k- RNN) techniques in tandem with the insurance claims, Enrico Laoh and Arian Dhini created an under-sampling model[13]. The under sampled modified dataset was then used to separate the illegitimate records using supervised learners like Support Vector Machine (SVM), Logistic Regression (LR). The act of presenting fictitious documentation in order to obtain financial benefits through staged or stolen incidents is known as auto insurance fraud. Several people may be involved in this fraudulent activity, including drivers, mechanics, chiropractors, attorneys, police officers, and insurance employees. Preprocessing the unprocessed dataset and using ELM to detect fraud are two steps in the suggested methodology. A modified dataset is utilized to train the ELM, and the trained model is subsequently applied to distinguish between legitimate and fraudulent insurance requests[14].

PROPOSED SYSTEM

In the below diagram, system architecture of proposed system is shown. It shows that insurance policyholder requests claim on the web application and necessary information from policyholder is collected and stored on backend database. The dataset used for implementing this system is 'fraud_oracle.csv'. It is a standard dataset from Kaggle.com.

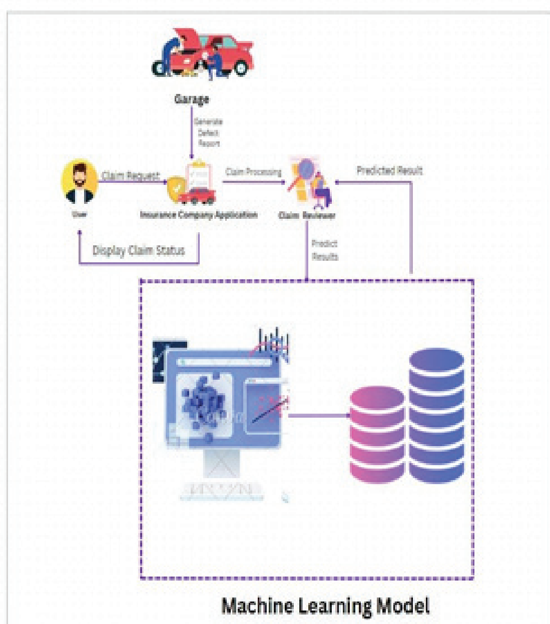

Fig. 1. System Architecture

The proposed system trains a random forest model on given dataset. For train-test split, the proposed system uses 80-20 percentage. The trained model of proposed system inputs the attributes of above features. The random forest model will build multiple decision trees from the training dataset and the result with multiple choice will be selected. Predicted result will be combined with the result predicted by garage owner. The decision of garage owner is taken on the basis of his personal decision. This proposed will detect frauds with more accuracy than the existing systems.

PROPOSED METHODOLOGY

The data collection, data pre-processing, feature selection, classifiers, result data description, and a succinct explanation of the techniques and procedures comprise the methodology of this study. One well-liked technique for addressing the issue of class imbalance in machine learning is the SMOTE technique. When one class in a dataset is underrepresented in comparison to other classes (the majority class), this is known as class imbalance[15]. This problem is prevalent in several fields, such as anomaly and fraud detection. SMOTE helps to add diversity into the minority class by creating synthetic samples rather than copying preexisting ones.

Fig. 2 Steps in Model Designing

Data Collection

The data collection used for our investigation is called "fraud_oracle.csv" and it includes insurance claims for automobiles, specifically autos. The dataset comprises approximately 15,420 claims between January 1994 and December 1996. A total of 32 attributes are taken into consideration, with the goal variable displaying "Fraud" and "No Fraud." Averaging the claims of fraud and non-fraud yields 6% of requests per month. The overall number of legitimate claims was found to be 94%, or 14,497, and the fraudulent claims to be about 923, or 6% of the entire dataset. The following is a description of 33 features:

- Personal data at the time of claim
- Information about the insurance contract, such as the kind of policy, number of supplements, agent type, and insurance coverages.
- The drivers detailed history etc
- A few insurance-related details (vehicle count, prior claims, driver rating, etc.)
- Fraud identified (if any): characteristic to be expected based on data gathered.

Data Pre-processing

The accuracy of machine learning absolutely relies on the perfection of dataset. Used dataset "fraud_oracle.csv" contain noise, irrelevant information or missing values that leads to reduce the accuracy, to ensure accuracy of model preprocessing is one of the most important step in enhancing the performance of the model by applying some processes on dataset to prepare for input data, The "fraud_oracle.csv" dataset of our use in csv format, it consist of 24 nominal type feature with 9 numerical, Although the heuristic cannot always predict the true type of the feature, there are several heuristic principles to estimate the likely type of each feature. There are some attribute presents in dataset which does not supported by the classification models that gives idea that required dataset must be in nominal type features, so features are converted in nominal form after importing of dataset.

Feature Selection

1) Feature selection, which involves identifying and selecting the dataset's most relevant properties while removing any that are extraneous or unnecessary, is a critical step in the development of machine learning models. This process helps to improve model performance, reduce overfitting, and make the model easier to interpret. The following is a description of some of the methods:

2) Filter Methods : These techniques choose features according to statistical characteristics such as mutual information, correlation, or significance testing. Typical methods include of:

   a) Pearson correlation coefficient: The linear connection between characteristics and the target variable is measured by the Pearson correlation coefficient.

   b) Chi-square test: Evaluates the degree of independence between the target and category characteristics.

   c) Wrapper Methods: These techniques assess feature subsets by repeatedly training models and choose the subset with the highest performance. Typical methods include of:

   d) Recursive Feature Elimination (RFE): This method begins with all features, trains the model, and then repeatedly eliminates the least significant features until the target feature count is attained.

   e) Forward Selection: Selects the feature that most enhances the performance of the model by starting with an empty set of features and adding them one at a time.

Classification

The dataset contains 6% of negative instances overall, which indicates that the traditional Cross Validation approach was used. The negative instances are examples of fraud as opposed to positive instances, which are cases of truth. We can rebalance the data set to readjust the proportion and obtain a better result by providing the machine learning algorithm with the data set while presenting a comparable share of positive and negative occurrences.

a) Decision Trees: Decision trees are a basic algorithmic method in the field of machine learning-based insurance fraud detection. Decision trees create a hierarchical structure of decision nodes by means of a recursive feature selection and splitting procedure[8]. The method chooses the feature and threshold that splits the data in the best possible way at each node, either increasing information gain or minimizing impurity. For domain specialists, their natural interpretability makes it easier to derive useful insights. Pruning is a necessary strategy to reduce model complexity since decision trees are prone to overfitting, particularly with complicated datasets. Decision tree algorithms come in three different flavors: ID3, C4.5, and CART[12].

To lessen redundancy in the tree structure, the Decision Tree C4.5 method uses a tree pruning strategy.

$$\text{Entropy(S)} = \sum_{i=1} pi\ logi$$

Where, chance of occurrence of an ith potential value is represented by pi. The above formula number of sample represented by S whereas N represent the total number of values

The construction of DT C4.5 begins by selecting the most critical variable to serve as the root node, determined through Information Entropy. Additional nodes and decisions are generated indefinitely until no additional knowledge gain is obtained by separating edge nodes further.

b) Random Forest : The random forest algoritham widely used for classification and regression. It is supervised learning algoritham. The accuracy of random forest depends on the nummber of trees formed,the less tree the less acurate result would be. In random forest overfitting is the main problem with the desicion tree method. The data is stored in the nodes of the decision tree to implimentation of model .By employing Random Forest, which provides an illustration of group learning in action, this is prevented[13]. "Ensemble learning" is used to combine more then one algoritham that produce improved result. In random forest a large set of decision trees are present. dividing everything into two phases: random sample and final division for the first step randomly collected features and bootstrap are included for processing. Each individual tree formed during the division process remains unpruned, thereby imbuing each tree with its distinct characteristics separate from the others.[14].

Synthetic Minority Oversampling Technique (SMOTE)

Synthetic Minority Oversampling Technique, or SMOTE, is a crucial approach for addressing class imbalance problems in machine learning datasets. This is particularly common in situations such as insurance fraud detection. Through the use of artificially generated samples from the minority class, SMOTE improves the dataset by mitigating the glaring disparity between cases of fraudulent and non-fraudulent claims[11].

$$S_{new} = s_j + (s_j - s_i)\ \Delta$$

where snew stands for the recently created synthetic minority class sample. Of the k nearest neighbours, si is the one chosen at random to be the nearest neighbor, making sj the sample of the minority class. The random number Δ ranges from 0 to 1. This promotes a fairer distribution for model training. The methodical stages in data preparation, feature selection, and model training ensure that the algorithm can distinguish fraudulent activity from a variety of claim attributes. Following training, the model's effectiveness is carefully assessed using industry-standard performance criteria, and models trained on both the original and SMOTE augmented datasets are compared. Cross-validation procedures validate the model's discriminatory abilities while hyperparameter tuning further refines the models.

RESULT AND ANALYSIS

The study assessed categorization performance using a confusion matrix, as indicated in Table I. Important metrics like accuracy, sensitivity (or true positive rate), and specificity were based on this matrix. While sensitivity means the ratio of rightly identified positive claims to the total number of real legitimate claim, accuracy evaluates the overall soundness of model's predictions. The percentage of correctly diagnosed negative cases relative to all negative cases is known as specificity. These metrics provide critical insights into the model's capacity to distinguish between different classes, which is necessary for assessing its practical usefulness. Using the confusion matrix and accompanying metrics, the study acquires a thorough insight into the model's performance, allowing for informed judgments about its deployment and optimization in real-world applications.

Table 1. Confusion Matrix

Actual Label	Predicted	
	Fraud	**Legitimate**
Fraud	True Positive (TP)	False Positive (FP)
Legitimate	False Negative (FN)	True Negative (TN)

Confusion matrix is essential tool for assessing a measuring the classification of model's based on performance in the confusion matrix. Offering a wide variety of entries in tabular overview of the model's predictions in comparison to the actual labels. Usually, the matrix has four entries:

1. True Positive (TP): Cases where the model rightly identified as right.
2. True Negative (TN): Examples that the model rightly categorized as wrong.

3. False Positive (FP): Cases when the model misclassified something as positive.
4. False Negative (FN): Examples of data that the model misclassified as negative.

The classifier's parameter evaluation is displayed in Table 2. The analysis the performance metrics derived from the provided table, revealing distinct patterns among four machine learning algorithms: Random Forest Outperforms other algorithms Decision Tree Building numerous trees, AdaBoost basically an Ensemble technique, and Support Vector Machine (SVM) a simple approach used to solve complex classification problems. Notably, Random Forest emerges as a top performer. Following Result Comparison table shows with 4663 instances correctly classified and 1136 incorrectly classified, alongside a precision of 0.8923, recall of 0.7647, and an F1 Score of 0.8236. Decision Tree closely follows, achieving 4635 correct classifications, 1164 misclassifications, and precision, recall, and F1 Score of 0.8876, 0.7607, and 0.8193, respectively. Conversely, AdaBoost demonstrates lower accuracy, with 3405 correct classifications, 2393 misclassifications, and a precision of 0.4591, recall of 0.6348, and F1 Score of 0.5328. SVM, too, exhibits relatively poorer performance, correctly classifying 3231 instances, misclassifying 2568, and attaining a precision of 0.3504, recall of 0.6206, and F1 Score of 0.4479. These numerical insights underscore Random Forest and Decision Tree's superiority over AdaBoost and SVM in classification tasks, emphasizing their higher accuracy, precision, and F1 Score. The information of the below table gives the useful insight of the performance of the machine learning models; results may be interpreted as needed.

Table 2. Result Comparison

Result	Random Forest	Decision Tree	AdaBoost	SVM
Correctly classified	4663	4635	3405	3231
Incorrectly classified	1136	1164	2393	2568
Precision	0.8923	0.8876	0.4591	0.350
Recall	0.7647	0.7607	0.6348	0.620
F1 Score	0.8236	0.8193	0.5328	0.447
Accuracy	80%	78%	60%	58%

Given Metrics gives various term which are When working on assignments when there is an imbalance between the classes or when it's necessary to strike a balance between false positives and false negatives, these metrics are especially important. There are various terminologies helpful for analysis of the model can be derived using the confusion matrix which are as follows:

Precision

Precision is the ratio of true positives to the total predicted positives. It measures the accuracy of positive predictions. The formula for precision is True Positives divided by the sum of True Positives and False Positives. It provides insight into the precision of positive forecasts.

Precision = TP / (TP + FP)

Accuracy

Accuracy represents the proportion of correctly anticipated observations to the total observations, indicating the model's overall correctness. It is calculated using the formula:

Accuracy = (TP+TN) / Total Observations

When the dataset's class distribution is balanced, accuracy is a valuable statistic. It may, however, be deceptive when there is a disparity in class.

F1 Score

When the dataset's class distribution is balanced, accuracy is a valuable statistic. It may, however, be deceptive when there is a disparity in class.

F1 Score = 2 *(P * R) / (P + R)

Where P is precision, R is recall. When there is an imbalance in the classes, the F1 score is especially helpful. Both false positives and false negatives are taken into account.

A comparison was conducted between four machine learning algorithms: RF, DT, AdaBoost, and SVM Classifier. These algorithms are frequently used in classification jobs with the goal of precisely identifying fraudulent claims. With an accuracy of 80%, Random

Forest a potent ensemble method performed better than the other algorithms. This implies the Random Forest makes strong forecasts by efficiently utilizing the joint judgments of several decision trees. A basic algorithm called Decision Tree obtained an accuracy of 78%, which was somewhat better than Random Forest. Decision Tree is remarkably effective in this assignment, even if it is simple. AdaBoost, a boosting method, performed relatively worse than the prior algorithms, with an accuracy of 60%. AdaBoost focuses on challenging circumstances by iteratively adjusting the weights of misclassified examples, yet it was unable to match the performance of Random Forest and Decision Tree in this scenario. SVM Classifier, a method based on defining hyperplanes to separate classes, demonstrated the lowest accuracy among the four algorithms, at 58%.

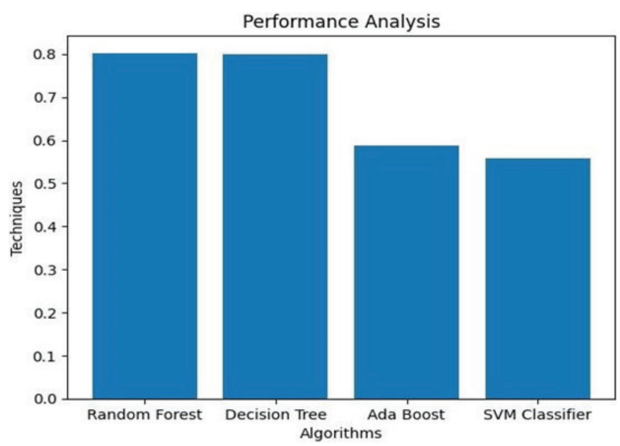

Fig. 3. Performance Analysis

CONCLUSION

Both the insurance company and the customers are quite concerned about fraudulent claims on auto insurance. Application of anomaly detection in machine learning can be achieved using above methodology. Numerous research projects have used several machine learning algorithms for detecting fake information. It proposes to use RF, DT C4.5 as a supervised classifier to differentiate between legitimate and fraudulent claims. In order for the training data to generate a sufficiently accurate model, SMOTE must be suggested. Performance of model is tested using testing data, a highly skewed dataset that represents real-world data. The result shows that RF, DT C4.5, and all of them attain good accuracy. Nonetheless, RF performs the best with 89.23% accuracy.

Such habit may be learned once and for all, or it may continue to change over time. Regression, classification, and clustering are the additional classifications for the supervised learning. Predicting which class an observation belongs to is the definition of classification; clustering divides the observation into meaningful groups. Regression allows us to forecast value based on observation . Assigning a document to a predetermined category is the fundamental notion of classification. Data and a program are the inputs for the conventional method . The computer receives the inputs and produces the output in the end. When it comes to machine learning, input and output go into a computer, which then produces a program as an output. Below is a comparison of the machine learning approach and the classical learning strategy.

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Social Media Sentiment Analysis using AWS Cloud

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ABSTRACT

Sentiments are emotions or feelings of a person which are expressed by a person. Through sentiments we can convey our message with help of expressions. Sentiments can be expressed in form of text, audio and video. The analysis is required of these sentiments. We are developing a system which analyze sentiments of video, audio and text. The input to the system is URL of YouTube video which automatically download the video and analyze sentiments. Classification of these sentiments is done by common ML techniques such as Multi Task Cascaded Convolutional Neural Networks, Support Vector Machines(SVM) and Natural Language Processing(NLP) models. Video data that has been collected will be divided into frames using OpenCV. From the frames, facial recognition will be performed using MTCNN expressions, which will detect expressions with the help of eyes, nose, and lips. For Audio data, speech will be converted to text using the Google API. For text data, techniques such as SVM and NLP models will be used to capture the expressions. Further the sentiments are uploaded on AWS cloud.s

KEYWORDS: *Sentiment analysis, Machine llearning, NLP, AWS ccloud.*

INTRODUCTION

In today's digitally interconnected world, social media platforms have become integral channels for communication, interaction, and expression. From sharing personal anecdotes to discussing global events, social media serves as a vast repository of diverse voices and sentiments. Understanding the nuances of these sentiments holds immense value for businesses, individuals, and policymakers alike, as it provides insights into public opinions, attitudes, and trends. Consequently, the development of robust sentiment analysis systems has emerged as a crucial endeavor in harnessing the wealth of information embedded within social media data. The advent of cloud computing technologies has revolutionized the landscape of data analytics and processing, offering scalable and cost-effective solutions for handling large volumes of data in real-time. Leveraging the capabilities of cloud platforms, particularly Amazon Web Services (AWS), presents an opportunity to build sophisticated sentiment analysis systems capable of processing streaming social media data with agility and efficiency. This research project sets out to address the burgeoning need for a real-time social media sentiment analysis system by harnessing the power of AWS cloud services. The overarching objective is to design and implement an architecture that seamlessly captures, processes, and analyzes streaming social media data, encompassing a variety of formats such as text, audio, and video. By integrating advanced machine learning models for sentiment classification, the system aims to provide timely insights into the prevailing sentiments across social media platforms. The significance of sentiment analysis lies in its ability to decipher the underlying emotions, attitudes, and opinions conveyed through social media content. Whether it's a video clip, a textual post, or an audio recording, each piece of content encapsulates valuable insights that can inform strategic decision-making and facilitate informed discourse. By employing a multifaceted approach that encompasses diverse data modalities, including facial expressions, speech patterns, and textual cues, the proposed system endeavors to achieve a comprehensive understanding of the sentiment landscape on social media. This paper explores the intricate facets of sentiment analysis within the realm of social media, delving into the methodologies, challenges, and implications associated with real-time sentiment analysis.

Through a synthesis of existing literature and empirical analysis, we aim to elucidate the underlying principles and techniques that underpin the development of an effective sentiment analysis system. Furthermore, we delineate the architectural design and implementation strategies tailored to harness the capabilities of AWS cloud services for real-time sentiment analysis. In summary, this research endeavor seeks to advance our understanding of sentiment analysis in the context of social media discourse while offering practical insights into the design and deployment of real-time sentiment analysis systems utilizing AWS cloud services.[3]By elucidating the importance of sentiment analysis and outlining a robust architectural framework, this paper aims to contribute to the burgeoning field of sentiment analysis and its application in driving actionable insights from social media data.

LITERATURE SURVEY

Machine learning and deep learning methods have been extensively used in understanding emotions through computers, particularly in the fields of semantics and sentiment analysis. This paper explores different ways these methods are applied for real-time sentiment analysis. It focuses on a project that helps users track their moods and get suggestions. The system combines Facial Emotion Recognition, Chat-Bot, and Sentiment Analysis models, as well as a Speech-to-Text model. Its goal is to create a user- friendly mobile app that allows people to regularly check and manage their moods.[1]

Author Mohemmed Sha[3] implements sentiment analysis using logistic regression within the context of live tweet analysis on AWS EC2, incorporating elastic load balancing for data regulation. Successful pre-processing of text categorization was achieved, crucial for training the machine learning algorithm effectively. The logistic regression classifier was trained using various tweet elements, facilitating precise categorization of new tweets in three sentiment groups positive, neutral, and negative, achieving an exactness of 94.17%.

This system works on lengthened words that present a sentiment extraction system with potential applications in emotion detection, emphasizing the importance of capturing both sentiment and mood. The paper identifies how longer words affect sentiment analysis and suggests a method for finding new words that carry sentiment without needing prior labeling. However, limitations include assuming correct spellings and achieving results comparable to gold standards.[7]

Ishaani Priyadarshini[9] proposed an innovative LSTM–CNN network for sentiment analysis, which surpassed standard algorithms, achieving an accuracy of over 96%. It highlights the importance of hyperparameter tuning and suggests exploring more hybrid machine-learning techniques. Future research aims to analyze datasets with non-English sentences, acknowledging the challenge of achieving 100% accuracy due to the diversity of the English language.

The authors introduced a sentiment analyzer designed to extract opinions about COVID-19 from social media. The study focuses on comments in the Albanian language from the NIPHK Facebook page. Three deep neural networks, incorporating attention mechanisms alongside a pre-trained fast Text model, undergo training and validation. The outcomes demonstrate the superiority of the proposed model over the standard classifier, achieving an F1 score of 72.09%. This research illustrates the efficacy of the approach in addressing sentiment conveyed in informal social media content, particularly in low-resource languages such as Albanian.[6]

METHODOLOGY

This section delineates the methodology employed in the study. Initially, we delve into the programming environments utilized. Subsequently, we scrutinize the methodology of data collection, alongside the procedures for data preparation.

Programming Environment

Python stands out as one of the most prevalent programming languages for Natural Language Processing (NLP), Machine Learning (ML), and data research endeavors. Its extensive library encompasses a wide array of NLP and ML techniques tailored to address diverse problem domains. Python was selected as the primary programming language for this investigation owing to its rich library ecosystem and user-friendly interface. Among the plethora of Python packages facilitating the manipulation of human language data, NLTK (Natural Language Toolkit) emerges prominently. Additionally, essential modules such as Matplotlib, NumPy, Pandas, TensorFlow, and Keras were incorporated. The exploration also encompasses alternative strategies for feature extraction.

Dataset

The dataset used in our project was sourced from Kaggle, specifically from the "Face Expression Recognition Dataset":https://www.kaggle.com/datasets/jonathanoheix/fa ce-expression-recognition-dataset. This dataset comprises a diverse collection of facial images annotated with corresponding emotion labels. Each image captures various facial expressions, including happiness, sadness, anger, surprise, fear, and disgust. The dataset provides a valuable resource for training and evaluating our sentiment analysis model, allowing us to build a robust system capable of accurately classifying emotions based on facial cues. With this rich dataset, we can effectively train our neural network models to recognize and classify emotions in real-world scenarios, thereby enhancing the accuracy and reliability of our sentiment analysis system.

Data Preparation

In the data preparation phase of our project, we meticulously curated and processed text, audio, and video data to ensure optimal performance of our sentiment analysis system. For text data, we preprocessed textual inputs by tokenizing, removing stop-words, and performing stemming or lemmatization to standardize the text format and reduce noise.[7] Additionally, we conducted data augmentation techniques such as synonym replacement or paraphrasing to enrich the diversity of our training dataset. For audio data, we utilized the Google API to transcribe speech into text, enabling seamless integration with our sentiment analysis pipeline. Furthermore, we extracted acoustic features from audio signals, including pitch, intensity, and duration, to capture nuanced vocal expressions. In the case of video data, we employed OpenCV to divide video streams into frames, facilitating facial recognition using techniques like Multi- Task Cascaded Convolutional Neural Networks (MTCNN). This enabled us to detect facial expressions by analyzing key facial landmarks such as the eyes, nose, and lips. By meticulously preparing and preprocessing text, audio, and video data, we ensured the robustness and accuracy of our sentiment analysis system across diverse multimedia inputs.

Proposed Architecture

The system architecture diagram for our sentiment analysis project intricately captures the workflow from user input to the final sentiment analysis results on the AWS platform. The user interface serves as the entry point for users, allowing them to input URLs that lead to multimedia content, primarily videos on platforms like YouTube. This input initiates a multi-step process that involves web scraping, data preprocessing, and the application of advanced machine learning techniques. The first branch of the workflow involves web scraping, a critical step in gathering relevant data for sentiment analysis. The web scraping module extracts information from the provided URL, focusing on comments, likes, and dislikes associated with the video. The extracted data is then organized and stored in a CSV file, creating a structured dataset that serves as the foundation for subsequent analysis.[1]

Simultaneously, the second branch of the workflow employs a Python script to process the video content. This script encompasses two key components: OpenCV for video processing and Multi-Task Cascaded Convolutional Neural Networks (MTCNN) for facial recognition. OpenCV is applied to divide the video into frames, setting the stage for a granular analysis of facial expressions. MTCNN, a sophisticated facial recognition technique, is then utilized on these frames to detect and interpret expressions using key facial features such as eyes, nose, and lips. This facial recognition process enhances the depth of sentiment analysis by capturing non-verbal cues and nuances expressed in the video content. Simultaneously, the Python script processes the audio component of the video. Using the Google API, the script transcribes the audio content into text, converting spoken words into a format compatible with the subsequent sentiment analysis. This audio-to-text conversion ensures that the sentiment analysis encompasses both visual and auditory elements of the multimedia content. The two branches of the workflow, one from web scraping and the other from the Python script, converge at a crucial juncture where the collected data undergoes sentiment analysis.

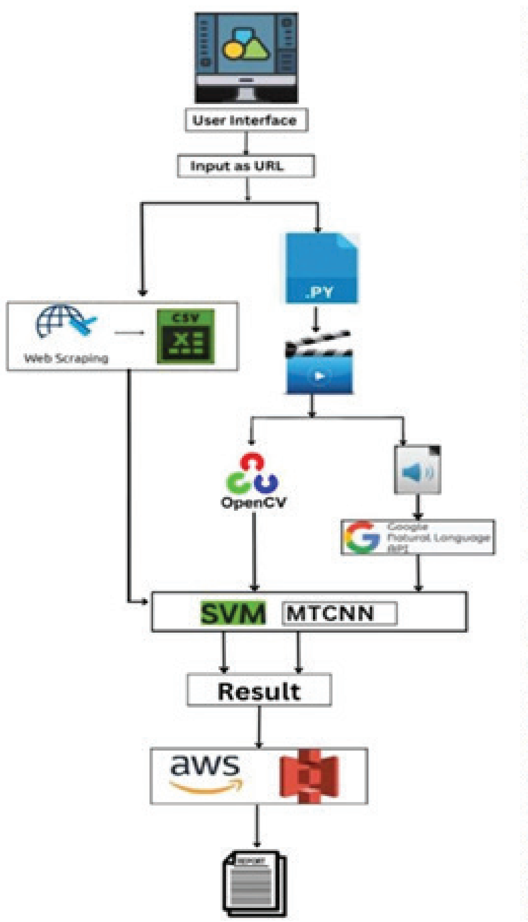

Fig 1. System Architecture

Support Vector Machines (SVM), a powerful machine learning algorithm, are applied to the CSV file containing comments, likes, and dislikes. SVM excels in classification tasks, making it an ideal choice for discerning sentiments expressed in textual data. This phase of analysis provides insights into the sentiments associated with the extual content of the video, contributing a valuable layer to he overall sentiment analysis. Simultaneously, the results form facial recognition using MTCNN and the transcribed audio content from the Google API are integrated into the sentiment analysis. This fusion of visual and auditory cues enriches the overall analysis, providing a more holistic understanding of the emotional nuances embedded in the multimedia content. The final output of the sentiment analysis process is a comprehensive evaluation of sentiments expressed in the given multimedia content. The results include a nuanced classification of emotions conveyed through comments, likes, dislikes, facial expressions, and audio content. This amalgamated sentiment analysis result serves as a valuable resource for understanding the emotional one and context of the analyzed multimedia content. The last leg of the system architecture involves the utilization of Amazon Web Services (AWS) for hosting and further analysis. The sentiment analysis results are seamlessly integrated into the AWS platform, specifically leveraging the AWS Elastic Compute Cloud (EC2). [3]

This cloud-based environment ensures scalability and efficiency in handling the computational requirements of our sentiment analysis system, making it robust and capable of handling large volumes of data. In further reflection, our comprehensive sentiment analysis system architecture signifies not only a technical triumph but also a testament to he evolving landscape of data analytics, machine learning, nd cloud computing. By delving into the intricacies of multimedia content, we acknowledge the multifaceted nature of communication in the digital era. Our project's ability to decipher sentiments from textual comments, visual expressions, and auditory cues highlights the richness of information embedded in diverse forms of user generated content. In conclusion, this system architecture diagram embodies a holistic approach to sentiment analysis, seamlessly integrating web scraping, computer vision, audio processing, and machine learning techniques. The two distinct data paths, coupled with advanced methods like MTCNN and SVM, contribute to a comprehensive understanding of sentiments conveyed in multimedia content. The incorporation of AWS as the final processing platform reflects a commitment to scalability and efficiency, allowing our system to handle the dynamic and voluminous nature of data sourced from YouTube and other social media platforms. This project not only showcases the technical prowess of the team but also underscores the potential of sentiment analysis in extracting valuable insights from the vast pool of multimedia content available online. As we move forward, the combination of cutting-edge technologies and cloud computing will undoubtedly play a crucial role in shaping the landscape of sentiment analysis and intelligent systems.

Algorithms

In this segment, we meticulously organize the algorithmic framework into three distinct sections, each representing a pivotal aspect of our research endeavor. Initially, the Multitask Cascaded Convolutional Neural Network (MTCNN) model is introduced, recognized for its adeptness in facial detection and alignment tasks. Subsequently, the second section elaborates on the Support Vector Machine (SVM) model, celebrated in machine learning for its robust classification capabilities. Lastly, the third section delves into the nuances of audio-to-text conversion algorithms, investigating methodologies for accurately transcribing spoken language into written text. Through this methodical presentation, our aim is to offer a comprehensive comprehension of the algorithmic methodologies utilized in our research, with each segment contributing uniquely to the overarching objective of advancing computational capabilities across various domains.

MTCNN

Initialization and setup :

-Initialize OpenCV face detector (face_cascade) and MTCNN model (mtcnn_detector).

-Load pre-trained Sentiment analysis model.

Face Detection and Saving Frames:

-Loop through frames in frames_folder_path.

-Detect faces using MTCNN model.

-Save frames with detected faces in output_folder_faces.

Unique Expression Extraction:

-Loop through frames with detected faces in output_folder_faces.

-Check for similarity between consecutive frames to extract frames with unique expressions. Save frames with unique expressions in output_folder_faces_unique.

Sentiment Analysis

-Iterate over frames with unique expressions in output_folder_faces_unique.

-Preprocess face image for sentiment prediction. Predict sentiment using pre-trained model. Display sentiment prediction result alongside corresponding face image.

Save MTCNN Model

-Save trained MTCNN model to .pkl file (model_filename) for future use.

SVM

Initialize SVM model with specified hyperparameters (kernel, C, gamma, etc.):

- For a linear SVM:

- Initialize a weight vector w and bias b to zero.

- For a non-linear SVM (e.g., with kernel trick):

Train the SVM model using the training data

- For linear SVM:

- Minimize the objective function:

J(w, b) = 1/2 ||w||^2 + C * Σ(max(0, 1 - y_i * (w * x_i + b))) where ||w||^2 represents the squared norm of the weight vector,C is the regularization parameter,x_i and y_i are the features and labels of the training examples.

-For non-linear SVM (e.g., with kernel trick):

Transform input features into a higher-dimensional space using a kernel function: φ(x) -> φ(x_i) for each training example x_i.

Solve the optimization problem in the transformed space.

After training, the model is capable of predicting the class label of new data points:

- For linear SVM:

- Predict the class label for a new data point x_test

- For non-linear SVM (e.g., with kernel trick):

- Predict the class label using the decision function.

Return the trained SVM model.

• Audio to Text Conversion Input:

Audio files directory (audio_files_directory) Output text file path (output_text_file_path)

Initialization and Setup

-Initialize speech recognition engine (speech_recognizer).

-Set up parameters for speech recognition, such as language model and audio file format compatibility.

Audio Transcription

-Loop through each audio file in the audio_files_directory.

-Load the audio file.

-Use speech recognition engine to transcribe the audio to text.

-Append the transcribed text to a list or data structure.

Save Transcribed Text

-Write the transcribed text from all audio files to the output text file (output_text_file_path).

End of Algorithm.

RESULTS

Sentiment Analysis Result

The results are divided into two parts of the system. One part includes the sentiment analysis of comments provided by the public. The comments are divided into four categories: positive, negative, neutral, and irrelevant. Statements containing positive synonyms are categorized into the positive class. A sample of the result is shown in the diagram.

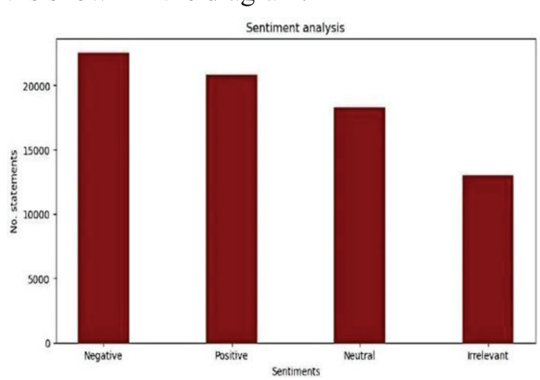

Fig 2. Sentiment Analysis Result of SVM model

The second part of the result includes the sentiment analysis of the video or frames. These are categorized into seven classes representing emotions: fear, happy, sad, disgust, surprise, neutral, and anger. These emotions are detected in the frames and counted to generate a bar graph as output. A sample of this is given in the diagram of emotions.

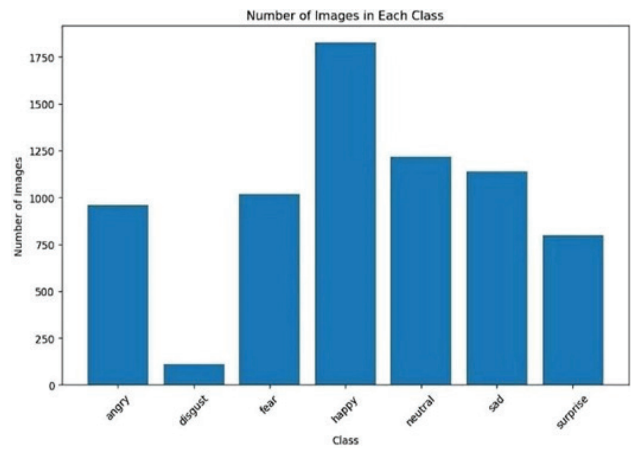

Fig 3. Sentiment Analysis Result of MTCNN model

Additionally, the results will be stored on the AWS cloud. These results will be uploaded to the S3 account connected to the backend of the application.

Performance Analysis

Analyzing the confusion matrix can help identify which sentiment classes the model struggles with, whether it's misclassifying positive sentiments as negative or vice versa.

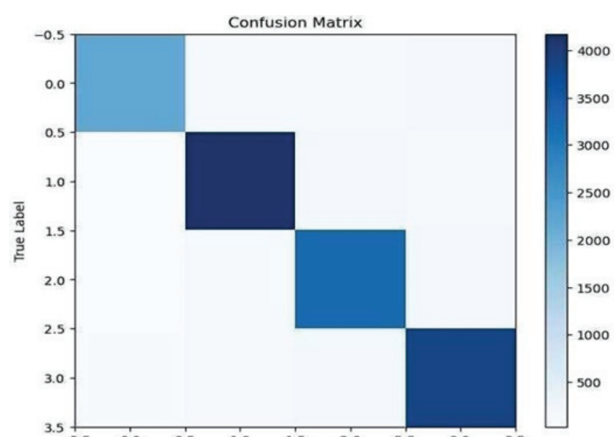

Fig 4. Confusion Matrix

This information can be used to refine the sentiment analysis model and improve its performance on social media data. Here, TP stands for true positives (correctly predicted positive sentiments), TN stands for true negatives (correctly predicted negative sentiments), FP stands for false positives (negative sentiments incorrectly predicted as positive), and FN stands for false negatives (positive sentiments incorrectly predicted as negative).

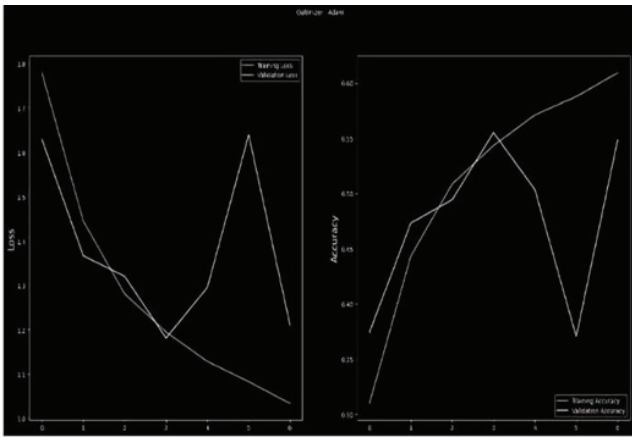

Fig. 5. MTCNN Loss and accuracy graphs

For social media sentiment analysis using AWS, MTCNN (Multi-Task Cascaded Convolutional Networks) can be employed for face detection. However, it's important to note that MTCNN is primarily used for object detection, particularly faces, rather than sentiment analysis directly.

If you're visualizing loss and accuracy graphs for MTCNN in the context of face detection, you might see loss decreasing over epochs as the model learns to detect faces more accurately, while accuracy increases accordingly. These graphs indicate how well the model is performing in terms of identifying faces within social media content.[1]

Remember, sentiment analysis involves a separate set of models and metrics to gauge sentiment within text data, which could be an additional component of your AWS-based social media sentiment analysis pipeline.

CONCLUSION AND FUTURE SCOPE

In this paper, we have presented a system for extracting sentiments. It can be used in other applications as well, i.e., emotion detection. Our system introduces a robust sentiment analysis framework, utilizing advanced machine learning techniques to decode emotions in audio, video, and text data. Leveraging technologies like Support Vector machine(SVM), Multi-task Cascaded Convolutional Network (MTCNN) , coupled with OpenCV and Google API, the system achieves accurate sentiment categorization. With a primary focus on intelligent systems for public opinion study on YouTube data, the system contributes to a nuanced understanding of societal sentiments. The integration of facial recognition and emotion analysis provides actionable insights for content creators, businesses, and company owners. In the dynamic digital landscape, this system underscores the significance of sentiment analysis in enhancing online content and deciphering audience emotions. With AWS, we are using Simple Storage Service(S3) for storing the data and Elastic Cloud(EC2) for integration. In Future, system can be developed for multiple social media platforms to analyze the sentiments and analysis of audio file can be done on basis of pitch and tone .

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Text Driven Image Synthesis using GAN Algorithm

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ABSTRACT

Text to image synthesis using Generative Adversarial Networks (GANs) has become a fascinating and innovative field at the intersection of computer vision and artificial intelligence. For a considerable amount of time, computer vision and machine learning research has focused heavily on image generation. It involves producing new visuals that closely resemble real-world pictures by utilizing a given input or set of inputs. This research provides a thorough examination of the advancements, challenges, and possible uses of GAN based text to image generation. This method seeks to close the distinction in meaning between verbal descriptions and images by using GAN, enabling the conversion of textual descriptions into high-quality pictures. We explore the underlying GAN architectures, highlighting the unique methods used by SS-Ti-GAN, StackGAN, FA- GAN, StyleGAN, Point-E, etc. to tackle the complexities of this synthesis task differently.

KEYWORDS: *Generative Adversarial Network (GAN), Scene Graph Stack Generative Adversarial Networks (SGS-GAN), Self-Supervised Text to Image Generative Adversarial Networks (SS-TiGAN), Feature Aware Generative Adversarial Networks (FA-GAN), Natural Language Processing (NLP), Graphics Processing Unit (GPU), Central Processing Unit (CPU)*

INTRODUCTION

Artificial intelligence (AI) has come a long way in the last few years, especially with regard to generative models. Among them, Generative Adversarial Networks have become an effective system for producing data samples that are realistic, including images, text, and audio. The ability of GANs to learn complex data distributions has opened up a wide range of applications in several fields, like natural language processing and computer vision.[1,7]

One such application gaining substantial attention is text-to-image synthesis using GANs. This task involves generating visually coherent images from textual descriptions, connecting the semantic barrier between graphical representations and conversational language. The significance of this endeavour lies in its potential to revolutionize content creation, virtual environments, and human-computer interactions.[2,4,5]

The synthesis of images from textual descriptions presents several challenges, including understanding the nuanced semantics of language, capturing intricate visual details, and ensuring the coherence and realism of generated images. Overcoming these challenges requires the integration of cutting-edge techniques from both natural language processing (NLP) and computer vision, making text-to-image synthesis a multidisciplinary research area at the intersection of AI and machine learning. [3,9]

The purpose of this research is to investigate current advanced methods and new developments in GAN-based text to image generation. Using a thorough analysis of the body of current literature, it delves into the evolution of techniques, architectures, and evaluation metrics employed in this domain. Additionally, it highlights the key challenges and open research questions, opening the way for further improvements in the transformation of text to images.

LITERATURE REVIEW

Stack Generative Adversarial Networks (Stack-GAN)

Reference [1,9,10] proposes a promising method for creating photo-realistic graphics from text is the stack generation of adversarial neural networks (Stack-GAN) with conditioning augmentation. It is possible to create photos that feature more photo realism and a higher level of quality with multi-staged GANs than with conventional text-to-image generative models. Numerous industries, including virtual reality, interior design, and assistive communication technologies, could benefit greatly from the application of this technology. When more sophisticated datasets and technological advancements occur, applying Stack-GAN with Conditioning Augmentation can produce even more remarkable outcomes in producing lifelike images from text descriptions.

Scene Graph Stack Generative Adversarial Networks (SGS-GAN)

Reference [5] states a Stacked GAN model that is utilized in the study of text to picture; by utilizing the scene graph's condition variable, the generated image's quality is enhanced from the entire image to the portion. The testing results demonstrate that the produced images are closer to real life images and have more precise edge features and local textures produced by the scene graph-based stacks producing conflict network on the same data set. Despite generating images with good outcomes, this approach still struggles with situations including more intricate items.

Self Supervised Text to Image Generative Adversarial Networks (SS-TiGAN)

Reference [7] introduces SSTiGAN which is an innovative text to image generation technique which creates vibrant visuals by using self-supervision. To ensure stability throughout the synthesis process, this technique makes use of a bilevel architecture with two distinct discriminators. SSTiGAN uses a variety of techniques to get around the restrictions of GANs during training, while self-supervision augments the data used for training with rotational variations to address the low-data regime issue. The Oxford-

102 and CUB benchmark datasets are used in the experiments to show how well SS-TiGAN performs in comparison to other methods. This highlights the technology's efficacy in producing sharper images generated by written descriptions.

Feature-Aware GAN (FA-GAN)

Reference [4] states FA-GAN for text to image generation is a technique that increases the generator's useable signal output. In order to extract meaningful features, we construct a self supervised discriminator that is trained via autoencoding. A model that generates images with identical features to real images can do so by using a feature-aware loss. The results of our experiments demonstrate the efficiency of our approach, and our model may produce images that are crisper and more realistic.

Point-E

Reference [6] proposed Point-E, which is a technique for text-conditional synthesis of three-dimensional point clouds that creates colored point clouds conditioned on synthetic views first. Based on text prompts, Point E can effectively generate a wide variety of intricate 3D shapes. We believe that our method can act as a springboard for additional research in the text-to-3D synthesis area.

PROPOSED SYSTEM

Architecture Overview

Several integrated components make up the system architecture for creating realistic visuals from textual descriptions. The user interface, which can be desktop, web, or API-based, allows users to interact with the system. User- provided textual descriptions are handled by a Text Processing Module, which uses Natural Language Processing methods such as tokenization and semantic analysis to get the input ready for further steps. A generator and discriminator are the foundation of a Generative Adversarial Network (GAN) architecture. With an eye toward realism, the generator creates visuals that are closely linked with the descriptions based on the textual input. An evaluation module evaluates the quality of images that are generated, maybe using measures such as Fréchet Inception

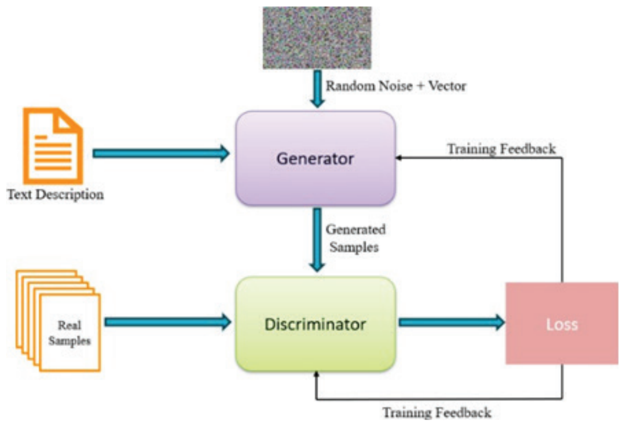

Fig. 1. GAN Architecture

Distance or Inception Score. Furthermore, a Feedback Mechanism enables users to offer feedback on generated images, facilitating iterative improvements to the training process.

Methodology

Data Collection and Preprocessing

First, compile a large dataset of image-text pairs that correlate to textual descriptions. To achieve robust model training, this dataset should include a wide range of objects, situations, and concepts. Next, tokenize the textual descriptions into words or sub word units as a preprocessing step. Transform these tokenized descriptions into GloVe word embeddings. GloVe word embeddings use a corpus's co-occurrence data to capture semantic associations between words.

Architecture Selection

Choose a GAN variation that is suitable for producing images of flowers based on textual descriptions. Deep Convolutional Generative Adversarial Networks (DCGANs), Conditional GANs (CGANs), and more sophisticated models like StackGAN or AttnGAN are some of the available options. Select the architecture that most effectively addresses the intricacy and variety of floral imagery present in the dataset. A diffusion model can also be used for image generation tasks. Diffusion models iteratively refine noise distribution via injections and diffusions to mirror the target data distribution. Unlike GANs, they optimize parameters directly to match the data, avoiding adversarial training. These models excel at generating high-quality, diverse, and high-resolution samples.

The Conditional GANs (CGANs) architecture was best fit for this research because Conditional Generative Adversarial Networks (CGANs) are a powerful architecture for generating images from textual descriptions. By conditioning the generator on both random noise and textual input, CGANs can produce visually realistic images that align closely with the provided descriptions. This approach enables the generator to incorporate specific features mentioned in the text into the generated images, resulting in semantically meaningful outputs. With their flexibility in handling various types of textual inputs, CGANs are well-suited for a wide range of text-driven image synthesis tasks, offering the potential to generate diverse, high-quality images that faithfully represent the provided descriptions.

Generator Network

First initialize the generator with layers designed to accept both noise vectors and GloVe text embeddings as input. The noise vector serves as the source of randomness, while the GloVe embeddings provide the semantic context for the generated image. These embeddings are fed through a series of dense neural layers, followed by recurrent layers which is LSTM, to capture the sequential nature of text. These layers transform the embeddings into a latent representation that captures the essence of the textual description. This latent representation is then concatenated with the noise vector and passed through a series of transposed convolutional layers. These layers up sample the input to generate the final image output. Throughout the network, batch normalization and activation functions such as ReLU ensure stable training and promote non-linearity, while the final activation function, typically sigmoid, scales the output to the desired image range. By integrating GloVe embeddings into the generator network, it enable the model to leverage semantic information from the text to produce images that align more closely with the provided descriptions.

Discriminator Network

To initialize the discriminator network, layers are designed to accept both images and corresponding GloVe text embeddings as input. The images serve as the visual content to be evaluated, while the GloVe embeddings provide the semantic context derived from the textual descriptions. These embeddings are concatenated with the image features extracted through convolutional layers, facilitating the integration of textual information into the image evaluation process. The concatenated features are then processed through additional convolutional layers to extract higher-level representations. Subsequently, these representations are flattened and passed through dense neural layers to compute the final discrimination score. Throughout the network, batch normalization and activation functions like Leaky ReLU promote stable training and introduce non-linearity. Finally, a sigmoid activation function is typically applied to the output layer to produce a probability score indicating the authenticity of the input image-text pairs. By incorporating GloVe embeddings into the discriminator network, it enable the model to consider both visual and semantic information when distinguishing between real and generated image-text pairs, enhancing the overall fidelity and coherence of the generated images.

Training Procedure

The training procedure involves initializing the generator and discriminator networks with architectures designed to accept both image and corresponding GloVe text embeddings as input. These networks are simultaneously trained using a dataset consisting of aligned image-text pairs. During each iteration of training, a batch of such pairs is sampled, and random noise vectors are generated as input for the generator. The textual descriptions are converted into GloVe embeddings and concatenated with the noise vectors before being fed into the generator to produce fake images. The discriminator is then trained to distinguish between real image-text pairs and the generated counterparts by computing its loss for both types of pairs and updating its weights accordingly. Conversely, the generator is trained to produce images that fool the discriminator, maximizing the discriminator's loss while minimizing its own. This adversarial training process continues iteratively until convergence, as determined by the quality of the generated images and the stability of the discriminator's loss. Throughout training, hyperparameters such as learning rates may be adjusted, and the model's performance can be periodically evaluated using validation data. By integrating GloVe embeddings into the training procedure, the CGAN leverages semantic information from textual descriptions to produce visually coherent and contextually relevant images.

Evaluation and Fine-Tuning

Metrics like Inception Score, Fréchet Inception Distance, or perceptual similarity metrics are used to evaluate the produced images' quality. Iterative adjustments are made to the GAN architecture and training process based on results from evaluations and user feedback. To increase image quality and variety, hyperparameters including learning rates, batch sizes, and network designs are changed. The goal of this iterative refinement procedure is to make the GAN perform better overall and make sure that realistic visuals are synthesized from textual descriptions.

RESULTS

After effectively integrating the functions and approaches previously discussed, the project is currently training a Generative Adversarial Network (GAN) to produce images from written descriptions. By bridging the gap between text and photorealistic picture, this novel approach has the potential to find use in a variety of sectors. The goal of the research is still to improve the model so that it can produce realistic, high-fidelity images that demonstrate the capabilities of artificial intelligence in visual synthesis.

Here are a few of the final images and their respective textual descriptions:

A tree

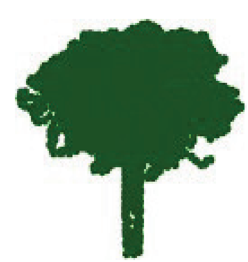

Fig. 2. Output of tree

A bike

Fig. 3. Output of bike

A chair

Fig. 4. Output of chair

An Airplane

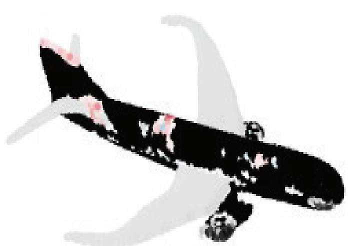

Fig. 5. Output of airplane

The variety of visuals that can match a single text description further compounds the problem.

Semantic Gap

Textual descriptions and visual representations differ significantly in their semantic content. While humans are able to bridge this gap with ease, machines frequently find it difficult to extract the context and subtle nuances from written descriptions in order to generate convincing visuals.

Mode Collapse

A common problem with GANs is mode collapse, in which the generator only generates a small number of different outputs, not covering the full range of possible images. This can lead to low-quality or repeated image production, particularly when dealing with a variety of textual inputs.

Fine-Grained Control

It is challenging to provide fine-grained control over the generated images depending on particular characteristics or information given in the text. A major problem is making sure that all the desired attributes listed in the text are appropriately reflected in the output photographs.

Evaluation Metrics

It is still challenging to determine the quality of generated photographs with accuracy. The quality and relevance of synthetic visuals to the input text may not be fully captured by common metrics like Fréchet Inception Distance or Inception Score.

Two commonly utilized measures are Inception Score (IS) and Fréchet Inception Distance (FID) to assess how well Generative Adversarial Networks (GANs) perform in producing realistic images. By evaluating the model's accuracy in predicting the right class labels for individual photos and the entropy of the class distributions, IS gauges the caliber and diversity of the generated images. However, FID provides a direct measure of similarity between actual and produced images by calculating the Fréchet distance between their feature vector distributions. FID assesses the realism and authenticity of generated images, whereas IS concentrates on image quality and diversity. In order to achieve a thorough evaluation of GAN performance, researchers frequently combine the two metrics, taking into account distributional similarity to real images as well as image quality. [2,3,8,10] The proposed models have 2.89±0.07 Inception Score (IS) and 47.13 Fréchet Inception Distance (FID)

LIMITATIONS AND CHALLENGES

Although there have been encouraging results in the domain of Generative Adversarial Networks (GANs) for text to picture synthesis, there are still many inherent limits and difficulties to overcome.

Data Complexity

Understanding complicated semantic linkages is necessary to produce high resolution images from text. It might be challenging to accurately convert text descriptions into graphic elements because they are sometimes unclear.

Enhancing text-to-image synthesis using GANs requires advances in multimodal data formats and machine learning methodologies. Furthermore, cutting-edge assessment measures and large, varied datasets are essential for expanding the boundaries of this area.

FUTURE SCOPE

Augmented Reality & Virtual Reality

By dynamically producing realistic graphics based on textual inputs, text-to-image synthesis utilizing GANs can enhance both AR and VR experiences. In AR/VR applications like games, training simulations, and virtual tours, this can improve immersion and realism.

Personalized Visual Content Creation

Turning ideas from conceptualization to physical prototypes is a crucial stage in the design and product development process. Traditionally, this technique entails hand drawing or rendering, which can take a long time and may not accurately reflect the original idea. An innovative method for this procedure is provided by Generative Adversarial Networks (GANs), which automate the creation of visual prototypes from written descriptions or conceptual drawings.

Medical Imaging and Scientific Visualization

In fields like medical imaging and scientific visualization, GANs can be utilized to generate realistic visualizations based on textual descriptions of biological processes, medical conditions, or scientific concepts. This could aid in data interpretation, educational purposes, and research visualization.

Design and Fashion Industry

By automatically producing graphic representations of textual design thoughts or fashion descriptions, GANs can help designers and fashion fans. This might encourage innovation in the fashion sector, expedite the design process, and make fast prototyping easier.

Cross-Modal Information Retrieval

GAN-based text to image generation can close the gap between systems for retrieving textual and visual information. GANs can facilitate more precise and extensive cross-modal search capabilities by producing images from textual queries and vice versa.

CONCLUSION

In conclusion, the research underscores the promise of merging cutting-edge machine learning methods with approachable interfaces, as exemplified by the text-driven image synthesis using GAN algorithm. By incorporating text-driven image synthesis, the study not only facilitates visualization and creative expression but also showcases technical mastery in GAN implementation and natural language processing. Moreover, the model's emphasis on user input and participation aligns with the objective of developing an innovative and user-focused picture synthesis system.

Looking ahead, the future scope of this idea is promising. Further advancements in machine learning techniques and interface design could enhance the flexibility and adaptability of the method for producing meaningful and visually appealing images in response to textual inputs. Additionally, exploring interdisciplinary collaborations could unlock new possibilities for leveraging text-driven image synthesis in various domains, such as multimedia content creation, virtual reality, and human-computer interaction. Overall, the research sets a solid foundation for future endeavors aimed at pushing the boundaries of text-driven image synthesis using GAN algorithms.

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UPI Payment Fruad Detection using Machine Learning

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ABSTRACT

As the popularity of UPI payments surges, so does the risk of fraud. To combat this, we've devised a project utilizing Convolutional Neural Networks (CNNs) to model the sequence of UPI transaction operations, aiding fraud detection. Here's how it works: Initially, the CNN is trained on typical cardholder behavior, learning the patterns of legitimate transactions. When a new UPI transaction occurs, the CNN evaluates it. If the CNN doesn't recognize the transaction as typical behavior with high confidence, it raises a flag for potential fraud. However, we're careful not to erroneously reject genuine transactions. Our experimental results showcase the effectiveness of this approach, demonstrating its superiority over existing techniques in fraud detection. By leveraging CNNs, we enhance the accuracy of fraud detection while minimizing false positives, thereby safeguarding users' UPI transactions. This innovative method serves as a proactive defense against the rising of UPI fraud, offering a reliable solution in an era where secure digital payments are paramount

INTRODUCTION

The rise of online shopping has revolutionized the way people make purchases, with a significant portion of the global population now opting for the convenience of virtual transactions. According to a study conducted by ACNielsen in 2005, approximately one-tenth of the world's population was engaged in online shopping, with Germany and Great Britain emerging as leading nations in terms of online shopping activity. Within this digital commerce landscape, the Unified Payments Interface (UPI) has emerged as a dominant mode of payment, constituting 59 percent of online transactions.

The adoption of UPI for online purchases has been substantial, with major retailers like Wal-Mart handling a significant volume of UPI transactions alongside regular purchases. However, as the number of UPI users continues to grow worldwide, so do the opportunities for fraudulent activities . Attackers seek to exploit vulnerabilities in UPI systems to steal sensitive information and perpetrate fraudulent transactions, posing a threat to both consumers and financial institutions. The magnitude of UPI fraud is staggering, with reports indicating a significant financial impact .For instance, in the United States alone, UPI fraud amounted to 2.7 billion in 2005 and was estimated to reach 3.0 billion in 2006,with a substantial portion attributed to online fraud. This underscores the pressing need for robust fraud detection mechanisms to safeguard against financial losses and maintain trust in online payment systems. One of the primary challenges in combating UPI fraud lies in the diverse nature fraudulent activities. Fraudulent transactions can be broadly categorized into two types: physical-card-based purchases and virtual-card- based purchases. In physical-card-based transactions, the cardholder physically presents their card to a merchant for payment. To carry out fraudulent transactions in this scenario, attackers must steal the physical card. However, in virtual-card-based transactions, only essential card information such as the card number, expiration date, and secure code is required, making it easier for fraudsters to conduct unauthorized transactions without the cardholder's knowledge.

Detecting fraud in virtual-card-based transactions presents a unique challenge, as perpetrators can exploit stolen card information without leaving physical traces. Traditional fraud detection methods of tenrely on analyzing spending patterns and detecting deviations from a cardholder's typical behavior. However, as fraudulent techniques evolve, there is a growing need for more advanced and adaptive fraud detection systems.

In response to the escalating threat of UPI fraud, re- searchers have explored various techniques leveraging data mining and neural networks for fraud detection. Ghosh and Reilly proposed a neural network-based fraud detection system trained on labeled UPI transaction data containing examples of various fraud types. Syeda et al. introduced parallel granular neural networks (PGNNs) to enhance the speed of fraud detection processes. Stolfo et al. employed meta learning techniques to build models of fraudulent UPI transactions, while Aleskerovetal. developed CARDWATCH, a neural learning-based system for UPI fraud detection. Despite the advancements in fraud detection technology, many existing approaches suffer from limitations such as the need for labeled data and the inability to detect new types of fraud for which labeled data is unavailable. Additionally, false positives— legitimate transactions mistakenly flagged as fraudulent— remain a significant challenge, as they can undermine the effectiveness of fraud detection systems and erode trust among users.

In light of these challenges, a novel approach utilizing Hidden Markov Models (HMMs) and advanced clustering techniques—such as Auto encoder , Local outlier Factor, And K means Clustering—has been pro- posed for UPI fraud detection. Unlike traditional methods, this approach does not rely on predefined fraud signatures, making it adaptable to evolving fraud patterns. Instead, it analyzes a cardholder's spending habits and detects anomalies indicative of fraudulent activity.

The Auto encoder, Local outlier factor, and K means Clustering-based approach offers several ad- vantages over traditional methods. By modeling UPI trans- action processing sequences as stochastic processes, it can effectively capture subtle deviations from normal spending behavior, enabling early detection of fraudulent transactions. Moreover, the use of advanced clustering techniques allows for a drastic reduction in false positives, ensuring that genuine transactions are not erroneously flagged as fraudulent. Central to the effectiveness of this approach is its ability to leverage the inherent characteristics of UPI transaction data. Unlike other methods that rely on labeled data, this approach utilizes unsupervised learning techniques to identify fraudulent patterns based on anomalies in spending behavior. By analyzing the sequence of transaction amounts, the model can uncover irregularities that may indicate fraudulent activity, even in the absence of explicit fraud labels. Furthermore, the Auto encoder, Local Outlier Factor, And K means Clustering-based approach addresses the challenge of false positives by prioritizing the detection of genuine transactions while minimizing the risk of erroneous alerts. This is crucial for maintaining the trust and confidence of both consumers and financial institutions in the UPI ecosystem.

The application of advanced clustering techniques and Hidden Markov Models presents a promising approach to UPI fraud detection. By harnessing the power of unsupervised learning and stochastic processes, this approach offers a robust and adaptive solution for combating evolving fraud threats in online payment systems. As the digital economy continues to expand, innovative approaches like these will play a crucial role in safeguarding financial transactions and preserving trust in online payment platforms.

RELATED WORK

Traditional work

In today's digital era, the Unified Payments Interface (UPI) has become a go-to method for financial transactions due to its simplicity and popularity. However, this increased reliance on digital platforms has also led to a surge in fraudulent activities. To address this concern, our paper proposes a robust UPI fraud detection system leveraging advanced machine learning techniques to bolster the security of digital transactions. Our system utilizes a comprehensive set of features, including transactional patterns, user behavior, and device information, to construct a holistic model for fraud detection. By harnessing machine learning algorithms such as super- vised learning classifiers and anomaly detection techniques, we analyze historical transaction data to identify patterns indicative of fraudulent activities.

To ensure the effectiveness of our model, we train it on a labeled dataset comprising both genuine and fraudulent transactions. This enable sour system to distinguish between fraudulent and non-fraudulent behavior accurately, enhancing its ability to detect and prevent fraudulent transactions.

In our research, we extensively reviewed existing literature on UPI payment fraud detection using machine learning. One notable study we examined focuses on credit card deception recognition, particularly emphasizing the random forest algorithm. This research achieved an impressive accuracy of 0.936, showcasing the efficacy of machine learning algorithms in fraud detection. Another paper we analyzed delves into addressing the challenge of highly imbalanced credit card fraud detection data. By synthesizing class labels and increasing the number of positive instances using unsupervised learning, this approach aims to improve classification performance, thereby enhancing fraud detection accuracy. Furthermore, we explored research on UPI fraud detection utilizing Convolutional Neural Networks (CNNs). This study specifically tackles the evolving landscape of digital banking and the urgent need for effective fraud detection mechanisms in UPI transactions.

Through our extensive review and analysis of various machine learning algorithms, we aimed to identify the most effective approaches for UPI fraud detection. By leveraging the strengths of different techniques and methodologies, we seek to develop a robust and reliable fraud detection system capable of safeguarding digital transactions and preserving trust in digital banking platforms. By developing a sophisticated fraud detection system that leverages transactional data and behavioral patterns, we aim to enhance the security and integrity of digital transactions, ultimately contributing to a safer and more secure digital banking ecosystem.

Neural Network Approach

Comparison of different machine learning models, including Decision Trees, Naive Bayes, Logistic Regression (with L1and L2 regularization), and K-Nearest Neighbors(KNN), we observed strong overall performance. Specifically, Decision Trees, Naïve Bayes and KNN displayed perfect average precision scores, indicating exceptional accuracy in identify- ing fraudulent cases with minimal false positives. Logistic Regression with L1 regularization also demonstrated high accuracy in terms of average precision. However, Logistic Regression with L2 regularization exhibited a slightly lower precision score, suggesting a higher rate of false positives compared to the other models.

Among these models, Convolutional Neural Networks (CNNs) stood out as particularly effective in detecting UPI payment fraud. CNNs leverage their ability to learn complex patterns and features from data, making them well- suited for tasks like fraud detection. Through their hierarchical structure and feature extraction capabilities, CNNs excel in identifying subtle patterns indicative of fraudulent behavior in UPI transactions. The superior performance of CNNs in fraud detection can be attributed to their capacity to capture intricate relationships within transactional data. By analyzing sequential patterns and extracting relevant features, CNNs can identify anomalies that may indicate fraudulent activity with high accuracy. Comparison of machine learning algorithms revealed that Convolutional Neural Networks(CNNs) out performed other models in detecting UPI payment fraud. Their ability to learn complex patterns and extract relevant features from transactional data makes them a valuable tool for safeguarding online payment systems against fraudulent activities. As the field of machine learning continues to evolve, leveraging advanced techniques like CNNs will be essential for enhancing the security and reliability of online payment platforms.

METHOD USED FOR UPI FRAUDS DETECTION

The main challenge of using this dataset is to predict fraud is the highly imbalanced distribution of fraud. First dataset is classify model along with libraries. Then dataset is used to removing the null values. Also feature selection of the dataset of input parameters given to the model and this model is part of the prediction. This dataset contains information about many transaction, and some of them are fraudulent . This helps the system to work better and more smoothly. This dataset has details about the increasing risk of online financial fraud, shoeing how hard it is to get this kind of data. The biggest technical problem it presents for predicting fraud is that there are many more normal transactions than fraudulent ones, making the detection more tough. So we compare different machine learning algorithm to find which algorithm gives more accuracy.

Logistic Regression

Logistic regression, a fundamental machine learning algorithm, is widely employed in both binary and multiclass classification problems. Beyond its application in classification tasks, logistic regression also finds utility in detecting financial misstatements, serving as a valuable tool in fraud detection and risk assessment within financial systems. The essence of logistic regression lies in constructing a predictive function that can accurately classify data into different categories. The first step involves defining the prediction function, which typically involves the use of a sigmoid function. The sigmoid function transforms input values into probabilities, making it particularly well-suited for classification tasks. By applying the sigmoid function to the linear combination of input features and model parameters, logistic regression generates probability scores that represent the likelihood of belonging to a particular class.

Once the prediction function is established, logistic regression proceeds to evaluate its performance using metrics such as accuracy score. The accuracy score quantifies the model's ability to correctly classify instances, providing insights into its effectiveness in making predictions. In Python, libraries like scikit-learn offer convenient functions for computing accuracy scores, simplifying the evaluation process.

K-nearest neighbor

K-Nearest Neighbors (KNN) is a supervised machine learning algorithm commonly utilized for both classification and regression problems. In the realm of credit card trans- actions, KNN has proven to be a valuable tool for detecting fraudulent activities. It stands out for its simplicity and ease of understanding, making it a popular choice among data scientists and analysts. In essence, KNN operates by classifying a data point based on the majority class of its k nearest neighbors in a feature space. It doesn't make any assumptions about the underlying data distribution, earning it the label of a non- parametric algorithm. This flexibility allows KNN to adapt well to different types of datasets and problem domains. In the context of credit card fraud detection, KNN works by analyzing various features of transactions, such as trans- action amount, time of transaction, location, and others. By comparing these features with those of known fraudulent and legitimate transactions, KNN can identify patterns indicative of fraudulent behavior.

One of the key advantages of KNN is its performance. Studies have shown that KNN often outperforms existing techniques in detecting fraudulent transactions. Its ability to consider the local structure of data points makes it particularly effective in scenarios where fraudulent transactions may exhibit subtle differences from legitimate ones.

Support vector machine

Support Vector Machine (SVM) stands as a formidable machine learning algorithm renowned for its prowess in classification tasks. As a supervised learning method, SVM leverages labeled training data points to effectively classify new data points. The algorithm's primary objective lies in delineating decision boundaries, represented by hyper planes, that segregate different classes within the data.

SVM excels in handling classification problems by discerning intricate patterns in the data and establishing optimal boundaries to separate distinct classes. It operates under the principle of maximizing the margin, which entails identifying the hyper plane that maximally distances it self from the nearest data points of each class, thereby enhancing generalization and robustness.

Two main variants of SVM exist: Linear SVM and Non- linear SVM. Linear SVM delineates decision boundaries in a linear fashion, making it suitable for datasets with linearly separable classes. On the other hand, Non-linear SVM employs kernel functions to map data points into higher-dimensional spaces, facilitating the identification of nonlinear decision boundaries, which proves beneficial for datasets with complex class distributions.

The hyperplane generated by SVM serves as the boundary of decision points, effectively demarcating the regions corresponding to different classes. Through careful optimization, SVM aims to strike a balance between maximizing the mar- gin and minimizing classification errors, thereby enhancing its predictive capabilities.

Decision Tree

Decision trees are a fundamental tool in machine learning, particularly for creating decision support systems. They operate by recursively partitioning the feature space into segments that correspond to different classes or outcomes. This binary classification process involves several key terminologies such as root node, leaf node, splitting, branch, pruning, and parent. The root node represents the initial point from which the decision tree begins its classification process. From the root node, the tree branches out into intermediate nodes, each of which represents a feature or attribute in the dataset. These intermediate nodes then split into further nodes or leaf nodes, which are the final endpoints of the decision tree. Each leaf node corresponds to a specific class or outcome. The process of splitting involves identifying the most informative features at each node to partition the data into subsets that are as homogenous as possible with respect to the target variable. This splitting process continues recursively until a stopping criterion is met, such as reaching a maximum depth or minimum number of samples in a node. Pruning is a technique used to prevent overfitting by removing unnecessary branches or nodes from the tree. This helps improve the generalization ability of the model and reduces the risk of capturing noise in the data.

In a supervised learning context, decision trees are trained using labeled data, where each instance is associated with a known class or outcome. Once trained, the decision tree can be used to predict the class labels of unseen instances by traversing the tree from the root node to a leaf node based on the feature values of the instance.

Random forest

Random Forest is a powerful machine learning algorithm that combines multiple decision trees in a unique way to make predictions. In essence, it creates an ensemble of decision trees, where each tree is trained on a different subset of the data and incorporates an element of randomness. This randomness is introduced during both the creation of the Individual trees and the selection of features used for splitting at each node.

The Random Forest algorithm works by generating a multitude of decision trees, each trained on a random subset of the data and a random subset of features. This diversity helps to reduce overfitting and improves the generalization capability of the model. Once the Random Forest has created these individual trees, it aggregates their predictions to make a final prediction.

When making predictions using a trained Random Forest model, each tree in the ensemble provides a prediction for the target variable based on the input features. The final prediction is then determined by combining the predictions of all the trees, typically through a simple voting mechanism. This ensemble approach tends to produce more robust and accurate predictions compared to a single decision tree.

CONVOLUTION NEURAL NETWORK

Convolutional neural network is the most popular algorithm of machine learning. CNN is used to predict the accurate output of the image. Basically CNN is used in computer vision to interpret the image and visual data. The architecture of convolutional neural network is

Input layer

In the input layer, data is processed and transmitted to the hidden layer. This process involves weights such as W1, W2, etc., which determine the strength of connections between input nodes and hidden nodes. These weights play a crucial role in shaping the network's ability to extract features and learn from the input data. By adjusting these weights during the training process, the neural network can optimize its performance and accurately represent complex relationships within the input data.

Hidden layer

In CNNs, multiple hidden layers process inputs from the input layer and feed them to the output layer. These hidden layers, like convolution, pooling, and fully connected layers, perform specific functions on the input data. Convolution layers extract features, pooling layers reduce dimensionality, and fully connected layers classify the data. The number of hidden layers varies based on the data size and complexity, allowing CNNs to effectively learn and extract relevant

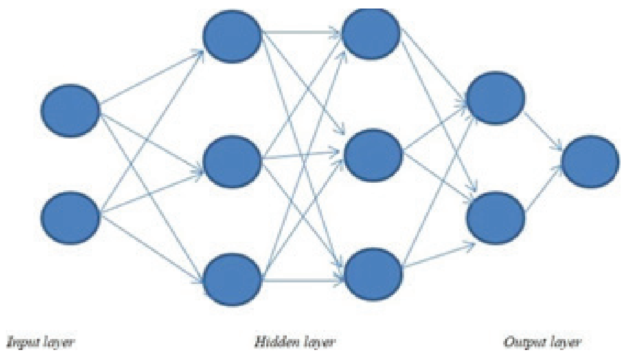

Fig.1.ConvolutionNeuralNetwork

Output layer

The output layer of a neural network receives the final result after processing input data through multiple layers. It consolidates the network's computations and produces the ultimate output, which could be predictions, classifications, or any desired outcome based on the network's task. This layer plays a critical role in generating meaningful insights or actions based on the information processed by the neural network

ARCHITECTURE

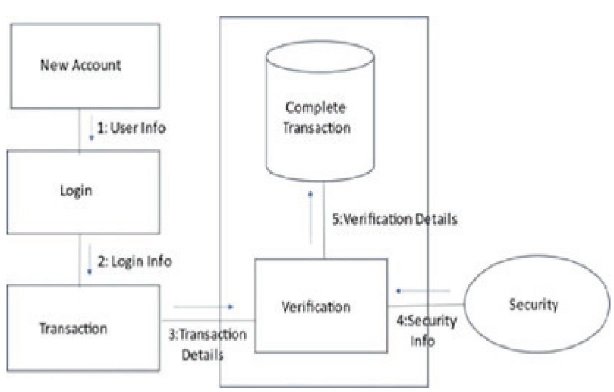

Fig.2.Architecture

MODULE DESCRIPTION

1. New Card Enrollment: Customers provide their contact details to enroll a new card. They are also prompted to create a unique login and password for future use. This step streamlines the process of card activation and sets the foundation for secure user authentication.
2. Login: The login module allows registered users to access additional resources on the website by entering their username and password. This step serves as a gateway to personalized services and ensures that only authorized users can access sensitive information or perform specific actions.
3. Security Information: In this module, users provide additional security details, which are securely stored in the database. If the card is lost or compromised, the security information module acts as an extra layer of protection. Users must correctly answer a set of predefined questions to verify their identity before proceeding to transaction processing. This robust security measure prioritizes informational privacy and self- determination, offering users a trusted means to safeguard their personal and confidential data.
4. Transaction Processing: The system facilitates UPI transactions by providing a communication interface between vendors and UPI transaction owners. When a transaction is initiated, a unique transaction number is generated and stored, along with relevant transaction details. This stream- lined process ensures efficient and secure transaction processing, enhancing the overall user experience.
5. Verification: Verification is a crucial step in ensuring the integrity and security of transactions. When a transaction quality is initiated, verification information is provided by a third- party verifier based on confidential information held by the initiating party. This verification process adds an extra layer of security by confirming the authenticity of the transaction. If the provided card number is correct, the transaction proceeds as intended. However, if the card number is incorrect, the user is notified via email, informing them that the card has been blocked to prevent further unauthorized transaction.

RESULT ANALYSIS

Performance

With the surge in digital transactions, especially via the Unified Payments Interface (UPI), the specter of fraudulent activities looms large. Fortunately, numerous UPI fraud detection systems harness the power of advanced machine learning techniques to fortify the security of digital trans- actions. These systems employ an array of features, en- compassing transactional patterns, user behavior, and device information, to construct robust models for fraud detection. By tapping into machine learning algorithms like supervised learning classifiers and anomaly detection techniques, these systems scrutinize historical transaction data, uncovering patterns indicative of fraudulent behavior.

Beyond UPI, similar methodologies extend to credit card fraud detection. Utilizing machine learning algorithms such as random forest, linear regression, XG Boost, K-Nearest Neighbors, Support Vector Classifier, Linear Discriminant Analysis, and Gaussian Naive Bayes, analysts dissect credit card transactions to sniff out deceitful activities. These algorithms undergo rigorous evaluation, with metrics like accuracy, precision, recall, and F1-score gauged against the ROC curve plotted from the confusion matrix, illuminating their performance.

The fusion of TensorFlow with machine learning emerges as a potent tool in erecting anti-fraud prediction models for UPI transactions. Trained on historical data, these models wield the power to forecast potential UPI payment theft in advance, with the recall rate and accuracy rate serving as pivotal performance metrics Fig. Confusion matrix of attributes

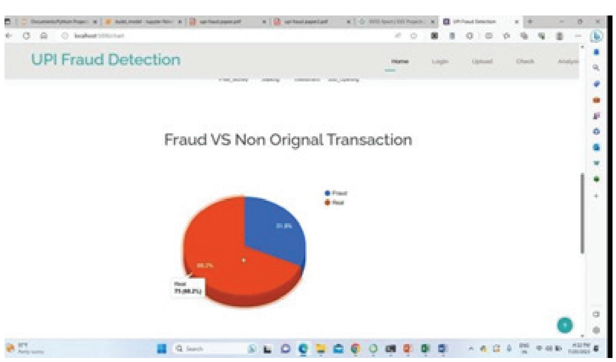

Fig. 3. Analysis

machine learning algorithms, including random forest, linear regression, XG Boost, K-Nearest, Support Vector Classifier, Convolutional Neural Network (CNN), and Gaussian NB. They meticulously assessed these algorithms based on key metrics like accuracy, precision, recall, and F1- score, while also constructing ROC curves from the confusion matrix to gauge performance. Their findings underscored the algorithm that excelled across these metrics as the optimal choice for fraud detection. However, the study didn't shy away from revealing the hurdles posed by class imbalance and the evolving statistical characteristics of transaction patterns over time.

CONCLUSION

The fusion of machine learning algorithms with the Tensor Flow library marks a substantial leap forward in enhancing the efficacy of fraud detection systems within digital payment platforms. Through rigorous experimentation, these systems have showcased their ability to mitigate financial losses stemming from fraudulent activities. Moreover, they of for the promise of heightened interpret ability and decreased development costs, which is a boon for financial striving to fortify their security measures while optimizing resources.

By subjecting various machine learning algorithms to comparative analysis, researchers have pinpointed the most efficient and accurate models for real-time fraud detection. This empirical approach has not only bolstered the reliability of fraud detection systems but has also instilled greater trust and confidence in digital transactions.

The experimental findings serve as a testament to the transformative impact of integrating machine learning with cutting-edge technologies like TensorFlow. They underscore the pivotal role of advanced analytics in safeguarding financial transactions against the ever-evolving tactics of fraudsters. With each iteration, these systems evolve to better anticipate fraudulent behavior, there by safeguarding the interests of both financial institutions and consumers alike.

Moreover, the heightened interpretability offered by these systems equips stakeholders with valuable insights into the underlying mechanisms driving fraudulent activities.

This transparency not only facilitates more informed decision-making but also enables proactive measures to be taken in response to emerging threats.

Furthermore, the reduced development costs associated with these systems pave the way for greater accessibility and adoption across the financial industry. This democratization of fraud detection technology ensures that even smaller institutions can leverage state-of-the-art tools to safeguard their operations and customer assets.

As digital transactions continue to proliferate, the imperative for robust fraud detection mechanisms becomes increasingly pronounced.

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"Praharnanuveshan"- A System to Remotely Track Police Officers Deployed on Duty

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ABSTRACT

In today's world, it's really important to watch over police officers when they're working. This helps make sure they're doing their job right and that resources are being used wisely. The idea is to use modern technology to keep track of police officers while they're on duty.

The proposed system provides a complete solution for managing and tracking officers remotely while they are on active duty by utilizing contemporary technologies. The purpose of the proposed system is to create a thorough tracking platform that would improve accountability and operational efficiency while on duty. The program tracks and monitors police officers' whereabouts and activity in real time while they are on duty by utilizing GPS technology. Officers and supervisors can coordinate and communicate more easily thanks to the platform. To improve community trust, public safety, and overall law enforcement efficacy, police departments should work to guarantee that officers are always available when needed and within designated zones.

KEYWORDS: *GSM, Human tracking, IoT Application, Monitoring system.*

INTRODUCTION

In an increasingly connected and data-driven world, ensuring the safety and efficient deployment of police officers on duty is of paramount importance. The "Praharnanuveshan" system, based on the Internet of Things (IoT) and Global Positioning System (GPS) technologies, represents a cutting-edge solution designed to address the challenges and enhance the security of law enforcement agencies [5] [6] [8] [9]. "Praharnanuveshan" represents a comprehensive and innovative solution for the remote tracking of police officers deployed on duty, leveraging state-of-the-art technology to enhance the security, response times, and overall effectiveness of police personnel. The primary goal of "Praharnanuveshan" is to provide real-time visibility and monitoring of police officers as they perform their duties, whether it is patrolling the streets, responding to emergencies, or engaging with the community. By equipping each officer with advanced technological components, including an Android Smartphone, GSM module, Microcontroller, Lora (Long Range) communication, microphone, GPS module, speaker, and a reliable battery source, the system facilitates seamless communication, data transmission, and location tracking [4]. Our lives are becoming increasingly digital and modern in a wireless environment. There are several wireless communication options that can be used with intelligent wear [2]. RFID tag knowledge is a known wear technology, and its working can be changed and simplified. Radio frequency identification (RFID) is a technology that make practice of a radio frequency waves to track and find people, animals, and objects. An RFID scheme contains of an RFID reader and an RFID tag [6] [7] [8] GPS antennas is used for military outdoor and indoor applications. This particular antenna enabled the GPS anchor node to function at wide- range power by adjusting the startup time [8] [6].

GPS can also be combined with WSN to allocate the longitude and latitude positions of the surrounding [6] [11]. For the accurate situation of the GPS, five standards are followed. i) Receiver sensitivity ii) channel choice, and iii) temperature difference to advance the correctness level [10] [11]. IoT has revolutionized the way we collect, transmit, and analyze data, enabling real-time monitoring and control of a wide array of devices and systems [4]. Devices interconnectedness allows for the seamless exchange of critical information, making it possible to remotely track police officers' movements and respond promptly to any emergencies [3] [4] [5] [11]. By equipping police officers with GPS-enabled devices, it is possible to track their movements, ensuring that they are deployed to the right locations and that their safety is always a top priority [2] [4]

[5] [8]. The ”Praharnanuveshan” system represents a significant step forward in the use of IoT and GPS technologies to improve the safety and efficiency of police officers deployed on duty. By providing real-time tracking, emergency response capabilities, and data-driven insights.

Detecting an object and tracking it uninterrupted is a very difficult task, and it not give 100% correct results. The present system encompasses a comprehensive structure for tracking human patterns across various coordinates and shows the feasibility of an end-to-end human tracking system using available methods in segmentation, movement observation and tracking [1] [3] [9].

There is man algorithms like as Kalman algorithm, mean shift algorithm, and Camshaft algorithm. Between various algorithms analyzed, the Kalman algorithm seems to be best for constant tracking from frame to frame .i.e. it reduces data with noise and provide almost 100 % results [1] [9] [11]. So, there is a requirement to examine the performance of the available human tracking algorithms. Thus, the study we analyzes and consideration will be taken based on main parameters, such as execution time, movement of the human relative to the distance of the human from the GSM module, and its positioning. It like hope that the output produced from this analysis can be used, like, as supervision and,like, outline in further future study in developing, like, a strong algorithm for like, human tracking [1] [6] [10] [11].

LITERATURE SURVEY

Human tracking is applied in a variety of domains, including autonomous navigation, human-computer interaction, and surveillance. Conventional methods, such as Camshift, are acknowledged for their utility but are criticized for their susceptibility to issues like illumination fluctuations, occlusion, and complex backdrops. To overcome these challenges, modern approaches for combining deep learning have emerged, including convolutional neural networks (CNNs), which extract key features straight from raw data. The study also includes information on the Kalman filter, a recursive approach commonly used for state estimation in dynamic systems like object tracking. Its ability to improve robustness to noise and uncertainty is noted. It offers the framework for the suggested modification to the Camshift method, which aims to alleviate the limitations by integrating knowledge [1].

COVID-19 transmission mitigation methods, with a focus on automating tracking, tracing of contacts, and geofencing operations. It highlights the limits of traditional manual contact tracing approaches, which frequently rely on users' memory recall and may hence fail to precisely capture exposures in the moment. Furthermore, the research sheds light on the limitations of established ways to deal with the pandemic's scope and dynamics. The literature survey advocates for a paradigm change towards more efficient and effective solutions through the use of IoT-based technology. Wearable gadgets, such as wristbands, are viewed as promising solutions for streamlining the tracking process while maintaining privacy and data security standards. Drawing on previous research, the study gives a thorough assessment of available IoT-based solutions for COVID-19 management [2].

The innovative method of collecting and organizing data on people's movements is discussed. The study proposes a smarter way for determining where devices are and identifying significant traits, which is useful for comparing comparable structures. One crucial concept is a system that monitors how users move in augmented reality. It uses two approaches, KLT and ORB, to determine where someone is in each frame of motion by referencing data from the preceding frame. This makes it easier to effectively track people as they move around, improving how we collect and organize data about their movements [3].

The human tracking system proposed in this paper, which is built on GPS and Internet of Things devices, successfully tracks, monitors, and aids individuals in a variety of settings by incorporating recent sensor developments such as GPS and gravity sensors. It addresses situations involving youngsters in congested settings and anyone in need of quick assistance,such as patients. The main goal of this device's development was to provide real-time position tracking, which would simplify the tracking procedure and lessen the operational burden on various organizations. The system is intended to promptly notify the appropriate authorities when assistance is required due to illness or inexperience, allowing for prompt intervention [4].

System for Tracking Humans the Internet of Things (IoT) (2020), which is based on GPS, presents a novel method of tracking and monitoring people using contemporary sensors, such as GPS and gravity sensors. This system is made to serve a variety of users, including patients and children in crowded areas who may need immediate assistance. Its main goal is to make tracking easier by cutting down on the overhead and expenses that come with having several agencies watch over one person. Its innovative approach makes it possible to follow a person's whereabouts in real time and guarantees that people in need—like people in need of medical attention or kids in danger—get help quickly by alerting the appropriate authorities [5].

This device allows for complete tracking by combining RFID and GPS antennas. RFID guarantees accurate tracking inside school grounds, supporting administrative duties like attendance and access control. However, GPS enables real- time surveillance during outdoor activities and trips, extending tracking beyond school borders. Through the integration of these technologies, the system provides a comprehensive solution for improving overall safety, meeting the needs of both specific and general tracking applications [6].

A human tracking system established specifically for enclosed spaces like buildings or restricted places is the subject of this study. To effectively monitor people within the authorized space, it highlights the use of IP cameras for visual surveillance and RFID sensors for precise geolocation. The system's integration of various technologies is emphasized as a crucial component that improves security measures and streamlines access control processes. This investigation also emphasizes the usefulness and adaptability of the suggested method, indicating that it may be appropriate for a variety of situations requiring accurate human tracking in enclosed spaces [7].

The system for tracking people that combines GPS and RFID technology for both inside and outdoor use is covered in the paper. It demonstrates that in both scenarios, there is a comparable discrepancy between GPS readings and actual field positions. But the authors point out that using RFID identification greatly improves the system's performance indoors, especially in locations where prompt detection is essential, such as sports complexes or amusement parks. They make the case for the possible advantages of adding IP cameras indoors for upcoming system upgrades. The study's overall findings emphasize how crucial it is to combine RFID and GPS for thorough human surveillance in a variety of settings [8].

It contrasts the performance of three algorithms: partial least squares, mean shift filter, and Kalman filter. Taking into account variables like movement, distance from the camera, and changes in illumination, the study discovered variations in each method's performance. The results offer valuable perspectives for enhancing tracking algorithms in the future, proposing additional investigations into group tracking and the utilization of diverse datasets. The study's overall goal is to improve people tracking accuracy in diverse settings [9].

The paper explores the performance of a Human Tracking Application based on the Global Positioning System (GPS) within a closed area, presented in the Internetworking Indonesia Journal in 2014. The mobile application effectively determines and updates the position on the map but encounters a critical issue with a displacement of up to 4 meters. This highlights the necessity for further enhancement in future versions.

Subsequent research aims to refine human tracking within closed areas without requiring pre-mapping, thus improving the application's usability in various indoor environments.[10]

The proposed method is designed to track persons simultaneously. It is determined from the test sequence produced using various pre-processing techniques that human tracking varies from frame to frame and that several parameters can impact tracking outcomes. The tracking algorithm the Kalman filter is best in relations of accuracy, dependability and runtime, according to experimental findings. Given that it nearly always finds the right person, eigenface-grounded PCA technique seems to be more useful algorithm for the recognition of rough persons. Specifically, when dealing with intricate video sequences, the application of multiple pre-processing techniques to identify persons in every frame of the series yields satisfactory outcomes. [11]

PROPOSED METHODOLOGY

The proposed system is to make it easier to track police officers who are out on duty remotely, improving operational supervision and guaranteeing the security and responsibility of law enforcement professionals. This system enables law enforcement authorities to have centralized control as well as coordination by enabling real-time tracked officers' locations and actions. Through the use of cutting-edge GPS technology coupled with wearable technology or mobile devices, the system allows for continuous tracking of officers' movements throughout their shifts. In order to create virtual boundaries for officers' activities and define assigned patrol regions, the system can also include capabilities like geofencing.

Alerts and notifications can be quickly delivered to given supervisors or command centers in the event of emergencies or missteps from required tasks. Furthermore, it is possible to incorporate extensive data monitoring and reporting features in order to monitor past movement trends, assess operational effectiveness, and guarantee protocol and procedure adherence. All things considered, the suggested remote tracking system is an essential instrument for improving safety, effectiveness, and transparency in law enforcement activities [2].

System Architecture

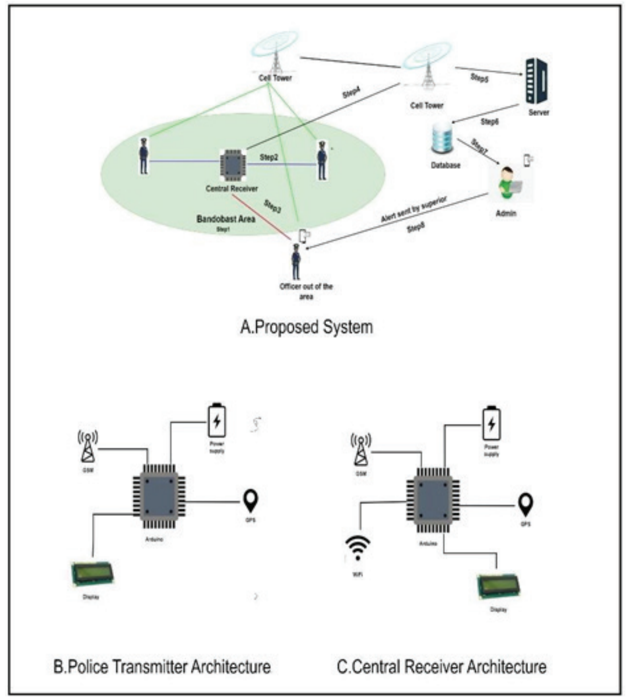

Fig. 1. System Architecture

Central Command Center

This is the central hub that monitors officer locations and coordinates activities. It houses the following:

- Database Server: Stores and manages officer location data and potentially other relevant information.
- Command Interface: Allows authorized personnel to send alerts or messages to officers in the field (optional functionality).

Police Officer Transmitter

A portable device carried by each officer. It includes:

- GPS Module: Continuously acquires the officer's location data (latitude, longitude). GSM Module: Connects to the cellular network (MDN) for data transmission.
- Speaker (Optional): May be used to receive audio alerts or messages from the central command (depending on system design).
- Battery: Powers the transmitter.

Communication Flow

- Officer Enters Bandobast Area: An officer equipped with a transmitter enters the designated area.
- Location Data Transmission: The officer's transmitter continuously transmits location data using the GPS module.
- Cellular Network Connection: The GSM module connects to the cellular network provided by cell towers in the area.
- Data Sent to Server: The transmitter sends the GPS data over the cellular network to the database server.
- Alert System (Optional): A central command can potentially send alerts or messages to officers' transmitters through the GSM cellular network. (This functionality depends on the specific system design)
- Database Storage: The server stores the received location data from officers.

Methodologies

To create a system for remotely tracking police officers deployed on duty, a structured methodology process is crucial. Initially, thorough research and stakeholder consultations, including law enforcement agencies, supervisors, and officers, will be conducted to gather requirements effectively.

Following this, an evaluation of suitable technologies like GPS, RFID will be undertaken, considering factors such as accuracy, reliability, and cost-effectiveness. The system's design will entail architecting both hardware (e.g., GPS devices, central servers) and software (e.g., web- based platform). Subsequently, development will commence, focusing on creating user-friendly interfaces, real-time tracking system, and robust data storage and communication protocols. Integration of software with selected hardware components will ensure seamless functionality.

Rigorous testing will be conducted to ensure system reliability, security, and performance across diverse scenarios. Deployment will occur gradually, starting with a pilot phase involving a select group of officers and supervisors for real- world testing and feedback collection. Continuous refinement based on user feedback, along with training and support for system adoption, will be prioritized. Post-deployment, ongoing monitoring and maintenance will ensure the system's sustained efficiency and effectiveness over time. This comprehensive approach ensures the successful development and implementation of the remote tracking system for police officers on duty. The GPS visualization device can be used to trace a person's routes if it is important to continuously monitor their movements within an organization [2].

In addition, geofencing will be incorporated for defining specific areas of interest or restriction, alerting if officers deviate from routes or enter restricted zones. Data encryption protocols will secure sensitive information, ensuring compliance and mitigating security risks. Regular audits and updates will maintain relevance and legal compliance. Collaboration with legal experts and civil liberties organizations will address privacy concerns and ensure transparency.

RESULT AND ANALYSIS

Detection System

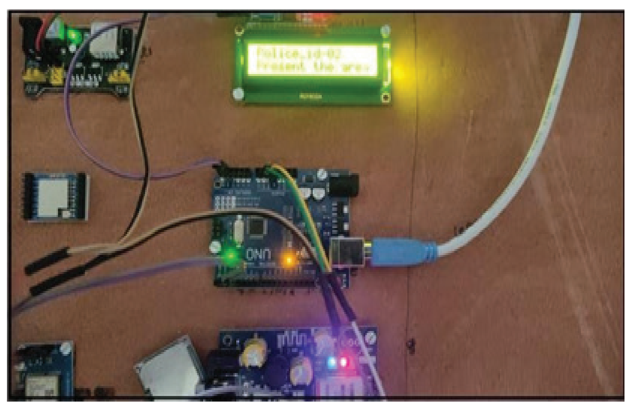

Fig. 2. Detection System

Each police officer must carry a selected tracking device while on duty this device enables real-time tracking of the officer's position and ensures accountability during allocated tasks.

Supervisors take access to a centralized monitoring system where they can outlook the place of all officers in real time. The tracking system continuously informs the officers location providing supervisors with real-time information about their movements and activities.

Position Analysis

If the officer is performing his duty in the designated area the supervisor will see a message on the device indicating that the officer is present in that area.

Fig. 3. Police Present at the designated area

If the officer moves out of the selected area the supervisor will see a message on the device indicating that the officer is in an out-of-bound area.

Fig. 4. Police Outside the area

CONCLUSION

In conclusion, a major advancement in law enforcement technology has been made with the deployment of a system that uses GPS (Global Positioning System) and Internet of Things devices to remotely track police officers who are on duty. Law enforcement agencies may effectively track the whereabouts of their officers in real time by integrating GPS and Internet of Things technologies. This confirms increases officer safety, accountability and improves the use of different resources.

Enhanced response times to crises, better coordination during major events, and the capacity to examine officer mobility patterns for planned arrangement are just a limited of the many important advantages that this system provides. Furthermore, the system encourages community trust and accountability by offering a transparent and verifiable record of officer activity.

But the successful implementation of such a system requires giving serious thought to issues of data security, confidentiality, and the moral implications of ongoing monitoring. To guard against possible misuse, law enforcement organizations must set explicit policies and procedures for the gathering, storing, and use of officer location data. Eventually, by utilizing the capabilities of GPS and IoT technologies, the installation of a remote tracking system for police personnel has the potential to advance law enforcement operations. This approach can protect people's rights and privacy while enhancing public safety if appropriate oversight and safeguards are in place. It will take more investigation and development in this field to improve the technology and deal with any remaining problems.

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Dynamic Load Balancing for Cross Region Tasks in Cloud Computing using Round-Robin

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ABSTRACT

In recent years, “Cloud computing” is a well- defined approach to computing services where resources and data are accessed from cloud service providers over the internet through dedicated hardware and software. It essentially offers users an economical collection of computer services and resources. The sharing of these resources, however, can lead to potential issues related to their availability, creating a challenging situation. To address this, load balancing comes into play, which involves the equitable distribution of network traffic across multiple servers. This ensures that no single server becomes overloaded, promoting a more balanced distribution of tasks. In turn, load balancing enhances application responsiveness and improves user accessibility for websites and applications. This paper aims to provide in deep understanding of the concept of load balancing with microservices architecture.

KEYWORDS: *Cloud computing, Load balancing significance, SWOC analysis, goals, Round-Robin.*

INTRODUCTION

Cloud computing represents a web-based and internet-centric advancement in communication technology, providing a versatile platform for applications and services. It operates in a decentralized manner, offering location independence, device independence, and efficient computational processes.

The term “ubiquitous” aptly describes the cloud, indicating its omnipresence. Its contents are configurable and shareable, contributing to the development of extensive computing networks. Major industry players like Amazon, IBM, Google, and Yahoo leverage cloud services to deliver on-demand applications and services globally, eliminating the need for users to install them locally. Load balancing is integral to the efficient functioning of cloud computing. It involves the equitable distribution of workloads across various computing resources, such as servers, CPUs, and network connections. This ensures that no resource is underutilized, overloaded, or left idle for the time being. Load balancing plays a critical role in preventing deadlocks and overloads, contributing to enhanced network and resource performance. It is a significant challenge in cloud computing environments.

Dynamic load balancing for cross-region tasks in cloud computing environments using Eureka Server, a component of the Spring Cloud framework that provides service discovery and registration capabilities. Eureka Server enables the automatic detection of services and facilitates communication between distributed components, making it an ideal solution for orchestrating the dynamic load balancing across multiple regions.

The primary objective of this paper is to explore the design, implementation, and evaluation of a dynamic load balancing system leveraging Eureka Server to efficiently manage cross- region tasks in cloud environments.

MOTIVATION AND OBJECTIVES

Motivation

There are several main reasons for implementing the dynamic load-balancing in cloud computing using API gateways. First off, it distributes requests among servers to help manage high traffic, guaranteeing uninterrupted service even during peak hours. Second, it makes sure that requests are automatically routed to other servers in the event of a server failure, maintaining uninterrupted service. Additionally, by ensuring resource efficiency, this system lowers expenses. By connecting users to the nearest and the fastest servers, it also enhances the experience for people everywhere. Finally, it provides the flexibility to swiftly adapt to changes, improving overall operational responsiveness and smoothness.

Implementing dynamic load balancing for cross-region jobs utilizing cloud computing is driven by economic and strategic considerations in addition to technological ones. Effectively meeting consumer requests is one of the main sources of motivation. As a result of people accessing services from all over the globe, it is critical to guarantee consistent performance and dependability. Organizations can dynamically assign resources depending on demand patterns thanks to dynamic load balancing, which guarantees the best possible user experience regardless of location.

Objectives

1. To Identify cross region task and its Scheduling.
2. To handle the dynamic load by deciding the threshold limit across the region.
3. To execute a suitable algorithm according to condition.

LITERATURE REVIEW

Load balancing (LB), is one of the primary issues with CC. LB aims to balance cloud server computing so that no host is overworked or underworked. It has been discovered that conventional LB algorithms are insufficient and do not take FT efficiency parameters into account when operating. Thus, one of the primary issues in cloud environments is the study paper's identification of the necessity for the FT efficiency indicator in LB algorithms. Thus, a new algorithm that uses FT in LB is put out [1].

The amount of labour in the cloud increases rapidly as more users sign up. This means that scheduling a large number of heterogeneous jobs across several heterogeneous resources of different lengths is necessary. As a result, the study suggested an optimal scheduling technique for effective task scheduling and resource allocation that may allocate virtual machines to host and disperse the work [2].

Numerous publications about cloud-based dynamic load balancing. In summary, Cloud load balancing makes sure that website traffic is sent to servers that are accessible in an efficient manner. It ensures that customers can always access the apps and avoids downtime or issues related to machine breakdown [3].

An overview of cloud computing and its deployment techniques is provided. Next, this research paper offers a comprehensive overview of the importance of load balancing, the most widely used load balancing method in cloud environments, and its disadvantages. Finally, a study proposal to enhance the Round Robin load balancing technique has been submitted [4].

The DWLOAD (Dynamic Weight Loading Algorithm) algorithm is suggested for the virtual node-based dynamic weight server in conjunction with the actual application scenario. The DWLOAD algorithm determines the real-time weights of each server by evaluating the throughput, response time, and number of recent requests of the same microservice module deployed in different servers. It does this by using the smooth polling loading algorithm to create virtual nodes in batches. The weight table then contains a record of these outcomes. The research study's author suggested a dynamic, high availability load balancing technique for microservices to address the problem of microservice request load distribution [5].

The load balancer's load balancing technique is suggested to be a request load balancing algorithm as viewed by the microservice chain. Simulation studies demonstrate that the algorithm in this study can maintain a relatively decent performance in an environment where instances are unevenly distributed and for workloads between hosts, while also effectively reducing request latency in a complicated microservice chain environment [6].

The Modified Round Robin Load Balancing Algorithm is a useful microservices solution in an alumni management program. By splitting up requests over multiple servers, the system may respond to user inquiries more quickly and with shorter response times. Additionally, it can recognize and reroute requests from overloaded servers, improving overall system performance. Ultimately, one effective way to ensure the continued dependability and security of the Alumni Management program is to employ the modified Round Robin Load Balancing Algorithm [7].

Load balancing improves user experience and raises cloud computing's efficiency. dependent on the concept of cloud partitioning, this paper offers an enhanced load-balancing model for public clouds that has a switch mechanism to choose multiple strategies dependent on the situation. By applying game theory, the technique improves the efficacy and efficiency of the load balancing strategy in the public cloud environment [8].

Conventional load balancing algorithms were created for server farms and groups of clients to be positioned between centralized load balancers. However, in a distributed microservice design with client-side load balancer deployment, these approaches do not translate well. BLOC, a self-managing load balancing system, is presented to give users constant response times without requiring explicit signaling between nodes or a centralized information store [9].

A distributed system's load distribution issue is resolved by analyzing various iterations of the Round-Robin method, which enhances task response time and resource utilization. Overloading and underloading scenarios are avoided. The suggested method responds more quickly than the other approaches [10].

IMPORTANCE OF LOAD BALANCING

In cloud systems, load balancing is essential, particularly when handling heavy workloads that might quickly overwhelm a single server. The significance of load balancing increases in situations when certain performance indicators, including response time and service availability, are vital for business operations [1].

The primary purpose of load balancing is to efficiently manage incoming traffic by identifying available servers and redistributing the workload among them. This proactive approach ensures that no single server is overloaded, thereby preventing performance degradation and downtime. Load balancing acts as a mechanism to redirect traffic to available servers, ensuring that each server is actively engaged and none are left idle [1].

In the absence of load balancing, the risk arises that new virtual servers won't be able to handle traffic coming in an organized and efficient manner. This could lead to uneven distribution of workloads, causing certain servers to be overwhelmed while others remain underutilized.

Consequently, the overall system performance and responsiveness may suffer. Therefore, load balancing becomes a critical component in maintaining the stability, efficiency, and reliability of cloud environments, particularly in the face of varying and demanding workloads [2].

Table 1. SWOC analysis

Strengths	Weakness
Services are economically affordable Simple to understand and use Provides on-demand access It is independent of device and location Can be accessed all over the world Provides more storage Easy to setup and maintain	No internet means no cloud services Balancing of load is required Cloud security is abig t
Opportunities	**Challenges**
Agility Scalability Elasticity Monitoring	Possible Data Leak Demerits of encryption methods Unreliable firewall Loss of data

Thus, the SWOC analysis aids in making efficient use of cloud computing resources. Load balancing is necessary because the volume of incoming requests is unpredictable, heterogeneous, and fluctuates in frequency. To ensure that users receive seamless service during peak hours, load management must be done correctly. Reducing downtime requires effective resource management, which can be achieved by utilizing the right resource scheduling algorithms and procedures. Virtualization plays a crucial role in cloud computing since it is required for resource accessibility through virtual machines. In order to provide users with the greatest services with the least amount of downtime, load balancing is essential.

TYPES OF CLOUD COMPUTING LOAD BALANCING

Based on the present state of the virtual machine, load balancing can be divided into two primary categories: static and dynamic. They are listed below.

Cloud Computing's Static Load Balancing

Static load-balancing relies on pre-existing system information and data, such as processing power, storage needs, and client requirements. The system's specifications, including memory and storage capacity, processing speed, computation time, and job resource requirements, are already known. It adheres to a set of predetermined guidelines without requiring knowledge of the network's current state. This strategy works best when there is little difference in the load across the nodes because it is fast and effective but not extensible. The duration of operation is comparatively shorter than that of dynamic load balancing. This leads to an inaccurate distribution of resources because the associated servers cannot be found. Static load balancing has a significant drawback in that decision making places very little weight on the system's actual state; as a result, distributed systems with dynamic states are unacceptable. It is unable to take into account variations in the load during run-time since it does not take into account ongoing node monitoring.

Optimal: The data communication network uses organized approaches to acquire resource information, which is then provided to the load balancer so that maximum allocation can be done in a constrained amount of time. Suboptimal: A suboptimal solution will be selected if a load balancer is unable to make an accurate choice. Min-Min, Max-Min, Round Robin, Shortest Job First, Throttled load balancing, and Central LB are examples of static load balancing algorithms.

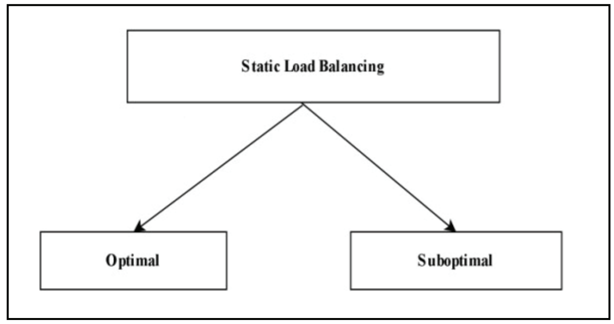

Fig. 1. Static Load Balancing Types

Cloud Computing's Dynamic Load Balancing

This type is more precise and effective since it makes decisions based on the system's current condition. Dynamic load balancing makes use of this adaptability to enhance performance by enabling jobs to move from an overloaded computer to an underloaded one. Additional advantages of dynamic load balancing include enhanced scalability, fault tolerance, and lower costs for greater efficiency that can also manage erratic processor loads. It continuously tracks the nodes' loading during processing in order to determine the workload on each node and adjust it accordingly. While fault tolerance and adaptability are advantages of dynamic load balancing techniques, their resource utilization is high and their stability is low [3].

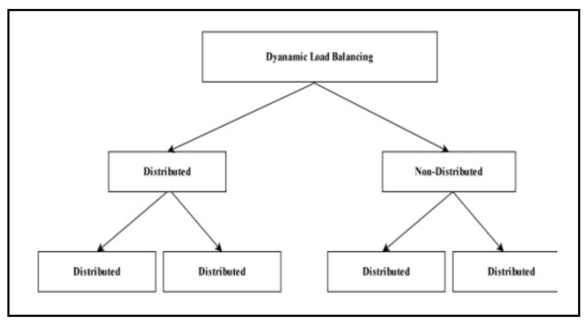

Fig.2. Dynamic Load Balancing Types

EXISTING SYSTEM

For load-balancing in a cloud computing context, the existing system uses a round-robin approach. The load balancer uses the round-robin method to choose the subsequent server that becomes available in a sequential fashion when a request reaches it. Each server receives an equal amount of the burden and distributes requests among itself in a circular pattern. The load balancer is the main part that takes in incoming requests and routes them to the right servers. Incoming requests are processed by the cloud infrastructure's computational resources or servers [4].

PROPOSED SYSTEM

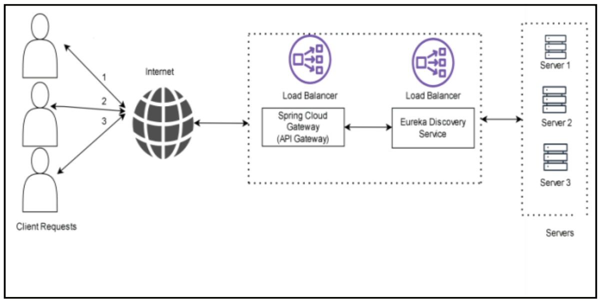

Fig. 3. System Architecture

The Proposed System aims to improve the load-balancing mechanism in a cloud computing environment by utilizing API gateways. To provide a centralized entry point for handling incoming requests, API gateways operate as go- betweens for clients and back-end services.

1. Configuring the server Eureka: To make service registration and discovery for microservices easier, deploy the Eureka server as a service registry. Set up every microservice such that it registers itself and provides host, port, and health status information to the Eureka server upon starting.
2. Implementing Microservice [6]: Using a framework such as Spring Boot, create microservice, each handling a particular task or capability. Each microservice should incorporate the Spring Cloud Eureka client library to allow for Eureka server registration and discovery.

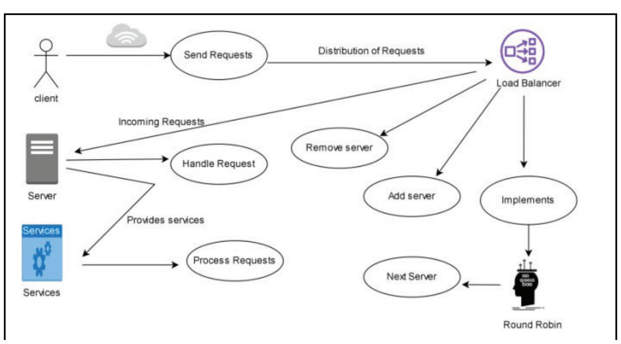

Fig.4. Use-Case diagram

1. Round Robin and Eureka Server Load Balancing: Set up the Eureka server to keep an updated list of microservice that are available and to periodically retrieve information about microservice registrations. Created a unique load balancing module for the Eureka server in order to apply the round-robin request distribution method. The round-robin technique is used by the Eureka server to choose the next microservice in a circularly upon receiving a client request.

Implementation

Setting Up Cloud Infrastructure:

- Provisioned virtual machines (instances) in multiple regions where the application needed to be deployed.
- Configured security groups or network access controls to allow communication between instances within the same region and across regions.
- Installed necessary software dependencies on each instance, such as Docker Engine or Java Runtime Environment (JRE), depending on the application's requirements.

Installed and Configured Eureka Servers:

- Selected one or more instances in each region to serve as Eureka servers.
- Installed Eureka Server on each chosen instance.
- Configured Eureka Server properties, such as region-specific configurations, in the application properties file.
- Started the Eureka Server instances.

Deployed Application Instances

- Packaged the application as containerized services using Docker containers or deployed it directly onto virtual machines.
- Registered each instance of the application with the respective Eureka Server in its region.
- Ensured that the application exposed health check endpoints that Eureka could use to monitor its status.
- Started the application instances, ensuring they

successfully registered themselves with the Eureka Server.

Implemented Round Robin Load Balancing with Eureka

- Developed a custom load balancer or utilized an existing one that supported the Round Robin algorithm.
- Configured the load balancer to retrieve the list of available instances from the Eureka Server using Eureka's REST APIs.
- Implemented the Round Robin algorithm to distribute incoming requests/tasks among the available instances retrieved from Eureka.
- Handled scenarios where instances became unavailable or unhealthy by dynamically updating the list of available instances retrieved from Eureka.

ROUND-ROBIN LOAD BALANCING ALGORITHM

Introduction

1. The Round-Robin algorithm for static load balancing is based on the system's software and resource knowledge from the past; the workload distribution decision is not solely based on the system's current state.
2. It assigns tasks in a round-robin manner, and the scheduling is a productive and successful time management strategy.
3. This algorithm selects the load-balancing nodes at random.
4. Data centers are responsible for managing and distributing load in cloud computing, which is an important task.
5. Round robin algorithm receives requests from users and processes them after relaying them to the data center controllers.
6. Time quantum, also known as slices of time,

Method

1. Initially, a circular queue holds all of the processors.
2. The scheduler assigns a server during a designated time slot to each processor in the queue.
3. The new procedures would be appended to the queue's end
4. The first process in the queue is chosen at random by the scheduler.
5. After being passed on from the server, the chosen process will run for the specified time slice and be added to the end of the queue when the time slice ends.
6. The server releases the process in the event that it finishes running entirely before the time slice.
7. After that, the server is allocated to the following process in the queue that is ready. In this sense, a round robin algorithm is used to process the user request in a circular fashion.

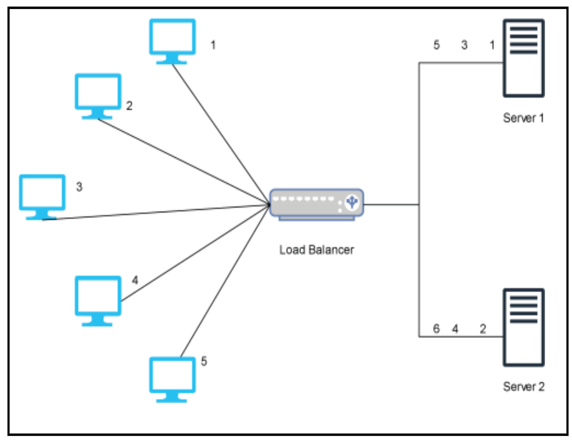

Fig. 5. Round-Robin Algorithm

Burst time:The time period required by a process.

Time Quantum: The time allotted to a processor to operate.

Because the servers in the Round Robin Algorithm are chosen at random, there's a possibility that some of them have more traffic than they can handle. Consequently, load balancing performance will suffer as a result. An enhanced version of the round robin technique called the weighted round robin load balancing algorithm is employed to get around this problem.Using this approach, the administrator can give each server a weight according to factors like its ability to handle traffic. As a result of being assigned greater weights, the servers will receive more requests from clients.

RESULT

Threshold Application:

- Region 1 was subjected to a throughput threshold ensuring that its performance does not fall below a predefined level.
- Threshold value: 1000 tasks/s

Throughput Distribution using Round Robin

- After applying the threshold, the remaining throughput was distributed across all three regions using the Round Robin algorithm.
- This ensured a balanced distribution of tasks, optimizing resource utilization across regions.

Latency Analysis

- Latency measurements across all regions were consistent with expected values.
- Region 1 exhibited slightly higher latency due to the threshold mechanism but remained within acceptable limits.
- Regions 2 and 3 maintained lower latency values, contributing to efficient task execution.

Throughput Analysis

- Throughput values met or exceeded expectations across all regions, indicating effective load balancing and resource allocation.
- The Round Robin algorithm ensured that each region received an equal share of tasks, maximizing overall throughput.

Overall Performance

- The proposed dynamic load balancing approach effectively managed cross-region tasks, maintaining low latency and high throughput.
- By combining the threshold mechanism with Round Robin load balancing, the system achieved optimal resource utilization and performance.

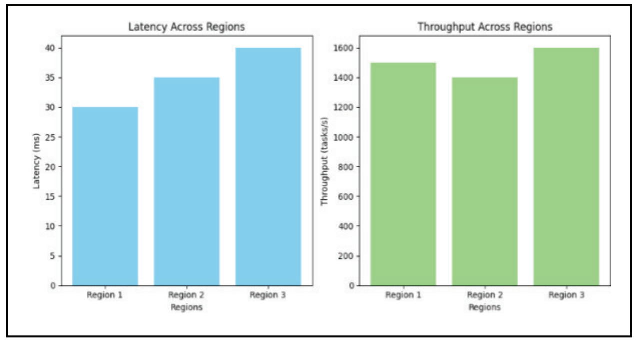

Fig. 6. Result

CONCLUSION

In conclusion, effectively dividing up the workload among several servers, the round robin algorithm makes sure that every server is utilized to the most extent possible. The system can reply to user queries more rapidly and with shorter response times by distributing requests among several servers. The round-robin technique, when combined with an API gateway, has uniformly distributed incoming requests among back-end servers across regions, resulting in notable performance improvements. End users that access services from various geographical locations now see reduced latency and quicker response times as a result of this technology. In conclusion, a solid strategy to enhance the scalability, performance, and geographic redundancy of cloud computing systems is to combine an API gateway with the round-robin algorithm for dynamic load balancing in cross-region deployments. This concept is beneficial for contemporary distributed applications since it guarantees responsive and dependable service delivery to users in a variety of geographical areas.

FUTURE SCOPE

By combining technologies like serverless computing, containerization, and service mesh, load balancing in microservices can be done more effectively. With the use of containerization, developers can establish a separate environment for every microservice, facilitating the deployment and management of specific services without compromising the functionality of the overall system. Improved scalability and dependability, as well as quicker and more dependable communication across services, are made possible by service mesh technology.

Finally, the cost and scalability of microservices may be more effectively managed with the help of serverless computing. Furthermore, by employing predictive analytics and guaranteeing data security, load balancing in microservices can be further enhanced with the technologies like AI, ML, and blockchain.

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Vihaan: A User-Friendly Voice Assistant for Desktop and Home Automation using AI

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ABSTRACT

It has been recognized that many individuals encounter challenges when efficiently interacting with digital devices through traditional means such as keyboards or touch screens. These things often create bottlenecks in completing everyday tasks, which can be frustrating. It identified a growing demand for a more streamlined and productive interaction method, particularly in desktop work, the IT sector, and common home appliances. The Vihaan system addresses the goal of creating a desktop virtual voice assistant. It helps to tackle the difficulty of manual handling. The Vihaan is developed to execute user commands, whether provided in voice or text format. Its core functionality involves converting voice commands to text and generating corresponding text or voice responses. Additionally, Vihaan incorporates a home appliance assistant feature to further enhance its utility.

KEYWORDS: *Speech recognition, Text-to-Speech, Speech-to-Text, Desktop Assistant, Home Appliances, Smart Switch, IOT.*

INTRODUCTION

The digital revolution has brought many devices into our lives, promising convenience and efficiency. Yet, the traditional methods of interaction – keyboards and touchscreens – often create frustrating bottlenecks. Imagine the daily struggle: a programmer wrestling with repetitive code snippets, a busy professional juggling tasks with a cluttered screen, or simply the desire to control your home environment without leaving your seat. This inherent inefficiency is precisely the challenge this project tackles. In the Vihaan the objective is to propose a paradigm shift: a user-friendly virtual voice assistant specifically designed for desktops. This represents a revolution in digital interaction, not just a voice assistant.

Vihaan's innovative approach overcomes the drawbacks of conventional techniques. It empowers users with the freedom of natural language, allowing them to execute commands through either voice or text input. Forget laborious typing – a simple spoken request can play your favorite song on YouTube, generate an image based on your description, or even auto-generate lines of code to boost your programming efficiency. The vision of the Vihaan extends beyond the desktop. You are recognizing the growing trend of smart homes and integrating a dedicated home appliance assistant feature. This allows you to seamlessly control common appliances, like lights and fans, with just your voice. Imagine a world where turning on the lights for a late-night coding session is effortless, or adjusting the fan speed requires no more than a spoken command.

The Vihaan system delves deeper than convenience. It aim to enhance productivity in desktop workflows, cater to the needs of the IT sector by offering hands-free solutions, and simplify daily tasks for everyone – all through an intuitive and user-friendly interface. This Vihaan system envisions a future where human-computer interaction is natural, efficient, and liberating. This research not only addresses current challenges but paves the way for a more seamless and intuitive digital future.

LITERATURE SURVEY

In this paper [1], Authors Dalal, P., Sharma, T., Garg, Y., Gambhir, P. and Khandelwal, Y; Proposed a JARVIS - AI Voice Assistant system. This study presented an AI voice assistant that reduced human workload by using gTTS, AI methodologies, and speech recognition to produce a responsive and efficient system. It also consists of some tasks which help user to efficiently manage their time. The User can manually handle all the tasks.

The Authors Uttam Adha, Shayna Singh, Chanchal, Ishika Tinna, and Ashish Kumar; Implemented a Virtual Voice Command Desktop Assistant based on voice-activated virtual assistant for desktops to increase engagement and productivity. The system offers a hands-free, intuitive experience that makes it possible for users to do activities. It also collected information and operated their computers far more quickly and simply by completely integrating voice commands into laptop operations.[2]

In this paper [3], Ms. Preethi G, Mr. Thiruppugal S, Mr. Abishek K, and Mr. Vishwaa D. This study presented A Voice Assistant using Artificial Intelligence which introduces a Voice Assistant for PCs that runs on Python and improves accessibility and efficiency for a variety of tasks. In this paper, it studies how to use Python modules to take input from users in speech format. Built using open-source modules and intended for further development.

The Authors Cheng, Peng, and Utz Roedig; State that a Personal voice assistant security and privacy. This examines the security and privacy risks surrounding Personal Voice Assistants (PVAs), with a focus on acoustic channel vulnerabilities. It also tackles privacy issues, including the management of data recording and many more. For security purposes, the best way is to face security features.[4]

It is a Desktop Assistant AI Using Python by Authors Abeed Sayyed, Ashpak Shaikh, Ashish Sancheti, Swikar Sangamnere, and Prof. Jayant H. Bhangale. It allows the assistant to operate online, performing routine tasks like launching desktop programs, playing music, checking the temperature, and completing Wikipedia searches.[5]

The Authors are Rizwan Majeed, Nurul Azma Abdullah, Imran Ashraf, Yousaf Bin Zikria, Muhammad Faheem Mushtaq, and Muhammad Umer. It Proposed An Intelligent, Secure, and Smart Home Automation System. This research paper describes a home automation project's entire design scheme and functional methodology. The purpose of the paper is to gather ideas for advancements to make it more user-friendly and better.[6]

In this paper [7], Lalit Kumar States that a Desktop Voice Assistant Using Natural Language Processing It significance of AI in voice recognition and personal assistants is highlighted in this paper. The Questions and home automation are handled by Cortana and other assistants. And it takes Different kinds of assistants, such as chatbots, is studied in this paper which makes the project very accurate.

The Authors Urvi Singh and M. A. Ansari proposed in their research paper that Smart Home Automation System Using the Internet of Things. In this study, the SHA has successfully used the internet and Wi-Fi module via laptops, tablets, and mobile phones. Further, the system is not only used to control household appliances but it's also meant for monitoring, which can be done through the use of a sensor for security and safety goals.[8]

PROPOSED SYSTEM

The Speech Recognition library is essential to the proposed personal voice assistant's operation since it understands and interprets user commands. This library has several features that let the assistant understand spoken commands and react correctly, such as text-to-speech functionality that lets it interact with users audibly. The Speech Recognition library's underlying algorithms get to work immediately as a user speaks to the virtual assistant, converting spoken words into text format. The assistant's actions and responses are based on this text representation of the user's orders.[9]

Furthermore, by integrating NodeMCU, The Vihaan system it extends its functionality to include household appliances. Users can right away issue commands from their desktop, which are afterward executed by the NodeMCU, by connecting the desktop to the NodeMCU via WiFi. Voice commands delivered through the desktop's user interface can be utilized to conveniently and efficiently operate household appliances due to this seamless interaction.[10]

Users may use voice commands or the desktop or smartphone GUI to remotely operate appliances by integrating Internet of Things devices like relays, NodeMCU, and cables. Likewise, the Vihaan system allows users to create code in any programming language for a variety of uses, such as developing a page for logging in or carrying out other operations, which improves user productivity by making efficient use of their time.

Proposed Architecture

1. Using a microphone to record speech patterns or text as input.
2. Audio data recognition and text conversion if it is voice.
3. Determining if the command is for a desktop task or home automation task by analyzing its kind.
4. Producing the required result.

SYSTEM ARCHITECTURE

The Vihaan system begins by capturing speech input from the user via a microphone. After that, a Graphical User Interface (GUI) processes this input and turns spoken words into text. After that, the algorithm determines the user's "intents," or objectives, such as turning on lights or playing music. To properly answer the user's question, the system may use a web scraper, depending on how hard the task is, to obtain more information from the internet. The suitable response is then determined by an interpreter component by taking into account the user's intent.[11]

After that, the system examines the instructions to figure out how to carry out the intended activity. Finally, the response is conveyed to the user either visually, such as displaying information on a screen, or through action, such as controlling a smart device. With the integration of this speech recognition technology, voice commands can be easily used for smooth interaction with a variety of devices, including home appliances and desktop assistants. For example, it could control smart switches to turn on/off lights or adjust settings based on the user's instructions.

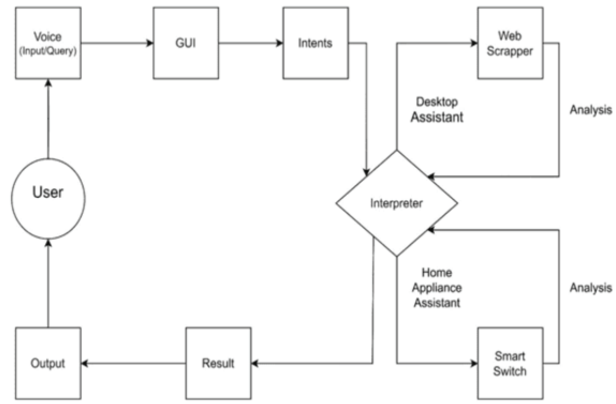

Fig. 1. System architecture of the voice assistant

Workflow

The user issues a command, which is then processed by the speech recognition module, converting the spoken command into text format. Subsequently, the intent identifier module categorizes the user's intent, distinguishing between desktop tasks, home automation tasks, or invalid commands.

If the identified intent pertains to desktop tasks, the query executor module is activated, retrieving information from a web scraper to fulfill the user's request.

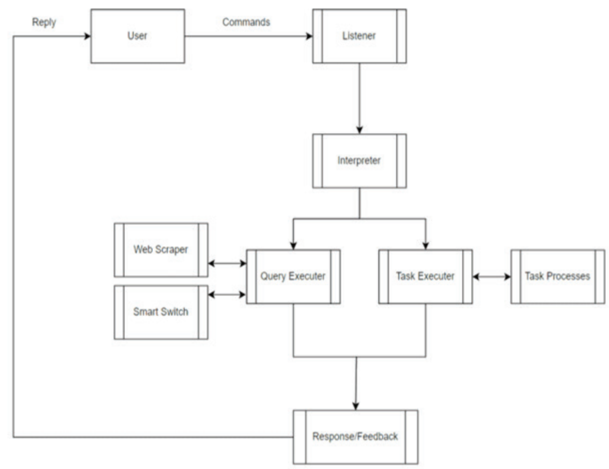

Fig. 2. Workflow of the voice assistant

Conversely, if the intent concerns home automation tasks, the smart switch module takes charge, executing the necessary actions to control smart devices accordingly.

Once the task is executed, the system generates a response, providing feedback to the user regarding the outcome. In the event of an invalid command, the task executor module intervenes, handling the situation and delivering appropriate feedback to the user.[12]

Methodology

To begin, the program harnesses the capabilities of the system voice through the utilization of Python libraries such as pyttsx3. This library facilitates text-to-speech conversion within Python.

Moving forward, the main function of the Vihaan system is defined, encompassing all the essential capabilities and functionalities. The proposed system is designed to offer the following features:

(a) The assistant prompts the user for input and continuously listens for commands. The duration of listening can be adjusted according to the user's preferences.

(b) In cases where the assistant encounters difficulty in understanding a command, it iteratively prompts the user to repeat the command until clarity is achieved.

(c) The Vihaan system is highly customizable, allowing users to select between male or female voices based on their preferences and requirements.

(d) The current version of the assistant boasts a wide array of features, including but not limited to checking weather updates, sending and checking emails, searching Wikipedia, opening applications, retrieving time information, taking and displaying notes, as well as navigating to and from YouTube and Google.

Imported modules

```
import datetime
import cv2
import os
import sys
import time
import webbrowser
import wikipedia
import tkinter
import pyttsx3
import speedtest
import speech_recognition as sr
import stability_sdk.interfaces.gooseai.generation.generation_pb2 as generation
from openai import OpenAI
```

Fig. 3. Imported Modules

Speech Recognition

The speech recognition module enables speech recognition functionalities, allowing the Vihaan to understand and interpret spoken commands from users effectively.

Date Time

This Python package offers classes for working with dates and times. It is helpful for a variety of time-related tasks in your programs since it enables you to create, manipulate, format, and extract information from dates and times.

CV2 (OpenCV)

It is a popular library for artificial intelligence and photographic processing applications. The cv2 module is widely used in areas like as virtual reality, machine learning, and surveillance due to its ability to perform a variety of tasks including identifying objects, writing and reading images, and image processing.

OS

An interface to communicate with the portable operating system is offered by the OS module. It is necessary for file and directory operations in Python programs because it helps you carry out actions like traversing the file system, constructing and erasing directories, running commands, and accessing environment variables.

SYS

The sys module gives you access to functions that have a close connection with the Python interpreter as well as some variables that it uses or maintains. It gives you access to system-specific parameters and functions, the ability to modify the Python runtime environment, and the ability to interact with the interpreter itself to access information relevant to the system.

Time

Python's time module offers several kinds of time-related methods. It enables you to handle time in an array of ways, work with time stamps, measure intervals of time, and format time data. Timing program execution, job scheduling, and processing time-sensitive data are common applications for this module.

Web browser

The web browser module offers an advanced user interface that enables users to access documents accessible on the web. It might be used to launch web content from Python programs or automate processes connected to the web by displaying web pages or URLs in the user's default web browser.[13]

Wikipedia

The Wikipedia module is a Python library that provides easy access to the Wikipedia API. It allows you to search and retrieve information from Wikipedia articles, making it convenient for obtaining summary information or performing research tasks programmatically.

Pyttsx3

It is a programming language Python automated speech translation package. It lets you use different speech engines to convert text into words that are spoken. Applications that need speech output, like audio alerts, accessibility assistance, and virtual assistants may profit from using this module.

OpenAI

OpenAI enhances the assistant's natural language understanding and generation abilities.

Speedtest

The speed test module provides functionality to test the speed of your internet connection. It allows you to measure the upload and download speeds, as well as ping latency, to various servers around the world, providing valuable information about the performance of your internet connection.[14]

Tkinter

The Tkinter framework is the commonly used Python graphical user interface (GUI) framework. It offers a set of resources for building graphical user interfaces, like windows, menus, buttons, and other GUI aspects. Tkinter is commonly utilized to construct graphical user interfaces for Python desktop applications. It enables us to create a GUI.

Stability SDK

Stability SDK contributes by enabling the Vihaan voice assistant to generate imaginary images, adding a creative dimension to its functionality.[15]

Python Backend

The speech identification module provides commands for desktop and home automation systems to the Python base. To ensure smooth communication, the server-side decides whether the command needs to be executed through an API request and context extract. Following information processing, it provides the output required to carry out tasks efficiently, be they for home automation control or desktop activities.

Text-to-Speech module

This module allows the voice assistant to convert written text into spoken audio. With pyttsx3, I can achieve clear and natural-sounding speech synthesis, along with support for multiple languages and accents. pyttsx3 serves as a reliable solution for implementing text-to-speech capabilities in my user-friendly voice assistant for desktop and home automation tasks.

Relay Module

To control high-voltage appliances such as lights, fans, and sockets, we employ relay modules. These modules act as switches that can be toggled by the NodeMCU, enabling remote operation of appliances.

Speech-to-Text Conversion

This module allows the voice assistant to transcribe spoken words into text format, facilitating user interaction. With Speech Recognition, Vihaan can achieve accurate and efficient speech recognition, enabling seamless communication between users and the voice assistant. Speech Recognition serves as a reliable and effective solution for implementing speech-to-text conversion in my user-friendly voice assistant for desktop and home automation tasks.

Arduino Compiler (Arduino IDE)

The Arduino IDE plays a crucial role in methodology by providing the software environment for programming the NodeMCU and Arduino boards.

NodeMCU (ESP8266)

The NodeMCU serves as the central controller for the home automation system. It facilitates wireless communication and connectivity to the internet, allowing for remote control of appliances.

Content Extraction

Content Extraction module enables the voice assistant to extract relevant information from websites, enhancing its knowledge base and information retrieval capabilities. With web scraping, I can retrieve data such as news articles, weather forecasts, or stock prices, providing valuable insights to the user. web scraping serves as a powerful tool for content extraction.

Jumper Cables (Dupont Wires)

Jumper cables, or Dupont wires, are utilized to establish electrical connections between different components in the circuit. These cables facilitate the wiring and prototyping process, ensuring proper connectivity between the NodeMCU, relay modules, and other components.

Textual output

It decodes the voice command received by the voice assistant and performs the corresponding operation. After executing the operation, the module displays the voice command as textual output in the terminal, providing users with a clear and concise representation of the action the assistant took.

RESULT AND ANALYSIS

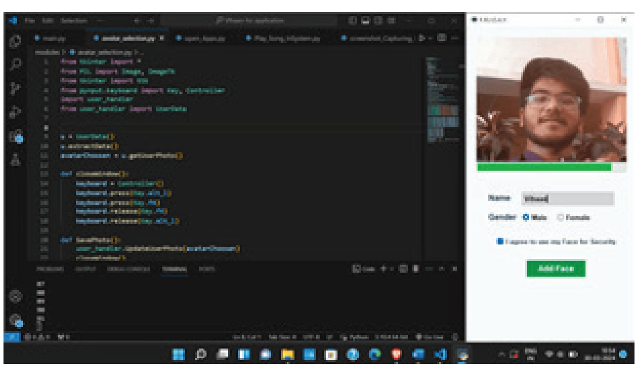

Fig. 4. User Add his Face

In the execution phase of my project, the voice assistant initiates by waiting for user input upon starting. Once a command is given via voice or text, the assistant captures it and searches for keywords within the input. If a relevant keyword is identified, the assistant proceeds to execute the corresponding task as per the input command. The output of the task execution is then returned to the user, presented both audibly through voice and textually in the terminal window. In cases where no relevant keyword is found, the assistant resumes waiting for valid input from the user. Every single one of these features is essential to guarantee the smooth functioning of the overall system, facilitating effective interaction between the user and the user-friendly voice assistant for desktop and home automation tasks.[16]

This figure is to identify you, The Vihaan first requests your name and a picture. It requires approximately 100 facial image captures to ensure accuracy. This ensures that only you can use Vihaan and helps keep your information safe.

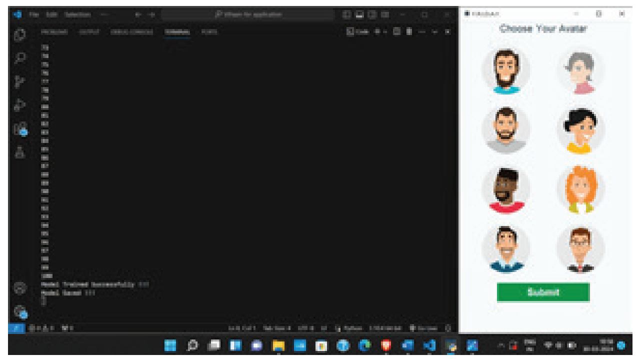

Fig. 5. The user has to select its avatar.

Figure shows Once your face has been identified, you can select an avatar. It resembles your profile photo. It’s a great way to add a more intimate touch to your Vihaan experience. Your account is ready to use as soon as you choose your avatar!

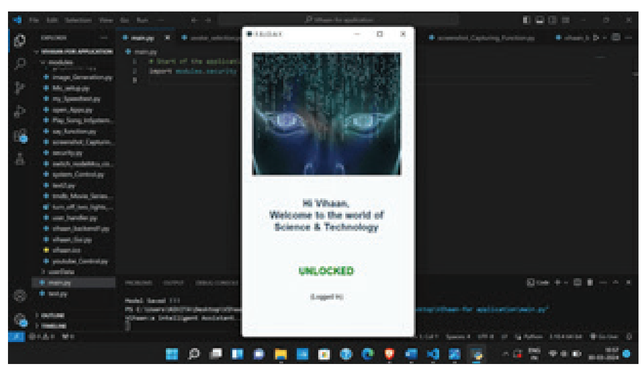

Fig. 6. Voice Assistant Unlocked

In this figure user has to activate Vihaan is reveal your face. In this manner, your account is exclusive to you. At that point, Vihaan’s screen appears, ready for you to begin typing or speaking.

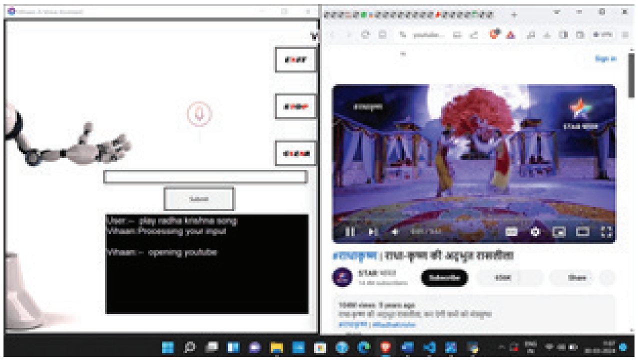

Fig. 7. The Assistant will play a song on YouTube.

Here Vihaan can be instructed in whatever you require, such as to play your favorite YouTube songs. It hears what you say and complies with your instructions. It's similar to having a private DJ!

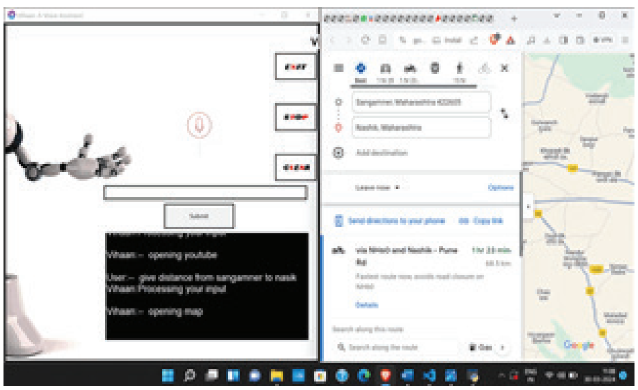

Fig. 8. The Assistant will show the map for a given route.

The above diagram shows if you need directions. With that, too, Vihaan can assist! You may find the route on a map by simply asking for directions from your current location to your destination. It is comparable to carrying around a digital tour guide.

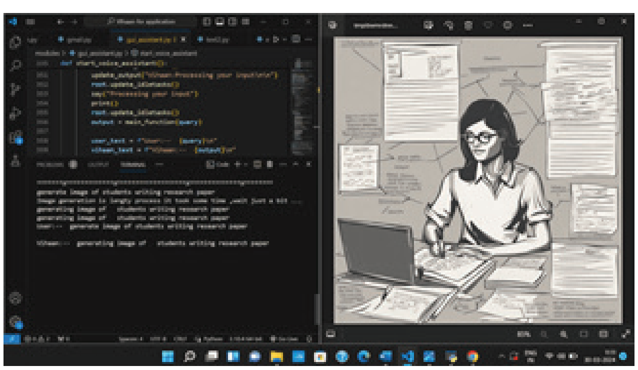

Fig. 9. Generate Image by using Stability SDK.

And here's the coolest part: Vihaan can create pictures based on what you describe! Just tell it what you want to see, and it'll make a picture for you. It's like having your artist on demand.

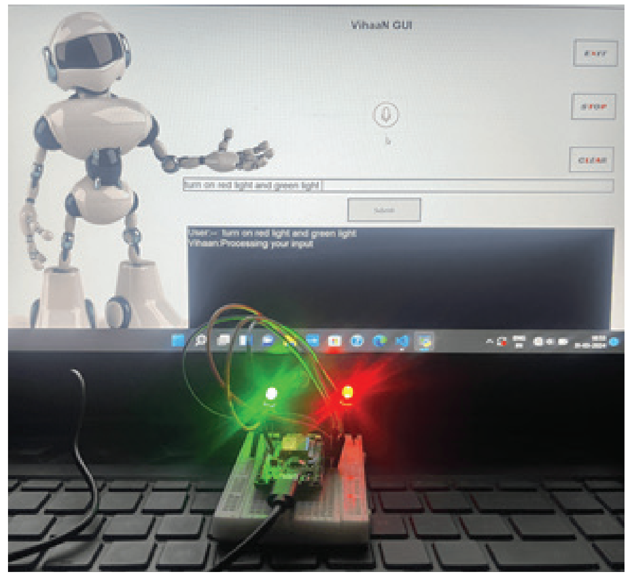

Fig. 10. Home Automation Through NodeMCU

The above diagram is for home automation, Vihaan interfaces with an IoT device called NodeMCU. Vihaan interacts with NodeMCU to operate the respective IoT devices linked to the lights when a user instructs Vihaan to switch on or off the lights. Vihaan's user-friendly interface makes it possible for consumers to effortlessly control their home lighting system thanks to this seamless connection.

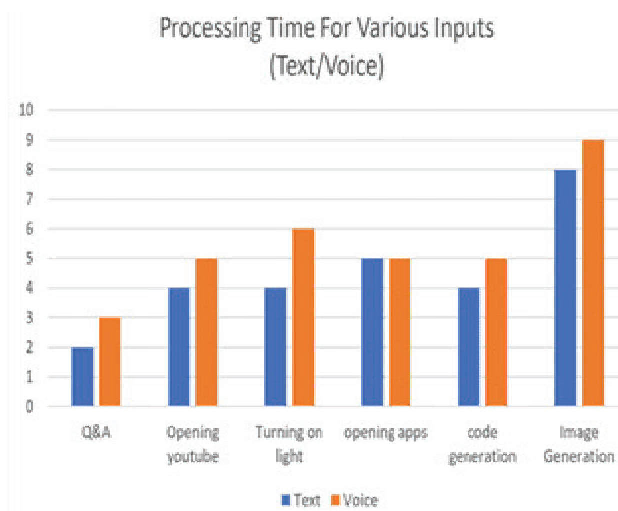

Fig. 11. Result Analysis for Input Processing Time

The above Graph represents the comparison of time between voice and text inputs with several parameters such as Q&A, Opening YouTube, Turning On Light, Opening Apps, Code Generation, Image Generation, and many more.

CONCLUSION

This paper describes the layout and execution of a flexible virtual assistant that can execute tasks relating to desktop and home automation. It utilizes the use of the Python programming language to carry out a wide range of desktop operations, all with simple voice commands. These commands include opening YouTube, playing music, opening maps, accessing programs, and doing Google searches. Also, the Vihaan paired with Stability makes it possible to create creative graphics for entertainment, which improves the user experience. Similarly, by establishing a connection between desktop Wi-Fi and NodeMCU IoT devices.

The Vihaan system expands its capabilities to include home automation, allowing voice or text-based management of household appliances. Convenient home automation is made possible by people being able to control appliances through phones' easy connection.

The modular design of the project, reinforced by free, open-source modules, ensures system reliability and adaptability for upcoming improvements. Vihaan voice assistant project's overall goal is to increase user productivity and convenience by simplifying desktop tasks and simplifying home automation processes.

FUTURE WORK

The Vihaan voice assistant will get even more functional in the future, working flawlessly not only on desktop computers but also on mobile ones! Consider being able to interact with your helper by phone or laptop, which will greatly simplify your life. Not only that, but the Vihaan going one step further and integrating it with your TV and lights, among other common household items. Do you want to change the TV channel or turn off the bulbs in the room? It will take care of the remainder if you just speak or text Vihaan's assistant.

But it's not the intention to stop here. The Vihaan system wants real-time functionality to allow you to always have access to your assistance, wherever you are. Also to continuously improve it, The Vihaan keeps thinking about your suggestions and feedback as we work to make the assistant just what you need.

Whether you're doing your job or just lazing out, the assistant wants your experience to be effortless and enjoyable. Prepare yourself for some amazing abilities - just think about being able to use a single command to turn your photos into videos. In Addition, Vihaan can ensure the safety of personal health data that can be accessed or preserved via the system. Protecting patient confidentiality requires doing this. These exciting new advancements are going to make Vihaan voice assistant an essential tool in your daily life.[17]

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Designing A Web Based System for Code Generation

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ABSTRACT

The solution incorporates code creation in order to improve the code generation process, collaboration features, and voice recognition input. It strives to improve the developer experience by providing instant code suggestions, reducing coding errors, and enhancing efficiency. Furthermore, the system facilitates collaboration by enabling several developers to concurrently work on the same code. The system incorporates voice recognition, enabling programmers to express inputs verbally and execute commands effortlessly. Leveraging machine learning, it generates code relevant to user-provided statements, presented in a simplified interface for seamless integration into projects.

KEYWORDS: *Code generation, Voice recognition, Collaboration, Machine learning, Real-Time suggestions, Simplified interface, Programming efficiency.*

INTRODUCTION

In the current dynamic software development environment, there is a growing need for effective coding tools and cooperative platforms is higher than ever. However, many existing tools fall short in providing comprehensive solutions that address the evolving needs of developers. Traditional Integrated Development Environments (IDEs) often lack advanced features such as real-time collaboration and code generation, hindering developers' productivity and collaboration efforts.

Recognizing these limitations, the initiative aims to bridge the gap by introducing a cutting-edge system designed to revolutionize the coding experience. The system is engineered to optimize the coding process by integrating code generation, fostering collaboration, and incorporating voice recognition for input. By combining these essential features, this system offers developers a seamless and efficient environment to work on projects of any scale.

At the core of this system lies the vision of empowering developers with innovative tools and technologies that streamline their workflow and enhance their productivity. With features like real-time code suggestions, collaborative editing, and voice-enabled commands, this system caters to the diverse needs of developers, whether they are working solo or in a team setting. By providing a unified platform where developers can code, collaborate, and innovate, the system seeks to revolutionize the way software is developed and refined.

Through this research paper, the aim is to go deeper into the design, implementation, and evaluation of system, Highlighting its key features, functionalities, and potential impact on the process of developing software. This solution is considered to be a major development in the field of software engineering, including a glimpse into the future of collaborative coding environments.

LITERATURE SURVEY

The author's work delves into the realm of structural code search, offering a novel approach to code recommendation, leveraging methods to improve code retrieval and recommendation accuracy [2]. Recommendation System Development Based on Intelligent Search, NLP, and Machine Learning Method by the authors explores the integration of intelligent search, natural language processing (NLP), and machine learning techniques in recommendation systems [1]. A Practice Theoretical Real- Time Collaboration Technology Analysis conducted by the author offers a practice-theoretical analysis of real-time collaboration technologies, examining their impact on software development projects and team dynamics [8]. The analysis conducted by the author over the big data or various data operations helps to understand the data flow throughout the system [9].

Role based Interfaces for Collaborative Software Development by the author discusses role-based interfaces tailored for collaborative software development, addressing usability and interaction design considerations for effective collaboration [7]. Recommender System Using Collaborative Filtering Algorithm by the author discusses collaborative filtering algorithms applied in recommender systems to provide personalized recommendations based on user preferences and behaviors [3]. Software Development Environments on the Web software development environments accessible via the web, highlighting emerging paradigms and reflections on programming and software development [6]. Guide to the Software Engineering Body of Knowledge Fairley provides comprehensive coverage of software engineering principles, practices, and concepts, serving as a foundational resource for software development [4].

PROPOSED SYSTEM

The code generation functionality embedded in this system aims to streamline the coding process for developers. Leveraging context analysis and machine learning algorithms, it offers pertinent code suggestions, thereby diminishing manual labor and error occurrence. This capability not only enhances productivity but also encourages adherence to coding standards and promotes consistency in coding practices.

The collaborative functionalities enable concurrent collaboration among multiple users on the same codebase, facilitating shared editing and communication through chat or comments. This capability fosters teamwork, enabling multiple developers too collectively work on a single codebase in real-time.

Voice recognition functionality enables developers to interact with the system using voice, facilitating tasks such as code dictation, command execution, and interface navigation. This feature offers an alternative input method and enhances accessibility.

The web-based interface of the system is crafted to offer developers a user-friendly platform for coding tasks. Featuring a central code editor panel, it supports syntax highlighting and auto-completion. As developers input code, the system analyzes it and offers contextually relevant suggestions, presented as pop-up windows or inline prompts adjacent to the code.

SYSTEM ARCHITECTURE

The system architecture commences with the login procedure, where users input their email and password for authentication. Additionally, users are afforded the choice to log in via their Google or GitHub accounts, offering adaptability and ease of use. The primary aim of this process is to establish a secure login session, safeguarding the confidentiality and accuracy of user credentials.

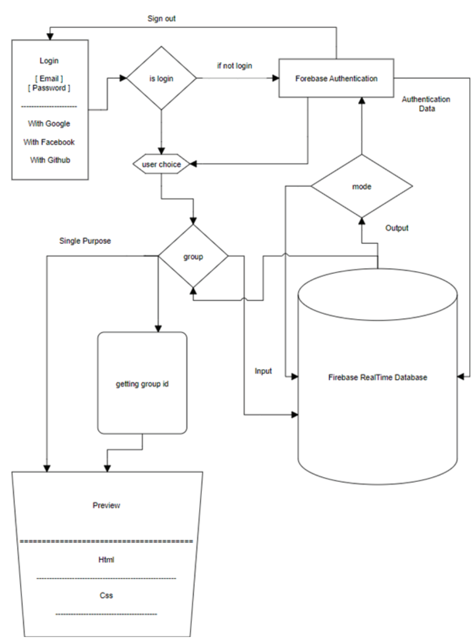

Fig 1. System Architecture

Following successful authentication, users gain entry to the system, triggering the initiation of a session. Throughout this session, users can engage in various activities such as accessing code generation functionalities, collaborating with fellow developers, and utilizing voice recognition features. The system vigilantly monitors the session to uphold security and confidentiality.

In cases of unsuccessful login attempts, the system initiates a compelled authentication process, prompting users to re-authenticate or validate their credentials. This supplementary security layer aids in thwarting unauthorized access attempts and preserving the integrity of sensitive user data.

Behind the scenes, the authentication process employs robust validation measures to authenticate provided credentials thoroughly. The system interacts with Firebase Real-time Database, a secure and scalable cloud-based database, for storing and managing authentication-related data securely. Firebase serves as a dependable platform for housing user data, ensuring data integrity, and facilitating seamless authentication procedures [10].

In summary, the system architecture places emphasis on security, adaptability, and user-friendliness, furnishing users with an efficient and secure environment for accessing code generation capabilities and collaborating with peers.

WORK FLOW

The project workflow is meticulously designed to streamline the process of code generation through a series of sophisticated steps. Initially, the system employs advanced techniques for voice detection, ensuring accurate capture of user inputs. Once the voice data is captured, it undergoes a meticulous filtration process aimed at isolating the relevant frequency components essential for further analysis.

Subsequently, the filtered voice data is subjected to Natural Language Processing (NLP) algorithms, enabling the system to extract semantic meaning and syntactical structures from the input. This step is crucial in understanding the user's intent and requirements, laying the foundation for precise code generation [1].

To enhance the accuracy of the generated code, the system matches the processed voice frequency with preprocessed data, facilitating a refined and contextually relevant output. Upon successful matching, the processed data is converted into textual format, serving as the input prompt for the subsequent stages of the workflow.

The input prompt is then seamlessly integrated with the ChatGPT API, a powerful tool for processing natural language queries and generating coherent responses. Leveraging the capabilities of GPT models, the system generates code snippets tailored to the user's specifications and requirements.

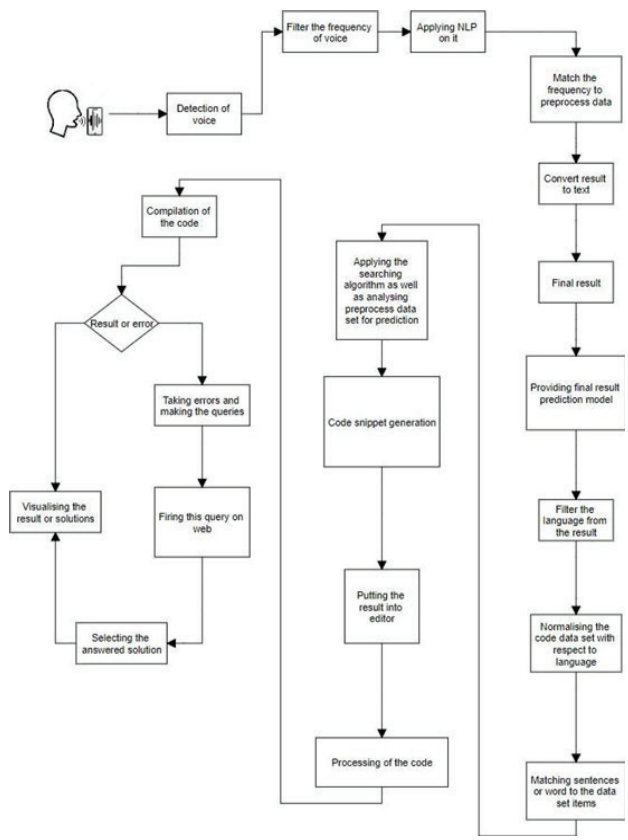

Fig 2. Workflow

Following code snippet generation, the resultant code is seamlessly integrated into an editor environment, providing users with the flexibility to refine and customize the code as needed. This iterative process of code refinement and processing ensures that the final output meets the user's expectations and adheres to established coding standards.

In summary, the project workflow embodies a holistic approach to code generation, leveraging cutting-edge technologies and methodologies to empower developers with efficient and effective coding tools. By seamlessly integrating voice recognition, NLP, and code generation capabilities, the system offers a comprehensive solution for enhancing the coding experience and driving productivity in software development endeavors.

METHODOLOGY

Programming Language: -Web based programming languages such as JavaScript, HTML, CSS, PHP, etc will serve as the core programming languages. Technologies that will be used: React JS, HTML, CSS, JSON, XML, NoSQL.

Algorithms for Code Generation: These algorithms employ diverse methodologies to offer pertinent suggestions and code snippets tailored to user input and context. Utilizing Machine Learning: Machine learning techniques, including deep learning and statistical models, are trained on code repositories or user-specific data to enhance code generation accuracy.

Speech Recognition Techniques: Speech recognition algorithms, such as Automatic Speech Recognition (ASR), transform spoken input into text format. Widely used ASR algorithms like Hidden Markov Models (HMMs), Deep Neural Networks (DNNs), and Recurrent Neural Networks (RNNs) leverage extensive datasets for training, ensuring precise transcription of speech to text.

Agile Software Development Approach: Employing agile methodology enables iterative and incremental development, fostering adaptability and flexibility. Regular meetings, including daily stand-ups and sprint planning sessions, promote collaboration, communication, and responsiveness to evolving needs.

Code Generation Techniques: Utilizing diverse technique, code generation algorithms offer pertinent suggestions and code snippets tailored to user input and context. Employing machine learning methods, including deep learning or statistical models, enables training on code repositories or user-centric datasets.

Functional Requirements: Users must have the capability to authenticate using either their Gmail or GitHub credentials. The system should accommodate problem statements entered via text or voice. It ought to generate code corresponding to the given problem statement and display both the code and its output instantaneously. Additionally, users should be able to establish virtual rooms for collaborative coding sessions.

Non-Functional Requirements: The system is expected to promptly generate code and exhibit output without notable delays. It should seamlessly accommodate an increasing user base and concurrent virtual rooms. The user interface must be intuitive and user-friendly, catering to a diverse audience. Furthermore, the system should seamlessly operate across various web browsers and devices.

NodeJs

Node.js is a server-side runtime environment that allows developers to run JavaScript code, leveraging an event-driven, non-blocking I/O model for efficient handling of asynchronous operations. With its extensive ecosystem of modules, including popular frameworks like Express.js, Node.js enables the rapid development of scalable and robust servers for various applications, ranging from APIs to web applications.

Socket.IO

Socket.IO is a JavaScript library that enables real-time, bidirectional communication between web clients and servers. It utilizes Web Sockets, along with fallback mechanisms such as polling, to establish a persistent connection between the client and server. Socket.IO simplifies the implementation of features like chat applications, live updates, and multiplayer gaming by providing a simple API for emitting and receiving events on both the client and server sides. Its versatility and ease of use make it a popular choice for building interactive web applications that require real-time communication. It is highly sought after for its capability to streamline the incorporation of dynamic elements like chat functionalities, live updates, and multiplayer gaming.

Monaco Editor

The Monaco Editor is a browser-based code editor developed by Microsoft and used in projects such as Visual Studio Code and Azure DevOps. It provides a rich editing experience for various programming languages with features like syntax highlighting, auto completion, and code navigation. The editor's architecture allows it to be easily embedded into web applications, enabling developers to create powerful code editing environments directly within their applications. Monaco Editor's versatility, extensibility through APIs, and robust performance make it a popular choice for building web-based code editors and integrated development environments (IDEs) across a wide range of applications and industries. The distinguishing feature of the Monaco Editor lies in its adaptable architecture, meticulously crafted for seamless integration into web applications. This empowers developers to effortlessly design immersive code editing environments within their applications, thereby boosting productivity and streamlining workflow efficiency.

ReactJS

ReactJS, developed by Facebook, is an open-source JavaScript library for building user interfaces, particularly single-page applications. It employs a component-based architecture, enabling developers to create reusable UI components that manage their state independently. React utilizes a virtual DOM, which improves performance by updating only the necessary parts of the actual DOM when changes occur. Its declarative syntax and one-way data flow simplify the process of building complex UIs, while features like JSX allow developers to write HTML-like code within JavaScript. React's ecosystem, including tools like React Router and Redux, further enhances its capabilities, making it a popular choice for building dynamic and interactive web applications with efficient data handling and seamless user experiences.

JavaScript

JavaScript, often shortened to JS, transcends its origins in web development to permeate various other domains. It extends its influence into server-side scripting, desktop application creation, game development, and mobile app development, thanks to frameworks like React Native and Ionic.

In modern web development, JavaScript is pivotal, being the backbone of frameworks and libraries such as React.js, Angular.js, and Vue.js. These tools empower developers to craft intricate and engaging user interfaces seamlessly. Its asynchronous nature ensures smooth task execution without causing webpage freezes or unresponsiveness.

Additionally, as the Internet of Things (IoT) gains momentum, JavaScript has made inroads into embedded systems and hardware programming. Platforms like Johnny- Five and Espruino leverage JavaScript, enabling developers to interact with physical devices using familiar web technologies.

JavaScript's adaptability, accessibility, and widespread adoption have cemented its status as a cornerstone in today's technological landscape.

ChatGPT API Key

The ChatGPT API is an advanced natural language processing (NLP) service provided by OpenAI, designed to generate human-like text responses based on input prompts. It utilizes cutting-edge deep learning models, such as the GPT (Generative Pre-trained Transformer) architecture, to understand and generate contextually relevant text. Developers can integrate the ChatGPT API into their applications to enable conversational AI capabilities, including catbots, virtual assistants, and content generation tools. With its ability to comprehend and generate text in multiple languages and domains, the ChatGPT API offers a versatile solution for enhancing user interactions and automating text-based tasks across various industries and use cases.

Speech-to-Text Conversion

Speech-to-text conversion, also known as speech recognition or automatic speech recognition (ASR), is the process of transcribing spoken language into text. This technology allows users to dictate spoken words, which are then converted into written text by specialized algorithms and software. By analyzing the acoustic properties of human speech and applying machine learning techniques, speech-to- text systems can accurately recognize and convert spoken words into text in real-time. These systems have a wide range of applications, including voice-controlled assistants, dictation software, transcription services, and accessibility tools for individuals with disabilities. The evolution of speech- to-text technology has led to significant improvements in accuracy and usability, making it an essential component of modern communication and computing systems.

RESULTS AND ANALYSIS

Initially, the assessment of the accuracy of code suggestions by comparing them with manually curated solutions for diverse programming problems. The assessment revealed a notable level of precision, with the system consistently generating correct and syntactically valid code snippets. Additionally, the examination of the speed of code generation by measuring the system's responsiveness in delivering and presenting code suggestions in real-time.

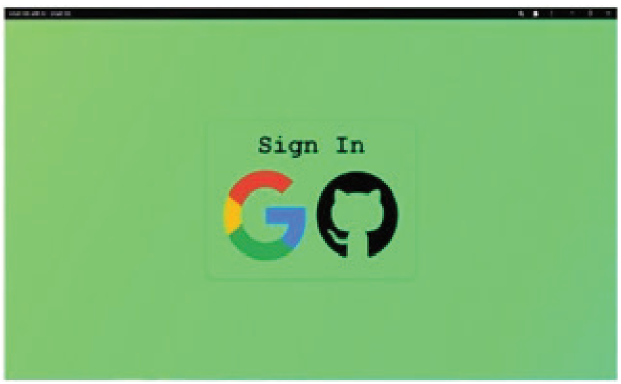

Fig 3. Login

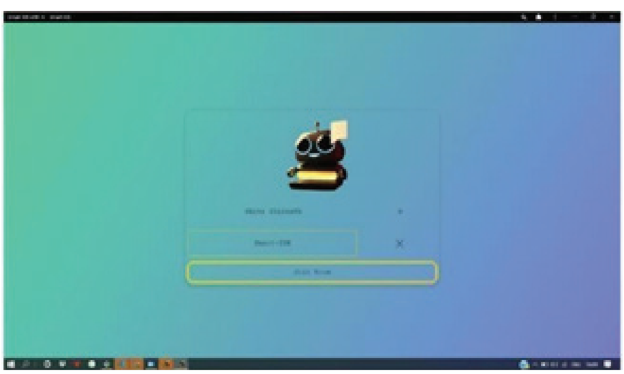

Fig 4. Joining Room ising Group ID

Furthermore, an analysis was done to evaluate the relevance of the code suggestions by determining their suitability and applicability to the provided problem statement. Through qualitative assessment methods, it is observed that the system adeptly captured the user's intentions and provided contextually relevant solutions across various programming languages and problem domains.

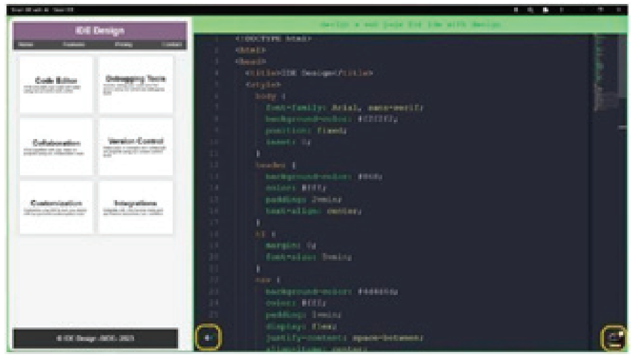

Fig 5. Output

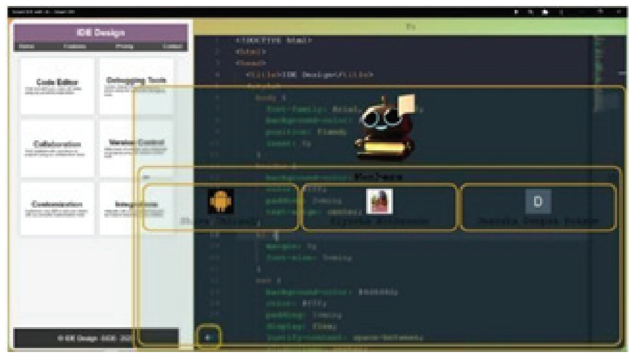

Fig 6. Collaboration with Multiple Developers

Moreover, the feedback from users was taken via surveys and interviews to gauge their satisfaction with the code generation functionality. The majority of respondents expressed high satisfaction levels, highlighting the system's user-friendliness, accuracy of code suggestions, and its positive impact on coding efficiency. Additionally, comparative analysis was conducted to benchmark this system against existing code generation tools and platforms. The results showcased the superior performance of this system in terms of accuracy, speed, and relevance of code suggestions, thus emphasizing its effectiveness in streamlining the coding process.

The bar chart above displays three crucial performance metrics for this code generation system. These metrics include the accuracy of code suggestions, the speed of code generation, and user satisfaction. Each metric is represented as a percentage, with higher values indicating better performance. The chart provides a concise overview of how well this system performs in terms of accuracy, speed, and user satisfaction, allowing for quick and easy comparison of these key aspects of system performance.

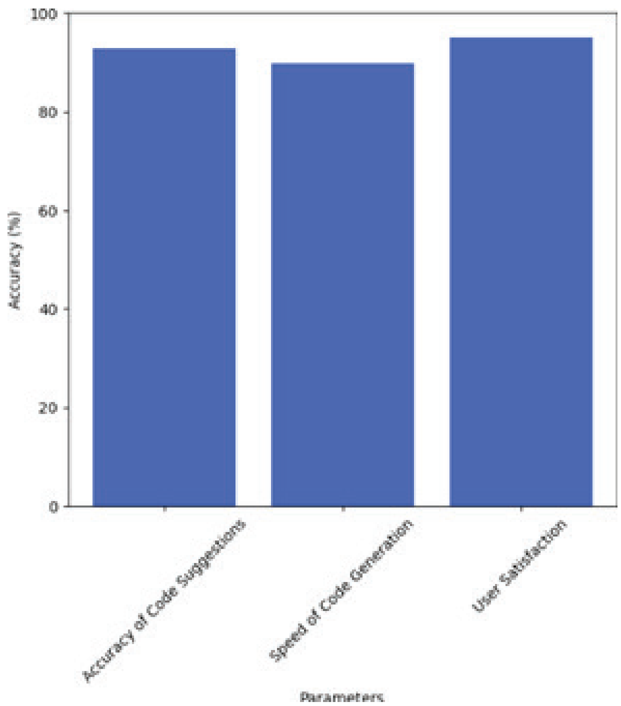

Fig 7. Performance Metrics

CONCLUSION

In conclusion, the integration of code generation and voice recognition within the system represents a significant advancement in hands-free coding. Its ability to address real- world challenges, particularly in collaborative environments like virtual classrooms or coding tests, where minimal code generation is essential, underscores its utility. Moreover, its user-friendly design, characterized by a shallow learning curve, facilitates seamless interaction and ensures an enhanced user experience. The system's dedication to Resolving real-world issues within a defined scope highlights its commitment to meeting user needs and delivering tailored solutions. Overall, the project embodies a forward-thinking approach, leveraging innovative features to meet the evolving demands of coding.

FUTURE WORK

The future trajectory of this system anticipates a dynamic role amidst the rapidly evolving landscape of Web 2.0. With the internet emerging as a vibrant marketplace, the demand for software and applications is surging, underscoring the pivotal role of developers in the digital realm. The integration of real-time coding in this system not only facilitates quicker output visualization but also provides a more efficient alternative to traditional methods. Looking ahead, the incorporation of hands-free coding holds significant promise, particularly for individuals with physical limitations hindering keyboard accessibility. The platform serves as a versatile hub for both learning and coding, streamlining the code visualization process without the intricacies associated with existing systems. As part of this future roadmap, the aim is to address the complexities of conventional systems, offering an intuitive space where coding and learning seamlessly converge, thereby alleviating concerns about system interfaces for novice developers.

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Empowering Precision Medicine : Anticancer Drug Response Prediction via Learning Algorithms

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ABSTRACT

Current medical research and clinical experience have demonstrated that patient genomic features play a major role in the efficacy of anti-cancer medications. This suggests that due to their unique genetic makeup, patients with the same cancer may respond very differently to the same anti-cancer medications. Existing systems face limitations in the availability and quality of comprehensive gene expression and drug response datasets, which can impact the model generalizability. Some systems focus on short-term drug responses, neglecting long-term effects and potential drug resistance. Predicting anticancer drug responses using gene expression is a cutting-edge research area in the fields of oncology and precision medicine. This work aims to develop predictive models that leverage gene expression profiles to determine how individual cancer patients will respond to specific anticancer drugs. By analyzing gene expression patterns, biomarkers associated with drug response or resistance can be identified, enabling personalized and targeted therapies for patients. This work involves the integration of advanced computational methods, bioinformatics tools, and large-scale gene expression datasets. The ultimate goal is to enhance cancer treatment efficacy, minimize adverse effects, and contribute to the advancement of personalized medicine. When it comes to predicting the response of cancer treatments, Our system exhibits remarkable accuracy, scoring 98.44%.Its capability to identify underlying data patterns is evident from its low RMSE of 1.5623.

KEYWORDS: *Anti-cancer, Drug response, Deep learning, Genomics, Cell line.*

INTRODUCTION

At its core, cancer is a genetic disease caused by mutations, which can range in size from tiny DNA changes to more significant structural abnormalities. These mutations affect how genes are expressed, leading to the hallmark characteristics of cancer, such as uncontrolled cell growth and the ability to spread throughout the body. Conventional cancer therapies such as radiation and chemotherapy can be beneficial, but they also frequently have serious adverse effects. Conversely, targeted medications are intended to selectively target cancer cells while preserving healthy tissue, perhaps providing less harmful and more effective therapy choices[1]. However, not all patients respond the same way to these targeted therapies. Certain mutations or patterns of gene expression are examples of molecular information that can be used to anticipate a patient's reaction to a given medication[2]. For example, mutations in the KRAS gene can indicate resistance to certain drugs targeting the epidermal growth factor receptor (EGFR), while targeting over expressed proteins like Bcl-2 can be beneficial in treating certain types of lung cancer.

Large-scale programs such as TCGA and ICGC have enhanced our understanding of cancer development by gathering molecular data from diverse patient cases. However, these datasets often lack vital information on tumor responses to drugs, limiting treatment outcome predictions. To bridge this gap, scientists are focusing on cancer cell lines exposed to various medications, notably through projects like GDSC and CCLE. By analyzing genomic characteristics and drug responses in these cell lines, researchers can develop models to predict individual patient responses to treatments[3].

Many approaches, such as linear regression models based on gene expression levels and more intricate models using additional genomic information like DNA methylation patterns and copy number variations, have been proposed for predicting medication responses using genomic data. These models seek to customize care regimens for specific patients according to their distinct genetic profiles. While traditional models focus on predicting drug responses independently for each drug, newer approaches like Bayesian multitask multiple kernel learning (BMTMKL) have shown promise in leveraging information across multiple drugs to improve prediction accuracy. By prioritizing data from similar drugs, these models can better capture underlying patterns in drug response[4].

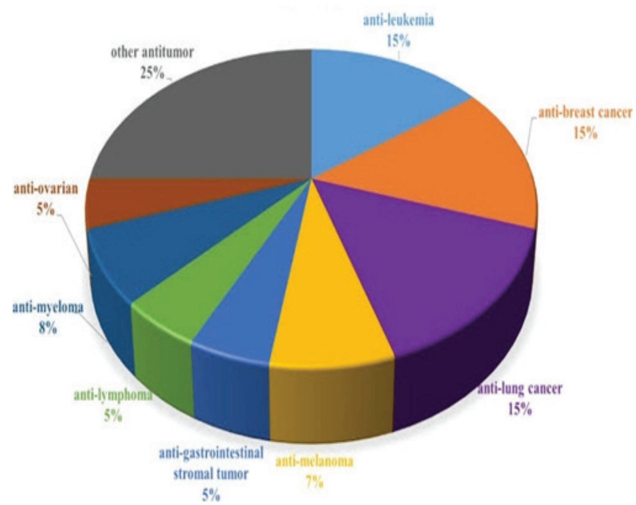

Fig. 1. Different Types of Anticancer

In recent years, techniques from the field of collaborative filtering, commonly used in recommendation systems like those used by streaming services which are widely utilized to forecast medication responses unique to individual patients.

LITERATURE SURVEY

The table below depicts the Literature Survey. For this topic topmost cited papers are taken that range from 2023-2015. It's imperative to acknowledge the progression of methodologies over the years, along with their associated limitations.

Table 1. Literature survey

Sr. No.	Year	Title	Method/Algorithm used	Limitations of Existing Methodology
1.	2023	Meticulous Predictive Modelling for Classification of Cancerous Molecular Profiles[3].	This study utilizes various neural network architectures such as LSTMs, CNNs, feedforward neural networks, and RNNs to identify cancer types from gene expressions efficiently.	Neural networks, such as CNNs, RNNs, and LSTMs, have a high degree of accuracy in classifying cancer cases, but because they are opaque, it is difficult to comprehend how the predictions are formed, which makes it more difficult to find relevant biomarkers or biological pathways.
2.	2023	Hybrid Feature Selection Technique for Cancer Classification Using Microarray Gene Expression Data[5].	The paper proposed a hybrid approach for cancer classification using microarray gene expression data. It combines Random Forest with Particle Swarm Optimization, Principal Component Analysis, and an Autoencoder for cancer type prediction.	When combining several feature selection techniques, particularly when working with huge datasets, the result can be intricate and computationally demanding procedures that may not be realistic to use.
3.	2022	Response rate of anticancer drugs approved by the Food and Drug Administration based on a single-arm trial[6].	Obtaining regulatory approval for a novel medicine may depend in part on the lower limit of the 95% confidence interval (CI) of its ORR in a SAT exceeding the point estimate of the BCT ORR.	Relying too heavily on single-arm trials might lead to overestimation of treatment efficacy and difficulties in extrapolating results to different patient groups because of the inherent biases and limitations of the selected patient population.

4.	2022	Hybrid Deep Approach for Cancer Type Prediction Using Functional Genomic Data[7].	This study adopts a hybrid approach for cancer prediction. It combines PSO and RF for feature selection, addresses dimensionality using PCA, and employs a blend of CNNs and Bi-LSTMs.	The model's capacity to guide clinical judgment and deepen our understanding of cancer biology may be limited by the intricate combination of methods used, which could mask the biological relevance of the model's predictions.
5.	2022	CancerOmicsNet: a multi-omics network-based approach to anticancer drug profiling[8].	With a performance of 0.83 AUROC, which is better than other methods, CancerOmicsNet, a graph neural network, combines heterogeneous data to predict the therapeutic effects of kinase inhibitors across malignancies.	CancerOmicsNet achieves a high AUROC but lacks experimental verification and direct biological validation of its predictions. The practicality and reliability of its predictions may be restricted in the absence of experimental validation.
6.	2021	Translational precision medicine: An industry perspective[9].	Digital biomarkers, patient-centric companion diagnostics, biomarker-guided trial designs, artificial intelligence, multi-omics profiling, and model-based data integration.	Though encouraging tactics have been described, interdisciplinary cooperation between academics, physicians, regulators, and industry stakeholders is still a barrier to the successful application of translational precision medicine, which could delay its prompt integration into clinical practice.
7.	2020	Pharmacogenomics of anticancer drugs: Personalizing the choice and dose to manage drug response[10].	The review emphasizes the relevance of pharmacogenomics in oncology, with a focus on genome-wide research and candidate genes to find drug-drug interactions and increase the precision of anticancer treatment response prediction.	The complexity of pharmacogenomic interactions makes it difficult to identify significant genetic markers and comprehend their functional importance in predicting drug reactions, particularly in genome-wide research.
8.	2019	Applicability of drug response metrics for cancer studies using biomaterials[11].	The study discusses how different measurements and cell growth rates make it difficult to compare cancer medication responses across biomaterial platforms. It suggests using a consistent "decision tree" to report drug response assessments in order to increase the coherence and precision of study results.	The translational relevance of medication response assessments may be limited by standardized measures that do not completely account for the biological diversity and environmental factors found in cancer cell models cultured on biomaterials.
9.	2019	A computational model for anti-cancer drug sensitivity prediction[12].	Created a dual-layer integrated cell line-drug network model that computes, for every cell line pair, the Pearson correlation of drug responses by activity area and the Pearson correlation of gene expression profiles.	Drug response comparisons can be made more difficult by the intrinsic complexity and variety of biomaterial platforms utilized in cancer studies, even in spite of the advocacy for a consistent reporting system. Applying a “decision tree” could oversimplify these distinctions, which could cause study results to be interpreted incorrectly.
10.	2019	Toward explainable anticancer compound sensitivity prediction via multimodal attention-based convolutional encoders[13].	The MCA model performed the best when it came to forecasting the IC50 of unknown drug-cell line pairings’ drug sensitivity. A one-sided Mann–Whitney U-test revealed that the SCNN encoder, which integrated and encoded data from the whole SMILES sequence, performed noticeably worse than the baseline.	Given the current state of cancer biology research and the scarcity of detailed molecular data, the characteristics produced by convolutional encoders may not have obvious biological significance in 2019 as compared to previous years.

11.	2019	Health: make precision medicine work for cancer care[14].	More than 90% of our patients have a mutation that may respond to a recognized medication, they have found. However, less than 10% of patients may be qualified for a clinical study due to logistical issues or a lack of data supporting the use of an unapproved medication.	Important privacy and ethical issues are brought up by precision medicine in relation to patient consent, data exchange, and the misuse of genetic information. This study doesn't fully address these issues or offer sufficient mitigation strategies.
12.	2018	A novel heterogeneous network-based method for drug response prediction in cancer cell lines[15].	A brand-new, heterogeneous network-based technique called HNMDRP is proposed for effectively predicting drug association in cancer cell lines and drug response prediction.	The completeness and quality of the heterogeneous network data utilized for prediction may have an impact on the method's efficacy, which could result in biases or inaccurate drug response predictions.
13.	2018	Predicting Cancer Drug Response using a Recommender System[16].	Methods include gene expression profiling, predictive modeling, and integration of computational techniques. Algorithms encompass machine learning models for drug response prediction and bioinformatics tools for data analysis.	Data availability limits model generalizability, focusing on short-term effects neglects long-term outcomes and resistance. Overfitting risks reduced model adaptability, biological variability challenges accurate predictions.
14.	2017	A link to approach to cancer drug sensitivity prediction[17].	It has been demonstrated that using model cancer medication sensitivity as a link prediction is an efficient method.	The method is highly dependent on the availability and caliber of interaction data, which isn't always reliable or complete. Furthermore, the variety of cancer cells and the dynamic structure of cellular networks may influence the method's efficacy.
15.	2015	Comprehensive anticancer drug response prediction based on a simple cell line-drug complex network model[18].	Created the CDCN model, a cell line-drug complex network model. It records the various contributions of every cell line-drug reaction that is known.	Its dependence on cellular interactions represented in a simplified manner, which might not adequately convey the complexity of biological systems, is one of the model's limitations.

Limitations of Existing System

Our knowledge of cancer biology and therapeutic approaches has completely changed as a result of developments in molecular profiling tools. It is still very difficult to turn this abundance of molecular data into useful insights for forecasting medication responses unique to individual patients. Conventional approaches frequently find it difficult to handle the enormous dimensionality of molecular data while still producing reliable predictions and understandable models across a variety of datasets. To address the requirement for precise and comprehensible forecasts of cancer medication responses, this system provide a novel technique inspired by recommender systems.

METHODS

The figure-2 depicts the architecture of the proposed system.The step by step flow and working procedure is explained below in detailed manner.

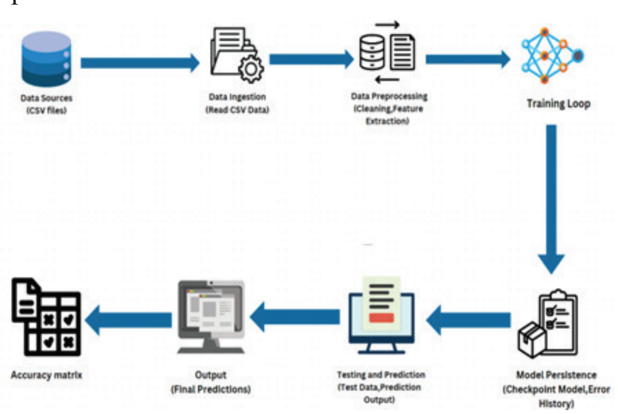

Fig. 2. Deep Learning Pipeline for Anticancer Drug Response Prediction

Gathering and Preparing Data

a. Data Collection: CCLE and the GDSC project provided information on drug screening.

b. Data Filtering: Kept only cell lines that have baseline gene expression information.

c. Data pre-processing: To guarantee consistency between datasets, IC50 values were recalculated using Bayesian sigmoid curve fitting. To promote comparability, data were standardized, and pharmaceuticals having a median IC50 values of less than 1 µM were removed, allowing the focus to be on targeted cancer treatments.

Formation of Datasets

Dataset: There were 223 drugs and 179,633 trials from GDSC in addition to 491 cell lines, 19 drugs, and 9096 experiments from CCLE in the final dataset. 276 more drugs were included from an internal investigation, 65 of which had GDSC overlap.

Finding the Characteristics of Cell Lines

a. Normalization: To ensure uniformity, baseline gene expression levels were adjusted for variance.

b. Key Gene Identification: 1856 important genes were found in order to provide a summary of the gene expression information for every cell line.

Examination of Pearson's Correlation

a. Identification of correlations: Based on the expression fold changes of important genes, Pearson's correlation was utilized to determine correlations between sets of cell lines.

b. Clarification of Trends: The objective of this stage was to make the underlying patterns and similarities in the dataset more understandable.

Model Training

a. Formulation of Drug Sensitivity Score: To measure the reactions of cell lines to medications, a drug sensitivity score was developed.

b. Dataset-specific Bias Mitigation: In order to increase the model's applicability and dependability, biases particular to each dataset were reduced.

Techniques for Factoring Matrix

a. Developing a Latent Pharmacogenomic Space: A latent pharmacogenomic space was developed through the use of matrix factorization techniques.

b. Data projection: To capture intricate relationships and interactions, data on cell lines and medications were projected into the same latent space.

Optimization

Gradient Descent: To optimize a "sum of squared error" loss function for modeling parameter fine-tuning, gradient descent was applied.

Testing for Robustness

a. Model Validation: To do complete testing and validation treatments, ten various designs originated from different random started points.

b. Examination of Consistency: To bolster trust in the model's predictive powers, the model's consistency

Overall, to reliably forecast cancer treatment responses, this system—known as Cancer Treatment Response Prediction using a Recommender System—utilizes state-of-the-art computational techniques and insights from large genomic datasets. It includes preprocessing, model training, optimisation, robustness testing, and data flow to produce accurate predictions for tailored cancer treatment.

Pseudo code for learning model

Require: ss name, ss test name, cl feature fname, drug list fname, out dir, f, max iterations, l rate, seed

Ensure: Prediction for Anticancer Drug Response

```
function read input arguments
Read input arguments using argparse
end function
function create output directory(out dir)
Create the output directory based on the provided parameters
end function
function read drug list(drug list fname)
Read the drug list file and select the drugs
end function
function read data files(ss name, ss test name)
Read the training and testing data files
```

```
end function
function convert to sensitivity scores(data)
Convert IC50 values to sensitivity scores
end function
while epoch < max iterations do
Model training loop
end while
```

RESULT

Output

To predict drug responses from cancer cell lines, a web application has been developed using the Flask framework. In this system, medical experts can select the cancer cell line and drug based on a patient's medical history and genetic profile. The system accurately predicts the most suitable drug for the selected conditions.

In the below figure-3, medical experts can choose the drugs and cancer cells from the available list and can also set up the threshold manually according to the patients need. Then he/she can view the predictions by clicking on the predict button.

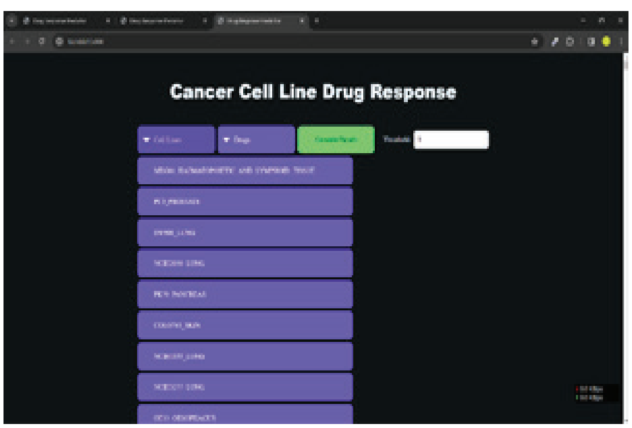

Fig. 3. System Overview

In the below figure-4, the system will predict the response accordingly and medical expert can get the overview of sensitive and resistive drugs to that selected cancer cell line.

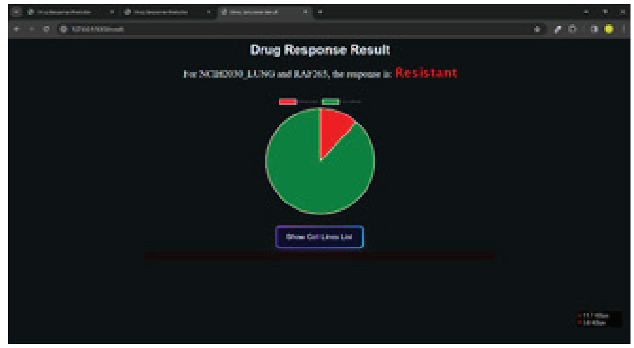

Fig. 4. Drug Response Prediction

In the below figure-5, This system also provided the option of alternative solutions for medical experts i.e drugs which will be sensitive and resistant to the patient for the better medical treatment. Medical expert can also download the file in his local system to get the better overviews of the prescribed medications to cancer patients.

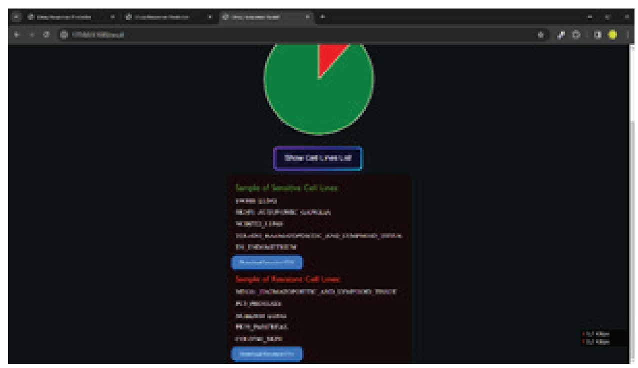

Fig. 5. List of Sensitive and Resistive Drugs

Discussion

Many models have been put out to forecast drug reactions, with a primary emphasis on forecasting how certain cell lines will react to particular medications. From a therapeutic perspective, it is imperative to prioritize medication rankings for patients or cell lines that are not yet observable, even though this approach offers insights into differential drug response pathways. In this investigation, the proposed system continuously showed strong performance in ranking medicines for particular cell-lines and forecasting individual drug responses.

The interpretability of the proposed system is a noteworthy benefit. Contrary to earlier research, which frequently disregarded this factor, proposed models offer a distinct projection of medications and cell lines into a pharmacogenomic space. This model aids in the identification of drug mechanisms and the understanding of model results by facilitating the investigation of complex interactions between medications, cell-lines, and pathways.

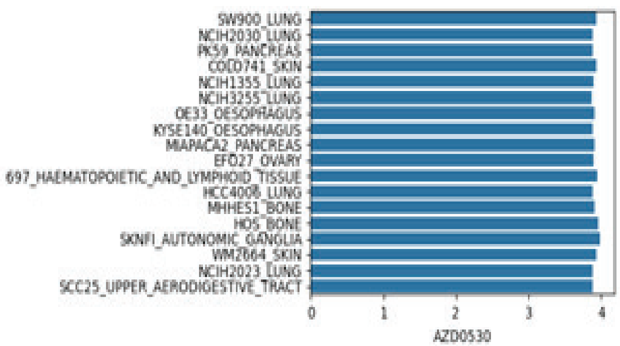

Fig. 6. AZDO530 Drug Response for Different types of Cancer

On the other hand, whereas ElasticNet and cwKBMF models produce strong concordance between observed and predicted cell-line rankings, their interpretability is limited due to their weak gene selection robustness. Furthermore, unlike the proposed system, which enables the detection of both the intensity and directionality of such correlations, these models might not offer directionality for drug-pathway associations.

Despite the advancements made, current drug response prediction models often neglect drug toxicity, which is crucial for clinical applicability. Integrating toxicity information could enhance the practical utility of these models, especially in predicting drug synergies and minimizing side effects. Furthermore, incorporating additional omics data, such as mutations, and leveraging gene interaction networks could further enrich the predictive performance of these models.

The small number of cell types and medications present in extant datasets relative to the complexity of the models is a major hurdle in the field. Experiments with inconsistent results and noise present challenges to information merging across datasets. Solving these problems will be crucial to building more reliable and broadly applicable models in the future.

Accuracy of Model

Performance of model evaluated based on accuracy matrics and RMSE.

Assessment of Model Accuracy: Model's accuracy is 98.44% it shows how precise it in forecasting cancer treatment responses.

The table below depicts the representation of model's Final Error, NDCG(Normalized discounted cumulative gain) and Accuracy.

Table 2. Accuracy Measures

Error	NDCG	Accuracy
1.562373023	0.885837783	98.43762698

NDCG (Normalized Discounted Cumulative Gain) measures the effectiveness of a ranking algorithm by evaluating the quality of its ordered predictions relative to the ground truth, with higher values indicating better performance.

Evaluation of RMSE Error: This Model's Root Mean Square Error (RMSE) was determined to be 1.5623, which represents the average divergence between the values of the expected and actual drug responses. The model's ability to identify the underlying patterns in the data is demonstrated by the low RMSE score.

CONCLUSION

In conclusion, predictive modeling in precision oncology holds great promise for improving cancer treatment outcomes by enabling personalized therapy selection based on individual patients' unique characteristics. By accurately predicting drug responses in cancer patients, clinicians can optimize treatment regimens, minimize adverse reactions, and ultimately improve patient outcomes. While challenges remain, the advent of predictive modeling in precision oncology represents a significant step toward more personalized and effective cancer treatment strategies.

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Design of Octagonal UWB Antenna using TCM for Wireless Applications

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ABSTRACT

A research paper introduces a compact microstrip-fed Ultra-wideband (UWB) antenna designed for wireless communication. It proposes employing Modal Significance characteristics of the Theory of Characteristics Mode (TCM) to analyze bandwidth enhancement in a monopole antenna. The antenna design achieves a Voltage Standing Wave Ratio (VSWR) of ≤ 2 across a frequency range spanning from 1.75 GHz to 12.80 GHz, encompassing the PCS1900, UMTS (3G, 1.885-2.025 GHz), Bluetooth (2.4-2.480 GHz), and UWB bands. Time-domain analysis indicates minimal variations in group delay and far electric field. The antenna's simulation is conducted using the CAD FEKO suite (version 6.3) employing the method of moments. A prototype of the antenna is fabricated using FR4 substrate with a dielectric constant (Ɛr) of 4.4 and loss tangent (tan□) of 0.02, with dimensions of 30 mm x 30 mm x 1.59 mm. The antenna design exhibits an almost omnidirectional radiation pattern in the horizontal plane (H-plane) and a more directional radiation pattern in the vertical plane (E-plane). The simulated and actual results of the antenna's performance indicate a minor variance, primarily attributed to disparities in manufacturing procedures.

KEYWORDS: *DGS, Method of moment, Monopole antenna, TCM, UWB, VSWR.*

INTRODUCTION

The Federal Communications Commission (FCC) authorized an unlicensed frequency band spanning from 3.1 to 10.6 GHz for the commercial deployment of ultra-wideband (UWB) technology. Since then, UWB has emerged as a highly promising wireless technology for transmitting signals at exceptionally high data rates [1]. Commercial applications of ultra-wideband (UWB) systems require compact and affordable antennas capable of omnidirectional radiation patterns and broad bandwidth [2-3].

Traditional microstrip antennas possess the capability to fulfill these criteria while typically featuring a narrow bandwidth. [4]. Planner monopole and printed monopole are different UWB antenna technologies. In developing the printed UWB antenna, optimization techniques are applied to the radiator, ground plane, and feed structures to achieve a substantial impedance bandwidth. [5]. he radiation pattern provides insight into the antenna's radiation behavior across a wide spectrum of operating frequencies [6].

Bandwidth enhancing methods are proposed in [7-

16]. Composite metamaterial with inner and outer ring resonators are used to obtain the dual band antenna [17]. Shape and size of circular strip is adjusted to create three different resonant mode for triple band applications [18].Use of shorting wall reduced the size and folded patch feed enhanced the bandwidth of UWB antenna [19].By determining the dominant mode at lower and higher frequency better return loss and stable radiation pattern has been obtained [20].Compact eye shape antenna at lower frequency of UWB provides a constant group delay [21].Multiple resonance with effective band width enhancement has been achieved by putting notches slots patches [22]. Multiple band antenna is obtained by integrating several strips in the patch [23]. The antenna's excitation and radiation behavior are analyzed and optimized through the application of the Theory of Characteristic Modes (TCM) [24]. Characteristic modes correspond to the Eigen currents of the matrix, thus they rely on the antenna's shape and size and remain unaffected by any external source or excitation [25]. TCM analysis indicates that a beveled ground plane enhances the antenna's impedance bandwidth [26].

Ultra-Wideband (UWB) technology represents a wireless communication approach that facilitates the transmission of extremely low-power signals across a vast array of radio frequencies, thereby enabling high transmission rates. Diverging from conventional methods reliant on sinusoidal waveforms condensed in frequency, UWB employs pulse-based waveforms compressed in time. As per the Shannon-Hartley channel capacity formula, the maximum channel capacity is directly linked to the bandwidth [27]. With its ultra-wide frequency spectrum, UWB technology can achieve significant capacities, boasting speeds ranging from hundreds of Mbps to several Gbps over distances spanning 1 to 10 meters [28]. Antenna simulation is conducted using CAD FEKO electromagnetic software employing the method of moments [29].

DESIGN OF PRINTED OCTAGONAL UWB ANTENNA

Figure 1 illustrates the geometry of the UWB antenna. It features an octagonal-shaped patch antenna fed by a microstrip line, both printed on one side of the substrate, while a Destructive Ground Structure (DGS) is printed on the opposite side. The substrate material used for simulation is FR4, characterized by a dielectric constant (εr) of 4.4 and a loss tangent (tan δ) of 0.02, with a substrate height of 1.59mm. During simulation, the height of the metal patch is disregarded and set to zero. The performance of the proposed Patch Antenna with DGS (POMA) is influenced by parameters such as the gap 'g' between the radiating patch and DGS, as well as the size and shape of the DGS. The dimensions of the POMA geometry are 30 x 30 x 1.59 mm. The design of the monopole antenna relies on specific formulas, with a focus on the lower edge frequency during the design process [6].

$$L = \frac{\lambda}{4} - 2 * \Delta L \tag{1}$$

$$W = \frac{c}{4f_r}\sqrt{\frac{2}{\varepsilon_r + 1}} \tag{2}$$

$$\lambda = \frac{C_0}{(f * \sqrt{\varepsilon_r})} \tag{3}$$

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left[1 + 12 * \left(\frac{h}{w}\right)\right]^{\frac{-1}{2}} \tag{4}$$

$$\Delta L = 0.412h \frac{(\varepsilon reff + 3)(\frac{w}{h} + 0.264)}{(\varepsilon reff - 0.258)(\frac{w}{h} + 0.8)} \tag{5}$$

In the context provided, L denotes the length of the patch, W represents the width of the patch, λ stands for the wavelength, εeff indicates the effective dielectric constant, εr signifies the dielectric constant of the substrate, ΔL denotes the extension along the length, h represents the substrate height, and w denotes the width of the substrate.

This paper employs the Theory of Characteristic Modes (TCM) to optimize the structure of a monopole antenna, aiming to enhance its impedance bandwidth. The parameters associated with TCM include Eigen value (λn), Modal significance (MS), and Characteristic angle (αn). Among these parameters, modal significance is particularly utilized to assess the broadband behavior of the antenna. The power radiated by a mode is inversely proportional to |λn|, where the range of λn extends from -∞ to +∞, with λn equaling 0 at resonance. A positive λn indicates magnetic energy storage in the mode, while a negative λn signifies electric energy storage. This parameter determines the contribution of a specific mode to the total radiation, where MS=1 denotes 100% mode contribution for radiation. The phase angle between the characteristic current (Jn) and the characteristic field (En), denoted as αn, is given by αn = 180o – tan-1(λn).

The range of αn varies from 0o to 360o, with αn equaling 180o at resonance. Modes with 0o < αn < 180o exhibit inductive behavior for Jn, whereas modes with 180o < αn < 360o display capacitive behavior[26].

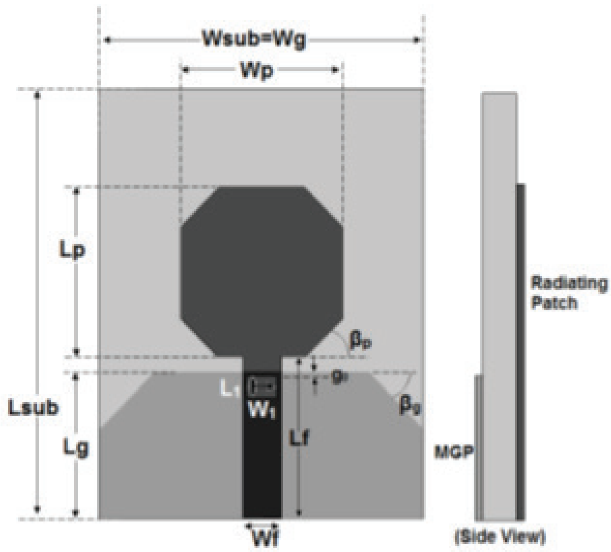


Fig. 1 Geometry of OPMA

PARAMETRIC STUDY OF OCTAGONAL UWB ANTENNA

Effect of gap between the destructive ground plane and radiating patch

The optimization process for POMA includes fine-tuning the gap distance 'g' between the destructive ground substrate and the radiating patch. When the gap 'g' between the DGS and radiating patch is set to 1mm, a broad operating bandwidth is attained. The distance between the radiating patch and the ground plane introduces a coupling capacitance, which offsets the inductance produced by the radiating patch [30].

This process ultimately achieves impedance matching, leading to a wide impedance bandwidth characteristic of ultrawideband behavior, as depicted in Fig. 2. The equivalent circuit representing the patch and the impact of the Destructive Ground Structure (DGS) are illustrated below.

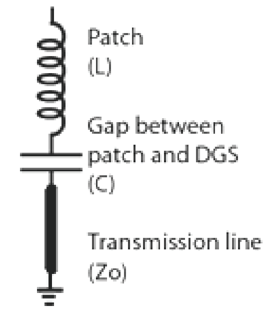


Fig. 2 The circuit equivalent to the radiating patch and the coupling gap between the radiating patch and the Destructive Ground Structure (DGS)

As the distance between the radiating patch and DGS decreases, the mutual coupling between the patch and ground plane increases, thereby broadening the operational bandwidth, as the ground plane also contributes to radiation [16]. Conversely, as the gap 'g' increases, the mutual coupling between the patch and ground plane decreases, leading to an impedance mismatch at higher frequencies.

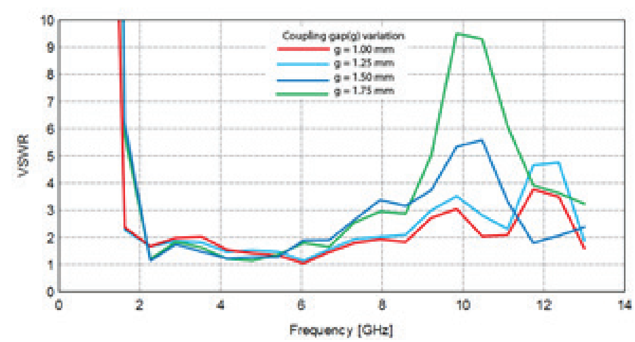


Fig. 3. Graph of VSWR versus Frequency at different gap 'g'

Effect of beveled DGS (Using Theory of Characteristics Mode)

A VSWR > 2 is noted in frequency range between 8.5 GHz to 10.45 GHz when 'g'=1mm (Fig. 3). To achieve the VSWR ≤ 2 over entire UWB frequency, parametric study have been conducted by changing the bevel angle and compared it with plane DGS using TCM.

Fig. 4 shows the modal significance (MS) of the first four characteristics mode for with and without bevel DGS. An MS value of 1 guarantees that the mode contributes fully, accounting for 100% of the radiation.. When DGS is beveled Mode1 become the prime contributor for radiation. After beveling the DGS, the resonance frequency of mode 1 is shifted towards the lower edge. Mode2 contributes less for radiation compare to mode1 as its resonance frequency is shifted to upper edge after bevel. Mode3 and Mode 4 are higher order closed loop current mode mainly stores the energy. Beveled DGS shifted the resonance frequency of Mode3 and Mode 4 towards higher frequency edge thereby reducing the effect of early energy storing at lower edge results in bandwidth enhancement. The implementation of a beveled ground plane facilitates a seamless transition between resonant modes, ensuring excellent impedance matching across a wide frequency range. [16].

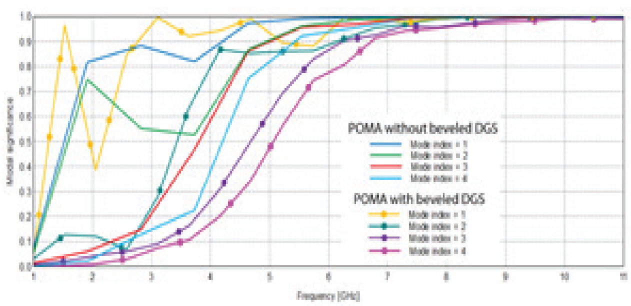


Fig. 4 Graph of Modal significance versus Frequency for with(at β = 45°) and without bevel DGS.

Bevel angle (β) is varied by 30°, 45° and 60° as shown in Fig. 5. When bevel angle β =30°, 45°and 60°;VSWR ≤2 is obtained from 1.78GHz to 6GHz, 2.2GHz to 10.35GHz and 2.2GHz to 7.1GHz respectively. Greater VSWR bandwidth is obtained when bevel angle β = 45°. Hence for further optimization bevel angle β = 45° is selected. Corresponding

VSWR versus Frequency graph for different DGS beveled angle is depicted in Fig. 6.

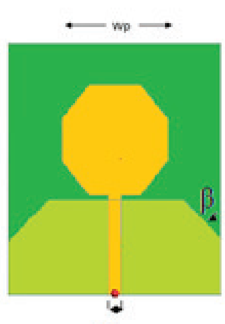


Fig. 5 Geometry of POMA with beveled destructive ground substrate

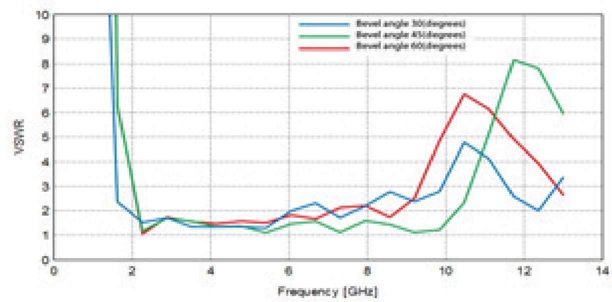


Fig. 6 Graph of VSWR versus Frequency at different DGS beveled angle

Effect of ground notch on DGS (Using Theory of Characteristics Mode)

This parametric study shows the effect of ground notch on antenna performance using TCM. ¬¬Fig. 7 shows the Modal Significance (MS) of four modes of proposed antenna before and after placing a notch in the ground. The presence of a notch in the ground plane is noted to induce a shift in the resonance frequencies of all modes towards lower frequencies, with the exception of mode 1, attributed to the influence of inductive loading. A notch produces a discontinuity in DGS and increases the current path causes ultimately bandwidth enhancement at higher edge frequency. Transmission line equivalent circuit of ground notch is shown in Fig.8 which represents an inductor that nullifies the capacitive effect formed by the parallel plates. Shift in resonance frequencies of all modes towards lower edge frequency contributes to enhanced radiation bandwidth when excited. For 5.5mm x 2.5mm ground notch dimension, obtained VSWR ≤ 2, is from 1.79GHz to 11GHz as depicted in Fig. 9.

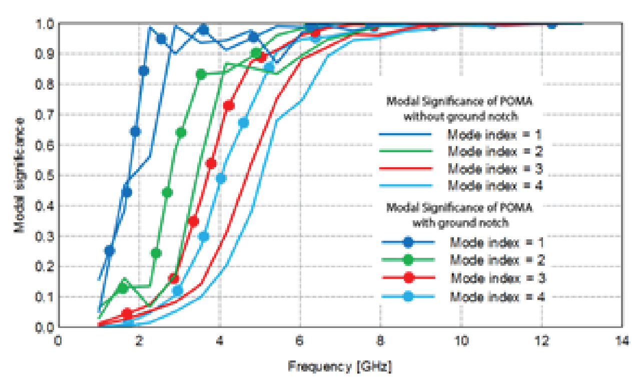


Fig. 7 Modal significance for with and without ground notch

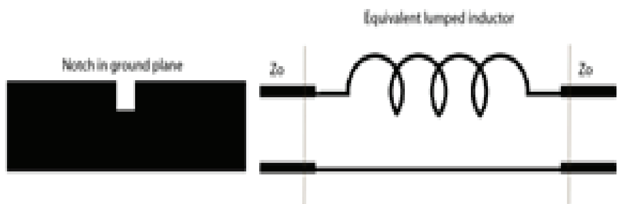


Fig. 8 Equivalent circuit of ground notch in DGS

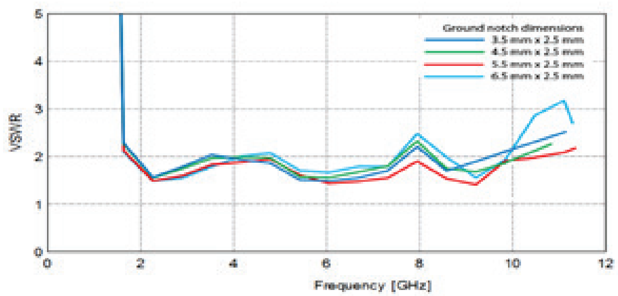


Fig. 9 Graph of VSWR versus Frequency for different ground notch dimensions

Effect of reduced ground plane width (Using Theory of Characteristics Mode)

Fig.10 shows the comparison of MS for POMA with beveled DGS, POMA with beveled DGS & ground notch and POMA with beveled DGS, ground notch & reduced ground plane width.MS graph shows both mode1 and mode2 are contributing for the radiation therefore wide impedance bandwidth from 1.75GHz to12.82GHz is achieved (Fig.12), when the width of the ground plane is reduced from 60mm to 30mm. Mode1 contributes for radiation when DGS was beveled. Mode2 contributes for the radiation when DGS was beveled with ground notch. Now mode1 and mode2 contributes for the radiation for beveled DGS with ground notch & reduced ground plane width. As current components at the edges of the ground plane are also responsible for bandwidth enhancement. The normalized current distribution of the initial three characteristic modes is depicted in Fig. 11, illustrating the effects of a beveled DGS with a ground notch and reduced ground plane width. The first mode exhibits horizontal currents, the second mode features vertical currents, and the third mode demonstrates circular currents. Among these modes, only the first two significantly contribute to radiation, while the third mode predominantly stores energy.

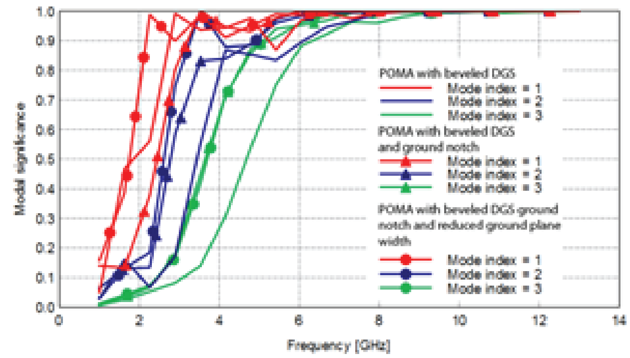
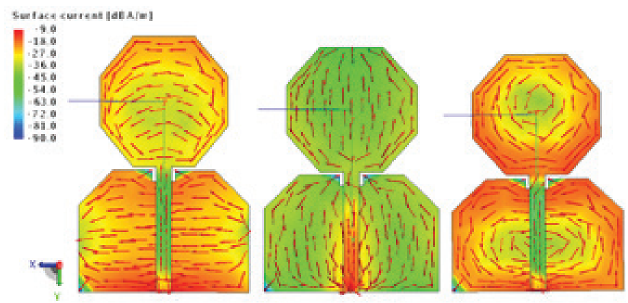


Fig. 10 Modal significance for POMA with beveled DGS, beveled DGS with ground notch and beveled DGS with ground notch & reduced ground plane width.



(a) Horizontal current (b) vertical current (c) Circular current

Fig. 11 Normalized current distribution for the initial three modes

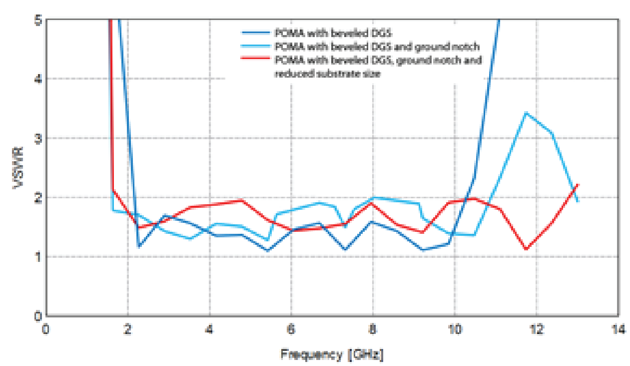


Fig. 12 Graph of VSWR versus Frequency for beveled DGS, beveled DGS with ground notch and beveled DGS with ground notch & reduced ground plane width

Antenna Efficiency

Fig. 13 shows antenna efficiency is greater at lower frequencies but diminishes at higher frequencies due to increased variations in the dielectric constant, particularly as the material becomes more lossy [31].

Efficiency of about 80% is obtained for beveled DGS with ground notch & reduced ground plane width.

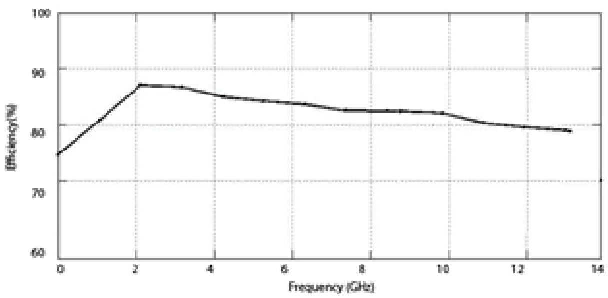
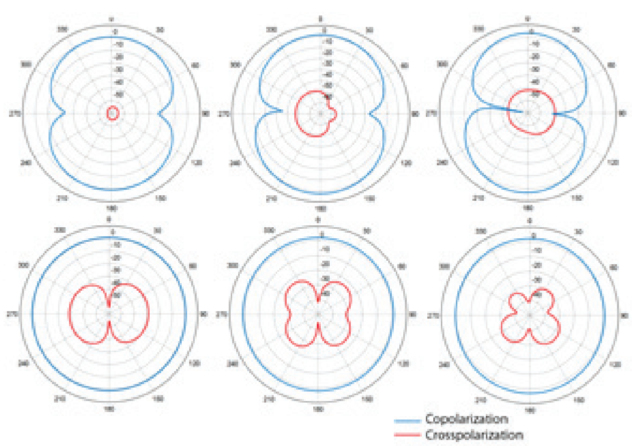


Fig. 13 Graph of Efficiency versus frequency for POMA with beveled DGS, ground notch and reduced ground plane

Radiation Characteristics

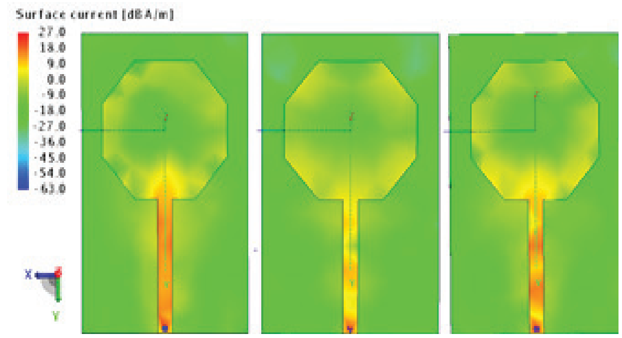
Figure 14 illustrates the radiation patterns in the elevation plane (ϕ=90º) and azimuth plane (ϕ=0º) at frequencies of 2.40 GHz, 5.5 GHz, and 7.5 GHz, showcasing how the antenna distributes its radiated energy [6]. The radiation pattern exhibits a figure-eight shape in the elevation plane and near-omnidirectional characteristics in the azimuth plane. This omnidirectional radiation pattern ensures nearly uniform radiation characteristics throughout the azimuth plane[16].



(a) 2.42GHz (b) 5.28GHz (c) 7.5GHz

Fig. 14 Radiation pattern of POMA for beveled DGS, ground notch and reduced ground plane width.

The cross-polar component in the radiation pattern escalates with frequency, with cross-polarization levels measuring approximately -48 dB along the E-plane and about -32 dB along the H-plane. This phenomenon arises from the concentration of more horizontal current components at the lower edge of the radiating patch and the upper edge of the DGS [27]. As higher-order modes are generated at higher frequencies, the radiation pattern tends towards nearly omnidirectional characteristics with minimal cross-polar components [33].



(a) 3.1GHz (b) 5.5 GHz (c) 7.5GHz

Fig. 15 Current distribution at 3.1GHz, 5.5GHz and 7.5 GHz

The current distribution at various frequencies is shown in Fig.15. Higher order mode gets excited at higher frequency.

TIME DOMAIN ANALYSIS

A crucial criterion for UWB antennas is ensuring good time domain performance [32]. A necessary attribute of a suitable UWB antenna is minimizing pulse dispersion in the received waveform, as it carries essential information [27]. Time domain analysis is obtained by using CAD FEKO time domain characteristics function [29].

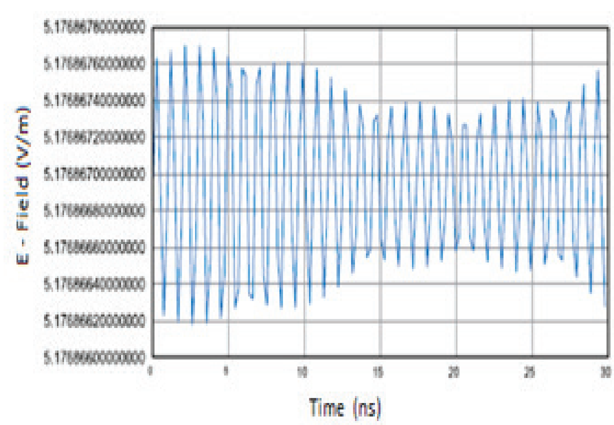


Fig. 16 E-Field Magnitude (V/m) versus Time (ns)

In this demonstration POMA is excited by a Gaussian source pulse. Gaussian source pulse is used as transmitting pulse (source pulse or time signal). Graph of E-Field (V/m) versus time (ns) is shown in Fig. 16. Negligible variation in electric field (E-field) indicates almost constant transmitted E-field over a time period.

EXPERIMENTAL RESULTS AND DISCUSSION

Antenna is manufactured on printed circuit board using photolithographic technique as shown in Fig. 17

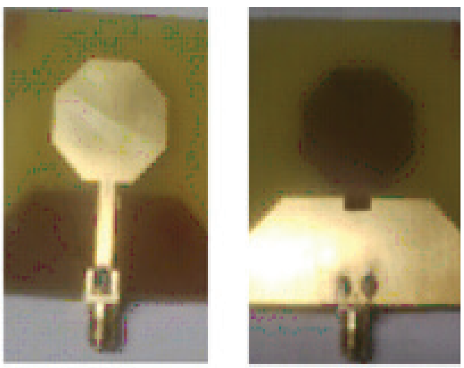


Fig.17 Prototype of POMA: (i) Top view and (ii) Bottom view

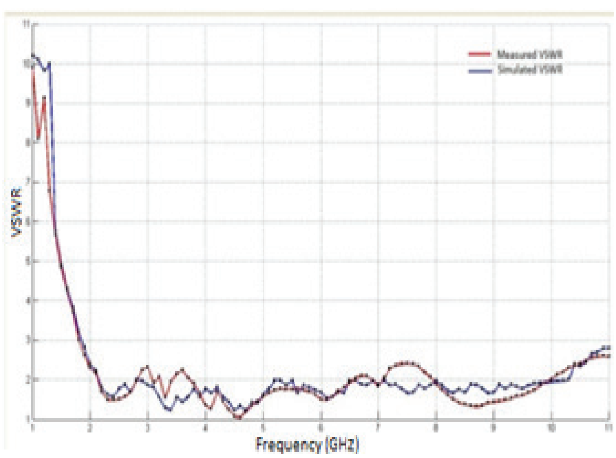


Fig. 18 Measured and simulated VSWR versus frequency of proposed antenna.

Group Delay Measurement

Group delay serves as another crucial parameter in the design of ultrawideband antennas, where maintaining constancy is essential as it indicates distortion of transmitted pulse [33].

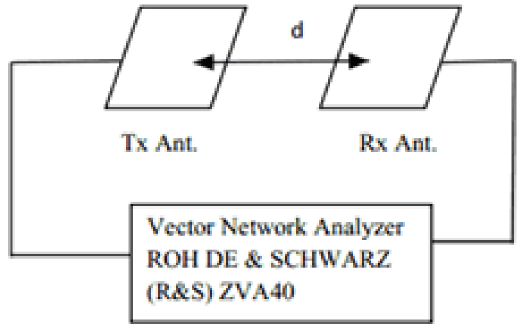


Fig. 19 Measurement set up for group delay (d-distance, Tx Ant-Transmitting antenna, Rx Ant-Receiving antenna)

To assess the group delay, two identical antennas are spaced 40cm apart, with their connectors linked to two ports of a vector network analyzer, as illustrated in Figure 19. The measured group delay, depicted in Figure 20, reveals minimal variation when the antennas are aligned face-to-face with azimuth plane alignment throughout the entire operating frequency range.

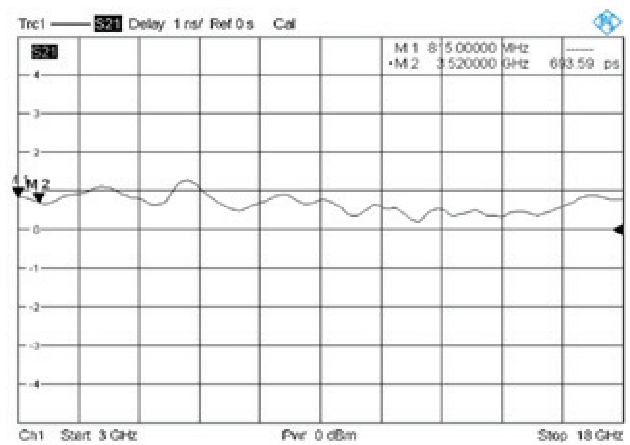
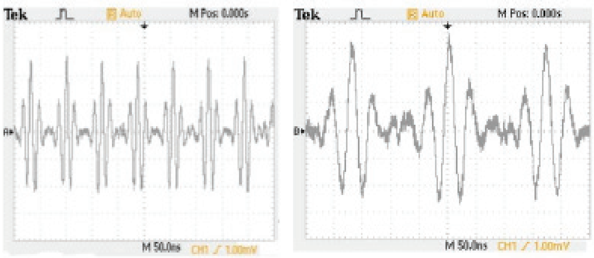


Fig. 20 Measured group delay of proposed antenna

Pulse Spreading and Deformation

Pulse spreading and deformation refer to the alignment of time between the transmitted and received pulses by the antenna. To ensure efficient operation in pulse system applications, minimizing pulse spreading by the antenna is imperative. The pulse transmission characteristics of the antenna are evaluated by comparing its performance in face-to-face and side-by-side orientations. An Arbitrary Function Generator (AFG-2225) is utilized to deliver a Gaussian pulse to the transmitting antenna, while the received signal is recorded on a Digital Storage Oscilloscope (Tektronix TDS-2014C). Comparison of received pulses in both side-by-side and face-to-face orientations reveals identical patterns, as depicted in Figure 21. Identical antennas are employed at both the transmitting and receiving ends.



(a) Face to face placed antenna (b) Side to side placed antenna

Fig. 21 Received pulse of POMA

CONCLUSION

A proposed antenna is operating from 1.75 GHz to 12.80 GHz covering PCS1900, UMTS Bluetooth, Wi-max, WLAN and UWB frequency bands. Modal significance shows mode1 and mode 2 both contributes for the radiation and provides enhanced VSWR bandwidth of POMA with beveled DGS, ground notch and reduced ground plane width. This antenna demonstrates compatibility with MMICs for easy integration. The proposed antenna achieves efficiency levels of up to 80%. Time-domain analysis reveals minimal variation in group delay. Both measured and simulated results affirm the suitability of the designed antenna for broadband applications.

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An Integrated Approach for Driver's Drowsiness Detection

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ABSTRACT

Driver's ability to control the vehicles is reduced when they are sleepy or exhausted. The main reason of the rising number of traffic fatalities and accidents is falling asleep while driving. Driving in drowsy state is therefore considered to be the most active field of research. An integrated strategy that depends on the EAR and MAR calculations as well as the eye and mouth closure status (PERCLOS) is proposed in this paper. This aids in determining whether the mouth is open or closed, or when driver is yawning. Using this approach, a camera is installed on the dashboard of the car to continuously take video of the face of the driver. After that, these video frames are analyzed to see if the driver appears sleepy or not. Real-time testing were conducted for the proposed system.

KEYWORDS: *Eye aspect ratio(EAR), Facial landmark, Mouth aspect ratio(MAR), Haar cascade, dlib68.*

INTRODUCTION

In the context of international road safety, driver sleepiness, also known as "drowsy driving," poses a complicated and multidimensional dilemma. It is a ubiquitous risk that is defined by a condition of reduced awareness and mental capacity while operating a vehicle, resulting from things like exhaustion, lack of sleep, or even side effects from medications. This pernicious ailment greatly increases the likelihood of car crashes, injuries, and fatalities; thus, prompt action and creative remedies are required. The realization that sleepy driving plays a significant role in traffic accidents has led to increased attempts in technology and research to lessen the effects of this behaviour. To efficiently detect and address driver drowsiness in real-time circumstances, a variety of approaches have been investigated, ranging from physiological monitoring to behavioural analysis and technological solutions.

Moreover, the dynamic character of sleepiness and its capacity to intensify quickly highlight the significance of preventative actions and quick reaction mechanisms. Integrating cutting-edge technologies, such as computer vision, machine learning provides promise for enhancing the precision and effectiveness of drowsiness detection systems.

These systems use real-time analysis of driving behaviour, eye movements, and face features to deliver timely alerts and actions to protect road users and prevent accidents. Notwithstanding noteworthy advancements, obstacles persist in attaining extensive integration and endorsement of these technologies, encompassing concerns pertaining to confidentiality, dependability, and economy of scale. Therefore, to advance the development and implementation of complete solutions for preventing driver sleepiness and guaranteeing safer road environments globally, a coordinated and cooperative effort involving stakeholders from multiple sectors is required.

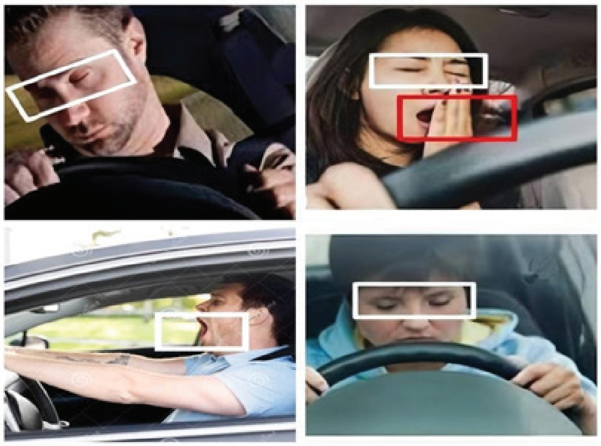


Fig. 1. Samples of Drivers Sleepy Condition While Driving Vehicle

3,081 accidents occurred in 2015 as a result of driver drowsiness sleep deprivation, or illness. 3,383 persons were hurt and 706 individuals lost their lives as a result of these accidents[18]. Automation simplifies people's busy lives while yet providing excellent services in a faster and safer method. Even though many organizations are already investing heavily in the subject, evaluating a driver's level of fatigue remains a difficult problem. Therefore, for real-time applications, an automated and effective system based on driver state prediction and sleepiness detection must be implemented.

Ocular measurements have also been established in several studies to be a potential means of detecting sleepiness. These methods frequently employ computer vision techniques to check the state of the driver's eyes. Many studies use the proportion of closed eyelids as a measure of tiredness too. Various metrics include blink rate and duration of ocular closure. Among those different approaches, monitoring the driver's eye condition along with yawning is the most effective and least invasive method. This yields the most accurate and dependable accident rate prevention results. For this the high computation and high execution speed required[13].

LITERATURE SURVEY

The technique that Rajanikanth Aluvalu, M. P. Kantipudi, Ketan Kotecha, and J. R. Saini, V. Uma Maheswari, Krishna K. Chennam suggested uses the eye closure status (PERCLOS), also known as the facial aspect ratio (FAR), to provide an integrated approach to closing one's eyes and yawning. Common hand gestures like nodding and covering one's lips with one hand are recognised by this method[1]. H.

U. Khan, A. Ismail, M. Ramzan, M. Ilyas, S. M. Awan and A. Mahmood review explores drowsiness detection systems, emphasizing physiological parameters' accuracy. Hybrid approaches combining physiological vehicular, and behavioral measures prove effective. Among supervised learning techniques, SVM stands out for accuracy, though not ideal for large datasets. The review highlights the need for integrated methods to enhance overall performance in drowsiness detection[4]. J.May and C.baldwin distinguishing between active (SR) and passive (TR) driver fatigue is crucial for targeted countermeasures. Technologies like increased automation benefit TR active fatigue, while interactive tools help mitigate TR passive fatigue. SR fatigue, linked to circadian rhythm and sleep deprivation, may be less responsive to countermeasures. Effective strategies for SR fatigue include naps and caffeine. Crash prevention technologies are beneficial for both SR and TR fatigue. Future research should focus on tailored countermeasures and integrated fatigue-detection technologies[5].

The issue with changing lighting and various driver postures was handled by B. Cheng, W. Zhang and Y. Lin.Six measurements, including PERCLOS and CV of the eyes, were included in addition to Fisher's linear discriminant function for enhanced categorization. Using customised characteristics and models at the alert Drivers phase is advised to increase identification rates[2]. The research by W.-Y. Chung and B.-

G. Lee suggested that the driver's state may be dynamically evaluated using a Bayesian network in an Android phone fatigue monitoring system by fusing information. The study demonstrates the value of utilising a variety of information sources, including facial expressions, to enhance the effectiveness of drowsiness detection[3]. Ruei.C. Wu, Chin.T. Lin, W.H. Chao, Sheng. F. Liang, T.P and Yu-jie Chen, and Jung suggests a VR-based driving environment sleepiness estimate approach based on EEG that uses ICA, power- spectrum analysis, and linear regression. The study shows stable correlations between people across sessions and reveals a consistent association between driving performance variations and the log subband power ICA/EEG spectrum. By applying linear regression on 10 subband log power spectra near -bands of two ICA components, the approach achieves good accuracy. This method provides a non-invasive way to track cognitive processes in situations when attention is crucial, and it is particularly useful for applications with few EEG channels[6].

Y. Xu, Y. Cui, and D. Wu suggested FWET method completely does away with the necessity for calibration by integrating feature weighting (FW) with ensemble training (ET). Tests demonstrate the usefulness of both FW and ET, and their combination improves generalisation capabilities. Future research seeks to adapt FWET to many areas beyond driver sleepiness detection. Plug-and-play applications can benefit from its convenience since it does not require calibration data from fresh participants[7]. Y. Zhang, Y. Jiang, D.Wu, C. Lin, and C.-T. Lin, created offline transfer regression model that requires little subject-specific calibration data to estimate driver drowsiness from EEG signals. To maintain consistency across many viewpoints, the model has been expanded to an online and multi-view context, encompassing elements from both the source and target domains. Future research aims to overcome constraints despite the promising performance, such as improving the simultaneous fixation of four parameters for increased accuracy and fine-tuning sample weighting in the target domain[8].Various researches used decision tree for problem solving[12-15].

M. J. Khan, M. Asjid. Tanveer, Noman Naseer, M. J. Qureshi and Keum-shik Hong used functional near-infrared spectroscopy and deep learning algorithms, this study explored the possibility of sleepiness detection for a passive brain-computer interface. A deep neural network with four windows (0-1, 0-3, 0-5, and 0-10) was utilised to identify driver sleepiness. Additionally, we employed a convolutional neural network with an accuracy of 99.3µ on the functional brain maps. This network allowed us to identify thirteen unique channels that are particularly active during sleepiness, as well as a newly identified area comprised of the channels with the greatest classification accuracy[9].S. Ganesan and M. Kahlon used a good algorithm for detecting sleepiness examines real-time video from a camera to determine if the driver's eyes are open or closed. When three or more consecutive open or closed eye states are identified, the driver is alerted to the possibility of drowsiness. Although the system can accept spectacles, it may not be accurate in different lighting situations or driving postures. By overcoming these obstacles, combining data from other components like the gas pedal and steering wheel, and applying self-learning capabilities at startup, future improvements hope to increase robustness[10].

HAAR CASCADE ALGORITHM

Haar Cascade can be implemented using below steps:

1. Pre-processing:

   To reduce computational complexity, convert the input image to grayscale, as face identification does not need color information.

2. Haar feature selection:

   Rectangular filters called Haar-like features are employed in face recognition; in the training phase, these features—which include edges, corners, and lines—are chosen based on their capacity to discriminate between faces and non-faces.

3. Integral image calculation:

   Compute the integral image of the grayscale image, which is a fast way to find the sum of all the pixel values in a rectangle region, for faster feature calculation.

4. Adaboost Training:

   Utilize the Adaboost (Adaptive Boosting) technique to train a series of classifiers. A sequence of weak classifiers, or straightforward decision functions based on Haar-like characteristics, make up each classifier. The best weak classifier that properly classifies the majority of the training data is chosen iteratively by Adaboost.

5. Cascading Classifier:

   Assemble the trained classifiers into a cascade, with each stage advancing to the next by filtering away a significant percentage of negative samples, or non- face regions. This improves computational performance and lowers false positives.

6. Sliding window detection

   Place a fixed-size window across the grayscale image, then apply the classifier cascade at each location. A region is categorized as a face if it successfully completes every step of the cascade.

METHODOLOGY

Systems for detecting drowsiness are essential for improving traffic safety and averting collisions. The proposed system is meant to forecast driver drowsiness and recognize different signs of drowsiness. These include spotting yawning, open mouths, and closed eyelids. The system crops and isolates the driver's face from a camera image by using the Haar Cascade Face Detection Algorithm. Then, it recognizes the mouth and eyes in the face area, which are used as inputs for the HAAR algorithm. By using an algorithm to categorize different states of drowsiness, accidents can be avoided in real time.

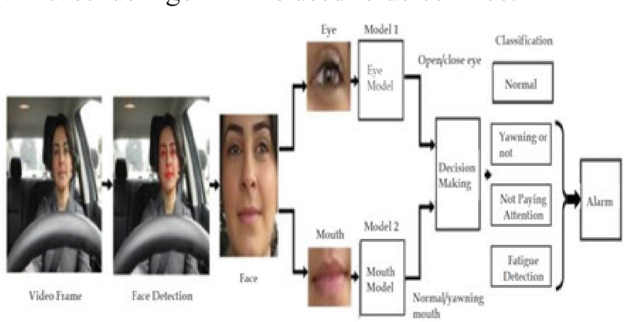
The proposed system involves the following steps:

Video capturing

Driver's face is captured via webcamera to extract video frames. this video frames input is pass to further processing for detection of drowsiness.

Face detection

Utilize a facial recognition technique to identify and retrieve the driver's face from the obtained pictures. Numerous face identification algorithms exist, including deep learning-based techniques like convolutional neural networks and Haar cascades. In proposed system, haar cascade algorithm is used to detect face.



Measurement of eye mouth Status

Analysing intricate problems such as expression recognition requires the ability to identify prominent features on the face. This procedure makes it possible for different programs to exploit particular feature statuses for additional processing. Automated face landmarking is a novel technique that effectively identifies salient distinctions for building suitable models. This technique computes crucial metrics such as the mouth aspect ratio and eye aspect ratio by labeling facial landmarks using the dlib68 point model. These factors are essential for determining how well the mouth and eyes are doing. EAR and MAR are computed once face landmarks are recognized, offering important information about the condition of facial features.

Equation to find status of eye:

EAR=||v-z||+w-y|| / 2||u-x|| (1)

The Eye Aspect Ratio calculates the ratio of distances between particular spots on the eye. Closed eyes are suggested by a lower EAR value, whilst wide eyes are indicated by a larger value.

For the proposed system,the threshold range of EAR taken is mentioned in table 1.

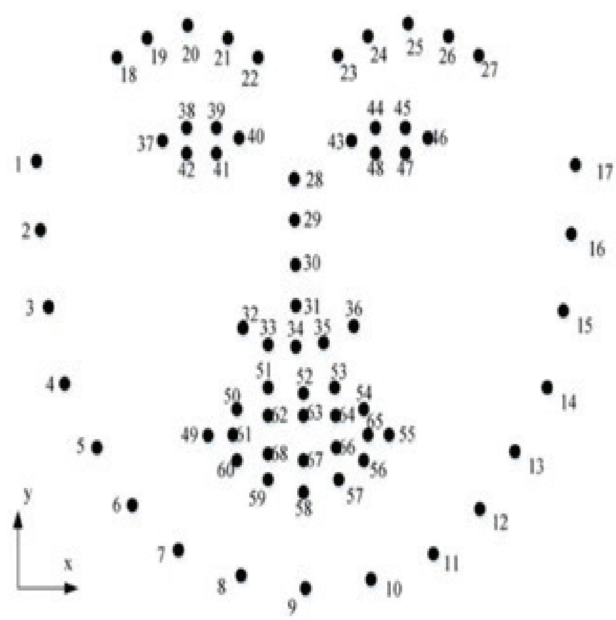


Fig. 2. Facial Landmarks

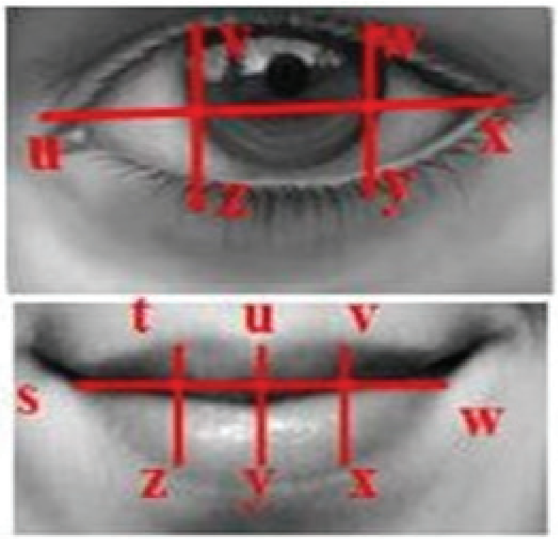


Fig. 3. dlib68 Landmark Illustration for MAR and EAR

Equation to find status of mouth:

$$MAR = ||t-z|| + ||u-y|| + ||v-x|| \,/3\, ||s-w|| \quad (2)$$

MAR, on the other hand, is a tool used to detect mouth opening and closure. It does this by measuring the ratio of distances between sites surrounding the mouth. One can interpret an open mouth as having a greater MAR value and a closed mouth as having a lower value.

Table 1: Threshold range for EAR

Range	Status
<0.25	Low (Drowsy)
0.25 – 0.30	Normal

Table2: Threshold range for MAR

Range	Status
0 – 15	Normal
>15	High (Yawning state)

Drowsiness alert

The threshold values successfully identify the state of driver whether driver is drowsy or not.If drowsiness detected then driver get alerted through alarm buzz until he comes in alert state.

Result and analysis

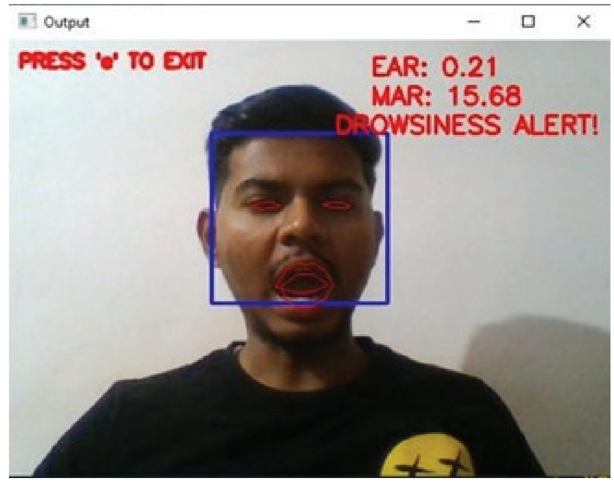


Fig. 4. Yawning Detection

As shown in fig5 threshold of MAR is greater than 15.which is successfully detecting the yawning movement of driver. After detection of yawning the driver get alerted using alarm.

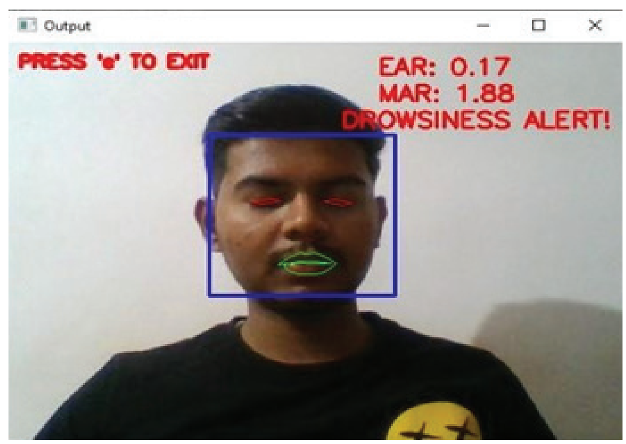


Fig. 5. Close Eye Detection

As shown in fig6 threshold of EAR is lesser than 0.25. which is successfully detecting the closing of eye of driver. After detection of eyelid closure the driver get alerted using alarm.

CONCLUSION

Major reason behind the road accidents is drivers drowsy condition. So,to avoid the rate of accidents caused by drowsiness, there should be alerting system to alert the driver. The proposed system able to successfully detect the drowsiness. The primary issue with the framework is its inability to extract the useful information from the cropped and sliced images from the video frame. A number of indicators, including closed eyelids and an open mouth when yawning, have been used by the planned study to identify the driver's drowsiness. EAR and MAR techniques were employed to extract features. Haar cascade gives more accuracy for face detection. Enhancing the presented work may also be accomplished by utilising CNN and classification algorithms, as well as by concentrating on extracting additional features utilising a variety of feature extraction approaches.

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Data Awareness in the LPW Algorithm-based Big Data Cache Replacement Method

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ABSTRACT

Attaining optimal system execution performance is difficult because of the diverse range of application features, the unpredictable behavior of memory resources, and the unpredictable utilization of the cache application programming interface (API). A range of performance difficulties can arise from ineffective cache replacement techniques, including as prolonged application execution durations, reduced memory use, frequent replacements, and potential program execution failures caused by memory outages. Currently, Spark is employing the cache refilling mechanism known as least recently used (LRU). Although LRU is often used in conventional strategies, it fails to include ambient circumstances and workloads. Consequently, it is unable to perform effectively in many circumstances. This research presents a novel cache replacement strategy known as least partition weight (LPW) in its model. The evaluation of a system's performance in LPW involves the consideration of various characteristics, including the partition size, computational cost, and reference count. After integrating the LPW algorithm into Spark, it was assessed with the LRU and other modern techniques. The recommended model, which incorporates auto data division and weighted tree approach, significantly enhances the functionality of the cache replacement model. Hence, the primary objective of this study is to gain a comprehensive understanding of the cache replacement procedure and propose an enhanced iteration of the catch replacement technique by including LPW in tandem with parallel computation.

KEYWORDS: *Big data, Cache replacement, Data mapping, LPW, Parallel computation, Tree data structure.*

INTRODUCTION

Many of the challenging real-world problems that arise in various domains nowadays can be classified as optimization issues. Efficiently and effectively searching the associated search space is crucial for finding optimal solutions in complex situations. Population-based heuristics have long been the go-to methods for finding optimal or closely optimal solutions to a different types of optimization problems. These meta-heuristics draw inspiration from the intelligent processes found in nature. There are two main categories of meta-heuristics: evolutionary algorithms and Swarm intelligence algorithms, such as particle swarm optimization, are notable aspects of computational methodologies swarm, ant colony, grey wolf, phylogram analysis, and cuckoo search. On the other hand, evolutionary algorithms consist of genetic algorithms and differential evolution. Various methodologies, such as hybridization and stochastic operators, have been utilized by scholars to improve the effectiveness of meta-heuristics in tackling specific optimization challenges. In the rapidly developing field of machine learning, algorithms with the necessary capabilities are now being introduced to effectively resolve optimization issues. This is due to the widespread use of meta-heuristics.

Utilizing caching to bring resources closer to the user can effectively reduce latency. Due to its importance in reducing latency, Multi-Access Edge Computing (MEC) is crucial. MEC is a cutting-edge ecosystem that seamlessly integrates cloud computing and telecommunication services at the radio access network's edge. Its primary objective is to reduce latency and enhance the overall performance. Therefore, edge caching becomes a feasible choice. With the increasing popularity of smartphones and other portable devices, the data traffic generated by mobile devices is growing rapidly.

Researchers utilize mobile devices and SBS storage capacity to cache popular files locally in order to tackle this bottleneck issue. Specifically, numerous individuals would often download the popular from remote servers. By caching these files in advance, the strain on MBSs and the backhaul link can be greatly reduced. By implementing this solution, users' requests can be efficiently addressed and resolved within their local environment. Our primary concern is determining the identification of cached files to enhance the capacity of local devices in handling user requests efficiently.

Running applications of big data on cluster computing systems using Apache Spark is increasingly prevalent. Applications submitted by users of Spark are allocated resources through a scheduler on the cluster. Typically, users are concerned about ensuring that their application operates within the desired timeframe. However, cluster operators strive to achieve both execution time targets and maximize resource utilization simultaneously. Operators often configure Spark apps to run alongside other apps in general purpose clusters to optimize resource utilization. Enabling multiple co- located apps to efficiently utilize shared resources, such as memory and processing cores, simultaneously on a cluster node. In cloud-based clusters, it is feasible for Spark Virtual Machines (VMs) to be situated alongside other VMs on physical machines, enabling resource sharing.

Applications may contend for shared node resources when it comes to resource sharing, which can impact their performance. Some Spark applications, especially those handling large data sets, may experience slower performance. Apps of this nature might experience extended run times and, in the most severe instances, could cease functioning entirely after prolonged use due to performance disruptions caused by other applications. Delayed interference mitigation can be frustrating for cluster users and it leads ineffective use of cluster resources. It is crucial for cluster operators to promptly identify any interference in applications. Furthermore, individuals can benefit from diagnostic data that helps identify the source of interference and allows for the development of tailored plans to address it.

[1] Aydin, A.R., et al. describes about data, that is widely regarded as a very valuable asset in the contemporary digital era due to its potential to unveil concealed important information. Organizations operating in many areas effectively address the complexities associated with The value chain of big data by leveraging a vast array of technologies to cater to their specific requirements and accomplish a multitude of objectives, hence facilitating informed decision-making processes. This research introduces value for the model of big data. The paper makes several contributions: Firstly, it establishes a conceptual framework of the big data value chain to offer a comprehensive depiction of the relationships between the attributes of big data and the corresponding technologies associated with each category. Additionally, unlike previous academic inquiries, this study conducts a thorough analysis of the technology relevant to each segment of the big data value chain.

[2] Park, S., et al. introduces the utilization of Apache Kafka for Big Data collection facilitated the acquisition of distributed data by leveraging broker and agent scalability. Consequently, it was feasible to provide a basis for the examination of diverse datasets. Additionally, it facilitated the gathering of data, as well as the connection and analysis of data. The escalating need for big data gathering and AI analysis across various entities, including corporations, governmental bodies, and educational institutions, has given rise to a requirement for a comprehensive data collecting and management system. Nevertheless, the task of extracting and refining data from outdated systems was a significant challenge.

[3] Kexin Rong et al. presents PS3, a technology that utilizes summary of statistics for conducting weighted selection of partition in clusters of large-scale data. These statistics aid in evaluating the similarity and

significance of partitions. The author demonstrates that the prototype PS3 offers significant improvements in speed when as compared with Selection of a random partition, while also having a little overhead storage.

This paper's Section 2 discusses previous works that are referred to as related works, while Section 3 goes into detail on how the idea is now being deployed using the term suggested methodology. Results and Discussions, section 4, analyze the obtained results. The conclusion and future scope found in section 5 mark the end of this research work.

RELATED WORKS

[4] Sara Migliorini et al. describes the utilization of the MapReduce programming paradigm is commonly employed for the purpose of processing and analyzing vast quantities of data. This paradigm is predicated upon the capacity to concurrently execute identical operations on distinct segments of data. The overall performance is significantly influenced by the manner in which data is distributed among the different computational nodes. The primary partitioning strategy employed by systems such as Hadoop or Spark is a random division of the records obtained, without taking into account their inherent characteristics and interrelationships. While the aforementioned approach may be suitable in the most basic scenario where it is essential to evaluate all input records, it becomes a constraint for more advanced analysis. In such cases, the correlations between records can be utilized to initially eliminate superfluous computations.

[5] Chen, Y., et al. introduces a novel methodology for downscaling by leveraging deep learning techniques, specifically GDPnet, to estimate gridded GDP data from conventional statistical GDP data. This approach involves the integration of diverse geospatial large datasets. The objective was to utilize Convolutional Neural Networks (CNN) and residual connections in order to analyze the intricate correlation between Gross Domestic Product (GDP) and auxiliary data. A comparative analysis was conducted on Resautonet, an established downscaling technique based on AE. In order to account for the distinct auxiliary data associated with each sector of the GDP, a distinct downscaling approach was developed for each sector. The proposed approach to form 1-km gridded GDP data in 2019 of China was supported by China's newest county level GDP data from yearbook of 2020. The experimental findings indicate that the two deep learning-based downscaling methods exhibited strong predictive capabilities, as evidenced by R2 values exceeding 0.8, 0.9, and 0.92 for the three sectors examined using county-level GDP data. Furthermore, the suggested GDPnet model surpassed the current Resautonet model in terms of performance.

[6] Timothée Dubuc et al describes about the 'Big Data' of the past has evolved into the 'data' of the present. With the advancement of technology, novel obstacles emerge and innovative remedies are devised. The Data Mining area has encountered the problem of processing and analyzing real- time data streams with high data throughput levels due to the rise of applications of IOT in the past decade. The phenomenon commonly known as the Velocity element of Big Data is frequently mentioned. While there exists a substantial body of literature on techniques of Data Stream Mining and applications, there is a noticeable dearth of research examining Data Stream processing paradigms and related technologies. Specifically, there is a lack of comprehensive studies that explore the entire process, from gathering data to feature processing and pre-processing, from the user's standpoint rather than the service provider. This article examines a specific approach that specifically targets processing pipelines and streaming data. These pipelines enable real-time analysis of stream of data that cannot be stored in their original form on the computer platform.

[7] Wei Li et al. researches about MapReduce method used for processing large amounts of data in a dynamic and opportunistic environment. In this environment, volunteers with different levels of computing capacity can join, quit, and crash without any restrictions. The initial finding of this study reveals that, under specific workload conditions, there exists an ideal overlay size that may be employed to attain a tolerable level of performance. As the size increases, the performance gain is minimal, with a growth rate of less than 3% for every additional 5,000 participants. The second finding of this study is that when the size of the overlay increases, such as by 5K volunteers, the improvement of performance is greater. Specifically, the improvement

of performance is 20% for overlays which are small, such as 15K volunteers, compared to 5% for large overlays, such as 50K volunteers. According to the findings, the initial optimization involves employing several small overlays rather than a single large overlay in order to reduce the associated cost with maintaining and stabilizing the overlay during the computation of local and intermediate results (Map stage).

[8] Imad Sassi et al explore the optimization of big data analytics through metaheuristics, focusing on the constraint satisfaction problem (CSP), known for its effectiveness across various domains. They highlight Hidden Markov Models (HMMs) as powerful tools in time series analysis but acknowledge challenges in reducing the search space. To address this, the authors propose a graph-based optimization strategy integrating CSP to enhance learning and prediction tasks in HMMs. Empirical validation of this approach is conducted using real-world data, with performance metrics such as mean absolute percentage error (MAPE) ensuring its robustness and effectiveness. Overall, their study provides insights into improving big data analytics through innovative optimization techniques measures to evaluate the accuracy of predictions. The experimental results demonstrate that the proposed model exhibits superior performance compared to the standard model. It decreases the Mean Absolute Percentage Error (MAPE) by 0.71% and provides a favorable balance between computational expenses and the accuracy of outcomes for extensive datasets.

[9] Wenyuan Xu et al describes the growing proliferation of Internet of Things (IoT) devices is consistently producing vast amounts of data. However, the existing cloud- based method for analyzing IoT big data has sparked public apprehension around data privacy and network expenses. The approach of federated learning (FL) has lately gained attention as a potential solution to address these problems. FL consists of combining the locale updates to learn a global model from different devices , while ensuring that privacy-sensitive data is not shared. Nevertheless, Internet of Things (IoT) devices typically possess limited computational capabilities and inadequate network connectivity, rendering the training of deep neural networks (DNNs) using the federated learning (FL) approach impractical or excessively sluggish. In this research, the author introduces a novel and effective framework termed FL-PQSU to tackle this issue.

[10] Fatima Hussain et al. review article primarily aims to examine the substantial consequences of Big Data techniques and technologies on the performance and outcomes of healthcare systems. The text presents the novel idea of Big Data, its progression throughout time, and its fundamental attributes including Volume, Variability, Velocity,Variety, Value, Veracity, Visualization, Vulnerability, Validity and Volatility. This extensive overview serves as an initial step towards conducting research on Big Data Analytics and enhances the comprehension of its characteristics, qualities, and difficulties. the ability to enhance the strategic capacities of healthcare organizations and enhance the quality of treatments through the utilization of Big Data Analytics. The implementation of Big Data Analytics in the healthcare sector has the potential to enhance productivity and mitigate healthcare expenses that may result from the failure to harness the advantages offered by Big Data Analytics.

[11] Ying Feng et al. Understanding urban structure and urban planning greatly relies by finding urban zones. The exponential expansion and widespread availability of diverse sources of large-scale data, such as remote sensing photography and social data sensing, have created a novel approach for dynamically identifying urban functional zones. The author of this paper presents a learning framework called SOE (scene-object-economy) that combines scene data obtained from remote sensing photography, object features derived from economy features , building footprints obtained from POIs (points of interest). Valuable information concealed within urban areas is unearthed for the purpose of identifying their functions. The utilization of convolutional neural networks is employed for the purpose of extracting high-level scene information from remote sensing photographs that possess varying resolutions. The construction of object features involves the measurement of various building indicators, such as area, floor number, year, perimeter of the building. Furthermore, the author involves the extraction of socioeconomic features from points of interest (POIs), which serve as indicators of various human activities inside the metropolitan zone.

[12] Ahmad El-Rouby et al. talks about the computational resources required for Big Data applications are quite demanding. However, general-purpose operating systems are not well-suited for this purpose. This study introduces a novel distributed micro-kernel specifically tailored to cater to the requirements of big data applications. The core-based Asymmetric Multiprocessing (technique is employed by the new micro-kernel. The Map-Reduce model is optimized in terms of interrupt management and input/output (I/O) operations. The microkernel architecture being proposed relies on the integration of a BareMetal Operating System Markup Language (BOSML) and an Inter-Processor Interrupt over Ethernet (IPIoE) framework.

[13] Olouataoui Widad et al. describes about the growing dependence on Big Data analytics has underscored the pivotal significance of data quality in guaranteeing precise and dependable outcomes. As a result, organizations that seek to harness the potential of Big Data acknowledge the pivotal significance of data quality as an essential element. The occurrence of outlier values is a prominent form of data quality anomaly that is commonly encountered in large datasets. The identification and resolution of these exceptional data points have garnered significant attention in several fields, resulting in the creation of multiple methodologies for anomaly detection. Despite the increasing use of anomaly detection techniques in recent years, there is still a notable deficiency in effectively resolving anomalies associated with other dimensions of data quality. While the majority of methodologies prioritize the detection of anomalies that depart from anticipated patterns, they fail to account for irregularities of data quality, like the absence, inaccuracy, or incongruity of data.

[14] Ankit Kumar et al conducted research that has yielded remarkable outcomes, such as the development of scheduling capabilities, the creation of a data placement inequality matrix, the implementation of clustering prior to time examination, and the reduction of repetitive tasks, domestic dependency, and mapping in order to mitigate and halt reactions. This experience serves as an illustration of how the establishment of a systematic approach to address various usage scenarios result in reduce in the overall expense of computations and enable the utilization of distributed systems for efficient partitioning. Developing ways that finds the relevant files in a compressed format and compress the data might be advantageous when archiving or processing substantial volumes of data. This study utilizes a methodology that is grounded in the actual procedures of sorting, iterating, query management, and ultimately generating the outcome.

[15] The current Hadoop framework treats each job independently, leading to repeated data retrieval from all Data. Nodes and a lack of job relationship management. To address these shortcomings, our proposed system focuses on enhancing Hadoop performance through metadata reuse, improved space management, and task deduplication. By storing metadata of data and locality of data details on the Name Node and implementing a task deduplication technique achieve better job execution efficiency. The preservation of executed job metadata reduces recomputation time, resulting in improved job execution times and reduced storage space usage.

[16] Current Hadoop systems treat each job independently, leading to inefficient data retrieval and neglect of job relationships. Weaknesses in user identity management and credential handling further hinder performance. Our proposed system addresses these issues by implementing task deduplication, storing metadata on the Name Node, and preserving executed job metadata. This approach enhances job execution efficiency, reduces storage space usage, and improves overall Hadoop performance, as demonstrated through experimental validation.

[17] In today's data-rich environment, efficient processing is paramount due to the sheer volume of data generated. paper focuses on enhancing Hadoop MapReduce performance by minimizing computation requirements. We introduce a method where MapReduce operations are only executed if the file is absent in HDFS; otherwise, previously computed results are retrieved, facilitated by additional information maintained by the Name Node. This approach significantly reduces the need for redundant computations, conserves resources, and expedites processing times, ultimately improving overall Hadoop MapReduce performance.

[18] The era of Big Data presents significant challenges in processing, analyzing, and managing vast and diverse datasets. Traditional databases and systems struggle with the variety, velocity, volume, and veracity of Big Data. MapReduce emerges as a framework enabling parallel processing of large datasets on commodity hardware, addressing these challenges to a considerable extent. Survey paper explores the workings of MapReduce, highlights challenges, and identifies opportunities, and discusses recent trends, aiming to guide further research and improvements in this domain.

[19] In today's data-driven world, Big Data presents challenges due to its sheer variety, velocity, volume, and veracity. Handling semi-structured, structured, and unstructured data poses difficulties in processing, analyzing, and managing within existing systems. MapReduce, a framework for parallel processing on commodity hardware, offers a solution to these challenges, with an ongoing effort to enhance its simplicity, effectiveness, and efficiency.

[20] Big Data poses challenges due to its large volume and complexity. Hadoop helps by storing and processing data quickly and efficiently. However, understanding Hadoop's internal files is crucial for digital forensics. Our paper explores these files and demonstrates using the Autopsy tool for efficient forensic analysis.

[21] In an age where privacy is prized, protecting personal information from prying eyes is imperative. This study pioneers a groundbreaking privacy-preserving technique that overcomes limitations of previous methods. By integrating Delicate Information and Delicate Weight attributes, it effectively gauges data sensitivity and ensures confidentiality. Additionally, the utilization of Frequency Distribution Blocks and Quasi-Identifier Distribution Blocks offers a new approach to anonymization. Empirical evidence underscores the superiority of this method, showcasing enhanced speed and minimal data loss compared to existing strategies, marking a significant advancement in privacy protection amidst the era of big data.

[22] Across diverse domains such as social media, stock markets, sentiment analysis, and applications of electronic health, privacy preservation methods play a crucial role. The exponential growth of dynamic stream data in electronic health applications necessitates scalable privacy-preserving techniques. This paper introduces a novel privacy preservation. A technique designed specifically for large-scale dynamic stream data processing in a distributed environment, aimed at thwarting similarity attacks. Leveraging replacement techniques and late validation methods, the proposed framework minimizes information loss and processing delays, making it applicable in areas like medical diagnosis and e- health data processing by third parties.

[23] In today's world of big data, combining various sources like social media and enterprise data poses privacy concerns. This paper explores methods to handle big data while tackling issues like unapproved data access and sharing. It discusses tools for integration and processing, stressing the importance of privacy preservation. These techniques find applications in areas such as electronic health records and government surveys, showing their broad relevance and potential for improvement.

PROPOSED METHODOLOGY

The proposed methodology for cache replacement technique using LPW algorithm through parallel processing on a Mongo DB database will be depicted in Figure 1. The subsequent section provides an extra explanation of the numerous stages comprising this methodology, as outlined in the previous part.

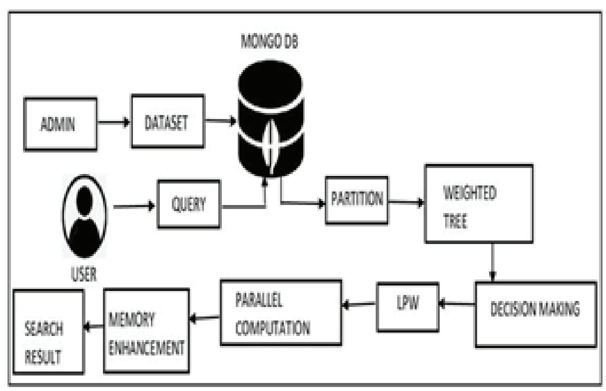

Fig 1. Overview of the proposed model

Step 1: Query Input and partition – In this phase, the input on the database's content large data queries need to be conducted. Large number of queries classified into different types for improving their implementation and transformation. During this phase, based on their implementation objective, the input queries were efficiently classified which includes operations like insert, update, delete etc.

Categorization is highly required due to the high volume of searches, which range from 100 to 500. The requests are large in size, which makes sequential processing difficult.

During this specific stage of the process, the input consists of the classified big data queries acquired from the previous stage. The previously described secret inquiries are then used to perform query partitioning, which seeks to eliminate any possible clashes among the questions that could lead to an incorrect response. The achievement of very efficient query processing can be facilitated through the implementation of appropriate partitioning techniques, which allow for the systematic grouping of requests.

The implementation of partitioning is of utmost importance as it facilitates the classification of queries, allowing for their allocation to threads for optimal execution. Threads are executed consecutively to save CPU stress and achieve optimal parallelism. The utilization of a mapping technique facilitates parallel computation, leading to reduced computational and temporal difficulties. This is especially important in the context of large-scale data processing. Algorithm 1, as shown below, delineates the process of partitioning queries.

ALGORITHM 1: Query Partitioning

//I/P : Size of Data = SIZE, N = Required Divisions

//O/P: QCL_Query_Classification_List que Classificaiton (SIZE, N)

1: Begin

2: SDL = ∅

3: segmentSize = SIZE / N

4: segmentStart = 0, segmentEnd = 0 5: for i = 1 to N

6: segmentList = ∅ [Segment List] 7: if (i == 1 OR i < N), then

8: segmentList[0] = segmentStart

9: segmentEnd = segmentStart + segmentSize - 1 10: segmentList[1] = segmentEnd

11: SDL = SDL + segmentList

12: segmentStart = segmentEnd + 1

13: end if

14: else if (i == N), then

15: segmentList[0] = segmentStart 16: segmentList[1] = SIZE - 1

17: SDL = SDL + segmentList 18: end if

19: end for

20: return SDL

21: End.

Step 2: Weighted tree and Decision Making – The Weighted tree approach utilizes the extracted frequent searched item sets to construct the tree structure based on the search items weight. The selection of the root frequent item set is determined by the initial candidate set encountered. Subsequent candidate sets are assigned locations based on the respective support levels.

The aforementioned processes are executed in a continuous manner using a recursive technique to produce a fully sorted sub-tree, as described in algorithm 2. This will be fed to the next step of the Least portioned weight process to handle the data more efficiently.

ALGORITHM 2: Weighted tree Formation

//input: Search Weight List SWL 0: Start

1: TR= ∅ [TR = Tree]

2: RN=∅ [RN = Root_node] 3: RN= FIL[0][Root_node] 4: for i=0 to size of SWL

5: RV= RN[1]

6: TMP-NODE= SWL[1][Temp_list]

7: VAL = TMP-NODE[1]

8: if (VAL <RV), then

9: TR ⇒ TMP-NODE[LEFT CHILD]

10: else

11: TR Symbol TMP-NODE[RIGHT CHILD]

12: end else

13: end for

14: return TR

15: Stop.

Step 3: Memory enhancement through LPW: After dividing the segments, we used weighted tree classification to determine the labels based on the data weights. Then, we estimated the minimum weight of the least partitioned data. This is accomplished by traversing the weighted tree in a systematic manner. Through the traversal of the tree, the weights of the partitions are obtained and sorted. This sorted list is then used to classify the data segments. Every segment is responsible for creating an equal number of parallel threads. The threads are filled with the necessary data through the use of getter and setter functions. When the data is loaded onto the threads, they are all activated at the same time to carry out the database search operations.

Threads are activated by creating their respective objects in an array. This array of thread objects are used to activate based on the least partitioned weight. This process allows all the array of objects to be invoked automatically in parallel mode. By optimizing the transaction performance and efficiently managing cache space, the system ensures that big data operations run smoothly.

This process efficiently organizes the cache data into smaller chunks to ensure the scalability of the primary memory device.

RESULTS AND DISCUSSIONS

A mechanism has been developed to ensure the reliable production and administration of cache replacement technique using the LPW for big data queries. This is achieved through parallel computation and Weighted tree mechanism on a mongo DB database. The implementation of NetBeans IDE and Java programming language are used to make mongo DB the database of choice. The methodology used involves a laptop running on the Windows platform, with an Intel Core i5 processor and 8GB of RAM. An extensive evaluation has been conducted through experimentation to measure the impact of the suggested approach using the following performance metrics.

Query optimization for performance evaluation

The experiment is performed by using different datasets used from Kaggle. The study is done to find time required to access specific rows from MongoDB database which involve two condition: with lpw and without lpw optimization cache data. Table 1 displays the findings from the inquiry.

Table 1: Optimization Recorded Values for Cache Replacement

Dataset Name	No.of data	No.of Attributes	Without Cache Optimization in milli seconds	With Cache Optimization in milli seconds
MOOC	989	15	2890	701
NHAI	2869	18	2589	1458
UID	911	23	1897	655
Shopping	999	8	1455	895
EEG	507	148	1110	488

Figure 2: Optimization Results for Different Dataset for Cache Replacement

Figure 2 shows that the cache replacement optimization strategy used by The implemented framework performed better in lowering the time required to run a specific queries. The experiment findings show that the proposed framework achieved an optimization level of roughly 54%, which is a significant achievement in the research's early testing phases.

CONCLUSION AND FUTURE SCOPE

In this paper, the weighted tree mechanism and LPW are used to implement a strategy that increases large data efficiency. The process begins with the user inputting big data queries into the system. On the Mongo DB cloud, these huge data searches work incredibly well for carrying out different tasks. The queries are useful in carrying out the CRUD operations on the large dataset. The queries undergo preprocessing before being partitioned. The classification module categorizes the preprocessed query data and passes it to following step in the partitioning approach. The approach of partitioning efficiently carries out the queries' partitioning, followed by their mapping. Queries are executed parallely on the mongo DB database, utilizing the weighted tree and LPW process. The efficiency of method is checked and compared with existing technologies to achieve improved outcomes.

For future research ,it can be useful to convert this approach into application programming interface (API) which is helpful in different level applications.

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Fake Product Identification and Verification Using Blockchain

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ABSTRACT

Blockchain technology is a digital ledger that is distributed and decentralized, storing transactional data in blocks across multiple blocks connected by chains. Since blockchain technology is safe, no block can be altered or compromised. The utilization of Blockchain technology eliminates the necessity for consumers or customers to depend on other users to verify the safety ofthe product. Fake products affect on company's reputation, revenue, and profit. In our project, Quick Response (QR) codes offer a strong method to combat the practice of product counterfeiting, given the rising trends in mobile and wireless technologies. This system is used to store product details and generate a unique code for that product. Counterfeit products are identified using a QR code scanner, where a product's QR code is linked to a Blockchain. The user's unique code is obtained, and it is then compared against entries in the Blockchain database. The customer will receive information if the codes match. Blockchain is therefore utilized to distinguish between genuine and fraudulent products

KEYWORDS: *Blockchain, QR code, Counterfeit goods.*

INTRODUCTION

Blockchain is a decentralized, scattered system that supplies data in blocks within databases and is connected via chain [1].Each time new data is entered into a database, it is connected to the previous block via a chain, adding it to the existing data. Every product that is created has some risk associated with it, such as the potential for copying or counterfeiting, which can harm the business's reputation, earnings, and clientele. The trade and marketing of counterfeit goods is growing quickly. On a blockchain, no user can edit data that already exists until a new block is added to the existing data. Because data on the blockchain cannot be removed or altered, data security and protection are guaranteed. Blockchain technology helps to address the problem of counterfeiting. [2]Over the past ten years, blockchain technology has drawn a lot of interest, and many applications are being created for it. Blockchain is a shared, immutable ledger that operates decentralized. Any application that uses Blockchain as its foundational technology guarantees that the data are tamper-resistant. It also makes the procedure of recording, exchanging, and pursuing properties over a system easier, hence lowering risks. Putting in place a blockchain-based system is one approach to resolving this problem. Blockchain is a decentralized, scattered system that puts information in blocks within databases and is connected via chains. Each time new data is entered into a database, it is connected to the previous block via a chain, adding it to the existing data. A chain of transactions for that product will be produced after itis stored on the network, allowing for the maintenance of entire transaction records affecting the products and its current holders. A hash code will be generated for the product at that time. In the blockchain, every transaction record will be kept as blocks. A created QR code is associated by the system with a specific product, and the end user can scan the code to obtain comprehensive product information. We can determine whether the thing is true or false by scanning the QR code.

LITERATURE SURVEY

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2. Ms. Nafisa Anjum and Mr. Pramit Dutta (2022). "Identifying Counterfeit Products using Blockchain Technology in Supply Chain System," The user's unique code is recorded and is then contrasted with Blockchain database entries. If the code matches, then the goods are authentic; if not, the user will be notified that the product is fake or counterfeit. In that scenario, we can offer all pertinent information.
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4. Mr. Shih-Ya Lin, Mr. Xin Chen, Mr. Hung-Min Sun, Ms. Yeh-Cheng Chen, and Ms. Jinhua Ma (2020) "A Product Anti-Counterfeiting Application System Based on Blockchain Technology." Solidity, an Ethereum programming language,serves as the back-end Blockchain operating system in the proposed system. Create a private chain with Geth and push the smart contract onto it to mirror the public chain's conditions.

Objectives

- To Understand the basic concepts of blockchain.
- To know the security concept related with blockchain.
- To verify the QR code of product details.
- To design security measures using blockchain.

PROPOSED SYSTEM

In this proposed concept effective way of implementing an online application consists of two main sides The manufacturer side which will store all the product details in blocks that will be secured and cannot be hacked or changed other side is of customer side where the buyer will validate the merchandise by scanning the QR code.

The proposed architecture is illustrated in Figure 1:-

1. Manufacture End: Using a system-generated QR code that contains all of the product details, the manufacturer can log in, add a new product or item, and upload the product details. Additionally suggested for increased product security is serializing the QR code. The product details will be kept in the database, and a secure graphic technology is used to make the QR code unchangeable.
2. Customer End: A username and password are required for registration or login. The device starts with a scan button to scan its QR code after user authentication is complete. Here, the user is the buyer who wishes to verify if the goods is authentic or not. Blocks of the manufacturer's code will be compared with the customer's unique scanned code. The user will thereafter receive a notification regarding the product's validity. Customers can view product details.
3. Giving the desired output as a product is counterfeit or real.

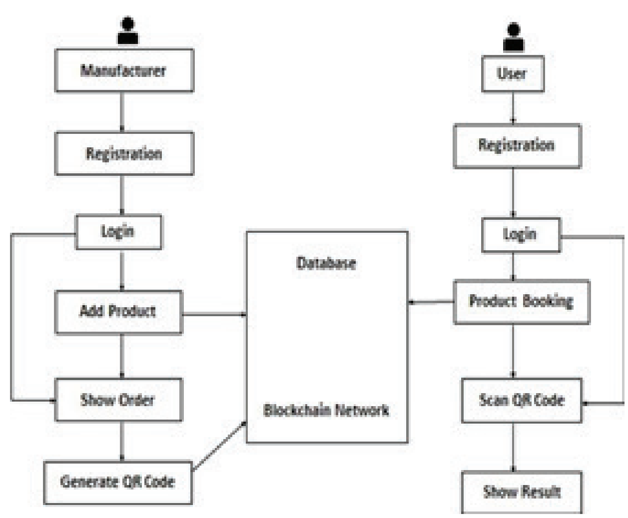

Fig. 1. System architecture

Fig. 2. Blockchain is a shared, immutable ledger that operates decentralized. Because data on the blockchain cannot be removed or altered, data security and protection are guaranteed [3] Blockchain technology helps to address the problem of counterfeiting. Over the previous ten years, blockchain technology has drawn more interest, and many apps have been developed for it. The buyer will then scan the QR code and cross-check it with the manufacturer's QR code after registering and logging in with his username and password. If they match, it will indicate if the item is authentic or fake.

Workflow

There are three primary aspects to the entire system:

1) Manufacturer
2) Buyer/Customer
3) database

Manufacturer side

The flow of the system begins with the manufacturer's register/login, The manufacturer has to log in with an authentication username and password which will be unique and only the manufacturer saves the data to the database in the secured blocks.

The manufacturer is the one who can add the products to the database or can store the data in the blocks which are secure and according to those added products, the manufacturer will generate a unique QR code.

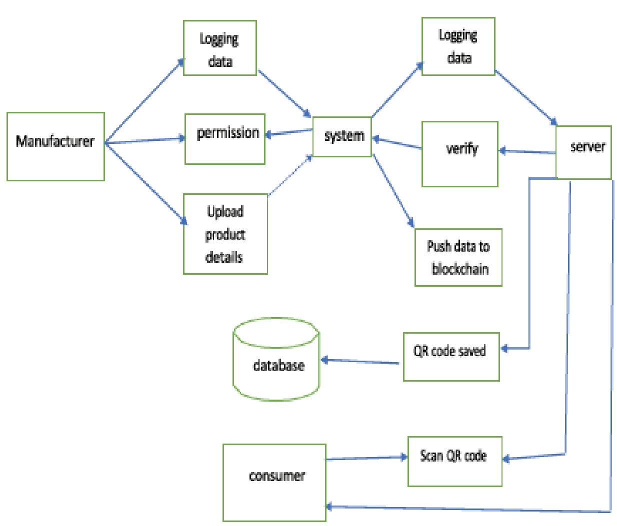

Fig. 2. Workflow of the fake product identification

Customer/Buyer side

Like with the manufacturer, the customer or buyer must register and log in to the application. Once logged in, they can scan the QR code on the product; if the code matches the product details in the database, the system will notify them that the product is original and display details; if not, the user will be notified that the product is fake.

Database

The backend makes use of the database. Blockchain systems are a type of shared database that puts information into blocks linked by cryptography, which is different from how databases put data. Though a blockchain can carry many types of information, records have been the most popular application for transactions on it.

METHODOLOGY

The core aim of this proposed system is to continue the Genuity of the product by helping the client track the supply chain history of the invention. The system gives clients the authority to path the history of a whole product from the producer to the client using blockchain. This invention anticounter feiting system built on Blockchain is composed of three roles, the Producer role, the Vendor role, and the User role. [4]

Now that the primary purpose of our system has been established, it includes all of its necessary features and functions. The following features are intended to be provided by the suggested system:

Product Registration: The registration of genuine products on the blockchain network is the responsibility of this module. Along with pertinent product data, every product is given a unique identifier (such as a serial number or QR code) that is recorded on the blockchain.

Blockchain Network Integration: By connecting the system to the blockchain network, this module makes it possible to record transactions about product authentication in a safe and unchangeable manner.

Smart contracts are self-executing contracts where the terms of the purchase and sale are written right into the code. Numerous processes associated with counterfeit product identification, such as ownership transfer, authenticity verification, and the imposition of penalties for the sale of counterfeit items, can be automated using smart contracts.

Supply Chain Tracking: This module uses the blockchain to record every transaction as it follows the flow of goods through the supply chain. This guarantees openness and enables customers to follow a product's path from point of origin to point of destination.

Authentication and Verification: Customers, retailers, and other interested parties can utilize QR code scanning or other identifying techniques to verify the legitimacy of products with the use of this module. The module verifies product data with the real product after retrieving it from the blockchain to confirm authenticity. [5]

User Interface: In order for stakeholders to engage with the system, an intuitive user interface is necessary. Users should be able to track product movements, register products, confirm authenticity, and retrieve pertinent data kept on the blockchain through this interface.

Imported modules

IDE: Jupyter Notebook: We have used Jupyter Notebook to create an Integrated work Environment (IDE) for Python- based work relative to building a blockchain-based system for the identification and verification of counterfeit products. In an interactive computing environment, you can create and share documents with Jupyter Notebook that include real- time code equations, visuals, and narrative prose. [6] Operating System: Windows/Linux: Regardless of the operating system Windows or Linux Jupyter Notebook is an easy-to-set-up and-use tool for developing a blockchain- based fake product detection and verification system.

Reverse end: Database: The backend database of a blockchain-based fake product detection and verification system uses an SQL database to hold various types of data that complement the blockchain's functionality.

Python: Using Python and the appropriate database technologies, you may safely administer the backend database for your fake product identification and verification system. This allows you to store, retrieve, and manipulate crucial data.

EXECUTION

For this system, the client logs into the application. After logging in, he fills out the necessary information to place the order and reserve the goods. The manufacturer may be supplied with the product's order. The acceptability of the product request is decided by the manufacturer. Once the product is ordered, the manufacturer generates the item's unique QR code. [7] Once an order is placed in the blocks, a product's hash code is generated, allowing the transaction for that product to be kept intact. Under the suggested technique, a QR code is generated for a particular product. Consumers can scan the QR code on a product or package using their own application or the QRcode reader app on their smart phone. The purchaser will discover if the products.

RESULT AND DISCUSSION

With the help of the suggested system, the manufacturer and the customer might communicate with the system and add their own block to the blockchain with the transaction data without changing any other blocks. To verify the integrity of the goods, the end consumer can scan the supply chain by scanning a QR code.

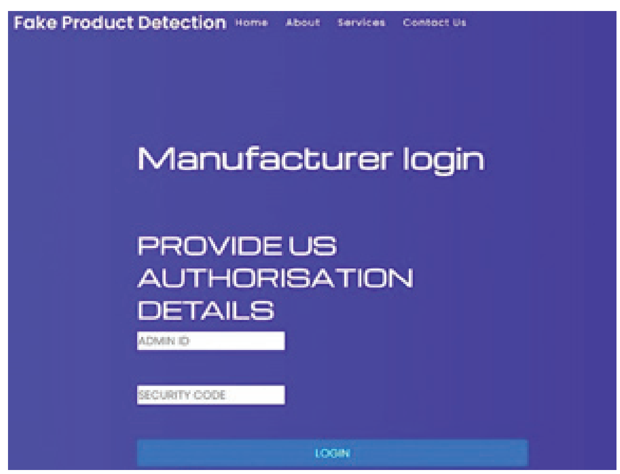

Fig.3. Manufacturer Login page

Manufacture uses his username and password to log into hisaccount, as seen in Figure 3.

SQL Server is where the credentials are kept. The login credentials and addresses of manufacturers and suppliers are kept in an SQL database.

As seen in Fig. 4, the maker creates the product's QR Code and assigns a unique serial number after logging into his account. When the product is transferred to different locations, this QR code is attached to it. In addition, the maker provides additional information about the product, such as its name, current address, source, and destination. The manufacturer adds all of the completed details to the blockchain by clicking the “add block” button after filling out all the required fields.

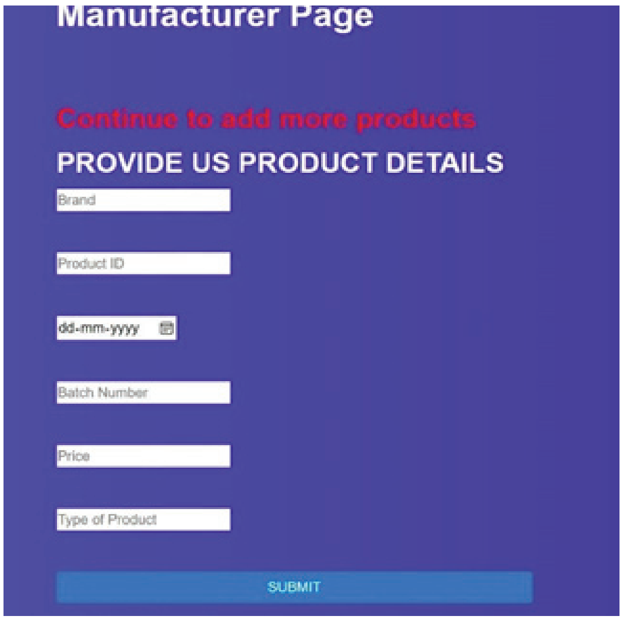

Fig.4. Manufacturer adds the details of the product.

As shown in Fig.5, After adding product details from the manufacturer side and then the buyer will log in with his Credentials and scan the QR code to verify the product and scan the QR code to verify the product.

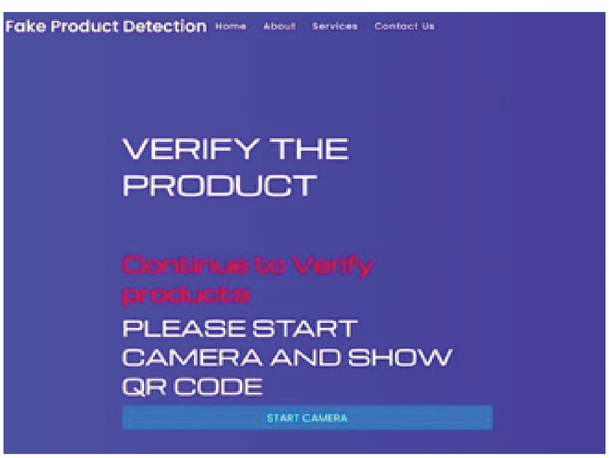

Fig. 5. Product Verification page

The buyer will be informed whether the goods are authentic or counterfeit after scanning the QR code.

If the product is phony, it will inform the customer of this, as illustrated in Fig. 6. [1]

Fig.6. Fake product identified

Suppose the product is original it will give message to buyer that product is original as shown in fig.7.

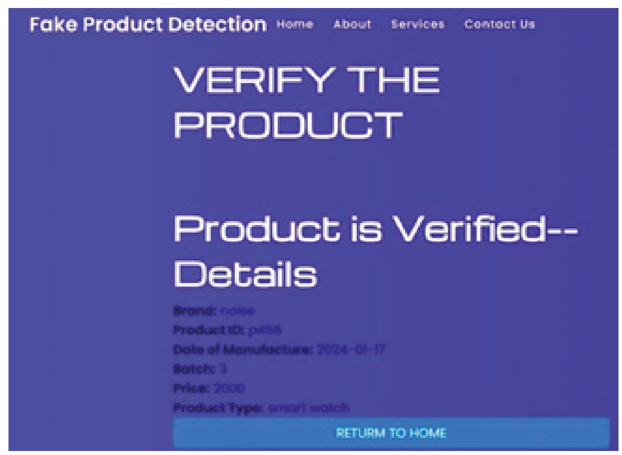

Fig. 7. Original product identified

CONCLUSION

Manufacturers can use blockchain technology to provide each product with a distinct, unchangeable digital identity, which makes it possible to track and validate product information through the supply chain. This lowers the possibility that customers may buy phony orcounterfeit goods by making it simple for them to confirm a product’s legitimacy. The technology allows suppliers and manufacturers to keep product details in Blockchain, which has benefits including network security and anonymity.

The buyer examines the product’s supply chain history to ensure authenticity. Consumers can feel secure in the quality of the products they buy. This system promotes economic growth and lowers the rate of counterfeiting. Additional systems can be added to prevent fraud in the banking, healthcare, online shopping, and other sectors. Furthermore, by facilitating the development of decentralized marketplaces that value authenticity and transparency, these real-time systems can lower the possibility of fraud and counterfeiting in online transactions.

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Smart Surveillance System Using Machine Learning

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ABSTRACT

In an era where safety and security are paramount, this project presents a holistic approach to fortifying the protection of students, faculty, and staff in educational settings. Through the implementation of advanced technologies, the project intro- duces a threefold system: real-time other class student detection using facial recognition, student fall detection, and fire detection within the campus environment. By automating the attendance monitoring process using facial recognition, the project streamlines administrative tasks while ensuring precise attendance records. Simultaneously, the system's capability to rapidly identify student falls and fire incidents paves the way for swift responses, potentially saving lives and minimizing property damage. The project's data- centric approach yields valuable insights for institutions, allowing them to make informed decisions, optimize safety protocols, and adhere to privacy and ethical standards. Its adaptability and scalability ensure long-term relevance, aligning with evolving campus needs. By prioritizing campus safety and adhering to responsible surveillance practices, this endeavor strives to create a se- cure and nurturing learning and working environment, ultimately contributing to the overall well-being and satisfaction of the campus community.[1]

KEYWORDS: *Safety and security, Holistic approach, Fortifying protection, Educational settings, Advanced technologies, Threefold system, Real-time Facial recognition, Student fall detection, Fire detection, Campus environmen.*

INTRODUCTION

The project introduces a comprehensive strategy to enhance safety and security within educational environments, addressing the critical need for protecting students, faculty, and staff. Leveraging advanced technologies, the initiative adopts a multifaceted approach centered around three key systems: real-time facial recognition for identifying individuals both inside and outside classrooms, student fall detection mechanisms, and fire detection capabilities across the campus. By automating attendance monitoring through facial recognition, administrative tasks are streamlined while ensuring accurate attendance records. Moreover, the system's ability to swiftly identify student falls and fire incidents enables prompt responses, potentially mitigating risks and minimizing harm. Embracing a data-centric framework, the project not only provides valuable insights for institutions to optimize safety protocols but also emphasizes adherence to privacy and ethical standards. Its adaptable and scalable nature ensures its continued relevance amidst evolving campus needs. Ultimately, by prioritizing safety and fostering a nurturing learning and working environment, the project aims to contribute significantly to the overall well-being and satisfaction of the campus communit.[2]

In an era where safety is paramount, the project presents a comprehensive solution to fortify the protection of students, faculty, and staff within educational settings. Through the integration of cutting-edge technologies, the initiative introduces a three-pronged system aimed at bolstering security measures. This includes the implementation of real-time facial recognition for seamless identification, student fall detection mechanisms for immediate response to emergencies, and advanced fire detection systems to mitigate potential risks. By automating attendance monitoring processes with facial recognition, administrative burdens are alleviated, while ensuring precise and efficient record-keeping. Moreover, the system's rapid detection capabilities not only enable swift responses to critical incidents but also have the potential to save lives and minimize property damage. Embracing a data-driven approach, the project facilitates informed decision-making for institutions, empowering them to optimize safety protocols while upholding strict privacy and ethical standards. With its adaptable and scalable design, the initiative is poised to meet the evolving safety needs of educational environments, ultimately fostering a secure and conducive atmosphere for learning and growth.[2]

PURPOSE

Identify need of Project

The project arises from a pressing need to prioritize safety and security within educational settings, where the well- being of students, faculty, and staff is of paramount importance. In recent years, incidents ranging from accidents to emergencies like fires have underscored the vulnerability of educational institutions to unforeseen risks. Recognizing these challenges, there is an urgent call for proactive measures that not only enhance preparedness but also ensure swift and effective responses to any potential threats. By leveraging advanced technologies such as facial recognition, fall detection, and fire detection systems, the project addresses these critical needs head-on, providing a comprehensive solution to fortify protection within campuses. Moreover, the automation of attendance monitoring processes streamlines administrative tasks, allowing educational institutions to allocate resources more efficiently towards ensuring safety and fostering a secure learning environment. In a rapidly evolving landscape where safety concerns continue to evolve, this project stands as a crucial initiative in safeguarding the well-being and security of all individuals within educational institutions.[1]

The implementation of facial recognition technology within educational settings serves as a significant step forward in bolstering security measures. By accurately identifying individuals entering campus premises, potential threats can be swiftly identified and addressed before they escalate. Additionally, this technology can aid in the monitoring of unauthorized access, further enhancing the overall safety of the institution.[2]

Fall detection systems offer another layer of protection, particularly for vulnerable populations such as young children and the elderly. By promptly detecting and alerting staff to any incidents, these systems minimize response times in medical emergencies, potentially saving lives and reducing the severity of injuries.

Fire detection systems, integrated with advanced sensors and algorithms, provide early warnings of potential fire hazards, enabling proactive measures to be taken to prevent disasters. Timely detection of smoke or heat abnormalities allows for rapid evacuation procedures, reducing the risk of casualties and property damage.

The automation of attendance monitoring not only simplifies administrative tasks but also enhances security by accurately tracking the presence of students, faculty, and staff within the campus. This data can be invaluable in emergency situations, facilitating efficient accountability measures and ensuring that all individuals are safely evacuated or attended to as needed.

As the threat landscape continues to evolve, it is imperative for educational institutions to stay ahead by adopting comprehensive security solutions. By leveraging advanced technologies and streamlining administrative processes, this project aims to create a safer and more secure environment for all members of the academic community, fostering an atmosphere conducive to learning and personal development.[4]

OBJECTIVE OF SYSTEM

1. Enhance safety and security within educational settings by implementing advanced technologies.
2. Develop a comprehensive system consisting of real-time facial recognition, student fall detection, and fire detection mechanisms.
3. Automate attendance monitoring processes to streamline administrative tasks and ensure accurate record-keeping.
4. Enable swift responses to emergencies, such as

student falls and fire incidents, to minimize harm and property damage.

5. Provide valuable insights for institutions to optimize safety protocols and make informed decisions.
6. Uphold privacy and ethical standards in the deployment and utilization of surveillance technologies.
7. Ensure adaptability and scalability to meet evolving safety needs and technological advancements.
8. Foster a secure and nurturing learning environment conducive to the overall well-being and satisfaction of the campus community..

LITERATURE SURVEY

Yaochang Xi; Peijiang Chen et al., ”Research on Fall Detec- tion Method of Empty-nesters Based on Computer Vision”,2022 IEEE 4th Eurasia Conference on Biomedical Engineering, Medical services and Maintainability (ECBIOS) This paper presents an engaged Because of the successive event of falls of void nesters, a convenient and accu-rate fall recognition strategy is planned in light of PC vision. Utilizing foundation deduction, the moving articles are distinguished from recordings, and afterward the limits of four fall highlights of the human body are set, including width-level proportion, centroid change rate, viable region proportion, and tendency point. Assuming the limit condition is met, the body fall is determined. Joined with multi-attributes, the technique precisely distinguishes non-fall ways of behaving like strolling, crouching, and plunking down. The exploratory outcomes show that the fall recognition calculation in light of multi-highlight combination precisely makes a decision about the fall. The calculation has the promotion vantages of a low measure of calculation and satisfiable power.[1]

uhua Feng et al, ”Improved Pedestrian Fall Detection Model Based on YOLOv5”,2022 IEEE 6th Advanced Information Technology, Electronic and Automation Control Conference (IAEAC) In this paper, Falls are a significant consider the demise and injury of laborers in complex working conditions. Considering the issues of missed recognition and wrong discovery of the first YOLOv5 organization, this paper proposes a person on foot fall identification model in light of YOLOv5. Oneself fabricated person on foot informational collection is utilized for fall identification research. In or-der to debilitate the impedance of complicated foundation on network highlight extraction, a better SENet consideration component is proposed, which assists the organization with focusing harder on the fall act. Likewise, to decrease the missed identification rate, Delicate NMS is acquainted with re-place the first NMS of YOLOv5. The outcomes show that the Guide of the fall person on foot discovery preparing set of the superior model is expanded from 97.62 to 98.33, which demonstrates that the superior model can better.[2]

Dara Ros et al, ”A Flexible Fall Detection Framework Based on Object Detection and Motion Analysis”, 2023 International Conference on Artificial Intelligence in Information and Commu- nication (ICAIIC) This paper proposes a Movement based Multi-Eye Fall Identification system (MMEFD) in view of recognizing human items and following items’ movement in the worldly space. Dissimilar to other vision-based strategies that require predefined limits to identify a fall, the proposed system restricts and tracks an individual in recordings through object location and movement examination throughout a period window with a proper size. As fall occasions might appear to be unique from various view points, a multi-view fall dataset is utilized to prepare a classifier to recognize falls. [3]

Sebastian Gelfert et al, ”Body Part Detection in Smoky Environ- ments with Thermal Camera Using Deep Learning”,2022 22nd International Conference on Control, Automation and Systems (ICCAS) In this paper, a way to deal with identify casualties progressively with a warm camera helping firemen in their hunt and salvage mission, is introduced. In this way, a low goal warm camera is mounted on a remote-controlled portable robot with a human hand discovery involving profound learning and show the identification continuously to an administrator outside the peril zone. Tests show that this approach empowers a proficient vic-tim identification in smoky indoor conditions. The human hand discovery model accomplishes a constant identification pace of over 90 in a thick smoke indoor climate.[4]

Jack Febrian Rusdi ”Student Attendance using Face

Recognition Technology," 2020 2nd International Conference on Cybernetics and Intelligent System (ICORIS) This article talks about the model of understudy participation recording that can turn out to be important for the grounds scholastic data framework. The advances utilized in recording understudy participation incorporate face acknowledgment innovation through PC Vision and Matlab. This study talks about the framework 6 module and the elements that influence the exactness and execution of the framework. This model can be the reason for creating understudy participation frameworks at colleges or other instructive foundations. This study demonstrates that the most common way of recording through face acknowledgment can possibly be applied to school systems in foundations, both as the essential framework or as an emotionally supportive network of a current system.[5]

PROPOSED SYSTEM

The proposed system encompasses a multifaceted approach aimed at fortifying safety and security within educational environments. At its core, the system integrates cutting-edge technologies to address various aspects of campus safety. Real-time facial recognition technology is deployed to accurately identify individuals within and around classrooms, enhancing overall surveillance capabilities. In tandem, student fall detection mechanisms are implemented to promptly detect and respond to emergencies, ensuring timely assistance in critical situations. Additionally, advanced fire detection systems are employed to mitigate the risks posed by potential fire incidents, enabling swift evacuation and minimizing property damage. The automation of attendance monitoring processes through facial recognition not only streamlines administrative tasks but also ensures precise record-keeping. Embracing a data-centric approach, the system provides valuable insights for institutions to optimize safety protocols and make informed decisions. Furthermore, a key focus of the proposed system is to uphold privacy and ethical standards in the deployment and utilization of surveillance technologies, fostering trust and compliance within the campus community. With its adaptable and scalable design, the proposed system is poised to effectively address evolving safety needs while fostering a secure and nurturing learning environment for all stakeholders involved.

In addition to its technological components, the proposed system emphasizes the importance of comprehensive training and preparedness programs for faculty, staff, and students. Through regular drills and simulations, individuals can familiarize themselves with emergency procedures and effectively respond to various scenarios. This proactive approach not only enhances overall safety awareness but also instills confidence in the community's ability to handle emergencies efficiently.

Moreover, the system integrates robust communication channels to facilitate seamless coordination and dissemination of critical information during emergencies. From mass notification systems to mobile applications, stakeholders can receive timely updates and instructions, enabling swift action and minimizing confusion during crisis situations. This real-time communication infrastructure enhances situational awareness and ensures that everyone remains informed and connected throughout any emergency event.

Furthermore, the proposed system emphasizes the importance of collaboration with local emergency response agencies and law enforcement authorities. By establishing partnerships and sharing resources, educational institutions can enhance their capacity to respond effectively to a wide range of emergencies, from natural disasters to security threats. This collaborative approach fosters a sense of community resilience and ensures that all available resources are leveraged to safeguard the well-being of students, faculty, and staff.

Additionally, the system incorporates continuous monitoring and evaluation mechanisms to assess its effectiveness and identify areas for improvement. Through data analysis and feedback mechanisms, institutions can refine their safety protocols and adapt to evolving threats, ensuring that the system remains robust and responsive to changing circumstances.

Overall, the proposed system represents a holistic approach to campus safety, integrating technology, training, communication, collaboration, and evaluation. By prioritizing safety and security, educational institutions can create an environment where all members of the community feel protected, empowered, and able to thrive academically and personally.

ADVANTAGES

1. Proactive Threat Detection: By integrating real-time facial recognition and fall detection technologies, the system can proactively identify potential threats and emergencies, allowing for swift responses and mitigation measures to be implemented.
2. Rapid Emergency Response: With advanced fire detection systems and streamlined communication channels, the project enables rapid emergency response, minimizing the impact of incidents such as fires and medical emergencies and potentially saving lives.
3. Efficient Administrative Processes: Automation of attendance monitoring through facial recognition reduces administrative burdens, allowing educational institutions to allocate resources more efficiently towards safety initiatives and educational programs.
4. Data-driven Decision Making: Embracing a data-centric approach, the system provides valuable insights for optimizing safety protocols and making informed decisions. By analyzing trends and patterns, institutions can identify areas for improvement and allocate resources effectively.
5. Privacy and Ethical Standards: The project emphasizes upholding privacy and ethical standards in the deployment and utilization of surveillance technologies, fostering trust and compliance within the campus community while ensuring that individuals' rights are respected.
6. Community Resilience: Through comprehensive training programs, robust communication channels, and collaboration with emergency response agencies, the project promotes community resilience, empowering individuals to effectively respond to emergencies and support one another during crisis situations.
7. Continuous Improvement: The incorporation of continuous monitoring and evaluation mechanisms allows institutions to assess the effectiveness of their safety protocols and make necessary adjustments over time, ensuring that the system remains responsive to evolving threats and challenges.

SYSTEM REQUIREMENTS

Software Used

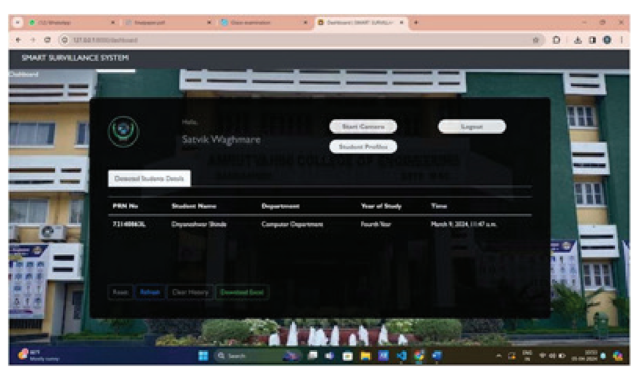
1. Programming Language – BootStrap, Python
2. Database – Sqlite
3. Tools – Visual Studio Code
4. Algorithm – Cnn, Opencv.

Hardware Used

1. Processor – i3 or above
2. Hard Disk – 150 GB
3. Memory – 4GB RAM

RESULTS

By automating the attendance monitoring process using facial recognition, the project streamlines administrative tasks while ensuring precise attendance records. Simultaneously, the system's capability to rapidly identify student falls and fire incidents paves the way for swift responses, potentially saving lives and minimizing property damage. The project's data- centric approach yields valuable insights for institutions, allowing them to make informed decisions, optimize safety protocols, and adhere to privacy and ethical standards. Its adaptability and scalability ensure long-term relevance, aligning with evolving campus needs. By prioritizing campus safety and adhering to responsible surveillance practices, this endeavor strives to create a secure and nurturing learning and working environment, ultimately contributing to the overall well-being and satisfaction of the campus community.



ADVANTAGES

- Enhanced Safety: The system improves campus safety by providing real-time monitoring and immediate response to incidents, reducing the risk to students and staff.
- Timely Emergency Response: With fall and fire detection capabilities, the system can automatically alert authorities, ensuring rapid response in emergency situations.
- Efficient Attendance Tracking: The system automates student attendance tracking, reducing administrative workload and errors in record-keeping.
- Facial Recognition: Facial recognition can be used for secure access control, helping prevent unauthorized individuals from entering campus facilities.
- Data Analysis: The system can provide valuable data insights for improving safety measures and campus operations by analyzing incident trends and pat- terns

CONCLUSION

In conclusion, the project to enhance campus safety and security through the development of an integrated system is a commendable initiative aimed at addressing critical safety challenges faced by educational institutions. By leveraging advanced technology, such as facial recognition, student fall detection, and fire detection, this project seeks to create a safer and more secure campus environment. The advantages of such a system are numerous, including enhanced safety, timely emergency response, efficient attendance tracking, and valuable data analysis capabilities. Moreover, the system's integration with existing campus infrastructure and its commitment to privacy regulations and ethical considerations are promising aspects.

However, it is essential to acknowledge the limitations and challenges associated with the project. These include the potential for false positives in fall detection and facial recognition, technical complexities, and the financial burden of development and maintenance. Privacy concerns and ethical dilemmas surrounding data collection and surveillance must be carefully navigated to ensure the system's responsible and ethical use.

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Emotional Well-Being Assessment through Social Media Posts

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ABSTRACT

The usage of social media platforms such as Facebook, Instagram, Twitter, and others has been rising quickly in the current digital era. Individuals frequently use social media sites as a means of expression for their ideas and emotions. Mental health as a problem has been a persistent subject of discussion for researchers globally, making it an outstanding concern in our culture. Our study presents an emotional assessment that can be used to forecast the likelihood of suicidal acts based on the polarity of the text. This work aims to present a text-analytics-based machine learning model for identifying an individual's emotional state. We seek to extract contextualized representations of social media text and analyze language patterns suggestive of different emotional states by utilizing the Bidirectional Encoder Representations from Transformers (BERT) paradigm. Our machine learning approach includes gathering data from widely used social media platform such as Twitter, preparing text data, extracting features with BERT embedding's, training and assessing the model, deploying the trained model to detect emotional states in real-time. We report experimental findings that demonstrate how well our method works to reliably identify the emotional state of posts on social media. Our findings demonstrate the potential advantages of machine learning methods for improving social media analysis for mental health monitoring and support, especially BERT-based models.

KEYWORDS: *BERT, Machine Learning, Twitter, Natural Language Processing (NLP), Sentiment analysis.*

INTRODUCTION

As per the WHO's estimations, depression is a major cause of disability and low quality of life, affecting approximately 264 million people worldwide. A person's emotional states have a significant impact on their thinking, behaviors, and social relationships, making them essential components of their mental health. Social media post emotional state detection provides insightful information on users' psychological states and can help with individualized assistance and intervention plans. While various people use social media in different ways, post updates offer a glimpse into the lives of many users. To present, most research has focused on determining which word best predicts a given outcome, positive and negative emotion. Machine learning methods can be used to automatically examine large amounts of textual material, which have shown great promise for producing insightful insights. You may learn a lot about someone's mental state from more than just their average frequency or word choice; you can also learn a lot from changes in how they express their emotions over time. The current study examines changes in emotional expression over time as an additional window into social media users' psychological well-being [1]. Health is primary as it influences an individual's quality of life, productivity, and overall well-being. Panic might arise from an unexpected disease outbreak. To stop a disease from spreading over an area, early detection is crucial.

Twitter users frequently and publicly discuss their personal experiences, thoughts, and feelings on, it is easy to examine and recognize sentiments in their posts. Depression is prominent health issue in worldwide [2]. In order to find a solution on this, our study includes emotional assessment that is contextual embedding from the users posts. People with mental health concerns frequently use social media as a platform to communicate and look for support.

Machine learning techniques can automatically analyze large volumes of textual data and have shown considerable promise in generating insightful information. In particular, computer models that recognize warning flags in user-generated content, such as tweets, have been developed using natural language processing (NLP) techniques [3]. These models offer a practical means of augmenting traditional diagnostic methods and provide a large-scale, scalable, cost-effective method of managing negative individuals. The technique we use to search for sentiment in any text is called sentiment analysis. Sentiments can be defined as beliefs, subjectivity, attitudes, or feelings. It makes it possible to analyze feelings and viewpoints in terms of their polarity positive or negative [4]. User can post the tweets on the Web-application, based on evaluation user gets output as "Positive" or "Negative" using sentiment analysis. In the case of negative output, an Email is sent to the guardian with the Psychologists details for consultancy and motivational quotes and videos. In the case of positive output, it displays the message as the tweet is positive. The need to create automatic methods for identifying the existence and severity of depression is growing due to the increasing threat that depression poses, as it can prevent future incidents from happening [5].

The objective of the study aims to explore machine learning techniques use for emotional assessment from user tweets. Our goal is to create a reliable and effective predictive model that can identify individuals who may be at risk of Melancholy by examining user tweets. This study has the potential to aid in the creation of cutting-edge digital health resources that support those in need of mental health care and enable early intervention. By investigating a dataset containing tweeter posts, we mean to build a strong and precise predictive model fit for recognizing users who might be in danger of gloom.

Our systems goal is to predict a person's emotional state from user-generated tweets with machine learning methods. Through the examination of a dataset of tweets, our goal is to create a reliable and precise predicting model with the ability to recognize users metal health conditions. Our initiative can aid in the creation of cutting-edge digital health solutions that support and enable early intervention for those in need of mental health services. A machine learning technique examines user posts on social media to identify depression [6].

There is immense research gap in this study. Even though sentiment analysis methods for detecting depression on social media sites like Twitter have advanced significantly, there is still a dearth of thorough research on how deep learning architectures to improve the precision and resilience of depression detection models. Previous study includes the use of support vector classifiers and Naïve Bayes algorithms results in a less accuracy. Opportunities for analyzing client behavior in social networks are always evolving. Specifically, computational linguistics techniques are effectively applied in the analysis of social media posts. Within the paper, a records-analytic-based approach is suggested to identify an individual's mental health. The data is collected from the posts made by users on Twitter, a well-known social media platforms. Device analysis is employed in this study to handle the scraped data collected from users of social networking sites [7].

Time and financial constraints can occasionally make it difficult to produce appropriate datasets for emotional assessment. By recycling an existing dataset, which was initially intended for sentiment analysis, and adapting it for emotional assessment using affordable custom algorithms that take into account real-world resource restrictions, the effort aims to reduce the gap. By examining user posts on social media, a machine learning technique is utilized to determine the user's state of sadness. Posts on Twitter have been thought to communicate the model. There are numerous factors to take into consideration when determining whether a user is depressed. The majority of users utilize tweets and posts to communicate their emotional states.

LITERATURE SURVEY

The application of machine learning (ML) and artificial intelligence (AI) to enhance mental health services has garnered more attention in recent years. As Shikha et al. noted [8], In addition to developing AI-powered therapies and increasing access to mental health care services, AI and ML may be used to identify and diagnose mental health issues. With an emphasis on machine learning techniques, a growing body of research has been done on the identification of emotion assessment from social media posts. In the study, linguistic patterns in social media posts that suggest depression are identified by the researchers using machine learning, sentiment analysis methods, and natural language processing (NLP). It might also look into research on the effectiveness of different traits, classifiers, and datasets applied to depression detection tasks [9]. Studies have looked at the correlation between negative language usage and emotional assessment, and the results support the idea that negative comments or emotions are frequently connected to sadness.

Gkotsis et al. classified mental health issues on social media using well-informed algorithms and strategies from deep learning domain. They identified mental health conditions such as depression by using deep learning algorithms and a vast collection of Twitter tweets. Their method demonstrated how deep learning models may be used to improve mental health monitoring and extract knowledge from user-generated content [10]. The importance of adding contextual data from social media platforms has also been highlighted by other studies. In recent years, a growing number of researchers have begun to use social media for mental health research.

Orabi. [11] assert that a user's private life may be revealed in considerable detail on social networking sites. They recommended using deep neural networks and other supervised machine learning approaches. The best linear classifier accuracy was determined to be 87.5 when depression was identified using the Naive Bayes and Support Vector Machine techniques. Text categorization and analysis Naive mathematical classifiers are frequently utilized in machine learning classification [10]. Health tweets pertaining to anxiety and depression were examined using the Multinomial Naïve Bayes and Support Vector Regression act as classifiers, respectively. Support vector regression and multinomial Naive Bayes techniques were employed as classifiers to separate the mixed tweets from the health tweets discussing melancholy and anxiety [12].

METHODOLOGY

Negativity, sadness, over thinking may cause serious mental health issues like people face depression, anxiety that interfere with a person's everyday activities. This prominent health issue need to identify and prevent it. So, in this paper we put up a solution analysis, often known as opinion mining or sentiment analysis. It is a natural language processing (NLP) technique that helps to identify the sentiment or emotion implied in a text. Our approach is centred around taking advantage of the BERT paradigm, which is widely recognized for its ability to retrieve contextual and semantic data from textual input. The expression may be positive or negative. Sentiment analysis is the automated technique of examining these viewpoints or data text. The method used in this paper is structured in a modular fashion in order to enhance the quality of the work flow. The system utilizes BERT model and Natural language processing techniques.

BERT- Google developed BERT, a cutting-edge NLP model. To create contextualized word embedding's, it employs a transformer architecture that considers left and right context in a bidirectional manner. For this work, the pre-trained version of BERT was optimized. BERT has demonstrated remarkable performance in several NLP tasks, including text categorization and sentiment analysis. BERT is a key component of this system that extracts social media post contextualized representations. The hugging face transformer based BERT model is used in this study. The model is able to identify complex linguistic patterns and contextual nuances that are indicative of an emotion state in text data by utilizing BERT's pre-trained language understanding skills. We decided to use the English-language uncased (all lowercase prior to tokenization) version of BERT among the other pre-skilled models that were available. By incorporating BERT into the project, the model's comprehension and analysis of the intricate language used in social media interactions are improved, increasing the efficacy of attempts to assess emotions. The first step in any machine learning or sentiment analysis project is gathering pertinent data from a variety of sources. In this paper, user tweets from Twitter are used as the data source for analysis. Through the Twitter developer API, tweets from the Twitter website may be acquired for a monthly or annual membership price. Regretfully, we had to use the readily available datasets because of time and financial constraints.

We used Sentiment140 dataset, which was developed with sentiment analysis in mind [MDPI], from the open-source Kaggle platform. It contains 1.6 million tweets. This tweets are English-language tweets which are collected from Twitter make up our dataset. Six columns are included: "target," "ids," "date," "flag," "user," and "text". Table 1 displays the dataset description. These tweets were gathered in April and June of 2009. In this dataset, every tweet has been given a sentiment polarity that indicates whether the message is positive or negative.

Table 1. Specification of dataset

Features	Details
target	The tweet's polarity is 0 = Negative. 4 = Positive
ids	The id of tweets (e.g., 1467811184)
date	The date of tweet tweeted (Mon Apr 06, 2009, 22:19:57 PDT).
flag	The Question. If there is no any query then the value is NO_QUERY. (e.g. NO_QUERY)
User	The tweeter (e.g. ElleCTF)
text	The tweet's wording, which contains expressions like "My entire body hurts and seems to be on fire."

"Target" and "text" columns are crucial for this investigation. The dataset update that includes the explanation in Table 1 offers a place to start when it comes to determining emotional state. For our convenience, we transformed the target feature by using function replace(4,1), such that after transformation 1 indicates positive sentiment.

Table 2. Description of the Transformed dataset

Features	Details
Label	Indicate on the label if the tweet is Positive or Negative.
Tweet	The user's Twitter post text.

SYSTEM ARCHITECTURE

Figure 1 illustrates the activities of our emotional assessment and content feature classification model. In our system, User enter the tweet, Guardian's email-id and user name in application. Then the system extracts tweet, perform pre-processing on it, then feature extraction is carried out to extract contextual embedding's, afterwards the BERT classifier classifies the text as positive or negative on the basis of embedding's. If the text is positive, it shows the result as positive. If the post is negative, then it displays the message saying the post is negative, shows some motivational quotes to inspire the individual, suggest motivational videos, suggest a psychologist for consult and sends the report to the guardian.

Data Preprocessing

Prior to sentiment analysis, preprocessing techniques are often employed on the text data. We used feature selection in the pre-processing stage to find and eliminate unnecessary features. It was found that the features "ids," "date," "flag," and "user" had no bearing on the objective of determining sentiment in tweets, hence they were removed from the dataset used in this study.

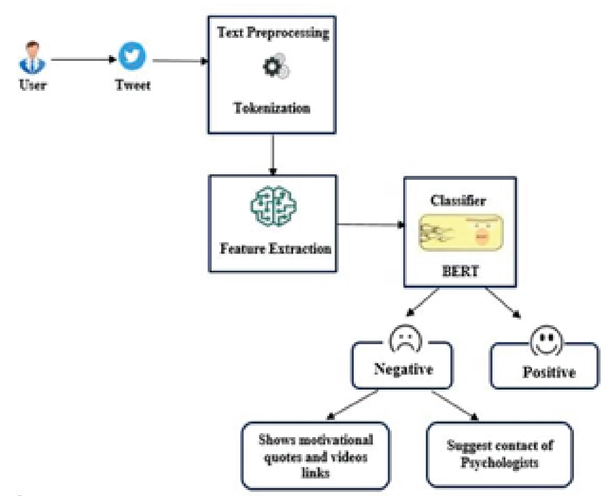

Fig. 1. Proposed architecture

This study involves following preprocessing techniques,

1) Handling Missing Values - We evaluated the dataset's quality and integrity by determining if any values were missing. Fortunately, the twitter data did not contain

any missing values. As a result, we were able to go further with the preprocessing stages without having to eliminate or impute any incomplete instances.

Data Cleaning

The range of cleaning procedures consists of,

- Lowercasing - Because differing capitalization methods can lead to repetition and preserve unity, we transformed all of the information to lowercase.
- Removal of User Mentions – The user mentions (e.g., @ ElleCTF) from the tweets are omitted. They might be regarded as noise in the analysis and usually don't include any significant sentiment information. Removal of links - We omitted all hyperlinks and URLs from the tweets since they add noise to the analysis and don't contribute to the semantic meaning.
- Eliminate Non-Letters - Since non-alphabetic characters typically don't add to the sentiment analysis, we eliminated all numbers, emoji's and special characters.
- Removal of Stop-words – We omitted the stop-words which are commonly used like "the", "is", "and", etc. as they have no significance in sentiment analysis.

Tokenization

We imported BERT-tokenizer for performing tokenization. The BERT tokenizer breaks down the input text into discrete tokens or subwords based on its vocabulary. Every token is associated with a word element; additional special tokens, such as [SEP] for separation and [CLS] for classification, added as needed. Along with these extra responsibilities, the tokenizer also truncates and pads input sequences to make sure that they are of the same length—a need for batching during model training. After tokenization, the vocabulary of the pretrained BERT tokenizer is used to map each token to a distinct numerical ID. Tokens are transformed into input IDs, or numerical representations, so the BERT model can handle them. It is also possible to create additional data, such attention masks, to show which tokens are padding tokens and which are real words. In this study, mask is 0 for padding and 1 to actual word. The tokenized and numericalised text data is then fed into the BERT model for further processing.

Feature Extraction

We used label encoding to get the target variable ready for machine learning methods. The labels designating Positive and Negative have numerical values embedded in them. In this, 0 indicates Negative and 1 indicates Positive which was appropriate for training and assessment. BERT's word embedding's are context-dependent and capture the meaning of words based on their surrounding context, in contrast to typical word embedding's like Word2Vec or GloVe, which create fixed representations for words. Because of this contextualization, BERT provide rich and complex representations of words that consider the syntactic and semantic interactions between them in the text. So, we used BERT for contextual embedding.

Model Training and Testing

Training

The classifier requires two parameters: the training set and the label the term "training set" refers to the set of tweets that require extra processing before being entered into a classifier. The collection of tweets has to be converted to vector format for further processing. In addition, the classifier receives a vector containing the set of Tweets that corresponds to each label. This section describes the process used to build our dataset using ground truth label information, or whether the tweets indicate a positive or negative outcome. The two primary components of the training dataset are testing and training.

Then the pre-processed dataset is splits into the training set and testing set by using the 'train_test_split' module from sklearn library in order to evaluate the efficacy of the trained model. The dataset was divided into two halves: 20% was set aside for testing and 80% for training. The BERT-based machine learning model for emotion evaluation is trained on the training set. The trained model is applied to the supervised dataset in the testing step. In order to calculate evaluations like positive or negative, the model predicts labels for the test set. These predictions are then checked with the ground truth tables. Figure 2 shows the model training and prediction processes.

Prediction

In this section, the system predicts using a pretrained BERT classifier by iterating over each sentence. User enter the tweet into the web application, then the system will predicts whether the text is positive or negative.

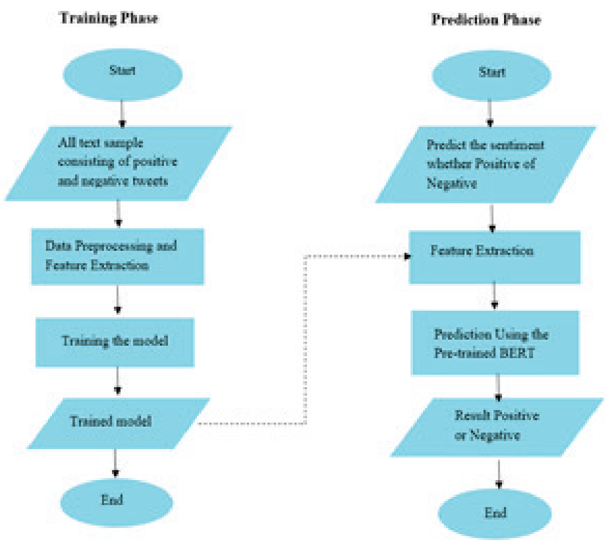

Figure 2. Flowchart of training and testing

Mathematical Model

System Overview:

Sys denotes {Ip, Op, Fun}

Sys = System

Ip = Input

Op = Output

Input Ip = set of Inputs

Where,

Ip = {User_Name, Users_Social_media_post}

Fun = Set of Functions

Where,

Fun1 = {Input Dataset}

Fun2 ={Pre-processing}

Fun3 = {Train test split}

Fun4 ={Tokenization}

Fun5 = {Classifier (BERT Algorithm)}

Op is the system's output.

Op1 = {Emotion Assessment} is the output.

Success criteria: Successful evaluation of emotions and seamless product operation.

Failure Conditions: In the event that there is no internet connection.

RESULT

The result of the system is shown in table 3.

Table 3. Result

Username	Tweets	Result
scotthamilton	Is angry because he can't text updates to his Facebook page and may cry as a result. He has school today.Oh no!	Negative
ElleCTF	My entire body aches and feels like it's on fire.	Negative
calihonda2001	loved the Getty Villa, but she detests that she's been suffering from a sore throat all day. It's only becoming worse as well.	Negative
Janhavi	"Feeling really anxious about the upcoming exams. ☹ Can't seem to shake off this feeling of dread. #stressed #examseason"	Negative
Ganesh	"Feeling overwhelmed with deadlines and responsibilities. ☹ Can't seem to catch a break. #stress #overworked"	Negative
Rukmin	"Life's unexpected twists and turns never cease to amaze me. Embracing the uncertainty and trusting in the journey. #perspective"	Positive
Akanksha	"I passed my exam with flying colors! 🎉 Hard work and dedication really paid off. Feeling on top of the world right now! #success"	Positive

Result of Emotion assessment application -

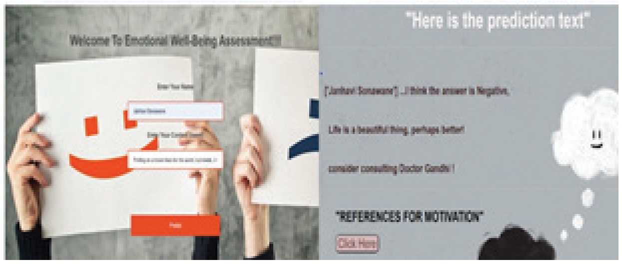

Figure 3. Emotion Assessment Application

Graph of figure no. 4 illustrates how many positive and negative feelings tweets there are in a dataset. In this graph, 0 indicates the negative sentiment tweets score and 1 indicates a score for positive sentiment tweets.

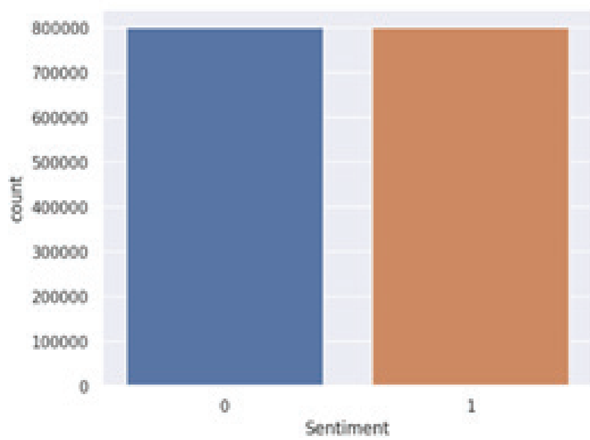

Figure 4. Graph denoting the number of positive and negative sentiment tweets

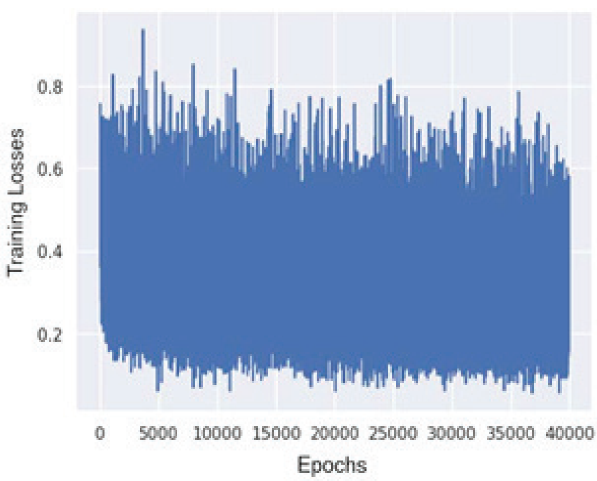

Figure 5. Graph of loss during training

Figure 5, shows the graph of training losses. The visualization helps in monitoring the training progress and identifying trends in loss function during training. The curve depicts the trend of training loss over time. There is decreasing a loss indicates that the model is effectively learning from the training data and improving its performance over time.

In this graph, the x-axis represents epochs or number of iterations during the training process. In each epoch, the model sees a batch of data. The y-axis represents the training loss at each iteration. It gauges the model's effectiveness using the training set of data. The difference between the actual target values and the values the model predicts is measured by the loss function. The lower numbers demonstrates that the model's predictions are more in line with the actual values, are indicative of better performance.

Figure 6 shows how words are contributing to sentiment. It represents which terms are more contributors and which are less contributors to negative as well as positive words.

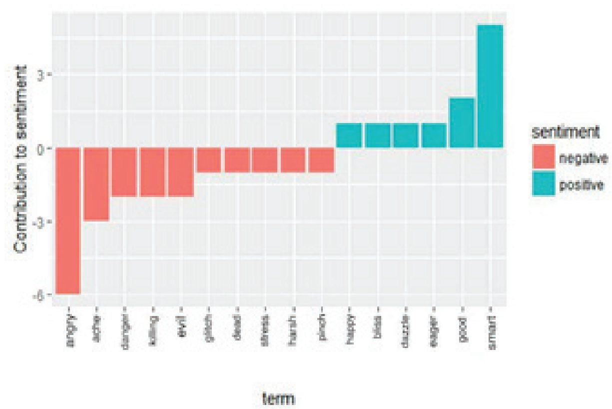

Figure 6. Graph of words contributing to sentiment

CONCLUSION

By comprehending past events, the suggested model could help the potential user preserve their life. Due to hectic schedules, most people don't have the time to fully please their friends or express their thoughts and feelings as they did in the past. As a result, our model plays a vital role in preventing any unintended human casualties. The model will inform their family members about the possibility of a depressive symptoms or negativity of that person. Thus, the person will be helped to emerge from despair by their own network of friends or relatives. The system will send him a few inspirational posts and videos and there is collaboration with psychologists. Our model was developed for determining if a user's tweet is negative, depressed through the supervised learning in sentiment analysis. The system offers promising avenues for early detection and support individual with mental health issues. It emphasis holistic approach, combining technology innovation with clinical expertise and ethical considerations. The integration of technology-driven solutions such as emotion assessment utilizing social media data, represents a significant advancement in enhancing existing mental health services. Our model gives 87.27% accuracy.

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QGIS Based Power Distribution System using Machine Learning

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ABSTRACT

Nowadays, the conventional electricity distribution network frequently faces issues with inefficient use of resources and inadequate distribution. Higher energy losses, longer outage recovery times, and higher operating expenses are the outcomes of this. The power system's planning and operation are greatly improved by the integration of GIS with electric utilities. The research suggests utilizing Geographic Information System (GIS) data in conjunction with machine learning to optimize power distribution systems in a conventional manner. Machine learning (ML) can be used to forecast demand, spot possible issues, and improve energy efficiency.

By predicting equipment failures and optimizing maintenance plans based on previous data, it helps raise the overall reliability of the power distribution network. The goal is to create a solid framework that optimizes power distribution network maintenance and operation by utilizing geographical data from GIS platforms. By utilizing the potential of GIS and machine learning in the field of energy management, it supports the continuous endeavors to construct a more intelligent and sustainable power infrastructure.

KEYWORDS: *QGIS, ML, GIS, DTC, DTR, SS.*

INTRODUCTION

Electricity is an essential peculiarity of the utility sector which is very necessary to the smooth and meaningful growth of any city. It is very important for any person living both in urban as well as in rural region.

The main purpose of electricity distribution system is transporting electricity from generation plant to end users and face growing challenges. These include rising demand, aging demand infrastructure and the integration of measurable energy Sources with variable output.

Geographic Information System (GIS) with machine learning algorithms has come out as transformative approach for optimizing power distribution system.

Traditional power distribution techniques are being re-evaluated to satisfy the changing needs of utilities & consumers alike, as the demand for electricity rises along with the complexity of managing the grid.

Geographic Information systems provide a powerful framework for analysis & visualization, enabling utilities for effectively monitor, map and manage the complex network of power infrastructure. By combining the machine learning techniques into GIS platforms, Utilities may use the abundance of data produced by sensors, meters and other smart devices to create real-time, actionable insights and decisions. Based on the time scale, electrical load forecasting is typically separated into three categories: Forecasts ranging from a few hours to a few days or a week are referred to as short term. Short-term forecasts are those made a few hours, days, or weeks in advance; medium-term forecasts are those made a few months to a year in advance; Estimates for the future years are sometimes included in long-term projections [2].

For energy systems, medium- and long-term projections are equally essential. Whereas capacity scheduling and maintenance planning depend heavily on long-term electrical demand forecasts. The approach proposed in the paper primarily falls under the category of short to medium-term time scale in electricity load forecasting. This is due to the fact that machine learning algorithms when combined with geographic information systems are frequently employed for applications like fault detection, load forecasting, and predictive maintenance, which usually have time intervals of few hours to several weeks or months The immediate focus of the research is on enhancing operational efficiency and reliability within shorter time periods, while some parts may touch upon longer-term forecasting and planning, such as infrastructure renovations [8].

By evaluating data from sensors and other sources, ML models may detect any problems in the distribution network, enabling proactive maintenance and reducing downtime. By examining usage trends and making real-time recommendations for improvements, machine learning techniques can help improve energy efficiency. Additionally, using historical performance data, machine learning algorithms may forecast equipment failures, opening the door to predictive maintenance plans that increase reliability and decrease total downtime.

The current system suffers from human surveys that are time-consuming and prone to inaccuracies, rampant electricity theft, and inefficiencies in establishing ideal paths for consumers from electrical poles. These study aims to minimize the need for manual surveys through automation, and accurately classifying the consumers as Domestic, Commercial, Industrial, Agriculture depending on their power demand and consumption.

The goal is to optimize electricity distribution systems by combining machine learning techniques with data from Geographic Information Systems (GIS). This integration ought to contribute to increased system performance, decreased downtime, and improved network reliability.

LITERATURE SURVEY

Economic corridors and dynamic programming are discussed as automated optimal routing techniques for new power lines. The location distribution system design for substation optimization can raise the cost and quality of the final [1]. GIS is helpful for controlling various electric loads as well as for planning and evaluating electrical networks [2]. It can be applied to electricity transmission lines to determine the most efficient and fastest path. Beyond standard GIS and mapping borders, it offers consumers benefits and operational efficiencies.

Utility management systems can be implemented using GIS to forecast and control risk factors for any kind of utility. This is known as a GIS-based system. The applications will enable online query by displaying certain assets and their attributes connected to utilities through the use of the JSF JavaEE platform [3].

Even though the machine learning model for electrical distribution asset failure prediction looks at a wide spectrum of failures, it only looks at one particular kind of asset: overhead power lines and the components that go with them. It was determined to concentrate on these areas based on the categories of assets and the degree of risk and damage [4].

Three algorithms—regression tree, tree boosting, and random forest—are used for embedded feature selection. They are applied to produce a feature importance ranking and a stepwise analysis to determine how many features need to be taken into account in order to get the best forecast performances [5].

The Italian gas consumption forecasting team conducted a thorough demand analysis and looked at the effects of temperature and seasonality in partnership with A2A, an Italian utility. The best strategies involve building and managing storage facilities and could offer direction for upcoming energy regulations and developed a novel process in association with EPFL Lausanne's DECODE laboratory that blends optimal experiment design with recursive identification.

The detection of network distribution equipment was made possible by the enhanced SSD network model, and ResNet50 was utilized in place of VGG16 to enhance image size and feature. Fusion was completed. According to the experimental data, the suggested algorithm has an accuracy of 87.9% and a recall rate of 83.3%. To identify distribution network flaws, the enhanced Faster-RCNN model is employed, and

Inception V2 is used in place of VGG16 to expand the image size. This research suggests an edge-calculated approach to fault identification and distribution network equipment [6].

Depending on the temperature, humidity, day status, season status, and load available for the last two hours and the preceding two days at the time of prediction. In a similar manner, the load that was available two days prior to the forecast, along with the day's status, season, temperature, and humidity, were used to forecast the load for the next day.

Provide a summary of the application of machine learning in the force framework for blame detection, which represents a significant development in control and security [7].

In particular, the supply and demand for electricity generation were balanced at all times, and the multistage adaptive robust optimization framework took into account the need for electricity storage and the need for greater technological diversity as ways to address the intermittency problem brought on by variable renewable energy. Furthermore, the framework accommodated renewable energy sources and climate targets. Give an overview of how machine learning is used in the force framework for blame detection, which is a crucial advancement in security and control [8].

Forecasting the amount of electricity consumed an hour and a day in advance is necessary for utilities to successfully submit a bid in the day-ahead and hour-ahead energy markets. This study forecasted the active power on a 33/11 kV substation for one hour. Depending on the load available over the previous two hours and the previous two days at the time of prediction, as well as the temperature, humidity, day status, and season status. Similar to this, a day's worth of load was forecast using the load that was available two days prior to the forecast, as well as the day's status, season, temperature, and humidity [9]. In general, traditional machine learning techniques such as SVM, ANN, and other variations are directed or semi-regulated learning algorithms. Each specific subsection discusses the uses, advantages, and drawbacks of each.

Ning Zhao, Fengqi You suggested a bottom-up, data-driven, multistage adaptive resilient optimization methodology for the power sector to identify viable, uncertain renewable transition paths. The needs for power generation, the marketability of wind turbines, and the marketability of solar photovoltaics were among the uncertainties in the framework. Additionally, the suggested framework guaranteed the maintenance of the power sector's system reliability throughout the transition to renewable energy [10].

METHODOLOGY

Developing a GIS-based power distribution system using machine learning involves a systematic methodology to optimize infrastructure management and enhance operational efficiency. The process typically begins with data collection, encompassing geographical, topographical, and infrastructure information. This data is then integrated into a GIS platform, providing a spatial framework for analysis and decision-making. Machine learning algorithms are applied to this integrated dataset to extract valuable insights and patterns, such as load forecasting, fault detection, and asset health monitoring. Machine learning models can also optimize asset allocation and routing, minimizing energy losses and improving system reliability [2]. Continuous monitoring and feedback loops ensure that the system adapts to changing conditions and incorporates new data effectively. Collaboration between GIS and machine learning is essential throughout the development process to ensure a comprehensive understanding of both the technical requirements and the operational constraints [4]. GIS-based power distribution systems using machine learning represents a holistic approach to modernizing infrastructure management and optimizing energy delivery in an increasingly dynamic and data-driven environment.

Parameters provide a comprehensive overview of the distribution network's infrastructure, operation, and performance. By analyzing and leveraging the dataset, it becomes possible to achieve the objectives mentioned, including remote management, load forecasting, identification of inefficiencies, and optimization of power distribution systems. Each parameter contributes valuable insights that can inform decision-making and optimization strategies within the distribution network.

- SS NO: Identifies substations in the network for layout and connectivity.

- Feeder No: Identifies feeders for load balancing and fault detection.
- DTC Code: Identifies transformer centers for load distribution understanding.
- Capacity KVA: Represents equipment capacity for forecasting and planning.
- Pole No from STN: Indicates pole distance for network layout assessment.
- Meter Number: Identifies meters for consumption tracking and billing.
- Meter PT Ratio: Indicates potential transformer ratio for voltage monitoring.
- Current Reading: Records current for consumption monitoring and anomaly detection.
- Longitude and Latitude: Geographic coordinates for spatial analysis and visualization.

Geographic Information System

Integrated collections of data, hardware, software, and processes created as a computer system for obtaining, organizing, mapping, and analyzing spatial data make up the potent instrument known as a geographic information system (GIS). One of the most significant new technologies is geographic information systems (GIS), which takes into account potential for growth in areas such as fault analysis, network optimization, load forecasting, cost calculation, and appropriate region selection [1].

QGIS

Quantum Geographic Information System, or QGIS is free and open-source data viewing, editing, and analysis tool.

- Open Source: The GNU General Public License (GPL) governs the use of QGIS as an open-source software project. This implies that anyone may download, use, alter, and distribute it without restriction.
- Multiplatform Compatibility: Numerous operating systems, including Windows, Linux, macOS, and Android, are compatible with QGIS. As a result, a wide range of users, regardless of their preferred operating system, can access it.
- Functionality: QGIS provides a wealth of options for managing geographic data. Geospatial data can be created, edited, visualized, analyzed, and published by users.
- User Interface: Users may quickly and easily browse through QGIS's capabilities because of its user-friendly design. It offers tools for managing data, creating bespoke maps, and conducting spatial analysis.
- Plugins: By installing extra plugins created by the QGIS community, users can increase the capabilities of QGIS to its plugin architecture. Numerous functions are covered by these plugins, such as data processing, mapping, and software integration.
- Integration: GPS devices, online mapping services, geographic databases, and remote sensing tools are just a few of the applications and services that QGIS can interact with.

Data Collection

We have collected data from different locations, having features such as region, zone, circle, division, sub-division, SS NO, feeder information, DTC code, capacity KVA, metering details, geographical coordinates, and metadata.

Data Preprocessing

Data Cleaning: Identification and handling of the values in the dataset. We Replace missing values using techniques such as mean imputation or interpolation, or remove records. Checking of duplicates in the dataset is done and remove some of the records from the dataset to ensure data integrity and consistency.

Data Formatting: Standardize the format of categorical variables such as region, zone, circle, division, and sub-division to ensure uniformity and compatibility for analysis.

Convert categorical variables like DTC NAME, METER INSTALLED, SURVEY DONE BY into numerical representations using techniques such as one-hot encoding for machine learning algorithms. Standardize the format of categorical variables such as region, zone, circle, division, and sub-division to ensure uniformity and compatibility for analysis.

Convert categorical variables like DTC NAME, METER INSTALLED, SURVEY DONE BY into numerical representations using techniques such as one-hot encoding for machine learning algorithms.

Feature Engineering: Extraction of relevant features from the dataset that are informative for power distribution system optimization. This may include creating new variables or combining existing ones to capture meaningful relationships.

For the location information Region, Zone, Circle, Division, Sub-Division these variables are used.

For the Mapping purpose DTC location i.e. Longitude, Latitude are used.

Meter Reading related information is available in Meter PT Ratio (Potential Transformer Ratio), Connected PT Ratio.

Classification

Classification is used here to identify the type of the consumer. Support Vector Machine is the algorithm used for classification (SVM). Support vector machines, or SVMs, provide a reliable way to do classification tasks, such as determining the kind of consumer in a power distribution system according to certain characteristics. SVM works by finding the hyperplane that best separates different classes in the feature space while maximizing the margin between them. In the context of identifying consumer types, SVM can utilize features such as energy consumption patterns, load profiles, voltage levels, and other relevant parameters extracted from smart meters or historical data. By training an SVM classifier on a labelled dataset containing examples of different consumer types, the model learns to differentiate between them based on their characteristic patterns.

During the training phase, SVM optimizes the decision boundary to accurately classify consumers into their respective categories, whether residential, commercial, or industrial, for instance. For the classification of the consumer type identification threshold value is set according to that value the classification is done. 2,000 kWh or more could be used in a larger home with air conditioners, which consume the most energy. The average household consumes 900 kWh a month. That comes to a daily total of 30 kWh or 1.25 kWh per hour.

MATHEMATICAL MODEL

Input Features

- X: A set of input features including:
- Geographical data (e.g., latitude, longitude, elevation)
- Weather data (e.g., temperature, humidity)
- Time-related features (e.g., time of day, day of week)

Output Variable

- Y: Power distribution (e.g., electricity consumption) at a specific location.

Machine Learning Model

- Let f(X; θ) represent the machine learning model with parameters θ which maps input features X to power distribution Y.

Model Representation

- The machine learning model can be represented as:

$Y=f(X;\theta)+\epsilon$

Where ϵ represents the error term, accounting for noise or unmodeled factors.

Objective Function

- Define an objective function J(θ) to minimize the discrepancy between predicted and actual power distribution values. A common choice is the mean squared error (MSE):ss

$$J(\theta)=\frac{1}{m}\sum_{i=1}^{m}(Y^{(i)}-f(X^{(i)};\theta))^2$$

where$(X^{(i)}, Y^{(i)})$ represents the i th training example.

Model Training:

- Training data to optimize the model parameters θ by minimizing the objective function:

$\theta^* = \text{argmin}_\theta J(\theta)$

SYSTEM ARCHITECTURE

The Fig. 1. illustrates the activities of a QGIS-based power distribution system using machine learning. New customers first register on the website and log in using the registered password & username. After that the customer has to pay the required registration fees & the payment verification is done by an Electricity Company Employee.

Then the power distribution employee will see the new connection requests on his dashboard & the QGIS will show the map & exact location of the DTC. Then ML algorithms will be applied to the dataset at the backend & the information is displayed on the GUI at Employee Login.

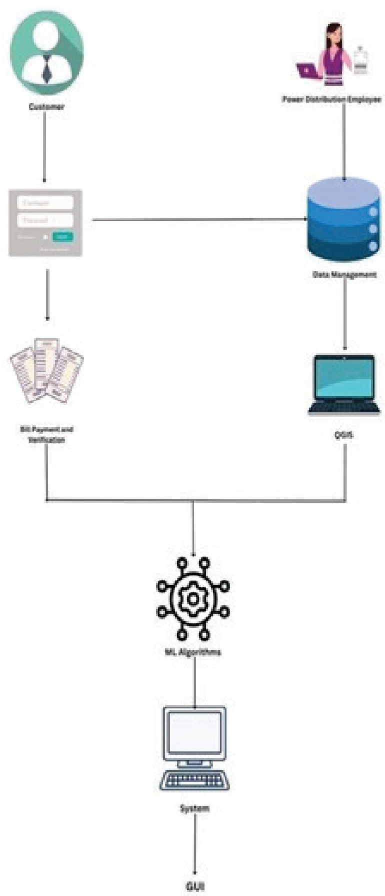


Fig 1. System Architecture

RESULT

QGIS

1) Import Data: -

The dataset is in CSV file format, go to the 'Layer' menu and pick "Add Layer"→ "Add Delimited Text Layer".

Locate and pick the dataset by browsing to its location.

To import the data into QGIS, click "Open."

2) Data Display

After importing the dataset to the QGIS layer, it will appear to QGIS.

3) Styling Data Points: -

Right-clicking on the layer in the Layers panel.

Open the 'Style' option and change the colour and size to your preference. Applying the style by clicking "OK".

4) Customize the map: -

To improve the map visualization and understanding we separated the dataset according to substation name and added the layers using the same process.

5) Import Google Hybrid map: -

Click on the web and go to "QuickMapServices".

The Result of GIS based Power Distribution System

Then click on "Google" and select "Google Hybrid".

6) Export the map: -

Click on the web and the select "qgis2web".

Then click on "Create web Map" and a dialogue box will open.

Then make changes according to dataset in the Layers and Groups Column and then click on Update Preview.

After the preview is updated click on Export.

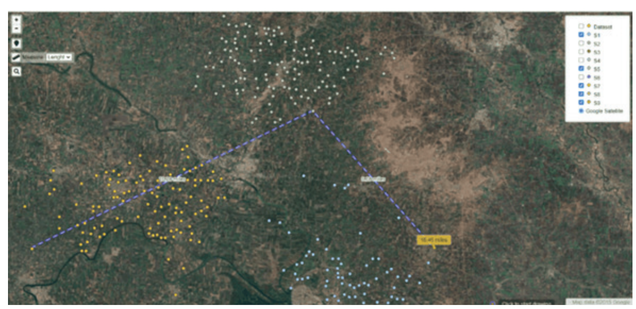


Fig 2. Data Layer Classification by SS Name

In fig.2 shows all the data points are separated according to their corresponding substation names.

The Measure Icon has two options-

1) To Measure the distance between two points

2) To Measure the Area of specific data points.

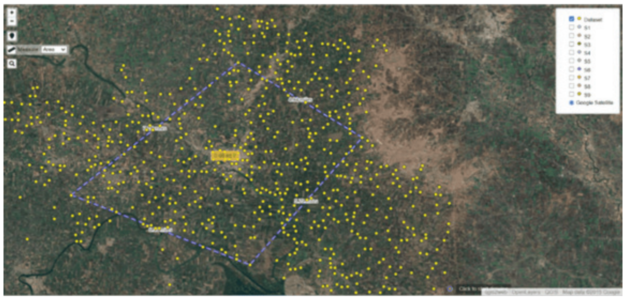
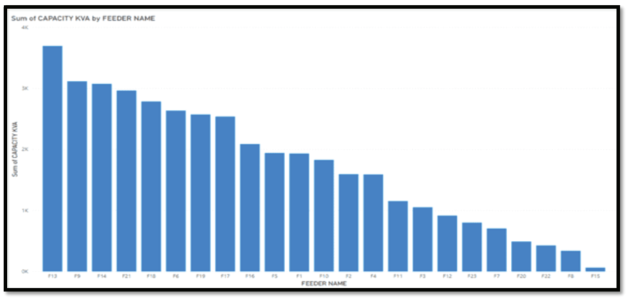


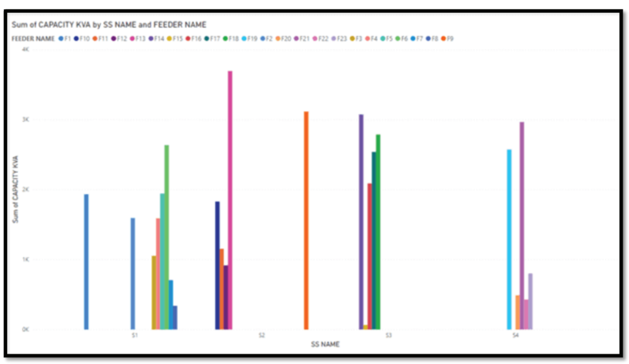
Fig 3. Mapping of data points of overall region

The fig.3 represents the mapping of all the DTC's and the area between the DTC's is shown in sq.ft



Graph 1. Feeder Name vs Sum of capacity KVA

The Graph 1 represents Feeder Name vs Sum of Capacity KVA. This shows sum of capacity on specific Feeder.



Graph 2. Sum of capacity KVA by SS Name and Feeder Name

The Graph 2 represents Sum of Capacity KVA by SS Name and Feeder Name. This shows sum of capacity on specific Feeder distributed among Substations.

CONCLUSION

In conclusion, the study demonstrates how well Geographic Information System (GIS) and machine learning can be combined to improve electricity distribution networks. It is possible to estimate energy use, spot any problems, and increase overall energy efficiency by using GIS data and machine learning algorithms. Additionally, by forecasting equipment failures and optimizing maintenance schedules, this strategy helps to increase the power distribution network's reliability. In the end, the creation of a more sophisticated and sustainable energy management system is aided by the integration of GIS and machine learning.

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An Optimized and Efficient Diagnosis System for Heart Disease Prediction using Machine Learning

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ABSTRACT

One of the hardest things to forecast in the medical industry is heart disease. Over the course of the year, scientists created a number of technologies to precisely forecast cardiac illness. This paper suggests a diagnosis method that correctly predicts Heart Disease using an enhanced version of the Extreme Gradient Boosting (XG Boost) algorithm. An accurate hyperparameter tuning is critical to the XG Boost Classifier's efficacy. To increase accuracy, the dataset's categorical features are encoded using the One Hot (OH) encoding technique. The model's efficiency is compared with alternative methodologies such as Random Forest, K Nearest Neighbors (KNN), and Logistic Regression. Sensitivity, F-1 Score, Specificity, and Accuracy are employed to evaluate the model's effectiveness. The proposed approach seeks to create a prediction model that, using a patient's medical history and other relevant information, can reliably determine whether or not a person has heart disease. It also attempts to offer early heart disease diagnosis. The proposed model achieves an improved accuracy of 88%.

KEYWORDS: *XG boost, OH encoding, Heart disease, Hyper parameter tuning.*

INTRODUCTION

There are currently a lot of deaths in the world, primarily from heart disease. Every year, late diagnosis of cardiovascular disease results in almost 17.9 million fatalities worldwide [2]. Thus, the system uses a machine learning algorithm to predict the early diagnosis of cardiac illness. Providing the highest caliber of care and precise, efficient diagnosis is the biggest problem facing the medical field today. Although heart problems are the leading cause of death worldwide these days, they are also the most easily prevented and effectively treated. The timely discovery of an illness is critical to the efficacy of its management. The suggested work aims to identify these cardiac conditions early on.

The proposed method that combines the encoding of categorical information with the prediction of heart disease. Then presented an enhanced model for predicting heart disease using XGBoost and OH encoding strategy at the data pre-processing stage to encode categorical characteristics [1]. Attempting to create a diagnostic system using the XG Boost algorithm, which is an effective application of the Gradient Boosting Algorithm's upgraded version. Regularization and overfitting/underfitting problems can be handled by it. It assesses its effectiveness in a classification task based on accuracy and AUC of ROC chart for a user-supplied set of hyper-parameter values [8].

LITERATURE SURVEY

Kartik Budholiya at el. [8] proposed that, an advanced XGBoost-based totally version for predicting coronary heart disease, where the hyperparameters of the version are high- quality-tuned the use of the Bayesian optimization approach, and the facts pre-processing degree uses the one-hot (OH) encoding approach to encode categorical information. A weighted medical decision guide machine (CDSS) with fuzzy common sense for the prognosis of cardiac conditions. There are two tiers to their counseled scientific selection assistance gadget. They first employed the mining method, characteristic selection technique, and attribute weighting method to generate the weighted fuzzy guidelines.

Devansh Shah at el. [11] conclude that, coronary heart disorder, sometimes known as cardiovascular ailment, is the main purpose of loss of life globally over the last several a long time. It encompasses a variety of disorders that affect the coronary heart. It hyperlinks some of coronary heart disorder hazard factors to the need of timely, accurate, and prudent strategies for making an early diagnosis and enforcing well timed illness care. There are 303 instances and 76 attributes within the series. just 14 of those seventy six traits are taken under consideration for checking out, that is vital to proving the effectiveness of numerous algorithms. The cause of this research work is to estimate the patients' hazard of obtaining heart ailment.

Bhavesh Dhande at el. [7] proposed that, a variety of statistics mining and neural community strategies have been used to assess the severity of heart ailment in people. To categorize the disease's severity, several algorithms are hired, inclusive of decision trees, genetic algorithms, Naive Bayes, and ok- nearest neighbor algorithms. The disorders require careful treatment because of the complex nature of their problems. Failure to achieve this might also result in an early dying or a lower inside the performance of organs. uncooked records mining combined with a scientific technological know-how approach is used to identify the one-of-a-kind metabolic illnesses. In data studies and cardiac sickness prediction, data mining procedures with categorization are crucial.

Armin Yazdani at el. [9] conclude that, in many countries the cardiovascular illnesses are the primary cause of loss of life. Cardiologists regularly make their diagnosis of cardiovascular infection primarily based on consequences from recent clinical examinations as well as past patient diagnoses with similar signs. heart disease sufferers need activate analysis, early intervention, and ongoing monitoring. several information mining strategies had been employed inside the past to diagnose and forecast coronary heart issues so as to meet their desires. locating the key characteristics that make contributions drastically to the prediction of heart disorder became also the focus of in advance research; the power of those functions turned into not as essential.

S. Subramani at el. [12] proposed that, because the primary reason of loss of life worldwide, cardiovascular disorder (CVD) has emerged as a major worldwide public fitness concern. sufferers, their households, and those nations' governments have all paid high socioeconomic fees as a end result. using risk stratification, prediction models can discover patients who're at excessive danger for cardiovascular disorder (CVD). Following that, unique interventions for this populace, like nutritional changes and statin use, can help decrease that chance and aid primary CVD prevention. system studying (ML) algorithms have demonstrated to be very useful predictors in the field of have a look at related to the cardiovascular device.

Chintan M. Bhatt at el. [1] proposed that, over 70% of deaths are because of cardiovascular disease (CVDs), that's the main cause of morbidity and mortality. A 2017 study on the worldwide Burden of sickness observed that about 43% of deaths are resulting from cardiovascular disease. excessive- profits international locations have many heart sickness chance factors, inclusive of smoking, ingesting a negative diet, consuming a whole lot of candies, and being obese or obese. although, the superiority of continual illnesses is also at the upward thrust in low- and center-income international locations. The estimated worldwide financial cost of cardiovascular illnesses among 2010 and 2015 became USD 3.7 trillion.

S. Bilgaiyan at el. [3] proposed that, any disorder affecting the heart is called heart disease. heart disorder encompasses several illnesses inclusive of cardiovascular disease, excessive blood stress, valve dysfunction, cardiomyopathy, right-sided coronary heart failure, pulmonary failure, and greater. coronary heart disorder danger elements can be received or inherited, and they are able to show up at any age. A sedentary life-style, diabetes, smoking, excessive blood pressure, ingesting ingredients excessive in fats (red meat, eggs, or trans fats), smoking, overindulging in junk meals, being overweight, abusing alcohol or tender liquids, and smoking are a number of the alternative causes.

N. Nadal at el. [5] proposed that, one of the principal causes of morbidity within the worldwide populace is heart attack prediction. One of the most full-size sections for the prediction in the scientific records evaluation is the disease that is most critical, namely cardiovascular ailment when predicting heart attacks, information technology and machine getting to know (ML) may be very beneficial diverse chance elements, including excessive blood strain, high ldl cholesterol, aberrant pulse rate, diabetes, and so forth., can be taken into consideration. The goal of this studies is to beautify the coronary heart ailment diagnosis via gadget gaining knowledge.

XG BOOST ALGORITHM

Extreme Gradient Boosting, or XGBoost, is a powerful and successful machine learning algorithm that belongs to the family of ensemble learning techniques. In order to increase prediction accuracy, ensemble learning combines several models, and XGBoost performs particularly well in tasks like classification, regression, and ranking. Its efficacy comes from its capacity to iteratively improve the predictions made by a sequence of weak learners, usually decision trees, through sequential training [4] [10].

Fundamentally, XGBoost uses a gradient boosting framework, which means it develops models one after the other in a sequential fashion, trying to fix the mistakes of the earlier models. Through this iterative method, XGBoost prediction performance can be continuously enhanced. In order to do this, XGBoost optimizes the gradients of the loss function in relation to the model predictions, thereby minimizing a predetermined loss function [8].

First, the algorithm builds a base model to make first predictions on the training data, which is often a straightforward decision tree. It then determines how much error there is between these forecasts and the actual target values. More weight is given to the data points that were poorly predicted in the ensuing iterations of the model fit by XGBoost to the residuals of the prior model. Until a predetermined number of models (trees) are produced or until no more advancements are possible, this process is carried out [6][13].

Regularization techniques are one of XGBoost standout features; they assist reduce overfitting and enhance generalization to new data. Reduction (learning rate) and feature importance penalties are two methods that manage the model's complexity and promote sparsity in regularization [8].

Furthermore, XGBoost is well-suited for huge datasets and high-dimensional feature spaces due to its high efficiency and scalability optimizations. It uses tree pruning methods and parallel computing to expedite training while preserving forecast precision.

In conclusion, XGBoost is a powerful and versatile method that combines the benefits of regularization approaches with gradient boosting to produce state-of-the-art performance in a variety of machine learning situations. Data scientists and machine learning practitioners favor it because of its robustness against overfitting and ability to handle complex datasets with efficiency.

```
The XGBoost Algorithm pseudocode:
Define the hyperparameters, such as learning
rate (0.1).
Maximum depth: 3;

number of estimators: 100;

minimum child weight: 1

subsample; sample by tree: 0.8

Set up the ensemble prediction by setting
ensemble_prediction = 0.
Repeat this process for each of the i estimators
(trees) in range(n_estimators):
Fit the residuals base to a basic decision tree
model.base_model.fit(X, y -
ensemble_prediction)
_model=DecisionTreeRegressor(max_depth=
max_depth, min_samples_leaf=1)

Appropriate for leftovers
Determine each instance's leaf outputs by
using leaf_outputs = base_model.apply(X).
Use base model output to update ensemble
prediction:
ensemble_prediction+=learning_rate*
base_model.predict(X)

Regularization: Penalize the model's
complexity # Execute regularization when
needed
final_prediction = ensemble_prediction
```

METHODOLOGY

The method employed, as illustrated in fig. (1) is thoroughly defined on this phase. There are 5 stages in all: splitting of dataset, categorical characteristic encoding, XGBoost schooling, and checking possibility and possibility of sickness. The XG increase classifier is used to categorize target variable into 0 and 1. It performs binary classification. The ensemble tree technique known as XG (improve extreme Gradient Boosting) boosts susceptible learners via utilizing the gradient descent architecture. However, XGBoost complements the fundamental GB architecture via algorithmic upgrades and system optimization. There are 13 class features within the heart disorder dataset. on this paper, we encoded express features. OH encoding was the approach we applied to convert category variables into numerical variables.

Dataset

For proposed model, we used Cleveland heart disease dataset. There are 919 subject record occurrences in the dataset. Each participant in the dataset has 76 variables, yet previous research has shown that 13 traits are useful in the detection of heart disease. Both numerical and category features are present in the dataset; Table 1 lists them. The dataset's goal is to forecast whether a subject has heart disease based on the findings of different medical tests that were performed on them. The dataset's "num" variable indicates whether the patient has heart disease or not. The values of the "num" variable range from 0 (no existence) to 1. Over the past ten years, a number of classification techniques have demonstrated good prediction accuracy for predicting heart disease using the Cleveland Heart Disease Dataset [8].

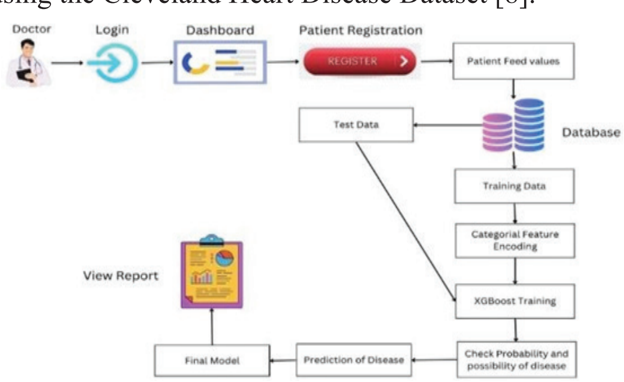

Fig. 1. Architecture

Data Preprocessing

The ratio of 75% to 25% divides the heart disease dataset into train and test datasets. We use the train dataset for training and model optimization. There are four missing values for "number of major vessels" and two missing values for "thalassemia" for six persons in the sample. Since both are categorical features, the categorical feature encoding strategy (OH encoding) will handle the missing values in the categorical features encoding stage, as shown in Figure 4. The objective variable "diagnosis," which has two classes—presence and absence of heart disease—replaced the dataset's "num" variable. The class labels of the target variable are 0 and 1, where 1 represents a heart disease and 0 indicates no heart disease. This is a challenge for binary categorization. The model uses the one-hot encoding technique, which does not imply an ordinal link between categories, to convert categorial features into numerical format [3].

Categorical Feature Encoding

One warm encoding method, sometimes known as the "dummy encoding approach," It is widely used in system learning to convert particular functions into numerical functions. A demonstration of OH Encoding as seen in Fig. (2)

Table 1. One Hot Encoding

Original	One Hot Encoded	
Exercise induced angina	Y	N
Y	1	0
N	0	1
Y	1	0

If there is missing value then, OH encoding keeps each row with a missing value (NaN) as Column.

Training

The dataset is split into 75% and 25% for training and testing respectively. XG Boost classifier is employed in the proposed model's training. In machine learning, hyperparameters are used to regulate the learning process. The following parameters are included in the proposed model: gamma, max_depth, n_estimator, and learning_rate etc. Fit the XGBoost model to the training data using the .fit() method. To evaluate the performance of the suggested model, ROC charts, accuracy, precision, specificity, and sensitivity are employed.

Prediction

The target variable is classified into 0 and 1 using the XG Boost classifier. 0 indicates no heart disease, whereas 1 indicates heart disease.

RESULTS

The XG Boost Machine Learning Algorithm is used by the suggested system for both testing and training. 75 percent of the data is utilized for training, while 25 percent is used for testing. XG Boost classifier is employed in the proposed model's training. The outcome demonstrates that the model can correctly identify cardiac problems in individuals. The suggested model's performance is assessed using the ROC Charts, Precision, Specificity, Sensitivity, and Accuracy metrics.

Table 2. Comparison of performance with other model

Algorithm	Accuarcy	Specificity	Sensitivity	ROC-Score
LR	0.8347	0.8428	0.8282	0.90
RF	0.8652	0.8785	0.8444	0.93
KNN	0.8551	0.8785	0.8444	0.93
XG Boost	0.8869	0.8714	0.8787	0.94

The performance evaluation of the suggested model is displayed in Table 1. The accuracy bar graph shown in Figure

3 compares the Accuracies of various machine learning techniques, such as logistic regression, Random Forest, and KNN, in the prediction of heart disease. Figure 3 demonstrates that the suggested model outperforms the following algorithms in terms of accuracy: K Nearest Neighbors (85.51%), Random Forest (86.52%), Logistic Regression (83.47%), and XG Boost (88.69%).

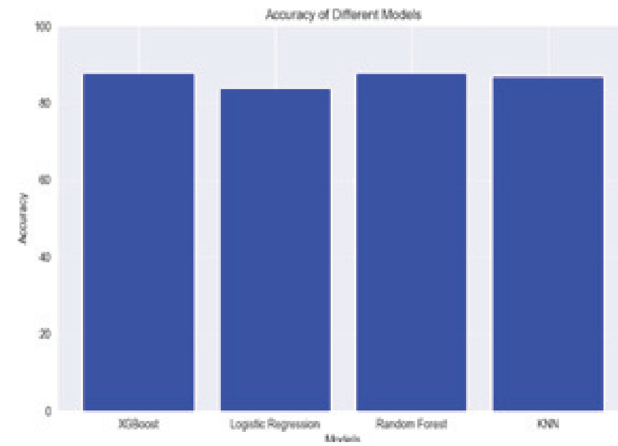

Fig. 2. Performance Comparison with other models

Concurrently, ROC AUC Score, another performance metric used to confirm the model's effectiveness, is the area under the ROC curve. The ROC curve illustrates the trade-off between the true positive rate and the false positive rate. Based on ROC Charts, Fig. 4 compares the suggested model's performance to that of alternative machine learning techniques. Figure 4 demonstrates that the suggested system's ROC curve AUC is 0.94. The AUC ROC Score for the Random Forest, Logistic Regression, and KNN is 0.93, 0.90, and 0.93, respectively. Based on this result, we can draw the conclusion that the recommended model outperforms Random Forest, Logistic Regression, and K Nearest Neighbors in terms of accuracy and AUC of ROC curve. This indicates that the suggested model's effectiveness.

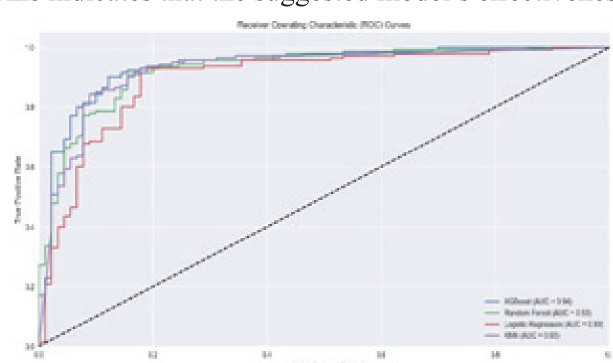

Fig. 3. ROC Chart of Different models

CONCLUSION

In this study, a diagnostic approach is suggested for the diagnosis of cardiac disease. The suggested approach for the diagnostic system optimizes XGBoost for classification and employs OH encoding to convert the dataset's categorical data into numerical. To evaluate the recommended approach, four unique assessment criteria were employed: The ROC charts' accuracy, sensitivity, specificity, and area under the curve (AUC). In terms of accuracy, tree-based ensemble approach outperforms the other three previously suggested techniques. The recommended strategy made use of Bayesian optimization, a hyper-parameter optimization method that has proven to be quite successful in identifying the appropriate hyper-parameters. Furthermore, the suggested approach's quality is evaluated in comparison to two alternative tree-based ensemble machine learning techniques. In terms of accuracy, model performs 3.28% better than both models. The suggested diagnostic strategy will raise the bar for decision-making when diagnosing heart illness, according to the experimental data.

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Image Captioning using EfficientNetV2 based on Encoder-Decoder Framework

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ABSTRACT

In this work, a deep neural network-based framework consisting of a "Gated Recurrent Unit (GRU)" decoder and an "EfficientNetV2B0-based Convolutional Neural Network (CNN)" encoder is used to offer a unique method of automatic picture captioning. The framework is designed to perceive information points within images and their contextual relationships, facilitating the generation of meaningful and contextually relevant captions. The CNN encoder built on the EfficientNetV2B0 architecture is very good at identifying objects in pictures and extracting features while preserving spatial information. Next, a language describing the visual information collected in the photographs is created using these qualities. To improve the captioning process, the GRU decoder is essential in word prediction and sentence construction using the retrieved characteristics. The suggested neural network system combines the GRU model with the effectiveness and precision of the EfficientNetV2B0 model as an image feature extractor to provide fixed-length output vectors for ultimate predictions. Popular open-source datasets like Flickr-8k and Flickr-30k are used in the study to train and evaluate the model. Using Python-Keras and TensorFlow backend, the framework is implemented, demonstrating the effectiveness of the GRU-based model and EfficientNetV2B0 in automatic picture captioning tasks. The suggested method for producing correct and contextually appropriate picture captions is shown to be successful and accurate when performance evaluation is carried out using the BLEU (BiLingual Evaluation Understudy) measure.

KEYWORDS: *Image Captioning, Convolutional Neural Networks (CNN), EfficientNetV2, Gated Recurrent Unit (GRU), Recurrent Neural Network (RNN).*

INTRODUCTION

Captioning an image involves providing a brief description of the image. When composing a caption for an image, it is necessary to first recognize the main components or elements, together with their attributes and connections, and then offer a fitting explanation. The employment of computer vision techniques in conjunction with a language pattern built from Natural-Language-Processing (NLP) is necessary to verify picture words convey images of objects and their interactions.

The study is about, the ability to identify objects, actions, and relationships is necessary for image understanding. These methods mostly rely on the encoding and decoding framework, which is separated into 2 essential stages. Firstly, CNN model is trained to make it as image encoder. 2nd , the input decoder which creates captions (picture description) is the hidden layer RNN model ImageNet is used to add model weights after CNN is used to extract features from the picture using the EfficientNetV2 model. Nonetheless, the bulk of contemporary encoder-decoder frameworks encode the input picture using a CNN, transform it into a dense feature vector,and then employ an architecture called a "Gated-Recurrent-Unit (GRU)" to translate the vector into an illustrative language.

In short, RNN performs effectively with any type of sequential knowledge, including building a group of words, while CNN is better at storing spatial data including recognize things in photos. Ultimately, performance comparisons against the most advanced approaches are shown, including a BLEU score for image captioning systems on datasets with multiple related datasets, such as Flickr30k and Flickr8k.The standard datasets from Flickr30k and Flickr8k, together with a few local datasets, have been used to study the suggested image caption generator.

LITERATURE SURVEY

Creating captions for characterization, regression, and prediction issues using natural language, the attention module, and CNN [1]. In order to integrate high-level semantic information into image captioning, this paper suggests a dynamic semantic attention technique. It enhances caption accuracy and richness by separating visual and non-visual word production, as demonstrated by encouraging trial findings [2]. "Natural language processing" and "machine learning" have the ability to automatically identify an image's content [3]. In order to improve the encoder-decoder model by incorporating geometric attention and capturing spatial relationships between identified objects, this study develops the Object Relation Transformer for picture captioning [4].

Provide a trainable, deterministically or stochastically trained attention-based model for visual description. The model gains the ability to create descriptive terms and concentrate on noticeable items [5]. Images are captioned using GRU [6]. Using EfficientNetB0 along with GRU, local tourist image captioning was built [7]. Three main issues plague the more recent approaches to traffic scene: vehicle detection, TSR recognizes traffic signs and detects pedestrians.VGG16 along with LSTM are utilized for sequential caption generation in order to comprehend traffic Department of Computer Engineering, AVCOE Sangamner scenes with different vehicle types (autonomous automobiles)[8].

Image description methods are top-down and bottom-up [9] by producing a suitable natural-language explanation of the visual subject, deep neural network algorithms can effectively address the challenges associated with image captioning [10]. An encoder-decoder model utilizing Wavelet-based CNN for visual feature extraction and attention processes is presented. By combining contextual data, channel, and spatial attention, this approach creates captions [11]. The favored method makes use of deep-learning techniques, like Recurrent-Neural-Networks (RNNs) for caption creation and Convolutional-Neural-Networks (CNNs) for extracting features from images [12].

METHODOLOGY

The proposed encoder-decoder framework is dependent on following steps:

Data Acquisition and Exploration

Conduct the exploratory data analysis (EDA) which gains insights into the Flickr8k and Flickr30k datasets used in the project.

Validate data completeness and accuracy through data comprehension techniques, ensuring reliable inputs for the image captioning model.

Data Preprocessing

Implement data preprocessing steps, including image resizing, normalization, and tokenization of captions, to prepare the data for model training.

Model Architecture Design

Create a deep learning architecture for picture captioning that is built on the Encoder-Decoder framework and uses EfficientNetV2B0 and GRU layers. To maximize performance, try out several model iterations, adjust hyperparameters, and try out alternative architectures.

Training and Evaluation

Train the deep learning model on the pre-processed data, utilizing technique like batch training to enhance convergence.

Evaluate the model's performance using BLEU metrics to assess caption quality and overall effectiveness.

Conduct a comparison analysis with existing techniques to demonstrate the advantages of our proposed model in generating accurate and relevant image captions.

Experimentation and results analysis

Conduct experiments to examine the impact of varying parameters, such as batch size, learning rate, and model complexity, on caption generation quality.

Demonstrate the model's capacity to provide a variety of different and semantically relevant captions for a range of images by presenting specific findings and performance data.

Data preprocessing and datasets

The accompanying subsections provide instructions on how to prepare associated photo and text data for the deep learning models after obtaining the relevant images and captions from datasets:

1) Related Image/photos and Caption Datasets: By using popular open-source datasets, including Flickr-8k, containing 8000 photographs, and Flickr-30k, containing 30000 images.

2) Photographic data preparation: The image quality is viewed using a pre-trained model. The goal of the study was to find out how the depth of Convolutional networks influences how accurate they are in large-scale picture recognition. To minimise the amount of parameters in the provided network models, all collected pictures are reduced to 224 x 224 pixels. A pre-trained model called EfficientNetV2 is then used to extract image properties. Lastly, the suggested caption generating method is applied to a particular image of the dataset by means of these attributes.

3) Text Data Preparation: Each image in the both datasets have five captions, which results in a long vocabulary. Together with changing words to lowercase letters, the procedure also eliminates newlines and punctuation from the descriptions (captions).

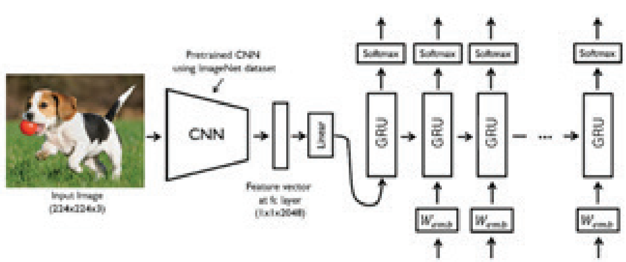

Fig. 1. Merging GRU layers with CNN models for image captioning.[13]

The Proposed methodology

The CNN encoder and the GRU decoder are the two main deep learning models included in the suggested framework. Both textual data and sequences are covered under "Natural Language Processing (NLP)".

CNN Encoder: Finally, because this model projects the picture's attributes and advances them to the next level, it discovers that extracting features from an image is simpler. The CNN architecture, such as EfficientNetV2B0, efficiently captures spatial details and identifies relevant image features, facilitating a rich representation of the visual content.

GRU Decoder: A Gated Recurrent Unit (GRU) decoder must first scan the encoded image before producing a sequential caption. The next step is to generate a text description, sometimes called the "Language Model" via word sequence formation.

1) Model Creation

The three main parts of the suggested deep learning-based merging model are an image feature extraction, sequence processor, and a decoder, as seen in Figure 1.

- Image feature extractor: The process of extracting features from photographs is known as image feature extraction. With the exception of the output layer, a pre-trained EfficientNetV2B0 model is used to extract the content from the photos. After pre-processing Ultimately, the model discovers that it is easier to extract features from a picture because it projects the image's attributes and advances them to the next level.

- Sequences processor: Text data is handled by a word embedding layer, which is followed by a GRU-based recurrent layer. Sequence modelling challenges are well-known for the competitive performance and computational efficiency of GRU units. When combined, these elements allow for the accurate creation of captions by capturing the textual data's sequential relationships.

- Decoder: The decoder takes charge of producing the ultimate textual descriptions, while a "Dense layer" integrates and processes the fixed-length vectors from the sequence processor and captions feature extractor.

Our objective was to establish an expansive lexicon while ensuring brevity, resulting in a more streamlined model conducive to quicker training. Each description undergoes segmentation into individual words. The model proceeds to analyze each word in conjunction with its corresponding photo, predicting subsequent words accordingly. The next word in the series is then predicted by the model using the first two words in the text description together with the corresponding image. This deep learning architecture is intended to function as a "merge-model," where a thick layer creates a condensed representation of the picture. In addition, the sequence processor part accepts input sequences with predetermined lengths. These sequences are then sent via an embedded layer, that employs a masking method to ignore padded data. Dropout regularization is used to reinforce both input models in order to prevent overfitting to the data set for training and take advantage of the model's quick learning speed.

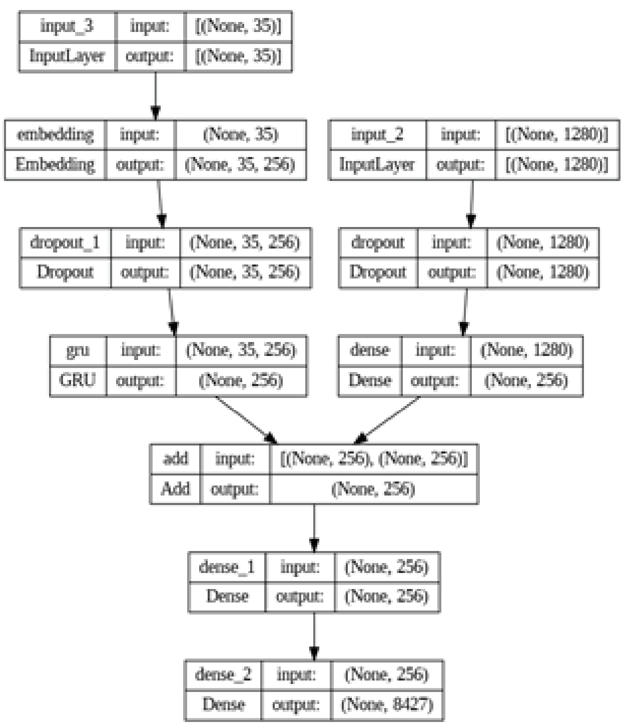

Fig.2. Model Summary

2) Training Procedure

The training process starts by taking useful information from images using a model that has already been trained, and then proceeds to process text data. This process includes changing captions to lowercase, eliminating non-alphabetic characters, and inserting start and end tokens. Afterwards, the text undergoes tokenization using the Tokenizer class, and the vocabulary size is determined by the number of distinct words. within the dataset known as corpus. The data is split into test and training sets, with 80% of the data designated for training, after the maximum caption length for padding is established. During the training of the model, a data generator function is used to produce batches of training data. This function pre-processes text and generates pairs of input and output for the training. The model architecture is built using TensorFlow Keras and consists of an encoder-decoder structure. It includes dropout regularization and dense layers. The image features are handled by the encoder, while the decoder utilizes GRU layers to incorporate sequence features. This particular model consists of distinct input layers for image attributes and encoded text. These layers are combined by utilizing the add function to create the network model. A predetermined number of epochs are processed to train the model, during which the Adam optimization algorithm and categorized cross-entropy loss are used to construct the model. Every period is made up of several stages, where the data generator supplies batches of training data to be used for model adjustment. The model learns to create descriptions for images using the given training data by going through this repeated process.

Computational resources used & hyperparameters

We made use of Colab Pro's powerful NVIDIA Tesla V100 GPU with 32GB VRAM, a subscription service that offers enhanced GPU capabilities and longer runtime. Our model training process was greatly expedited by this configuration, with the training and testing stages being finished in around three hours. To provide a stable development environment, we used TensorFlow, Keras, NumPy, pandas, tqdm, matplotlib, NLTK, and pickle in our software stack. We used Colab Pro's cloud data storage management feature and batch processing with a 64-batch size to achieve effective training iterations. The performance of our model was further enhanced by adjusting hyperparameters such as the optimizer (Adam), embedding dimensions (256), and dropout rate (0.4). Once we reached convergence after 11 epochs of training, we saved the trained model as 'best_model.h5' for further analysis and assessment.

EXPERIMENTAL RESULTS

Datasets

The Flickr8k, Flickr30k shared datasets were the two common datasets utilized in the research. These datasets were chosen because of their reasonable size-small enough to be generated on a desktop computer with a single CPU-realism, and open-source nature. The dataset contains eighty different categories of items depicted in the photos. Each image is associated with five captions stored in token.txt. Additionally, the proposed model underwent testing on a local dataset. Prior to processing, Every image is cropped to 224 by 224 pixels. Additionally, the suggested model was integrated into datasets used for testing & training.

Outcomes

The proposed approach focuses on providing image captions that describe the pictures. A few anticipated results of deep learning-driven image description generator are shown in the figure, which depicts the user interfaces of the proposed system. It was observed that images featuring people or other human subjects achieved the highest accuracy, as most training images are individual photos. Local images sourced from local camera shots, university websites, and other platforms were also utilized to evaluate the suggested model, which yielded satisfactory results in captioning the images.

Fig. 3. Actual and predicted captions for image from the dataset

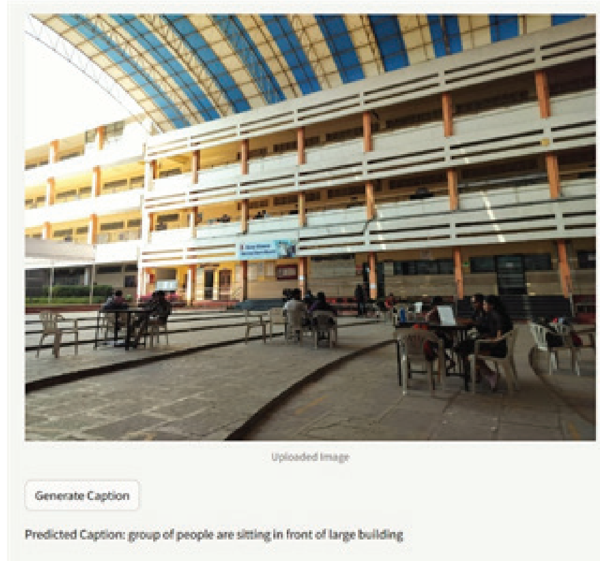

Fig.4. Predicted caption for custom image

Performance Evaluation

BLEU Metric	Flickr8k	Flickr30k
BLEU-1	0.625841	0.598135

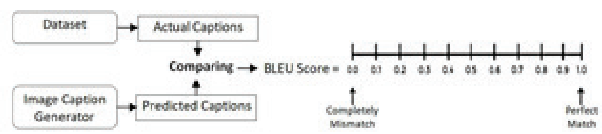

Fig.5. The process of generating BLEU score [13]

The test set is used to predict picture captions, and these predictions are then evaluated using an established metric to evaluate the proposed model. BLEU ('Bilingual-Evaluation-Understudy'), a bilingual assessment metric, was used to gauge how effective the proposed photo captioning method was.

To calculate BLEU score, a predicted sentence is compared to a reference sentence. The corresponding BLEU score perfection and examples of relevant captions are displayed. The Python NLTK module was used to produce the BLEU score for the evaluation of the candidate text. The quality of machine-generated versions is evaluated using the BLEU (Bilingual-Evaluation-Understudy) score. Phrase BLEU Score for each sentence and Corpus BLEU Rating for groups of sentences are the two levels at which it works. Comparing comparable grammes in a preset order—for example, one gramme for single words and two grammes for word pairs—determines the N-gram scores. Every N-gram match receives a weight, usually 0 for non-matches and one for matches. Balanced geometric averages of N-gram scores over a range of orders—from 1 to n—are computed to determine the BLEU score. The Collective N-gram values (BLEU-N), which are produced by calculating the weighted geometrical average of the individual N-gram scores, are a crucial factor in determining the overall BLEU score.

CONCLUSION

Constructing a system for encoding and decoding for deep neural networks for a practical photo captioning system was the aim of this effort. After processing and passing through the RNN layers for all relevant keywords, text strings, and captions, The CNN algorithm layer aids in extracting features from the images. Adding anticipated words to the feed forwarding model is the last step. This produces a final word description that is based on the input image's features (derived by CNN) and the data source's words (words from a dataset by RNN). Suggested deep-learning model (BLEU metrices) for picture caption creation was assessed in the experiments with two standard datasets (Flickr-8k and Flickr-30k) and images from various local sources. The image captioning test produced satisfactory results and showed that photographs with people or other humans in them are the most accurate. The suggested system, however, has significant computational expenses and needs powerful GPU hardware in order to operate. This prevented us from training the entire dataset, resulting in a vocabulary reduction that is insufficient for precise item detection.

FUTURE SCOPE

- Attention mechanisms: Attention mechanisms will be leveraged in future image captioning developments to allow models to concentrate on important picture aspects for improved relevance and accuracy in captions.
- Teacher forcing: Implementation of teacher forcing techniques to improve training stability and convergence, ensuring more accurate and coherent caption generation by leveraging ground truth information during model training.
- Real-time and optimization: Innovations in real-time captioning will make it easier to generate captions instantly. This will be especially helpful for live events and video streams that need precise captions right away.
- Fine-tuning: To increase model performance, fine-tuning approaches will be used to incorporate transfer learning, improve hyperparameters, and guarantee flexibility across a variety of datasets.
- Scalability: Improvements in scalability will guarantee effective handling of big datasets and instantaneous picture analysis, rendering the model adaptable and useful in a range of industries, including media, healthcare, and industrial automation.

All things considered, these developments hold up the possibility of more precise, contextually appropriate, and adaptable picture captions, increasing the image captioning technology's usefulness in a variety of fields and applications.

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Advanced Data Storage Security System For Public Cloud

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ABSTRACT

Cloud is an on-demand service, especially for data storage. In recent years cloud computing is the most innovative field for every individual. But still, there are some issues like privacy and security of data that restrict the wide use and adoption of the cloud in different fields. This research provides the Security challenges, threats, and some security measures to achieve advanced data storage security for the public cloud. The current System implements symmetric-key encryption to improve data search security, efficiency, and adaptability. Proposed technology ensures cloud data privacy, safe data sharing and searching, and the elimination of a single point of failure. In this paper, there are three modules that are Data Owner, Data User, and Admin authority in that the system's central authority is given to admin. Data sharing, receiving, uploading, and downloading tasks are done by the Data Owner and Receiver. The file uploaded in the cloud is encrypted for advanced security, the key used to encrypt the file is also encrypted which is double encryption hence it achieves more security, Compared with the existing system.

KEYWORDS: *Cloud data security, Data owner, Data user, Admin, Key, Encryption, Decryption, Server.*

INTRODUCTION

Cloud computing is about storing and accessing data online. It helps you grow and quickly get resources you need. These resources come from virtual sources. All this happens with high reliability. Cloud computing changed how we use IT. Using the cloud means getting resources and services in a flexible way. It also helps save money. Yet there are risks with security, mainly in public cloud areas.[9]

Many businesses utilize public clouds, which are computing services provided by third-party companies. These providers deliver resources like servers and storage over the Internet. Often, public clouds offer free or pay-per-use plans. However, since public cloud data is stored in the provider's data center, it faces potential security risks. Hackers could attempt unauthorized access or cyber attacks. To keep sensitive information safe, companies must implement strong security measures when using public clouds. Robust cybersecurity protections, like encryption and access controls, are crucial for mitigating threats and safe-guarding data in these shared environments.

When relying on public cloud services, businesses do not have direct control over the infrastructure hosting their data and applications. This lack of direct oversight raises concerns about data privacy, as the service provider manages and maintains the underlying systems.

Keeping information safe on the cloud is important. One good way to do this is encryption. Encryption makes original information unreadable. Only the right key can turn encrypted text back to the original form. This paper suggests a strong security system. It uses AES to encrypt files. It uses SHA-256 to encrypt keys. This double encryption ensures outsiders cannot read data. Even if an unauthorized person gets the data, they cannot decrypt it. They would need the¬ correct keys to do so.

This study is motivated by the notable influence of providing the good services in the public cloud which are easily get in the private cloud. This paper will delve into the technical aspects of file encryption, discuss the challenges of implementing such services in the public cloud. The goal is to provide a comprehensive understanding of how file encryption can enhance data security in cloud computing, paving the way for more secure and efficient cloud-based solutions.

RELATED WORK

Cloud means where we can store, access, and retrieve data whenever we want at any time and anywhere. Cloud storage is a network made up of distributed data centers that act like virtual machines. Virtual machines are used to make virtual networks, which means combining the physical storage from multiple different networks which acts like a single storage device is virtualization. The data which is stored in the cloud can be accessed by only authorized persons. Due to some data breaches and loopholes unauthorized persons and attackers enter in system and try to steal the data which can be misused by unauthorized persons thus to protect the confidential data of users people made some policies and guidelines to address the data storing, sharing, and receiving purpose. [1]

Cloud computing represents a simple approach for multiple organizations to provide them with computing resources at minimum cost. However, the primary goal of cloud computing is to resolve data privacy and ensure the protection of confidential data of users within the cloud. Many cloud user organizations think before storing data and trusting public cloud service providers because of privacy issues. To mitigate these boundaries this paper gives the various security risks, challenges, and threats faced by various cloud users and providers. Also Enable security protocols, Encryption of data, prevention measures for data loss, and employee awareness. [5]

Upon client request, accessing data or information from cloud storage entails classifying it into personal, public, or confidential categories. However, it’s challenging to fully trust third-party cloud providers, particularly with confidential and personal data, as all data stored in the cloud resides on external infrastructure. Cryptographic measures are essential to ensure the security of stored information, preventing unauthorized access. Despite numerous security challenges faced by cloud-stored data, various algorithms have been developed to address them. Yet, relying solely on one algorithm isn’t sufficient for comprehensive cloud security. This research proposes enhancing cloud storage security through cryptographic algorithms, such as AES with S-box and Feistel Algorithm, to mitigate security concerns.[2]

While storing data in the cloud with plain text format faces some significant risks and threats of data steal and loss. Plain text is not as secure as encrypted text so it is better to store encrypted text in the cloud rather than the plain text. Plain text stored in the cloud faces some problems. Plain text has limitations in that anyone can read it or if an unauthorized person accesses that plain text he can misuse that data or text. To address this plain text issue, the referred paper gives a solution based on Identity-Based Cryptography (IBE) for secure cloud data storage, enabling users to securely store and retrieve data while ensuring that only authenticate clients can access data from the cloud. This approach not only enhances security but also guarantees privacy for data stored on public servers. [8]

RESEARCH METHODOLOGY

Idea of Encloud

This paper focuses on advancing the data storage security for the public cloud. There are various types of cloud such as public cloud, private cloud, organizational cloud, and hybrid cloud. The project is mainly directed toward the public cloud and is directly working to increase the security of the public cloud. The application development is focused on the agile methodology, feature-driven application development which makes better visibility to the project and better and robust software quality throughout the whole application development lifecycle. This helps the project application to build effectively and ensures that it meets the final requirements of the software application. Various software development techniques are available such as the waterfall model, spiral model, v mode, incremental model, iterative approach, etc. This method helps build the software effectively and eventually defines the software development life cycle. This method is very helpful in building large software applications. This project is focused on building its own cloud called the ''Encloud''. The Encloud is the public cloud platform that has advanced security which helps to reduce the security threats to the data.

Challenges faced in encloud development

- For a cloud to be more secure, all the entities that are participating must be secure.[1]
- The neighboring entities may provide a chance for an attacker to bypass the user's defenses [10].
- The attack may be delivered by the users who are already present in the system.
- Due to all of the above reasons the high security must be delivered to each node present in the encloud.

Specific Security Threats–

Data Management Challenges

- Modern organizations grapple with privacy issues due to the proliferation of cloud services like Google Drive, Dropbox, and Microsoft Azure.
- The exploitation of third-party file-sharing systems can lead to sensitive data being removed from the company's IT environment.
- This situation results in the company losing control over its data security, as the security of information is far removed from the company's management.

Data Outflow Concerns

- Organizations are increasingly storing more data in the public cloud, which offers efficiency, flexibility, and easy access to emerging technologies.
- However, some organizations resist this trend due to fears of data leakage. The public cloud is a multi-user system where services are shared, and it relies on trusted third-party services.
- This setup exposes companies to potential risks, such as the service provider mishandling information or external threats like cloud-based hacking or account intrusions, leading to data leakage.

Risks of Snooping

- Cloud files can be highly insecure without proper security mechanisms to prevent hacking.
- Data stored and transmitted over the internet is at significant risk, and it can be intercepted en route to its destination.
- A robust security framework that encrypts files and transmits them over a secure network is essential to prevent unauthorized access to cloud metadata.

Nodes Present in Encloud

- Owner of data - It is the actual owner of the data who uploads the files to the Encloud. For uploading a file to Encloud data owner must be a registered user of the cloud. The data owner of data must be registered to Encloud to be an authenticated user. The data owner uploads the file to the cloud and after the file is uploaded it is converted into a text file and encrypted using the AES algorithm and a symmetric key is generated after the encryption. AES stands for Advanced Encryption Standard and it is used to encrypt the file.
- Key - Secret keys play an important role in the cloud [1]. The key is the entity that is used to decrypt the file which is encrypted using the AES algorithm.
- User of data - The actual user of data which is uploaded by data owner to the cloud is called the user of data. Data user also needs to be an authenticated user to use the data uploaded by data owner of cloud. Data user must be registered to Encloud to be an authenticated user.
- Admin node - Admin node is one that coordinates all the things in the Encloud from the registration of data owner and data user.

Encryption used in the Encloud

Module 1: Introduction to File Upload and Encryption

The document owner initiates the process by uploading a file to a cloud server. Uploaded File is then transformed from its original format to a text file format. Then Advanced Encryption Standard (AES) algorithm is used to encrypt files uploaded by the data owner of that data. This process ensures that the document becomes inaccessible to unauthorized persons. After encryption, a key is generated. This key is critical in decrypting the document at a later stage. The generated public key is then encrypted using the SHA256 algorithm to enhance the security of the uploaded file. After the encryption of the key generated by Advanced Encryption Standard (AES) algorithm and key further encrypted by Secured Hashed Algorithm (SHA256), encrypted file together with the key generated by SHA256 is then stored in a secure database.

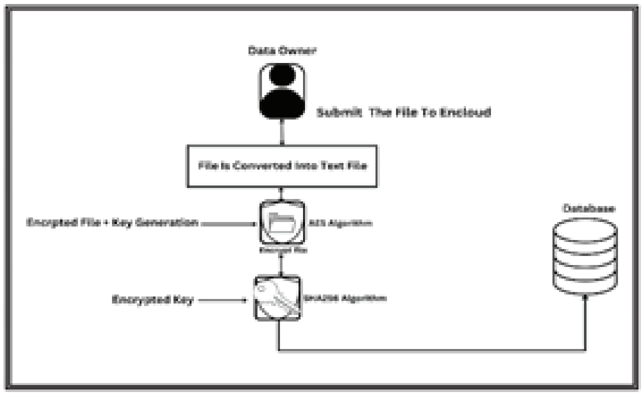

Fig. 1. Data Owner of Encloud

Module 2: User Registration and Access Request

User and data owner Registration

For the entire process firstly the data user and data owner should be registered to the cloud.

Admin Approval

After the registration to the cloud, the request is sent to the admin for accessing the cloud information.

Module 3: File Access and Decryption

User Request for File Access

If the user wants to access the file on the cloud it requests the file and the admin accepts the request. Admin Approval and File Retrieval.

If the user is authorized the admin accepts the request of the user and gives access to the file.

File Decryption: After accepting the request of the user the file is get decrypted using the key and sent to the user.

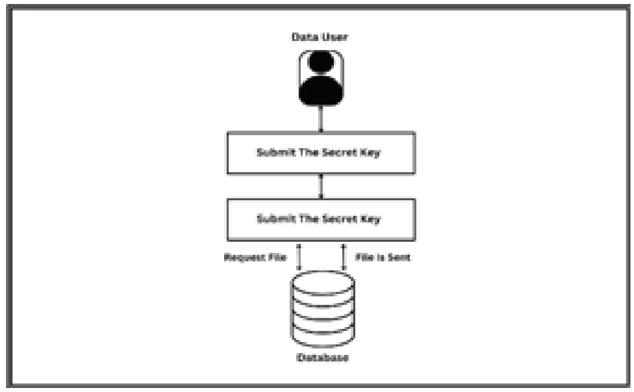

Fig. 2. Data User of Encloud

Data Security:

1. AES algorithm is used to encrypt the file.
2. The AES algorithm is used to create the public key.
3. Then SHA256 algorithm is used to encrypt the keys.
4. And key is used to decrypt the file.
5. SHA256 algorithm is used to decrypt the key.

Access Control

Admin is accepting the request of the authorized users of the cloud. This structured approach will help to present each module clearly, detailing its functionalities within the architecture, and the interactions between these components

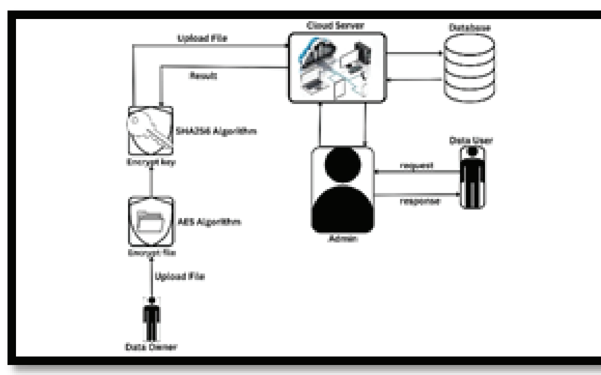

Fig. 3. Architecture of Enclod

RESULT AND DISCUSSION

The proposed research has brought about good results on applying AES and SHA-256 algorithms in securing data storage in public cloud. This provides a strong security framework, which is the dual encryption process whereby AES does the file encryption while the generated key is encrypted using SHA-256. This approach successfully deals with the crucial concern of data security in cloud storage.

Using AES for file encryption means that without the key, data cannot be read and so it offers a strong defense against unauthorized access. Additionally, by further securing the AES-generated key through SHA-256 another level of protection is added thus making the system even more robust to possible violations.

However, it's important to note that while this system ensures higher levels of security as compared with others; it also requires more computational resources as a result of having double encryption processes. The system's performance may be affected especially when dealing with huge amounts of information.

Summarily, findings indicate that this proposed system can increase significantly data safety in public cloud store. Nevertheless, additional investigation is required to optimize performance of the system and consider other potential enhancements.

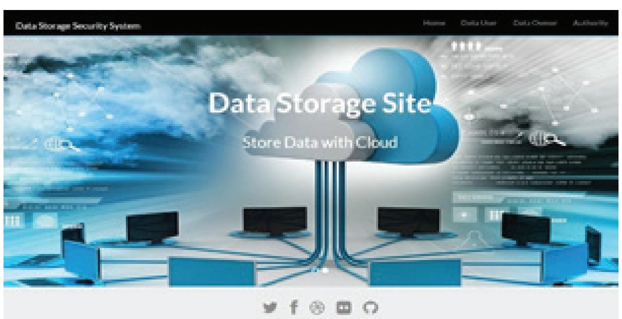

Fig. 4. Result of Encloud Conclusion

Statistical characteristics of the AES and the SHA-256

Advanced Encryption Standard (AES)

- Role: The primary function of AES is to encrypt data.
- Key Sizes: AES can work with keys of 128, 192, and 256 bits.
- Type of Algorithm: AES is a symmetric-key algorithm, implying that encryption and decryption are performed using the same key.
- Security Level: AES offers strong data encryption.
- Working Principle: It operates based on substitution-permutation networks.
- Resistance to Quantum Computing: While quantum algorithms could theoretically compromise SHA-256, AES remains secure by the standards of classical computing.
- Use Case: Opt for AES when the confidentiality of data is the main concern.

Secure Hash Algorithm 256-bit (SHA-256):

- Role: SHA-256 is a hashing algorithm utilized for creating unique fingerprints of data.
- Hash Length: It produces a hash of a fixed length of 256 bits.
- One-way Function: SHA-256 generates irreversible hash outputs, making it impossible to recover the original data from the hash.
- Comparison with SHA-3: SHA-256 belongs to the SHA-2 family, while SHA-3 (Secure Hash Algorithm 3) is the newest addition to the SHA family. SHA-3 has a distinct internal structure and offers additional security features.
- Mapping Method: SHA-3 transforms binary data into a fixed-size hash output

CONCLUSION

The proposed advanced data storage security system for public cloud combines the strengths of both AES and SHA-256 algorithms to provide a robust and secure solution. AES ensues efficient encryption of data, while SHA-256 adds an extra layer of security by encrypting the AES key. This system addresses the need for enhanced security in public cloud environments. By ensuring data confidentiality and integrity, it helps build trust among users and encourages cloud service adoption. However, it's essential to remember that no system is completely foolproof. Continuous research and development are necessary to stay ahead of evolving security threats.

The proposed system demonstrates the potential for combining different cryptographic techniques to enhance data security. It underscores the importance of data security in the digital age and paves the way for future research in this domain.

FUTURE SCOPE

The proposed research on advanced data storage security systems for public cloud using AES and SHA-256 algorithms holds great potential for future advancements. As data security becomes increasingly crucial in the era of big data and cloud computing, the need for robust and efficient encryption algorithms is paramount. One possible direction for future research could be exploring other cryptographic algorithms and their combinations to enhance security even further. For instance, integrating RSA or Elliptic Curve Cryptography (ECC) could provide an additional layer of protection. Another promising avenue could be developing a dynamic encryption system, where the encryption algorithms used are not static but change periodically.[6] This would make it even more challenging for potential attackers to breach the system. Furthermore, the project could be expanded to include not just data at rest, but also data in transit. Ensuring the secure transmission of data is equally important in the modern digital landscape.

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River and Basin Segmentation using Deep Learning Framework from Landsat-8 Images

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ABSTRACT

Accurate delineation and segmentation of risers and watersheds from satellite images old age is of significant importance in various environmental studies and resource management. The methodology includes preprocessing of Landsat-8 multispectral imagery to enhance features related to water bodies. We propose a convolutional neural network (CNN) architecture designed to learn to discriminate spectral and spatial patterns indicating rivers and watersheds. The model is trained using a label dataset containing annotated regions of interest showing rivers and their affiliates basin. Our framework demonstrates robust performance in river segmentation and de-edging of watershed boundaries, achieving high precision and spatial accuracy. Over suggests extensive experimentation and validation with ground truth data the method shows its effectiveness in handling diverse landscapes and different environments conditions. Next, we examine the usefulness of the generated river a basin segmentation maps in practical applications, including hydrological analysis, spatial planning and environmental monitoring.

KEYWORDS: *Deep learning, Classification, Convolutional neural network.*

INTRODUCTION

Rivers and basins constitute main points influencing various ecological, environmental, and socio-economic aspects. Understanding their dynamics and characteristics is essential for effective water resource management, flood prediction, and environmental conservation[]]. Traditional water and water identification methods often rely on interpretation of data from remote areas; this is the time consuming, -highly subjective and inaccurate [2]. With the advancements in deep learning techniques and the availability of high-resolution satellite imagery such as Landsat-8, there is a growing interest in automated approaches for river and basin segmentation[3].

This study focuses on the development and application of a deep learning framework for classifying rivers and watersheds from Landsat-8 images. Deep learning, especially convolutional neural networks (CNN), has been incredibly successful in many computing tasks, including image segmentation[4]. By leveraging the multi-spectral and spatial information provided by Landsat-8 imagery, we aim to accurately delineate rivers and basins at a regional[5].

The proposed deep learning framework consists of several key components. Firstly, a dataset comprising labeled.

Landsat-8 images with annotated rivers and basins is curated for model training. The dataset is meticulously prepared to encompass a diverse range of environmental conditions, including variations in terrain, land cover types, and hydrological characteristics. Next, a CNN architecture tailored for semantic segmentation is designed and trained using the collected dataset[6], The model is optimized to effectively learn the complex spatial patterns associated with rivers and basins while generalizing well to unseen regions.

Once trained, the deep learning model is applied to large-scale Landsat-8 imagery to automatically segment rivers and basins. The segmentation results are validated against ground truth data, including manually delineated river networks and maps. Calculate performance metrics such as accuracy, precision, recall, and F 1 score to evaluate the reliability and consist ency of the automated segmentation process17].

The use of Landsat-8 imagery offers several advantages for this task. Landsat-8 provides multispectral data with a spatial resolution of 30 meters, enabling the capture of detailed information about land cover and land use[8]. Additionally, Landsat-8 images are freely available and have a long history, allowing for temporal analysis of river and basin dynamics. The outcomes of this research have significant implications for various applications, including hydrological modeling, watershed management, and environmental monitoring. Accurate and efficient river and basin segmentation can enhance our understanding of water resource dynamics, support decision-making processes, and facilitate sustainable development practices.

The main aim of study is to create a deep learning system to classify rivers and basins based on Landsat-8 satellite images. By harnessing convolutional neural networks (CNNs), we seek to streamline the process of river and basin delineation, mitigating the need for manual interpretation. Leveraging Landsat-8's rich multi-spectral and spatial data, our framework aims to accurately identify rivers and basins at a regional scale. We meticulously curate a dataset comprising labeled Landsat-8 images for model training, optimizing a CNN architecture for semantic segmentation. Validation against ground truth data allows us to assess the reliability and effectiveness of the model, employing metrics such as accuracy and precision[9]. The automated segmentation holds promise for various applications, including hydrological modeling and environmental monitoring. This research contributes to advancing remote sensing techniques in environmental science.

RELATED WORK

In the realm of river and basin segmentation, previous research has explored various methodologies, ranging from traditional remote sensing techniques to more advanced deep learning approaches. These methods typically involve thresholding, edge detection, and classification algorithms to identify water bodies and delineate river networks. While effective to some extent, these techniques often struggle with complex environmental conditions and limited spatial resolution.

Furthermore, the availability of large-scale labeled datasets, such as those derived from Landsat-8 imagery, has facilitated the development and training of CNN models specifically tailored for river and basin delineation. These models have shown promising results in accurately identifying rivers, lakes, and basins across diverse landscapes and environmental conditions, surpassing the performance of traditional methods. Despite these advancements, challenges remain in optimizing deep learning frameworks for real-time processing and scalability to large geographic areas. Ongoing research efforts continue to refine and enhance deep learning-based approaches for river and basin segmentation, with the aim of improving accuracy, scalability, and computational efficiency in hydrological applications.

MATERIALS

one random region from Sambalpur in the state of Odisha in India is selected as the study area. Corresponding to study area the landsat-8 images of 4 different bandwidth were taken from Earth-explore and the metadata for these images is shown in Table 1. All the images covers different bandwidths of study area and contains lot of noise. The study focuses on a specific geographic region encompassing [provide details such as geographical coordinates, administrative boundaries, or descriptive location]. The selected area has various land cover types, including urban areas, agriculture lands, forests and groundwater.

Table 1 Metadata

Images No	Bandwidth(um)	Time	Cloud Cover	Band Type
1	0.52-0.60	2017-5-02	0.4591	Green
2	0.77-0.90	2017-5-02	0.6348	NIR

3	1.55-1.75	2017-5-02	0.5328	SWIR
4	2.09-2.35	2017-5-02	0.4689	SWIR2

PROPOSED METHODOLOGY

Image pre-processing

Preliminary images play an important role in the optimization and suitability of Landsat-8 satellite image segmentation tasks. This initial pipeline consists of a few simple steps. Initially, radiometric calibration corrects for sensor-specific bias and ensures an accurate representation of brightness or reflectance. Atmospheric correction then removes atmospheric effects such as blur and scattering to improve image clarity. Geometric correction for distortions caused by satellite orbit and sensor characteristics ensures spatial alignment. Pansharpening technology combines high-resolution panchromatic bands with low-resolution multispectral hands to enhance spatial details while preserving spectral information. Normalization scales pixel values into a range for consistent analysis. Noise reduction improves signal fidelity by filtering out sensor and environmental noise. Cloud and shadow removal technology reduces noise for more accurate identification. Image fusion combines multiple spectral bands or images to improve feature separation. Feature extraction identifies and extracts features of interest, such as water bodies and land cover types. Finally, the data enhancement process helps increase the generality and robustness of the model by increasing the diversity and quantity of training data. Together, these preliminary steps produce accurate and reliable I.andsat-8 images of rivers and streams using deep learning techniques.

Normalise Different water index (ND WI)

Normalized Water Index (NDWI) is a spectral index extensively utilized in remote sensing, particularly for water body detection and identification. It comprises the near-infrared (NIR) and green (G) bands from various satellite images (including Landsat-8 data) based on the following criteria:

NDW1=(NIR+G)/(NIR-G)

NDWI values range from -1 to 1, with higher values meaning more water. The device takes advantage of the strong absorption of water in the near-infrared spectrum while minimizing the impact of other features such as vegetation.

In the context of river and basin segmentation using Landsat¬8 images, NDWI can be a valuable input feature for deep learning models or used as a pre-processing step to enhance water body detection. By incorporating NDWI into the segmentation framework, the model can better distinguish between water bodies and surrounding land cover types, thus improving the accuracy of river network and basin delineation.

Furthermore, NDWI can complement the information derived from other spectral indices or data sources, providing additional insights into hydrological processes and spatial patterns. Its simplicity and effectiveness make NDWI a versatile tool for various environmental applications, including watershed management, flood monitoring, and habitat assessment....

Convolutional Neural Network (CNN)

Convolutional Neural Networks (CNNs) are commonly employed for the classification of rivers and lakes. CNNs excel at extracting hierarchical features from images, making them well-suited for tasks like image classification. For the classification of rivers and lakes, a CNN model typically takes images of these water bodies as input and learns to distinguish between them based on visual features such as shape, texture, and color distribution. The CNN architecture consists of a convolutional process th at extracts features at different levels of abstraction, followed by convolutional and convolutional operations to subsample the feature maps and reduce computer complexity. A fully connected layer at the end of the network combines these features to predict the category of the input image (e.g. water or lake). During training, the CNN learns to adjust its parameters using labeled data through back propagation and optimization techniques such as stochastic gradient descent. With sufficient training data and appropriate model architecture, CNNs can achieve high accuracy in classifying rivers and lakes, providing valuable insights for environmental monitoring and management.

RESULT AND ANALYSIS

The study assessed categorization performance using a confusion matrix, as indicated in Table 1. Important metrics like accuracy, sensitivity (or true positive rate), and specificity were based on this matrix. While sensitivity gauges the ratio of correctly identified positive cases to the total number of real positive cases, accuracy evaluates the overall soundness of the model's predictions. The percentage of correctly diagnosed negative cases relative to all negative cases is known as specificity. These metrics provide critical insights into the model's capacity to distinguish between different classes, which is necessary for assessing its practical usefulness. Using the confusion matrix and accompanying metrics, the study acquires a thorough insight into the model's performance, allowing for informed judgments about its deployment and optimization in real-world applications.

The acquired images might undergo radiometric and geometric calibration to correct sensor and satellite-related errors. Atmospheric Correction: Correctinu, for atmospheric effects to improve the quality of the imagery. Image Registration which aligning multiple images if there are any discrepancies due to factors such as orbital drift.

NDWI includes Landsat-8 bands sensitive to water absorption: mainly the green (hand 3) and near-infrared (hand 5) bands. The NDWI formula is: NDWI = (Band 3 - Band 5) / (Band 3 + Band 5).This index highlights water bodies as they absorb more near-infrared light and reflect more green light. Pixels with higher NDWI values are considered more likely to represent water bodies.

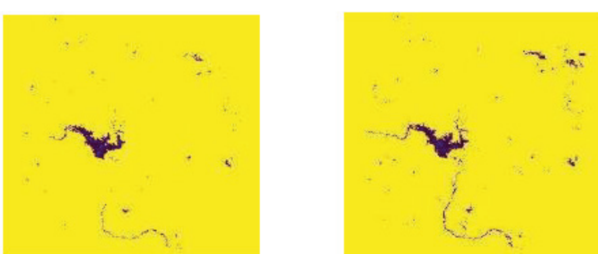

Fig. 2. Landsat-8 Processed images

Intuitively select water and waterless training models on the ENVI platform to train multilayer models of convolutional neural networks. WI indicators can identify bodies of water without the need for testing. Three water distribution methods were established as shown in Figure 3.

Figure 2 shows the distribution of water in the test site actor ding to the NDWI (Normalized Differential Water Index) in method. Based on the same training model, results obtained using machine learning and multilayer perceptron can achieve similar performance in identifying water space.

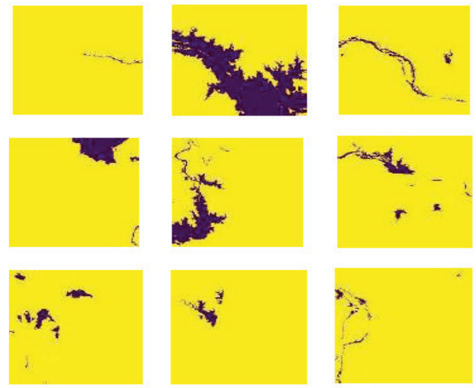

Fig. 3. Landsat-8 crop images

After completing the survey of the water body, we will segment the water body into rivers and numerous smaller water bodies using neural network algorithms. Deep learning models, such as convolutional neural networks (CNN), are trained specifically on water portions extracted from NDWI images. Training data would consist of NDWI images labelled with ground truth annotations indicating the presence or absence of water bodies. Common architectures like U-Net or Mask R-CNN might be adapted for this task. CNNs use layers, each detecting different features of the input image, as shown in Figure 3. Depending on the complexity of its purpose, a CNN can have tens, hundreds, or thousands of layers, with each layer building on top of the previous layer. This hierarchical structure enables the network to learn complex patterns and representations from input data, ultimately leading to a more comprehensive and intuitive understanding of key features.

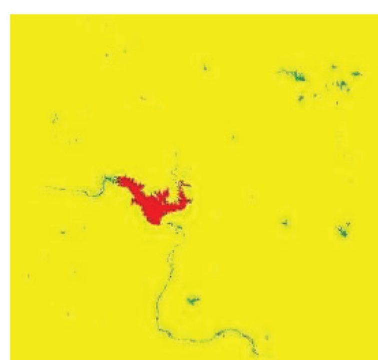

Fig. 4. Result

As the above figure 3 indicates red and green area where red area is lakh area and the green area is river area of the Hirakud dam. We had also find the approximate area of these water body by reading the raster data(it is a model uses an array of cells or pixel to represent real world object).

CONCLUSION

our research demonstrates the effectiveness of utilizing a deep learning framework for river and basin segmentation from Landsat-8 images. Through the application of advanced convolutional neural networks (CNNs) and segmentation algorithms, we have achieved notable success in accurately delineating river networks and basin boundaries from satellite imagery. Our results highlight the potential of deep learning techniques to overcome traditional challenges in remote sensing, such as variability in terrain, land cover, and atmospheric conditions. By leveraging the rich spatial and spectral information provided by Landsat-8 imagery, our model has exhibited robustness and generalizability across diverse geographic regions.

This innovative technique, powered by deep learning models and geospheric instruments, holds great promise in fields ranging from hydrology to disaster and environmental studies. Despite challenges related to data quality, model complexity, and clarity, the ability to provide highly accurate segmentation offers valuable insights for informed decision making, policy making, and sustainable resource management. As progress continues, addressing limitations and refining methodologies will increase their applicability and become an indispensable tool for understanding and protecting our aquatic ecosystems in the developing world.

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Deepfake Image Detection Using Efficient DCNN Architecture

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ABSTRACT

The legitimacy of visual media is seriously threatened by the emergence of deepfake technology, making it necessary for robust detection mechanisms. In this study, we introduce a new deepfake detection system utilizing the EfficientNetV2B0 architecture, recognized for its efficiency and accuracy in image classification tasks. Through extensive experimentation with a diverse dataset, our system achieves a notable accuracy of 74.73%. Furthermore, we conduct a thorough comparative evaluation of various CNN architectures. Inception and EfficientNetV2B0, to assess their performance in distinguishing genuine from manipulated images. Our findings provide valuable insights into the efficacy of different architectures, aiding the continuous initiatives to stop the proliferation of fake media and uphold the integrity of visual content.

KEYWORDS: *CNN, Deepfake detection, Face manipulation, Computer vision, machine learning, deep learning, and image processing.*

INTRODUCTION

The emergence of deepfake technology, facilitated by advancements in artificial intelligence and machine learning, poses a formidable challenge to the integrity of visual media. Deepfake techniques enable the creation of highly realistic synthetic images and videos, often indistinguishable from authentic content, through the application of deep learning techniques such as convolutional neural networks. As a consequence, deepfake technology has the potential to undermine trust in visual media, exacerbate misinformation campaigns, and pose significant threats to individuals, businesses, and society as a whole. For researchers or practitioners, here is the deployment of a diverse array of detection systems leveraging machine learning algorithms and computer vision techniques. These systems aim Our study proposes a novel deepfake detection system based on the EfficientNetV2B0 architecture, renowned for its efficacy in image classification. Leveraging this advanced CNN, we achieve high accuracy in distinguishing between genuine and manipulated images. Through comprehensive experimentation and validation on a comprehensive dataset, we achieve an accuracy of 74.73% and analyze various performance metrics to provide insights into the system's strengths and limitations. By combining the robustness of EfficientNetV2B0 with strategic layers like dropout and batch normalization, our system aims to surpass existing detection methods while addressing computational constraints for scalable real-world deployment.

LITERATURE SURVEY

In recent years, the proliferation of deepfake technology has raised significant concerns regarding its potential misuse for generating deepfakes. As a response to this Convolutional Neural Networks (CNNs) for developing effective deepfake detection systems. The literature survey scrutinizes recent strides in deepfake detection methods, particularly emphasizing the efficacy of Convolutional Neural Networks (CNNs) in tackling the rampant spread of deepfake technology. Notable findings include the outstanding performance of VGGFace [2], ResNet50 [2], and DenseNet201 [2], achieving accuracy rates of 99%, 97%, and 96%, respectively. Additionally, the survey highlights NA-VGG [3] as a promising deepfake detection model, leveraging noise enhancement and facial feature reduction, along with FF-LBPH coupled with DBN and RBM for efficient detection [5]. Lastly, the survey offers valuable insights into recent in advancement in deep fake detection techniques, facilitating comparisons with existing methods[8], [10], [11].

PROPOSE SYSTEM

A simplified convolutional neural network architecture called EfficientNetV2B0 is ideal for image classification applications. It consists of stem convolutional blocks for initial processing, efficient blocks with inverted residual blocks and SE blocks for feature extraction, and global average pooling for spatial feature aggregation. With fewer parameters than other architectures, EfficientNetV2B0 achieves high accuracy, making it ideal for resource-efficient applications.

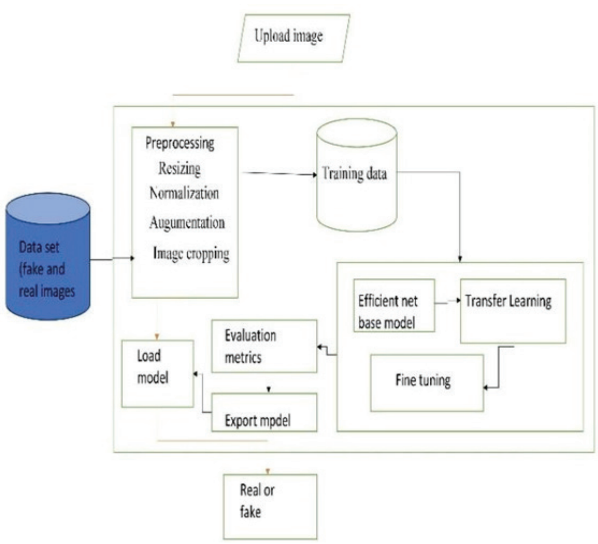

Fig. 1. System Architecture

EfficientNetV2B0's workflow for deepfake image detection incorporates additional components for enhanced performance. Beginning with image resizing to 224x224 pixels and batch organization into groups of 32, the architecture applies the Rectified Linear Unit (ReLU) activation function throughout its layers to introduce non-linearity and capture complex patterns effectively. Following feature extraction, global average pooling consolidates spatial features, preserving essential details while reducing dimensionality. The aggregated features undergo classification through fully connected layers with a sigmoid activation function, generating final probabilities indicating the likelihood of each image being a deepfake. The binary cross-entropy loss function is used to train the model, and the Adam optimizer is used to optimize it, ensuring efficient convergence and robust performance. This comprehensive approach ensures both efficiency and effectiveness in deepfake detection by leveraging the model's advanced architecture and optimization techniques. Building upon the foundation laid by the original Efficient Net, EfficientNetV2B0 introduces several key enhancements aimed at improving both efficiency and performance.

PROPOSED METHODOLOGY

Data Preparation

For deepfake detection, an extensive dataset was assembled, which included both synthetic deepfake images produced by sophisticated neural network-based techniques and real images obtained from reliable public repositories. The dataset was carefully selected to ensure representative training data by maintaining a balanced distribution of manipulated and real images.

Before the model was trained, all images were pre-processed to standardize dimensions and pixel values. Specifically, each image was resized to 224x224 pixels and normalized to the [0, 1] range to conform to the EfficientNetV2B0 architecture's input specifications.

Model Architecture

The EfficientNetV2B0 variation, which is well-known for its scalability and efficiency, was chosen as the foundational architecture for deepfake detection. EfficientNetV2B0, which is distinguished by compound scaling of network depth, width, and resolution, represents the cutting edge of neural network architecture. In addition to depth-wise separable convolutions and effective building blocks, the architecture consists of several layers of convolutional and pooling processes. The well-balanced combination of computational complexity and representational capability in this simplified architecture makes it an excellent choice for image classification tasks, such as deepfake detection.

Preprocessing

Preprocessing is done on the input image to make sure it satisfies the EfficientNetV2B0 model's specifications. This usually entails normalizing the pixel values and scaling.

The pre-processed image is sent into the EfficientNetV2B0 model, which uses its efficient building blocks and convolutional layers to extract pertinent characteristics from the image. These properties and patterns of the image are captured by these features.

Classification

The EfficientNetV2B0 model's fully connected layers process the retrieved features and classify the data using the learned representations. Usually, there are two units in the final output layer, each of which represents a class label. To turn the raw scores into probabilities, the output layers.

Decision Making

It can be determined by selecting the class label with the highest probability. For instance, the image is categorized as real if the likelihood of the "real" class is higher than the like deepfake.

To decide the final categorization, the estimated probabilities may be subjected to a decision threshold. Depending on the ideal ratio of false positives to false negatives, this threshold can be changed.

Transfer Learning

Transfer learning was used to initialize the parameters of the EfficientNetV2B0 model using weights learned from a large-scale dataset like image net to use the richness of knowledge embodied in pre-trained models. Rapid convergence and fine-tuning to the subtleties of the deepfake detection domain are made possible by this intentional initialization.

Then, using the task-specific deepfake detection dataset, the pre-trained EfficientNetV2B0 model was adjusted to modify its feature extraction capabilities to identify faint signals suggestive of artificial manipulation.

Training Procedure

The deepfake detection model was trained with a fixed learning rate of 0.001 using the Adam optimizer. A mini-batch size of 32 samples was employed during stochastic gradient descent to balance the gradient accuracy.

The model learned to distinguish between real and altered photos during 50 epochs of training. Standard data augmentation methods, such as random flips, rotations, and translations, were utilized to add variety to the training dataset, enhancing the model's resilience and capacity for generalization.

RESULT AND ANALYSIS

Setup for Simulation

Training has been conducted using the Google Collab typically allocating T4 GPU and using tenser flow, keras library. Ever since Google ordered to preserve the top-performing model based on the lowest validation loss value during training, checkpointing has been used; collab for bids on the ongoing use of GPUs. It has never been utilized, but if needed, training might be resumed using the most recent model that was preserved.

Dataset

From a Deepfake and real picture collection comprising 190,000 photos, comprising both Deepfake and actual images, we extracted 10,000 images in total. Three directories train, test, and validation are used to arrange the dataset.

Training Set: Seven thousand photos, or 70% of the dataset, aside for training. Testing Set: Fifteen percent of the 1,500-image dataset was set aside specifically for evaluating the performance model.

Validation Set: In a similar vein, 1,500 photos, or 15% of the dataset, were reserved for validation to evaluate model's capacity for generalization. To prevent overfitting, this partitioning strategy makes sure the model is tested on unknown samples, validated separately, and trained on a variety of data sets.

Training

Procedure for teaching the EfficientNetV2B0 architecture-based deepfake image detection model. Importing the required libraries and creating the model architecture come first. EfficientNetV2B0 is used as the main convolutional backbone, and additional layers are added for classification after that. Using binary cross-entropy loss and a learning rate of 0.0001, the model is compiled using the Adam optimizer.

To avoid overfitting and preserve the optimal model weights, early halting and model checkpointing callbacks are implemented. The model is then trained for 20 epochs, with 25 epochs in each phase, and the training process is tracked and shown. Using the capabilities of EfficientNetV2B0 and following best practices in deep learning techniques, this pipeline guarantees effective training and evaluation of the deepfake detection model.

The train a Convolutional Neural Network (CNN) for image classification tasks using tensor flow and Keras. The challenge at hand is the differentiation between authentic from counterfeit photographs. Let's examine the code in more detail matplotlib, numpy, tensor flow, seaborn, and a few other components from tensor flow, keras are imported together with the required libraries. These libraries are essential for tasks like building deep learning models, manipulating data, and visualizing it.

Image Data Generator for testing, validation, and training data. These generators are necessary for effectively loading and preparing picture data. To improve model generalization, they rescale pixel values to a range of [0,1] and optionally carry out data augmentation methods such as horizontal flipping. The model is created using accuracy as the evaluation metric, the Adam optimizer using binary cross-entropy loss, and a learning rate of 0.0001. Binary classification tasks are frequently carried out with these settings.

To track validation loss and save optimal model weights during training, callbacks are created for early halting and model checkpointing. The best model is saved for deployment and overfitting is avoided. All required libraries are imported, such as seaborn, matplotlib, numpy, tensor flow, and different parts from tensor flow keras these are not public libraries.

Lastly, using a set number of steps per epoch, the model is trained for 20 epochs using the training data. The training history is kept in the history variable for further analysis and visualization, while the validation data is used for validation during training. It offers a thorough pipeline for TensorFlow and Keras-based CNN model construction and training for binary image categorization. It combines industry best practices for building models, optimizing training, and preparing data to produce reliable and accurate classification results.

Performance Evaluation

The proposed model with a precision of 69.7%, recall of 96.7%, and binary accuracy of 77.3%, the deepfake image detecting system is impressive. The substantial number of true positives (725) and true negatives (435) indicates a high capacity to distinguish between legitimate and deepfake images. The system gets an exceptional F1- score of 0.810, showing a balance between precision and recall, despite occasional false positives (315) and false negatives (25).

The ROC curve's area under the curve, which is 0.878, illustrates how well the model can differentiate between real positives and false positives at different thresholds. These findings highlight the system's encouraging ability to reduce the spread of distorted media, even while there is still a need for improvement and understanding among end-users. Efforts to elucidate the rationale behind the model's predictions through techniques like visualization of activation maps and feature visualization are underway to enhance transparency in the decision-making process.

EfficientNetV2B0's feature extraction capabilities, combined with transfer learning and discriminative training techniques, make it well-suited for deepfake detection tasks.

By leveraging its ability to learn discriminative features.

- Minimizer of false positives and false negatives: 0.696
- Binary Accuracy: 0.773
- Precision: 0.697
- Recall: 0.967
- True Positives: 725.000
- True Negatives: 435.000
- False Positives: 315.000

- False Negatives: 25.000
- Number of right guesses: 1160.000
- Number of wrong guesses: 340.000
- Area under curve ROC: 0.878
- F1-Score: 0.878
- Precision: The ability of the model to correctly categorize positive outcomes out of all predicted positive outcomes is known as this.

It measures shows how many pictures were deepfake among all the photos that the suggested model classified as deepfake. The photos that are categorized as truly deepfake will be taken into account as True Positives. On the other hand, photographs that were real but were predicted to be deepfakes would be categorized as false positives. The accuracy calculation will be used when the actual False positives are denoted as FP and positives as TP. Accuracy equals TP in addition to FP.

Out of all the deepfake photos that were fed into the model, a large number of images were categorized as such. Thus, the photos that were categorized as deepfake and that were deepfake would be regarded as True Positives, while those that were incorrectly identified as real photos but were deepfakes will be viewed as false negatives. This is a recalling formula where TP stands for True Positives and FN for False Negatives.

- Recall: It measures how well the model can identify positive positives. Thus, it's a metric that shows how many of the images were identified as deepfakes. Actual deepfake pictures that were fed into the model. Therefore, images that were correctly identified as deep fakes but incorrectly labeled as photographs that were truly deep fakes and categorized as such will be called True Positives, whereas real photographs would be categorized as false negatives. When TP denotes True Positives and FN denotes False Negatives. The context of classification tasks measures the proportion of actual positive cases that were correctly identified by the model. It is calculated as the ratio of true positives to the sum of true positives and false negatives. Stated differently, recall quantifies the model's capacity to identify every pertinent instance present in a dataset. Specific values or context provided for recall about EfficientNetV2B0, it's challenging to provide further details or analysis.

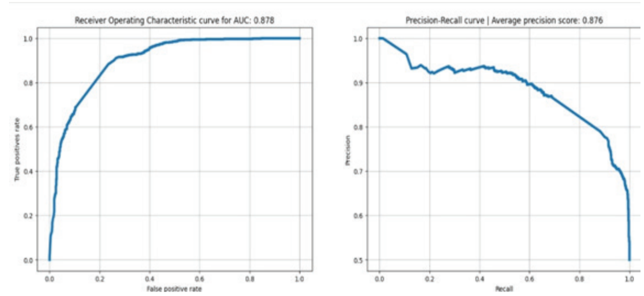

Fig. 2. AUC=0.878

Both true positives and true negatives are desirable outcomes in deepfake detection, as they indicate that the model effectively distinguishes between manipulated (deepfake) and unmanipulated (authentic) images.

The statement "AUC=0.878 EfficientNetV2B0" encapsulates the evaluation result of a classification model developed using the EfficientNetV2B0 architecture. In binary classification tasks, binary classification tasks, the area under the receiver operating characteristic curve (AUC) is a pivotal metric for assessing model performance. An AUC value of 0.878 indicates that the model demonstrates a strong discriminatory ability between the positive and negative classes across different decision thresholds. The EfficientNetV2B0 architecture, renowned for its efficiency and effectiveness in computer vision applications, serves as the backbone for this model. With its optimized design, the model attains robust classification capabilities, showcasing its aptitude for distinguishing between the two classes under consideration. This result underscores the efficacy of the EfficientNetV2B0 architecture in facilitating the creation of high-performing classification models for diverse real-world scenarios.

EfficientNetV2B0's feature extraction capabilities, combined with transfer learning and discriminative training techniques, make it well-suited for deepfake detection tasks, by leveraging its ability to learn discriminative features from visual data.

Deep fake image detection models based on DCNNs represent a significant technological response to the growing concerns surrounding the authenticity and integrity of visual content in the digital age. These models have demonstrated not only their efficacy in identifying manipulated images but also their potential to mitigate the societal risks associated with the widespread dissemination of deep fake content. Despite their effectiveness, ongoing research efforts are directed toward addressing various challenges and limitations. In this way, this model will specify the real or fake images in the DCNN architecture.

The EfficientNetV2B0 model's performance is evaluated using metrics such as true positives (TP) and true negatives (TN) within the confusion matrix. A true positive occurs when the model correctly identifies an image containing a deepfake as a deepfake, accurately detecting manipulation within the image. True negative happens when the model correctly identifies an authentic image as authentic, recognizing images without manipulation.

Confusion Matrix

Analyzing these metrics allows us to assess the effectiveness of the deepfake image detection model. High numbers of true positives and true negatives indicate a robust ability to differentiate between manipulated and authentic images. On the other hand, a high proportion of false positives and false negatives indicates potential areas for model improvement. such as reducing false alarms or enhancing sensitivity to detect manipulated content accurately. Additionally, Metrics like recall, accuracy, precision, and F1-score can shed more light on how well the model performs overall in deepfake identification.

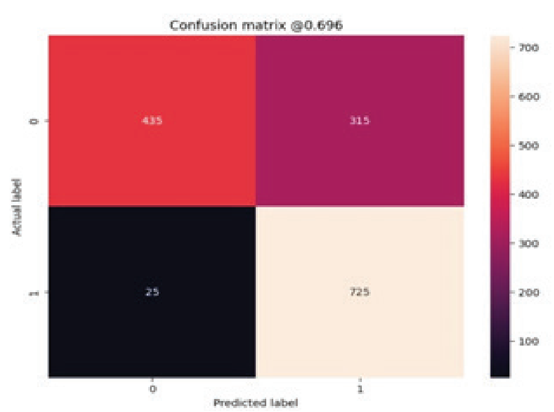

Fig. 3. Confusion Matrix

Outcomes

In our research, we developed a deepfake image detection system using EfficientNetV2B0 and integrated it into a user-friendly web application using Python's Stream lit library. This system allows users to upload images and quickly receive binary classification predictions as manipulated i.e. deepfake or real image, regarding their authenticity. Our approach emphasizes efficiency, accuracy, and user accessibility, aiming to combat the spread of manipulated visual content online while providing interpretability and transparency in the detection process.

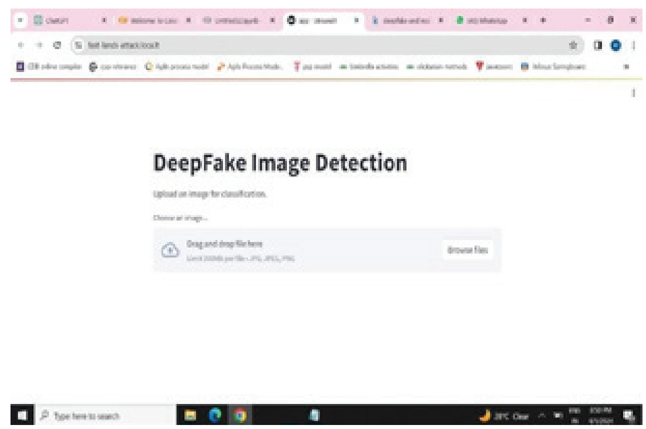

Fig. 3. Deepfake image detection

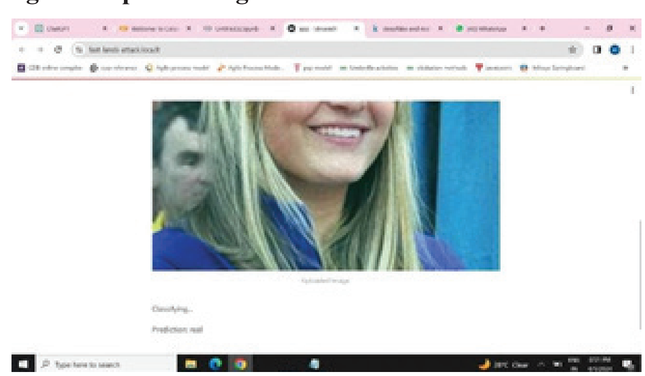

Fig. 4. Output of the deepfake image

CONCLUSION

This project aimed to develop a Dense CNN architecture to make a reliable deepfake image detection system. CNN layers were used for picture input and processing to extract features. Later layers included dropout, batch normalization, and fully linked dense layers. The efficacy of the model was assessed using three benchmark datasets of 10,000 images obtained from different local sources. The model achieved 74.73% accuracy in categorizing images as real or deepfake, with satisfactory F1 scores. Although the system was implemented using open- source resources including datasets, Python routines, and Google Colab, it required high-performance GPU support, notably T4 GPU, which resulted in hefty computational costs. As a result, the incapacity to train the complete dataset caused a vocabulary reduction that compromised the accuracy of item detection.

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Tomato Leaf Diseases Detection using Deep Learning

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ABSTRACT

Tomatoes are among the most basic crops with a significant showcase esteem that get developed in gigantic sums. They are broadly developed and expended not as it were in India but moreover all around the world. The fundamental figure affecting this crop's generation quality and amount is infection. In past considers, as it were the takes off of the plant were considered to distinguish maladies but, in a few infections, it's as it were the natural product that gets influenced whereas the other parts of the plant fair see fine. Recognizing the illness with the bare eye some of the time leads to an wrong forecast, coming about in applying the off-base pesticide, which might ruin the plant. The inaccessibility of specialists in numerous of the areas makes it troublesome for the ranchers to recognize the illness. In spite of specialists being accessible in a few locales, it's a time and cost-consuming handle. Recognizing the illnesses prior would diminish their impact on plants and raise trim efficiency. Subsequently, it is significant to accurately analyze these infections and apply the right pesticide. An mechanized framework can be utilized to illuminate these issues. To address this issue, we have come up with a framework that employments a convolutional neural arrange (CNN) to recognize the infection and recommends a pesticide to offer assistance kill that illness. This framework executes a CNN since it gives the most noteworthy level of precision.

KEYWORDS: *CNN, Feature extraction, Pesticide suggestion, Disease detection.*

INTRODUCTION

Agriculture is a main source of income for a majority of the population in countries like India. Every nation's economy depends on agriculture escpecially country like India. Over the years, technology has proved to be extremely useful in the agricultural sector and will continue to be so. The fundamental goal of agricultural advancement is to satisfy the expanding population's demand. To thrive in the current climate, agriculture needs to be upgraded. Both fungal and bacterial infections can harm crops. The productivity of farmers is severely harmed by this. Crops should be in good health for the best yield. Disease detection through visual examination will always be challenging. To achieve this,the farm must be constantly watched. This technique is time-consuming. When the farm is large, this can be very expensive as well. Owing to this complexity, even agricultural professionals struggle to identify the diseases and come up with a fix. The farmers would benefit significantly from an automated system that could detect plant diseases. The farmers may use this system as a tool to alert them at the appropriate time and take the necessary precautions. Plant parts including leaves, fruits, seeds, etc. can be affected by a variety of diseases that impact the plant. Certain plant segments involved are more susceptible to these diseases. The most significant component of a plant is its leaves. If a plant's leaf gets infected, it will directly destroy the life cycle of that well grown plant. Bacterial illnesses,fungal diseases, and other conditions are frequently seen in leaves. Thus, it is important to find plant diseases early.

RELATED WORK

Hareem Kibriya, Rimsha Rafique, Wakeel Ahmad,

S.M Adnan [1], the authors have implemented a method for detecting the disease using a deep-learning method. Google Net and VGG16 CNN-based models were employed to classify tomato leaf disease.VGG-16 achieved an accuracy rate of 98.00%, while Google Net achieved a higher accuracy rate of 99.23%. The plant town dataset is utilized to recognize the maladies containing 10735 pictures. They have identified the disease on the leaf images for Tomato. Evaluated the performance of the two models by calculating different performance evaluation metrics like TP, TN, FN, and ACC.

Lili Li, Shujuan Zhang, Bin Wang [2], The authors explained how deep learning is being used to recognize plant diseases, which has greatly improved the recognition accuracy of image classification and object detection systems. They provided a detailed analysis of recent research on the use of deep learning to identify plant leaf diseases. To improve the precision of classification, huge datasets with high variability are collected, transfer learning is performed, data is augmented, and CNN activation maps are visualized, as well as the importance of hyper spectral technologies for detecting the disease.

Deepa, Rashmi N, Chinmai Shetty [3], the authors discussed machine-learning techniques for detecting leaf disease. The identification of diseases involves the use of a supervised machine learning algorithm i.e., the Support Vector Machine (SVM) algorithm. the methodology used in detecting the diseases which involves the basic steps like taking input image, then image pre-processing after pre-processing extracting the useful features which are crucial in the classification of the image, training the model using the infected image and healthy images followed by clustering and classification.

A. Rahman et al. [4] This paper reviews IoT technologies for advanced monitoring and control in agriculture, aiming to comprehensively evaluate smart agricultural practices. It explores IoT applications, benefits, challenges, and potential solutions within the agricultural domain. The focus is on optimizing crop yield and efficiency by leveraging existing techniques such as water and pesticide management, irrigation practices, crop monitoring, and fertilizer application.

Melike Sardogan, Adem Tuncer, Yunus Ozen, [5], presents a system for disease classification using a combination of Convolutional Neural Network (CNN) and Learning Vector Quantization (LVQ) algorithm. The system was tested on a dataset consisting of 400 training images and 100 test tomato leaf images, and it was able to classify the data into a predetermined number of classes. It is suitable for solving minor problems.

Sakshi Raina, Dr. Abhishek Gupta, [6] is research on various plant leaf disease detection techniques using leaf Images. Here, the authors have presented different plant disease detection techniques They have given a tabular analysis of several identification, segmentation, and classification algorithms based on diverse datasets, with their advantages, disadvantages, and accuracy. Perceiving essential features without the need for human interference deviating from its models is the benefit of a Multi layered Convolutional Neural Network.

PROPOSED SYSTEM

This system focuses on using a convolutional neural network to identify diseases. This model will be deployed as a web application. The dataset utilized in this study consists of a total of 1386 images, encompassing both tomato leaf and fruit images. A total of 13 categories are given in the model, 10 of which are based on tomato leaves, and 3 are based on the fruit. Images of tomato leaves are extracted from the Plant Village dataset and tomato fruits are collected from the internet. Images belonging to the healthy category are 148 including tomato leaves and fruit. The dataset used for training and testing the models consisted of 1240 images for training and 146 images for testing. The images were in JPG format and had a size of 224x224 pixels in terms of width and height.

The framework comprises multiple stages to improve the accuracy of disease identification, as illustrated in the image. Our system operates as follows:

Step 1: Picture preprocessing steps are performed on the dataset. The dataset will be preprocessed involving image rescaling,reshaping, and array format conversion. Resizing images to match the input size of a convolutional neural network (CNN) is a common preprocessing step in image classification tasks.

Step 2: The following step includes developing a CNN show, which is gone before by information preprocessing. CNN is fed the training dataset, and the weights are modified to accurately identify the disease and distinguish one from the other. CNN aims to extract an optimal set of features such as color, shape, and texture from the pixel information from an image collected using convolutions.

Step 3: After training the model, the fully connected layer performs the task of classification to predict the disease based on the features obtained by the preceding layers and their respective filters.

Step 4: Pesticides will be suggested, taken after by a list of the areas of the pesticide sellers.

CNN Consist of Four Component

Convolution

Convolution is a fundamental operation in image processing and computer vision that allows the extraction of local features from an image. In other words, the network learns specific patterns within the image and becomes capable of recognizing them universally. Convolution is an element- by-element multiplication. The process involves scanning a section of the image, typically with a size of 3×3, and performing a convolution operation by multiplying it with a filter.

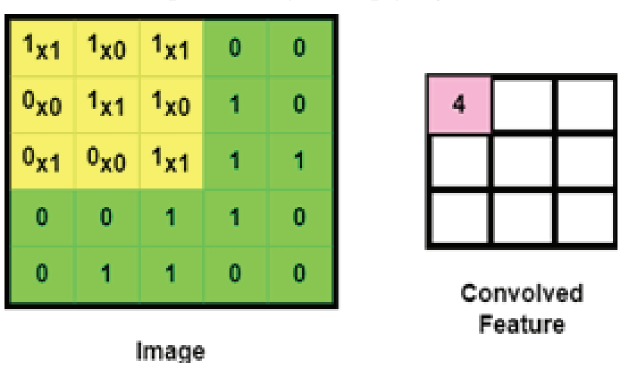

Fig. 1. Convolution on 5x5 image and 3x3 filter

Non-Linearity (ReLU)

An activation function is applied to the output after the convolution procedure to accommodate for non-linearity. The Relu is the typical convent activation function. Any pixels with negative values are substituted with zero.

Pooling Operation

The purpose of pooling in convolutional neural networks is to decrease the spatial dimensionality of the input image. The steps are taken to decrease the computational complexity of the operation. By decreasing the dimensionality, the neural network has fewer weights to calculate, thereby reducing the likelihood of overfitting. In the current stage, it is necessary to define both the size and the stride. Utilizing the include map's most extreme esteem is a ordinary strategy of pooling the input image

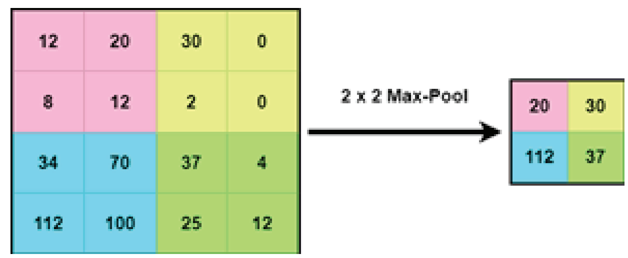

Fig. 2. 2x2 Max pooling

Fully Connected Layers

The final stage involves constructing a conventional artificial neural network. Connecting all the neurons of the previous layer to the next layer is a common method used in neural networks for image classification tasks. The softmax activation function is applied to enable the network to classify input images.

CNN (Convolution Neural Network)

Convolutional neural networks, or CNNs, are network architectures for deep learning. They can consist of multiple layers, sometimes reaching tens or even hundreds of layers. Each layer within a CNN is designed to learn and detect distinct features or patterns in an image. In the training process of convolutional neural networks (CNNs), various resolution filters are applied to each input image. The coming about convolved pictures are at that point passed as input to ensuing layers. These filters initially detect basic features such as brightness and edges and progressively learn more complex features that help in uniquely defining the objects being classified. Errands like scene categorization, question acknowledgment, division, and picture preparing can be instructed to a CNN. The process involves scanning a section of the image, typically with a size of 3×3, and performing a convolution operation by multiplying it with a filter.

METHODOLOGY

The proposed methodology detects tomato plant diseases. The classification of whether a leaf or plant is infected with a diseaseis done by considering the images of a leaf, using image processing techniques, feature extraction, and lastly model development. Once the model is trained, it is evaluated on a separate set of images to ensure its accuracy and reliability.

Dataset Collection

The data set utilized for training was gathered from the software and comprised pictures of both healthy leaves and plants with various illnesses. The dataset used in the experiment consists of 1386 images, comprising both tomato leaves and tomato fruit.

Dataset Pre-processing

The pre-processing method is used to minimize noise and improve image characteristics. Contrast enhancement is applied before processing the images. By translating input intensity to a new value, it enhances visual characteristics.

Model Building

During the training process, pre-processed images are fed into the CNN model to classify various plant diseases.

Feature extraction

The classification of images depends on this phase. We only extract features from the affected area rather than choosing the entire image. In the image processing technique, feature extraction is a crucial phase that offers an appropriate platform and the most beneficial constraints. Examining the attributes of a leaf image, such as shape, color, pattern, and size, efficiently is crucial in feature extraction.

Fertilizer Recommendation

Develop a fertilizer recommendation system that considers factors such as crop type, soil conditions, growth stages, and predictions. This system should generate data-driven fertilizer recommendations for farmers.

User Interface for Farmers

Create a user-friendly interface for farmers, which provide access to real-time data, diseases predictions, and fertilizer recommendations. This interface can be accessed through a web application or a mobile app.

Testing and Validation

Thoroughly test the entire system by collecting data over an extended period, making real-world predictions, and comparing them to actual outcomes. Validate the accuracy and effectiveness of the algorithm and fertilizer recommendations.

SYSTEM ARCHITECTURE

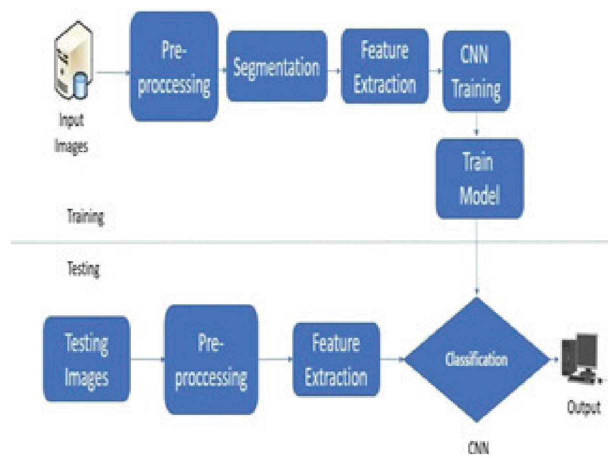

Fig. 3. Architecture Diagram of Tomato Leaf Diseases Detection using Deep Learning

This Tomato Leaf Diseases Detection using Deep learning to empower farmers. The system just required the image of leaf which having diseases. By analyzing this data using a machine learning model, the system can predict crop diseases and recommend the most suitable fertilizer for specific conditions. This information is then presented to the user through a user interface, enabling farmers to make informed decisions for better agricultural outcomes.

RESULTS

A Tomato Leaf Diseases Detection using Deep learning provides real-time, data-driven guidance for applying the right amount of fertilizer to crops. It optimizes fertilization by considering soil conditions, crop type, and environmental factors. The result increased crop yields, reduced fertilizer waste, and improved resource efficiency.

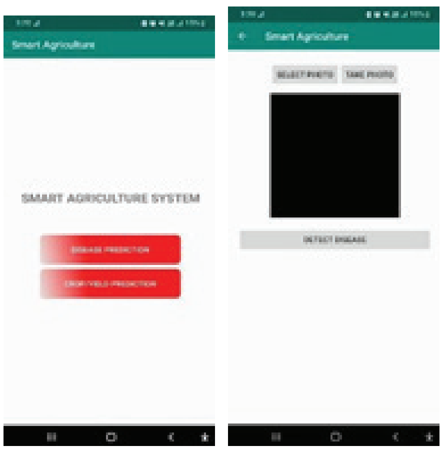

Fig. 4. Capturing .Image of Tomato leaf

Fig. 5. Diseases Deyection based on different environmental factors

CONCLUSION

The agrarian division is a exceptionally critical segment that incredibly impacts the society. It is not only a necessity but also important for the economy of the country. Tomato being an important crop must be grown with utmost care. Sometimes the fruits of the plant are affected with no visible damage to the leaves. Exposed eye perceptions can be wrong and can lead to utilizing the off- base cures. Seeking help from an expert can be costly as well as time-consuming.Convolution Neural Systems are best suited for picture acknowledgment due to their exactness. Subsequently. Hence, we have used it to make this tool that will help lessen the time and cost consumed during manual prediction. It gives momentous precision in recognizing 13 illnesses. It classifies diseases based on the fruit as well as leaves as sometimes only the fruit is damaged. It along with predicting the disease, suggests the name of the pesticide.

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A Survey on Comprehensive Challenges in Storage-as-a-Service in Cloud Computing

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ABSTRACT

Storage-as-a-Service (STaaS) plays a vital role in the realm of cloud computing. It provides users with the ability to store data remotely, eliminating the need for on- premises hardware and infrastructure. Addressing the challenges of Storage-as-a-Service (STaaS) in cloud computing is crucial for ensuring its efficient and secure functioning This paper delves into the multifaceted challenges encountered by Storage-as-a- Service (STaaS) within the landscape of cloud computing. It examines critical areas such as security privacy, data management, performance, and cost. this paper also delves into potential solutions and strategies to address these obstacles effectively.

KEYWORDS: *Cloud, Computing, STaaS.*

INTRODUCTION

Cloud computing has ushered in a paradigm shift in the way both businesses and individuals handle their data. By offering convenient, on-demand access to a versatile pool of configurable computing resources via the internet, it has transformed traditional approaches to data storage and management. This revolution has democratized access to powerful computing capabilities, enabling organizations of all sizes to scale their operations efficiently and effectively. Among these resources, Storage-as-a-Service (STaaS) plays a crucial role in offering users the ability to store and retrieve data without the need for maintaining physical hardware[1].

OVERVIEW OF STORAGE AS A SERVICES IN CLOUD COMPUTING

Storage-as-a-Service (StaaS) represents a pivotal component of cloud computing, facilitating the remote storage of data for consumers while providing convenient access from any location, at any time. This model seamlessly integrates storage with specific data formats and applications, offering a diverse array of options, including general-purpose storage solutions like Dropbox. Despite its potential benefits, StaaS has not yet reached widespread adoption. One contributing factor may be the limited coverage and explanation of cloud storage within the service models of cloud computing. As such, there's a need to further elucidate the capabilities and advantages of cloud storage within the broader context of cloud computing services to encourage its broader utilization and appreciation.[2].

- Scalability: Scalability stands as a hallmark feature of Storage-as-a-Service (STaaS), empowering organizations to dynamically adjust their storage resources in response to fluctuating demands without necessitating substantial upfront investments in hardware. This flexibility is especially invaluable for businesses contending with varying storage requirements over time. By leveraging STaaS, organizations can seamlessly scale their storage capacity up or down as needed, ensuring optimal resource utilization and cost-effectiveness while effectively accommodating evolving business needs.
- Cost Efficiency: Cost efficiency emerges as a significant advantage of Storage-as-a-Service (STaaS) adoption. By entrusting their storage infrastructure to a cloud provider, organizations can sidestep the expenses linked with procuring, managing, and updating physical storage hardware.

Additionally, the pay-as-you-go model prevalent in STaaS means that organizations only incur costs for the storage capacity they utilize, mitigating the need for over provisioning and resulting in potential savings compared to maintaining on-premises storage solutions. This approach not only optimizes resource allocation but also enhances financial predictability, enabling organizations to allocate their budgets more strategically and efficiently.

- Flexibility and Accessibility: Storage-as-a-Service (STaaS) offers users unparalleled flexibility by allowing them to access their data from anywhere with an internet connection. This accessibility opens up a world of possibilities, facilitating remote work, collaboration, and seamless data sharing among employees, partners, and customers across diverse locations and devices. Whether accessing files from a laptop, smartphone, or tablet, users can tap into their stored data effortlessly, breaking down barriers of time and geography. This level of accessibility not only enhances productivity but also fosters innovation and agility within organizations, empowering teams to work collaboratively and efficiently regardless of their physical location.

- Data Redundancy and Disaster Recovery: Many STAAS providers offer built-in redundancy and disaster recovery capabilities, ensuring that data is replicated across multiple locations and protected against hardware failures, natural disasters, and other unforeseen events. By maintaining multiple copies of data across distributed storage systems or geographic locations, organizations can mitigate the risk of data loss due to hardware failures, natural disasters, or other unforeseen events. In the event of a system failure or data corruption, redundant copies of data serve as backups, enabling organizations to restore operations swiftly and minimize downtime.

SECURITY CHALLENGES

Cloud storage offers numerous benefits, including scalability, accessibility, and cost-effectiveness. However, it also introduces several security challenges that organizations need to address to ensure the safety and confidentiality of their data. This is shown in below figure 1.

Here are some common security challenges in cloud storage:

Data Breaches

Data breaches pose a significant threat in the realm of cloud storage, eliciting considerable apprehension among users and organizations alike. These breaches can manifest due to an array of factors, foremost among them being weak authentication mechanisms, insufficient encryption protocols, or vulnerability- ties inherent in the infrastructure provided by cloud service providers.

Fig. 1. Security Challenges

Data Loss

Despite robust backup systems in place, data loss can still occur in cloud storage due to accidental deletion, hardware failures, or natural disasters. Data loss stands as a formidable concern for organizations leveraging cloud storage solutions, necessitating the implementation of robust data backup and recovery strategies to mitigate this risk. One critical aspect contributing to this risk is the loss of control over data, inherent in the model where the provider assumes ownership of the client's information. Consequently, there exists the perpetual risk of unauthorized access or manipulation, underscoring the importance of stringent security measures.[3][5]

Insecure Interfaces and APIs

Security assessments, encompassing penetration testing and code reviews, play a pivotal role in fortifying the integrity of API implementations. These assessments serve as a proactive measure, diligently identifying vulnerabilities that could potentially be exploited by malicious entities. Through rigorous testing and meticulous code examination, weaknesses are uncovered and promptly addressed, thereby bolstering the overall security posture of the system[8].

Insider Threats

Insider threats emerge as a formidable risk confronting the security of cloud storage systems, highlighting the vulnerability posed by individuals within an organization itself. Whether driven by malicious intent or stemming from negligence, employee granted access to sensitive data wield considerable power to compromise data security. Malicious insiders may deliberately ex-pilot their access privileges to perpetrate data breaches or leaks, while negligent employees, whether due to lack of awareness or carelessness, can inadvertently expose confidential information to unauthorized parties.

Shared Infrastructure

Shared infrastructure in cloud computing introduces a plethora of security challenges, necessitating thorough consideration and mitigation strategies. The multi-tenant environment of cloud computing raises concerns regarding data segregation, as sensitive information from different tenants must be adequately isolated to thwart unauthorized access and data breaches[7].

Compliance and Legal Issues

Storing data in the cloud may raise compliance and legal concerns, especially regarding data privacy regulations such as GDPR, HIPAA, or CCPA. Organizations must ensure that their cloud storage solutions comply with relevant regulatory requirements and industry standards.

Data Encryption

Encrypting data is essential for protecting it from unauthorized access, both during transmission and while at rest in the cloud. However, managing encryption keys securely and ensuring strong encryption algorithms are crucial to maintaining data confidentiality.

Data Governance and Access Control

Establishing robust data governance policies and implementing stringent access controls are paramount for effectively managing permissions, monitoring user activities, and mitigating the risks of unauthorized access to sensitive data stored in the cloud. By defining clear protocols and access levels, organizations can ensure that data is only accessible to authorized personnel, minimizing the potential for breaches or data misuse. Continuous monitoring of user activities allows for prompt detection of any irregularities or suspicious behavior, enabling swift intervention to safeguard data integrity[6].

PRIVACY CONCERN

When utilizing Storage as a Service (STaaS) for data storage, users and organizations must navigate various privacy concerns inherent in entrusting their information to third- party providers. Concerns persist surrounding data ownership, portability, and the transparency of privacy policies, significantly impacting user trust in cloud services. Users often grapple with uncertainties regarding who ultimately owns the data stored in the cloud, and the ease with which they can migrate it elsewhere if needed. Furthermore, the opacity of privacy policies adds another layer of complexity, leaving users questioning how their data is handled and protected by service providers[9].Here are some of the key ones:

- Data Security: One of the primary concerns with storing data in the cloud is security. Users must prioritize ensuring that the storage service provider implements robust security measures to safeguard their data from unauthorized access, breaches, or cyber attacks.
- Data Encryption: Data should be encrypted both during transmission and while at rest. Users should ensure that the storage service provider offers strong encryption protocols to safeguard their sensitive information
- Data Breach Response Plan: Users should have a clear plan in place to respond to potential data breaches. This includes promptly notifying affected parties, investigating the breach, and taking appropriate remedial actions • Data Portability: Users should ensure that they can easily retrieve their data from the storage service provider if needed. The provider should support standard data formats and offer tools for data migration.
- Data Ownership: In today’s digital landscape, it’s imperative for users to diligently clarify the ownership of data stored in the cloud and delineate the rights retained by storage service providers. To achieve this, comprehensive terms of service

agreements must be established, explicitly addressing data ownership and usage rights. This ensures transparency and protects both parties involved, fostering trust and accountability in the handling of sensitive information.[4]

DATA MANAGEMENT COMPLEXITY

Managing data in Software as a Service (SaaS) applications that leverage cloud storage introduces a myriad of complexities. Integration with cloud storage requires careful consideration of compatibility, data mapping, and synchronization between the SaaS application's data model and the structure of the cloud storage system. This process is essential to ensure seamless functionality and efficient data transfer between the application and the storage platform. Moreover, security emerges as a critical concern during integration, emphasizing the need for robust measures to protect sensitive data. Encryption of data both in transit and at rest, implementation of stringent access controls, and continuous monitoring are vital components to safeguard against breaches and ensure compliance with regulatory requirements. Despite data residing in cloud storage, organizations retain ownership and must negotiate clear agreements with SaaS providers regarding access, usage, and retention policies. Establishing effective data governance and compliance protocols, including defining roles, responsibilities, and processes, is essential. Furthermore, ensuring seamless backup, recovery, and migration procedures while considering data integrity and regulatory requirements adds layers of complexity. Performance optimization and cost management are critical, requiring constant monitoring of access patterns, resource utilization, and expenditure to maintain efficiency and control expenses. Effective vendor management is essential for addressing data management issues, service agreements, and support. Lastly, ensuring data portability facilitates migration between SaaS applications or cloud storage providers, mitigating the risk of vendor lock-in and preserving organizational flexibility. Addressing these complexities holistically enables organizations to effectively harness the benefits of SaaS and cloud storage while safeguarding their data assets.

COST MANAGEMENT

While cloud storage offers scalability and flexibility, it also introduces cost management challenges. Users must carefully balance storage capacity, performance requirements, and cost considerations to optimize their storage investments. Pricing models, such as pay-as-you-go and tiered storage, add complexity to cost estimation and forecasting.

METHODOLOGY

The realm of Software as a Service (SaaS) within cloud computing, .Here are some methodology used in the STaaS for theirs challenges:

Security and Privacy

In security and privacy ensuring data confidentiality,integrity and availability while data reside off premises. The methodology is to implement robust encryption mechanism for data at rest and in transit. Regularly audit access control and permissions. Use secure communication protocols.

Scalability and Performance

In the scalability and performance, handling varying workloads and scaling storage resource dynamically. The methodology is employ auto scaling mechanism to adopt to changing demands. Optimize data distribution access storage mode. Monitor performance metrices and adjust resource allocation.

Data migration and Integration

In data migration and integration ,seamlessly migrating data to /from StaaS providers and integrating it with existing system. The methodology is to plan data migration carefully ,considering downtime ,data consistency and bandwidth limitations. Use Standardized API for seamless integration. Validate the data integrity during migration.

Vendor Lock_in

In vendor lock_in ,Avoiding dependence on a single STaaS provider. The methodology is to choose providers with open standards and interoperability. Design application to be agnostic to specific StaaS implementation. Regularly evaluate alternative providers. Suppose company x is searching STaaS provider. They Evaluate factors such as reliability ,service level agreement and data accessibility ,choosing the right vendor is crucial for a smooth transition and long term success.

Regulatory Compliance

In regulatory compliance, the methodology is to keep up to date with recent regulation is needed to sure StaaS applications development process complies with all necessary legislation.

Integration Issues

In the integration issues, specific to Storage as a Service (StaaS) in cloud computing, a focused methodology is essential to ensure efficient and seamless integration of storage solutions into the cloud environment. The methodology is in-depth assessment ,Strategic integration plan, appropriate storage plan,appropriate storage technology ,integration architecture.

Improving Customer Support:

Improving customer support in Storage as a Service (STaaS) requires a comprehensive methodology tailored to meet the unique needs and challenges of cloud-based storage solutions beginning with thorough understanding and analysis of customer requirements, secondly robust support infrastructure must be established to provide timely assistance and resolution to customer issues. Implementing proactive monitoring and alerting mechanisms is crucial for identifying potential issues before they impact customers.

FUTURE WORK AND CONCLUSION

Future endeavors in the realm of storage services within cloud computing are poised to concentrate on several pivotal fronts aimed at mitigating emerging security challenges. In conclusion, while Storage as a Service (STaaS) offers numerous benefits such as scalability, flexibility, and cost-effectiveness, it also presents several challenges in the context of cloud computing. Chief among these challenges are issues related to security and data privacy, as storing sensitive information in the cloud raises concerns about unauthorized access, data breaches, and compliance with regulatory requirements. Additionally, ensuring data availability and reliability in a multi-tenant environment poses technical challenges such as latency, bandwidth limitations, and network congestion.

Furthermore, transaction integrity remained consistently high, ensuring reliable data consistency throughout different workloads. a primary focal point will be directed towards addressing the intricate compliance challenges concerning data sovereignty, privacy regulations, and industry standards within cloud storage environments. This endeavor will involve the advancement and refinement of automated tools and frameworks tailored specifically for auditing, monitoring, and enforcing regulatory compliance. These tools will serve as indispensable aids, assisting organizations in navigating the labyrinth of regulatory requirements while ensuring adherence to stringent data protection laws and industry best practices[10].

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