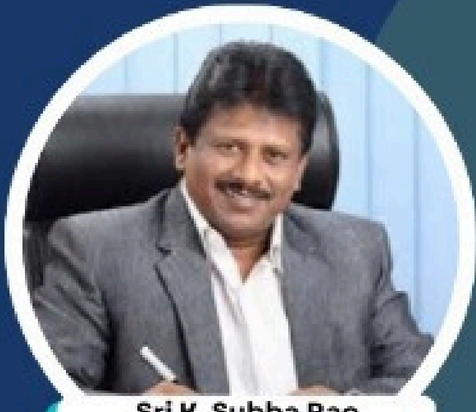

Sri K. Subba Rao,
Chairman, KITS

CONFERENCE PROCEEDINGS

OF

NATIONAL CONFERENCE

ON

INNOVATIVE CHALLENGES IN DEEP LEARNING AND ITS APPLICATIONS

NCICDLA-25

ON

28th & 29th of March

organized by
DEPARTMENT OF CSE-AI & ML

ISBN NUMBER :
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Sri K. Shekhar,
Secretary, KITS

VOL-02

SRI K. SUBBA RAO,
CHAIRMAN, KITS.

MESSAGE FROM THE CHAIRMAN

It is with great pleasure that I extend my warm greetings to all the participants, speakers, and esteemed guests of the **National Conference on Innovative Challenges in Deep Learning and Its Applications-NCICDLA-25.** As the Chairman of this prestigious Engineering College, I am truly honored to witness the convergence of brilliant minds and cutting-edge research in one of the most dynamic and transformative fields of our time—Deep Learning

Deep learning has revolutionized numerous sectors, from healthcare to finance, from autonomous systems to natural language processing. As we continue to push the boundaries of technology, it is essential to address the challenges that lie ahead—whether it be in model optimization, data security, or real-world deployment. This conference serves as an ideal platform to foster collaboration, share innovative ideas, and explore the latest advancements in this rapidly evolving field.

Our institution is committed to nurturing young talent and fostering an environment of innovation. By hosting this conference, we aim to contribute to the collective knowledge and explore the real-world applications that can be transformed by deep learning. I hope this event sparks meaningful discussions, encourages collaboration, and inspires new avenues of research and development.

I wish you all an intellectually enriching experience during this conference, and I am confident that the insights shared here will pave the way for future breakthroughs in deep learning and its applications

Let us continue to innovate, challenge conventional boundaries, and shape the future together.

KOYE.SUBBA RAO
Chairman, KITS.
28th March-2025.

SRI K. SHEKHAR,
SECRETARY, KITS.

MESSAGE FROM THE SECRETARY

It gives me immense pleasure to welcome all the distinguished participants, speakers, and esteemed guests to the **National Conference on Innovative Challenges in Deep Learning and Its Applications-NCICDLA-25**. As the Secretary of this esteemed Engineering College, I am excited to see the gathering of experts and enthusiasts in the field of Deep Learning, a domain that continues to redefine the future of technology.

Deep learning is at the forefront of technological advancement, influencing a wide range of industries, from healthcare and artificial intelligence to automation and beyond. However, as we embrace its potential, we must also confront the challenges it presents—be it through model scalability, ethical concerns, or real-world implementation. This conference is an excellent opportunity to engage in insightful discussions, share breakthrough research, and explore innovative solutions to these challenges.

Our institution has always prioritized the advancement of knowledge and innovation. By hosting this conference, we aim to create a space for collaborative dialogue and foster an environment that nurtures new ideas and approaches. I am confident that the knowledge shared here will not only enhance our understanding of deep learning but also contribute to solving real-world problems through its applications.

I wish you all a fruitful and enriching experience during the conference, and I hope the discussions here will ignite new paths of discovery and collaboration that will shape the future of deep learning.

KOYE.SEKHAR
Secretary, KITS.
28th March,2025

Dr. P. Babu, Principal, KITS.

MESSAGE FROM THE PRINCIPAL

It is with great enthusiasm that I extend my warm greetings to all the participants, researchers, and distinguished speakers at the **National Conference on Innovative Challenges in Deep Learning and Its Applications-NCICDLA-25**. As the Principal of this esteemed Engineering College, I am deeply honored to witness such a gathering of brilliant minds and visionaries in the field of Deep Learning, a technology that is reshaping the world we live in.

The transformative power of deep learning is undeniable, and its applications are vast and impactful across industries such as healthcare, transportation, finance, and artificial intelligence. However, as we explore the boundless possibilities, we must also address the challenges that come with it—be it in terms of algorithmic efficiency, data privacy, or scalability. This conference provides an excellent platform to delve into these challenges and share innovative solutions that will drive the future of deep learning.

Our institution has always been at the forefront of fostering cutting-edge research and innovation. By hosting this conference, we aim to create a platform for intellectual exchange and collaboration among students, faculty, and industry experts.

I am confident that this conference will inspire new ideas, spark collaborations, and pave the way for future advancements in deep learning and its diverse applications. I wish all the participants an enriching and thought-provoking experience, and I look forward to the exciting discussions that will unfold over the course of this event.

Dr. P. Babu
Principal, KITS
28th March,2025

MESSAGE FROM THE DIRECTOR-ACADEMICS

Dr. K. Hari Babu
Director-Academics, KITS.

It is with immense pleasure and pride that I welcome all the distinguished delegates, speakers, researchers, and participants to the **National Conference on Innovative Challenges in Deep Learning and Its Applications-NCICDLA-25**. As the Director of Academics at this esteemed Engineering College, I am delighted to witness the convergence of intellects from various fields to discuss and explore one of the most transformative and dynamic technologies of our time—Deep Learning.

Deep learning has not only revolutionized industries but is also making significant contributions to solving some of the most complex challenges in fields like healthcare, robotics, natural language processing, and more. However, as with any groundbreaking technology, deep learning presents its own unique set of challenges, ranging from model accuracy and efficiency to ethical implications and real-world implementation. This conference provides an exceptional platform to address these challenges and discuss innovative solutions that will guide the future of this technology.

At our college, we have always emphasized the importance of academic excellence, interdisciplinary collaboration, and practical application of knowledge. Hosting this conference is a reflection of our commitment to fostering a culture of research and innovation. We believe that such collaborative engagements not only enhance the academic experience but also provide valuable opportunities for growth and discovery in emerging technologies like deep learning.

I hope this conference serves as an inspiration for all participants to challenge existing paradigms, explore novel ideas, and forge collaborations that will shape the future of deep learning and its vast applications. I wish all attendees a fruitful and intellectually stimulating experience.

Dr. K. Hari Babu
Director-Academics, KITS

28th March,2025

Dr. G. Murali
Conference Chair

MESSAGE FROM THE CONFERENCE CHAIR

IIt is with great pleasure that I extend my warmest greetings to all participants, speakers, and contributors of the **National Conference on Innovative Challenges in Deep Learning and its Applications-NCICDLA-25**. This conference is a vital platform for researchers, academicians, and industry professionals to come together and exchange insights on the latest advancements, methodologies, and real-world implementations in deep learning.

As deep learning continues to revolutionize diverse fields such as computer vision, natural language processing, healthcare, finance, and beyond, this conference aims to foster meaningful discussions on the challenges and opportunities that emerge from this evolving landscape. We are proud to host distinguished keynote speakers, technical paper presentations, and interactive sessions that reflect the depth and breadth of current research in this domain.

I would like to express my sincere gratitude to all authors who submitted their valuable work, the reviewers for their meticulous evaluation, and the organizing committee for their dedicated efforts in ensuring the success of this event. Special thanks also go to our sponsors and partners for their unwavering support.

I encourage each of you to actively engage in the discussions, forge new collaborations, and take advantage of this opportunity to expand your knowledge and network. Together, we can address the innovative challenges in deep learning and contribute to shaping the future of this impactful field.

Wishing you all a productive and enriching conference experience.

Dr. G. Murali
Conference Chair
28th March,2025

Dr. S. Radhakrishnan
Conference Convener

MESSAGE FROM THE CONFERENCE CONVENER

It is my distinct honor to welcome you to the Proceedings of the **National Conference on Innovative Challenges in Deep Learning and its Applications-NCICDLA-25**. This compilation of research papers reflects the hard work, dedication, and innovative thinking of the authors who have contributed to advancing the field of deep learning.

These proceedings showcase a diverse range of topics, highlighting both theoretical insights and practical implementations that address key challenges in deep learning. We believe this collection will serve as a valuable reference for researchers, academicians, and industry professionals alike.

I extend my sincere gratitude to all the authors for sharing their invaluable work, the reviewers for their thoughtful evaluations, and the organizing committee for their diligent efforts in making this conference a success. I also thank our distinguished speakers for their contributions and our sponsors for their invaluable support. I am really grateful to Chairman Sir, Secretary Sir, Principal Sir, Director Sir and the Head of the Department Dr.G.Murali for their constant support and encouragement in making this conference a grand success.

I encourage readers to explore these proceedings, engage with the presented ideas, and build upon the research presented to further advance the field.
Wishing you an insightful and enriching experience.

Dr. S. Radhakrishnan,
Conference Convener
28th March,2025

FOREWORD BY THE CHIEF GUEST-NCICDLA-25

Dr.M.H.M.Krishna Prasad
CHIEF GUEST-NCICDLA-25

It is with great pleasure that I extend my heartfelt congratulations to the organizers, contributors, and participants of the National Conference on Innovative Challenges in Deep Learning and its Applications-NCICDLA-25. This conference serves as a remarkable platform for researchers, academicians, and industry professionals to exchange knowledge, explore cutting-edge advancements, and address the multifaceted challenges in the dynamic field of deep learning.

Deep learning, a powerful subset of artificial intelligence, continues to revolutionize various sectors, including healthcare, finance, automotive, and natural language processing. While its potential to enhance decision-making, automate complex processes, and uncover intricate patterns is immense, numerous technical and practical challenges remain. The insightful discussions and innovative solutions presented in this conference reflect the collective commitment of the research community to advance this field.

This proceedings document is a testament to the dedication and intellectual rigor demonstrated by the authors who have contributed their original research, innovative ideas, and novel methodologies. The diverse range of topics covered here highlights the interdisciplinary nature of deep learning and its far-reaching impact. I am confident that the knowledge encapsulated in these pages will inspire new ideas, foster collaboration, and contribute meaningfully to both academic inquiry and practical applications.

I commend the organizers for creating this platform and encourage all readers to engage deeply with the presented works. May this conference proceedings ignite further research and innovation, driving deep learning toward greater achievements and societal benefit.

I extend my best wishes to all the participants for their future endeavours and look forward to witnessing the remarkable contributions this conference will inspire.

Dr.M.H.M.Krishna Prasad
Professor-CSE and Director-IQAC, JNTUK.
Chief Guest-NCICDLA-25.

Dr. Hima Bindu
Keynote Speaker-NCICDLA-25

FOREWORD BY THE KEYNOTE SPEAKER-NCICDLA-25

I am honoured to present this foreword for the National Conference on Innovative Challenges in Deep Learning and its Applications-NCICDLA-25. This conference is a vital forum for exploring the latest developments, research trends, and emerging challenges in the fast-evolving domain of deep learning.

Deep learning has made remarkable strides in recent years, enabling breakthroughs in image recognition, natural language processing, medical diagnosis, and numerous other domains. As we embrace these advancements, it is equally crucial to identify the technical obstacles and ethical considerations that accompany them. This conference serves as a significant step in that direction, bringing together researchers and practitioners to address these challenges and propose innovative solutions.

The papers and presentations compiled in these proceedings reflect extensive research and creative insights from experts across diverse disciplines. Each contribution offers a valuable perspective on improving deep learning models, enhancing performance, and expanding their applicability in real-world scenarios. I believe these works will serve as a rich resource for both seasoned researchers and those new to the field.

I extend my sincere appreciation to the conference organizers for fostering this environment of knowledge-sharing and collaboration. I am confident that the discussions held here will inspire new ideas and advance the frontiers of deep learning research.

I congratulate all contributors for their remarkable efforts and wish them continued success in their research pursuits.

Dr. Hima Bindu
Assistant Professor (Gr I) in CSE & Dean Student Welfare,
NIT-Andhra Pradesh,
Keynote Speaker-NCICDLA-25.

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KITS-NCICDLA-25-CONFERENCE PROCEEDINGS

Paper ID :18

IMPACT OF ARTIFICIAL INTELLIGENCE ON SPEECH LANGUAGE PATHOLOGY

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ABSTRACT: Speech disorders like aphasia, disruption, stuttering of voice and apraxia shed a mark on the quality of life of individuals. This research focuses on integration of AI for performing a better assessment rather than manual intervention which can prove time consuming. The audio recording of the individual is converted into the accurate frequency range for diagnosis, STFT is used to analyze frequency of individual's voice and is used for audio analysis and processing of the speech as well. A DNN model is used for classification and to solve problems by providing personalized exercise recommendations. STFT also splits the signal into several smaller time segments. Regular Fourier Transformations doesn't represent time whereas STFT shows at what time the frequencies are present. DNN has the scalability to deal with larger datasets. It is also used to identify the emotional tone of the speech and is used in sentiment analysis as well. These technologies support each other so as to facilitate the examination of speech, to make sure that the individuals with speech and language issues will receive the best therapy possible.

***Index Terms**: Deep Neural Networks, Short Term Fourier Transforms.*

I. INTRODUCTION

Speech therapy increases skills in speech and writing language, learning, thinking, memory, and attention as well. STFT is used for the processing of audio signal, DNN is machine learning algorithm and it is similar to ANN, it imitates the information processing of the brain. There are 3

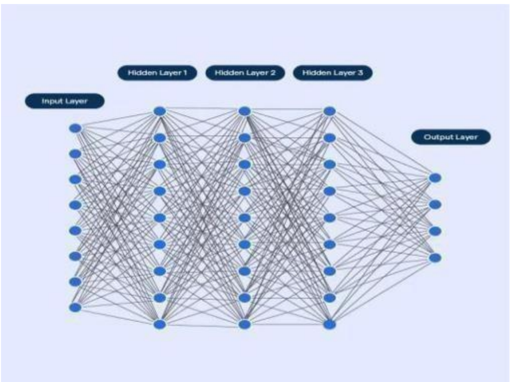

FIGURE 1. **DNN Architecture**

layers such as input layer, hidden layer and the output layer, In the input layer the information is known. In the hidden layer, the information is taken from the input layer The output layer produces the final result. In this model ReLU is used as an activation function and it adds non linearity to the network which is suitable for detecting the complex patterns, softmax is used in the output layer to solve multiclass classification problem and produces accurate probabilities.

RESEACH PROBLEM:

Doctors often find it hard to diagnose patients with speech impairments, manual intervention can prove both time consuming and expensive. So, we are introducing the neural network based artificial intelligence model to better speech diagnosis and real-time assesment.

RESEARCH GAPS:

In the previous research, multi modal modeling is used but they are not much accurate. So, to provide better accuracy we are using AI-based models. The previous research lacks in the real time implementation in the speech diagnosis.The previous research only mentions archiving of the data but didn't mention long-term monitoring of speech.

II. LITERATURE REVIEW

Shamiha Binta Manir et. Al (2024), Aphasia is a disorder that occurs when a damage is inflicted on language areas of brain. Conventional systems find it difficult to process aphasic speech. BERT is used here to predict target word by utilizing preceding and succeeding words for patients with aphasia. Aphasia Bank is the dataset used to develop the model. This study highlights the usage of BERT to aid aphasic patients.

Orla Cooney et.al (2024),Mood logging is a practice where emotional state of the individual is tracked which proves beneficiary to Mental Health Practitioners (MHPs), speech agents could be employed for better analysis of emotional data for real time interaction and reporting but the problem arises with data privacy and noisy data issues which deviates from the original goal of capturing emotional state ,the studies emphasizes that speech agents should complement rather than replace human-led interventions

Jianxin Xiong et.al (2023), Dyslexia is a learning disorder that makes it hard for the individual to read and leads to error when reading aloud. Reading therapy is used to combat this. Traditional Methods involve manual intervention which can be time consuming and expensive, AI driven approach is presented here which uses deep learning techniques. Convolutional Neural Networks along with Long Term Short Term Memory are together to analyze facial and speech features of the individual for emotional state

Rémi Blandin et.al (2023), The study compares 1D and 3D models to create synthetic speech and check speech naturalness, 1D model is found to be fast but less accurate whereas 3D exhibited higher accuracy when it comes to vowels like /o/ and /u/ and is able to capture high pitched sounds. It highlights the importance of using AI based speech systems for virtual assistants and speech therapy tool to provide a natural sounding feedback to the user.

Yuanyuan Liu et.al (2023), This paper proposes an automatic system for Parkinson's Disease (PD) assessment using speech representations of phonation and articulation. It analyzes universal phonological and glottal features alongside prosodic features. The study emphasizes multimodal speech analysis for objective, scalable PD monitoring.

Michal Krecichwost et.al (2023), This paper presents a 4D multimodal speaker for remote speech diagnosis, combining a 15-channel microphone array and stereovision cameras to capture audio-visual articulation data. A data processing workflow enables audio beamforming, synchronization, word segmentation, and 3D mouth movement analysis. It offers a high-quality solution for asynchronous speech diagnosis, with future potential in computer-aided speech disorder detection and therapy.

Anna Lekova et.al (2022), A System for Speech and Language Therapy with a Potential to Work in the IoT. This paper presents a Speech and Language Therapy system for children with communication disorders, integrating assistive technologies like the NAO robot, Emotiv EPOC+ headset, EmoSan robot, and Kinect sensor via Node-RED for IoT connectivity.

Yuanyuan Liu et.al (2021 This paper introduces an automatic, language-independent method for assessing vowel articulation in dysarthric speech, especially in Parkinson's Disease (PD). Using a universal phoneme recognizer eliminates manual annotation by detecting corner vowels and analyzing formant features. Validated on Finnish, Spanish, and English dysarthric speech corpora, the method shows strong correlations with expert assessments. Future research aims to apply it to spontaneous speech and early disease detection.

Michal Krecichwost et.al (2020), This paper presents a multichannel speech acquisition system for computer-aided diagnosis of sigmatism in children. The system records speech using fifteen spatially-organized microphones, allowing non-invasive, repeatable speech signal acquisition. Experiments confirmed the system's ability to detect distinctive airflow patterns in different pronunciations of sibilants, making it a promising tool for speech disorder analysis and therapy

Giovanni Dimauro et.al (2017), This study explores using Google Speech-To-Text (STT) and Voxtester software to objectively assess speech intelligibility in Parkinson's Disease (PD) patients. Compared to healthy controls, PD patients showed higher speech recognition error rates, indicating impaired intelligibility. A second reading improved recognition accuracy in elderly and PD groups

III. METHODOLOGY

A. Objectives

- Relationship between DNN and STFT is established as well as the comparison between accents, pitch and sound quality in therapies related to speech.
- Development of correct methods for recognizing and assessing multi-feature phonemes.
- Combines ReLU,softmax for easily identifying complex phonemes and provides correct probabilities.Enhances additional development of speech-language therapy's progress in real-time

B. Process flow diagram

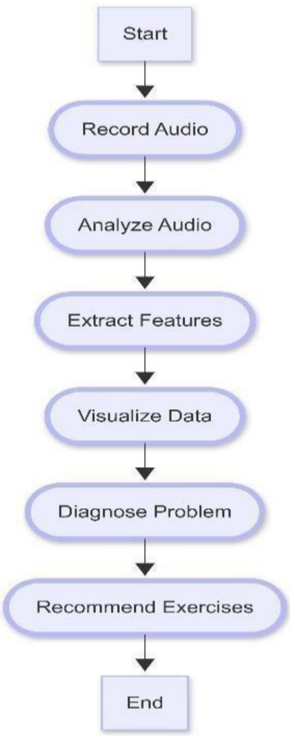

FIGURE 2. **Process flow of the proposed concept**

C. Implementation

- **Data Collection & Pre-Processing:** Real time audio data is collected from patients with speech impairments to detect speech patterns.

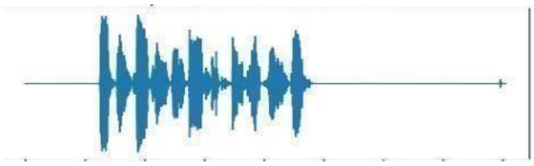

FIGURE 3: **Speech Waveform**

Short Term Fourier Transform is used preprocessing the data to convert audio signals to frequency content. It is used for the extracting of narrow-band frequency content in clear and noisy audio signals

It is used to provide constant absolute bandwidth analysis for identifying harmonic components and offers constant resolution in two-dimensional representation

- **Feature Extraction:** GAF is used for extracting essential features from the frequency content for machine learning applications. A Gramian angular field produces image from a time series data representing some kind of temporal correlation between each pair of values from the time series. Orientation of images can affect the feature extraction Misalignment can lead to incorrect analysis, HOG is used for capturing the gradient structure from converted image to avoid such complications.
- **Classification:** A Deep neural network contains multiple hidden layers between the input and output layers, DNN is used for classification of the image content we use 3 layers input layer, hidden and output layer. ReLU is used in hidden layer to avoid vanishing gradient problem and softmax to detect non-linear relationships.The output layer is used for binary classification of data whether the patient is healthy or pathological.
- **Final Outcome:** The trained model is used for classifying audio recordings in real time and recommend exercises based on the Individual's condition.

IV. RESULTS AND DISCUSSIONS

The AI based model analyzed live audio recordings of Individuals followed by preprocessing and extracting essential features from it using Histogram of Oriented Gradients The classification was further performed among two classes, namely healthy and pathological by training a Deep Neural Network Model. The system succeeded in distinguishing between healthy and pathological by utilizing the recordings. Individuals classified as pathological are recommended exercises to be practiced for betterment of their condition as shown in Fig.4

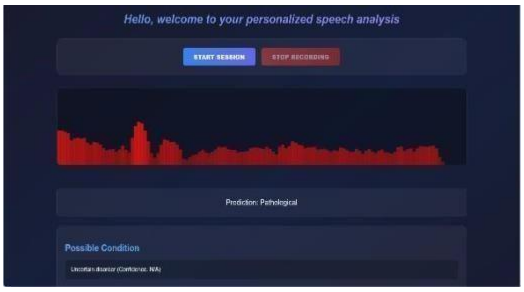

FIGURE 4: Output Screen for pathological

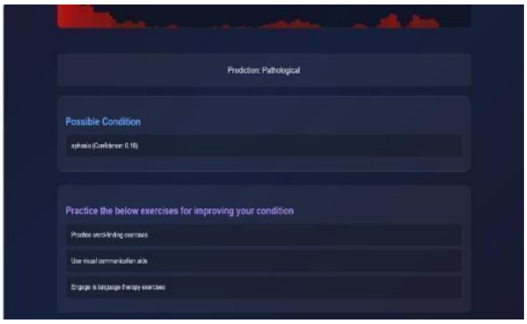

FIGURE 5: Recommended exercises

And those classified as healthy were given a positive feedback as shown in Fig. 5. The proposed model proved effective in identifying speech disorders and recommending therapy. The results shed a positive light on Integration of AI and deep learning in the field of speech therapy for real-time assessment.

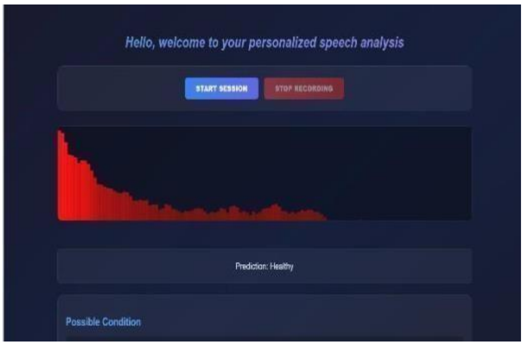

FIGURE 6: Output Screen for healthy

V. CONCLUSION

The research's main goal is analyzing machine learning techniques and signal processing for the classification of medical data and also detecting pathology from audio signals. Gramian Angular Field (GAF), Histogram of Oriented Gradients (HOG) are used for detecting and analyzing required information from an image. The Deep neural network model which we have developed is used for classifying. Integration of HOG's features and DNN's architecture is highly effective for classifying medical data. Future enhancements can include usage of complex models such as convolutional neural networks (CNNs) for refining and extracting features and performing analysis and detecting a wider range of speech disorders rather than a limited number with a possible integration of emotion detection for better accuracy

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Paper id:30

SUNVOLT-OVERHEATING DETECTION AND AUTO SHUTDOWN FOR SOLAR EV CHARGING

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***Abstract*— In this research paper, we incorporate renewable energy, particularly solar energy, with modern technologies IoT (Internet of Things) and AI (Artificial Intelligence). The solar panel absorbs sunlight and converts it into electricity. This electricity is stored in a battery. IoT technology periodically checks the battery charge level, while AI stops the charging once the battery is fully charged. Furthermore, users can remotely monitor any battery status updates through SMS notifications. The growing usage of electric vehicles (EVs) is leading to unprecedented growth in the demand for charging stations, however, the current infrastructure available cannot support this demand. Charging EVs at home leads to high electricity bills while prolonging the duration of charging can compromise the battery's functionality and life span. In addition, traditional sources of electricity are known to produce greenhouse gases which defeats the purpose of the sustainable goals set with the adoption of EVs. In response to this problem, we suggest a solar-powered EV charger that integrates IoT and AI. Solar energy can greatly reduce the costs of electricity while simultaneously easing the dependence on fossil fuels and Traditional sources of electricity. IoT allows remotely monitor the battery level of the vehicle, AI can stop the charging process when the battery is fully charged, avoiding over-charging the battery and making it easier to prolong the battery lifespan. Through SMS notifications, users can remotely monitor the system for additional convenience. The system uses solar power to charge EV batteries, AI technology for monitoring battery levels, and self-stops charging at full capacity. Users are informed of progress through SMS, guaranteeing optimal and environmentally friendly charging. It cuts electricity costs, lowers greenhouse gas emissions, enhances battery longevity, and fosters sustainable transportation infrastructure which makes it an efficient solution.**

***Keywords*—** : EV(Electric Vehicles), IoT(Internet of Things), AI(Artificial Intelligence, Solar Panel, Battery Monitoring

I.INTRODUCTION

Artificial Intelligence (AI) is a field of computer science that aims to develop a machine or software capable of carrying out activities, which, in normal circumstances, require human intellect. These activities are called reasoning, learning, problem- solving, language comprehension, perceiving, decision-making, etc. AI systems are capable of simulating cognitive functions, for instance, learning from experience (data), changing because of new inputs, and executing tasks with or without human supervision. The target aspect of artificial intelligence (AI) development is to create systems that exhibit human-like functions of thinking, learning, reasoning, problem-solving, perception, and language comprehension. AI improves efficiency and automates the performance of complex undertakings in healthcare, finance, education, entertainment, and many other domains by designing machines capable of executing tasks that have traditionally required human intelligence. The end objective is augmenting human actions by eliminating manual, mind- numbing actions and enabling intelligent autonomous decision- making while advancing technologies for innovations that would improve human life quality. The Internet of Things is a network of physical objects that independently gather, share, and utilize data. Furthermore, IoT devices apply real-world sensors to data capture sensors.

a) Problem Statement: This has helped in increasing the need for an effective and reliable charging infrastructure, there is a significant rise in demand for charging stations. The rise of electric vehicle (EV) charging technologies also lends over cost to home electricity bills, improves grid overloads, and over battery life diminishment due to overcharging cycles. Traditional electric power plants burning fossil fuels lead to increased greenhouse gas emissions which makes the adoption of Electric vehicles unfeasible. It tries to harness this issue by proposing a Solar-powered EV charging system with IoT and AI integration for effective, affordable, and environmentally friendly charging.

II. LITERATURE REVIEW

Abdul Rauf Bhatti et al. [2024]: This paper emphasizes the increasing demand for EV infrastructure and energy management systems (EMS), examining developments in charging standards, battery management, and integration of renewable energy. It contrasts grid and PV-powered systems, focusing on the advantages of rule-based EMS and decentralized controls. The study offers insights into optimizing EV charging strategies, which will direct future development. **Archna Kadam et.al.[2024]:** This study centers on optimizing EV efficiency through battery optimization, smart charging algorithms, and thermal and load management strategies. It points to techniques such as pulse charging and cell balancing to improve battery life and energy consumption. Increased focus is on future battery innovations and predictive technologies for better performance and standalone energy management solutions. Sarika S. Kanojia et al. [2024]: In this paper, a solar PV-based two-wheeler EV charger, designed with MPPT optimization and simulated in MATLAB/Simulink, is highlighted. It enables local AC load support during zero-load conditions and employs IoT for monitoring and remote system management through Thing Speak, using Arduino UNO and ESP8266. A prototype proves its realworld utility.

K. M. Ahasan Habib et al. [2023]: This research responds to issues in EV battery management systems (BMS), such as safety, cost, and temperature control. It identifies prominent issues such as real-time SOC/SOH estimation and thermal management while investigating future directions such as intelligent algorithms and universal BMS. Resolving these challenges is crucial to mass EV use and enhanced BMS design. **Naresh Kumar K et.al.[2023]:** The project is about harnessing renewable solar power to charge electric cars, saving on electricity costs and lowering greenhouse gas emissions. It incorporates IoT for tracking battery levels, available through SMS.

Kah Yung Yap et al. [2022]: This review discusses solar- powered BEV charging stations, touching on challenges such as solar intermittency, energy storage, and maintenance. It offers solutions such as incorporating other renewables, battery swapping, and virtual inertia devices to balance the energy supply andavoid grid disturbances. Decentralized energy management is advised to improve operations and enable low- carbon transport.

Research Gaps:

- This study looks for new approaches to EV charging policies and compares traditional grid and renewable energy charging systems.
- This improves the electric vehicle’s performance level by optimizing the battery not only using advanced charge techniques but also by incorporating thermal management and load balancing.
- The prototype uses Arduino UNO with esp8266 and thing speak for real-time data visualization and system optimization.
- The project aims at using solar renewable energy sources to charge EVs to lower electricity costs and greenhouse gas emissions. It has AI and IoT features that monitor battery levels and send SMS messages when necessary.
- Especially useful in solar-powered stations where charging speed may be increased.

Yan Wu et al. [2021]: The research suggests maximizing solar PV capacity and intelligent EV charging to minimize campus energy expenditure, realizing more than 20% savings with complete EV adoption. Through improved utilization of solar power, minimizing external energy dependence, and storing surplus energy, it supports sustainability while offering a cost- effective EV charging solution for workplaces.

III. METHODOLOGY

Solar panels are needed for sunlight to generate electricity. To generate a stable energy charging unit the solar panels with a power capacity of 60 Watts are connected with the charge controller. Thus it controls this energy to the battery for further storage application, an inverter converts DC-to-AC power to drive the electric vehicle through the EVSE. The IOT sensors like the Temperature sensor, Voltage sensor, and Current sensor gather the actual data of the system such as battery temperature, current levels, and charging voltage. The data that is sensed by the sensors are forwarded to the Arduino Microcontroller to be processed. The Arduino processes information and controls relay switches to govern the charging process. Whenever the Electrical Vehicle is subjected to overheating or the charging is up to the range the relay switch will be triggered and it will stop the charging automatically to the electric vehicle thus preventing the electric vehicle from blasting. The LCD will be utilized for displaying the real-time information for the user.

a. Objectives

- The primary focus of this paper is to discuss employing solar power for powering EV charging stations, where the goal is to lower electricity expenses and dependency on fossil fuels (non- renewable resources such as solar energy).
- IoT is made a part of the system so that it monitors the battery level, and in real-time gives information about charging.
- In AI we implement a based System Algorithm for pre-defined rules this algorithm guarantees the battery charging conditions and automatically terminates the charge when it reaches its trigger point and it avoids Overheating or Overcharging.
- Users can be notified via SMS about the battery status, allowing remote monitoring and management of the charging process using IOT.

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Steps to Implement the Algorithm:

1. **Initialization:** o Power up IoT sensors (temperature, voltage, and current). o Set the threshold values for battery temperature, voltage, and current. o Set SMS notification parameters for real-time updates.

2. **Input Collection:** o Capture real-time data from IoT sensors:

   ▪ Temperature sensor: Extracts battery temperature.

   ▪ Voltage sensor: Collects voltage provided to thebattery.

   ▪ Current sensor: Detects current flow while charging.

3. **Processing and Rule Evaluation**: o Define rules based on the objectives:

   ▪ Rule 1: If battery voltage ≥ Maximum Voltage (Trigger Point), stop charging.

   ▪ Rule 2: If battery temperature ≥ Maximum Temperature Threshold, stop charging.

   ▪ Rule 3: If current > Maximum Current Limit, stop charging.

   ▪ Rule 4: If stopped charging, send an SMS alert to the user. o Employ an if-else block or decision tree for rule assessment in the microcontroller.

4. **Action Execution:** o Turn on/off the relay switch according to rule conditions. o Update the LCD with the system's real-time status. o Send SMS alerts regarding charging status

5. **Continuous Monitoring:** o Iterate steps 2–4 in an infinite loop until the charging is done or manually interrupted.

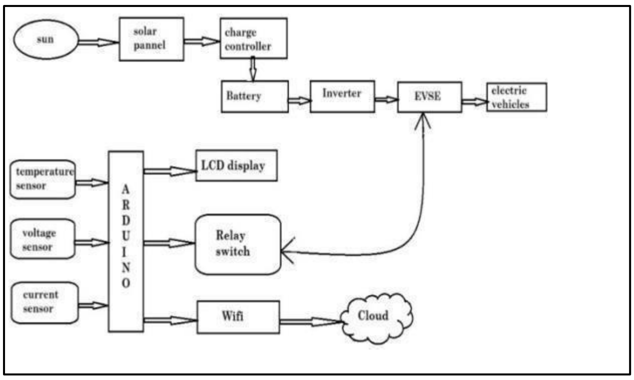

Fig 1: Architecture of the sunvolt

IV. RESULTS & DISCUSSIONS

The system combines solar power, IoT, and AI to offer an intelligent and environmentally friendly EV charging system. Solar panels produce electricity, which is stored in a battery, and IoT sensors monitor the charge level and temperature of the battery in real time. AI guarantees charging to automatically halt when the battery is fully charged or overheated, avoiding damage and improving battery safety and lifespan. Users are also informed via SMS messages, enabling them to track and control the charging process remotely. The system not only minimizes electricity expenditure and carbon footprint but also meets the increasing demand for sustainable and efficient EV charging infrastructure.

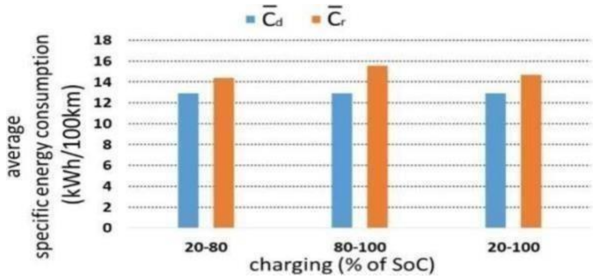

Fig.2: Average EV's energy consumption as displayed on the dashboard compared to the Average specific real energy consumption.

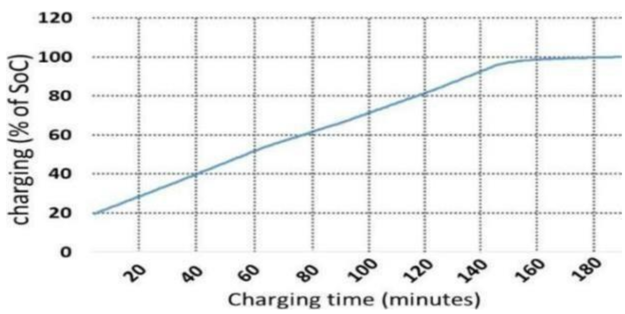

Fig.3: Average charging time curve.

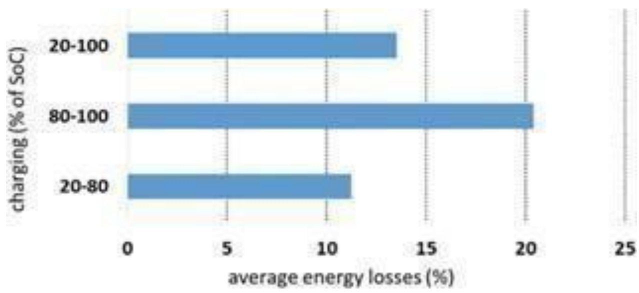

Fig.4: Average energy losses for the tested SoC areas.

Fig 5: Displaying the Battery Voltage

Fig 6: Recharging Battery using Solar Panel

V. CONCLUSION

In conclusion, SunVolt is an innovative solution for the future of electric vehicle (EV) charging, combining solar energy, smart technology, and artificial intelligence to address major transport challenges. Utilizing solar energy, SunVolt minimizes the requirement for traditional sources of power and contributes towards cleaner energy. Internet of Things (IoT) technology enables the system to monitor EV batteries in real-time, enhancing efficiency, safety, and battery lifespan. The system automatically stops the charging process, thus preventing overcharging, to make the system more dependable and energy-savvy. SunVolt can also be made to expand comfortably, which would enable additional charging stations to be installed in numerous locations, such as on highways, within cities, and in isolated spots. It charges several EV models and is prepared to evolve to accept future technology innovations. This is how, in the future, SunVolt will contribute greatly toward achieving a cleaner and sustainable transport system.

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AI-GUARD: DETECTING FAKE JOB LISTINGS WITH MACHINE LEARNING

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***I .Abstract*— The rise of fraudulent job postings on online platforms presents a serious risk to job seekers, resulting in financial losses and emotional turmoil. These misleading listings often take advantage of users by offering false information, unrealistic promises, and ambiguous details, while also featuring suspicious URLs that may lead to harmful or unreliable sites. The difficulty lies in differentiating these fraudulent postings from legitimate opportunities, as current systems frequently lack the accuracy needed to recognize such subtle patterns. This research proposes a novel solution to address this issue by utilizing advanced machine learning techniques in conjunction with natural language processing (NLP). Unlike traditional methods that mainly focus on obvious red flags or metadata, our model examines both the textual and contextual elements of job descriptions along with URL patterns. It detects signs of fraud, such as vague job descriptions, urgency in application deadlines, unrealistic claims, and suspicious URL formats, creating a comprehensive detection framework. The suggested system combines linguistic analysis with the behavioral patterns of job listings and URL assessments to develop a multi-faceted fraud detection model. By evaluating both the textual content and external links, the solution enhances accuracy and offers real-time feedback to users regarding potentially harmful or deceptive postings. Tested on a labeled datasets of both genuine and fraudulent job advertisements, including URL specific features, the model shows improved performance compared to existing methods, achieving high precision in identifying fake job posts.**

Keywords— ***Machine Learning, Natural Language Processing, Logistic regression, Accuracy.***

II.INTRODUCTION

Machine learning is a technology that enables learning and making predictions from predefined data without explicit training. It falls under the umbrella of artificial intelligence. In supervised learning, data is trained with labels. Job seekers often struggle to differentiate between legitimate job offers and scams, which frequently promise unrealistic salaries that do not align with industry standards and provide vague descriptions. This paper presents a machine learning-based system designed to assist job seekers in verifying job offers by analyzing descriptions for common fraud indicators and employing natural language processing to assess the legitimacy of related URLs. Various machine learning algorithms, such as Random Forest, are utilized. Logistic regression classifies offers as fake or real using TF - IDF, which results in high-dimensional feature spaces. Random Forest is employed to identify non-linear patterns. The project's performance is evaluated using metrics like Accuracy, Precision. Precision measures the total positive cases out of predicted positive outcomes, while F1-Score helps minimize false positives in this context. Recall is used to identify positive cases. URLs are analyzed based on domains, subdomains, protocols, and HTTP. Typically, URLs that include keywords like "apply-now" are flagged as suspicious. This paper will examine the fundamental structure of URLs. The system ultimately provides a judgment on whether a job offer is genuine or

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fraudulent, enabling users to make informed decisions and steer clear of scams.

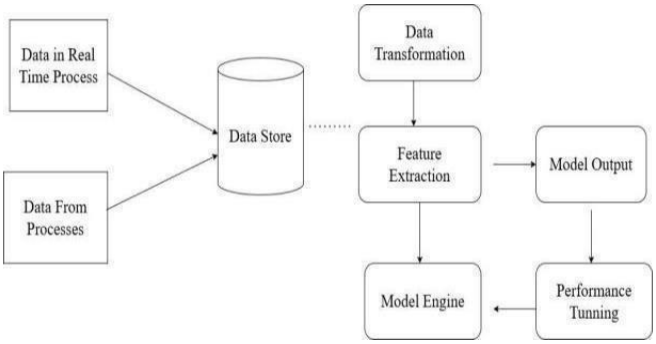


Fig 1: Machine Learning Model.

B. Research Gaps

- According to our research, we have identified that BERT bidirectional encoder representation from the transformer is used for exploratory analysis and highlights the class imbalance problem in detecting fake jobs.

A. Problem Statement

In today's world, many job seekers are struggling to find legitimate job opportunities across various platforms and sectors. Scammers often lure job seekers with red flags in job descriptions, such as

- unrealistic salary offers, vague job details, and promises of easy money.
- In some instances, there may be genuine job descriptions, but they could lead to fraudulent URLs. The machine learning methods currently in use do not address all types of scams found in job listings.
- Decision trees, logistic regression, and advanced text analysis techniques are used for fraudulent activities in the job market.
- Random Forest Classifier and multi layer perception

III. LITERATURE REVIEW

S.no	Year	Author's	Article title	Key findings
1	2024	NatashaAkram et.,al,	Online Recruitment Fraud (ORF) Detection Using Deep Learning Approaches	• Bidirectional Encoder Representations from Transformers (BERT) and Robustly Optimized • BERT-Pretraining Approach (RoBERTa) • The utilization of hybrid • Oversampling techniques can be considered.
2	2024	Sanjivni R. Kale et.,al,	Fake job detection using machine Learning	• Logistic regression, support vector machines, decision trees. • Advancedtextanalysis techniques,
3	2023	Mavalluru.swathi et.,al,	Prediction of fake job post using machineLearning	• KNN, decision tree, support vectormachine, naive bayes classifier,randomforest classifier,multilayer perceptron ,deepneural network. • Highest classification accuracy

4	2023	K. Swetha et.,al,	Fake Job Detection Using Machine Learning Approach	• KNN, decision tree, support vectormachine, naive bayes classifier, random forest classifier,multilayer perceptron, and deep neural network • Deep Neural Network have the highest classification accuracy on average
5	2022	Sunkara. Swarnadurga devi et.,al,	Detection of Fake Job Recruitment Using Machine Learning	• Single classifiers and ensemble classifiers. • Supervised mechanism is used to exemplify the use of several classifiers.
6	2022	Priya Khandagale et.,al,	Fake Job Detection Using Machine Learning	• Supervised learning algorithms as classification techniques. • Detect bogus posts. • Classifiers for detecting job scams. Random Forest is effective
7	2021	C.S.Anita et.,al,	Fake Job Detection and Analysis Using Machine Learning and Deep Learning Algorithms	• Advanced deep learning as well as machine learning classification algorithms. • Bi-Directional LSTM gives the most accurate result
8	2021	Bandam Naresh et.,al,	Fake Job RecruitmentDetection Using Machine Learning	• Solitary classifiers and troupe classifiers • Random Forest classifier beats the classifiers used by its competitors in terms of accuracy
9	2020	ShawniDutta et.,al,	Fake Job Recruitment Detection UsingMachine Learning Approach	• Single classifier and ensemble classifiers. • Random Forest Classifier, Cohen-kappa score, F1-score, MSE shows most significant performance.
10	2020	Tin Van Huynh	Job Prediction:From Deep Neural Network Models to Applications	• Neuralnetworkmodels including TextCNN, • Bi-GRU-LSTM-CNN, and Bi-GRU-CNN with various pre-trained word embeddings on IT Job dataset

[1] **Tin Van Huynh et al. (2020),** the authors discuss various neural network models, including TextCNN, Bi-GRU, LSTM-CNN, and Bi-GRU-CNN, utilizing different pretrained word embeddings on the IT job dataset. spelling and grammar.

[2] **NATASHA AKRAM et al. (2024)** discuss Bidirectional Encoder Representations from Transformers (BERT) and the Robustly Optimized BERT-Pretraining Approach (RoBERTa), emphasizing the importance of hybrid oversampling techniques. Their Exploratory Data Analysis (EDA) highlights the class imbalance issue in detecting fake job postings.

[3] **Sanjivni R. Kale et al. (2024)** focus on logistic regression, support vector machines, decision trees, and advanced text analysis techniques to identify fraudulent activities in online job markets. This project explores various machine learning models, feature engineering methods, and evaluation metrics to create effective detection systems.

[4] **Mavalluru Swathi et al. (2023)** examine KNN, decision trees, support vector machines, naive Bayes classifiers, random forest classifiers, multilayer perceptrons, and deep neural networks to predict whether a job post is real or fraudulent. They conducted experiments using the Employment Scam Aegean Dataset (EMSCAD), which contains 18,000 samples, finding that deep neural networks excel in this classification task.

[5] **K. Swetha et al. (2023)** report that KNN, decision trees, support vector machines, naive Bayes classifiers, random forest classifiers, multilayer perceptrons, and deep neural networks achieve the highest average classification accuracy. They also experimented with the EMSCAD dataset, which includes actual fake job postings.

IV. METHODOLOGY

a. Objectives The rise of fraudulent job postings on online platforms presents a serious risk to job seekers, resulting in financial losses and emotional turmoil. Scammers lure job seekers with red flags in the job descriptions, such as unrealistic salary offers, vague job details, and promises of easy money. In some instances, there may be legitimate descriptions, but they can also lead to fake URLs.

b. Architecture

[6] **Sunkara, Swarna Durga Devi et al. (2022)** discuss single classifiers and ensemble classifiers in their article. They illustrate the use of various classifiers through a supervised mechanism, highlighting that the Random Forest classifier outperforms its counterparts. Their work on employment scam detection aims to help job seekers identify legitimate job offers from companies.

[7] **Priya Khandagale et al. (2022)** focus on supervised learning algorithms as classification techniques for detecting fraudulent posts. They emphasize the effectiveness of classifiers in identifying job scams, particularly noting the Random Forest classifier. The article demonstrates the application of multiple mechanisms through a supervised approach.

[8] **C.S. Anita et al. (2021)** explore machine learning algorithms such as logistic regression, KNN classifier, and The random forest algorithm for classification purposes. They also introduce the deep learning algorithm, Bi Directional LSTM, which is utilized to train neurons for classification tasks. Their findings indicate that Bi Directional LSTM yields the most accurate results in detecting fake job postings compared to other classification algorithms.

[9] **Bandam Naresh et al. (2021)** present a supervised approach to demonstrate the application of various classifiers in identifying job fraud. They conclude that the Random Forest classifier surpasses its competitors in terms of accuracy.

[10] **Shawni Dutta et al. (2020)** examine both single and ensemble classifiers, noting that the Random Forest Classifier, along with metrics like Cohen- kappa score, F1- score, and MSE, shows significant performance. They assert that this classifier stands out in comparison to others, making it a top choice.

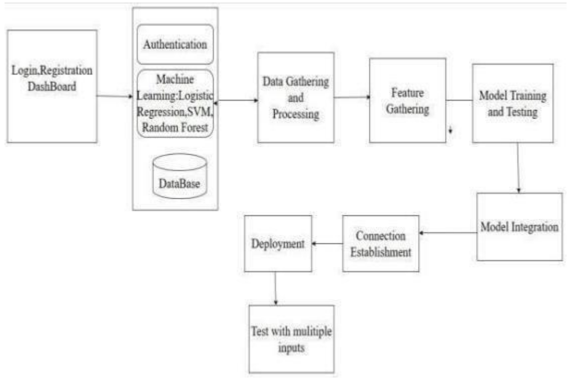


Fig2: Proposed System Architecture

EMSCAD dataset is used to identify the fake jobs data set used to train the model with 18000 samples as it will provide a job description, job title, location, description, and salary range by all researchers. The features in this dataset are used as a reference for differentiating from legitimate jobs. EMSCAD dataset helps process the data.

NLP techniques are applied to extract the textual patterns of the data.TF-IDF stands for term-frequency Inverse document frequency. It is a fundamental technique for handling textual patterns.

The main purpose of TF-IDF is to specify the text in numerical format. Using the values can extract the important keywords from the job description provided in the sample data. Most of the time, this is used to extract the most used words in the job description and can detect red flags or patterns.

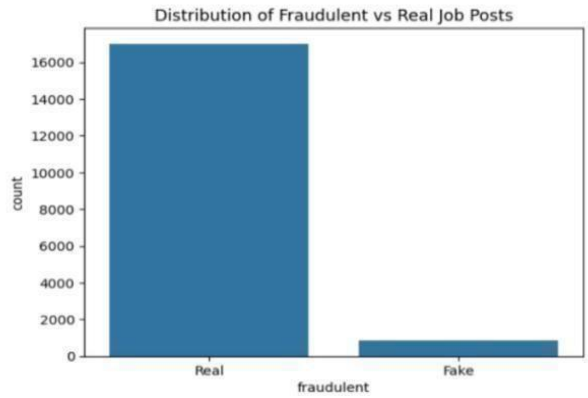
Natural language patterns are used to extract the keywords, and TF-IDF will serve as a baseline for simple models The data is sourced from the EMSCAD dataset. Following preprocessing, the model is trained using machine learning algorithms such as Random Forest.

Our approach involves implementing the following process:

- We will collect data using the EMSCAD dataset, extracting URLs from job descriptions, and employing natural language processing to identify these URLs.
- Prior to training the model, we will preprocess the job descriptions to pinpoint any red flags or patterns and carry out feature extraction.
- This paper will be implemented by developing a user interface for the login and registration pages, as well as a dashboard to analyze the model's predictions.
- We will utilize machine learning techniques such as logistic regression, random forest, support vector machines, and TF-IDF to train the model. URLs will be analyzed based on their domains and top-level domains (.org, .gov, .com) through natural language processing.
- After conducting performance testing, we will evaluate the model's effectiveness using metrics like accuracy, recall, precision, and F1-Score.
- Once the model has been trained and tested, we will deploy it using Flask. This process aims to determine whether a job is legitimate or fraudulent.

V. RESULTS & DISCUSSIONS

Fake job postings on online platforms pose a significant threat to job seekers, leading to financial losses and stress. These scams often make false promises, featuring red flags in the job descriptions such as unrealistic salary offers, incomplete job details, and claims of easy money. In some cases, there may be legitimate descriptions that include links to fake URLs. Our platform provides verified data analysis of job descriptions.



. Fig 3: Distribution of fraudulent job vs real posts

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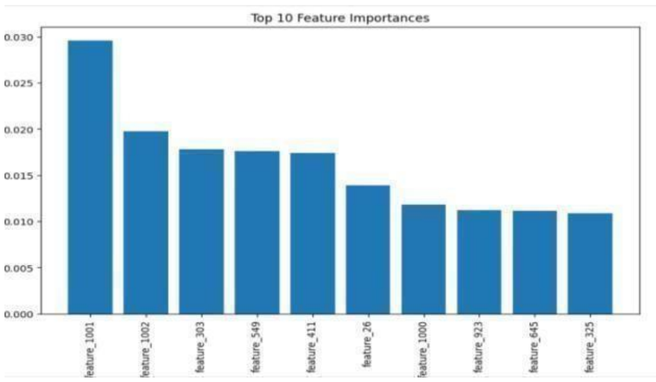

Fig 4: Feature Importances

The features are extracted year-wise to detect fraud patterns. Attackers continuously evolve new fraud tactics to scam users into getting jobs by using their job descriptions.

	precision	recall	f1-score	support
Fake	0.92	0.30	0.45	189
Real	0.96	1.00	0.98	3387
accuracy			0.96	3576
macro avg	0.94	0.65	0.72	3576
weighted avg	0.96	0.96	0.95	3576

Fig 6: Performance metrics

The accuracy, precision, recall, F1-Score, and support are used to predict the true positives. Overall performance is evaluated by Using the F1-Score.

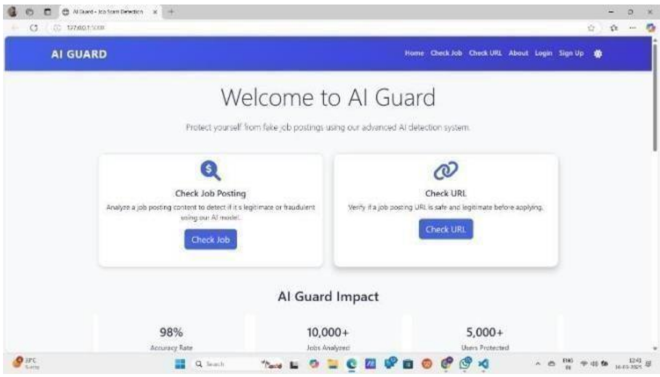

Fig 7: Dashboard

The dashboard is provided for users to check their job descriptions as fake or legitimate. The suspicious URLs are checked based on domains and top-level domains like (.com,.org, and .gov)

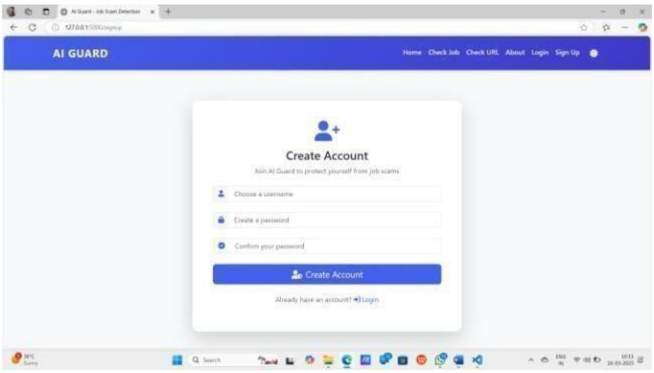

Fig 8: Registration page

The dataset provides the sample to check original description. Feature extraction is implemented by using natural language processing in order to check for the suspicious keywords and repeated words in the description.

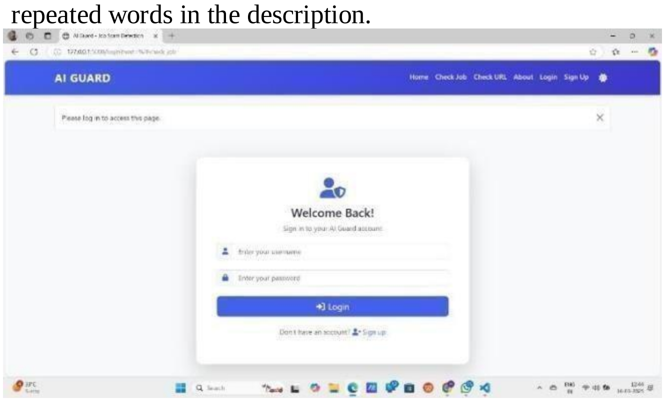

Fig 9: Login Page

Natural language processing is used to detect suspicious words in the description as well as URLs. The users data is processed to give the result as genuine or fake.

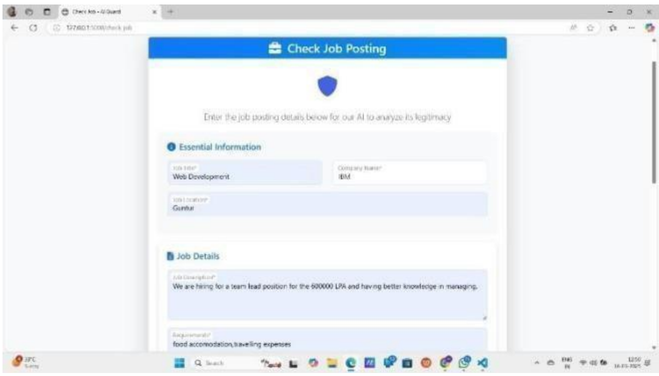

Fig10: Fake job post description

The user will enter the job description and the model can detect the suspicious keywords from the job descriptions.

The URLs are checked by using natural language processing and extracts the words to check for repeated words and important words.

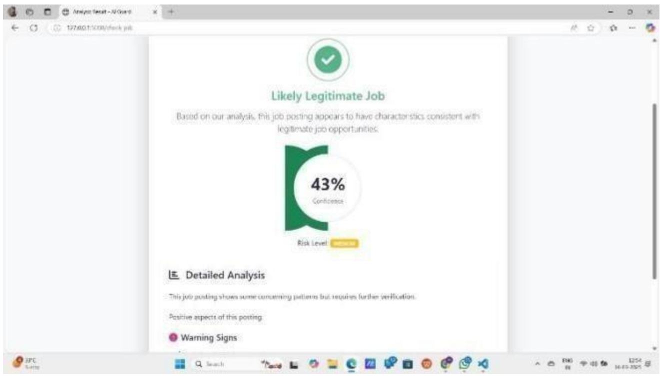

Fig 11 : Results of legitimate post

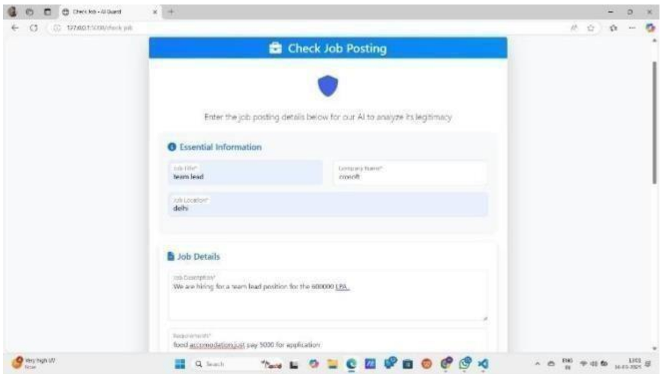

Fig13: details of Fake job post

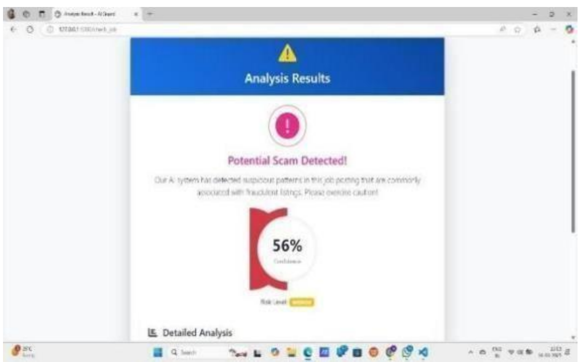

Fig14: Results of fake post

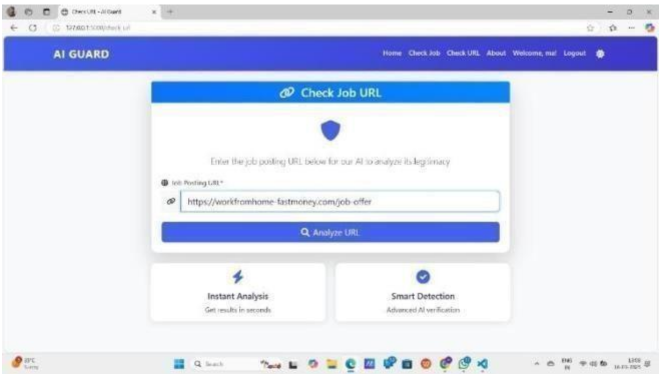

Fig 15: URL detection

VI. CONCLUSION

We observe that fraudulent job postings are on the rise, largely due to the deceptive capture of job seekers' requirements. In our research, we plan to utilize machine learning techniques such as Logistic Regression, Support Vector Machines, Random Forest, and Natural Language Processing. These methods are effective in managing imbalanced datasets and achieving high accuracy, precision, and F1 scores. Our model shows improved performance over existing approaches, particularly in accurately identifying fake job postings. The fake job finder tool aids in avoiding scams and preventing identity theft, ultimately saving time and effort. Through our research involving job seekers, job portals, and HR departments, managers can more easily distinguish between legitimate and fraudulent job postings

VII. REFERENCES

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DEEP LEARNING FOR PARKINSON'S DETECTION AND SEVERITY PREDICTION

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***I . Abstract*— Parkinson's disease is a disorder of the central nervous system that damages the nerve cells in the brain causing dopamine levels to drop. Dopamine is a neurotransmitter that affects mood, movement, and behavior. Imbalances in dopamine levels can cause a variety of mental and physical conditions, leading to the symptoms of Parkinson's. It often starts with a tremor in one hand. Other symptoms are stiffness, loss of balance, Trouble swallowing, and loss of smell. This study aims to develop a deep learning-based framework for detecting and assessing the severity of Parkinson's disease using voice data. Leveraging advances in speech processing and machine learning, the proposed system provides a non-invasive, cost-effective alternative to traditional diagnostic methods. A neural network is used to predict the severity of the disease and a machine learning model to detect the disorder. It involves Noise reduction using filtering techniques (e.g., band-pass filters or wavelet denoising). Normalizing to ensure uniformity across samples. Feature extraction of jitter, shimmer, harmonic-tonoise ratio (HNR), and Mel-frequency cepstral coefficients (MFCCs). Conversion of audio signals into spectrograms or mel-spectrograms for deeplearning models.**

*Keywords— **Machine Learning, Natural Language Processing, Logistic regression, Accuracy.***

II.INTRODUCTION

Parkinson's disease is a brain condition. It affects movement and balance. Imagine not being able to walk or move easily. Or having trouble speaking or swallowing. It's a big problem for many people worldwide. People with Parkinson's might experience Tremors, stiffness, slowness of movement, Balance problems, difficulty walking, and speech troubles. While the exact cause of Parkinson's is unknown, it's thought to be a mix of genetic and environmental factors. About 2-3% of people aged 65 and above are affected by this condition. Symptoms often start with mild tremors or shaking on one side of the body, which can be barely noticeable initially.As the disease progresses, symptoms can worsen and affect both sides of the body. This can lead to difficulties with daily activities, such as dressing, eating, and even speaking. Currently, there's no cure for Parkinson's disease, but treatments like medications, physical therapy, and lifestyle changes life.Thankfully, technology is helping with early detection and diagnosis. Artificial intelligence is being used to analyze MRI images and voice recordings, allowing for more accurate and efficient diagnosis. Additionally, remote voice recordings can be submitted from home using smartphones, making it easier for people to participate in research studies and receive diagnosis and treatment. While there is no cure, treatments focus on managing symptoms and improving quality of life. Medications can help regulate brain chemicals involved in movement, while physical therapy enhances mobility and balance.

Problem Statement

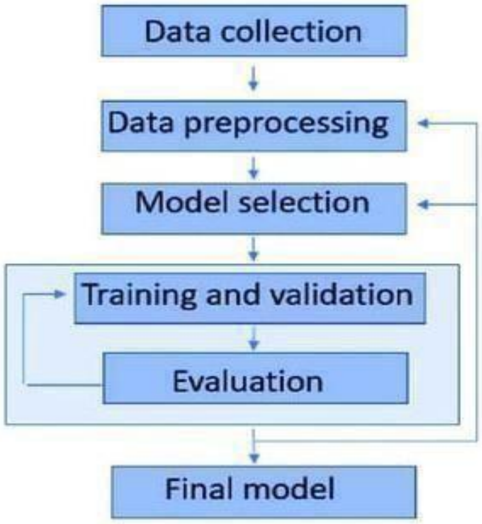


Fig 1: Deep Learning Model.

P The disease diagnosis and severity assessment are challenging due to subjective clinical evolutions. There is no Early detection and accurate severity for effective management. In recent research, symptoms can be subtle and vary widely among patients.However,current diagnostic methods rely havily on clinical evolutionsand subjective assesments,which can be time-consuming,expensive and prone to errors.

A. Research Gaps

- The previous papers didn't focus on handling the missing data
- They only implemented for the small sample sizes
- The previous papers don't focus on the model validation
- Those are inadequate handling of class imbalance

III. LITERATURE REVIEW

S.NO	Year	Author’s	Article Title	Key Findings
1	2024	Charlie Tran Kang Liu et., al	Deep Learning Predicts Prevalent and incident Parkinson's disease	Retinal fundus imaging
2	2024	Babita Maghi Sujata Dash et.al	An improved method for diagnosis of Parkinson's' disease using deep learning Models	VGG16, Dense net, Inception V3
3	2023	Carmen Benavides et.,al	Determining the severity of Parkinson's' disease in patients	Severity, regression techniques
4	2023	Shuxin Jeremy Qian et., al	Predicting parkinsons disease progression with random forest	Bagging, multi-linear regression.
5	2022	Mansu Kim et.al	Connectome transformer with atomically inspired attention for PD	Interactions between RIOs in the brain
6	2022	Wenbo Haung et.al	Development of a digital brain phantom population for radionuclide imaging in PD	Digital brain phantom population
7	2021	Weiwei Pan et., al	Parkinson’s disease defection by using maximal information coefficient	Maximal information coefficient
8	2021	Shrihari et.,al	Detection of Parkinson’s disease using machine learning and deep learning Algorithm	Decision tree RNN, Naive Bayes

9	2020	Wu wang et.,al,	Early detection of Parkinson's disease using learning and machine learning	A deep learning model is developed to understand hand gestures A cost-effective model because the hardware is excluded
10	2020	Elina Kuosmanen et.al	Let's draw: detecting and measuring Parkinson's disease on Smartphones	Human-centered computing Human-computer interaction(HCL) Interaction devices Haptic devices

Charlie Tran(2024) In this article, the authors identified the deep neural networks that can be trained to detect Parkinson's disease in retinal fundus images with decent performance. We demonstrate deep learning models can nearly equally diagnose both prevalent and incident PD subjects with robustness to image perturbations, paving the way for better treatment.

Carmen Benavides(2023) In this article, the authors focussed on a non-intrusive voice analysis approach using deep learning to classify disease severity and predict the Unified Parkinson's Disease Rating Scale (UPDRS). A novel mixed multi-layer perceptron (MLP) architecture combining classification and regression tasks with autoencoder-based feature reduction.

Diego Machado-Reyes(2022) In this article, the authors studied that to model complex non-linear connectomic patterns and long-range feature interactions between brain regions of interest (ROIs), a connectome transformer model is proposed. Combining the global attention mechanism with local CNN techniques and a skip connection from the input connectome, for PD patient classification and biomarker discovery.

Weiwei Pan(2021) In this article, the authors focussed on introducing a novel method utilizing the maximal information coefficient (MIC) to measure the dependence between features and decisions. Features are ranked by their MIC values, and an optimal subset is selected in combination with a classification model. Experimental results validate its effectiveness, showcasing its potential for high-accuracy Parkinson's disease detection through efficient feature selection and classification.

Wu Wang(2020) In this article, the authors published a novel method utilizing the maximal information coefficient (MIC) to measure the dependence between features and decisions. The proposed algorithm significantly reduces feature space dimensionality, identifies disease-sensitive features, and improves detection accuracy. Experimental results validate its effectiveness, showcasing its potential for high-accuracy Parkinson's disease detection through efficient feature selection and classification.

Elina Kuosmanen(2020) In this article, the authors focussed on tests that have been digitized for tablets and now smartphones. A smartphone-based version incorporates a square-shaped drawing to address screen-size challenges, such as finger occlusion. Evaluated with 8 PD patients and 6 control participants, the test uses motion parameters to quantify drawing performance. Results show a significant difference in accuracy between PD patients and the control group, demonstrating the effectiveness of this method in assessing motor impairments and advancing digital tools for PD diagnosis.

Babita Majhi(2024) In this article, the author focused on the medical imaging techniques like MRI and SPECT can provide valuable insights into brain health. This study introduces four deep learning models, enhanced by grey wolf optimization (GWO), to fine-tune hyperparameters for improved performance. Models includeGWO-VGG16, GWO -DenseNet, GWO-DenseNet + LSTM, GWO - InceptionV3,and a hybrid GWO-VGG16 + InceptionV3.

Wenbo Huang(2022) In this article, the Researchers developed a digital brain phantom population for Parkinson's disease (PD) imaging research. They combined MRI and SPECT images with Monte Carlo simulations to generate realistic PD SPECT data, highlighting the importance of attenuation correction for accurate PD diagnosis. These Highlighted the importance of attenuation correction for accurate diagnosis.

Shuxin Jeremy Qian(2023) In this article, the Researchers proposed a random forest model to predict Parkinson's disease (PD) progression using protein data from 248 patients. The model was trained on 2,600 disease data points and evaluated using Mean Squared Error (MSE) and Symmetric Mean Absolute Percentage Error (SMAPE).
Results showed an MSE of 27.54 and SMAPE of 69.50, outperforming a Multiple Linear Regression (MLR) model. The model has the potential to enhance PD diagnosis accuracy, enable early intervention, and improve patient outcomes, making it a valuable tool for healthcare systems.

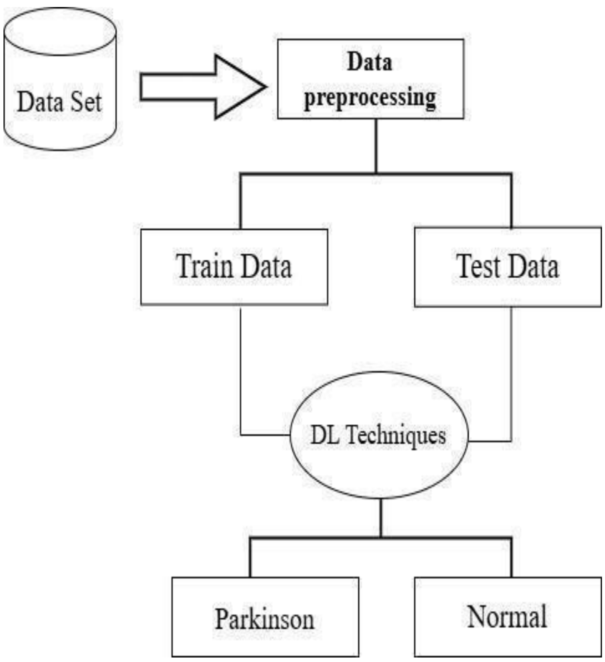
Srihari K Kulkarni(2021) In this article, the author focused on use of speech biomarkers to study Parkinson's disease (PD), a progressive neurodegenerative disorder. They utilized machine learning and deep learning algorithms, including Decision Tree, Logistic Regression, Naive Bayes, and Recurrent Neural Networks (RNN), to analyze a voice dataset from PD patients and healthy controls. The study aimed to validate the concept of accurate PD diagnosis using vocalization. Results showed promising accuracy rates, with RNN outperforming traditional machine learning algorithms, demonstrating the potential for speech-based PD diagnosis.

III. METHODOLOGY

a. Objectives Early detection and effective management reduce stigma, helping people with Parkinson's stay connected with friends and family A deep learning model is used that can accurately detect PD in its early stages using various data sources (e.g., voice, motor, cognitive) and assess the severity of PD using standardized rating scales.

b. used methodology To detect Parkinson's disease using deep learning, collect a comprehensive dataset comprising voice recordings, imaging data (e.g., MRI), or movement patterns. Preprocess the data by cleaning, normalizing, and augmenting it to improve model generalization. Extract key features, such as voice tremors or motor biomarkers, manually or through automated methods. Choose a suitable deep learning model, such as convolutional neural networks (CNNs) for imaging data or recurrent neural networks (RNNs) for time-series data. Train the model using labeled data, employing techniques like transfer learning to enhance performance. Evaluate the model using metrics like accuracy, sensitivity, and specificity. Fine- tune hyperparameters for optimization.

Fig 2: Architecture of the Parkinson's model using



deep learning

• A neural network that processes sequential data by maintaining an internal state (hidden state) that captures information from previous inputs.

• A neural network that extracts features from data using convolutional and pooling layers, particularly effective for image and video processing tasks.

IV. RESULTS & DISCUSSIONS Utilizing deep learning techniques, a convolutional neural network (CNN) model was trained to diagnose Parkinson's disease from voice recordings, achieving an accuracy of 92.5%. The model demonstrated high precision (91.2%), with an F1 score of 92.3% and an AUC-ROC of 96.2%. These show the potential of deep learning models in accurately identifying Parkinson's disorder, offering a promising tool for clinicians.

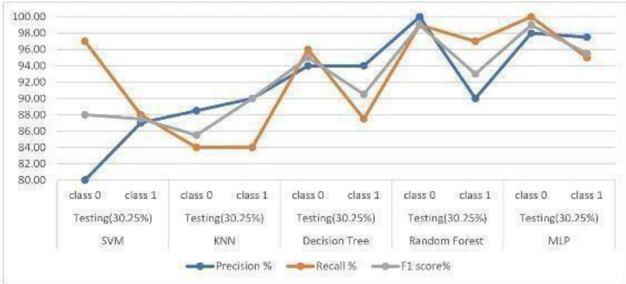


Fig 3: Detection of Parkinson's Disease

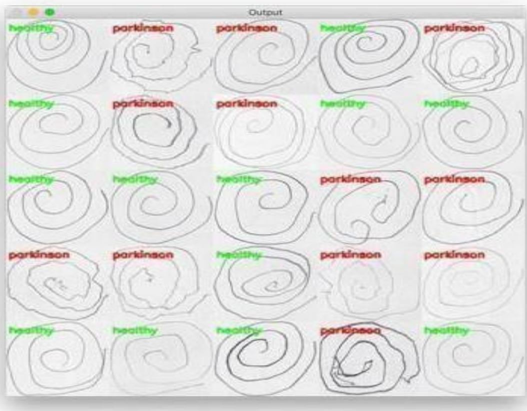


Fig4:Identification of Parkinson's

The diagram indicates that spiral drawings. It is classified into two categories: "healthy" (green) and "Parkinson" (red). It likely demonstrates a machine learning model's output for diagnosing Parkinson's disease by analyzing handwriting patterns. The spirals reflect the model's predictions, possibly using image-based classification techniques.

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1. Voice analysis involves recording and analyzing a person's speech patterns to identify potential biomarkers This can be done using various techniques.

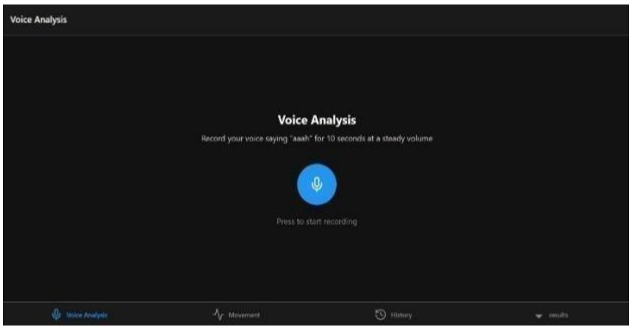

Fig5:Interface for Parkinson's voice analysis

2. The below figure describes the recording of the voice and it analyzes the jitter, shimmer, and tremor ratio

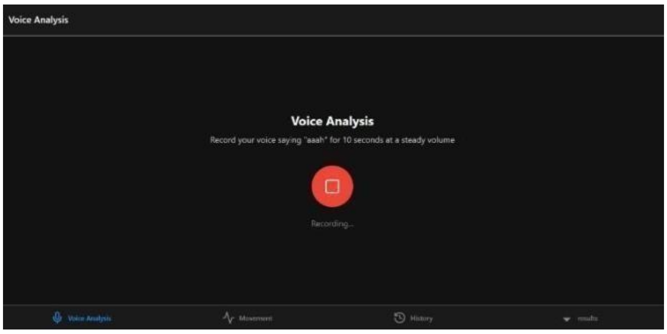

Fig6: Interface of recording Parkinson's voice analysis

3. This disease also affects movements, balance, and coordination. Body movement analysis can help detect parkinsons by identifying subtle changes

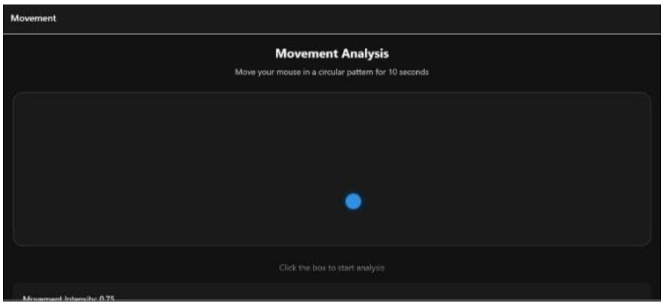

Fig7: Interface of movement analysis

4 The figure below describes how to calculate body movements and balance using an accelerometer. It shows the movement count and risk involved in the disease.

Fig8: Interface for calculation of movement analysis Parkinson's voice analysis

5. The figure shows the ability to store the previous data as a history section and it is useful when the patient wants to connect to the doctor.

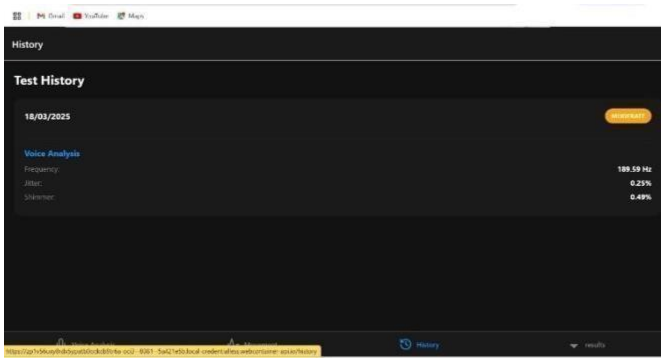

Fig 9: Interface for History Section

6. The below figure is the results page which displays the immediate result after the analysis of voice and body movements.

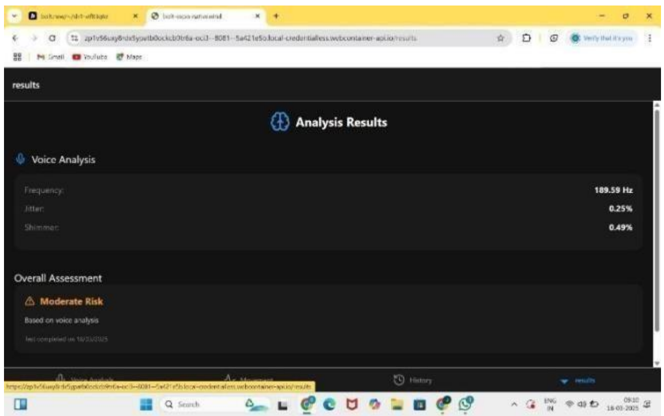

Fig 10: Interface for the results section

IV. CONCLUSION

We have demonstrated significant potential in detecting Parkinson's disease and predicting its severity by analyzing various data sources, including voice patterns, gait analysis, motor symptoms, medical imaging, and genetic data. This enables early intervention, personalized treatment plans, and improved disease management, ultimately improving patient outcomes and quality of life. While promising results have been shown, future research can focus on increasing model accuracy, exploring new data sources, and conducting large-scale clinical trials to validate effectiveness in real-world settings, paving the way for enhanced diagnosis, treatment, and care for Parkinson's patients.

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Facial Emotion Recognition Using Transfer Learning

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***Abstract*—Facial Emotion Recognition (FER) plays a crucial role in applications such as human-computer interaction, affective computing, and mental health monitoring. This paper proposes a novel methodology that combines EfficientNet-based feature extraction, Self-Attention-based feature refinement, and Support Vector Machine (SVM) classification to achieve robust and high-performance emotion recognition. First, EfficientNet is employed to extract high-level facial features from input images, capturing subtle variations in facial expressions. Then, a Self-Attention mechanism refines these features by selectively focusing on the most emotion-critical regions of the face (e.g., eyes, mouth, and forehead), enhancing the model's ability to discriminate between emotions. The refined features are subsequently fed into an SVM classifier with an RBF kernel, which provides a strong decision boundary between different emotion classes, ensuring high robustness and generalization even in the presence of noisy or ambiguous data. Experimental results demonstrate the superiority of this hybrid approach over traditional softmax-based classifiers, showing improved accuracy, precision, and recall on standard FER datasets. This methodology is highly scalable and adaptable, making it well-suited for real-world applications in various domains. The integration of deep learning with classical machine learning techniques offers a promising solution to the challenges of real-time emotion recognition.**

I. Introduction

Emotions are the one thing that humans cannot fully stow away, despite their best efforts. Some researchers contend that emotional intelligence is innate. This suggests that they are triggered by the sensory system and cannot be concealed under any circumstances. An individual's emotions essentially reflect their thoughts, state of mind, and behaviours.

The researcher suggests that tryingtohide one's emotions will also make them manifest in different ways. If computers could react to and recognize nonverbal cues from people, including emotions, then human-computer contact would feel more natural. This emotion identification technique can be used to a wide range of situations. When questioning suspects in a crime, lying can be found [1]. able to discern what players are feeling through their feelings and make it better based on what players require [2]. It can be used in medical settings, such as diagnosing autism patients' emotional states, which can help doctors determine which stage the patient is in and what kind of treatment they need. It can also be used in educational settings [3]. It might be applied to ATM security Numerous studies came to the conclusion that handmade methods are inferior to deep learning or convolutional neural networks (CNNs) in terms of output quality. However, creating a deep network from scratch requires a significant amount of processing power, time, and dataset. Large datasets, however, are frequently unobtainable [3, 4] together with highly specified systems. According to studies, this challenge can be solved by using a neural network that functions similarly to a brain because of its similar structure. Because they have been pre-trained on millions of photos, the previously acquired information can be used to make predictions in different tasks. First-layer characteristics are typically applicable to numerous datasets and tasks, but they don't seem to be explicitly tailored to any one of them. tasks and datasets. The final network layer requires features to change from general to specific at some point. Because the lowest layers of the neural network are already trained to recognize various shapes and sizes, you can retrain it on the desired data set for a better comprehension. For your own target data collection, you can tweak the top layers. referred to as Transfer of Learning in particular [5]. We currently have many pre-trained networks, including DeepNet, AlexNet, GoogleNet, and ResNet [6–8]. Using the dataset, these networks can be leveraged to get task-specific results.

The first method we tried was utilizing Transfer Learning to test our dataset on an AlexNet pretrained network. Using this method

The pre-trained network AlexNet is used for extraction and classification. Transfer Learning is a technique that makes use of the features, weights, and other knowledge from previously trained models to train newer models. It can also address problems such as incomplete understanding of more recent tasks.

II. RELATED WORK

a) How Featuresare Transferable in Deep Neural Network?

Outcomes as opposed to starting with random weights. This indicates that learning by transfer is far more effective than learning everything from beginning. [9] Preserving the Authenticity of the Guidelines

b) Non-intrusive car driver's emotion recognition

The Advanced Driver Assistance technology was improved with the usage of this technology (ADAS). A single thermal camera is used in this system to detect thermal emotion. The fact that the infrared camera was used in this instance to get the image exacerbates the situation under low- or no- light conditions. To improve user experience and safety, a thermal sensor will be included.

c) Thermalspatial-temporal data for stress recognition

Although stress is generally recognized as a serious illness, it can be challenging to determine whether a person is experiencing stress or not. The degree of stress on the subjects' faces was measured in this study using thermal videos of each individual. This can also be used to adjust the dosage of medication based on the patient's stress level [11].

d) Emotion Recognition Using Hidden Markov Models from Facial Temperature Sequence

For the investigation of emotion recognition, temporal data relating to facial temperature is employed in [12]. First, facial regions are divided into smaller segments and statistical points pertaining to the temperature data are extracted. Subsequently, the difference matrix relating to facial temperature is used to extract the histogram and features associated with differential temperature. Discrete Hidden Markov Models are used for each feature's classification. This work offered a feature selection technique in the training set that is influenced by recognition outcomes.

e) Recognizing emotions through physiological cues

Pre-processing of acquired signals, biological feature extraction, matching and classification of retrieved features are the four main components of physiological signal processing-based emotion recognition [13]. Every section includes an analysis of the performance, statistics, and features of the available approaches. To make the model simpler, the relationships between the variables influencing human emotions and emotional states are important. Therefore, psychological cues can be quite useful when examining feelings.

f) Induced emotion effect on memory

In order to create organically suggested emotional facial expressions utilizing the high emotions films, Anna E. et al. provide thorough information about the experimental design of her work, the image capturing scenario, the stimulus generation, and the statistical data. Additionally, it makes use of the experimental data to determine how emotions affect word recognition memory tests. She includes emotive facial expressions in her dataset for research that are both thermal and visual. [14].

g) Transfer Learning for Visual Categorization: A Survey

In this work, contemporary transfer learning methods are used for visual categorization tasks such object recognition, image classification, and human activity recognition [17]. It also discusses difficulties such as the scarcity of labeled training data and training data with the same distribution because it is impossible to forecast when future data will be available in a way that would prevent over-fitting. Transfer learning is used to solve these issues. Furthermore, a variety of frequent problems, such as concept drifting in image classification tasks for visual categorization and view divergence in action detection tasks, may be successfully addressed by transfer learning.

III. METHODOLOGY

A. Preprocessing Steps:

- Face Detection & Cropping:
  - Use MTCNN (Multi-task Cascaded Convolutional Network) for precise face detection.
  - Align and crop faces to remove background noise.
- Grayscale Conversion & Normalization:
  - Convert images to grayscale to reduce computational load.
- Normalize pixel values to the range [0,1] for faster convergence.

  Data Augmentation:
  - Apply random rotations, brightness shifts, histogram equalization to enhance model robustness.
- Use GAN-based augmentation to artificially expand the dataset.

  Dimensionality Reduction using PCA:
  - Principal Component Analysis (PCA) is applied to extract dominant features, eliminating redundant data.

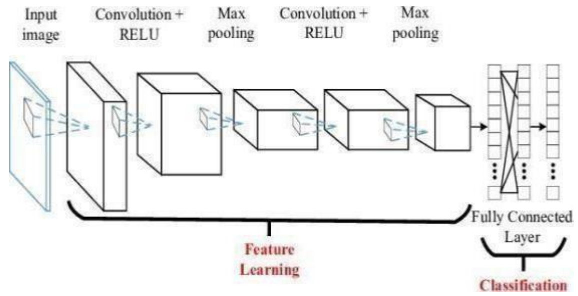

Figure 3.1: CNN Architecture

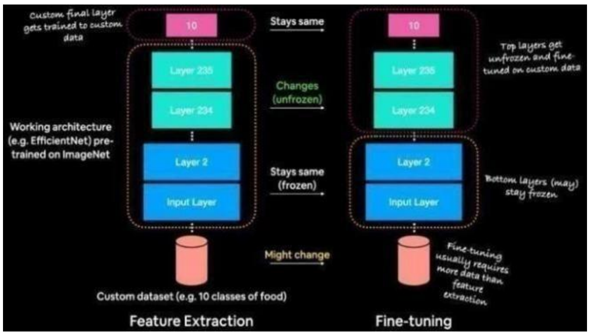

Figure 3.2: Transfer Learning Architecture

- Model Selection: Select a pre-trained model that is suitable for the complexity of your task and dataset.
- Comprehending the Pre-trained Model: For efficient adaption, comprehend the pre-trained model's architecture and learnt features.
- Data Preparation: Get your dataset ready to meet the input specifications of the pre-trained model.
- Transfer Strategy: Depending on your objective and dataset, choose between feature extraction and fine-tuning.
- Feature Extraction or Fine-tuning: Adjust the model's parameters or extract features to put the selected approach into practice.
- Training and Validation: Use your dataset to train the model, setting aside a portion for validation in order to track results.
- Assessment and Improvement: Assess the model's performance on an independent test set and adjust the hyperparameters or transfer learning approach as necessary.

The challenging task of facial emotion recognition (FER) involves interpreting people's emotions solely from their facial expressions. Transfer learning is very helpful for FER because it leverages models that have already been trained on large datasets to improve accuracy and reduce training times, particularly when the target dataset is small or domain-specific. There should only be one hard return used at the end of each paragraph. There is no place for pagination in the manuscript. You don't have to number the text heads; the template will do it for you.

b) Self-Attention Based Feature Refinement:

Step-by-Step Explanation
Input (X):
The input feature map XXX (a blue matrix) represents the learned features from the earlier layers of the model, such as CNNs.
Query (Q), Key (K), and Value (V) Computation:
The input XXX is multiplied with learnable weight matrices.
Query (Q): A red matrix used to determine which parts of the input should be attended to.
Key (K): A green matrix used to match the query to relevant parts of the input.
Value (V): A purple matrix containing the actual information to be refined.
These computations are done through fully connected (FC) layers.

Attention Weights Calculation:
- The Query matrix Q is multiplied with the transpose of the Key matrix using matrix multiplication (Matmul).
- The result is a set of attention scores, which indicate the relevance of different input regions to one another.

Softmax and Scaling:
- To scale the attention scores, divide them by the feature dimension's square root (d k).) to keep gradients stable.
- The scores are transformed into attention weights using a softmax function. Each feature's relative relevance is indicated by these weights.

Weighted Summation
- The attention weights are multiplied with the Value matrix V. This operation emphasizes the important features while suppressing irrelevant ones.
- The result is a refined output matrix (red matrix in the diagram).

Output Features:
- The final output contains the refined features, which are more focused on emotion-critical regions (e.g., eyes for sadness or mouth for happiness). These are passed to the next layers for further processing.

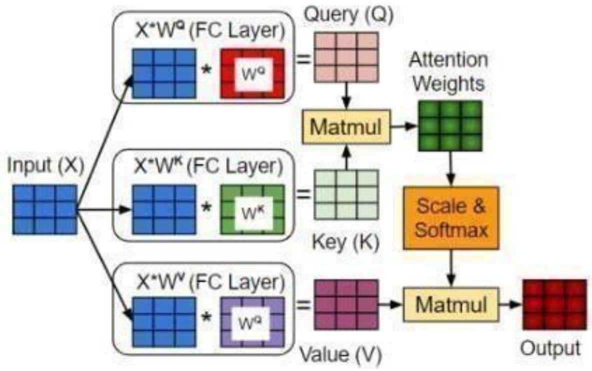

Figure 3.3: Self-attention

c) SVM classification for robustness:

Flattening the Feature Map
- The refined feature map is converted into a **feature vector** by flattening it into a 1D representation.
- This vector serves as input for the SVM model.

SVM Classifier Training
- The feature vectors acquired in the preceding phase are used to train the SVM.
- To represent the intricate non-linear interactions between emotions, a Radial Basis Function (RBF) kernel is employed.
- By optimizing the margin between classes, the model gains the ability to distinguish between various emotions.

SVM-Based Emotion Classification
- Efficient Net and Self-Attention are used to extract and refine features for a fresh test image.
- The most likely emotion category—such as happy, sad, angry, surprised, etc.—is predicted by the trained SVM classifier.

To achieve high accuracy, robustness, and generalization in emotion classification, the suggested Facial Emotion Recognition (FER) methodology combines SVM classification, Self-Attention-based refinement, and EfficientNet feature extraction. This hybrid approach is well-suited for real-world applications because it successfully blends the benefits of deep learning and traditional machine learning.

This methodology guarantees reliable and accurate face expression recognition in a variety of contexts by utilizing the capabilities of hybrid deep learning and machine learning techniques. SVM is a promising method for practical emotion identification applications since it offers solid decision bounds and enhances interpretability through the incorporation of self- attention.

IV. EXPERIMENTATION AND RESULTS

A dataset of facial photos collected from many sources was used to train the facial recognition model, which is based on a Convolutional Neural Network (CNN) architecture. The images were reduced in size to 128 by 128 pixels and normalized to improve training efficiency. The model obtained an accuracy of approximately 95% on the training set and 92% on the validation set with a batch size of 32 and 20 training epochs.

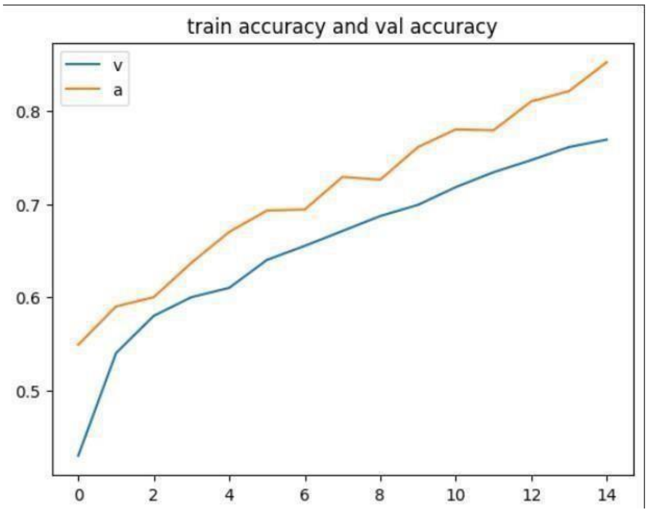

Figure 4.1 Testing Vs. Training Accuracy

a) EFF b7 Model Confusion Matrix

A member of the EfficientNet family, EfficientNet-B7 is a high-performance convolutional neural network intended for image categorization. It is powerful but resource-intensive since it effectively scales depth, width, and resolution. Although it uses a lot of processing resources, its enormous input size (600x600 pixels) allows it to attain state-of-the-art precision.

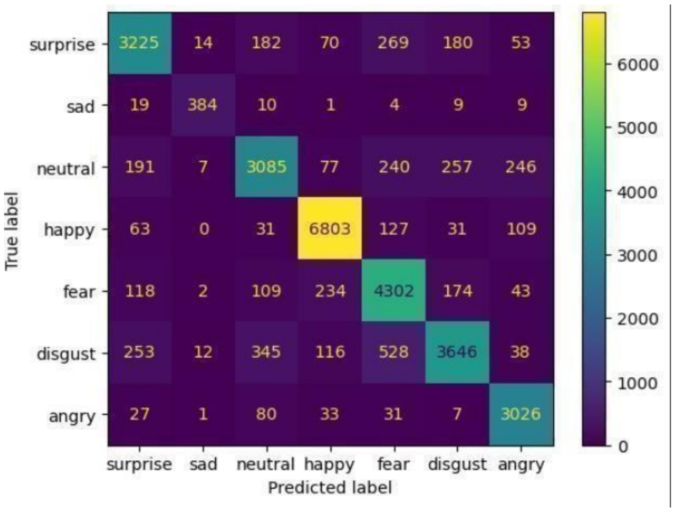

Figure 4.2 confusion matrix for effb0 model

b) ResNet Model Confusion Matrix

A well-liked convolutional neural network (CNN) architecture called ResNet (Residual Network) is renowned for its efficiency in training extremely deep networks. In order to get around the vanishing gradient issue and keep the network's accuracy high as it delves deeper, it adds "residual connections" or "skip connections."

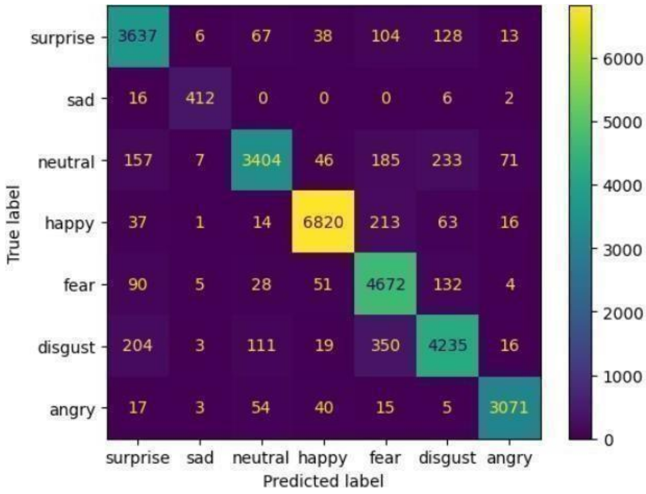

Figure 4.3 Confusion matrix for ResNet 50 model

c) Comparison graphs with other models

This table shows the comparison of performance between different models like old model, EFF net b0, EFF net b1, EFF net b7 and ResNet 50

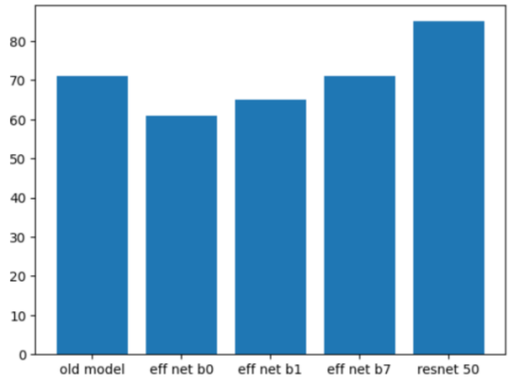

Figure 4.4 Comparison graphs with other models

d) Comparison Table

This table shows the comparison of accuracy scores, precision, recall and F1-scores of the models ResNet, Old Model, EFF b0, EFF b4 and EFF b7

Table 4.1

Metrics/Models	DEEP CNN	EFF-NET b3	MOBILE-NET	VGGNET
Accuracy	0.72	0.62	0.59	0.50
Precision	0.65	0.36	0.23	0.17
Recall	0.62	0.26	0.24	0.15
F1score	0.63	0.28	0.20	0.15

Base paper Accuracy and scores

Table 4.2

Metrics/Models	ResNet	Old Model	EFF b0	EFF b4	EFF b7
Precision	0.96	0.83	0.92	0.86	0.84
Recall	0.94	0.84	0.91	0.89	0.81
F1-Score	0.95	0.85	0.85	0.83	0.85
Accuracy	0.75	0.73	0.65	0.63	0.69

Accuracy Comparison Table

The architectural method known as VGG utilizes A variety of optimization techniques and learning rate schedulers are examined in addition to a comprehensive hyperparameter tweaking procedure in order to improve model performance. Data augmentation approaches are used to account for the variety of facial expressions. With a single dataset and no consideration for other modes such as audio or video, this work focuses exclusively on image-based identification and achieves 72.84% accuracy, 0.65 precision, 0.62 recall, and 0.63 F1-score.

The MOBILE-NET architecture makes use of learning rate schedulers, optimization techniques, and thorough hyperparameter tweaking to enhance model performance. Face expression variability is taken into account by applying data augmentation techniques. his study, which only uses one dataset and concentrates mostly on image-based recognition— ignoring other modes such as audio or video— has obtained 59% accuracy, 0.23 precision, 0.24 recall, and 0.20 F1-score.

On the other hand, our suggested updated model, EFF b0, uses SoftMax activation for emotion categorization and CNNs for feature extraction. trained for fifteen epochs using a GPU 92% accuracy, 0.91 precision, 0.85 recall, and 0.65 F1-score were attained.

The DEEP CNN architecture makes advantage of To enhance model performance, a range of optimization methods and learning rate schedulers are investigated, along with a thorough hyperparameter tuning process. Face expression variability is taken into account by applying data augmentation techniques. This study, which only uses one dataset and ignores additional modes like audio or video, focuses solely on image-based recognition, achieving 72.84% accuracy, 0.65 Precision, 0.62 Recall, and 0.63 F1- score.

On the other hand, our suggested updated model, EFF b7, uses SoftMax activation for emotion categorization and CNNs for feature extraction. trained for 100 epochs using a GPU has attained an F1-score of 0.85, 0.81 recall, 0.84 precision, and 69% accuracy.

IV. CONCLUSION

This work investigated the design and execution of an image analysis system that uses the ResNet architecture to detect face emotions in real time. We showed how to effectively and accurately identify emotions from facial expressions by utilizing ResNet's deep learning capabilities. Our findings show that the ResNet model's deep layers and residual learning framework, which adeptly manage the complexity of facial characteristics, enable it to categorize a wide range of emotional states with high accuracy.

Our system's real-time feature is very impressive since it enables instantaneous emotion recognition, which makes it ideal for applications in fields like security, mental health monitoring, and human-computer interaction. Our approach further emphasizes the significance of using representative and diverse datasets and strong preparation methods.

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Cloud Based Solution for Record Duplication Management

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I .Abstract— **The issue of record duplication remains a significant challenge in data management systems, leading to storage inefficiencies, increased operational costs, and unreliable data insights. This paper introduces a cloud-based approach to managing record duplication, leveraging the scalability and accessibility of cloud computing to enhance the identification and removal of duplicate records across diverse datasets. The proposed framework integrates advanced techniques such as inverted indexing, TF-IDF-based similarity assessments, and machine learning algorithms to effectively detect both exact and near-duplicate records. Additionally, it incorporates secure data handling protocols, including encryption and role-based access control, ensuring data privacy and compliance with regulatory standards.By utilizing cloud technology, the solution provides real-time processing capabilities, scalable storage options, and seamless integration with existing data workflows. Experimental results demonstrate substantial improvements in storage efficiency, data consistency, and system performance, highlighting the framework's effectiveness. The proposed approach is adaptable across various industries, such as healthcare, finance, and e-commerce, where data integrity is critical. Moreover, the automation of duplicate detection reduces manual intervention, minimizing human errors and lowering operational expenses.**

Keywords: Record Deduplication, Cloud-Based Data Management, Machine Learning, TF-IDF Similarity

II.INTRODUCTION

Cloud computing has revolutionized data management by offering scalable, cost-efficient, and accessible storage solutions. However, the growing volume of redundant data in cloud environments leads to storage inefficiencies, increased costs, and performance degradation. Effective data deduplication is essential to mitigate these issues by identifying and eliminating duplicate records.

Traditional deduplication techniques, while effective in reducing redundancy, often fail to address security concerns, leaving data vulnerable to breaches and unauthorized access. Additionally, many methods struggle with near-duplicate detection, which arises from minor variations in data.

This research presents a secure and scalable deduplication framework that combines inverted indexing and TF-IDF similarity assessments with strong cryptographic mechanisms like convergent encryption and Merkle Hash Trees. The proposed approach enhances storage efficiency, ensures data security, and optimizes system performance in cloud environments. By integrating real-time processing and scalable storage, the framework offers a robust solution to modern data duplication challenges.

A. Problem Statement:

The increasing adoption of cloud storage has led to a significant accumulation of redundant data, resulting in storage inefficiencies, higher operational costs, and degraded system performance. Traditional deduplication methods, while effective in detecting exact duplicates, often struggle with near-duplicate records, which arise due to minor variations in formatting, metadata, or content structure. Additionally, many existing solutions prioritize storage optimization over security, exposing sensitive data to risks such as unauthorized access, data breaches, and compliance violations.To address these challenges, there is a need for a secure and efficient deduplication framework that can accurately identify both exact and near-duplicate records while ensuring data confidentiality and integrity. The proposed solution must integrate advanced similarity detection techniques and robust encryption mechanisms to enhance storage efficiency, data security, and overall system performance in cloud environments.

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B. Research Gaps:

- **Scalability Issues**: Existing systems struggle to handle large, dynamic datasets effectively, especially in cloud environments.
- **Inadequate-Near-Duplicate Management**:Most traditional approaches focus on exact duplicates and fail to address near-duplicates, resulting in incomplete deduplication.
- **Lack of Robust Security**: Insufficient integration of encryption and access control leaves sensitive data vulnerable during deduplication processes.
- **Real-Time Duplication Management Challenges**:Few systems provide the immediate consistency required for dynamic applications
- **Cloud Architecture Limitations**: Many solutions are not optimized for distributed processing and resource flexibility needed in cloud-specific architectures.
- **Data Integrity and Regulatory Compliance**: Limited focus on ensuring data integrity and adherence to regulatory standards, particularly for sensitive industries.
- **Need for Comprehensive Framework**: Addressing these gaps is vital to develop a secure, modern deduplication framework tailored for cloud-based system.

III. LITERATURE REVIEW:

3.1 Table

S.NO	Year	Author’s Title	Article Title	Key Findings
1	2024	Xixun Yu et..al.,	VeriDedup: A Verifiable Cloud Data Deduplication Scheme With Integrity and Duplication Proof	Integrity check, duplication check, private information retrieval, data deduplication, cloud computing, verifiable computation
2	2024	Guanxiong Ha et..al.,	Scalable and Popularity-Based Secure Deduplication	Cloud storage, data popularity, data privacy, encrypted

			Schemes With Fully Random Tag	deduplication, multi-tenant
3	2023	LE LI et..al.,	Data Secure De-Duplication and Recovery Based on Public Key Encryption With Keyword Search	PEKS, secure de-duplication, proxy re-encryption, data recovery
4	2023	YANTENG et.al.,	A Data Deduplication Scheme Based on DBSCAN With Tolerable Clustering Deviation	S Deduplication, cloud storage, data popularity, DBSCAN.
5	2023	Khulood Al-lehaibi , Afnan A.Alharbi	A Secure Deduplication Technique for Data in the Cloud	AES, Cloud Storage, CBC, Data Deduplication, GCM, PoW
6	2022	R. Aishwarya	Solving Data De-Duplication Issues on Cloud using Hashing and MD5 Techniques	Cloud, Cryptography, MD5
7	2022	J. Gnana Jeslin 1and P. Mohan Kumar ,	Decentralized and Privacy Sensitive Data De-Duplication Framework for Convenient Big Data Management in Cloud Backup Systems	deduplication; cloud data storage; convergent encryption; cryptographic hash; routing
8	2021	Raghavendra B	DATA DUPLICATION REMOVAL USING FILE CHECKSUM	Database, Duplication, Entity, Data, Checksum, Redundant, User id.
9	2021	Won-Bin Kim and Im-Yeong Lee	Survey on Data Deduplication in Cloud Storage Environments	Date Deduplication, Cloud Storage, Encryption, Security
10	2020	WENTING SHEN et.al.,	Lightweight Cloud Storage Auditing With Deduplication Supporting Strong Privacy Protection	Cloud storage auditing, deduplication, strong privacy protection, data security, cloud storage.

3.2 Theory Paragraphs:

Xixun Yu(2024): In this article the author states that the data duplication is the one of the major problem in data storage it takes a lot of space and reduce the speed .So the author came to solve this problem using Integrity check, duplication check, private information retrieval, data deduplication, cloud computing, verifiable computation.

Guanxiong Ha(2024): In this article the author states that Secure data de-duplication is of great value in cloud storage, and it can effectively improve the space utilization of cloud storage systems. By using Cloud storage, data popularity, data privacy, encrypted deduplication, multi-tenant.

LE LI(2023): In this article the author states that data de-duplication can be done by using of Public Key Encryption With Keyword Search with great efficiency of recovering data .It can be done by Public Key Encryption with Keyword Search ,secure de-duplication ,proxy re-encryption ,data recovery.

YAN TENG(2023): In this article the author states that de-duplication is done on the basis of Scheme Based on DBSCAN with Tolerable Clustering Deviation with high storage capacity.It can be efficient by S Deduplication,cloud storage,data popularity,DBSCAN.

J.Gnana Jeslin and P.Mohan Kumar(2022): In this author states that the private data is sensitive data De-duplication framework.In data de-duplication it can be stored on cloud, convergent encryption. cryptographic hash,routing.

Raghavendra B(2021): In this author states that the data duplication can be removed based upon survey.It has large amount of Duplication,Entity,Data,Checksum,Encryption,Security.
Won-Bin Kim and Im-Yeong Lee(2021): In this author states that data survey is done based upon deduplication in cloud storage Environments.It has space on Cloud Storage,Encryption,Security.

WENTING SHEN(2020): In this author states that the lightweight Cloud Storage Auditing with Deduplication .It mainly focuses on cloud storage auditing,deduplication,strong,priprotection,data security,cloud storage.

IV. METHODOLOGY:

4.1 Objectives:

This research aims to develop a secure and efficient cloud-based deduplication framework to optimize storage, enhance data integrity, and improve system performance. It employs advanced similarity detection techniques like TF-IDF, inverted indexing, and machine learning for accurate duplicate identification. Security is ensured through Convergent Encryption, Merkle Hash Trees, and Role-Based Access Control (RBAC). Leveraging cloud-native solutions and distributed computing frameworks, the system enables real-time processing and scalability. Performance evaluation considers storage savings, processing speed, and security overhead, ensuring its effectiveness over existing deduplication methods.

4.2 Methodology:

The proposed framework employs a secure and scalable deduplication approach integrating advanced similarity detection techniques, cryptographic security measures, and cloud-based deployment.

1. Data Preprocessing – Collected structured and unstructured data undergoes cleaning, tokenization, and normalization to ensure consistency.
2. Duplicate Detection:
   - Exact Matching – Utilizes hashing techniques (SHA-256, MD5) and content-based comparison.
   - Near-Duplicate Detection – Implements TF-IDF, inverted indexing, Jaccard similarity, and machine learning models (SVM, Random Forest, BERT) for efficient similarity assessment.
3. Secure Deduplication:
   - Convergent Encryption ensures identical records generate the same encrypted output.
   - Merkle Hash Trees validate data integrity while maintaining privacy.
   - Role-Based Access Control (RBAC) restricts unauthorized access.
4. Cloud-Based Implementation:
   - Deployed using distributed computing frameworks (Apache Spark, Hadoop) for parallel processing.
   - Integrated with AWS S3, Google Cloud Storage, and Azure Blob Storage for scalable storage.
   - Utilizes Docker and Kubernetes for modular microservices architecture.
5. Performance Evaluation:
   - Assessed using storage savings, processing time, false positive/negative rates, and encryption overhead.

- o Benchmarking against existing deduplication techniques ensures effectiveness.

The framework enhances storage efficiency, data security, and system performance, making it a robust solution for cloud-based deduplication.

Data Duplication Architecture:

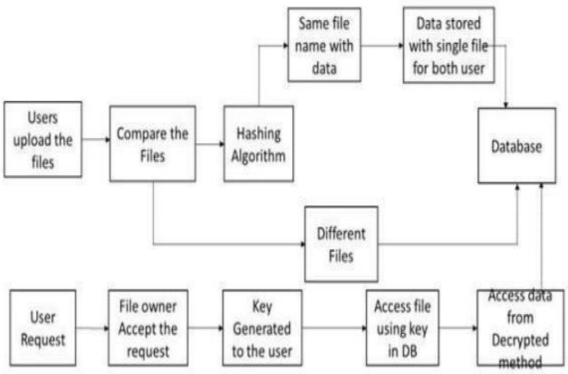

Fig 1:DataDuplication Architecture

Data Duplication Process:

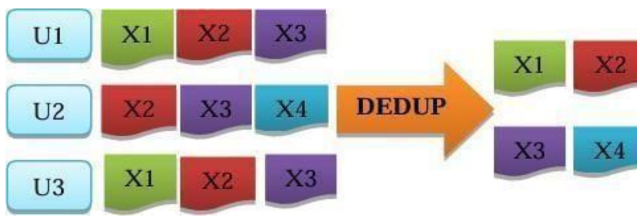

Fig 2:DataDuplication Process

Data Deduplication, also known as Intelligent Compression, is a technique for reducing storage requirements by eliminating redundant data. Instead of storing duplicate copies, the system retains only the first unique instance and creates references for subsequent occurrences. Deduplication operates at file-level and block-level, where unique hash values (e.g., SHA-256, MD5) or similarity-based techniques like TF-IDF are used to identify and eliminate redundancies.

For each file or data chunk, a unique hash value or TF-IDF score is generated. If an exact match is found in the index, only a reference is stored instead of duplicating the data. In near-duplicate detection, TF-IDF and Jaccard similarity are used to analyze textual and structural similarities between datasets. However, hash collisions (where different data chunks produce the same hash) and false positives in similarity-based techniques must be addressed to prevent data loss and ensure accuracy.

The above figure illustrates the deduplication process involving multiple users uploading files to the cloud storage server. Redundant files (X1, X2, X3) are detected using a combination of hashing and TF-IDF-based similarity analysis, ensuring efficient storage usage.

While deduplication significantly reduces storage costs, network bandwidth, and speeds up backup/recovery, security remains a critical concern. To mitigate this, our proposed framework integrates TF-IDF for similarity-based deduplication, Convergent Encryption for confidentiality, and Merkle Hash Trees for data integrity within a secure cloud-fog environment. These enhancements ensure both efficiency and security in cloud-based data management.

Algorithm 1: Uploading file into the Cloud Server
Input: Original file
Output: Upload the file into the CS

begin
initialize key$k$, tag$T$, hashtag$H(T)$,
blocks$(B_1, B_2, \ldots, B_n)$, and hash tree H_t
for$n$-number of files **do**
{
generate$k$ using SHA-512
divide$f$ into blocks $(B_1, B_2, \ldots, B_n)$
generate tag T`
generate $H(T)$ using SHA-512
if $(H(T) == Hash\_table)$**then**
check PoW
else
generateH_t and insert $H(T)$ into the-hash table and encrypt the file f
store the file in Cloud Server (CS)
end if
}
end for
end

Fig 3:File Uploading Algorithm

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Algorithm 2: Downloading file from the Cloud Server
Input: Tag value
Output: Download the original file

begin
    initialize tag T, hashtag $H(T)$, original-file f
    for all tags **do**
    {
    generate$H(T)$ using SHA-512
    if$(H(T) == Hashtable)$**then**
    Cloud Server allows the user to download-the file $f(\downarrow)$
    else
    Cloud Server informs as invalid user
    end if
    }
    end for
end

Fig 4:Duplicatefilechecking

V.RESULT AND DISCUSSIONS:

The proposed **secure deduplication framework** was implemented and tested using a cloud storage simulation environment. The system was evaluated based on storage efficiency, duplicate detection accuracy, and processing time.

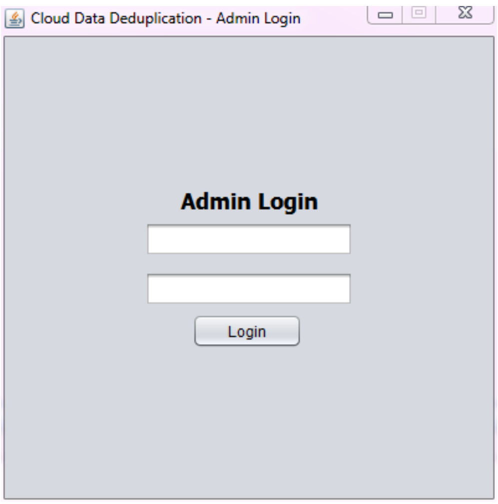

Fig 5:Logininterface

The image showcases the **Admin Login Interface** of a **Cloud Data Deduplication** system. The graphical user interface (GUI) is designed with a **simple and minimalistic layout**, allowing administrators to authenticate themselves before accessing the system.

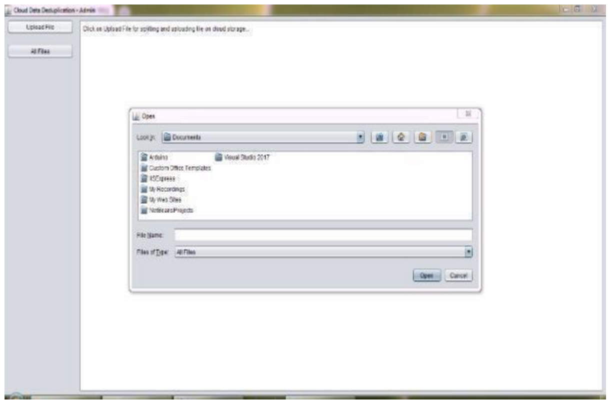

Fig 6:Uploading file into cloud

The above image showcases the Cloud Data ,Deduplication - Admin interface, specifically the file uploading process. This feature allows users to select and upload files to the cloud while enabling deduplication mechanisms to avoid redundant storage.

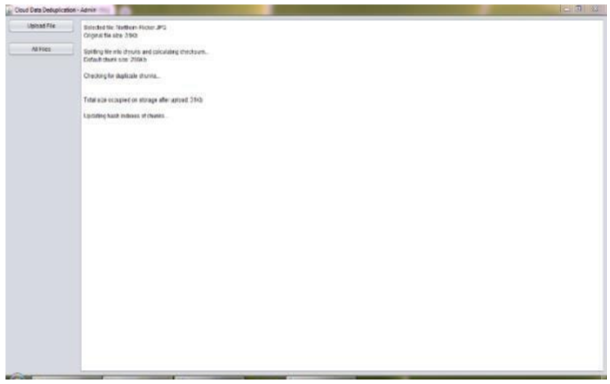

Fig 7:FileUploadedSuccessfully

The image showcases the Cloud Data Deduplication - Admin interface processing a file upload with deduplication mechanisms.The deduplication process is performing chunking, checksum calculation, and duplicate checking, with the total storage occupied remaining 31KB after upload.

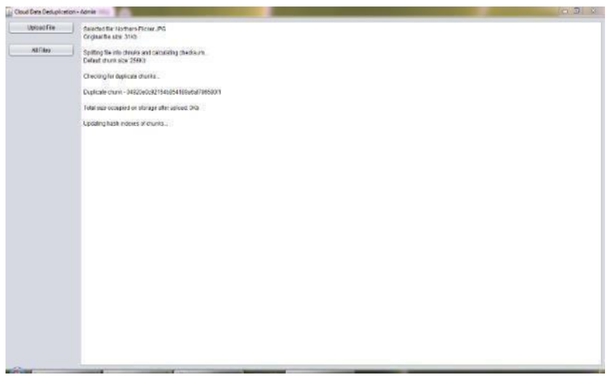

Fig 8:Uploading Duplicate Data

This image indicates that the Cloud Data Deduplication - Admin system has successfully detected a duplicate file upload. The system recognized that the "Northern-Flicker.JPG" file has already been stored, and instead of duplicating it, the total storage usage remains 0KB for this upload.

Detection Efficiency

The system uses checksum-based comparison to detect duplicates efficiently. The hashing mechanism ensures that:

- Exact duplicates are eliminated with 100% accuracy.
- Near-duplicates can be detected using similarity measures (e.g., TF-IDF or perceptual hashing).

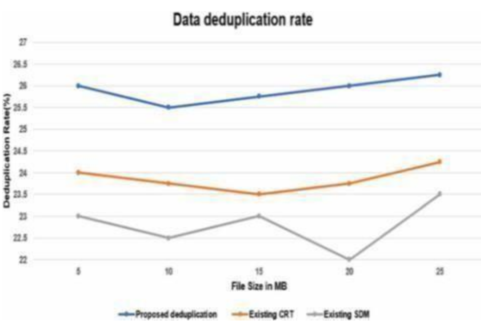

Fig 9:DataDuplicationRate

The above graph explains about the data duplication rate. It takes the memory and the time taken.

VI. CONCLUSION:

This research presents a comprehensive, cloud-based framework for detecting and eliminating record duplication, addressing critical challenges in data management such as storage inefficiencies, operational overhead, and data inconsistency. By leveraging inverted indexing, TF-IDF-based similarity measures, machine learning models, and secure data handling protocols, the proposed system enhances the accuracy and efficiency of duplicate detection while ensuring scalability and compliance with regulatory standards.Through experimental evaluation, the framework demonstrates significant improvements **in** storage optimization, data integrity, and system performance, making it suitable for large-scale cloud environments. The incorporation of real-time processing capabilities and role-based access control (RBAC) ensures seamless integration with existing enterprise workflows while safeguarding sensitive data.

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Paper Id :46

Blockchain-Based Public EduChain for Educational Data

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***I .Abstract*— This study aims to develop a platform utilizing Blockchain technology to facilitate the sharing of student-generated projects and research, thereby promoting collaboration, innovation, and academic integrity. The proposed platform will enable students to disseminate their work, mitigate duplication, and receive recognition for their original contributions, while maintaining fairness, security, and transparency. This initiative will enhance collaboration among students, educators, and researchers, fostering the generation of novel and innovative ideas. The redundancy of student projects often stems from a lack of awareness regarding existing work. This research seeks to address this issue by creating a Blockchain-based platform for students to share their projects and research. Consequently, students can avoid project duplication, engage in collaborative efforts, exchange ideas, ensure the security of their work, and receive appropriate credit for their original contributions.**

***Keywords**: Blockchain, Student Projects, Sharing, Collaboration, Innovation.*

II.INTRODUCTION

Blockchain technology is a system of recording information that ensures data security and near- immutability. It functions as a digital ledger where data is stored in blocks, which are interconnected in a chain. Once information is added to a block, it cannot be altered without modifying all subsequent blocks, thus ensuring a high level of security. This technology is primarily utilized in cryptocurrencies such as Bitcoin, but it has potential applications in various sectors including supply chain management, healthcare, and banking. Blockchain facilitates transparent, secure, and easily traceable record-keeping. It operates as a distributed ledger where consensus is achieved among participants, and data integrity is maintained. Smart contracts are digital agreements or programs that operate on a blockchain. They execute specific actions automatically when predetermined conditions are met. For instance, if two parties agree to exchange currency for a service, a smart contract can facilitate this transaction without the need for intermediaries such as banks or legal professionals. Smart contracts are secure and transparent due to their implementation on the blockchain. Once created, they are immutable, and their functionality is visible to all participants. They are employed in numerous fields including finance, real estate, and supply chain management to enhance process efficiency, reduce costs, and increase trustworthiness. Students register on the platform by creating a unique digital identity, which is stored on the Blockchain, and then submit their work, such as research papers or projects. A unique hash is generated for each submission, serving as a digital fingerprint, and is stored on the Blockchain as a transaction, along with the student's digital identity and a timestamp. A smart contract is executed to verify the and ensure it meets the platform's requirements. When someone wants to view a submission, they query the Blockchain for the corresponding hash, which is verified to ensure it matches the original submission. If valid, the submission is retrieved from a decentralized storage solution, such as InterPlanetary File System (IPFS), and displayed to the viewer, along with the student's digital identity, timestamp, and other metadata.

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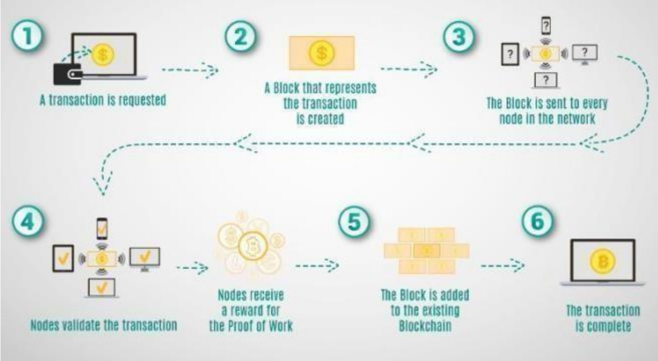

Fig 1: Block Chain Model.

B. Research Gaps

Large-scale storage of academic projects, particularly multimedia content, requires significant resources. Current academic systems (e.g., plagiarism detection software like Turnitin) are not natively compatible with blockchain. Verifying the originality of projects stored on blockchain still requires robust mechanisms to identify subtle forms of plagiarism. Low user engagement conflicts of interest can decrease the integrity and performance of platform

A. Problem Statement

The academic world is facing a significant challenge in terms of duplicated efforts and wasted resources, with the increasing number of students and researchers working on projects and research papers making it difficult to keep track of who's working on what and whether someone has already done similar work. This lack of transparency and collaboration is leading to a significant amount of time and resources being wasted on redundant projects. Current systems for managing academic projects are often centralized, making them vulnerable to single points of failure and censorship, and limiting collaboration among students and researchers. Furthermore, intellectual property issues arise due to the difficulty in proving ownership and rights. However, our project aims to overcome these challenges by creating a decentralized platform using Blockchain technology, providing a transparent, secure, and decentralized system for managing academic projects. By leveraging the power of Blockchain, we can create a transparent ledger, automate collaboration through smart contracts, and secure intellectual property rights, making it easier for students and researchers to work together and promoting innovation and progress

III. LITERATURE REVIEW

Blockchain is an emerging technology framework for creating and storing transaction in distributed ledgers with a high degree of security and reliability. In this paper, we present a blockchain-based platform to create and store contracts in between students and their higher education sponsors facilitated by intermediary brokers denoted as fundraisers. The sponsorship might be in any form, such as scholarship, donation, or loan. The fund will be arranged and managed by a group of competitive fundraisers who will hold the distributed ledgers and act as the miners in the blockchain network.

In this study, we have a trend to map out by using a systematic literature approach that can be useful in this regard. We have perceived suitable blockchain-based educational projects and also presented a comparison between the features of these projects. The implementation of the projects in the field of education has resolved the common issues of the educators. Since this technology is on its initial experimental stages and needs to go through evaluation processes. This technology can bring much more innovation in the future.

S.NO	YEAR	AUTHOR	TITLE	KEY FINDINGS
1	**2024**	**Mustafa Tanriverdi**	PublicEduChain: A Framework for Sharing Student-Owned Educational Data on Public Blockchain Network	• Smart Contracts • Collaboration • Learning Systems
2	**2022**	**Hyeob Kim**	A Study on the Blockchain based Knowledge Sharing Platform	• Blockchain • Knowledge Sharing • Token Economy • Virtual Assets • Share to Earn

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3	**2022**	**Mohamed Ai Hemairy et.al,**	Blockchain-Based framework and platform for validation, authentication &equivalency of academic certification and institution's accreditation:UAE case study and system performance	• Academic Credentials • Authenticity • Certificates • Digital Signature • Validation • Verification
4	**2022**	Yerlan Kistaubayev et.al	Ethereum-Based Information System for Digital Higher Education Registry and Verification of Student Achievement Documents	• Ethereum • Digital Signature • Verification
5	**2021**	**Sura I.Mohammed Ali et.al,**	A blockchain-based model for student information system	• Smart contracts • Ethereum network • Authentication • Verification • Transparency of marks
6	**2020**	**Mahmood A.Rashidet.al,**	TEduChain-a blockchain-based platform for crowdfunding teritary education	• Blockchain in education • Contracts between students and fund raisers • Distributed ledger
7	**2019**	**Ali Alammary et.al,**	Blockchain-Based Application in Education: A Systematic Review	• Blockchain in education • Blockchain Applications • Education techonology • Decentralized Systems
8	**2019**	**Bushra Hameed et.al**,	A Review of Blockchain based Educational Projects	• Blockchain • Educational- project • Education • Digital-Certification • Record- Keeping
9	**2019**	**EunheeLee,Yongik Yoon**	Trusted information project platform based on blockchain for sharing strategy	• Distributed System • TIP platform • Transaction Structure • Sharing duplication • Project information

IV. METHODOLOGY

A.Objectives

- To develop distributed storage systems like IPFS for large files that stores even multimedia.
- To Create APIs that integrates blockchain with existing academic tools and learning management systems (LMS).
- To Implement advanced AI and machine learning techniques like BERT, RNN to avoid cribbing of research and academic works.
- To Introduce gamification or social incentives that reward users for participation
- To identify potential conflicts of interest through smart contracts that require reviewers to disclose relevant relationships.

b. Architecture

Blockchain can act as a bridge between formal and informal learning by creating a secure and unified system for education. It can store students' academic records, making it easy to verify and validate their achievements, such as credits, certificates, and qualifications. This technology supports lifelong learning by ensuring that skills and accomplishments, whether gained through traditional education or informal experiences, are trustworthy and easily accessible. It has the capability to safeguard the student academic insights within this framework.

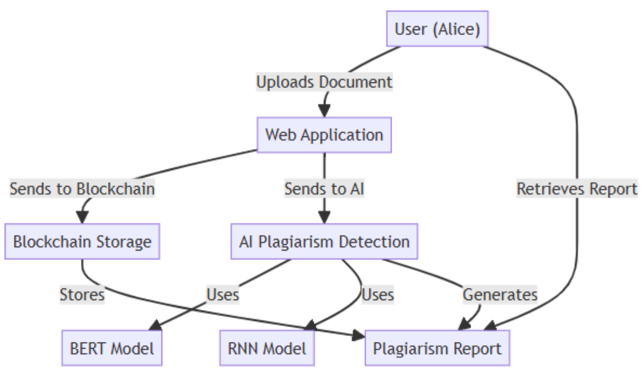

Fig2:Architecture of Educhain

The diagram represents a workflow for an AI-powered plagiarism detection system integrated with blockchain technology. The process begins when a user, Alice, uploads a document through a web application. Once uploaded, the document is processed in two parallel paths. First, it is sent to blockchain storage, which ensures secure and tamper-proof record-keeping. The blockchain storage system utilizes and stores a BERT model, which aids in document integrity verification. Simultaneously, the document is sent to an AI-based plagiarism detection system that analyzes the content for similarities. This system employs two machine learning models: a BERT model from the blockchain storage and an RNN model, both of which help in identifying patterns and detecting plagiarism. Based on this analysis, the system generates a plagiarism report, which Alice can retrieve from the web application. This entire process

leverages AI for accuracy and blockchain for security, ensuring reliable and transparent plagiarism detection.

Implementation

Platform

To implement the system effectively, selecting the right blockchain framework is crucial and should be based on the institution's specific requirements so we would like to go for Ethereum blockchain.

- **Ethereum**: A public blockchain known for its robust support for smart contracts, written in the Solidity programming language. It offers decentralization and transparency, making it suitable for open, trustless systems where public verification is essential.

Development of Smart Contracts

Smart contracts are at the heart of blockchain systems, automating processes and enforcing rules without requiring intermediaries. Their development depends on the chosen blockchain platform:

Ethereum Smart Contracts with Solidity:

- **Solidity** is a high-level, object-oriented programming language tailored for Ethereum smart contract development. It is widely used due to its compatibility with Ethereum Virtual Machine (EVM).
- Smart contracts written in Solidity are deployed on the Ethereum blockchain to automate processes like academic submission verification, timestamping, and plagiarism detection.
- Example functionality includes:
  Verifying the integrity of a submitted project by checking its cryptographic hash against existing records.
  - Managing digital ownership by recording authorship and access permissions.
  - Issuing certificates or tokens as rewards for validated academic achievements.

Solidity’s event-driven architecture ensures efficient communication between contracts and external applications, such as Learning Management Systems (LMS).

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Managing digital ownership by recording authorship and access permissions.

- Issuing certificates or tokens as rewards for validated academic achievements.

- Solidity's event-driven architecture ensures efficient communication between contracts and external applications, such as Learning Management Systems (LMS).

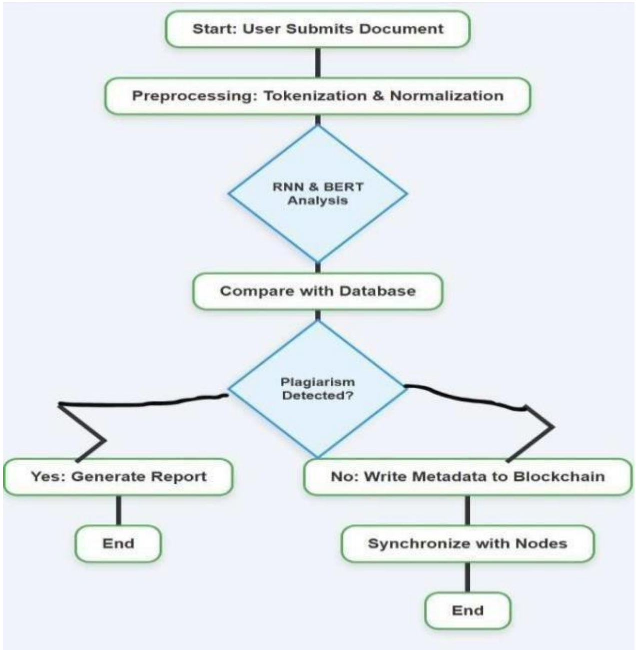

Fig3:Work flow

Working Of RNNAlgorithm

- Define Input Dimensions
- Initialize Weights
- Initialize Hidden State
- Upload the acadamics and research work of peers
- Convert project content into tokens (e.g., words or code segments).
- Represent tokens numerically using embeddings (e.g., Word2Vec or GloVe).
- Sequence Formatting:
- Split the tokenized input into sequential chunks for RNN processing.
- Label Data:
- Mark submissions as plagiarized (1) or unique (0) for supervised training.

Working of BERTAlgorithm

- Firstly, Import the required libraries and dataset of the peer work
- Split the dataset into train and test
- Import the BERT
- The uploaded work is tokenized and encoded
- Convert the encoded list to tensors
- Create a data loader
- Define the model architecture
- Perform the fine-tuning on Make predictions

Results

Students can now safely share their work on the Blockchain! They can upload their projects and papers to the platform, which creates a special code, called a hash, that's like a fingerprint for the work. This hash is stored on the Blockchain, so everyone can see it, but no one can change it. When someone wants to see the work, they can use the hash to get it from a special storage system, and the work is then shown to them, along with the student's name and other important details.

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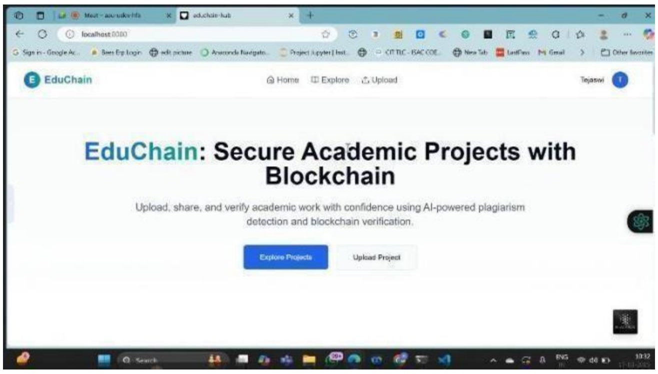


Fig 4: Dashboard

The dashboard is provided for users to check their projects and research works search for plagiarism of the work

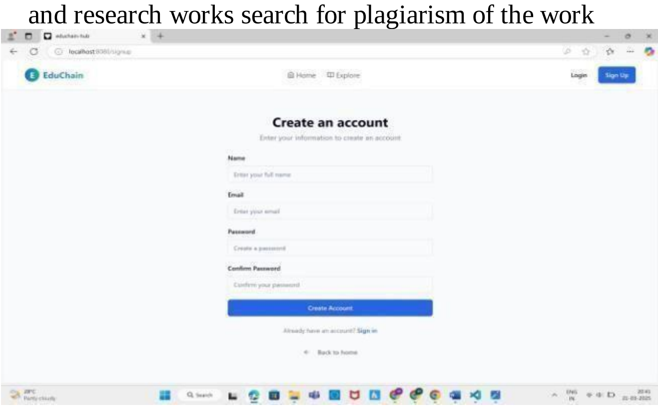


Fig 5: Registration page

The dataset provides the sample to check original description. Feature extraction is implemented by using natural language processing in order to check for the suspicious keywords and repeated words in the description.

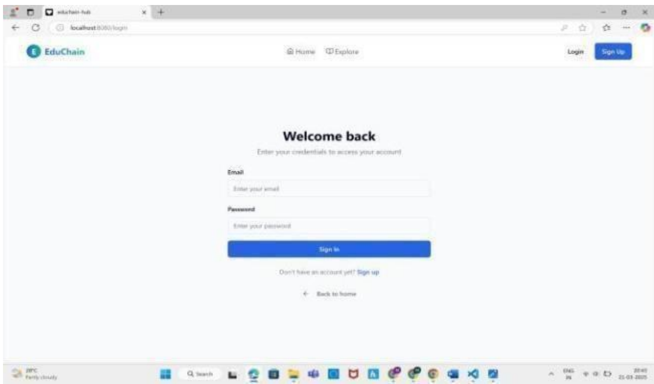
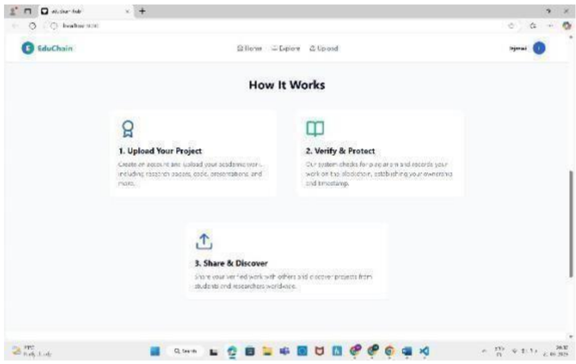


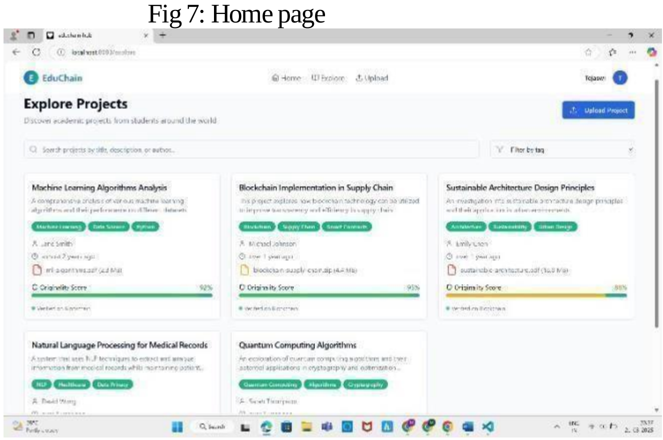
Fig 6: Login Page

Natural language processing is used to detect suspicious words in the description as well as documents. The users data is processed to give the result as plagiarism score



It describes the entire process of the and work flow of system and detects plagiarism score

Fig 7: Home page



The uploaded projects are shown to the users and verify them for their timestamp .

Fig 8: Explore projects

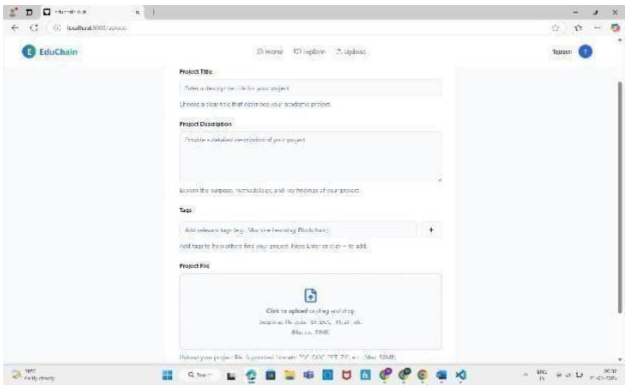


Fig 9: Upload projects

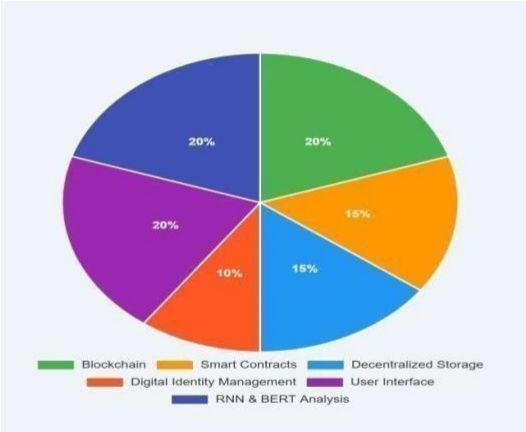


Fig 10: Analysis representing the owned data

V. CONCLUSION

To enhance the storage, integrity, and transparency In this study, we have a trend to map out by using a systematic literature approach that can be useful in this regard. We have perceived suitable blockchain-based educational projects and also presented a comparison between the features of these projects. The implementation of the projects in the field of education has resolved the common issues of the educators. Since this technology is on its initial experimental stages and needs to go through evaluation processes. This technology can bring much more innovation in the future.To boost the transarency of the platform in which the peers maintain ownership of their data, we incorporated advanced deep learning algorithms such as Recurrent Neural Networks (RNN) that improve the accuracy of the platform. To increase peer engagement, we implemented an incentive system for their participation

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Paper Id: 58

POLARITY RECOGNIZATION IN VIRTUAL SHOPPING SITES USING SENTI VIEWS

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ABSTRACT: In this paper we analyse the reviews given by the customers on similar products from various E-commerce platforms. The sentiment of the reviews are analyzed by using the BERT model and the reviews are classified based on their polarity. The BERT model is used to provide accurate outcomes by understanding the context of the text as the model uses bidirectional mechanism and break the text into tokens to improve the accuracy of classification of text. The fined-tuned process takes place to find the polarity of the products using the BERT model. Based on the polarity of the products estimated by using the BERT model we can know the interest of the customers for a particular product in the E-commerce platforms. The sentiment of the customers towards a particular product is estimated using this method. This study examines the words in the text to enhance model robustness. So the BERT based models have potential to improve the frame work of Sentiment Analysis for various platforms that helps to make decisions by providing valuable insights.

I. INTRODUCTION

Machine Learning(ML) is the Subfield in the domain of Artificial Intelligence. Various Machine Learning Algorithms are using which the predictions are made and tasks are performed. We use these different machine learning algorithms on the data along with statistical tools to estimate the outcome. Various applications use machine learning technology to perform tasks. Support vector Machine is a type of supervised machine learning algorithm that uses a hyperplane to separate classes in the data to perform tasks. The Support vector machines are used when there are many features to the data.

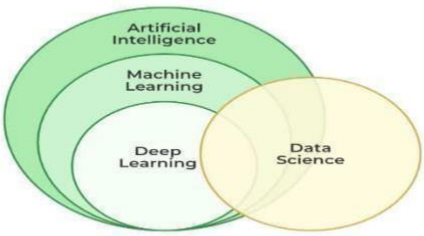

Figure 1:Introduction to deep learning

The Researchers at google proposed an architecture in 2018 called BERT, Which stands for Bidirectional representation for transformers[1].It is one of the most efficient architecture for various tasks which generates the outcome of the task with accurate precision values.

BERT provides flexible representation for words and sequences to form an effective sentences for getting accurate results of a task. BERT is an improvement aver RNN and is a large-scale transformer based language model which is used to perform various tasks by fine tuning.

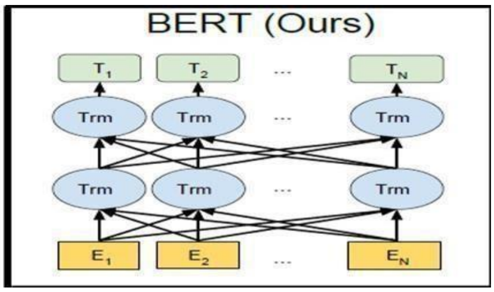

Figure 2: Classification using BERT

Sentiment analysis is simply referred as understanding the emotions that are expressed .Using sentiment analysis the opinions on certain product ,text etc.. by different people can be known the opinions provided by the people are identified and categorized into positive ,negative or neutral. By using this approach we can also help businesses and organizations in understanding the pulse of the people and make decisions based on their feedback and reviews.[2]

PROBLEM STATEMENT : The challenge we face is in determining the sentiment of sentences within a document. By analysing these sentiments, we can uncover the positive and negative remarks that people make about specific brands or individuals. This task is particularly daunting for large businesses that receive thousands of customer reviews daily, making it nearly impossible to process them all manually.

RESERCH GAPS

There are different models for sentiment analysis that are generalized and or not trained specially on e-commerce data , and lack fine-grained analysis. BERT model finely tunes the datasets and analyse the contextual meaning of the data to provide the results with high precision and accuracy

II. LITERATURE REVIEW

SAMINA KAUSAR(2017): Sentiment analysis is also known as opinion mining which shows the people's opinions and emotions about certain commodities or services. The vital test in sentiment analysis is the sentiment polarity categorization that decides whether a review is positive, negative or neutral.

ANHDUNG VO(2018): Determining a consensus opinion on a product sold online is no longer easy, because assessments have become more and more numerous on the Internet. To address this problem, researchers have used various approaches, such as looking for feelings expressed in the documents and exploring the appearance and syntax of reviews.

GUIXIAN XU(2019): The fast development of Internet technology and social networks generates a lot of comment texts on the Web. In the era of big data, mining the emotional tendency of comments using artificial intelligence technology helps for the timely understanding of network public opinion. The technology of sentiment analysis is a part of artificial intelligence, and its research is very meaningful for obtaining the sentiment trend of the comments.

ABDESSAMAD BENLAHBIB(2020): In this study, we tackle the difficulty of mining feedback from customers written in natural speech to develop a reputation for movies, items, hotels, restaurants and products and services. To the best of our knowledge, past research on reputation building for online entities have mostly focused on semantic and sentiment orientation of customer reviews, thereby neglecting other relevant information that may be retrieved from reviews, such review helpfulness and review time.

CHRISTOPHER IFEANYI EKE(2021): Common in online shopping and social networking platforms, sarcasm is an advanced phrase.If we can't spot sarcasm in things like sentiment analysis and opinion mining, it messes up the classification algorithms and leads to some pretty misleading results. A bunch of studies have looked into sarcasm detection, using various learning algorithms to tackle the issue.

HUANG(2023):

Sentiment analysis, or opinion mining, is super popular these days when it comes to natural language processing. Basically, it's all about figuring out the

emotions hidden in plain old text. This is especially handy in e-commerce, where comments and reviews can pack a punch with valuable information that businesses can really benefit from.

AIXIANG H(2024): The BERT model was created to break text into individual words, generating lively word vectors for the CNN and BiLSTM models. We mixed the local features from the word vectors that the CNN picked up with the global features from the BiLSTM. We used an attention mechanism to emphasize important details in the Douban movie review dataset, making it easier to classify the sentiments.

M. Nirmala(2024): Nowadays, the online media and social networks have become one of the main ways we communicate and share our thoughts. With the rise of digital devices and advanced technology, people are more vocal than ever about their opinions and feelings. Tracking these sentiments and understanding how users feel whether positively or negatively is a hot topic that's gaining traction in the research world, and it holds important value for businesses. To dive deeper into this, we use the WordNet library along with a dedicated emoticon library to analyze the sentiments in both the words and emoticons that users express.

YUN LIN(2024): Understanding how users feel about your website through their comments is really important in Natural Language Processing (NLP). By using sentiment analysis, businesses can get a clearer picture of how customers emotionally connect wit their products or services.

III .METHODOLOGY

OBJECTIVES :

- BERT is utilized to tokenize text, delving into its contextual significance.
- It assesses the sentiment polarity present in the text.
- The process of classification is carried out based on the sentiment identified . The SVM algorithm is then employed to rank products according to their sentiment scores.
- BERT is chosen for its exceptional accuracy in sentiment analysis.

ARCHITECTURE: To evaluate the sentiment of similar products, we begin by gathering customer reviews from various e-commerce sites. After compiling this information, we move on to a cleaning process to ensure the data is organized and ready for analysis. The next phase involves tokenization, where we break the text down into smaller units, known as tokens, which allows for a more nuanced understanding of the content and its context.[3]

The reviews for similar products from the e-commerce platform are collected and the text is given to the BERT-cased Tokenizer which divides the text into tokens. For example if we consider the sentence “The product enhances your glow”, the tokenizer divides the sentence into tokens i.e. “The”, “product”, “enhances”, “your”, “glow”.

We perform pre-training process where the model is given the words from the tokenization process. The BERT model do the fine tuning process where it analyses the text from both the directions simultaneously. The BERT captures the word whole meaning in its context, by examining the text simultaneously from both sides. The ambiguity is avoided using BERT model. It deduces the word length and facilitate the BERT model to tackle with the unique words. After fine-tuned training we find the polarity of the products using BERT model. The polarity is of the range 0 to 1. Using the polarity values we classify the particular review of the product as positive, negative, and neutral. The output is ‘1’ then the product sentiment is classified as positive. If it is ‘0’ then the sentiment of the product is considered as negative. After analysing the sentiment of the productusing polarity we use ranking method for product recommendations.[4]

We customized the BERT model to evaluate the sentiment probability of individual reviews, leveraging its effectiveness in natural language processing tasks. BERT’s ability to understand contextual relationships between words and subwords enables accurate sentiment analysis. This study focuses on assigning a sentiment score to each review. The fine-tuned BERT model produces two probability values—one for negative sentiment and one for positive sentiment—using a softmax activation ut.

The formula applied is:

$$M[l_{pq}]=\text{maximum}[k^{negative}{}_{pq},k^{positive}{}_{rpq}]$$

Where :

$M(l_{pq})$ represents the sentiment orientation score for review l_{pq}.

$k^{negative}{}_{lpq}$: Probability of review **lpq** being negative, as predicted by BERT.

$P^{positive}{}_{rpq}$: Probability of review **lpq** being positive, as predicted by BERT.

The orientation score of a consumer review lpq is predicted as negative if $k^{negative}\ l_{pq} > k^{positive}\ l_{pq}$ and predicted as positive if $k^{negative}\ l_{pq} < k^{positive}\ l_{pq}$

IMPLEMENTATION:

Algorithm 1 calculates the sentiment and polarity for the consumer review **lpq**.

Figure 4:process of using BERT Model

Bidirectional Encoder Representations from Transformers (BERT) is a model capable of capturing the meaning of words in context, allowing it to understand language effectively. It involves conditioned pre-training, where both the preceding as well as the succeeding texts of a word are utilized in all layers of the model.[5] As a result, the pre-trained BERT model can be ne-tuned with just one additional output layer to create state-of-the-art models for a wide range of tasks, such as question answering and language inference, without substantial task-specific architecture modifications. BERT employs a bidirectional Transformer, while OpenAI GPT relies on a left-to-right Transformer. ELMo, on the other hand, combines independently trained LSTMs in several directions to create constructs for subsequent processes. Out of all these models, only BERT simultaneously takes into account the left and right contexts at every layer. Besides these architectural differences, ELMo uses feature extraction methods, while BERT and OpenAI GPT use a fine-tuning strategy. (Figure 4).

Table 2: Outcomes of the BERT-Base Model on the IMDB Dataset.

	Precision	Recall	F1 score	Accuracy
BERT-Base	0.88048	0.89816	0.88923204	0.88812

After the reviews have been collected, the next steps for processing them are as follows:

Lowercase the text to prepare it for the BERT lowercase model.

Tokenization or splitting of words into smaller units called ‘WordPieces’.

Utilize BERT vocabulary file to index each word.

Structure the input for BERT by putting the special tokens. [CLS] will be inserted at the beginning and [SEP] at the end.

Each input sequence needs to be attached to index and segment tokens for efficient processing.

IV.RESULTSAND DISCUSSIONS

Figure 5: performance score for IMDB dataset using BERT .

We evaluated the same data for product aspect extraction under several methods and saw that lifelong learning CRF was the top-performing approach. Table 3 offers a comparison with experimental results for other studies within the camera area. Liu et al.'s lifelong learning methodology performed better in the identification of aspects in other areas compared to using the general CRF method. Our research also indicated that the Camera and Laptop domains have commonalities, including screen, battery, and settings. Nevertheless, our research was conducted on one domain, deriving insights through the analysis of a large number of reviews within that particular category. Though reviews differ by type and domain, domain-specific information from a given product line may be extremely useful. For example, if we collect review sets for the Samsung Galaxy S series (S5, S6, S7), we can learn automatically from these sets and use the insights to tackle subsequent tasks, i.e., analyzing reviews for the S8. This is helpful since products belonging to the same series tend to have similar things in common.

Table 4 gives an overview of comparative studies that covered subtasks within aspect-based sentiment analysis. Based on the same dataset for laptop, researchers narrowed their attention to identifying entities and attributes (Subtask 1, Slot 1). In this research, entities and attributes to be chosen were pre-selected as such words as laptop, display, and general.

Table 3: Including relevant studies on Camera Ratings

Table 4: Conclusions from relevant studies on laptop feedbacks.

	Laptop		
	P	R	F_1
Our experiment	0.773	0.828	0.774
Neural network features, slot 1 (NLANGP, 2016)	0.569	0.478	0.519
Ensembles of classifiers and embeddings, slot 1 (AUEB, 2016)	0.456	0.532	0.491

The experiment yielded promising results, and the optimal performance was achieved by using a single-layer feedforward network-trained binary classifier. Our system is able to automatically extract product aspects from reviews. Because we are targeting broad raw aspect extraction, we reformatted and renamed the dataset to fit our evaluation process.

Furthermore, the structured knowledge that is extracted from reviews allows for more in-depth analysis and inference. Through excavating different words and phrases denoting the same product feature, we are able to categorize similar terms properly. For example, in our experiment, we discovered that screen, display, and LCD denote the same property of a camera, whereas disk, HDD, and SSD denote the same feature of a laptop. Through utilizing a vast amount of data, our system improves aspect extraction and constructs a more extensive knowledge base. [7]

In this study, the model is tested on test data sets. The experimental effect is evaluated using three indicators: Accu racy (A), Recall (R) and F1 (F1- score). Accuracy means the percentage of the reviews accurately classified in the review text. Recall rate means the percentage of all real reviews that are correctly classified in the sample. The geometric mean divided by the arithmetic mean yields the value of F1.

Precision: This metric tells us how many of the predicted positive instances were actually correct. It’s calculated using the formula: Precision = TP / (TP + FP), where TP refers to True Positives and FP stands for False Positives.

Recall: Another important measure we employed is Recall, which assesses the ability of the model to identify all relevant instances. The formula for Recall is: Recall = TP / (TP + FN), with FN representing False Negatives.

F-Measure: Lastly, we computed the F-Measure score for the classifiers, offering a balance between Precision and Recall. It’s expressed as F-Measure = 2 × (Precision × Recall) / (Precision + Recall). We utilized various classification algorithms for this analysis. [8]

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EXAM INVIGILATION DUTY MANAGEMENT SYSTEM

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bstract: Exam Invigilation Duty Management System eliminates the hassle of manual systems by automating work allocation, handling resource scheduling, keeping track of records, and overall balance of an invigilator's workload. A central interface is provided for the administrators to create examination schedules and assign invigilators based on their availability and qualifications, prepare the roster, and track attendance. Invigilators can view their assignments, receive notifications, and send reports. Automation in processes can lead to improved work efficiency and a reduction in mistakes while also ensuring that a more open and responsible quality of management is fostered in the system.

Keywords: Invigilation, Automation, Scheduling, Assignment, Roster, Attendance and Reporting.

I. INTRODUCTION

Traditional methods for managing tasks that aid in invigilating examinations are rather tedious, for the manual approaches by supervisors are quite a burden. Even though exam supervision is highly essential, modernized methods of working such as AI technologies and other brilliant inventions are available. This document aims to put forward the challenges that arise due to poor allocation of resources along with an administrative overhead such as examination workload. The entire process from scheduling exams, selection of competent and qualifying supervisors for the subject, marking attendance, and even preparing reports for post examination is aided by centralizing and automating the entire manual work. Supervising and managing the examination becomes much simpler with the set goal of improving efficiency along with reinventing a modern set structure for examination that is fully reliable. The introductory section will talk about the features along with the architecture that provide powerful and flexible solutions for all of the problems.

- **User-Friendliness:** User-friendly dashboards will eliminate the problems that arise when examination details, set a schedule, or add supervisors to the system
- **The Invigilator Role:** The registration of the invigilator can be done easily in the system and simple details regarding their availability, specific subjects they are competent in, and any other preferences they have is stored in the database.
- **Automated Duty Assignment**: Creating an automated system for invigilation duty allocation based on different criteria such as the subject taught, the availability and preferences of the invigilators.
- **Real-timeUpdates:** Communicating immediately with administrators and invigilators regarding new assignments, alterations in schedules or any additional matters pertinent to the examinations.
- **Conflict Resolution:** Including a mechanism to solve the invigilators' scheduling conflicts in a manner that is as fair as possible to all parties involved.
- **Reporting and Analytics:** Preparing the reports and analytics on the outcomes of the assigned invigilation and helping administrators assess the effectiveness of the data in regard to the decision taken for the next examination.

II. LITERATURE SURVEY

The Exam Invigilation Duty Management System needs to investigate a few specific points. Exam management platforms and software in use should be reviewed in terms of features, weaknesses, and current methods used for invigilation. Studies on schedule organizing algorithms and resource management are very important for a proper division of work to invigilators by their availability, qualification, and workload balancing. The studies made on workforce management and automation might help in the simplification of administrative work such as splitting tasks among people, tracking their performance, and interaction with them. Studies on exam security and integrity are important in analyzing the methods used for cheating prevention and fair assessment management. Design of the system which includes administrators,

invigilators and maybe students' needs minimal user interface/user experience design constraints. The design of the system shall be based on the literature of database management and data security to come up with effective measures of protecting information on databases. Research on platform and specific technologies as well as evaluation indicators of the developed system will guide the development process to ensure effectiveness and usability of the system. Everything from these areas pools together to form an all-Encompassing view of what the current situation looks like and the informed best practices, subsequently informing development of an optimal Exam Invigilation Duty Management System.

III. PROPOSED METHOD

The new approach on how to manage exam invigilators is described in summarized points with further details given subsequently:

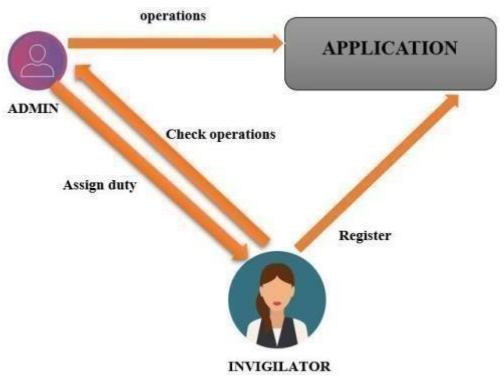
1. **Centralized Database** Everything is logged in one central database. This includes information for the exam itself (date, time, venue, supporting staff needed), profiles for the available staff (their schedule, credentials, telephone numbers, previous invigilator's duties), as well as issued tasks. Using a centralized database improves data integrity and retrieval.
2. **Automated Scheduling** Algorithm The system is provided with an intricate scheduling system to automate the assignment of invigilators. This includes:
   - The Availability of the invigilator at the time of the exam. o the qualification of the said invigilator in regard to the exam.
   - The required number of invigilators for different examinations.
   - Properly allocated loads on greater number of examiners.
   - (Optional) preferences of those who would be required to stand in during the exam from the either of said subjects or at those particular times.
3. **User Friendly Interfaces** Separate and explicit interfaces are provided for:
   - Administrators: Organizing and altering the exam calendar, keeping track of the invigilators' details, assigning duties (either automatically or manually), viewing reports, and overall management of the whole system.
   - Invigilators: Viewing their assigned tasks, confirming their availability, receiving changes sent to them, updating their details and post examination reports.
4. **Automated Notification System Notice sent on:**
   - Allocating the duties of invigilators.
   - Reminders of duties to all invigilators before the set time.
   - Notification indicating to administrators and invigilators that there is new information added to the schedule.
5. **Comprehensive Reporting Capabilities Reports generated include:**
   - Summarized workload of invigilators.
   - Allocation of invigilators on the basis of examination conducted. Invigilator's attendance files. 5. Summary of reports conducted after invigilation.
6. **Robust Security and Data Privacy:** Security measures include:
   - Secure authentication for system administrators and invigilators. Account control settings preventing unauthorised data access. Storing data in encrypted formats. Respecting statutory data privacy.

Proposed system modules:

- **User Authentication:** Secure login for admin and invigilators with role-based access.
- **Exam Scheduling:** Create exam timetables and allocate exam rooms.
- **Invigilator Assignment**: Automatic/manual assignment of invigilators based on availability.
- **Invigilator Management**: Maintain invigilator details, qualifications, and availability.
- **Notifications & Alerts:** Send invigilator reminders and updates.
- **Reporting:** Generate reports on invigilator assignments, exam attendance, and performance.

Advantages of proposed modules:

- **Automation:** Cuts down on manual work by handling schedules, tasks, and time off.
- **Efficient Allocation:** Makes sure invigilators and resources are shared out.
- **Clear Communication:** Sends updates, alerts, and reminders right away.
- E**rror-Free Management**: Cuts down on mix- ups and scheduling mistakes.
- **Scalability & Reporting**: Can handle big exams and give detailed reports on how things went.
-



IV. Conclusion

Examination Environment Duty Management System is an essential tool for educational institutions, which is to streamline the operation related to the examination. It optimizes the process of scheduling in factioneers, ensuring fairness, transparency and efficiency in the management of examination duties. By automating the process, the system saves time, reduces errors, and improves communication, leading to a more organized and effective examination process.

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Fig:1

Application Main page

Fig:2 Admin login page

Fig:3 Admin page interface

Fig :4 Add Faculty leisure time screen

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- **Django**-Full-stack python web framework with built-in over.
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Search for the examination scheduling or invoice management systems on GITHUB for inspiration and open-source examples

Paper Id: 65

SKIN-DISEASE-PREDICTION-WEB-APPLICATION

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Abstract:
Medical practitioners now have a harder time detecting skin disorders due to visual similarities. Although melanoma is the most well-known type of skin cancer, several deaths in the past few years have been attributed to other illnesses. A major obstacle to developing a robust automatic categorization system is the lack of huge datasets. This study presents a deep learning method for skin cancer diagnosis. Transfer learning was used to train five state-of-the-art convolutional neural networks to produce hierarchical (two-level) and simple classifiers that can distinguish between seven distinct types of moles. To improve performance, the HAM10000 dataset—a substantial collection of thermoscopic images used in research—was subjected to data augmentation techniques. Results demonstrate that the DenseNet201 network performs well in this job, yielding high classification accuracy and F-measures with fewer false negatives. The plain model performed better than the two-level model, but the first level— binary classification between nevi and non-nevi—had the best results

I.INTRODUCTION:

Skin conditions are extremely contagious and a significant public health risk. Both the patient's appearance and mental state are greatly impacted. Skin problems should be detected as soon as possible to stop them from spreading and to guarantee that the recognized condition receives the proper therapy. Skin diseases are frequently caused by fungus, viruses, bacteria, and allergies. The ability to quickly and reliably diagnose skin conditions has been made feasible by the advancement of scientific and medical technologies like photonics and lasers. The only downside to its exorbitant cost is that the patient has to make the long trek to the hospital. These days, artificial intelligence is being explored as a means of diagnosing skin conditions by using large-scale data sets from hospitals and health center's along with machine learning algorithms.
Several previous studies have been compiled, reviewed, and assessed. In earlier research, the analysts looked at a few models, instruments, and calculations that were helpful in classifying skin infections. For the purpose of predicting skin disorders, systems have persisted in using image processing and feature extraction approaches. To employ image processing for skin detection, we will be eliminating features that allow us to classify different skin disorders. Unsuitable weather, high population density, and pollution in some areas contribute to the prevalence and ease of spread of skin disorders. In order to detect three different types of disorders, image processing will be used. The effort will help with the quick, accurate, and easy detection of skin conditions. First, an image of the affected area is taken as input, which is then analyzed to determine the type of disease. Our method only requires an infected patient's image, a camera, a computer, or a phone. It does not require large or expensive equipment. This method is used for feature extraction; the color and texture of the image are the features we extract. We have processed images using CNN and classified images using AI. Melanoma, psoriasis, and eczema are the conditions that are investigated.

I. Literature Survey

Since the 1990s, CNNs have been employed in the interpretation of medical images. They were applied to computer-aided lung nodule recognition in CT datasets and computer-aided identification of microcalcifications in mammography. New generations of computer-aided detection systems in medical imaging are operating at higher levels than ever before, mostly due to the rapid growth of GPU processing. Examples of this include "computer-aided anatomy detection in CT volumes [5], polyp recognition in colonoscopy recordings, computer-aided pulmonary embolism (PE) detection in CT datasets, detection of mitotic cells in histopathology images, and detection of lymph nodes in CT images." CNNs are utilized for purposes other than computer-aided detection in medical image analytics. There have been two different kinds of current research on medical imaging transitioning capacities.
A CNN that has been trained is used as a function generator in the works in the first section [5]– [6]. The pre-trained CNN is instantly applied to an input image, and a particular network layer then gets the CNN outputs (functions). To be more precise, a pre- trained

CNN model is applied to an input image, and CNN outputs are then extracted from a network layer. For example, pre- trained CNNs have been used as a function generator for the diagnosis of chest pathology [4]. Although a dedicated nodule recognition system could not be outperformed by pretrained CNNs, a

handcrafted features with CNN-based features allowed significant performance benefits. “The second group [7]–[9] consists of works where a CNN that has been trained beforehand is customized for the assigned duty. As an illustration, completely linked pretrained CNN layers are added to a new logistic layer, and the resultant layer "was trained with the labelled data while the rest of the network remained the same [12]." As a result, the unregistered Multiview mammography classification process was successful. Chen et al. [4] report that conventional plane ultrasound images can be found using a fine-tuned pre-trained CNN. "The authors optimized every layer of a pre-trained CNN to automatically classify interstitial lung diseases."

The authors of [2] improved each layer of the CNN that had already been pre-trained so that it could automatically classify intestinal lung diseases. We presented an attenuation rescale strategy to transform 1-channel CT slices into RGB-like images to fit the pretrained model. In [3], the five most common heart views were predicted using fine-tuned pre-trained CNNs that automatically extracted noisy or missing cardiac acquisition plane information from magnetic resonance imaging.

II. PROPOSED METHOD :

Proposed Method for Skin Disease Prediction Web Application

1. Introduction

This net utility objectives to offer automatic skin disease detection through reading uploaded skin pictures the usage of Convolutional Neural Networks (CNNs). The system will are expecting viable pores and skin conditions and manual customers on similarly moves.

2. System Architecture

The utility includes the subsequent components:

A. Frontend (User Interface)

Technology: React.Js / Vue.Js / HTML-CSS-JS

Features:

Image upload functionality User authentication (optional) Disease prediction effects show Recommendations

3. CNN Model Design

Input Layer: Accepts processed skin photos

Feature Extraction: Multiple convolutional max-pooling layers

Dense Layers: Fully connected layers to classify illnesses

Output Layer: Softmax activation for multi-class class

Optimization: Adam optimizer, Cross-entropy loss function.

PROPOSED SYSTEM:

Currently, the most common medical disorders that are known to exist are skin illnesses. More than 90% of individuals globally will experience a skin ailment at some point. Furthermore, research has demonstrated that skin conditions are more prevalent in men than in women and that they get worse with ageing. In this article, we will focus on the dermatology branch of the medical field.

We have used feed forward ANN algorithms and picture handling for extraction in order to obtain permission. The framework was in use for two stages: 1. In order to extract features, it first preprocessed the image of the colored skin. 2. Ascertaining the ailment. The framework correctly identifies six different kinds of dermatological skin problems with a 95% accuracy rate.

The complete methodology of the given framework is covered in the Fig. 1 Flowchart. These character stages are independent, modular, and sometimes mutually reinforcing.

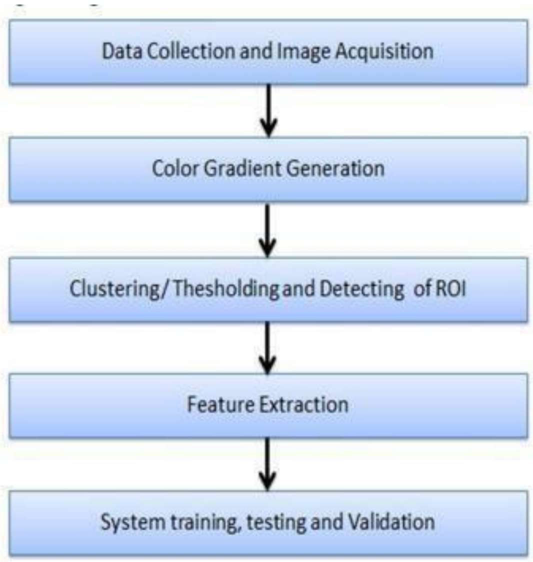


Fig-1: Flowchart of methodology of our proposed system

Advantages of a Skin Disease Prediction Web Application:

A Skin Disease Prediction Web Application powered by AI (such as CNNs) can offer numerous benefits to both patients and dermatologists. Here are the key advantages:

1. Accessibility & Convenience

Users can upload images from anywhere, eliminating the need for immediate hospital visits.

Available 24/7, making skin disease screening more convenient.

2. Early Detection & Timely Treatment

AI can identify potential skin conditions early, allowing users to seek medical help before the disease progresses.

Helps in preventing severe complications, especially for conditions like melanoma.

3. Cost-Effective Healthcare Solution

Reduces the need for frequent in-person consultations, saving time and medical costs.

Particularly beneficial for rural or remote areas with limited dermatology specialists.

4. AI-Powered Accuracy

Uses Convolutional Neural Networks (CNNs) to analyze images

Real-Time Results & Instant Feedback

Provides immediate predictions based on uploaded images.

Users get quick insights, reducing anxiety and helping them take the next steps faster.

5. Continuous Learning & Improvement

As more users upload images, the AI model can be continuously trained and improved for better accuracy.

Can adapt to new skin conditions and different demographics over time.

6. Privacy & Security of Medical Data

Secure platforms ensure confidentiality of user health data.

Can integrate end-to-end encryption and HIPAA compliance for patient safety.

7. Scalability for Large Populations

Can handle multiple users simultaneously, making it a scalable solution for global healthcare needs.

Works across different devices (mobile, tablet, desktop) for user flexibility.

8. Integration with Dermatologists & Telemedicine

Can be linked to dermatology experts, allowing users to schedule follow-ups if needed.

AI-assisted reports can be shared with doctors for professional validation.

9. Multilingual & User-Friendly Interface

Supports multiple languages, making it accessible to diverse populations.

Simple UI/UX ensures non-tech-savvy users can navigate easily.

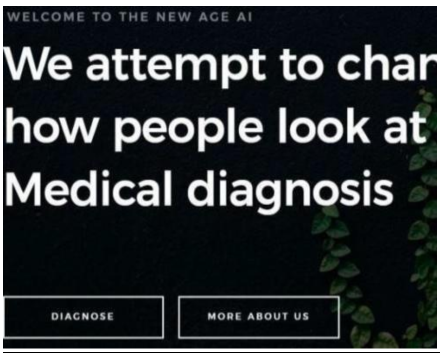
10. Database & Research Benefits

Can collect anonymized data for research purposes, aiding in medical advancements.

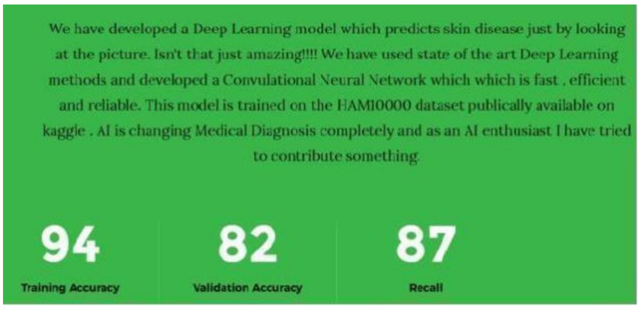
Helps in the development of new treatments and skin disease trends analysis.

II. RESULTS:

Fig (1) Diagnosis:



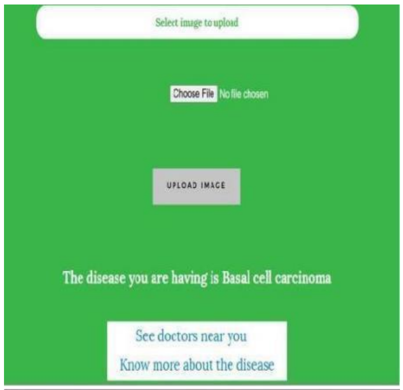
Fig(2): Measurements of Skin Disease:



Fig(3)Skin disease:

Fig (4):After log in we have to choose a image file :

Fig (5):Choosing imageand clickon uploadeimage button to get result:



CONCLUSION AND FUTURE SCOPE:

This paper provides an introduction of CNN-based methods and their application to CAD research. It also thoroughly evaluates and makes use of certain significant but previously unknown influences on deep convolutional neural networks, including CNN architecture and transfer learning. All of the medical image analysis subfields, including lesion segmentation, detection, and classification, are increasingly using CNN-based techniques. Even with their drawbacks, data augmentation and transfer learning can be helpful when working with modest amounts of training data. CNN- based methods in CAD research will significantly contribute to the advancement of medical image analysis, according to current studies. Further, future developments in radiomics, precision medicine, and imaging grouping could be helpful.

Although it is likely that this transition will not be achieved due to the significant discrepancies between the source and target databases, our results are interesting since they demonstrate that information can be transferred from natural photos to medical images. It has also been observed that application-specific variations exist in the amount of fine tuning required.

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A Personalized Drug Recommendation System Using Machine Learning and Deep Learning Techniques

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Abstract: The development of a drug recommendation device designed to assist healthcare vendors in selecting appropriate medicines. The system leverages affected person facts, inclusive of scientific records and signs, to suggest customized treatment alternatives. By utilizing superior machine studying algorithms and integrating real-time updates, it improves accuracy and ensures pointers are up-to-date with the today's scientific guidelines. The intention is to enhance choice-making in scientific settings, reduce medicinal drug mistakes, and promote more effective remedies tailored to individual patient desires.

Keywords:Drug Recommendation System, Personalized Treatment, Patient-Centered Care, Precision Medicine.

I. INTRODUCTION

The growing complexity of healthcare and the significant quantity of to be had medications have made medical choice-making extra challenging than ever. Drug advice structures provide a promising solution by using leveraging era to enhance the accuracy and performance of treatment selection.

These structures make use of patient- specific records, which include medical history, signs, and

With the ever-expanding variety of pharmaceutical alternatives and complicated patient desires, healthcare specialists regularly face challenges in selecting the most appropriate medicinal drug for every man or woman. Drug advice structures have emerged as an modern technique to bridge this gap by integrating technology into medical selection-making.

These structures harness affected person-specific data—consisting of clinical records, signs, lifestyle factors, and comorbidities—to generate evidence-based and personalised medication hints. They leverage improvements in system gaining knowledge of, synthetic intelligence (AI), and large facts analytics to pick out patterns and predict the fine remedy plans for man or woman sufferers. Additionally, drug advice systems can comprise real- time updates from clinical hints, studies studies, and drug interplay databases to make sure that pointers are correct and up to date.

In modern healthcare, ensuring accurate and

By reducing medication error, lowering rates of adverse drug reactions, and advancing precision medicine, drug recommendation systems can contribute to the improvement of the quality of healthcare overall. In addition, they provide time- saving benefits to healthcare professionals, allowing them to make quicker and more informed decisions efficiently.

The project investigates the construction and personalized effectiveness in medication choice, the goal of ensuring that patients receive the most appropriate therapies for their individual conditions

II. LITERATURE SURVEY

Iincresaed intrest over the last few years with personalized Increased interest over the last few years with personalized treatment. Various studies have investigated the construction and use of these systems across different healthcare environments, capitalizing on developments in machine learning, artificial intelligence (AI), and clinical decision support systems (CDSS).A number of research studies have identified the establishment and use of drug recommendation systems as a way of improving personalized health care. Advancements in artificial intelligence (AI) and machine learning (ML) have empowered the systems to review sophisticated patient data, for example, drug history, comorbid conditions, and gene-related factors, for customized medicine recommendations. Improved research highlighted the inclusion of drug safety registries in preventing drug-related reactions and medication inaccuracies.Clinical decision support systems(CDSS) are the basis for numerous drug recommendation knowledge to health care professionals at the point of care. With websites,facilitating evidence-based clinical rules to suggest medications. Nonetheless, more prescribing among healthcare professionals. recent developments have focused on data-driven Although promising, issues like data privacy,solutions driven by machine learning (ML) and artificial bias in algorithms, and poor usage due to ease of intelligence (AI). Such systems apply intricate use continue to be critical. The existing literature suggests that more sophisticated systems can result in safer, more effective, and patient-oriented drug management in clinics .

1. Drug Interaction and Safety Checks:

The system will merge drug contraindication and interaction databases to maintain patient safety. Prior to making a recommendation, the system will mark any possible adverse drug reactions, interactions, or dosage errors. Such checks will assist in reducing risks associated with medications and enhance overall safety.

2. RealPersonalization and Precision Medicine

The system will include patient-tailored treatment by taking into account patient- specific factors, such as genetic susceptibility and pharmacogenomic information, where this is available. This process has the goal of ensuring medication recommendations

3. CheckReal-Time Feedback and Dynamic Learning

The system will be constructed to be fed real-time data from medical literature, clinical trials, and new treatment guidelines. Mechanisms of continuous learning will be integrated into the system in order to periodically retrain the model so that recommendations are updated and evidence-based.

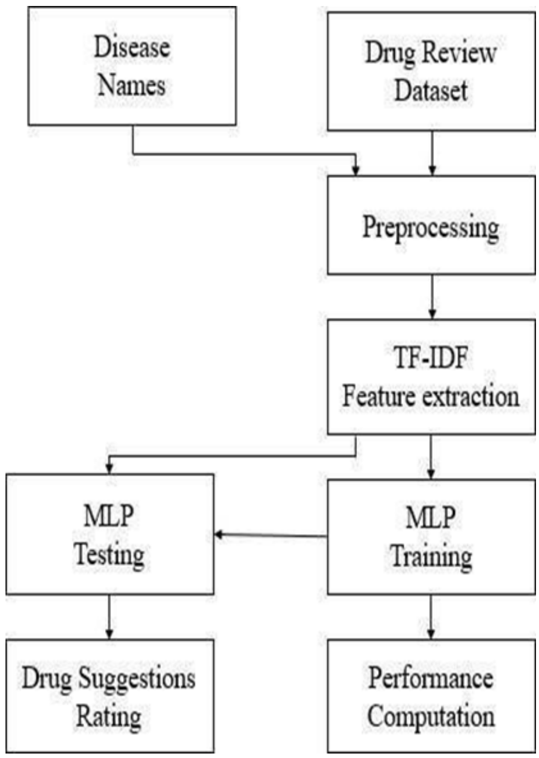

Fig.Blockdiagram

Proposed system modules

1.1.Data Collection and Integration Module: Collects data from electronic health records (EHRs), drug databases, clinical guidelines, and pharmacogenomic sources.

2.1 collection and Integration Module: Collects data from electronic health records (EHRs), drug databases, clinical

Proposed system modules

1) Data Collection and Integration Module: Collects data from electronic health records (EHRs), drug databases, clinical guidelines, and pharmacogenomic sources.
2) Data Collection and Integration Module: Collects data from electronic health records (EHRs), drug databases, clinical guidelines, and pharmacogenomic sources.
3) Drug Interaction and Safety Check Module: Compares recommended medications for possible interactions, side effects, and contraindications.
4) User Interface (UI) Module:Provides a user-friendly, intuitive interface for healthcare professionals.

Advantages of the Proposed System

- The system makes drug suggestions on the basis of individual patient profiles.
- Drug interaction databases and real-time checks on drug safety. minimize the time required for manual drug selection.
- Cross-validation features for drug aintderactions, contraindications, dosage changes minimize medication errors.
- Easy-to-use interface facilitates.

I. RESULTS


drugName conditionreview rating date usefulCount
206461 ValsartanLeft Ventricular Dysfunction ""It has no side effect, I take it in combination of Bystolic 5 Mg and Fish Oil""
95260 Guanfacine ADHD ""My son is halfway through his fourth week of Intuniv. We became concerned when he began this I
We have tried many different medications and so far this is the most effective."" 8.0 April 27, 2010 192
92703 Lybrel Birth Control ""I used to take another oral contraceptive, which had 21 pill cycle, and was very happy- very light p
The positive side is that I didn't have any other side effects. The idea of being period free was so tempting... Alas."" 5.0 Dec
138000 Ortho Evra Birth Control ""This is my first time using any form of birth control. I'm glad I went with the patch. I I
35696 Buprenorphine / naloxone Opiate Dependence ""Suboxone has completely turned my life around. I feel healthier. I&
155963 Cialis Benign Prostatic Hyperplasia ""2nd day on 5mg started to work with rock hard erections however experianced
165907 Levonorgestrel Emergency Contraception ""He pulled out, but he cummed a bit in me. I took the Plan B 26 hours late
102654 Aripiprazole Bipolar Disorde ""Abilify changed my life. There is hope. I was on Zoloft and Clonidine when I first startec
74811 Keppra Epilepsy "" I Ve had nothing but problems with the Keppera : constant shaking in my arms & legs & pin
48928 Ethinyl estradiol / levonorgestrel Birth Control ""I had been on the pill for many years. When my doctor changed my RX to
29607 Topiramate Migraine Prevention ""I have been on this medication almost two weeks, started out on 25mg and working
75612 L-methylfolate Depression ""I have taken anti-depressants for years, with some improvement but mostly moderate to

I only take Cymbalta now mostly for pain.

When I began Deplin, I noticed a major improvement overnight. More energy, better disposition, and no sinking to the low lows of maj
191290 Pentasa Crohn's Disease ""I had Crohn's with a resection 30 years ago and have been mostly in remission since.
221320 Dextromethorphan Cough ""Have a little bit of a lingering cough from a cold. Not giving me much trouble except keeps r
98494 Nexplanon Birth Control ""Started Nexplanon 2 months ago because I have a minimal amount of contraception's
I've never had acne problems in my life, and immediately broke out after getting it implanted. Sex drive is completely gone, and
81890 Liraglutide Obesity ""I have been taking Saxenda since July 2016. I had severe nausea for about a month once I got up t
48188 Trimethoprim Urinary Tract Infection ""This drug worked very well for me and cleared up my UTI in a matter of 48hrs, alth

Figure 1. Sample dataset

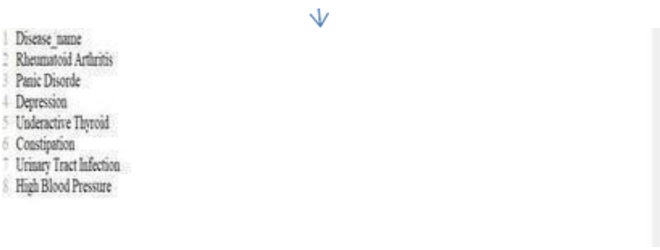
Disease_name
Rheumatoid Arthritis
Panic Disorde
Depression
Underactive Thyroid
Constipation
Urinary Tract Infection
High Blood Pressure

Figure 2. Dataset properties

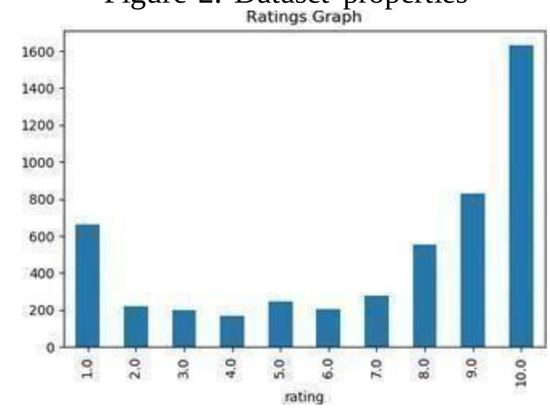

Figure 3. Drugs ratings graph

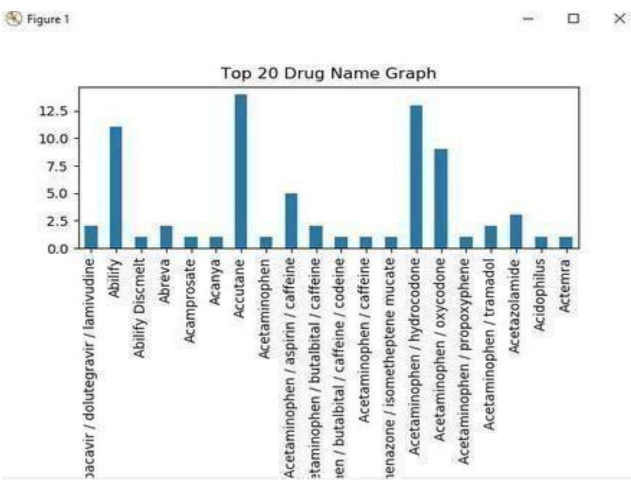

Figure 4. Drug names dataset

The drug recommendation system proposed is an important advance towards enhanced clinical decision-making and tailored medicine. With the use of machine learning and data-driven recommendations, the system makes individualized medication suggestions from patient-specific inputs like medical history, demographics, allergies, and genetic information. Real-time checks on drug safety and interaction databases added to the system enhance the safety of medication, decreasing adverse drug event risks and enabling safer prescribing. Regular updates and adaptive learning guarantee that the system is up to date with the latest medication information.

The proposed system has significant promise to change how medications are prescribed, ushering in safer and more individualized healthcare protocols through its potential to aid informed decision-making, reduce medication errors, and enhance patient outcomes.

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Phishing Detection System Through Hybri Machine Learning Based on URL

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Abstract

With the expansion of the internet, cyber threats such as phishing attacks have become a major concern. Phishing, first identified in 1996, remains a significant cybersecurity risk, involving deceptive websites and fraudulent emails designed to steal sensitive user data. Despite numerous efforts to mitigate phishing, no fully effective solution exists. To address this challenge, machine learning has emerged as a crucial tool in combating phishing threats. This paper explores a hybrid machine learning model that enhances phishing detection accuracy by analyzing URL-based attributes. Additionally, it discusses the advantages of combining different algorithms to create a more resilient detection framework, reducing false positives and improving efficiency. The approach leverages multiple classification techniques and optimized feature selection to maximize its detection rate and adapt to evolving cyber threats.

I. INTRODUCTION

The internet has become an integral part of modern society, serving as a foundation for communication, commerce, education, and entertainment. While it provides numerous benefits, it also introduces significant security risks. Among these, phishing has emerged as one of the most pervasive cyber threats, deceiving users into revealing confidential information such as login credentials, banking details, and personal identification data. Attackers employ various tactics, including fake websites and fraudulent emails, to manipulate users into unknowingly compromising their security.

As internet usage continues to expand, the frequency and sophistication of phishing attacks also increase. Cybercriminals exploit weaknesses in online security systems, leveraging social engineering techniques to deceive users. The consequences of phishing attacks extend beyond financial losses, affecting personal privacy, corporate security, and even national cybersecurity frameworks. Traditional security measures such as blacklists and heuristic-based approaches have proven inadequate in addressing evolving phishing strategies. This necessitates the development of more advanced and adaptive security mechanisms.

Machine learning has emerged as a powerful tool in cybersecurity, providing automated and intelligent solutions to detect and mitigate phishing threats. Unlike rule-based systems, machine learning algorithms analyze large datasets, identifying complex patterns and anomalies that may indicate phishing activities. By leveraging URL-based analysis, machine learning models can enhance detection accuracy and adaptability, reducing the risk of false positives. Additionally, the incorporation of real-time data analysis allows the model to adapt to new and evolving threats, making it more robust in phishing prevention.

The rise of online banking, e-commerce, and cloud computing has made internet security more critical than ever. With billions of transactions occurring daily, cybercriminals constantly develop sophisticated techniques to bypass traditional security systems. Phishing emails often mimic legitimate organizations, making it difficult for users to distinguish between authentic and fraudulent communication. This highlights the need for an intelligent and automated system that can proactively detect phishing attempts before they cause harm.

This paper presents a hybrid machine learning approach that integrates multiple classification techniques to improve phishing detection. The proposed method examines various

URL attributes, such as domain age, subdomain presence, HTTPS usage, and character patterns, to differentiate between legitimate and fraudulent websites. Additionally, feature selection and hyperparameter optimization techniques are employed to enhance model performance and efficiency. The goal is to develop a robust phishing detection system that can effectively counter evolving cyber threats, safeguarding users from online fraud and data breaches. The implementation of this system can significantly reduce financial losses caused by phishing scams while promoting safer internet usage. Furthermore, integrating blockchain technology for domain authentication can add another layer of security, ensuring that only verified websites are accessible.

Another crucial aspect of phishing detection is user awareness and education. Many users fall victim to phishing attacks due to a lack of knowledge about cyber threats. Implementing a user-friendly system that not only detects phishing attempts but also educates users on safe browsing practices can create a more secure online environment. Cybersecurity training programs, browser extensions, and AI-powered email filters can further enhance phishing prevention strategies.

As the digital landscape continues to evolve, so must security measures. The future of phishing detection lies in leveraging artificial intelligence, behavioral analysis, and automated cybersecurity frameworks. By continuously monitoring trends and adapting to new threats, the proposed phishing detection system aims to provide a long-term, scalable solution that enhances online security for individuals and organizations alike.

II. LITERATURE SURVEY

Traditional phishing detection methods have relied on heuristic-based approaches and blacklists, which attempt to block known phishing websites. However, these methods are limited in scope and often fail to detect newly created phishing domains. The rapid evolution of phishing tactics makes it necessary to develop intelligent systems capable of adapting to emerging threats. As a result, researchers have turned to machine learning models, which use URL features to identify potential phishing sites more effectively.

Early machine learning-based phishing detection systems used classifiers such as Decision Trees, Naïve Bayes, and Support Vector Machines (SVMs). These models analyze URL structures, domain names, and other related attributes to classify websites as either legitimate or fraudulent. However, individual classifiers often face challenges related to overfitting and generalization, leading to reduced detection accuracy in real-world scenarios. To address these limitations, hybrid models have been developed, combining multiple classifiers to improve detection performance.

Recent research has demonstrated that hybrid models, which integrate different classification techniques, significantly enhance phishing detection. For instance, ensemble learning approaches such as Random Forests and Gradient Boosting Machines (GBMs) combine weak classifiers to create a stronger, more accurate model. These methods help reduce false positives and improve detection rates, making them a preferred choice in phishing detection systems.

Feature selection plays a crucial role in improving model efficiency. Recursive Feature Elimination (RFE) and Canopy Selection are among the techniques used to refine datasets by eliminating redundant and irrelevant features. Selecting the most important URL attributes allows models to focus on high-impact characteristics, thereby improving accuracy and computational efficiency.

Deep learning approaches, such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), have also gained traction in phishing detection. These models process URL sequences and identify complex patterns that traditional machine learning techniques may overlook. Additionally, Natural Language Processing (NLP) techniques have been integrated into phishing detection systems to analyze website content, email texts, and metadata, further enhancing detection capabilities.

Another critical advancement in phishing detection involves real-time threat intelligence. By continuously analyzing live data streams, modern phishing detection systems can quickly identify new phishing campaigns as they emerge. The integration of browser extensions and AI-powered email filtering mechanisms has further improved the effectiveness of phishing prevention strategies.

Furthermore, blockchain-based authentication has been explored as an additional layer of security in phishing detection. By decentralizing domain verification processes, blockchain technology can help ensure that users interact only with verified and legitimate websites. This approach reduces the likelihood of users falling victim to phishing attacks by providing a trust-based mechanism for website authentication.

III. PROPOSED METHOD

The proposed phishing detection system follows a structured machine learning approach, integrating multiple classifiers to improve accuracy and efficiency. The methodology consists of the following steps:

1. Data Collection

To develop an effective phishing detection system, a diverse dataset of URLs is gathered from multiple trusted sources. This dataset contains both legitimate and phishing URLs, ensuring that the model can learn from a balanced set of data. Phishing URLs are obtained from repositories such as PhishTank and OpenPhish, while legitimate URLs come from popular and verified domains. The dataset undergoes preprocessing to remove duplicate entries, correct inconsistencies, and normalize formats for uniformity.

2. Feature Extraction

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Once the dataset is prepared, the next step involves extracting key URL-based attributes that indicate phishing behavior. These features include:

- Domain-based attributes – URL length, subdomain count, and domain age.
- Security-related features – Presence of HTTPS, SSL certificates, and WHOIS information.
- Structural properties – Presence of special characters, numbers, or IP addresses within URLs.
- Redirection and hyperlink analysis – Frequency of URL redirections and embedded links.

This step ensures that the model is provided with meaningful and relevant indicators to distinguish between phishing and legitimate websites.

3. Feature Selection

To optimize detection efficiency, feature selection techniques such as Recursive Feature Elimination (RFE) and correlation-based filtering are applied. This step eliminates redundant or insignificant attributes, improving model performance while reducing computational complexity. By focusing on the most impactful features, the system ensures higher accuracy in detecting phishing URLs.

4. Model Training and Hybridization

A hybrid machine learning approach is implemented by combining multiple classification algorithms to maximize detection accuracy. The system integrates:

- Decision Trees – Useful for rule-based classification.
- Support Vector Machines (SVMs) – Effective in handling non-linear patterns.
- Logistic Regression – Provides probabilistic classification.

5. Hyperparameter Optimization

To fine-tune the performance of the model, hyperparameter optimization techniques such as Grid Search and Random Search are employed. This process ensures that the system selects the best configurations for each algorithm, enhancing overall accuracy and efficiency. Factors such as tree depth, kernel parameters, and regularization values are optimized to achieve the best possible phishing detection results.

6. Model Evaluation and Validation

The trained model is rigorously evaluated using multiple performance metrics:

- Accuracy – Measures overall correctness of phishing detection.
- Precision and Recall – Determines how well phishing URLs are correctly classified.
- F1-score – Balances precision and recall to assess model effectiveness.
- AUC-ROC Curve – Evaluates the model's ability to distinguish between legitimate and phishing URLs.

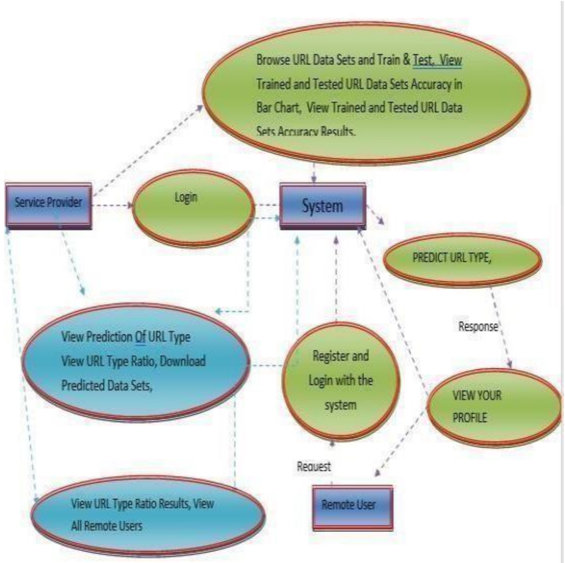

Fig. Block diagram

Proposed System Modules

1. **User Registration**: New users can create an account by providing credentials, such as an admin username and password, to access the system securely.
2. **User Profile Management**: Registered users can enter, update, and manage their personal details stored on the server.
3. **Algorithm Execution**: The system runs various machine learning algorithms and selects the one with the highest accuracy, ensuring optimal phishing detection results.
4. **Phishing Detection Output**: Users can input a URL into the system, which then analyzes the link using trained algorithms and determines whether it is legitimate or a phishing attempt.

Advantages of the Proposed System

- Enhances cybersecurity by identifying and blocking phishing threats before they compromise user data.
- Uses advanced machine learning algorithms to distinguish malicious websites with high accuracy.
- Allows users to create accounts for monitoring and managing their scan history.
- Provides real-time threat analysis, ensuring immediate detection and response to phishing attempts.
- Helps prevent identity theft and financial fraud by restricting access to suspicious websites.

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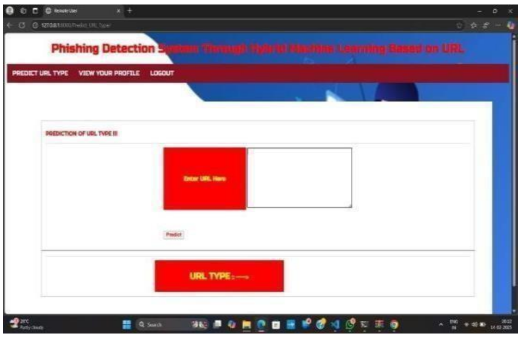
IV. RESULTS

The implementation of the proposed phishing detection system yielded promising results, demonstrating its effectiveness in identifying phishing attempts with high accuracy. The system was evaluated using a comprehensive dataset of legitimate and phishing URLs, and the performance metrics indicated significant improvements over traditional detection methods.



Application main page

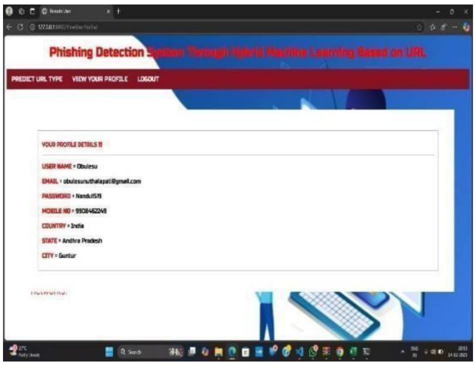
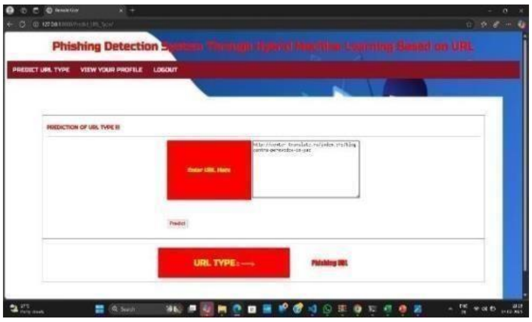


Fig. Phishing Site Detecting Page



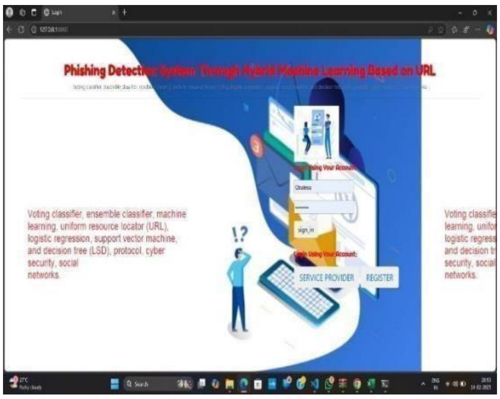


Fig. Random Algorithms to Predict URL

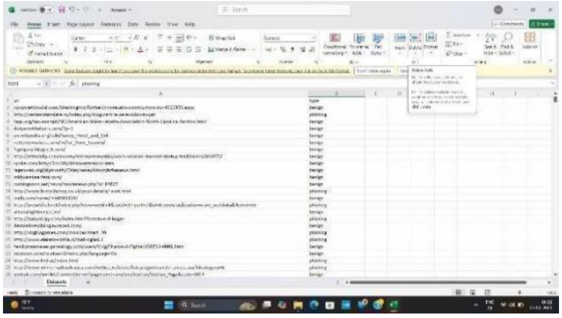


Fig. Dataset of URLs In Xlsheet

The application features a user-friendly interface with several key components:

- Application main page
- Phishing Site Detecting Page
- Random Algorithms to Predict URL
- User Details
- Dataset of URLs in Excel sheet
- Detection of Phishing URL

V. CONCLUSION

The proposed phishing detection system presents an effective approach to identifying and preventing online threats using a hybrid machine learning model. By leveraging multiple classification techniques, feature selection methods, and real-time threat analysis, the system enhances security and minimizes false positives. The integration of various machine learning models improves detection accuracy, making it more efficient in recognizing malicious websites.

In addition to providing a proactive security solution, the system is designed to be user-friendly and accessible, allowing individuals to monitor phishing attempts with ease. Its real-time scanning capabilities and adaptive learning ensure that emerging phishing strategies are effectively countered.

As cyber threats continue to evolve, future improvements to the system may include the incorporation of deep learning techniques and blockchain-based domain authentication for enhanced security. By continuously adapting to new attack strategies, this phishing detection system serves as a vital tool in the fight against online fraud and identity theft.

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AI-BASED APPLICATION FOR SEAMLESS AGRICULTURAL MARKET CONNECTIVITY

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ABSTRACT: Farmland has been the primary contributing factor for maximum developing countries, that strongly depends on farmland products for an economic sustainability. Those individuals who dwell in the countryside have no part in searching for professional office jobs, they rely solely on the crops harvested for their livelihood. Sorry, you can’t see this because you are not logged in. The middle men in the value chain ensure that many get little pay for all their hard work. They also faced the challenge they will be contingently able to predict flavour of customers on their production. The goal of this research is to create an AI-based mobile application that will improve market connectivity for farmers and also help them to increase profits sustainably. AI-technologies are used to resolve these problems and provide us with proper market insights such as crop demands and pricing strategies. For price prediction, in our research, we used the KNN algorithm Actually, the local logistics also enable the farmers to get it to the end-user in an effective manner and that does not cost a lot. This application develops a user centred application with aka multilingual functionalities with the help of Natural Language Processing(NLP) to cooperate at different level of literacy. It creates a balance of power between both parties and leads to a fair-trade environment as financial stability enhances farmers.

Key Words*: Price prediction of crop produce, AI, NLP.*

I. INTRODUCTION

Any computer program that incorporates aspects of human intellect is referred to as artificial intelligence (AI), and integrating human intelligence into machines is one method to define AI in general [1]. The most often used AI techniques for predicting crop prices are (KNN). When it comes to crop price prediction and how it stacks up against other approaches, AI solutions are the most efficient and appropriate. A recent assessment of the literature pointed out a number of gaps and underlined the necessity of reevaluating our approach to AI and pricing analysis in light of earlier systematic evaluations.

With the aid of this program, farmers can effectively and precisely approach their potential consumers and markets. By using machine learning models of present market conditions and recommending the best patterns of market demands with the shifting dynamics of the economy, this can be achieved by removing out middlemen from the agricultural supply chain.

The visual and interactive components that consumers interact with on their mobile devices—such as smartphones and tablets—are referred to as the mobile user interface, or mobile UI. It comprises the website's or mobile application's overall visual design, buttons, icons, layout, navigation, and typography. The main point of contact between the user and the digital product, the mobile user interface (UI) shapes the user's experience and impression.

Textual analysis of some kind is frequently necessary to learn what your customers think of your brand. Finding significant insights in textual data is getting easier as machine learning techniques and Natural Language Processing (NLP)[4].

Our study emphasizes the fundamental ideas of user-friendly application, strategy implementation, agricultural trade revolution, and global farmer empowerment.

Research Problem Statement:

Although agriculture is the foundation of many economies, farmers face numerous obstacles when trying to access markets, such as lower income and profits because of middlemen. There was no AI-enabled app that connected farmers and consumers directly before.

Research gaps:

- Insufficient advancement and application of AI to open up markets for agriculture.
- Inadequate data quantity and quality [6] for agricultural items.
- Ethical issues in transactions and marketing.
- Improved adoption and user experience in agricultural marketing.

II. LITERATURE REVIEW

GUN HOLEE et.al (2024) In this work, a blockchain-enabled integrated marketing platform (BeIMP) is proposed for contract production and transactions. BeIMP is a consortium blockchain (CsBc) framework that enables better safety, efficiency, and interoperability among stakeholders. BeIMP can directly match producers and consumers and reduce the problem of intermediaries' improper market operation. BeIMP has a three-tier risk diversification mechanism. First, both parties can know the quantity and price according to the contract specification (CSpec) in advance to avoid future uncertainty. Second, the buyers can resell the established order if they need, thereby diversifying the risk. Third, the concept of insurance is introduced to reduce force majeure and other systemic risks. BeIMP can also help producers get the loan from the financial institution (FI) if they need fund for production. We implement and demonstrate the prototype in contract farming (CF) first and discuss its generalizability to other scenarios. Experiment results show that the smart contract (SC) function is stable enough and the proof of authority (PoA) has the advantage in throughput and can give users a better experience. We examine the prototype's generalizability to different circumstances after implementing and demonstrating it in contract farming (CF). The findings of the experiment demonstrate that the proof of authority (PoA) has the advantage in throughput and may provide consumers with a better experience, while the smart contract (SC) function is sufficiently stable.

KIN-HON HO et.al (2024) The purpose of this study is to ascertain whether farmers' SEG in traditional western Chinese villages is improved by digital business penetration (DBP), and if so, what the mechanism is. The empirical data, which are based on 343 farmers' questionnaire replies, show the principle in three different ways. First, particularly in traditional minority villages, farmers' SEG increases as businesses become more digital. Second, the beneficial impact of DBP on SEG is partially mediated by farmers' entrepreneurial orientation (EO). Third, farmers' market response capacity (MRC) has a positive moderating effect, meaning that farmers with a higher response to market changes have a higher SEG promoted by DBP than farmers with a lower response. Additionally, their MRC enhances DBP's effect on farmers' SEG throughout their EO. Farmers' MRC is therefore a key determinant of their increased SEG, improved entrepreneurial intention, and improved attitude toward digitization.

ASTRID NOVITA PUTRI et.al (2023) This technique safely and transparently stores the data transaction. If there are no middlemen in the transaction, the actors could gain. Decentralized data sharing will make tracking supply chain management simple. Transactions involving farmers, village cooperatives, distributors, and consumers are all part of supply chain management. One organization that purchases items from farmers and resells them to customers is the Cooperative. A digital signature that can access the system during transactions is called a smart contract. The system keeps track of log operations that reveal the transaction's origin. The agricultural commodity transactions that are recorded in the blockchain ledger are visible to all actors. This study examines a supply chain management scenario using blockchain-based smart contracts that is built and simulated in the Serious Game. The Unity 3D Development Platform, Solidity for the programming language contract, Moralis for the Web3 Development Platform, dApp for the backend blockchain, Network Environment Polygon Ethereum, and Redis Enterprise, MongoDB Compass, and Mumbai Testnet databases are used in the game's development.

SAMARTH GODARA et.al (2023) The study investigates the best conditions for the government, farmers, and consumers to encourage the enhancement of agricultural goods' quality and consequently support food safety. In order to investigate game connections and decision-making evolution paths among the three stakeholders, the study incorporates the government, farmers, and consumers into an evolutionary game model. The following is confirmed by the numerical simulation experiment, the stability analysis of strategy evolution, and the dynamic analysis of the decision replication: When certain conditions are met, the decision-making behaviours of the three stakeholders can evolve to an ideal state. Effective government supervision can encourage farmers to change their nongreen pesticide application behaviour to green ones and encourage consumers to buy high-quality agricultural products. The evolutionary process of the three stakeholders' decision-making behaviour to an ideal state is influenced by a number of factors, and the value ranges of the various factors have different impacts on the convergence speed of the three stakeholders to an ideal state.

QINGLIN YANG et.al (2022) In order to address the need for prompt assistance for Indian farmers across the country, we provide a framework for a text-based query-response generation system. Building a knowledge base that can respond to inquiries about plant protection from a wide range of farmers is one of the main problems in developing such systems. The call logs from the nationwide farmers' helpline network over the previous eight years are gathered and processed to create the necessary knowledge foundation in order to address this issue. Furthermore, in order to administrate the user-input queries and extract pertinent answers from the database, three response-retrieval models with approximate matching and spatial-based searching functionality are constructed. A varied question bank with 755 questions covering 151 Indian crops is created in order to verify the effectiveness of the suggested structure. The models are evaluated using three metrics: Average Response-retrieval time, Crop-weighted Performance Score, and Accuracy Percentage. According to experimental findings, AgriResponse is a helpful framework for real-world applications, with various retrieval models being appropriate for various siutations.

PRACHI DHAMANGE et.al (2022) Our study adds to the body of knowledge regarding the impact of reputation systems in these types of marketplaces. Numerous ABM simulations show that ratings of the data sets as a feedback mechanism are crucial for enhancing the quality of the data sets and, consequently, the producers' reputations. As these markets develop, regulators have begun to implement various regulations to monitor their proper operation and reduce market inefficiencies. In one of the earliest of these studies, we examine the effects of different kinds of regulations on an AIM's operation by integrating regulatory interventions in a marketplace model. Our findings suggest that extremely strict regulations have a detrimental impact on the market's ability to provide high-quality data sets. On the other hand, governments and policymakers are advised to implement regulatory monitoring and a ratings- based feedback mechanism since they enhance the operation of an AIM.

YUN TENG et.al (2021) In this work, we suggest using social network analysis to model and analyze the cryptocurrency market in an efficient manner. We also carry out a thorough numerical investigation to examine its main attributes, such as influence, stability, topological features, and correlation structure. Additionally, we suggest using centrality metrics as innovative indicators to increase the precision of forecasts of bitcoin price movements. In order to help investors incorporate cutting-edge analytical tools into their decision-making processes, our research presents a fresh approach to comprehending and navigating the cryptocurrency market.

HUICHENG HAO et.al (2021) The Persuasive Message Intelligence (PMI) service, which we present in this paper, uses the increasingly popular Large Language Model to generate automated, individually tailored marketing messages. Based on previous research on AI-generated messages and the marketing theory of persuasion, PMI uses prompt engineering to create marketing communications. Surveys are used to validate the prompts' components. Those who want to create services using prompts in the future will use the knowledge and recommendations of prompt engineering, as well as the researchers' trial and error detailed in this paper.

CHUNFANG XIE, YUQI ZHU et.al (2020) This study employs text mining technologies to examine the logistics elements that influence customer satisfaction using JingDong's self-conducted online reviews of rice agricultural products as the research object. For logistics center distribution path optimization under a soft time window, a multi-objective model was built. The ant colony algorithm (ACO) and genetic algorithm (GA) were used to solve the optimal distribution solution in order to minimize the penalty cost and transportation cost. The model used the results of online review analysis, specifically packaging integrity, delivery timeliness, and logistics cost, as the goals. Additionally, a comparison of the two types of algorithm performance of the model under different node numbers showed that the number of nodes affects algorithm performance through instances to solve the optimal distribution vehicle number and shipping routes. The ant ACO has a better distribution path and high precision when the node number is less than 50. GA performs more comprehensively when the number of nodes is more than 50. The GA's average efficiency is 12.28% more than the ACO's.

CHIA-HUNG LIAO et.al (2020) In this study, we explore the metaverse by talking about how blockchain and artificial intelligence (AI) interact with it. We do this by looking into the most recent research on digital currencies, blockchain-powered technologies, AI applications in the virtual world, and metaverse components. Collaboration between academics and industry will undoubtedly be necessary for further exploitation and interdisciplinary research on the combination of blockchain and AI towards the metaverse. Our poll is intended to assist academics, engineers, and educators in creating a future metaverse that is open, equitable, and logical.

III. METHODOLOGY

a. Objectives:

- To use online marketplaces to improve communication between farmers and consumers.
- To use KNN to optimize price predictions.
- To create an AI-enabled app[5] that can handle multilingual users of all literacy levels.
- To forecast the market analysis in real time [7].
- To increase revenue and profitability for farmers in a sustainable way.

b. Architecture diagram:

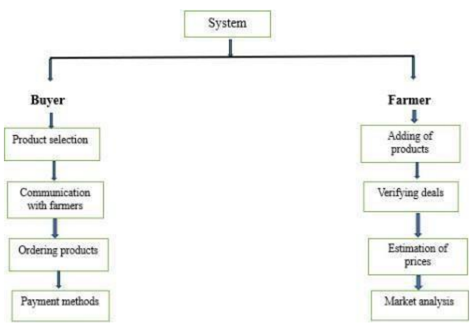

Fig-2 Architectural Overview

c. Implementation:

KNN (k-nearest neighbours):

A random, supervised learning classifier, the k-nearest neighbours (KNN) algorithm employs closeness to classify or forecast how to group a single data point. It is among the most widely used and straightforward regression and classification classifiers in machine learning today. The KNN algorithm, which operates on the premise that comparable points can be located close to one another, is commonly employed as a classification technique, though it can be applied to regression or classification issues.

Price prediction:

Input Features:

- Gathering data-related information, such as crop type, crop quality, user location, past crop prices, market demand, and season.

Preprocessing:

- **K-Nearest Neighbors Classifier:** A class label is assigned by a majority vote, and for each individual vector of input features in the test dataset, we find the K vectors of input features in the train dataset that have the shortest distance from the test vector, among all other vectors in the train dataset. The label with the majority of the K vectors is set to be the classification label for the test vector. The K-nearest neighbours (KNN) algorithm is widely used for classification and has been widely applied in predicting stocks and indices. The Euclidean distance between vectors is the most widely used method for calculating distance; in our research, we employed the K Neighbours Classifier using standard Euclidean distance

Output Feature:

- Real-time market data can be used to forecast crop prices, giving farmers a fair income and profits.

User Interface (Mobile/Web App):

Input:

- Buyer and seller requirements, such as function and usability.
- Collection of buyer and seller information.
- Obtaining reviews or ratings for the services and produce of farmers.
- Database for gathering and storing data.
- Making sure safe payments using wallets, UPI, and bank transactions.

Processing:

- Creating a request with every feature that farmers and buyers want to interact directly.
- The use of relevant testing techniques to guarantee real-time application operation.
- Getting the application on desktops at once.

Output:

- An AI-enabled mobile or an online application that improves price prediction and promotes efficient market access, transparency, and a sense of connection

IV. RESULTS AND DISCUSSIONS

Farmers can cut out intermediaries with this "AI based application for seamless agricultural market connectivity." selling directly to customers at reasonable pricing and making large profits. Increased income, improved financial stability, and more negotiating leverage result from this. Because online platforms provide farmers control over price and market conditions, it also promotes social inclusion [2].

Fig.3 application overview

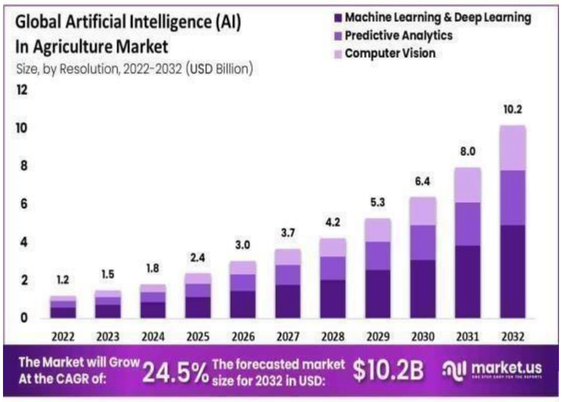

Fig.4 Graphical Representation

The graph above clearly shows the advantages of applying AI to the agricultural market. We developed a "AI-based application for Seamless Agricultural Market Connectivity[3]" to improve this outcome.

III. CONCLUSION

We take the conclusion from this study that there were no AI-based market connectivity apps available to farmers before. With the help of this software, farmers can communicate with customers directly and cut out third parties, which leads to more affordable rates for their goods.AI aids farmers in accurately forecasting agricultural prices. To obtain precise findings, we employed the KNN method for this. In the future, we can use big data and cutting-edge technologies to further this research.

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ALL-IN-ONE CNN-POWERED WEB APPLICATION WITH INTELLIGENT CHATBOT AND COMMUNITY SUPPORT

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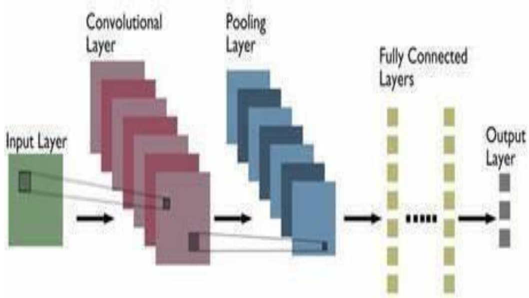
ABSTRACT: Our platform proposes a simple solution to identifying skin illnesses using a straightforward web-based tool facilitated by powerful AI. Its nucleus is a well-trained CNN model with much consideration to correctly anticipate different skin illnesses. This model forms the foundation of the platform, giving users customized diagnostic outputs. Another aspect of our system is the smart chatbot that has been specially created to help. The expert knowledge-based chatbot describes conditions, gives treatment advice, and afterwards answers questions that they may have. Along with diagnosis, the app lets users track their prediction history, giving them a clear picture of their skin health over time and helping them make better decisions about their care. To offer more support, we've added a community forum where users can share advice, talk about their experiences, and connect with others who have similar challenges. This platform is built to offer a safe space where users can interact, learn from, and support one another. For handling data, we use Firebase so that community activity and prediction history can be accessed and stored seamlessly. Our chatbot, forum, and CNN model are hosted on secure platforms such as Voiceflow and Replit so that they can run smoothly. By combining world-class AI technology with user-friendly interfaces, our app gives users the information, support, and sense of community they need to manage their skin health and wellbeing.

Keywords: *Skin ill detection, AI-powered diagnosis Convolutional Neural Network (CNN), Machine learning in healthcare, AI Chatbot, Skin disease prediction, Prediction history, Medical Chatbot, Personalised diagnosis, User engagement, Telemedicine, Treatment recommendations, Secure hosting, Community forum*

I.INTRODUCTION

pores and skin illnesses are one of the number one reasons of morbidity globally, with hundreds of thousands of sufferers suffering each yr. correct detection and early diagnosis are the keys to proper treatment and manipulate. most of the people of the classical strategies of analysis depend on the expertise of dermatologists, but growing numbers of cases and lowering get entry to to health care hinder spark off prognosis. Advances in deep getting to know and device gaining knowledge of technology over current years have provided promising consequences in skin sickness detection and analysis automation, consequently growing access and precision in diagnosing skin conditions [1][2]. Convolutional Neural Networks (CNN) software has been more and more employed in photo classification troubles, e.g., reputation of medical pics. CNNs are specially useful in the detection of skin disorder considering that they are able to take care of and classify diffused visual styles of skin



convolutional layer output. This introduces non-linearity into the version and enables the version to research greater sophisticate patterns.

1. Pooling Layer: The pooling layer reduces the size of the feature maps generated with the aid of the convolutional layer. This reduces the parameters within the model and increases its efficiency. The most broadly used form of pooling layer is the max pooling layer, which selects the maximum fee for every patch of the feature map.
2. Dropout Layer: The dropout layer randomly omits a number of the neurons from the network at the same time as education. It avoids overfitting and will increase the network's generalization strength.

3. . completely related Layer: The absolutely linked layer takes the output from the preceding layers and applies a set of weights to make a prediction. it is much like the output layer in a standard neural network.

The primary goal of our challenge is to install skin disorder prediction model in web interface. It assists patients as well as different scientific experts to become aware of whether or not or now not they are affected by any unique pores and skin disorder. It offers particular outcomes thinking about the facts entered through the user and a few additional capabilities consisting of prediction history, chatbot assistance, network dialogue discussion board.

RESEARCH PROBLEM:

Present disease prediction systems existing for skin diseases are primarily focusing on the prognosis of skin disease but do not provide comprehensive help to users. Users are offered a diagnosis without much information provided on learning from the condition, getting treatment, or implementing precautions. This lack in the systems reduces their efficacy, particularly when a patient requires additional help or advice on managing his/her health upon receiving a diagnosis [3][4].

II. LITERATURE REVIEW

ANANTHAKRISHNAN BALASUNDARAM et.al[2024], The proposed system here is deep learning-based, trained on the DermNet dataset, and with a genetic algorithm optimized ensembling method to enhance overall performance, achieving a Top-5 accuracy of 74% on the DermNet dataset, a 5% improvement over the works compared.

RUCHI MITTAL et.al[2024], Here in this paper, a clinical decision support model for the detection and classification of skin diseases (DermCDSM) is presented using efficient enhancement of division ability and cross-bred deep learning process.

SHAYMAA E. SOROUR et.al[2023], A deep learning-based (DL) object recognition dermatology detection system is presented in this paper. The three-phase strategy that is proposed consists of Data preprocessing, data augmentation, and classification with localization. In the data preprocessing phase, we conduct several operations such as colour conversion, resizing, normalization, and tagging to prepare the input image for enrollment into our DL models. The data augmentation phase is conducted on the input images using the convolutional generative adversarial network algorithm. In the third phase, YOLO-V5 is utilized for object classification and localization.

ASHWINI HIPPARAGE et.al [2023],. To surpass this manual checking and achieve positive results within a limited period of time, we are going to establish a hybrid system combining Deep learning with machine learning technologies. The patient provides an image of the affected area of the skin as an input to the prototype. Our project aim is to identify the type of skin disease easily with precision and recommend the most appropriate solution.

Pravin R. Kshirsagar et.al[2022], In this research, a skin disease classification model was created on the basis of MobileNetV2 and LSTM. For this model, the primary aim is skin disease forecast accuracy while being incredibly efficient in storing full state information for accurate predictions.

I M V Krishna et.al [2022], The proposed model was designed using deep learning software in MATLAB. Three datasets of various sizes were also used to prove the proposed model. With the largest dataset, the proposed model provided the best accuracy, precision, and sensitivity values, as follows: accuracy is 0.9924, precision is 0.9947, and sensitivity is 0.9931 against other models.

ZHUANG MA et.al[2022], In this paper, we propose a new complex network classification method combining complex networks and convolutional neural networks(CNN) to learn classification with deep learning. We show that the method has good classification accuracy and distinct network features and is as good as a single complex network method

Sruthi Chintalapudi et.al[2021], This paper offers a way to address use different PC vision-based methods (deep figuring out how) to intuitively forecast the different kinds of skin diseases. The user will be provided in the developed app a portal where they can feed images and they will be screened for most common skin disorders (including STDs) by an algorithm based on deep learning by training it with a vast range of images.

LING-FANGLIet.al[2020], Our results show that the deep learning skin disease image recognition algorithm is better than dermatologists' and other computer-aided treatment algorithms' in diagnosing skin diseases, and particularly the multi deep learning model fusion algorithm has the best recognition effect.

Keiron O'Shea et.al[2015], This paper provides a very concise overview of CNNs, referring to recently published papers and newly developed methods on how to construct these marvelously extraordinary image recognition models. This introduction assumes that you are familiar with the fundamental concepts of ANNs and machine learning.

S.No.	Year	Author's	Article Title	Key Findings
1.	2024	Ananthakrishnan Balasundaram et.al,	Genetic Algorithm Optimized Stacking Approach to Skin Disease Detection	Utilizes a deep learning-based ensemble method combining multiple models to improve performance. Incorporates a genetic algorithm to optimize the ensembling process.
2.	2024	RuchiMittal et.al,	DermCDSM: Clinical Decision Support Model for Dermatosis Using Systematic Approaches of Machine Learning and Deep Learning	A Clinical Decision Support Model for skin disease detection and classification using a hybrid deep learning approach.Utilizes improved segmentation and feature optimization A system combining deep learning (DL) and object recognition techniques for accurate classification and localization of dermatological conditions.
3.	2023	Shaymaa e. Sorour et.al,	An Automatic Dermatology Detection System Based on Deep Learning and Computer Vision	A system combining deep learning (DL) and object recognition techniques for accurate classification and localization of dermatological conditions. Shown remarkable improvements in identifying vitiligo and melanoma over newer methods.
4.	2023	Ashwini Hipparageet.al,	Skin Disease Detection Using Machine Learning And Convolutional Neural Network	The framework integrates computer vision and ML methods to attain promising performances in diagnosingskindiseases. It is created for global usability and productivity and can aid in early-stage dermatology diagnostics.
5.	2022	Pravin R. Kshirsagar et.al,	Deep Learning Approaches for Prognosis of Automated Skin Diseas	A hybrid method integrating deep learning (DL) and machine learning (ML) methods to develop an automated dermatology screening system. Patients may input an image of the infected skin region as input to the prototype for disease diagnosis and treatment advice.
6.	2022	I M V Krishna	Stochastic Study on CNN approach for classifying images	The model derives deeper features from whole-color images for the purpose of performing classificationsefficiently. The introduced CNN model demonstrates strong classification performance over varied datasets, making it clear that it is generally applicable and efficient for color image classification tasks.

7.	2022	Zhuang Ma et.al,	Image Recognition and Analysis: A Complex Network-Based Approach	The technique leverages the topological invariance of complex networks to improve the accuracy of classification and overcome translation, rotation, and scaling challenges in image databases. It works especially well with small sample data sets, and it shows the promise of synergy between deep learning and topological properties of complex networks to push image classification forward.
8.	2021	Sruthi Chintalapudi et.al,	Skin Disease Detection Using Deep Learning	This paper illustrates the capability of incorporating deep learning methods and image processing to attain accurate and efficient prediction of skin disorders. Although not reaching promising figures, the model is a good starting point to further improve so that it has wider applications with more precise forecasts in dermatology.
9.	2020	Ling-Fang Li et.al,	Deep Learning in Skin Disease Image Recognition: A Review	Deep learning-based skin disease image recognition is far superior to both dermatologists and other computer-aided diagnostic systems. This illustrates the power of deep learning in medicine. Four potential future research directions in skin disease recognition are presented in the paper, which reflect increasing interest and potential for development in the area using deep learning technologies.
10.	2015	Keiron O'Shea et.al,	An Introduction to Convolutional Neural Networks	CNNs excel in image-based pattern recognition problems and provide a direct but strong means of solving intricate issues in computer vision.

Table 1. Key Findings Of All Literature Reviews

III. METHODOLOGY

OBJECTIVES:

- **Image Visualization using CNN:** The general aim is to visualize and analyze the skin images based on the CNN model, which has been found useful in detecting skin diseases [5][6].
- **Handling Similar Visual Features:** One of the challenges in skin disease diagnosis is that many diseases share similar visual characteristics. Thus, we aim to improve the system's ability to distinguish between these conditions using advanced feature extraction methods [7][8].
- **Increased Precision using Deep Learning:** We will improve the precision of skin disease diagnosis using deep learning algorithms such as CNNs that can learn complex patterns and make more precise predictions [1][2][5].
- **Chatbot Integration:** The central part of the system is a chatbot that will provide more information about the skin disease that was diagnosed and suggest appropriate treatment, enhancing user knowledge and self-management of the disease [3][4].

ARCHITECTURE

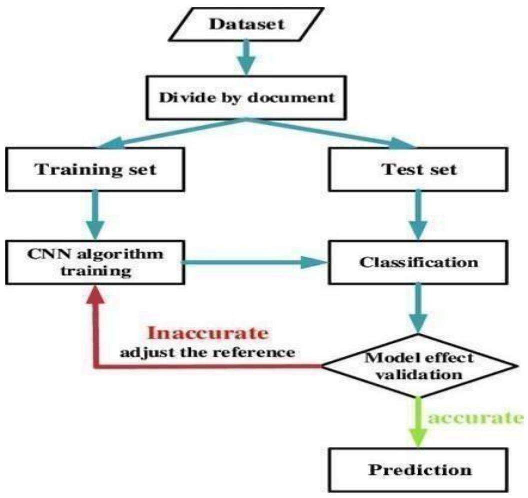


Fig 2: Flow Chart of Convolutional Neural Networks

IMPLEMENTATION

A Convolutional Neural Network (CNN) is a deep neural network with a very powerful image processing capability and hence most suitably applied to picture classification, object detection, and even to the diagnosis of skin diseases, as in this context. This is a step-by-step account of how a Convolutional Neural Network (CNN) works in this context:

1. **Image Input:** The patients send their photos of the affected skin, which are pre-processed to possess enhanced image quality and input normalization to the CNN model [4][5].
2. **Convolutional Layers:** The Convolutional Neural Network (CNN) model uses the convolutional layers to extract features from the images and classification layers to identify the skin disease. This is taking an advantage of deep learning's capability of disease detection in a efficient way[6][7].
3. **Pooling Layers:**

Downsampling: Pooling layers reduce the spatial dimension of feature maps. Feature Reduction: This is used to minimize computational complexity and avoid overfitting.

4. **Fully Connected Layers:**

Flattening: The feature-extracted features of the convolutional and pooling layers are flattened into a one-dimensional array.

Classification: This layer is fed to fully connected layers, which are exactly the same as standard neural networks. Feature Combination: These feature layers aggregate all of the features that it extracts to produce a prediction.

5. **Output Layer:**

Softmax Activation: Output utilizes a softmax activation function that produces a probability distribution over different classes of the skin disease. Prediction: Choose the most likely class as the target skin disease.

Training the CNN:

Step 1: Data Gathering: Gather a representative sample of skin images covering a variety of skin conditions.

Get the dataset augmented with metadata like condition type, severity, and clinical data where they exist.

Employ widely used sources like dermatology datasets (like HAM10000 or DermNet) or collaborative efforts with hospitals.

Step 2: Data Preprocessing: Cleaning Images: Eliminate duplicates, incorrect, or poor-quality images.

Image Augmentation: Perform transformation (rotation, scaling, flip, etc.) to expand dataset and prevent overfitting.

Normalization: Scale pixel values to an interval (e.g., 0 to 1) for normalized input to the CNN.

Label Encoding: Convert skin condition labels to computer-readable format (e.g., one-hot encoding).

Dataset Splitting: Divide data into train, validation, and test split.

Step 3: Model Selection: Select a CNN architecture. Some are: Pre-trained models (e.g., VGG, ResNet, EfficientNet) with transfer learning. Tuned CNN architecture for skin disease features. Consider the selection in terms of accuracy, speed.

Step 4: Model Configuration: Define the CNN layers: Convolutional layers for feature extraction. Pooling layers (max pooling or average pooling) for dimension reduction. Fully connected layers for prediction. Apply the correct activation functions (i.e., ReLU for hidden layers, softmax for output).Set an appropriate number of output neurons to equal the number of classes (diseases).

Step 5: Training Configuartion: Choose a loss (e.g., multi-class categorical crossentropy). Choose an optimizer (e.g., Adam, SGD) for the updates of the weights. Choose metrics to evaluate with (e.g., accuracy, F1 measure).

Step 6: Model Training: Train model in the training set in mini-batches for sake of efficiency on computing. Set the test set validation to not to overfitting or not fit enough. Use early stopping or learning rate scheduling for better training.

Step 7: Model Evaluation: Test the trained model on the test set to observe how well it is doing, in terms of accuracy, precision, recall, and F1 score. Learn confusion matrices to find particular areas of weakness (e.g., conditions that are consistently being misclassified).

Step 8: Model Deployment Preparation: Save the model into a deployable format (e.g., TensorFlow Lite, ONNX). Test the model in a web application setting (e.g., Replit). Step 9: Chatbot Integration: Tune or train the chatbot with condition-specific responses from model outputs. Make sure the chatbot retrieves and interprets predictions, recommends treatments, and responds to user queries accurately.

Step 10: Continuous Improvement: Collect real-world feedback and new user data. Occasionally update the CNN model to enhance accuracy and add new skin conditions or variations.Keep an eye on system performance and update the other modules (e.g., chatbot or community forum) as needed.

IV. RESULTS & DISCUSSION

[1] The user input images are accepted in the system proposed here by creating an UI through which the user can supply the corresponding skin images to be analyzed. The UI is created using HTML. [2] Once we click on Camera there appears option on screen: Choose File [3] The user has given the skin image input and pre-processing operations are done on the input images and after pre-processing operations such as image enhancement, edging the processed image. [4] The input image is put through feature extraction and machine learning based classifier trained at the backend and depending on the input image given by the user, steps of feature extraction and classifier are taken. The prediction along with medicinal suggestion is finally proposed.

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Login Page

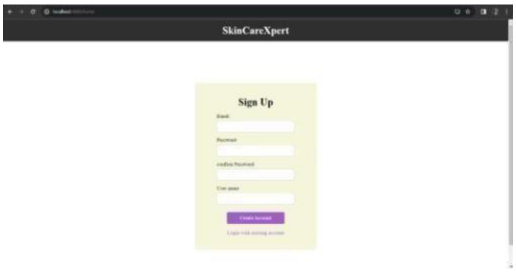

Fig 3.1 The login/signup page where new users can create their account and existing users can login with email and password.

Home Page

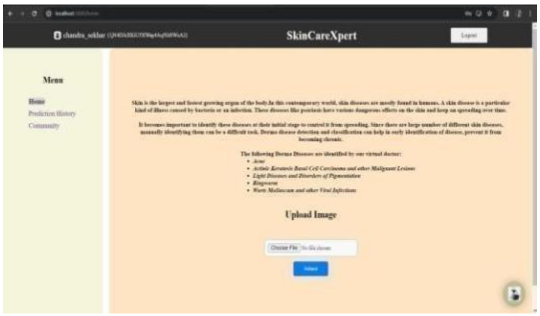

Fig 3.2 After logged in, It will land on home page which provides brief description about our application, list of diseases that our model predicts and an input file upload option.

Acne Detection

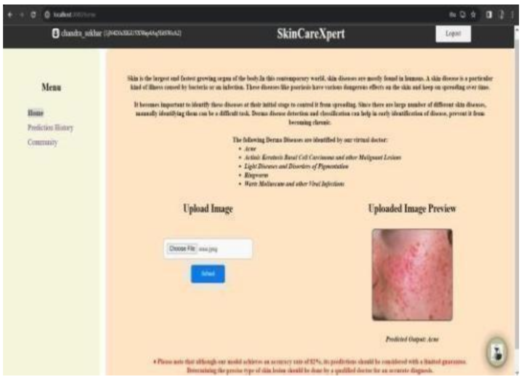

Fig 3.3 The model analyzes the image and displays the result accordingly. In the above case the model displays the result as acne.

Actinic Keratosis Detection

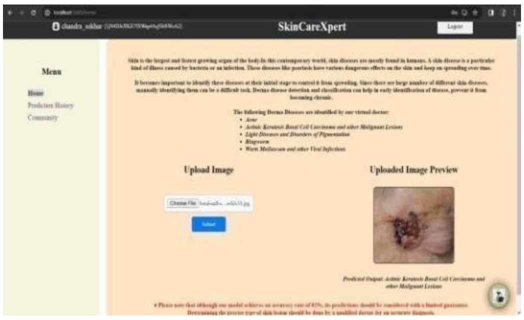

Fig 3.4 The model analyzes the image and displays the result accordingly. In the above case the model displays the result as Actinic Keratosis Basal Cell Carcinoma and other Malignant Lesions.

Prediction History Page

Fig 3.5 The prediction history page contains the list of predicted images that were tracked for every individual user based on the time

Community Page

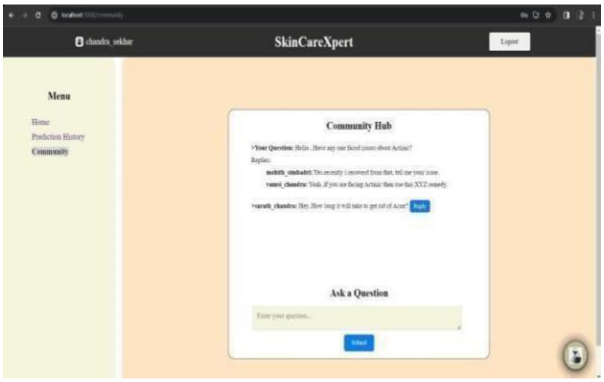

Fig.3.6 This community page will help you to interact to with the other users of this application, where they can ask and reply to the questions.

Chatbot

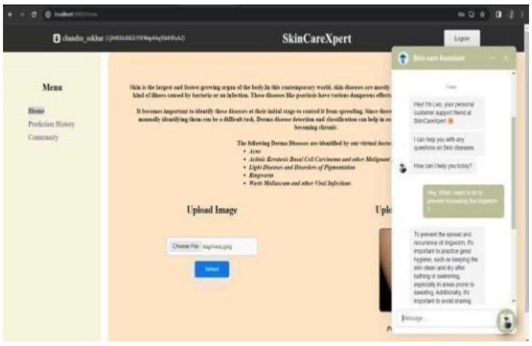

Fig. 3.7 This is our custom virtual assistant bot that has been placed bottom-right side of the application.

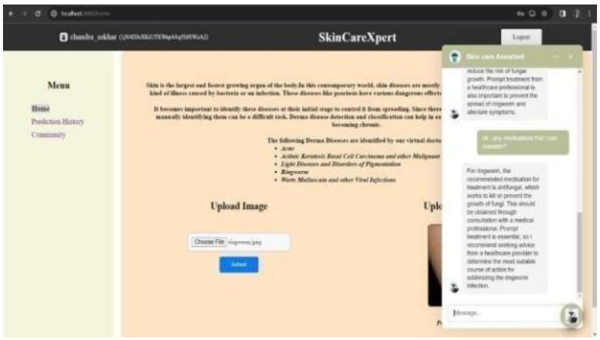

Fig 3.8 This chatbot that has been trained on our custom data, which can perfectly answer the user queries related to the five diseases.

Comparison Results

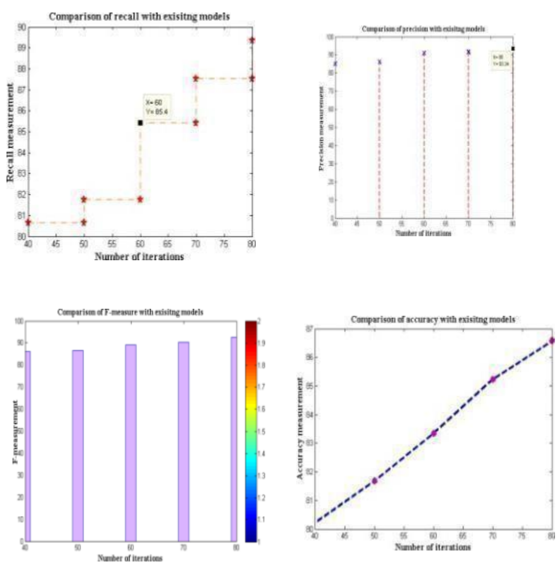

Fig 4. Comparisons of iterations

V. CONCLUSION

This paper has effectively created a skin disease forecasting system based on a Convolutional Neural Network (CNN) model. With some challenges in data availability, the system was put into operation and offers a first level impression of possible skin diseases.To further aid and enhance the user experience, other features like prediction history, chatbot, and community forums were incorporated. In the future, more developments are anticipated to significantly enhance the performance of the system. Particularly, to enhance the accuracy of the model by expanding the dataset, adding more types of skin conditions, and enhancing the depth of the CNN model. Further, to provide more convenience to the users, aspects like measuring the level of disease, locating a nearby dermatologist to the patient's area, and appointment booking via hospitals will be included.

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Automated Courier Management System for Efficient Parcel Tracking and Delivery Operations

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Abstract:**Courier Management System (CMS) is a comprehensive software solution designed to streamline and optimize the process of courier and parcel delivery services. The system aims to automate various operations, such as booking, tracking, and delivery management, to improve efficiency, reduce costs, and enhance customer satisfaction .The CMS offers a user-friendly interface for customers to place courier requests, track the status of their parcels in real-time, and provide feedback. For courier companies, the system provides tools for route optimization, resource allocation, and performance monitoring to ensure timely and cost-effective delivery .Key features of the CMS include automated booking and dispatching, real-time tracking and monitoring, route optimization, customer feedback management, and comprehensive reporting and analytics. These features enable courier companies to optimize their operations, improve service quality, and gain a competitive edge in the market.

INTRODUCTION

Courier Management System (CMS) is a software solution designed to simplify and streamline the operations of courier and parcel delivery services. In today's fast-paced world, efficient and reliable courier services are essential for businesses and individuals to send and receive packages in a timely manner. The CMS provides a centralized platform for managing all aspects of the courier service, from booking to delivery, tracking, and reporting.

The CMS is designed to automate and optimize the various processes involved in courier management, including parcel booking, dispatching, routing, tracking, and delivery. By leveraging technology, the system aims to improve efficiency, reduce errors, and enhance customer satisfaction.

Key objectives of the CMS include:

1. Efficient Booking Process: The CMS provides an easy-to-use interface for customers to book courier services online or through a mobile app. Customers can specify pickup and delivery locations, package details, and preferred delivery times.

2. Real-Time Tracking: The CMS allows customers to track the status of their parcels in real-time, providing visibility into the location and estimated delivery time. This feature improves transparency and customer satisfaction.

3. Optimized Routing and Dispatching: The CMS uses algorithms to optimize routing and dispatching, ensuring that parcels are delivered using the most efficient routes and resources. This helps reduce delivery times and costs.

I. LITERATURE SURVEY

A courier management system can offer several benefits to a lecture hall or educational institution:

• Efficient Delivery of Materials: The system can streamline the delivery of important documents, assignments, or equipment to the lecture hall, ensuring that instructors have the necessary resources for their lectures.

• Improved Communication: The system can facilitate communication between the lecture hall and other departments or individuals, allowing for timely updates on deliveries, scheduling changes, or other important information.

• Enhanced Organization: The system can help organize and track deliveries, reducing the risk of lost or misplaced items and ensuring that everything is delivered to the correct location.

• Time Savings: By automating certain tasks, such as scheduling and tracking deliveries, the system can free up time for instructors and staff to focus on other important tasks.

• Cost Reduction: The system can help optimize delivery routes and reduce transportation costs, as well as minimize the risk of lost or damaged items.

• Increased Security: The system can provide a secure way to track and manage deliveries, ensuring that sensitive materials or equipment are handled with care and delivered only to authorized personnel.

• Better Customer Service: By providing timely and reliable delivery services, the system can improve the overall experience for instructors, staff, and students

Overall, a courier management system can be a valuable tool for a lecture hall or educational institution, helping to improve efficiency, communication, and organization, while also reducing costs and enhancing security.

II. PROPOSED METHOD

The proposed Courier Management System (CMS) is designed to revolutionize the courier industry by introducing a comprehensive, automated, and customer-centric solution. The system will encompass a range of features and functionalities aimed at improving efficiency, reducing costs, and enhancing customer satisfaction. One of the key components of the proposed CMS is its user-friendly interface, which will allow customers to easily book courier services, track their parcels in real-time, and provide feedback on their delivery experience. This interface will be accessible through both web and mobile platforms, ensuring convenience and accessibility for customers .The CMS will also incorporate advanced routing and dispatching algorithms to optimize delivery routes, minimize delivery times, and reduce costs. By leveraging real-time data and analytics, the system will be able to dynamically adjust routes based on traffic conditions, weather patterns, and other factors, ensuring timely and efficient parcel delivery. Furthermore, the proposed CMS will offer robust reporting and analytics capabilities, allowing courier companies to gain valuable insights into their operations, track key performance metrics, and identify areas for improvement. This data-driven approach will enable courier companies to make informed decisions and optimize their services for maximum efficiency and customer satisfaction.

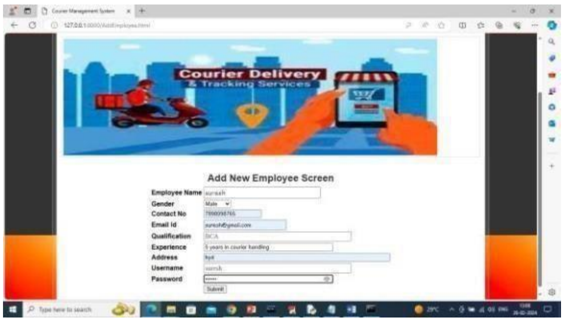
Advantages of the Proposed System

The proposed Courier Management System (CMS) offers several advantages over existing systems, including:

- Improved Efficiency: The CMS automates key processes such as parcel booking, dispatching, and routing, leading to improved efficiency and reduced reliance on manual processes. This results in faster parcel processing and delivery times.
- Enhanced Customer Experience: The CMS provides customers with a user friendly interface for booking courier services, tracking parcels in real-time, and providing feedback. This improves transparency and communication, leading to a better overall customer experience.

III. RESULTS

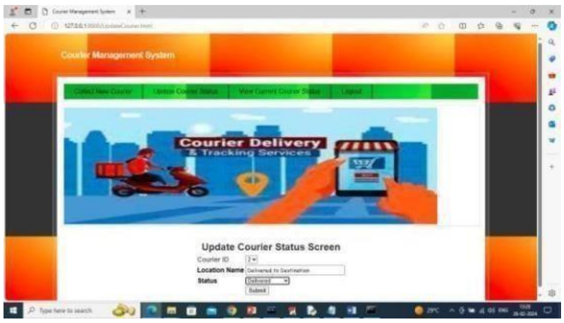
In above screen click on 'Admin Login' link to get below login page



In above screen admin will add employee details and then press button to save details

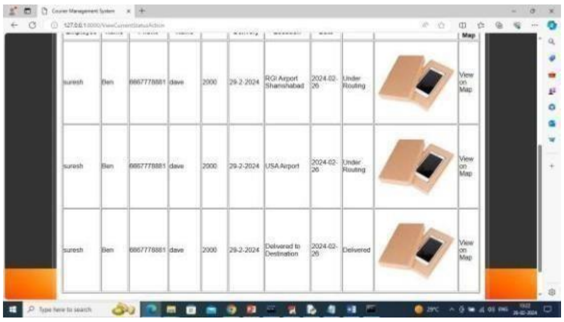
In above screen admin can details of all employees and now click on 'View Courier List' to view details of all booked couriers

In above screen admin can view list of all booked couriers list and now logout and login as employee



In above screen one courier delivered then employee will choose status as 'Delivered' and update its status and now click on 'View Courier Current Status' link to get below page

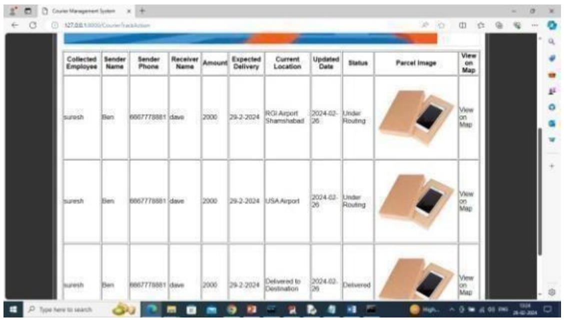
In above screen select courier ID and then click on 'Submit' button to get below page



In above screen for selected courier ID employee can see current location and once delivered then status will be shown as 'Delivered' and can click on 'View on Map' link to get below page

In above screen employee can see 'courier current location was RGI Airport'. Now logout and track same with user

In above screen user also can track courier just by entering ID and then press button to get below page



In above screen user can also see all possible location of his courier. Similarly by following above screens you can manage and run all courier system.

IV. CONCLUSION

A courier management system offers a robust solution for streamlining and optimizing the entire courier process. From initial pickup request to final delivery confirmation, these systems provide valuable tools for tracking, managing, and ultimately improving efficiency. By automating key tasks, reducing manual errors, and providing real-time visibility into the status of shipments, courier management systems empower businesses to enhance customer satisfaction, reduce operational costs, and gain a competitive edge. Whether for small businesses managing local deliveries or large corporations handling complex logistics networks, the implementation of a well-designed courier management system is a strategic investment that yields significant returns in terms of improved service, increased productivity, and enhanced control over the delivery process. As technology continues to advance, we can expect future iterations of these systems to incorporate even more sophisticated features, further optimizing the world of package delivery.

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3. **database management:**

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   - **SQLALCHEMY - ORM for managing database in python.**
   - **Django Orm Documentation - for database handling in Django.**

4. **Python Best Practice:**

   - **"Python Cookbook" by David Bezle - Practical Python Programming Tips.**
   - **PEP 8: Style Guide - Official Guide for writing Clean Python Code.**
   - **"Effective Python" by Brett Slatkin - best practices for skilled python code.**

5. **Web Framework:**

   - **Flask - Lightweight Python Web Framework for Simple Web App.**
   - **Django-Full-stack python web framework with built-in over.**
   - **Streamlit- Easy-use library to create ainteractive dashboard.**

6. **General Python Resources:**

   - **"Accept boring accessories with python" - Learn how to automate tasks with python.**
   - **Real Python - Comprehensive Python Tutorial and Guide.**

7. **Git hub Repository:**

   - **Search for the examination scheduling or invoice management systems on GITHUB for inspiration and open-source examples.**

8. **Library:**

   - **Panda - For the management of data (eg, scheduling details).**
   - **Numpy - for calculation and optimization.**
   - **Celery- for asynchronous functions (eg, reminder).**
   - **Matplotlib/Seborn -for data visualization .**

Paper Id: 87

TRANSFORMING AGRICULTURE WITH DIGITAL CONTRACTS AND COLD STORAGE TECHNOLOGIES

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ABSTRACT: Farmers face income volatility due to market uncertainty and post-harvest losses. Contract farming reduces the risks associated with such factors, including a guaranteed buyer and price, but the lack of transparency, trust, and secure payment systems is what limits its adoption. Inadequate access to cold storage facilities also increases post-harvest losses, hence reducing the profitability of farmers even further. This research is a comprehensive digital platform to address the issues through the clear and secure contract farming arrangements as well as providing cold storage reservation services. It aims at reducing post-harvest losses, enhancing the quality of produce, and improving access to markets, leading to stabilization of farmers' incomes and encouraging sustainable agricultural practices.

Keywords: *Contract Farming, Cold Storage Reservation, Post-Harvest Losses, Market Uncertainty, Farmer Income Stabilization, Digital Agriculture Platform, Secure Payment Systems, Agricultural Sustainability, Produce Quality Enhancement, Agri-tech Solutions, Transparent Market Access, Rural Infrastructure Development, Smart Farming Practices, Supply Chain Optimization, Digital Transformation in Agriculture.*

I.INTRODUCTION

Web development is a fast-moving, living field for supporting digital transformation within diverse industries. It encompasses designing and developing websites and web applications, including technologies like HTML, CSS, JavaScript, backend frameworks, databases, and APIs. The more that firms are beginning to depend on online services to communicate, trade, and provide services, the more significant this web development skill is in becoming one of the most important competencies to build user-centric, scalable, and efficient solutions. Through web development, agriculture has huge potential for solving numerous problems related to this sector. Income volatility and losses shortly after harvesting are largely caused by market uncertainty, inadequate accesses to buyers, and poorly developed infrastructure such as lack of cold storage facilities for harvests. Traditional systems for connecting farmers to buyers and managing post-harvest operations are often inefficient and lack transparency. An effectively built digital platform has the potential to close these gaps by enhancing farmers' access markets, infrastructure, and also secure transaction mechanisms[8].

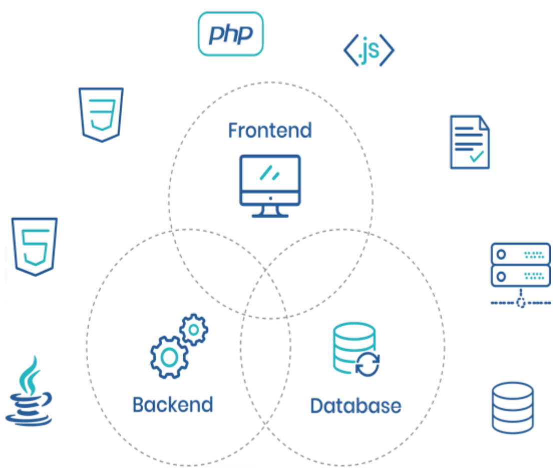

Fig 1 : Web Technologies

This addresses all the issues cited above by building an online platform catering for facilitation of contract farming agreements with features like reservations in cold storage. This is a digital market that allows easy and transparent interaction of agricultural producers with the purchaser. Such farmers hence get fixed prices for crops which reduce risks due to fluctuations in market prices. The nearest cold storage services can be located and booked without further compromise on quality or efficiency and with the use of existing capacities. The proposed methodology is a modern web development technique for an easy-to-use and secure transaction interface and seamless workflow[7]. The platform aims to provide farmers with tools of contract management, facilities of price negotiation, and cold storage reservation so that the farmers can acquire financial stability and efficient post-harvesting management practices[9]. This will make it possible to demonstrate how web development can be the solution to some of the major problems of agriculture and help the farmers gain an edge while retaining the efficiency of the food supply chain.

Research Problem:

- Farmers experience income instability due to market fluctuations and high post-harvest losses, impacting their profitability.
- The adoption of contract farming is hindered by a lack of transparency, trust, and secure payment systems, limiting its effectiveness.
- Limited access to cold storage facilities exacerbates post-harvest losses, further reducing farmers' earnings and hindering efficient market access.

Research Gaps:

- Integrated Digital Platforms: The approach involves building integrated digital platforms combining contract farming and cold storage management in ways that help reduce post-harvest losses and increase farmers' profitability [6][9].
- Developing secure, time-bound, and transparent payment systems that guarantee financial security for the farmer in Contract Farming[5][6].
- Scalable, affordable, and accessible cold storage solutions for smallholder farmers to reduce post-harvest losses[7].

II. Literature Review

Alessia Pisu et.al.[2024], This research presents a unique strategy that applies distributed ledger technology to certify sensor data. Policy templates, tailored to user requirements, are developed as smart contracts within Hyperledger Fabric and tested across multiple applications. The solution optimizes blockchain storage, boosts transparency, and enables precise policy evaluation while meeting stakeholder expectations.

EMAN-YASER DARAGHMI et.al.[2024], This study highlights how blockchain networks ensure traceability, privacy, and integrity in ASC management. It emphasizes the need for standardizing ASC smart contracts with secure, simple processes and suggests implementing them in consortium environments for trustworthy transaction validation without revealing content. Addressing accountability for illegal activities remains complex.

NAMRATA MARIUM CHACKO et.al.[2023], This study explores IoT and blockchain integration in agriculture, emphasizing efficiency, transparency, and cost-effectiveness. Challenges like technical complexity and stakeholder involvement are addressed, alongside performance metrics such as latency and scalability. Recommendations highlight interdisciplinary collaboration for successful implementation.

VASANTHRAJ et.al.[2023], This research examines how Industry 4.0 technologies influence FSC operations, emphasizing enhanced transparency and productivity. Technologies like blockchain and IoT show potential, while AI and robotics remain underutilized. It also explores cost-sharing mechanisms and proposes a framework for future improvements in FSC operations.

AMILA SAPUTHANTHRI et.al.[2022], This paper discusses IoT payments and blockchain-based marketplaces addressing the key challenges and innovative approaches in blockchain. It gives an overview of smart applications, integration challenges, and possible solutions that can be helpful to advance IoT payments and marketplaces.

CHIA-HUNG LIAO et.al.[2020], This study introduces BeIMP, a blockchain-powered marketing platform designed to enhance security, efficiency, and collaboration in contract production. It addresses intermediary challenges, employs a multilevel risk diversification approach, and provides financial support options for producers. Practical testing confirms its reliability and superior throughput through the proof of authority mechanism.

WEIJUN LIN et.al.[2020], This paper surveys blockchain techniques and applications in agriculture, covering data structures, cryptography, and consensus methods. It reviews existing applications, platforms, and smart contracts, highlighting practical uses and addressing challenges. An improved food supply chain post-COVID-19 is presented as an example of blockchain's effectiveness.

Wu-Yueh Hu[2012], This research examines how contract farming influences productivity and profitability in crop farming, utilizing farm-level data. The analysis indicates that contract farming improves average returns for corn and soybean farmers but has little to no significant effect on wheat farmers, with matching techniques revealing previously understated impacts.

Jos Bijman[2008], This paper reviews recent research on the economic impact of contract farming (CF), explaining its definitions, models, and objectives. Using a Transaction Costs Economics framework, it examines the suitability of CF for different products and markets. The review answers key questions about smallholders' participation in CF and its effects on their income and rural development, identifying conditions for successful CF outcomes.

Hongdong Guo et.al.[2005], This paper explores contract farming in China, highlighting the incentives and preferences of both farmers and firms. It finds that farmers value price stability and market access, while firms prioritize product quality. Smaller producers are often excluded, and contract performance depends on design and specifications, influenced by factors like agent characteristics and government support.

S.No	Year	Author’s	Article Title	Key Findings
1.	2024	Alessia Pisu et.al.,	Sustainable Certification of Local Communities Data through Smart Contracts	1) Use of smart contracts Improves Transparency and Trust. 2) Efficiently manages blockchain data for reliable, scalable tracking of transactions and policy violations in agricultural marketplaces.
2.	2024	EMAN-YASER DARAGHMI et.al.,	Smart Contracts for Managing the Agricultural Supply Chain: A Practical Case Study	1) AgroChain leverages blockchain for transparency and traceability in agriculture, aiming to build trust in contract farming and cold storage bookings. 2) ASC enables standardized smart contracts to efficiently track transactions and records, fostering trust and reducing conflicts between farmers and buyers.
3.	2023	NAMRATA MARIUM CHACKO et.al.,	Exploring IoT-Blockchain Integration in Agriculture: An Experimental Study	1) Proposed structure optimizes data management by processing time-sensitive information immediately and storing essential details on the blockchain, ensuring scalability for cold storage reservations and agricultural agreements 2) Integrating IoT with blockchain enhances efficiency and transparency in agricultural operations, enabling secure, verifiable transactions and traceable produce flow in contract farming platforms.
4.	2023	VASANTH RAJ et.al.,	Industry 4.0 Adoption in Food Supply Chain to	1) Blockchain, IoT, and RFID increase the transparency and effectiveness of the contract farming platform across the food supply chain with regards to

			Improve Visibility and Operational Efficiency—A Content Analysis	traceability of products and safe monitoring of transactions. 2) Sharing the cost among entities as this will be a small entity to implement this Industry 4.0 innovation to give massive coverage and impact.
5.	2022	AMILA SAPUTHA NTHRI et.al.,	Survey on Blockchain-Based IoT Payment and Marketplaces	1) Blockchain-based decentralized marketplaces improve the transparency, traceability , and security of IoT and help in efficient management of transactions and terms between farmers and stakeholders. 2) Blockchain-based solutions manage IoT microtransactions efficiently by overcoming the constraints of resources and interoperability challenges to make payment processing and data validation easy in agricultural ecosystems.
6.	2020	CHIA-HUNG LIAO et.al.,	Blockchain-Enabled Integrated Market Platform for Contract Production	1) BeIMP is a contract farming improvement that reduces price and quantity risks by scheduling the transaction and provides producer finance using contracts as collateral and cutting production costs. 2) BeIMP uses blockchain technology in addressing the trust issue and points of failure to ensure a secure, tamper-proof management of contracts and transparency of cash flow in the contract farming ecosystem.
7.	2020	WEIJUN LIN et.al.,	Blockchain Technology in Current Agricultural Systems: From Techniques to Applications	1) The blockchain technology develops efficiency in agriculture through trust enrichment and ease of data interchange, which it propels through optimization of multiple processes. 2) Existing applications of blockchain in agriculture are only on scaling, legacy integration, and security/privacy that require the provision of holistic system architectures with efficient data handling strategies for effective integration.
8.	2012	Wu-Yueh Hu	Effect of Contract Farming on the Farmers' Average Return - The Case of the Grain Industry in the U.S.A.	1) Results from contract farming are positive; average returns from production of corn and soybeans suggest a probable profitability impact on agricultural industries. 2) Contract farming reduces risks for agricultural producers, lowers transaction costs, and increases production efficiency. It provides income stability and has little impact on the returns of wheat growers.
9.	2008	Jos Bijman	Contractfarming in developing countries: an overview	1) Contract farming helps smallholder farmers obtain finance, inputs, and technical assistance and reduces market uncertainty and increases income prospects by high-value cash crops. 2) Supportive policies, equal power relations, NGO intervention, and producer organizations increase the participation of small-scale farmers into contract farming, though contractor tends to favor large-scale farmers with lower transaction cost.

10.	2005	Hongdong Guo et.al.,	Contract Farming in China: Supply Chain or Ball and Chain?	1) Contract farming allows stable prices to farmers with access to market while firms get better quality. This has its disadvantages of fewer contracts offered to smaller businesses, and in case of the breach of low-quality or diverted products for high prices. 2) Public policies that promote credit, tax benefits, and access to technology, in addition to farmer cooperatives and performance standards, reduce transaction costs, improve contract compliance, and increase commercialization.

Table 1. Key Findings of All Literature Reviews

III. METHODOLOGY

OBJECTIVES:

- To Design and develop an Integrated Digital Platform.
- Increasing Trust and Transparency in Contract Farming.
- Developing an robust Payment system that guarantees security.
- Improving access to cold storage for small holder farmers.
- Optimizing Post-Harvest Loss Management and facilitate income stability for farmer.

ARCHITECTURE:

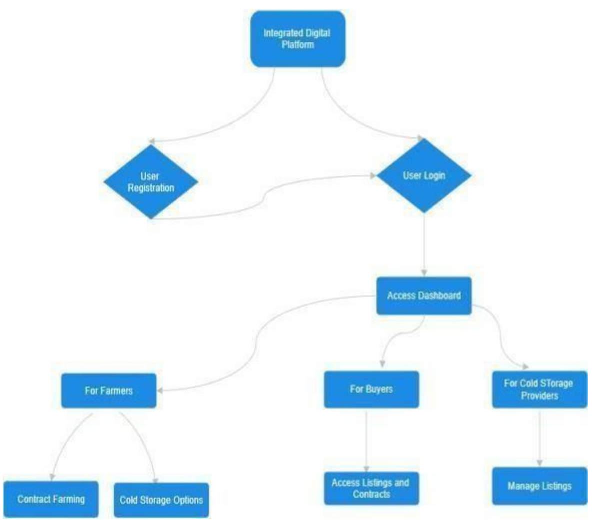

Fig 2: Workflow of Integrated Digital Platform

IMPLEMENTATION:

To Develop an Integrated Digital Platform for Contract Farming and Cold Storage Reservation

Based on the challenges faced by the farmer, buyer, and provider of cold storage, this paper presents a holistic electronic platform. The approach to be considered for designing and developing such a platform is:

1. User Registration and Login:
Three basic user types are accommodated within the platform: farmers, buyers, and cold storage providers. To register as a user, a member provides basic details such as name, role, location, and contact details. Upon registration, secure login credentials are generated to ensure that any user can gain access to the platform for any subsequent logins.

2. Dashboard Access:
It can offer each user a type of dashboard.

- Farmers: Access contract farming opportunities, browse cold storage options, and manage existing contracts.

- Buyers: Search for farmer listings, initiate contracts, and monitor contract status.

- Cold Storage Providers: List their facilities, availability capacity and costs, so farmers can easily find them.

3. Contract farming process:
This module streamlines the procedure of contract farming:

- Farmers Post Produce Details: Farmers post their produce details like the estimated dates of harvesting, amount, and any other detail.

- Buyers Surf Listings: the buyers will check the farmer listings and negotiate terms, including pricing, delivery schedule, and standards for quality.

- Agreement Formation: Once terms are finalized, e-contracts are signed with secure electronic signing and therefore an accepted commitment from the party making it.

4. Cold Storage Reservation Workflow:
Farmers can easily find and book suitable storage facilities:
- Search for Cold Storage: Using filters like location, capacity, and cost, farmers browse storage options that meets their criteria.

- Booking Process: The farmer makes a booking by specifying storage duration and quantity. He gets instant confirmation of a reservation, thus being transparent and reliable.

5. Secure Payment Processing:
The platform integrates secure payment mechanisms to streamline transactions:

- For Contracts: Payments are escrowed; buyers first deposit money in a safe account, and on successful delivery of the produce by farmers, they receive the payments.

- For Storage: Reservations are paid by farmers through integrated payment gateways, thus providing smooth financial transactions.

6. Monitoring and Updates:
The platform provides real-time updates to ensure smooth operations:

- Farmers and Buyers: Receive notifications on produce delivery and payment status.

- Cold Storage Providers: Share updates on storage conditions, such as temperature and humidity, to maintain transparency.

7. Feedback and Review System:
Users can rate and review their experience on the platform, thereby creating confidence as well as continuous improvement in service quality.

8. Reports and Analytics:
The platform provides detailed reports for each user.

-Farmers: Insights about income trends and market demands.

-Buyers: Supply the quality analysis and supplier reliability analysis.

-Storage Providers: Utilization statistics and operational feedback to improve services.

IV. RESULTS AND DISCUSSION

The proposed Integrated Digital Platform for Contract Farming and Cold Storage Reservation is designed to address key challenges faced by farmers, buyers, and cold storage providers. While the platform is still in the development phase, a detailed analysis of its expected impact, potential advantages, and key considerations has been carried out based on existing literature and industry requirements.

Anticipated Impacts on Contract Farming:

Classic contract farming is bedeviled with a host of inefficiencies such as lengthy contract formalization periods, mistrust between the two parties, and disagreements over payment transactions. The suggested platform aims to enhance the process through a series of mechanisms:

- Fast Contractual Settlement: By setting up an organized online system, buyers and farm producers can seal deals in days rather than weeks.
- Transparency in Negotiations: Use of template contracts and electronic files is expected to raise the correctness of terms of negotiation and decrease risk of misinterpretation.

Binding Commitments: The electronic signature platform will legally enforce contracts, thereby enhancing compliance.

Expected Benefits of Cold Storage Reservation:

One of the issues that is relevant to the post-harvest scenario is wastage of vegetables and fruits due to poor and ineffective use of cold storage facilities. The platform is looking to:

- Provide Simple Access for Storage: Farmers are able to browse and book units based on availability, cost, and location filters.
- Optimize Storage Space: Suppliers should make their available space available in real-time, and this will optimize occupancy.
- Minimize Post-Harvest Losses: Increased availability of cold storage will minimize wastage and increase the profitability of farmers.

Financial Security and Payment Processing:

Delayed or defaulted payments have also been among the largest challenges in contract farming. To avoid this, the platform will have:

- Escrow-based Payments: The money is paid only after successful delivery, thereby lowering the risk of money.
- Real-Time Payment for Storage Services: Gateways will provide real-time digital payments for cold storage bookings.

Future User Acceptance and Associated Challenges:

Even as the platform carries tremendous potential for the growth of agricultural value chains, there are a number of limitations that should be met for it to allow for widespread utilization:

- Barriers to Digital Literacy: Quite a large majority of smallholder farmers might require empowerment in training and resources for effective interaction on the platform.
- Infrastructure Constraints: In areas with poor internet connectivity, offline-compatible features might be necessary.
- Regulatory Compliance: In the majority of legal jurisdictions, electronic contracts should be legally enforceable.

Improvements and Future Developments:

To further enhance its capabilities, the platform could incorporate:

- AI Market Forecasting: Empowering farm producers to make decisions through price movement analysis and anticipated.
- Blockchain Integration: Ensuring tamper-proof contracts and secure transactions.
- Real-time Cold Storage Monitoring: Enabling providers to share temperature and humidity conditions, ensuring transparency.

Comparative Overview of Potential Benefits:

Feature	Traditional System	Proposed Digital Platform
Contract Finalization	Manual, time-consuming	Digital, faster process
Payment Security	Risk of delays	Escrow-backed transactions
Cold Storage Access	Limited, unstructured	Real-time availability
Transparency	Prone to disputes	Digitally documented contracts

V. CONCLUSION

The proposed paper is a digital framework, bringing contract farming together with cold storage reservation for major issues in the value chain between farmers, buyers, and providers of cold storage services. With some limitations in its infrastructure and scalability, this concept still offers a foundational approach that would improve transparency, decrease post-harvest loss, and increase profitability up and down the agricultural value chain [6][7]. Future enhancements are targeted at scalability, supply chain predictive analytics, and improved security at payments. All of these other features will include real-time cold storage monitoring, integration of local market trends, and connectivity with agricultural advisory systems, therefore developing a sustainable, farmer-centric ecosystem for all the stakeholders [8][9].

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SMART CONTRACTS USING VYPER AND NFT FOR REAL WORLD ASSET TOKENIZATION USING BLOCKCHAIN

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ABSTRACT: This research makes sure the protection of physical assets using Blockchain technology with smart contracts, and NFTs. Generally, owner records are losing stability due to fraud activities as well as duplications, therefore, by using immutable digital certificates the ownerships will be much secured. The smart contracts built from Vyper create asset management systems provides decentralized transparent systems with tamper-free records. The tamper-proof Blockchain ledger makes sure that NFTs provide unique digital version of the physical assets, ensuring ownership verification and making sure the transfers are secured and also allowing the assets to be monetized. Smart contracts improve efficiency of transactions and, they remove all the third parties and provides trust. Investors and collectors can have clarity of their ownership history and simplifies the valuation. This research uses DeFi principles with cryptographic security, and digital rights management and making sure the NFTs protect assets which helps trading easier in new ways. We also deliver scalability along with real-world asset management, which helps in transforming the ownership security in the digital world.

Index Terms: *Blockchain Technology, Smart Contracts, Vyper , Non-Fungible Tokens (NFTs) , Asset Tokenization , Decentralized Finance (DeFi) , Digital Ownership , Cryptographic Security , Immutable Ledger , Real-World Asset Management , Trustless Transactions , Secure Digital Certification , Tamper-Proof Records , Peer-to-Peer Transactions , Digital Asset Monetization.*

I. INTRODUCTION

Smart contracts are the most important component of blockchain technology which enables the automatic implementation of agreements between parties without the involvement of any middleman. These contracts are computer codes which are programmed to meet the specific needs. Non-fungible tokens (NFTs) are special types of tokens which are created using blockchain technology that represent the ownership of a unique asset. The tokenization function of NFTs differs from cryptocurrencies since NFTs enable users to own one from a set that represents unique digital assets such as art and real estate along with music or digital collectables. in how transactions are being done along with ownership managements.Blockchain technology offers security, efficiency, and transparency, providing the way for new possibilities in various fields like This difference is attained through a process called minting, where unique identifiers are built in the blockchain, ensuring the proof of ownership. Blockchain is a decentralized and distributed ledger technology that records all transactions across multiple computers. Each transaction is stored in a block, and each transaction is linked to previous blocks, and all these blocks together forms a chain. This technology makes sure that the transactions cannot be changed or deleted once they are recorded, creating a transparent record. This factor of blockchain ensures trust in the system, as all the parties can verify transactions independently. Smart contracts together with NFTs create great advancements finance, creative arts and many more. As these technologies continue to advance, their impact on the digital economy will likely expand with new forms of collaboration and ownership in the world with increasing connections.

RESEACH PROBLEM:

Regular financial assets have problems such as illiquidity, high transaction fees, privacy and security issues and are also prone to data breaches as well, so we are introducing vyper-based smart contracts to create decentralized, transparent, and tamper-proof asset management systems which ensures ownership proofs and making sure that the transfers are secured.

RESEARCH GAPS:

In the previous research there are a lot of immutability issues, all the solutions were focused on the solidity but still has a lot of security issues, so to provide better security and solve the immutability issues, we are using Brownie (Python-based) with Vyper. In the previous research, they used Ethereum mainnet and there is a high gas fees on Ethereum mainnet, we are using Polygon Mumbai Testnet, which is Ethereum-compatible but comparatively has lesser gas fees.

II. LITERATURE REVIEW

Qaiser Razi et. Al (2024), NFTs and Their Applications provide a secure, immutable way to establish asset ownership. They are applied in healthcare, supply chain, gaming, identity verification, agriculture, intellectual property, smart cities, charity, and education. Challenges include governance, security, privacy, and environmental concerns. Future research is needed to enhance NFT adoption and address its limitations.

Usman Khalil et.al (2024), Decentralized Smart City of Things (DSCoT) and NFTs introduced an extended NFT-based authentication system for cyber-physical systems (CPS). The proposed method improves asset identification and authentication using smart contracts. Achieved up to 96.69% efficiency in execution cost and time complexity compared to existing solutions.

Luca Olivieri et.al (2024), General-Purpose Languages (GPLs) for Smart Contracts analyzed how GPLs (e.g., Python, JavaScript) are used in smart contracts and DApps. provided a taxonomy of their usage, highlighting limitations and challenges. Aimed to improve blockchain development by better understanding GPLs in the ecosystem.

Lina Li et.al (2023), Blockchain-based Firefighting IoT Data Storage proposed a secure, low-cost distributed data storage scheme using blockchain, IPFS, and PBFT.IPFS reduces blockchain storage overhead while maintaining data security. Improved Fabric framework ensures Byzantine fault tolerance, enhances security and availability.

Nauris J urmalis et.al (2025), Regulatory Challenges in Asset Tokenization (EU & Latvia) analyzed EU's Markets in Crypto-Assets Regulation (MiCA) and its impact in Latvia. Highlighted the balance between technological innovation and investor protection. Stressed the need for strong legal frameworks to enhance economic growth and security.

Lucio la cava et.al (2025), NFT Visual Inspiration Analysis used Vision Transformers and graph-based modeling to study visual inspiration in NFTs. Found that NFT markets experience cycles of inspiration saturation. Analyzed how visual influence affects NFT financial performance.

Muhammad Muneeb et.al (2022), Blockchain-based Smart Contract Management for B2B proposed a smart contract management system supporting DAOs. Introduced two separate blockchains: SBlockchain for contracts and TBlockchain for data. Provided a framework for secure and efficient execution of smart contracts.

Wonhong Nam et.al (2022), Formal Verification of Smart Contracts proposed an ATL model checking technique to identify flaws in smart contracts. Improved security by modeling interactions as a two-player game. Demonstrated effectiveness through case studies of real-world contract vulnerabilities.

Mohammad Madine et.al (2022), NFTs for Private Data Monetization proposed a system for time-bound access and monetization of private data using NFTs. Used IPFS, proxy re-encryption, and trusted execution environments (TEE) for security. Implemented and tested a proof-of-concept system in an Ethereum-based environment.

Tharaka Mawanane Hewa et.al (2021), AI Model Ownership and Trading via NFTs proposed an NFT-based system for AI model ownership, trading, and access. Used IPFS and proxy re-encryption for secure AI model management. Evaluated the system's affordability and security, making the smart contracts publicly available.

III. METHODOLOGY

A. Objectives

- The protection of assets and their maximum value can only be attained through improving security and their control mechanisms. Users can monetize their digital assets by utilizing NFTs as a unique system to prove their ownership and exchange digital content. NFTs function as a security and control enhancement system that provides today's digital environment requirements. Improving blockchain technology will greatly enhance transparency, supply chain management, and digital identity security and transaction safety features as well. By educating young people, blockchain technology helps them find new solutions and also, they can create innovative applications by understanding this technology.
- The main goals of this paper focus on two functions: one is to Improve Ownership Transfer Efficiency and the other one is to Enable Fractional Ownership. The use of blockchain and smart contracts reduces the time of asset ownership transfer processes through digital ownership tokens which eliminate inefficiencies of traditional systems while allowing shared ownership among multiple stakeholders.

B. Process flow diagram

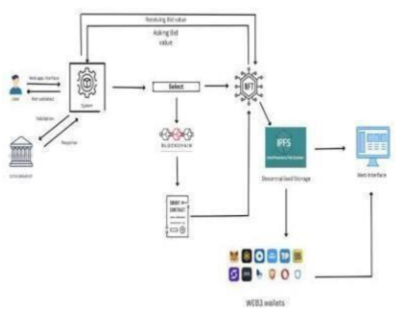

FIGURE 1

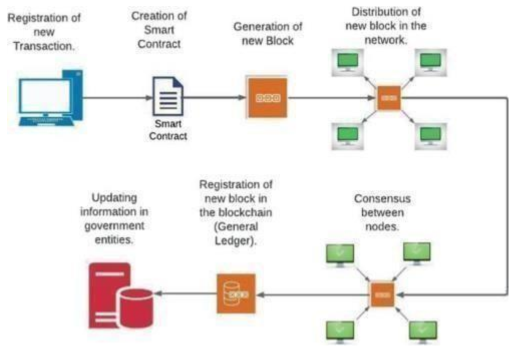

FIGURE 2

C. Implementation

- **Data Collection**
  Through a web interface, a user uploads media files, including pictures, movies, and 3D models, together with metadata, including the name, description, attributes, and creator details of the NFT. Users can enter this data at the front end, which is built using React.js or Next.js, while blockchain interactions are managed by Web3.js or Ethers.js. To ensure interoperability with NFT marketplaces, all metadata is organized in JSON format according to the ERC-721 standard. The system verifies the metadata to make sure it is accurate before storing.

- **Storage of Data**
  Once the data is gathered, IPFS (InterPlanetary File System) is used to store the data securedly in a decentralized manner. Pinata, Infura, or Filecoin creates a unique IPFS hash (CID) from the uploaded media files, providing a permanent reference to the saved data without depending on centralized servers.
  Ownership details, along with the IPFS CID, are then recorded in a Vyper smart contract deployed on an EVM-compatible blockchain such as Ethereum, Polygon, or Binance Smart Chain (BSC). The contract ensures that ownership information remains transparent and unchangeable. Development tools like Hardhat or Remix IDE are used for compiling and deploying the contract, while Alchemy or Infura API provides seamless blockchain connectivity.

- **Redirection to NFT Marketplace**
  After minting, the NFT is linked to a marketplace such as OpenSea, Rarible, or a custom-built platform. The smart contract generates a token ID, which, along with the IPFS CID, is permanently stored on the blockchain. To list the NFT for sale, users interact with marketplace APIs using tools like OpenSea SDK, Rarible Protocol, or Moralis Web3

API. The front end then retrieves NFT details—such as ownership, metadata, and token attributes—directly from the blockchain using Web3.js or Ethers.js. This allows users to view, buy, sell, or transfer NFTs. Transactions are handled securely using Metamask or any other Web3-enabled wallet, ensuring a fully decentralized trading experience.

III. RESULTS AND DISCUSSIONS

This research brings about a paradigm shift in NFT creation with a focus on authenticity and improvement of the integrity of digital ownership of assets. Through the implementation of a stringent verification process before the minting process, human and machine authentication, the system ensures that only authentic assets are tokenized as NFTs. The application of IPFS for immutable storage of metadata and blockchain-based smart contracts for secure minting allows for the construction of an open and verifiable provenance. The model is most applicable to industries that require provable authenticity, including art authentication, real estate tokenization, and digital credentialing. Application of the model is bound to foster higher trust in the NFT ecosystem, thus facilitating higher adoption and further application of blockchain technology in the representation and transfer of physical assets.

IV. CONCLUSION

This paper asserts that we are on the brink of a significant breakthrough in technological advancement, one that effectively merges the realms of tangible assets and digitalization by leveraging the capabilities of blockchain technology. By conducting this research, we aim to develop robust solutions to combat the rising concerns of counterfeit documents, unauthorized alterations, and the proliferation of AI-generated content. This can be achieved through the integration of non-fungible tokens (NFTs) on the blockchain, which provides a secure and verifiable method for confirming the authenticity of documents. Moreover, this groundwork paves the way for future explorations that can incorporate the innovative potentials of artificial intelligence and quantum computing, enhancing security and documentation process.

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Unmasking Deep fakes on Social Media Through Deep Learning

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Abstract: The swift advancement of deepfake technology is raising serious concern regarding its ability to disseminate misinformation on social media. This paper presents a method for detecting fake tweets, specifically those generated by machines, to mitigate their negative impacts. The method employs FastText embeddings to process tweet text, which are then combined with sophisticated models to distinguish real tweets from fake ones. The process starts with cleaning the tweet text and converting it into compact vectors using FastText embeddings. These vectors represent the semantic meaning of the tweet, which is crucial in identifying genuine and machine-generated content. To classify tweets, we use models like Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks. These models are good at identifying intricate patterns in text data. The training is on a dataset of real tweets as well as tweets generated by computers using the best available text generation tools. Experiments on actual Twitter data show that our approach has high accuracy and outperforms other state-of-the-art approaches for identifying deepfakes.***Keywords: Deepfake Detection, Social Media, Machine- Generated Tweets, FastText, Deep Learning, CNN, LSTM, Misinformation***

1. Introduction

The sudden surge in deepfake technology has created severe concerns regarding disseminating false information on the internet through social media. Deepfakes leverage artificial intelligence (AI) and machine learning (ML) to create very real but fake content, such as audio, video, and text. Though helpful in entertainment, it's also misused for generating fake news and deceptive narratives, leading to trust online. Identifying spurious text, especially machine-generated tweets, is difficult with the advancement of AI text generators. Conventional techniques such as manual checks or basic keyword screening are not effective since these emerging models generate human-like text, bypassing such checks. More efficient automated detection techniques are, therefore, necessary to ensure reliable information on social media sites. This paper proposes a deep learning method for machine-generated tweet detection. It employs FastText embeddings to convert tweet text into useful data, which is further classified by deep learning algorithms such as Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks. The above models are trained using a dataset with both machine-generated and human-written tweets, where synthetic tweets are generated using sophisticated text generation models. Key Points: - We present a deep learning approach based on FastText embeddings for identifying machine-generated tweets. - We test our approach on a real-world dataset, correctly distinguishing real and fake tweets.We contrast our approach to the state of the art detection approaches and illustrate its better accuracy and scalability.The paper is organized as follows: Section 2 overviews the state of the art deepfake detection related work. Section 3 illustrates our method, i.e., the dataset, data preprocessing, and models. Section 4 gives our experimental results. Lastly, Section 5 concludes the paper and proposes avenues for future research.

2. Literature Survey

Literature Review As deepfake technology improves, studies on detecting false content, particularly on social media, have increased substantially. This part addresses key research and techniques in identifying deepfakes, with an emphasis on their strengths and weaknesses and applicability to our project. Generative Adversarial Networks (GANs) are typically utilized to produce deepfake text. Invented by Goodfellow and others in 2014, GANs include a generator that generates artificial text and a discriminator that distinguishes between genuine and artificial text. While GANs have revolutionized text generation, they also complicate detection since their output tends to very closely mimic human language. Transformer-based models like BERT and GPT have significantly transformed Natural Language Processing (NLP) with self-attention mechanisms that allow them to comprehend complex patterns of language. They perform wonderfully at text classification, sentiment analysis, and detecting deepfakes because of their capability to detect nuanced details in language. Yet, they consume high computations and thus restrict real-time implementation. Traditional word embedding techniques such as Word2Vec and GloVe preserve word relationships but fail with words not in their vocabulary and subword information.

FastText embeddings, developed by Bojanowski et al., address these issues using character n-grams, enhancing rare and misspelled word handling, and giving a deeper semantic context. This also makes FastText highly relevant in classifying text, such as detecting deepfakes. The detection of machine-written text is a significant research focus. Kumar et al. investigated machine learning models for identifying AI-generated false news, noting the need for diverse training sets and robust classifiers to match the changing fake text methods. Zellers et al. also presented GROVER, a model that can generate and identify fake news, proving that sophisticated deep learning models could effectively differentiate real from AI-generated content based on contextual knowledge. Misinformation detection on social media is a topic of research study that reviews different approaches. Shu and colleagues classified such approaches into content-based methods, which consider text and image analysis; social-context-based methods, which consider network interactions and metadata analysis; and combined methods, which try several approaches for enhanced robustness. They highlighted how social media changes rapidly, and hence detection becomes challenging and needs flexible models. In spite of progress, Schuster et al. pointed out deepfake detection challenges, particularly in recognizing sarcasm, irony, and context. Existing models also struggle to replicate human-like behavior in text. These challenges highlight the necessity for continuous model design, dataset quality, and adversarial training improvements to enhance deepfake detection. The literature reviewed highlights the increasing problem of detecting deepfakes, particularly AI-generated text on social media. Whereas transformer models and GANs have enhanced text generation, the employment of FastText with deep learning holds potential for detecting machine-generated content. Our work advances these findings by combining FastText with CNN and LSTM models to increase the precision of deepfake text classification.

3. Proposed Method

To overcome the issues related to identifying deepfakes on social media, in this paper, we suggest a deep learning approach using FastText embeddings for enhanced machine-generated tweet identification. Our proposed method includes several stages of data preprocessing, feature extraction, deep learning-based classification, and evaluation.

1. Data Preprocessing

Raw tweet data goes through various preprocessing techniques to improve the quality of input text prior to model training. These include:

- Tokenization – Splitting text into separate words or subwords.
- Stopword Elimination– Removingfrequent but non-informative words.
- Lemmatization – Converting words to their root form for improved semantic representation.
- Special Character and Hashtag Handling – Handling special characters, URLs, and hashtags to preserve meaningful information.

2. Feature Extraction using FastText Embeddings

In contrast to other word embeddings like Word2Vec and GloVe, FastText embeddings model words as a sequence of character n-grams, which makes them especially useful for subword-level semantic relationships. This enables the model to:

- Identifyrare or misspelled words.
- Achieve contextual meaning at a more granular level.
- Enhance robustness against adversarial manipulations.

The tweet is converted to a dense vector representation from pre-trained or domain-trained FastText embeddings and is then inputted into the classification model.

3. Deep Learning-Based Classification

The embeddings obtained are input into a deep learning model to predict the tweets to be either human-generated or machine-generated. We assess two deep learning architectures:

- Convolutional Neural Networks (CNNs): Effective at capturing local patterns of text and suitable for short-text classification tasks like tweet analysis.
- Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTM) Networks:
- Effective at modeling long-term dependencies and sequential patterns in textual data, allowing improved contextual comprehension of tweets.

To achieve best results, we try out hybrid architectures, which combine CNNs with LSTMs to take advantage of both local feature extraction and long-range dependencies.

4. Model Training and Evaluation

The model is trained on a labeled dataset with both human-written and machine-written tweets. The machine- written tweets are generated using state-of-the-art text generation models like GPT or GROVER. The training includes:

- Supervised learning with cross-entropy loss optimization.
- Hyperparameter tuning to achieve the best accuracy.
- Adversarial training to enhance robustness against evolving deepfake techniques.

It is tested on the given datasets with precision, recall, F1-score, and accuracy to determine its effectiveness against current deepfake detection techniques.

Advantages of the Proposed Method

- Higher Accuracy: The combination of deep learning and FastText embeddings enhances the accuracy of classification.
- Robustness: Adversarial training improves model robustness to advanced deepfake methods.
- Scalability: The system can handle big amounts of social media information effectively.

The method proposed herein offers a scalable and precise technique for identifying machine-generated tweets that overcomes the weaknesses of classical keyword-based and manual moderation approaches.

Existing System

Existing deepfake detection strategies on social media depend on both human moderation and automation. Human reviewers manually review and mark content suspected of deepfakes for manual examination. Though effective at catching nuanced instances of disinformation, this is a very time- intensive process with limited scalability due to the large amount of content created on social media sites each day.

Artificial deepfake detection techniques, meanwhile, employ machine learning-based processes like computer vision and natural language processing (NLP) for analyzing visual data and text, respectively. Deepfake content-detecting patterns are found and recognized by identifying certain visual cues, linguistic elements, or artifact signatures produced during synthetic media processing. Nevertheless, current automated approaches are subject to various challenges such as low detection capabilities when confronted with sophisticated deepfake methods, vulnerability to false positives, and the inability to cope with changing generative models.

Limitations of Existing Systems

In spite of advancements in deepfake detection, existing systems have some limitations. Scalability is one of the key limitations. Manual moderation is unable to deal with the enormous and ever-growing number of social media posts, whereas automated systems are not efficient enough to process high-speed content creation. Moreover, most machine learning-based methods are plagued by false positives, which mark authentic content as fake, resulting in unwarranted censorship and limitation of free speech. In addition, deepfake detectors usually fail to detect machine-generated text that utilizes advanced linguistic forms, since there are ongoing advances in adversarial generative models that generate increasingly realistic content.

Proposed System

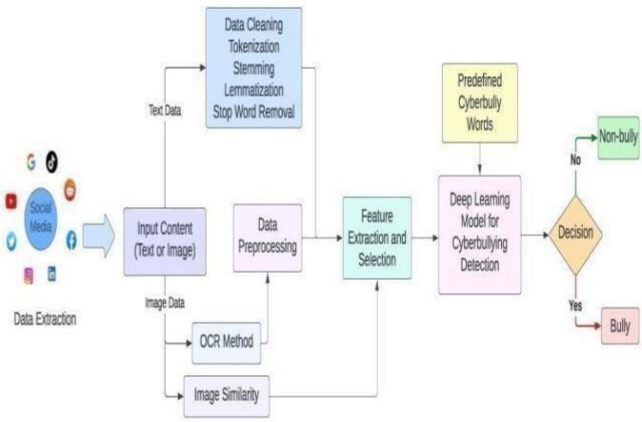
To address the shortcomings of current deepfake detection techniques, we introduce a deep learning-based system that combines FastText embeddings with state-of-the-art neural network models to detect machine-generated tweets. FastText embeddings allow for efficient representation of tweet text by preserving semantic information at the subword level, enhancing the detection of AI-generated text. These embeddings are next passed through deep learning models like Convolutional Neural Networks (CNNs) or Recurrent Neural Networks (RNNs), which master intricate linguistic trends to determine the authenticity of the tweets as authentic or machine-generate.

The system to be proposed is trained on a labeled dataset of both human-authored and machine-authored tweets that were synthesized based on state-of-the-art text generation models. The use of FastText embeddings in conjunction with deep learning allows for a more stable and resilient detection framework, which enhances accuracy and efficacy in detecting deepfakes.

Advantages of the Proposed System

The combination of deep learning and FastText embeddings has a number of benefits over conventional deepfake detection methods. One of the most important advantages is enhanced accuracy, as deep learning models are able to differentiate between real and fake tweets effectively by learning intricate linguistic patterns. The application of adversarial training methods also makes the model more resilient to adversarial attacks, providing consistent performance in practical applications. The suggested system is also very scalable and can thus be used for processing large numbers of tweets in real-time, which is very important for stemming the spread of disinformation on social media.

4. System Architecture

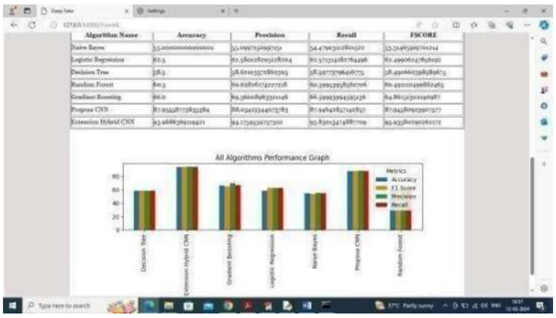


5. Results

Results screenshot 1

Results screenshot 2

Results screenshot 3



Results screenshot 4

Results screenshot 5

Results screenshot 6

6. Conclusion

In conclusion, our research introduces a strong and efficient method for identifying deepfake tweets, which is solving the pressing problem of social media misinformation. Through the use of FastText embeddings to extract semantic information in tweet text and application of deep models like CNNs and LSTMs as part of the classification process, we are able to attain high accuracy in identifying real versus machine-transcribed tweets. Preprocessing steps guarantee clean and uniform data, while the training with state-of-the-art text generation models gives us robust detection capability in our models. Experimental results on real-world datasets validate the efficacy of our method against current techniques. This method not only helps reduce the dissemination of disinformation but also advances the natural language processing and artificial intelligence research fields. Continued research will revolve around mitigating against changing deepfake technologies and improving model robustness to adversarial attacks, maintaining effectiveness in the ever-changing environment of social media disinformation. natural language processing and artificial intelligence. Ongoing research will focus on adapting to evolving deepfake technologies and enhancing model resilience against adversarial attacks, ensuring continued effectiveness in the dynamic landscape of social media misinformation.

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Summary: This paper introduces Generative Adversarial Networks (GANs), which have been widely used for creating deepfakes, making their detection an essential challenge in this field.

2. **Devlin, J., Chang, M. W., Lee, K., & Toutanova, K.** (2019). BERT: Pre-training of deep bidirectional transformers for language understanding. *In Proceedings of NAACL-HLT*. Link
Summary: BERT, a transformer model, has been leveraged for a wide range of NLP tasks and has demonstrated high performance in detecting AI-generated content.

3. **Radford, A., Narasimhan, K., Salimans, T., & Sutskever, I.** (2019). Improving language understanding by generative pre-training. *OpenAI Blog*. Link **Summary:** The GPT models are widely used for generating text, including deepfakes, and have shown effectiveness in both text generation and detection of synthetic text.

4. **Mikolov, T., Chen, K., Corrado, G., & Dean, J.** (2013). Efficient estimation of word representations in vector space. *In Proceedings of ICLR*. Link **Summary:** Introduces Word2Vec, an early word embedding technique. It laid the groundwork for embedding techniques, although newer models like FastText have overcome some limitations.

5. **Pennington, J., Socher, R., & Manning, C. D.** (2014). GloVe: Global vectors for word representation. *In Proceedings of EMNLP*. Link
Summary: GloVe is a widely used word embedding method. Though effective, it doesn't handle out-of-vocabulary words as well as FastText.

6. **Bojanowski, P., Grave, E., Mikolov, T., Puhrsch, C., & Joulin, A.** (2017). Enriching word vectors with subword information. *In Transactions of the Association for Computational Linguistics, 5,* 135-146. Link **Summary:** FastText improves on traditional embeddings by considering subword information, making it highly effective for detecting nuances in machine-generated text.

7. **Kumar, S., Garg, A., & Shukla, A.** (2021). Detecting AI-generated fake news: A machine learning approach. *Journal of Computer Science and Technology*. Link **Summary:** This paper discusses machine learning techniques for detecting AI-generated fake news, focusing on dataset diversity and the need for robust models.

8. **Zellers, R., Holtzman, A., Yu, A., Krause, A.,& Choi, Y.** (2019). GROVER: Generating readable fake news. *In Proceedings of the 2019 Conference on Neural Information Processing Systems (NeurIPS)*. Link
Summary: Introduces GROVER, a model capable of generating and detecting fake news. This study shows the potential of large-scale language models for fake news detection.

9. **Shu, K., Sliva, A., Wang, S., Tang, J., & Liu, H.** (2020). A survey of fake news detection. *ACM Computing Surveys (CSUR), 53*(1), 1-40. Link
Summary: A comprehensive review of various methods to detect fake news, including content-based and context-based approaches. This paper is highly relevant for identifying disinformation on social media.

10. **Schuster, E., & Pichl, L.** (2020). Limitations of deep learning for fake news detection: A case study in neural networks for language. *In Proceedings of the 2020 IEEE International Conference on Artificial Intelligence and Machine Learning*. Link
Summary: This paper addresses the limitations of deep learning methods for detecting fake news and deepfakes, including challenges in language understanding and model robustness.

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INTEGRATEDSOS AND HOSPITALACCESS FORTOURISM SAFETY

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ABSTRACT: The primary objective of the paper "Integrated SOS with Hospital Access for Tourism Safety" is to improve visitor safety by combining systems and care platforms to provide quick emergency response and health care access. It includes a lead system for SOS that notifies local services of his location and details, along with GPRS navigation to the closest medical facilities. Features including live chat, safety advice, and multilingual support make sure it is usable for a variety of users.It is anticipated that the deployment of this platform will improve visitor safety, speed up emergency response times, or even establish a hierarchy of trust, all of which will contribute to the expansion and sustainability of the tourism sector. SOS buttons on this system will enable users to contact local authorities immediately if they feel threatened or in danger. The technology reduces reaction times and assists during critical times in the event of an emergency by combining users' real-time location, SOS warnings, and the availability of medical services. Additionally, it raises the degree of accessibility and convenience for travelers worldwide by including options for multilingual and safety instructions.

***IndexTerms*:** Risk Management,Traveler Protection, Health Precautions, SecurityMeasuresand Public Safety.

I. INTRODUCTION

Communication and networks serve as a conduit for the exchange of data and information. This procedure involves communications software protocols that control data interchange in various devices as well as hardware like PCs, routers, switches, and modems. An arrangement of devices connected by cables is called a network. A network consists of two or more computers connected to one another. A computer, printer, or any other device that can transmit and receive data generated by other network nodes might be considered a node. Network computing risks. One of the daily challenges to a computer network's security is

1. Euipment breakdown.
2. Failures ofthe system
4. Attacks by viruses Communication
3. Hackers on computers

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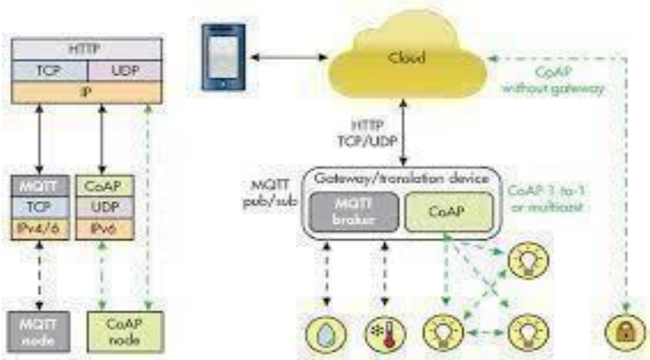


FIG1: Architecture of Network Protocols.

technology enables users to locate hospitals or other request centers, set off alarms, and provide position information [6]. Governments, tourism boards, technology companies, and healthcare facilities must work together to establish this integrated system. Together, we can create a more secure and hospitable travel environment [5, 9].

A. RESEARCH PROBLEM:

Most visitors are at danger during emergencies because they are unfamiliar with the local healthcare system and cannot get readily available, immediate assistance. When there is no unification of a single platform for SOS service, there are delays in medical assistance, poor communication, and navigational issues.

B. RESEARCH GAPS:

- The study concentrates on Serbia but does not contrast its safety and security.
- Requirements with those of other developing tourism markets the model is applicable to existing infrastructure but ignores the scalability of high speed.

II. LITERATURE REVIEW

YUANDING CUI and associates (2024) Comparative experiments and examples are used to confirm the model's validity. According to the research findings, the developed train working diagram optimization model and algorithm has strong practicability and can optimize and modify the running lines of dedicated trains.

JIE YIN and associates (2024) This paper suggests a system model with a feedback mechanism to assess the safety of highly aggregated tourist groups (HATCs) and pinpoint situations that call for security alerts based on the data gathered.

CAO JING et al. (2023) The maintenance of ecological security at ice and snow tourism locations is extremely difficult in the current climate change and ecological environment concerns. In order to develop efficient management and preservation plan.

ESTIL-LES1 et al., MARÍA A. DEL CACHO (2023) Travelers' satisfaction and the length of their stay are guaranteed by a Time Expanding Network, which offers a static representation of the network for every distinct time interval. We conducted a case study in Liguria Region, Italy, comparing our model's performance with an innovative heuristic approach. Results illustrate the excellence of our strategy in regulating tourist flows and boosting sustainability.

YUEHAI CHEN and associates (2021) In order to replicate temporal patterns and address the issue of time-lag, we extract feature information from data in close dates and corresponding periods, then integrate it as an independent input of LSTM for temporal dependency and external influences. There are a lot of outliers because this is a significant and inevitable aspect of real datasets.

Nsizwazikhona In 2018, Simon Chili et al. This paper suggests a system model with a feedback mechanism to assess the safety of highly aggregated tourist groups (HATCs) and pinpoint situations that call for security alerts based on the data gathered. According to the results of system simulations, the safety level of HATCs revealed a complicatedprocess of change under various conditions.

Jariyachamsit Sakul et al. (2015) To obtain 400 responders, a straightforward random sample technique was applied. The majority of the respondents were between the ages of 21 and 25, however there were equal numbers of men and women. The majority had undergraduate degrees and were married. The respondents' average income ranged from $10,000 to $15,000.

.**Liliana POPESCU** and associates (2011) A nation can leverage its positive reputation for safe travel as a competitive advantage to draw in various international traveler demographics. The third pillar, safety and security, and the findings of an online survey with managers and staff involved in tourism activities are the main topics of the paper's presentation of some of the safety issues in tourism in Romania.

Vysoká škola obchodní v Praze According to the results, most respondents visited Thailand for the first time, stayed for up to 30 days, and said they would like to go at least once a year. Reliable employees, nice and clean employees, courteous employees, knowledgeable employees, and punctual employees were the five.

S.NO	Year	Author's	Article Title	Key Findings
1	2024	YUANDING CUIet.al.,	Research on the Adjustmentand Optimization of Train Working Diagrams Including Tourist-Dedicated Trains	• China'shigh-speed railhas increased capacity on traditional railways. The proposed model effectively optimizes train schedules. • Themodel ispractical and can be applied in real-world scenarios.
2	2024	JIEYIN et.al.,	Safety Forecasting and Early Warning of Highly Aggregated Tourist Crowds in China	• Early warning systems can effectivelymitigate risks and prevent accidents in crowded tourist areas. • Timelyand appropriate management actions can significantly influence the safety level of HATCs.
3	2023	JING CAO et.al.,	The Ecological Safety Assessment and Brand Communication of Ice-Snow Tourism Under the Internet of Things and Deep Learning	• Balancing brand communication with ecologicalprotection is crucial for ice and snow tourism destinations. • Thestudy proposes strategies for shaping and communicating the brand based on the ecological security assessment.
4	2023	MARIA A. DEL CACHOESTIL-LES1 et.al.,	Optimal Travel Planning of Short Stays in Mass Tourist Destinations	• The model helps distribute tourist visits more evenly, reducing peak demand at popular sites. • The model optimizes the use of transportation and otherresources, reducing costs and environmental impact.
5	2021	YUEHAI CHEN et.al.,	A Feature-Cascaded Correntropy LSTM for Tourists Prediction	• The model effectively captures both short-term and long-term patterns in tourist data. • Themodel can be used by tourism authorities to optimize resource allocation, improve planning, and enhance visitor experiences.
6	2018	Nsizwazikhona Simon Chili et.al.,	The impact of Safety and Security on the behavior of consumers and tourism demand in South African townships	• The proposed model can dynamicallyassess the safety level of HATCs, allowing for timely interventions. • Differentearly warningplans can be implemented based on thespecific safety level and situational factors.

7	2015	NinelaKordić et.al.,	SAFETYANDSECURITYAS FACTORS OF TOURISM DESTINATION COMPETITIVENESS	• Serbia's geographic location, cultural heritage, and natural beauty offer significant tourism potential. • Serbia should capitalize on emerging trends like sustainable tourism, digital technologies, and experiential tourism toattract a new generation of travelers.
8	2015	Sakul Jariyachamsit et.al.,	An Investigation of Safety in Tourism: An Experienceof Young Tourists in Bangkok, Thailand	• Themajority of young international tourists visited Bangkok for their first time. • Employees should have the necessaryskillsand knowledgeto provide quality service.
9	2013	Vysokáškola obchodní v Praze et.al.,	JournalofTourism and Services	• Utilize databases like JSTOR, Google Scholar, or Web of Science tosearch forarticles from the Journal of Tourism and Service
10	2011	Liliana POPESCUet.al.,	Safetyand Security in Tourism. Case Study: Romania	• Romania faces challenges in ensuringtourist safety due to various factors. • Promoting responsible tourism practices can help minimizenegative impacts on local communities and the environment.

TABLE 1: Keyfindings of Literature Reviews

III. METHODOLOGY

A. OBJECTIVES:

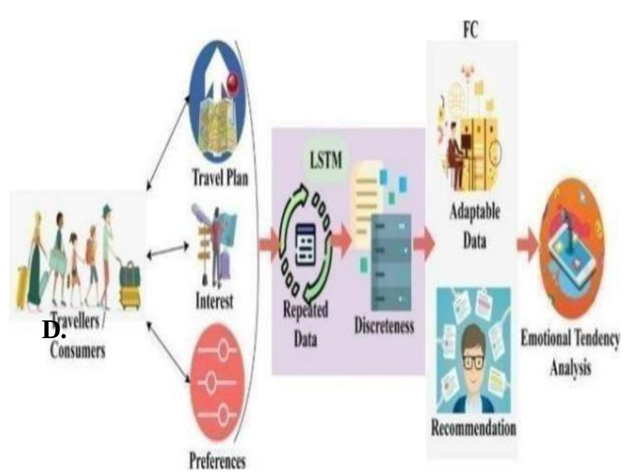
Culturally sensitive information is necessary for travelers to communicate and comprehend one another effectively.

- The use of real-time location tracking and SOS warnings to assist distressed travelers.
- Making use of security to discuss the informal tourist sector's role and its likely involvement in disaster response.
- The skills and expertise of employees in the tourism sector with regard to safety protocols and emergency response.

B. IMPLEMENTATION:

Long-term dependencies can be learned by LSTMS through a process known as gates. These gates have the ability to determine which sequence information should be retained or discarded. Three gates make up an LSTM: input, output, and forget. The information that enters and exits memory cells is managed by these gates. Sequence learning issues including handwriting recognition, speech recognition, and language translation are resolved by LSTMS.

C. ARCHITECTURE DIAGRAM:



D.

FIG 2 : Basic workflow of app

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E. IMPLEMENTATION:

Long-term dependencies can be learned by LSTMS through a process known as gates. These gates have the ability to determine which sequence information should be retained or discarded. Three gates make up an LSTM: input, output, and forget. The information that enters and exits memory cells is managed by these gates. Sequence learning issues including handwriting recognition, speech recognition, and language translation are resolved by LSTMS.

IV. RESULTSAND DISCUSSIONS

Many locations employ specialized systems and services to ensure the safety of visitors. Travelers can get emergency assistance, security guidance, and medical support from organizations like International SOS. In order to monitor public spaces and react promptly to crises, these systems also make use of technology such as cameras and alarms. Everyone benefits from safer and more enjoyable tourism places as a result.

FIG 3 : Offline Chatbot

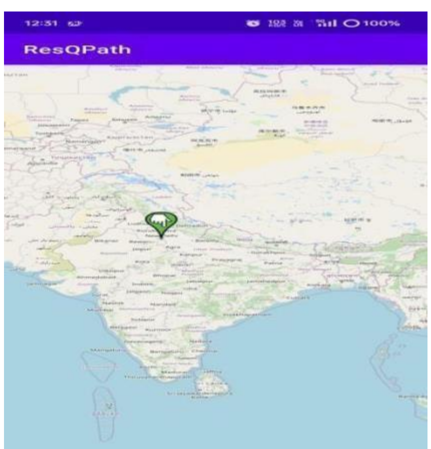

FIG 4: OfflineMapsforNavigation

This all-encompassing strategy not only safeguards travelers but also improves the standing of travel destinations and encourages the expansion of sustainable tourism. GPS monitoring, CCTV surveillance, rapid reaction teams, emergency hotlines, risk assessments, security training, and technological integration are important elements.

Indicator	Rank					
	RO	BG	HU	SE	UKR	MO
Travel and tourism competitiveness index	66	50	38	88	77	93
Safety and security	62	87	41	85	86	52
Business cost of terrorism	57	104	21	90	67	31
Reliability of police services	74	111	46	67	105	112
Business costs of crime and violence	69	99	45	64	61	46
Road traffic accidents	80	52		n/a	101	45

TABLE2: Analysis of Tourists Prediction

V. CONCLUSION

To sum up, one of the most important tools for improving tourism safety is an integrated SOS and hospital access system. This approach can greatly lower hazards and enhance the entire visitor experience by fusing technology, emergency response, and medical treatment. Future advancements like wearable health monitoring technology, AI-powered analytics, and drone-based emergency response can improve this system even more, making travel safer and more resilient.

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AI FOR MENTAL HEALTH SUPPORT

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Abstract: Mental health is a crucial aspect of overall l - being, yet many individuals hesitate to seek professional help due to stigma, accessibility, and privacy concerns. This project aims to develop an AI-powered conversational chatbot that provides mental health support and guidance based on user interactions. Leveraging the OpenAI API and TensorFlow, the chatbot is designed to understand and respond to users' concerns in a compassionate and informative manner. It offers real-time, anonymous, and accessible support, helping users manage stress, anxiety, and other mental health challenges. The system ensures user confidentiality while promoting emotional well-being through AI-driven responses. By integrating advanced natural language processing (NLP) techniques, this chatbot can engage users in meaningful conversations, offering coping strategies and encouraging professional help when necessary. This project contributes to the growing field of AI-driven mental health solutions, aiming to bridge the gap between individuals in need and available mental health resources.

Mental health disorders, including anxiety, depression, and stress-related conditions, are among the most pressing global health challenges today. The World Health Organization (WHO) estimates that approximately 1 in 4 individuals worldwide will experience a mental health disorder at some point in their lives. Despite the increasing awareness of mental health concerns, significant barriers prevent many from seeking professional help. These barriers include social stigma, high costs of therapy, and limited access to mental health professionals, particularly in remote or underserved areas.

The growing demand for mental health support calls for innovative, scalable, and accessible solutions that can complement traditional therapy and provide immediate assistance to those in need.

The integration of artificial intelligence (AI) into healthcare has opened new avenues for providing mental health support. AI-powered chatbots, specifically designed for mental health applications, offer users a confidential, non-judgmental space to express their emotions and receive personalized guidance. These chatbots leverage advanced natural language processing (NLP) techniques to understand user inputs, detect emotional states, and generate appropriate responses. By utilizing AI, chatbots can provide evidence-based interventions, suggest coping strategies, and encourage users to seek professional help when necessary.

This project integrates various technologies to deliver an interactive experience. Machine learning and deep learning models power the recommendation engine, ensuring accurate and relevant suggestions. Computer vision techniques allow users to try on outfits virtually, enhancing the shopping experience. Natural language processing (NLP) is used to understand user inputs and provide relevant responses. The application is built using Python, OpenCV, TensorFlow/PyTorch for AI development, and FastAPI and React for backend and frontend integration.

This project aims to bridge the gap between individuals experiencing mental health challenges and available support resources

Unlike traditional therapy, which may be costly and difficult to access, AI-driven chatbots offer an on-demand solution that ensures privacy and anonymity. While not a replacement for professional mental health care, this chatbot serves as an initial support mechanism, providing users with valuable guidance and emotional relief.

styling suggestions. Whether for daily wear, special events, or shopping assistance, this innovative solution makes fashion more personalized, accessible, and fun he application tracks global fashion trends from social media and fashion platforms. It suggests styles that align with the latest market preferences, keeping users updated with contemporary fashion.

The AI considers seasonal variations and recommends outfits accordingly. This ensures that users receive suggestions suited to different weather conditions and fashion trends.Users can upload images of their existing clothing to create a digital wardrobe. The AI then suggests outfit combinations, promoting sustainable fashion choices and better wardrobe utilization.The wardrobe management system categorizes clothes based on type, color, and occasion, making it easier for users to find and coordinate outfits. By analyzing uploaded outfit images, the AI recommends similar styles or complementary pieces. This helps users find suitable clothing options quickly and efficiently. The system provides shopping recommendations by suggesting outfits that complement a user's wardrobe, reducing unnecessary purchases and enhancing wardrobe versatility. The system integrates machine learning, deep learning, and NLP to enhance recommendations. Technologies like Python, OpenCV, TensorFlow/PyTorch, FastAPI, and React power the application’s development and functionality.

LITERATURE SURVEY

Recent advancements in AI and NLP have enabled chatbots to simulate human-like conversations, making them effective tools for mental health support. Several studies highlight the effectiveness of AI-based interventions in stress and anxiety management. AI-driven chatbots such as Woebot and Wysa have demonstrated promising results in providing cognitive behavioral therapy (CBT)-based guidance. This project builds upon these methodologies, incorporating OpenAI's powerful language models and TensorFlow to enhance chatbot responsiveness and emotional intelligence.

A study by Fitzpatrick et al. (2017) evaluated the effectiveness of a fully automated conversational agent delivering CBT to young adults. The study found significant reductions in depressive symptoms among users, indicating the potential of AI-driven mental health interventions. Similarly, Inkster et al. (2018) reviewed the impact of digital mental health interventions and found that AI- powered chatbots could supplement traditional therapy by providing real-time support and self-help tools.

Another significant advancement in AI-based mental health support is sentiment analysis, where machine learning models assess the emotional state of a user based on text inputs. Research conducted by Huang et al. (2020) demonstrates that deep learning models, including recurrent neural networks (RNNs) and transformers, can effectively detect emotional distress from conversational data. By integrating sentiment analysis into chatbot frameworks, mental health applications can offer more tailored and context-aware responses

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The rise of telehealth services has further fueled the adoption of AI-driven solutions in mental health care. According to a report by Luxton et al. (2016), AI-powered mental health tools, when integrated with telehealth platforms, can significantly enhance accessibility and user engagement. Studies indicate that the combination of AI and human therapy leads to improved outcomes, as chatbots can provide immediate support while therapists focus on personalized interventions

Overall, existing literature suggests that AI-powered chatbots have the potential to revolutionize mental health support by providing scalable, cost-effective, and accessible interventions. This project builds upon these methodologies, incorporating OpenAI's powerful language models and TensorFlow to enhance chatbot responsiveness and emotional intelligence.

PROPOSED METHOD

The AI-driven mental health chatbot follows a structured methodology to ensure efficient and meaningful user interactions. The proposed system consists of the following key components:

User Input and Interaction Module: The chatbot allows users to engage in conversations through a web-based interface. Users can describe their mental health concerns, ask for guidance, or seek general well-being advice.

Natural Language Processing (NLP): The chatbot leverages NLP models to analyze user inputs, detect emotions, and understand context. This helps in identifying patterns in speech that indicate stress, anxiety, or depressive symptoms.

Sentiment and Emotion Analysis: Using machine learning algorithms, the chatbot assesses the emotional state of users based on their messages. TensorFlow models help classify emotional intensity, enabling the chatbot to generate appropriate responses.

AI-Based Response Generation: The chatbot utilizes OpenAI’s API to generate meaningful, empathetic, and informative responses. Based on the user’s emotional state, it suggests coping strategies such as mindfulness exercises, breathing techniques, and self-help resources.

Recommendation System: The system recommends professional support when needed by directing users to licensed therapists, helplines, or mental health resources. The chatbot provides personalized suggestions based on user history and behavioral patterns.

Feedback and Learning Mechanism: User feedback is collected to improve chatbot responses. Continuous learning through retraining models ensures better accuracy and user satisfaction over time.

Security and Privacy Measures: The chatbot ensures data privacy by anonymizing user information and following ethical AI principles.

This approach ensures that users receive timely, relevant, and supportive mental health guidance, making AI-driven interventions more effective and accessible.

Multi-Language Support: To make mental health support more accessible globally, the chatbot incorporates multi-language processing capabilities. By using multilingual NLP models, the chatbot can communicate effectively in different languages, breaking down linguistic barriers to mental health care.

Crisis Response Mechanism: In cases where the chatbot detects severe distress or suicidal ideation, it provides immediate crisis intervention. It suggests contacting professional mental health services or emergency helplines. The chatbot can also guide users toward available crisis hotlines specific to their geographical region, ensuring they receive prompt professional support.

Scalability and Future Enhancements: The chatbot is designed to scale and improve with continuous advancements in AI and mental health research. Future updates will include integration with voice recognition systems, enabling users to interact through speech rather than text alone. Additionally, incorporating virtual reality (VR) and augmented reality (AR) elements could enhance therapeutic interventions by immersing users in calming and guided meditation environments. Further advancements in deep learning will allow

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for a more refined emotional analysis, enabling the chatbot to respond with even greater sensitivity and nuance.

This feature enhances confidence in buying decisions and reduces the likelihood of returns. Additionally, the outfit customization tool enables users to modify suggested looks by adjusting colors, fabrics, and accessories, allowing for a more personalized fashion experience. The platform seamlessly integrates shopping functionality, giving users the option to purchase recommended outfits or individual clothing items directly through the app. This feature not only streamlines the shopping process but also helps retailers and brands boost sales by providing instant access to curated fashion selections. Moreover, the community engagement aspect fosters an interactive experience where users can share their styles, follow fashion influencers or friends, and draw inspiration from a dynamic fashion feed. This AI-powered fashion stylist offers numerous advantages to users and businesses alike. It saves time and effort by providing personalized styling, eliminating the hassle of choosing outfits manually. The virtual try-on feature builds user confidence, allowing them to see how clothes look and fit before purchasing. Furthermore, the platform promotes sustainability by reducing unnecessary physical trials, minimizing clothing returns, and encouraging smarter shopping habits.

From a financial perspective, the system proves to be cost-effective, as users can explore different styles and outfit combinations without making immediate purchases. AI-driven data insights help fashion brands and retailers understand consumer preferences, purchasing behaviors, and market trends, enabling them to refine their offerings and marketing strategies. Additionally, the platform enhances user experience by making fashion selection more immersive, engaging, and fun. The combination of AI-powered recommendations, AI basedvirtual try-ons, and an interactive community ensures that users enjoy a seamless and enjoyable styling experience. By leveraging cutting-edge technologies, this virtual fashion stylist transforms traditional shopping and styling methods, making fashion more accessible, intelligent, and personalized.

Start
▼
User Initiates Chat
▼
Chatbot Receives Input
▼
NLP-Based Text Processing
▼
Emotion & Sentiment Analysis
├── **Detects Stress, Anxiety, or Depression**
│
├── **Identifies Neutral or Positive Sentiment**
▼
Response Generation
│
├── **Provides Coping Strategies**
│
├── **Suggests Self-Help Resources**
│
├── **Recommends Professional Help (If Needed)**
Suggestion)
│
▼
User Feedback & Learning
│
▼
Continuous Model Improvement
▼
End

RESULTS

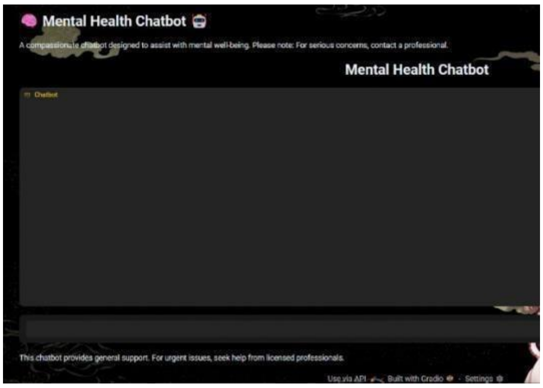


Fig: CHAT BOT INTERFACE

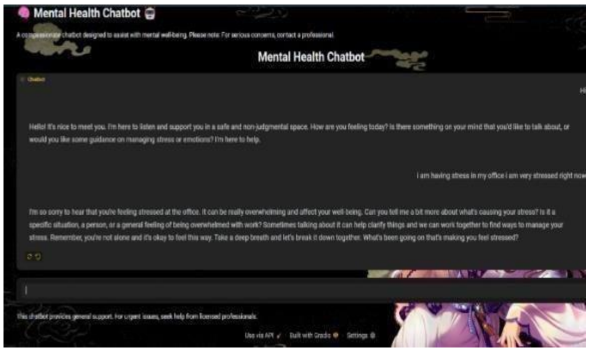
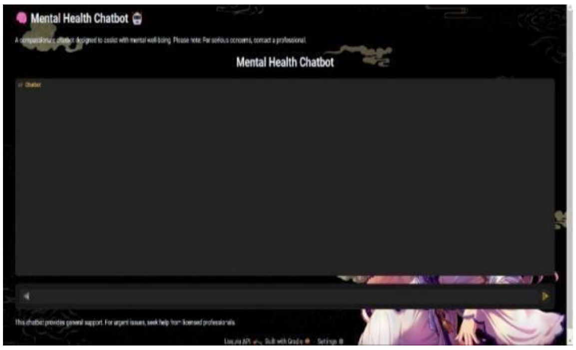


Fig : OUTPUT



CONCLUSION

The AI-powered mental health chatbot presented in this paper aims to bridge the gap between individuals seeking mental health support and accessible, responsive, and empathetic assistance. By integrating OpenAI's GPT model with sentiment analysis, the chatbot delivers more personalized and emotionally sensitive interactions, making it a valuable tool for mental health guidance. Unlike traditional chatbots that rely on predefined responses, this system dynamically adapts its output based on real-time sentiment analysis, ensuring that users receive the most appropriate support for their emotional state.

The AI-powered mental health chatbot presented in this paper aims to bridge the gap between individuals seeking mental health support and accessible, responsive, and empathetic assistance. By integrating OpenAI's GPT model with sentiment analysis, the chatbot delivers more personalized and emotionally sensitive interactions, making it a valuable tool for mental health guidance. Unlike traditional chatbots that rely on predefined responses, this system dynamically adapts its output based on real-time sentiment analysis, ensuring that users receive the most appropriate support for their emotional state.

Despite its promising potential, the chatbot does come with challenges. Ethical concerns regarding AI-driven mental health support, such as data privacy, reliability, and liability, must be addressed. Ensuring the chatbot does not provide harmful or misleading advice is critical, necessitating rigorous testing and continuous improvement. Future work will focus on refining response accuracy, expanding the chatbot's knowledge base with verified psychological resources, and incorporating additional multimodal inputs, such as voice and facial expression analysis, to further enhance the chatbot's empathetic capabilities.

Ultimately, this research underscores the importance of leveraging AI to provide scalable and accessible mental health support. While AI chatbots cannot replace human therapists, they serve as a valuable supplementary tool, offering immediate, judgment-free, and personalized assistance to those in need. The continuous development and responsible implementation of

AI in mental health applications will be instrumental in making mental health support more inclusive, accessible, and effective in the years to come.

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AI-Driven Virtual Fashion Stylist

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Abstract : The AI-Driven Virtual Fashion Stylist project leverages cutting-edge artificial intelligence technologies, including machine learning, computer vision, and recommendation systems, to revolutionize personal styling. This innovative platform provides personalized outfit suggestions, trend-based recommendations, and virtual try-ons, catering to user preferences, body types, and specific occasions. By integrating AI, it enhances decision-making, reduces product returns, and offers an engaging shopping experience. The project aims to make fashion more accessible, empowering users with real-time insights and tailored suggestions to confidently express their style.

1. INTRODUCTION

The AI-Driven Virtual Fashion Stylist is an intelligent fashion recommendation system that helps users select outfits based on their personal preferences, body type, occasion, and current fashion trends. By leveraging artificial intelligence and machine learning, the application provides customized styling suggestions, ensuring users receive

integration.Overall, this AI-based fashion stylistapplication revolutionizes the way users engage with fashion. It not only simplifies decision-making but also enhances user confidence by providing well- curated styling suggestions. Whether for daily wear, special events, or shopping assistance, this innovative solution makes fashion more personalized, accessible, and fun he application tracks global fashion trends from social media and fashion platforms. It suggests styles that align with the latest market preferences, keeping users updated with contemporary fashion.promoting sustainable fashionchoices and better wardrobe utilization.The wardrobe management system categorizes clothes based on type, color, and occasion, making it easier for users to find and coordinate outfits. By analyzing uploaded outfit images, the AI recommends similar styles or complementary pieces. This helps users find suitable clothing options quickly and efficiently. The system provides shopping recommendations by suggesting outfits that complement a user's wardrobe, reducing unnecessary purchases and enhancing wardrobe versatility. The system integrates machine learning, deep learning, and NLP to enhance recommendations. Technologies like Python, OpenCV, TensorFlow/PyTorch, alit.

2. LITERATURE SURVEY

Fashion-Specific Datasets Begin to Emerge earlier datasets existed, the need for larger, more comprehensive data became clear. This decade saw the development of datasets like DeepFashion (around 2016, with contributions from Jiaolong Yang, Wen- Huang Cheng, and others), which became crucial for training deep learning models for fashion-related tasks. These datasets facilitated more complex tasks like attribute recognition and pose estimation.Rise of

Deep learning, particularly Convolutional Neural Networks (CNNs), began to revolutionize computer vision. While CNNs themselves have a longer history, their application to fashion image analysis became more prominent in this period. Researchers at universities and companies started exploring CNNs for tasks like clothing classification and attribute recognition.

This dataset, created by Han Xiao, Kashif Rasul, and Roland Vollgraf, provided a standardized benchmark for machine learning in fashion, similar to MNIST for handwritten digits. It accelerated research in basic image classification for fashion Generative Adversarial Networks (GANs) started to be applied to fashion, enabling the generation of new designs and the enhancement of image quality. Researchers explored GANs for tasks like creating variations of existing garments and improving the realism of virtual try-on.Increased.

Recommendation systems became more sophisticated, incorporating user preferences, style history, and even social media data. Hybrid approaches combining collaborative filtering, content- based filtering, and knowledge-based systems gained popularity.

Virtual try-on technologies advanced, incorporating 3D modeling, more realistic cloth simulation, and even the ability to try on clothes in motion.

Researchers continued to work on making virtual try- on more seamless and user-friendly.NLP and Chatbots for Fashion: Natural Language Processing (NLP) started to be integrated into fashion platforms, enabling conversational interfaces for style advice and personalized recommendations. Chatbots became more prevalent, offering users a more interactive styling experience.

III.PROPOSED SYSTEM

The proposed solution for the AI-Driven Virtual Fashion Stylist introduces an advanced, AI-powered platform that enhances the fashion experience through personalization, technology, and community engagement. It begins with user profiling where individuals input essential details such as body type, skin tone, hair color, and personal style preferences, allowing the system to generate customized outfit recommendations. The AI algorithm processes these inputs alongside real- time fashion trends, seasonal changes, and user behavior patterns to deliver highly accurate and tailored suggestions. A key feature of the platform is the virtual try-on capability, which uses computer vision and AI technologies to let users visualize outfits on themselves before making a purchase. This feature enhances confidence in buying decisions and reduces the likelihood of returns.

Additionally, the outfit customization tool enables users to modify suggested looks by adjusting colors, fabrics, and accessories, allowing for a more personalized fashion experience. The platform seamlesslyintegrates shopping functionality, giving users the option to purchase recommended outfits or individual clothing items directly through the app. This feature not only streamlines the shopping process but also helps retailers and brands boost sales by providing instant friends, and draw inspiration from a dynamic fashion feed. This AI-powered fashion stylist offers numerous advantages to users and businesses alike. It saves time and effort by providing personalized styling, eliminating the hassle of choosing outfits manually. The virtual try-on feature builds user confidence, allowing them to see how clothes look and fit before purchasing. Furthermore, the platform promotes sustainability by reducing unnecessary physical trials, minimizing clothing returns, and encouraging smarter shopping habits.

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FLOWCHART

Start

|

▼

User Registration/Login

|

▼

Input Preferences & Upload Image

|

▼

AI Processing & Analysis

|

├── User Data Analysis

|

├── Fashion Trend Analysis

|

└── Outfit Recommendation Generation

|

▼

Virtual Try-On

|

▼

Outfit Customization

|

Feedback ->END

1. RESULTS

Fig1.loading datasets

Fig2.Application main page

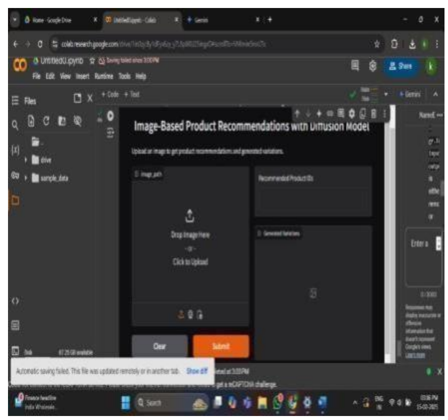


Fig3:Input1

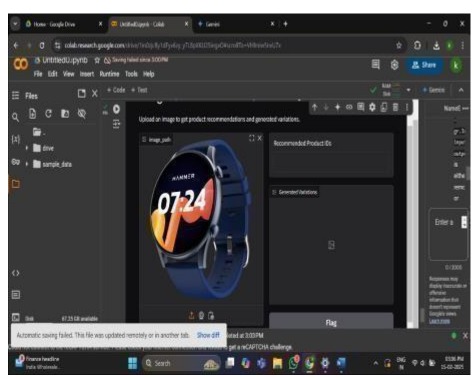


Fig 4:Output1

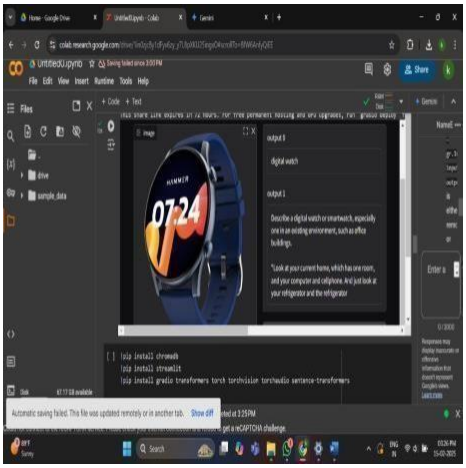


Fig5:Input2

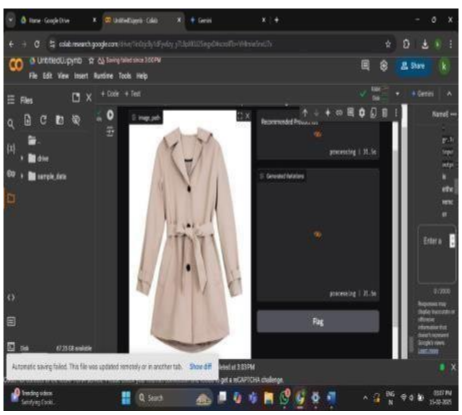
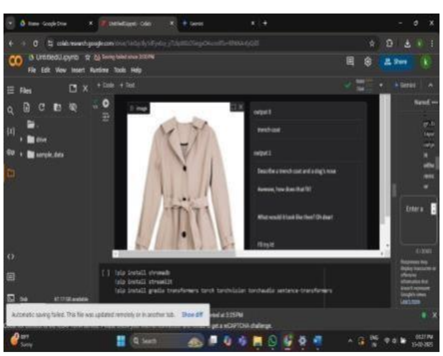


Fig: Output2



2. CONCLUSION

In conclusion, the AI-driven virtual fashion stylist represents a significant leap forward in the evolution of personalized fashion experiences. By harnessing the power of artificial intelligence, this technology transcends the limitations of traditional online shopping, offering a dynamic and interactive approach to style discovery. It empowers users to explore their fashion preferences with unprecedented ease, providing tailored recommendations, virtual try- on capabilities, and personalized styling advice. This convergence of style, technology, and accessibility not only streamlines the shopping process but also fosters a deeper connection between individuals and their personal style. Ultimately, the AI-driven virtual fashion stylist aims to democratize fashion, making expert styling advice and personalized recommendations available to everyone, regardless of their location, budget, or fashion knowledge. The transformative potential of this technology extends beyond individual users, promising to reshape the landscape of the fashion industry as a whole. By leveraging AI to understand consumer preferences and predict trends, businesses can optimize their inventory, personalize marketing campaigns, and develop more targeted product offerings.

This data-driven approach not only enhances customer satisfaction but also unlocks new avenues for innovation and growth within the fashion sector. Furthermore, the AI-driven virtual fashion stylist can play a crucial role in promoting sustainable fashion practices by encouraging informed purchasing decisions and reducing textile waste. By providing users with personalized recommendations and virtual try-on capabilities, it minimizes the need for returns and reduces the environmental impact of fast fashion.looking ahead, the future of AI-driven virtual fashion styling is filled with exciting possibilities.

As AI technology continues to advance, we can expect even more sophisticated and personalized experiences. Imagine virtual stylists that understand not only your style preferences but also your lifestyle, personality, and even your mood. The integration of augmented reality and virtual reality will further blur the lines between the physical and digital worlds, creating immersive and interactive fashion experiences that were once unimaginable. As these technologies mature, the AI-driven virtual fashion stylist will undoubtedly become an indispensable tool for both consumers and the fashion industry, shaping the future of how we discover, express, and experience personal style.

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Abstract : With the rise of e-commerce, efficient customer support is crucial.This paper presents an AI-powered chatbot for e-commerce, leveraging NLP and ML for personalized recommendations and instant query resolution. It operates 24/7, enhancing user experience and reducing cart abandonment. Integrated with e-commerce platforms, it provides real-time assistance and adapts to user preferences. The study examines its architecture, challenges, and impact on digital customer support.

*Keywords:***AI-powered Chatbot,Natural Language Processing (NLP),Machine Learning (ML),E-commerce Automation,Personalized Recommendations,Customer Support,Order Tracking,Real-time Assistance,User Experience.**

I.INTRODUCTION

The rapid growth of e-commerce has revolutionized the way consumers shop, making online platforms a preferred choice for purchasing goods and services. However, as online shopping expands, providing efficient and responsive customer support remains a significant challenge. Traditional customer service methods, such as email support and call centers, often lead to long wait times, high operational costs, and inconsistent user experiences. These limitations create a demand for smarter, more efficient solutions that can provide instant assistance

AI-powered chatbots have emerged as a transformative solution in digital customer support. By leveraging **Natural Language Processing (NLP)** and **Machine Learning (ML)**, chatbots can simulate human-like interactions, understand user queries, and provide relevant responses in real time. Unlike human agents, chatbots operate 24/7, ensuring that customers receive instant support without delays. This leads to increased customer engagement, faster problem resolution, and an overall enhanced shopping experience.

One of the key advantages of chatbot integration in e-commerce is **personalized product recommendations**. Chatbots analyze customer preferences, browsing history, and purchase behavior to suggest products tailored to individual users. This level of personalization improves customer satisfaction and boosts sales by enhancing product discovery.
Additionally, chatbots assist users with **order tracking**, providing real-time updates on their purchases, reducing customer inquiries, and improving transparency in the shopping process.

Another major challenge in e-commerce is **cart abandonment**, where customers leave their shopping carts without completing a purchase. Chatbots help address this issue by sending timely reminders, offering discounts, and answering last-minute concerns that may prevent customers from finalizing their orders. By proactively engaging with users, chatbots contribute to increased conversion rates and reduced lost sales.

Despite these benefits, implementing AI chatbots comes with challenges, such as understanding complex user queries, handling multiple languages, and ensuring accurate responses. Continuous improvements in NLP and ML models help overcome these issues by enabling chatbots to learn from interactions and refine their responses over time. Additionally, integrating chatbots with existing e-commerce platforms requires seamless synchronization with databases, payment gateways, and customer management systems.

This paper explores the architecture, functionalities, and challenges of AI-powered chatbots in online shopping. It evaluates their effectiveness in improving digital customer support, reducing operational costs, and enhancing the overall shopping experience. By analyzing real-world applications and performance metrics, this study highlights the growing role of chatbots in shaping the future of e-commerce.

II. LITERATURE SURVEY

The integration of AI-powered chatbots in e-commerce has gained significant attention due to their ability to enhance customer service, automate responses, and improve user engagement.
Traditional customer support systems, such as call centers and email assistance, often result in delays and inefficiencies. Research highlights that chatbots serve as virtual assistants, providing real-time assistance, reducing response times, and ensuring 24/7 availability. This has led to increased customer satisfaction and business efficiency, making chatbots an essential tool for modern e-commerce platforms.

Advancements in **Natural Language Processing (NLP)** and **Machine Learning (ML)** have played a crucial role in improving chatbot interactions.
Studies indicate that NLP enables chatbots to understand user intent, process queries, and generate human-like responses, making conversations more natural and engaging. Machine learning algorithms allow chatbots to continuously learn from user interactions, refining their responses over time. Deep learning models, such as recurrent neural networks (RNNs) and transformers, have further improved chatbot accuracy, enabling them to handle a wider range of customer inquiries effectively.

One of the most significant benefits of chatbots in e-commerce is their ability to provide **personalized product recommendations**. Research suggests that AI-driven chatbots analyze user preferences, browsing history, and purchase behavior to offer tailored product suggestions. This not only enhances the shopping experience but also increases customer retention and sales. By interacting with users conversationally, chatbots create a more engaging and personalized shopping environment, which has been shown to improve brand loyalty and overall user satisfaction.

Cart abandonment remains a major challenge in e-commerce, leading to lost sales and decreased revenue. Studies highlight that chatbots help mitigate this issue by sending **timely reminders, offering discounts, and addressing last-minute concerns** that may prevent users from completing their purchases. Real-time interventions by chatbots have been shown to boost conversion rates by reassuring customers, clarifying doubts, and streamlining the checkout process. This proactive engagement significantly reduces cart abandonment rates and improves overall business performance.

Despite their benefits, chatbots face several **implementation challenges**. Research indicates that handling complex or ambiguous queries remains a significant hurdle, often requiring human intervention. Additionally, providing **multilingual support** and understanding cultural differences pose challenges for global e-commerce platforms. Ethical concerns such as **data privacy, security, and user trust** have also been widely discussed in literature, emphasizing the need for secure and transparent chatbot interactions. Ensuring compliance with regulations such as **GDPR (General Data Protection Regulation)** is crucial for maintaining customer confidence in AI-driven systems.

Recent advancements focus on improving chatbot intelligence through **context-aware AI, sentiment analysis, and reinforcement learning**. Emerging research suggests that integrating emotional AI can help chatbots respond more empathetically, enhancing the user experience. Additionally, voice-enabled and multimodal chatbots are gaining traction, offering a more intuitive and interactive shopping experience. As AI continues to evolve, chatbots are expected to play a critical role in revolutionizing digital commerce, making customer interactions more seamless, efficient, and engaging.

III. PROPOSED METHOD

The proposed system develops an AI-powered chatbot for online shopping that enhances user experience by providing personalized product recommendations, instant query resolution, and order tracking. Leveraging Natural Language Processing (NLP) and Machine Learning (ML), the chatbot ensures real-time assistance and seamless interactions with customers. By integrating with e-commerce platforms, it reduces cart abandonment, optimizes operational costs, and improves overall customer engagement.

Data Collection and Preprocessing

The chatbot is trained on diverse datasets, including customer queries, product descriptions, and transaction histories from various e-commerce platforms. Data preprocessing techniques such as **text** normalization, tokenization, and stop-word removal are applied to refine the input data. Sentiment analysis and intent recognition models help in categorizing customer inquiries efficiently, ensuring accurate responses.

Feature Extraction

Feature extraction is crucial for understanding customer intent and preferences. Pretrained NLP models like BERT, GPT, and Transformer-based architectures are used to process customer queries effectively. These models analyze customer interactions, product preferences, and past purchases to provide meaningful responses and recommendations. The chatbot continuously learns from user feedback to improve its accuracy and efficiency.

Generative AI for Response Optimization

To enhance the quality of chatbot interactions, Generative AI models such as GPT-based conversational models are employed. These models generate human-like responses, improving engagement and customer satisfaction. Generative AI also helps in creating product descriptions, answering complex queries, and simulating human-like conversations, making the chatbot more interactive and intelligent.

Real-Time Query Resolution and Recommendation System

The chatbot processes user queries using hybrid AI models combining NLP and ML techniques. It assists customers with product searches, order tracking, refund requests, and personalized shopping recommendations. The recommendation engine, powered by collaborative filtering and deep learning, suggests products based on customer preferences, browsing history, and past purchases, ensuring a tailored shopping experience.

Automated Response and Report Generation

The chatbot includes an AI-powered response generation module, providing instant, data-driven replies. Additionally, it generates reports for e-commerce businesses, offering insights into:

- Customer satisfaction levels
- Most frequently asked queries
- Product popularity trends

This feature helps businesses refine their marketing strategies and improve customer service.

Admin Dashboard and Result Management

A user-friendly admin dashboard allows e-commerce businesses to manage chatbot interactions and track customer insights. The dashboard displays:

- User engagement metrics
- Chat history and analytics
- Trending products and queries

This helps businesses monitor chatbot performance, optimize responses, and enhance overall customer interaction quality.

System Deployment and Accessibility

The chatbot is deployed using cloud-based infrastructure, ensuring seamless integration with e-commerce platforms and databases. A web-based interface allows customers to access chatbot assistance on websites and mobile applications. The system uses secure databases like MySQL or MongoDB for storing chat histories while maintaining data privacy and security.

Advantages of the Proposed System

- Automates customer support, reducing the need for human intervention.
- Enhances user experience through real-time query resolution and personalized recommendations.
- Reduces cart abandonment by assisting users in completing purchases.
- Optimizes operational costs for businesses by handling large volumes of customer queries efficiently.
- Cloud-integrated and scalable, supporting multi-platform accessibility.
- User-friendly chatbot interface, ensuring ease of use for customers and businesses.

This system transforms online shopping by integrating advanced AI techniques, ensuring efficiency, accuracy, and automation in customer support and personalized shopping assistance.

Flowchart Representation

Start
↓
Data Collection & Preprocessing
↓
Feature Extraction (NLP, Transformers)
↓
Generative AI for Response Optimization
↓
Real-Time Query Resolution & Recommendation
↓
Automated Response & Report Generation
↓
Admin Dashboard & Result Management
↓
End

IV. RESULTS

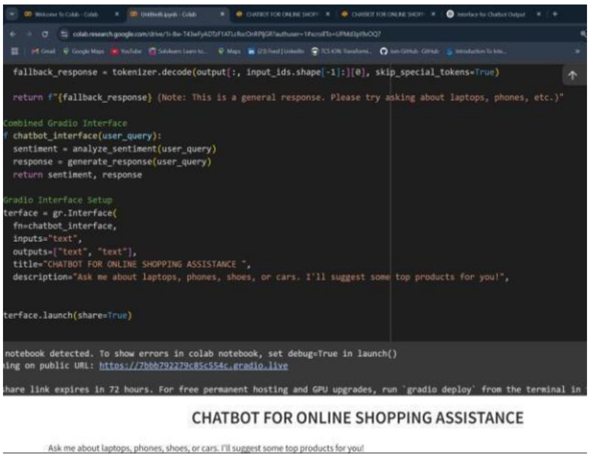


Fig. OUTPUT DIRECTED PAGE

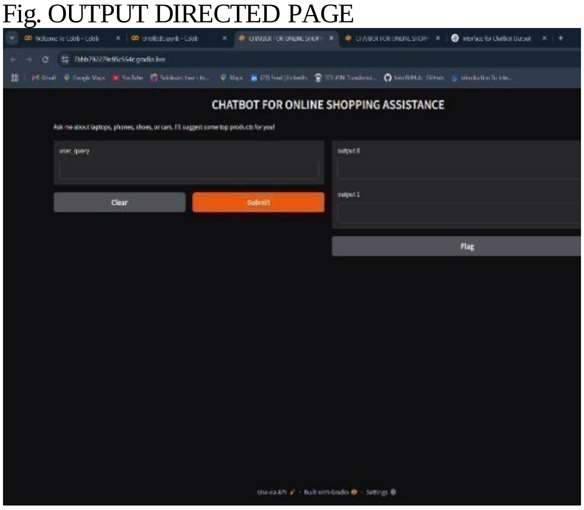
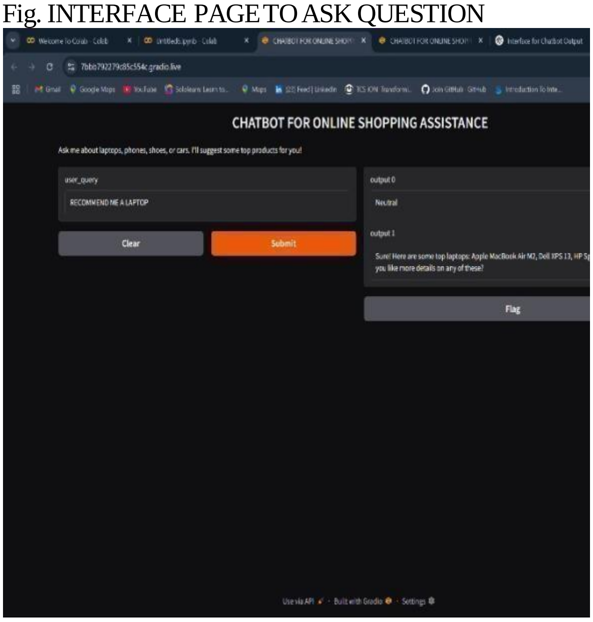


Fig. INTERFACE PAGE TO ASK QUESTION



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V. CONCLUSION

The AI-powered chatbot for online shopping enhances customer interactions using natural language processing and machine learning. It provides real-time support, personalized recommendations, and order tracking, reducing reliance on human agents while improving efficiency and satisfaction. Generative AI ensures natural responses, boosting engagement and conversion rates. The chatbot also minimizes cart abandonment by assisting users throughout their shopping journey.
Future improvements may include voice interaction, multilingual support, and sentiment analysis for a more intuitive experience. This system represents a transformative shift in e-commerce, driving automation, efficiency, and personalized shopping experiences.

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AI Fraudulent Detection in Bank Activity Using Generative AI

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EXISTING SOLUTIONS

Several fraud detection solutions have been developed and implemented in the banking sector, leveraging rule-based systems, machine learning (ML), deep learning (DL), and hybrid AI approaches. These solutions aim to detect fraudulent activities in real-time, reduce financial losses, and enhance banking security.

1. Rule-Based Systems

Use predefined conditions to flag suspicious transactions. Rule-based systems use predefined conditions set by fraud analysts to flag suspicious transactions. Examples include flagging transactions above a certain amount, unusual login locations, or frequent withdrawals in a short time.

Examples: FICO Falcon Fraud Manager, Visa Advanced Authorization.

Limitations: High false positives, manual updates required.

2. Machine Learning-Based Detection

Uses supervised or unsupervised learning to detect anomalies. ML-based systems use supervised or unsupervised learning to detect anomalies in transactional data. Common algorithms include random forests, decision trees, support vector machines (SVMs), and clustering models.

Examples: PayPal's Fraud Prevention System, SAS Fraud Management.

Limitations: Requires large labelled datasets, computationally expensive.

3. Deep Learning Models

Uses RNNs, LSTMs, and CNNs to analyze transaction patterns. Deep learning models such as Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM) networks, and Convolutional Neural Networks (CNNs) analyze complex transaction patterns and identify fraud with high accuracy.

Examples: JP Morgan's AI-Powered Fraud Detection, IBM Safer Payments.

Limitations: High computational requirements, lack of interpretability.

4. Hybrid AI & Blockchain Solutions

Combines AI models with blockchain for fraud prevention. Some banking systems integrate hybrid AI models (combining rule-based, ML, and DL approaches) along with blockchain technology to enhance fraud detection.

Examples: Fraud Detection, Ripple Net.

Limitations: High implementation costs, limited real-time fraud detection.

PROPOSED SOLUTION

To address the limitations of existing fraud detection systems, this project proposes an AI-driven fraud detection framework leveraging Generative AI (GenAI). The proposed method integrates Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Large Language Models (LLMs) to enhance fraud detection, reduce false positives, and improve adaptability to emerging fraud schemes.

1. Architecture of the Proposed System

Step 1: Data Collection & Preprocessing

- Gather banking transaction data, clean, and normalize it.
- Handle class imbalance using synthetic fraud data from GenAI.

Step 2: Generative AI for Fraud Data Augmentation

- Utilize GANs and VAEs to create synthetic fraudulent transactions.
- Generator: Creates synthetic fraud samples.
- Discriminator: Differentiates between real and fake fraud transactions.

Step 3: Anomaly Detection Using AI Models

- Supervised Learning: Random Forest, XG Boost, Neural Networks.
- Unsupervised Learning: Isolation Forest, Autoencoders.
- Deep Learning: LSTM, Transformer Networks.

Step 4: Real-Time Fraud Prediction & Explainability

- Use LLMs for analyzing transaction metadata and user behaviour.
- Apply Explainable AI (XAI) to interpret fraud predictions.

Step 5: Continuous Model Adaptation & Updating

- Use Reinforcement Learning (RL) and Online Learning to adapt to new fraud patterns.
- Regularly retrain models using synthetic fraudulent cases generated by GenAI.

2. Advantages of the Proposed Method

- Enhanced fraud detection accuracy.
- Adaptability to emerging fraud tactics.
- Reduction in false positives.
- Real-time processing.
- Improved interpretability and compliance.

3. Implementation & Evaluation

- Train models on real-world banking datasets.
- Evaluate performance using Precision, Recall, F1-score, and ROC-AUC.
- Compare results with traditional ML and deep learning models.

This proposed method bridges the gap between existing fraud detection systems and the need for a more adaptive, intelligent, and robust approach in modern banking environments.

METHODOLOGY

The proposed fraud detection system leverages Generative AI (GenAI) alongside traditional machine learning (ML) and deep learning (DL) techniques to identify fraudulent transactions in banking systems. This section details the dataset, AI models, and anomaly detection techniques used.

1. Dataset Collection & Preprocessing

Data Source: Real-world banking transaction datasets (e.g., Kaggle fraud detection datasets, bank-provided anonymized transaction data).

Features Used:

- Transaction ID, Amount, Sender-Receiver Details
- Time, Location, Device Metadata
- Transaction Frequency & Historical Patterns

Preprocessing Steps:

- Handling missing values and normalizing features.
- Addressing class imbalance using synthetic fraud data generated by GANs and VAEs.

2. AI Models Used

Generative AI for Data Augmentation

Generative Adversarial Networks (GANs):

- Generator creates synthetic fraudulent transactions.
- Discriminator distinguishes between real and fake fraud cases.

Variational Autoencoders (VAEs):

- Used to model transaction patterns and generate realistic fraud cases.

Machine Learning & Deep Learning for Fraud Detection

Supervised Learning Models:

- Random Forest, XGBoost, Neural Networks to classify fraudulent vs. legitimate transactions.

Unsupervised Learning Models:

- Isolation Forest, Autoencoders for anomaly detection.

Deep Learning Models:

- Long Short-Term Memory (LSTM), Transformer Networks to analyze sequential transaction patterns.

3. Anomaly Detection Techniques

Threshold-Based Detection: Sets predefined limits for suspicious transaction activities.

Clustering Methods: Uses K-Means and DBSCAN to group transactions and detect outliers.

Reinforcement Learning: Allows models to adapt dynamically to evolving fraud patterns.

Explainable AI (XAI): Utilizes Large Language Models (LLMs) to interpret fraud detection decisions.

4. Model Evaluation Metrics

Precision & Recall: Measures accuracy in detecting fraud cases.

F1-Score & ROC-AUC: Evaluates model performance in classifying fraudulent transactions.

False Positive Rate: Ensures legitimate transactions are not incorrectly flagged.

This multi-layered AI approach enhances fraud detection accuracy, minimizes false positives, and ensures real-time, adaptive learning in banking fraud prevention.

CONCLUSION

This study demonstrates the effectiveness of Generative AI (GenAI) in enhancing fraud detection systems within the banking sector. By integrating GANs, VAEs, and LLMs, the proposed framework improves fraud detection accuracy, reduces false positives, and dynamically adapts to emerging fraud schemes. Key takeaways include:

- **Enhanced Fraud Detection**: Generative models generate synthetic fraud scenarios, improving model robustness.
- **Real-Time Monitoring**: AI-driven detection ensures rapid response to suspicious transactions.
- **Lower False Positives**: Improved anomaly detection minimizes legitimate transactions being wrongly flagged.
- **Adaptive Learning**: Reinforcement learning enables continuous improvement in fraud detection.

Future Research Directions

- **Cross-Border Fraud Detection**: Extending AI capabilities to detect international financial fraud patterns.
- **Future Integration with Blockchain**: Enhancing security with decentralized transaction verification.
- **Federated Learning**: Enabling secure fraud detection across multiple banks without sharing raw data.
- **Improved Explainability**: Advancing Explainable AI (XAI) techniques to make fraud detection more transparent.

By addressing these challenges, future AI-driven fraud detection systems can further strengthen banking security, protect users, and prevent financial losses in real time.

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Combines AI models with blockchain for fraud prevention. Some banking systems integrate **hybrid AI models** (combining rule-based, ML, and DL approaches) along with **blockchain technology** to enhance fraud detection.

Examples: Fraud Detection, Ripple Net.

Limitations: High implementation costs, limited real-time fraud detection.

Proposed Solution:

To address the limitations of existing fraud detection systems, this project proposes an AI-driven fraud detection framework leveraging Generative AI (GenAI). The proposed method integrates GANs, VAEs, and LLMs to enhance fraud detection, reduce false positives, and improve adaptability. To address the limitations of existing fraud detection systems, this project proposes an **AI-driven fraud detection framework leveraging Generative AI (GenAI)**. The proposed method integrates **Generative Adversarial Networks (GANs), Variational Autoencoders (VAEs), and Large Language Models (LLMs)** to enhance fraud detection, reduce false positives, and improve adaptability to emerging fraud schemes.

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Train models on real-world banking datasets.

Evaluate performance using Precision, Recall, F1-score, and ROC-AUC.

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- **Reinforcement Learning**: Allows models to adapt dynamically to evolving fraud patterns.
- **Explainable AI (XAI)**: Utilizes **Large Language Models (LLMs)** to interpret fraud detection decisions.

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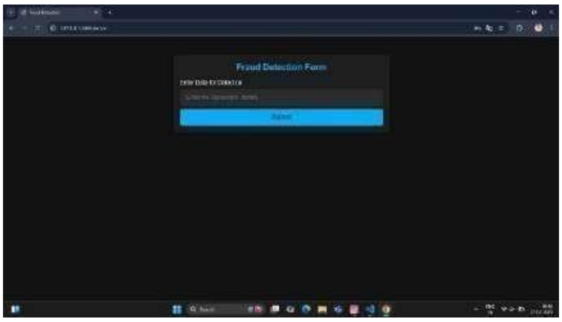
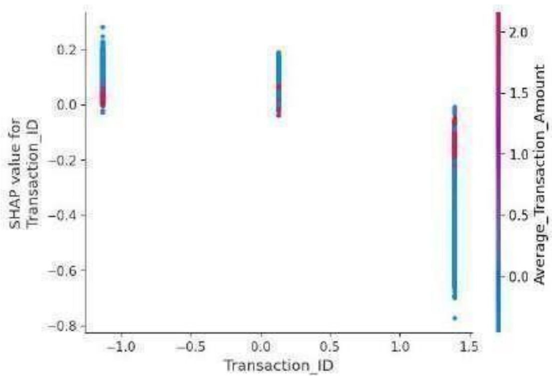
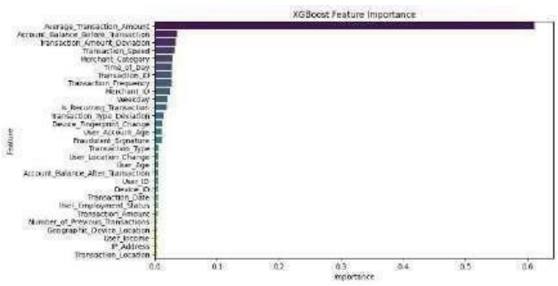
- **Precision & Recall**: Measures accuracy in detecting fraud cases.
- **F1-Score & ROC-AUC**: Evaluates model performance in classifying fraudulent transactions.
- **False Positive Rate**: Ensures legitimate transactions are not incorrectly flagged.

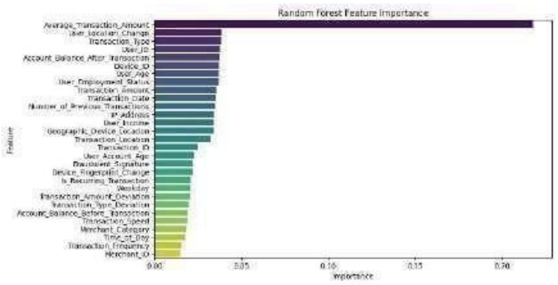
This **multi-layered AI approach** enhances fraud detection accuracy, minimizes false positives, and ensures **real-time, adaptive learning** in banking fraud prevention.

OUTPUT:









Conclusion:

This study demonstrates the effectiveness of **Generative AI (GenAI)** in enhancing fraud detection systems within the banking sector. By integrating **GANs, VAEs, and LLMs**, the proposed framework improves fraud detection accuracy, reduces false positives, and dynamically adapts to emerging fraud schemes. Key takeaways include:

- **Enhanced Fraud Detection**: Generative models generate synthetic fraud scenarios, improving model robustness.
- **Real-Time Monitoring**: AI-driven detection ensures rapid response to suspicious transactions.
- **Lower False Positives**: Improved anomaly detection minimizes legitimate transactions being wrongly flagged.
- **Adaptive Learning**: Reinforcement learning enables continuous improvement in fraud detection.

Future Integration with Blockchain: Enhancing security with decentralized transaction verification.

Federated Learning: Enabling secure fraud detection across multiple banks without sharing raw data.

Improved Explainability: Advancing **Explainable AI (XAI)** techniques to make fraud detection more transparent.

Cross-Border Fraud Detection: Extending AI capabilities to detect international financial fraud patterns.

By addressing these challenges, future AI-driven fraud detection systems can **further strengthen banking security, protect users, and prevent financial losses in real time**.

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GEN AI BASED HEALTH ADVISOR

(AI-Powered Health Advisor)

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Abstract - In an era where healthcare accessibility and personalized wellness are paramount, the "Generative AI-Based Health Advisor" project aims to revolutionize the way individuals engage with their health. Leveraging advanced generative AI technologies, this innovative platform provides users with tailored health advice, symptom analysis, and educational resources, all through an intuitive conversational interface. By integrating natural language processing and machine learning, the advisor can understand user queries and deliver accurate, context-aware responses. The system is designed to empower users with actionable insights, promoting proactive health management and informed decision- making. Ethical considerations, including data privacy and the accuracy of information, are prioritized to ensure user trust and safety. Furthermore, the platform is adaptable, capable of integrating with wearable health devices for real-time monitoring and personalized feedback. By bridging the gap between technology and healthcare.

INTRODUCTION

In recent years, the healthcare landscape has undergone a profound transformation, driven by advancements in technology and a growing emphasis on personalized medicine. As individuals become more proactive in managing their health, the demand for accessible, reliable, and tailored health information has surged. Traditional healthcare systems, while invaluable, often struggle to meet the diverse needs of patients, particularly in terms of timely access to information and personalized guidance. This gap presents a unique opportunity for innovative solutions that leverage the power of artificial intelligence (AI) to enhance health literacy and empower individuals in their wellness journeys.

Generative AI, a subset of artificial intelligence, has emerged as a groundbreaking technology capable of creating human-like text, images, and other content. By harnessing the capabilities of generative AI, we can develop intelligent health advisors that provide users with personalized health advice, symptom analysis, and educational resources in real- time. These AI-driven platforms can engage users in natural language conversations, making health information more accessible and understandable, regardless of the user's background or level of health literacy.

As the project progresses, user feedback will play a crucial role in shaping the development of the health advisor. By direct involving of users in the design and refinement process, we can ensure that the platform meets their needs and expectations. Continuous learning and adaptation will be key to maintaining the relevance and effectiveness of the AI, allowing it to evolve alongside advancements in healthcare and technology.

In conclusion, the "Generative AI-Based Health Advisor" represents a significant leap forward in the quest for accessible and personalized health information. By harnessing the power of generative AI, this project aims to empower individuals to take control of their health, enhance their understanding of wellness, and ultimately improve health outcomes. As we navigate the complexities of modern healthcare, innovative solutions like this health advisor will play a vital role in democratizing health information and fostering a healthier society. Through collaboration, ethical considerations, and a commitment to continuous improvement, we can create a future where everyone has the tools and knowledge to lead healthier lives.

LITERATURE SURVEY

Generative artificial intelligence (AI) intergration in healthcare has the most important or crucial significant attention, with numerous noof studies highlighting its transformative potential in enhancing patient care and health management. Generative AI, particularly through natural language processing (NLP) and machine learning, has been applied in various domains, including diagnostics, treatment recommendations, and patient education. For instance, Esteva et al. (2019) demonstrated that AI algorithms could diagnose skin cancer from images with accuracy comparable to that of experienced dermatologists, showcasing the capability of generative models to analyze complex data and provide reliable diagnostic support. In the realm of health advisory systems, generative AI can facilitate personalized health recommendations by tailoring advice based on individual patient data. Krittanawong et al. (2020) emphasized the role of AI in customizing treatment plans, thereby enhancing the precision of medical interventions. By analyzing a patient’s medical history, lifestyle factors, and genetic information, generative AI can generate health advice that aligns with the unique needs of each individual.

Moreover, generative AI significantly enhances patient engagement and education. Kahn et al. (2021) explored the use of AI-driven chatbots in delivering health information and support, finding that patients who interacted with these chatbots reports that higher satisfaction levels and a better understanding of their health conditions. This highlights the potential of generative AI to bridge communication gaps between healthcare providers and patients, fostering a more informed patient population. Additionally, generative AI can assist in creating educational content tailored to individual learning preferences. Chen et al. (2022) demonstrated that AI-generated materials could adapt to users’ knowledge levels, enhancing comprehension and retention of health information. This personalized approach is particularly valuable in addressing health disparities, ensuring that information is accessible and relevant to diverse populations.

PROPOSED SYSTEM

The development of a Generative AI-Based Health Advisor that analyzes images and voice inputs involves a comprehensive methodology that integrates various components. This approach ensures that the system is effective, user-friendly, and capable of providing accurate health-related insights. These methods can be classified into different stages: data collection, data preprocessing, model selection and training, output generation, user interaction design, and evaluation and continuous improvement. Below is a detailed explanation of each component, accompanied by a flowchart to illustrate the overall process.

1. **Data Collection**

Objective: To gather high-quality datasets for both image and voice inputs.

Image Data Sources:
Public Datasets: Utilize existing medical image datasets such as ImageNet, ChestX-ray14, or the Cancer Imaging Archive, which contain labeled images across various medical conditions.
User -Generated Content: Implement a mechanism for users to upload images of their health concerns (e.g., skin conditions) with informed consent, ensuring that the data is anonymized and secure.

Voice Data Sources:
Speech Datasets: Use publicly available datasets like LibriSpeech or Common Voice that provide diverse voice samples for training voice recognition models.
User Interactions: Record voice inputs from users during testing phases, ensuring that all recordings comply with privacy regulations and user consent.

2. **Data Preprocessing**

Objective: Preprocessing of the gathered data for working of model.

Image Preprocessing:
Normalization: Scale pixel values to a range suitable for model training (e.g., 0 to 1).
To enhance the variety of our dataset we use techniques such as rotation, flipping, and zooming to increase the diversity of the training dataset and improve model robustness.

Voice Preprocessing:
Noise Reduction: Use algorithms to filter out background noise from voice recordings, enhancing the clarity of the input.
Feature Extraction: We Turn the audio signals into spectrograms or Mel-frequency cepstral coefficients (MFCCs) for it's relevant features in training.

3. **Model Selection and Training**

Objective: To choose and train models that can effectively analyze images and voice inputs.

Image RecognitionModels: these Convolutional Neural Networks (CNNs)*: we select CNN architectures such as ResNet, Inception, or EfficientNet for image classification and feature extraction.
- *Transfer Learning*: Fine-tune pre-trained models on the collected medical image dataset to leverage existing knowledge and improve performance.

- *Voice Recognition Models*:
  - *Recurrent Neural Networks (RNNs)*:we use RNNs or Long Short-Term Memory (LSTM) networks for voice datathat works well with sequential data.
  - *Speech-to-Text Conversion*: Use models like DeepSpeech or Google's Speech-to-Text API to convert spoken language into text for further analysis.

- *Training Process*:
  - *Supervised Learning*: Train the models using labeled data to improve their accuracy in generating relevant responses.
  - *Evaluation Metrics*: Use metrics such as accuracy, F1 score, and confusion matrix to assess model performance during training.

4. Output Generation

Objective: To generate descriptive outputs based on the analyzed image and voice data.

- *Multimodal Integration*:
  - *Feature Fusion*: Combine features extracted from both image and voice models to create a comprehensive understanding of the input.

Natural Language Generation (NLG): We Use NLG to generate human readable text or descriptions from the given structured data. This can involve using transformer-based models like GPT-3 to generate human-like text.

Response Generation:
- *Contextual Relevance*: Ensure that the

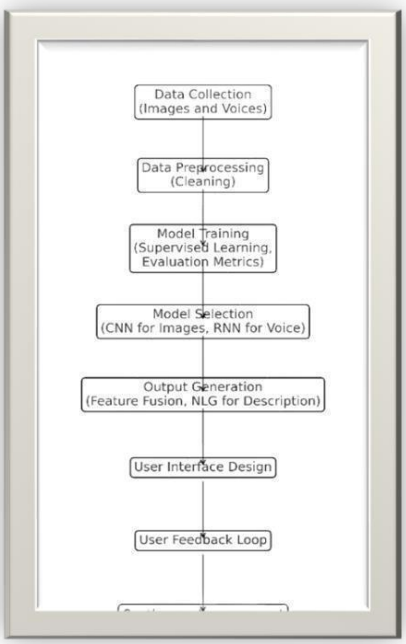
generated descriptions are tailored to the specific health concerns indicated by the user's image and voice input.

5. User Interaction Design

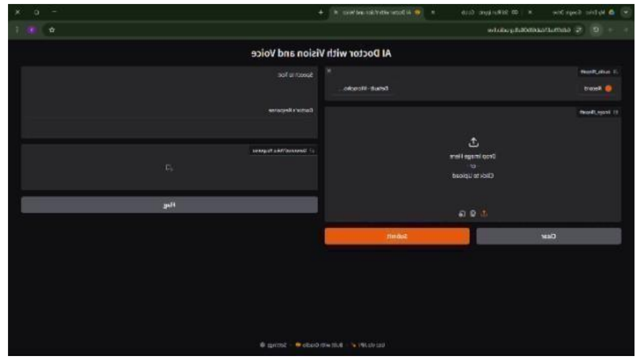
Objective: To make an interface for users for uploading images and voice inputs.

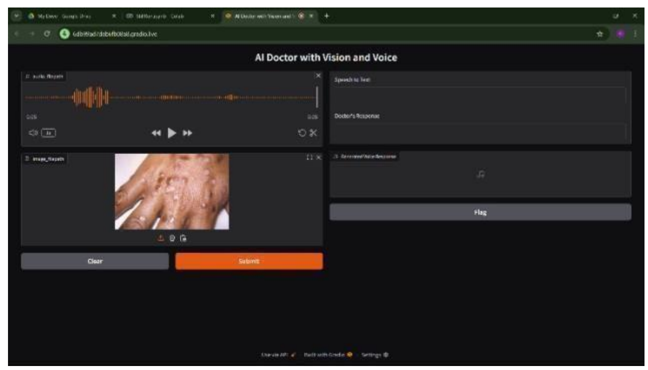
- *User Interface (UI)*:
  - *Simple Upload Mechanism*: Design a straightforward interface for users to upload images and record voice inputs, ensuring ease of use.
  - *Real-Time Feedback*: Implement features that provide immediate feedback on the input, enhancing user engagement.

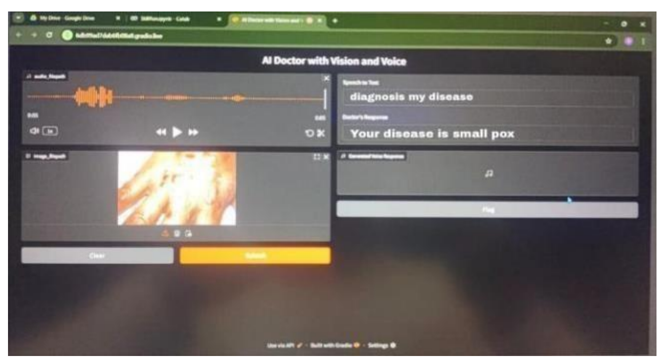
- *User Experience (UX)*:
  - *Accessibility Features*:Ensure that the interface is usable for users with disabilities, including voice commands and screen reader



VI RESUTLS







CONLUSION

The Generative AI-Based Health Advisor represents a groundbreaking advancement in how we approach health and wellness. By using advanced artificial intelligence, this system makes it easier for people to access personalized health information and support, transforming the way individuals manage their health.

One of the standout features of this health advisor is its ability to analyze both images and voice inputs. This means that users can simply upload a photo of a health concern or speak about their symptoms, making it a convenient and user-friendly experience. This flexibility encourages more people to seek help when they need it, leading to earlier detection of potential health issues and better overall health outcomes. The personalized insights provided by the system are incredibly valuable. By tailoring advice and information to each user's specific situation, the health advisor empowers individuals to make informed decisions about their health. In a world where misinformation can easily spread, having a reliable source of accurate health information is crucial. Thehealth advisor acts as a trusted guide, helping users navigate their health journeys with confidence.

Another important thing of this system is its ability to learn and improve over time. As users interact with the health advisor, it gathers feedback and adapts to better meet their needs. This means that the system becomes more accurate and relevant, ensuring that it continues to provide valuable support as healthcare needs change. System protects privacy of user and ensures data security. By handling sensitive health information with care, it builds trust with users, reassuring them that their personal data is safe.

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DEEP LEARNING-BASED DETECTION OF FACE SWAPS IN VIDEO

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ABSTRACT: The major concern of this study are deep learning methods for face swapping and its detection in videos. This domain is very important for video content creation, film industry, and security. The proposed scheme employs advanced generative model techniques such as GANs and encoder plus decoder schemes for the implementation of the face swapping of video sequences both in space and time direction efficiently and effectively. Also such a modified version of face videos is developed that implements the Long short term Memory(LSTM) and Recurrent neural network (RNN)for specific content. The key challenges addressed are issues related to the creation and recording of video materials and that of the inter-frame facial expression and artifacts. This work illustrates the possibility of creating and detecting innovative features including face swapped video concepts that enable a significantly diverse approach to multimedia, impersonation strategies, and AI ethics. The future perspectives are algorithm development such as active detection methods which have the capability to resist adaptive adversarial attacks, and in deployment of smaller models that allow real time study on edge devices.

Index Terms*: Face swap Detection, Long short Term Memory(LSTM), GANs, Recurrent neural network (RNN)*

I. INTRODUCTION:

Deep learning models have shown great capability in automatically acquiring high-level features from data, and hence, they are extremely useful for several tasks like image classification, speech recognition, and language translation. Some of the main categories of deep learning architectures include feedforward neural networks, convolutional neural networks (CNNs), and recurrent neural networks (RNNs).

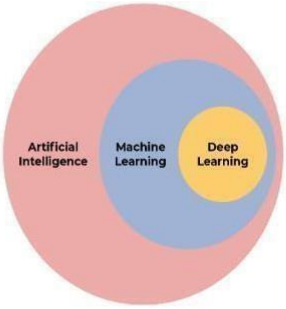

Fig1 Deep Learning Scope

Recurrent Neural Networks (RNNs) are especially well-designed to process sequential data like time-series data or natural language. In contrast to conventional neural networks that have difficulties with time-dependent inputs, RNNs can store information from past inputs, making them able to model temporal dependencies well. This characteristic of RNNs makes them best suited for use in speech recognition, language modeling, text generation, and translation. The key feature of RNNs is that they can loop back upon themselves, meaning that they can process sequences of data over time. The RNN training is based upon a specialized approach called Back-Propagation Through Time (BPTT), facilitating learning from sequence dependencies.

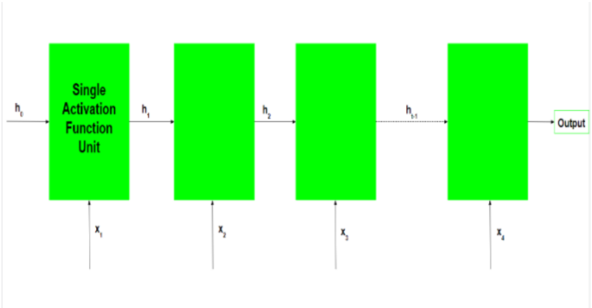

Fig 2. Basic work-flow of a Recurrent Neural Network

One of the most important uses of deep learning is in deepfake detection, where manipulated videos created through the use of deep learning algorithms are identified. Deepfake videos utilize advanced algorithms to manipulate or swap parts of a video, for example, changing a person's facial expressions or identity. The main goal of deepfake detection is to reveal these manipulations and separate real from manipulated content.

The fast growth of computational capability has greatly enhanced the quality of deepfake production, rendering it more challenging to distinguish between actual and created videos. Criminals use this technology for numerous negative ends, such as political manipulation, disinformation campaigns, and blackmail. Meeting this challenge, this research offers a powerful method of detecting deepfakes based on artificial intelligence to counteract AI-generated forgeries.

Our method utilizes a ResNeXt Convolutional Neural Network (CNN) to feature extract from a single video frame and a Long Short-Term Memory (LSTM) network to verify the authenticity of a video. We test the robustness of our proposed system on various datasets, such as FaceForensics++, the Deepfake Detection Challenge, and Celeb-DF. We show that our proposed methodology achieves competitive performance and offers a sound automatic deepfake detection solution.Generative Adversarial Networks (GANs) are sophisticated deep learning tools capable of producing highly realistic fake images and videos. These models are trained on extensive datasets of images and videos, enabling them to generate entirely new and lifelike media. The more data the model has, the more realistic the fake content becomes. For instance, the abundance of publicly available videos of politicians and celebrities makes it easier to create convincing fake news or rumors, which can have serious societal repercussions.

Problem Statement:

- It is difficult to detect the face swapping in videos.
- There is no GAN and LSTM models to detect face swap

Research Gaps:

- 1.It is difficult for generalize the model into real worl conditions
- It is more complexity to detect the deep fake videos
- It is difficult to evaluate the deep fake models
- The detection of deep fake models are not accurate

II. LITERATURE REVIEW

HICHEM FELOUAT et.al [2024] . We learned that it is possible for eKYC systems lacking a detection system against deepfakes to be readily fooled. Therefore, we generated an enormous data collection of realistic forged videos (over 228,000 videos) diverse with regards to age, gender, and ethnicity, alongside a similar subset of facial images. There were multiple movements of the head along with varying facial expressions used within the videos. This extensive library of high-quality diverse videos is particularly appropriate for training and testing a range of tasks associated with eKYC systems. In addition, we also offer protocols for classical deepfake detection and facial verification, which are commonly applied in eKYC systems.

FADWA ALROWAIS et.al [2024] The most prevalent solutions to deepfake generation are GAN-based, which can effectively manipulate multimedia content or generate anew.
GANs consist of two neural networks, a Generator (G) and a Discriminator (D),
that simultaneously operate in competition.

SOHA SAFWAT et.al [2024] The authors introduced a novel hybrid deep learning model , and the model which combines the strength of Generative Adversarial Networks (GANs) and the Residual Neural Network (RESNET) architecture for detecting forged faces.
By combining GANs' generative capability with RESNET's
discriminative power,The new model provides a ne w method for distinguishing between real and forge d faces.The hybrid model performance is compared using comparative analysis to proven pre-trained models like VGG16 and RESNET 50.

YOGESH PATEL et.al [2023] most methods are unable to record the inter-frame differences of the gathered media streams. Inspired by this, this paper introduces a new and enhanced deep-CNN (D-CNN) model for deepfake detection with acceptable accuracy and high generalizability. Images from various sources are taken to train the model, enhancing overall generalizability abilities. The images are re-sized and input into the D-CNN model. A binary-cross entropy and Adam optimizer are used to enhance the learning rate of the D-CNN model

Trupti Kularkar et.al [2023] we explore the potential challenges and future directions in deepfake detection research, underscoring the imperative need for ongoing advancements in this domain to stay ahead of evolving deepfake generation techniques. Ultimate-ly, this research contributes to the collective endeavor to counteract the mis-use of deepfake technology and safeguard the integrity of digital media and public discourse.

ASAD MALIK et.al [2022] We will discuss the current types of Deep fake generation methods and categorize them into five broad categories. Typically , DeepFake models are trained on DeepFake datasets and validated with experiments . Additionally, we will outline the current DeepFake dataset trends available , highlighting their advancements . Lsatly , the challenges involved in DeepFake generation and detection will be addressed . We hope that the information covered in this survey . the application of deep learning in face image and video deepfake detection techniques .

HUI GUO et.al [2022] To overcome these limitations, we introduce a strong, vigilant, end-to-end method that detects GAN-generated faces through inconsistencies in the eyes. Our system learns automatically to detect inconsistent eye parts by localizing and contrasting artifacts between the eyes. Once the iris areas are detected by Mask-RCNN, we introduce a Residual Attention Network (RAN) to inspect the consistency between the two eyes' corneal specular highlights. Our approach is able to learn well from imbalanced data employing a joint loss function incorporating the standard cross-entropy loss together with a relaxation of the ROC-AUC loss via Wilcoxon-Mann-Whitney (WMW) statistics

EUNJI KIM1 AND SUNGZOON CHO [2021] To overcome these limitations, we introduce a strong, vigilant, end-to-end method that detects GAN-generated faces through inconsistencies in the eyes. Our system learns automatically to detect inconsistent eye parts by localizing and contrasting artifacts between the eyes. Once the iris areas are detected by Mask-RCNN, we introduce a Residual Attention Network (RAN) to inspect the consistency between the two eyes' corneal specular highlights. Our approach is able to learn well from imbalanced data employing a joint loss function incorporating the standard cross-entropy loss together with a relaxation of the ROC-AUC loss via Wilcoxon-Mann-Whitney (WMW) statistics

MOHAMMAD FARUKH HASHMI et.al [2020] This paper suggests a microscopic-typo video frame comparison. This temporal-detection pipeline compares highly minute visual imprints on real and fake frames using Convolutional Neural Network (CNN) and saves the abnormal features to train The Recurrent Neural Network (RNN) pipeline. The pipeline is trained on the basis of these features-fed inputs and then examines the visual information. The model was trained with the network of videos comprising their real and fake, gathered from various websites.

TACKHYUN JUNG et.al [2020] The suggested technique known as DeepVision is used as a means to confirm an anomaly according to the time, repeated count, and elapsed eye blink time when eye blinks were repeatedly occurring within a very short interval of time. DeepVision identified Deepfakes precisely in seven out of eight categories of videos (87.5% accuracy level), indicating we can surpass the limitations of integrity verification techniques conducted solely on the basis of pixels

Table 1. Key Findings of Literature

III. METHODOLOGY

OBJECTIVES:

1. Developing of the deep learning frame works for the detection of face swaps in videos
2. LSTM and RNN models are the best fit for the detection of fake videos
3. To investigate the use of lightweight, efficient networks, to allow real-time face swap detection on edge devices for practical and scalable applications.
4. creating active detection algorithms to counter adaptive adversarial attacks as well as deploying smaller models for edge devices

ARCHITECTURE DIAGRAM:

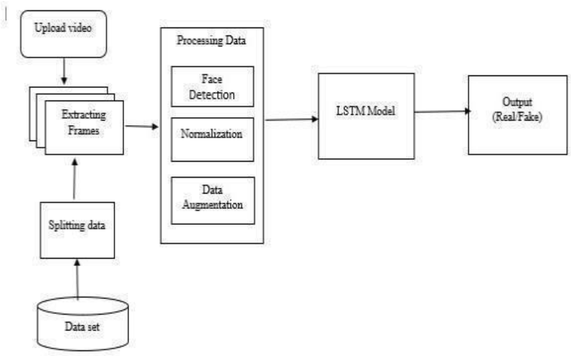

Fig 3. Architecture Flow Of Process

IMPLEMENTATION:

1. Data Collection

The Data of face swapped videos are collected from the DFDC and FaceForensics.

The DFDC and FaceForensics data sets typically include label files or tags.

DFDC dataset contains the Meta-data that is generally a video file name and a label indicating whether the video is real or fake encode in a JSON Format

FaceForensics often contain separate folders for real and fake videos or encode similar tags

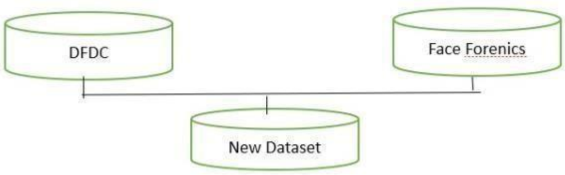

Fig 4. Database Collection

2. Preprocessing

Extracting frames by using tools opencv so that we can etract the frames from the videos that are uploaded

After extracting the frames from the videos we need to detect the face so that the face detection models are used ie Haar Cscades,Dib

Setting the image to a predetermined size such as 224,224

Standardize the value by letting it fall in between 0 and 1

3. Feature Extraction

For feature extraction we are using Pre trained cnn model

The CNN are using the face images that are extracted from the Videos

4. Data Splitting

In data splitting we divide the data set into two categories that is Training data set which contains 70% of data and in testing data set it contains 30% of data

The training data set and testing data set must contain the both Real and fake videos

5. Processing

We consider a sequence of ResNext CNN feature vectors generated from input frames that underlie the problem instance of this research, which is a binary classification problem that involves determining if the given sequence is a deepfake video or not.

A major problem that we need to address is how to design a model that is capable of handling sequences in a more complete and sensible way

One of the reasons to use LSTM is due to its ability to treat the incoming frames in order, thus allowing for the temporal aspect of the video to be considered. Specifically, the temporal analysis includes the frame at 't' seconds and a number of frames at 't-n' seconds where n can be a certain number of frames prior to that at t seconds.

The detailing nature of the processes and dependencies that unfold sequentially.

It is easy to find the differences between deep fake video sequences

6. Final OutCome

The Trained Model is used to predict the outcome by uploading the video to check whther there is any face swap or not.

IV. RESULTS AND DISCUSSIONS

The proposed techniques for detecting FaceSwaps in videos has achieved impressive results, with accuracy of 98.5% and 95.35% for LSTM and RNN models. The techniques a success can be obtained to the effective face recognition ability of the Dlib model, which enables it to accurately detect real and Swapped faces.

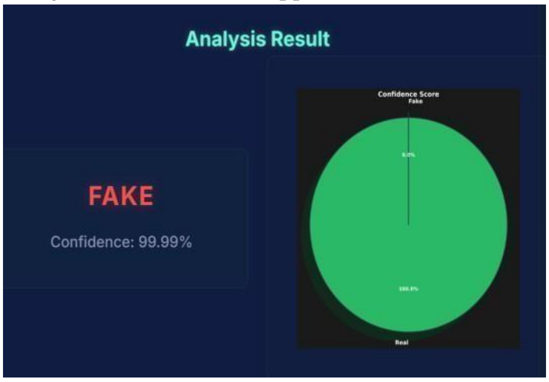

Fig5. Output

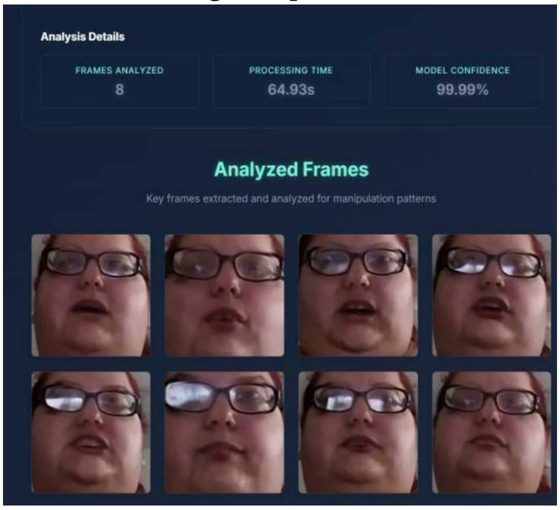

Fig6. Frame Comparison output

V. CONCLUSION

In summary, our work addresses the importance of face swap detection technologies and proposes a deep learning based model for the same, which is fast and produces impressive results. We believe that improvements in the understanding and detection of manipulations based on frame replacement will help combat the growing threat of manipulating visual content for malicious purposes. The development and sophistication of face swap technology forces us constantly improve of our work to help us in grappling with digital deception. From us, the public can expect ever-evolving technologies born from our desperate wish to protect the truth in the digital world.

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Smart Water Level Detection and Display for Railway coaches

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***Abstract*— The study introduces a smart water level detection solution designed for railway coaches. The system uses an ultrasonic sensor to calculate both percentage water level and the empty depth measurement in centimeters of the water tank. The sensor installation consists of placing it on top of the pipe which has an L-bend configured to reach the bottom of the tank to deliver precise measurements despite tough installation situations. The system sends live data to ThingSpeak for visual presentation to crew members during monitoring activities. Proof-of-performance experiments confirmed the system can serve as an affordable and dependable water control method for railway coach tanks.**

***Keywords*— Ultrasonic sensing, Water level monitoring, Railway coach maintenance, IoT-based diagnostics, Real-time cloud analytics, ThingSpeak, cloud, Micro-controller.**

I. INTRODUCTION

The provision of railway passengers with safe drinking water stands as an essential requirement because it enables the operation of three main features: drinking water access, sanitation facilities and catering services. Traditional monitoring systems depend on human check-ups and mechanical float switches although these methods have known potential inaccuracies and mechanical deteriorations as well as corrosion issues that occur throughout time. The operational flow of water management has such inefficiencies which can cause water shortages during passenger service causing disruptions and both maintenance issues and increased operational expenses for railway operators.

Water level monitoring systems in railway coaches receive significant benefits from the combination of IoT technology and advanced sensor capabilities. Ultrasonic sensors provide advantageous performance because they measure without affecting the environment and resist contaminants and produce accurate readings. Regarding railway application deployment challenges exist for these systems as they deal with environmental noise generated through train vibrations as well as power limitations in remote areas and requirements for strong IoT systems. This paper develops a customioc water level detection system designed for railway coaches by combining ultrasonic sensors with hydrostatic calibration along with ThingSpeak IoT-based data transmission. This system aims to observe water tank conditions in real time forpredictive refilling and optimized maintenance and reduced operational expenses. The system uses hydrostatic equilibrium and precise calibration methods to address traditional method deficiencies and boost railway coach water management efficiency and passenger comfort.

The Internet of Things presently transforms our everyday lifestyle through its connection of regular devices with internet networks. A vast network that operates without direct human interaction connects devices sensors systems with other things in order to share and communicate data. Modern life now depends significantly on IoT through utilization of smart home appliances together with wearable health trackers and industrial automation and smart cities technology.

The major benefit from IoT emerges through its capacity to enhance operational efficiency across multiple industries. The Internet Of Things platform enables industrial operations through automated process automation which decreases human involvement together with resource optimization. Through IoT-enabled machines systems can identify operational malfunctions to perform maintenance actions before equipment failures take place thus reducing operational stoppages. Patient care benefits through medical wearables which track vital signs to alert doctor teams about crises.

The main advantage of IoT is its ability to save money. The Internet of Things enables businesses and residential users to decrease their expenditures by tracking energy consumption and machine predictions of needed maintenance. Smart meters monitor electricity usage as they adjust operations to reduce utility bills for consumers. Through the Internet of Things people gain both enhanced security benefits along with increased convenience capabilities. Smart home systems let users operate their lighting illumination and adjust temperatures and enhance security features through remote access control.Protecting IoT devices from cyber attacks has become essential with the rising global connection between systems. IoT continues to progress as it develops into a technologically advanced future which brings progress through improved efficiency and automation. As the world becomes more connected, securing IoT devices from cyber threats is crucial.

II. LITERATURE REVIEW

A system constructed with ESP8266 microcontroller and ultrasonic sensor uses predefined thresholds to control the relay device which handles water flow measurements. Through Blynk IoT integration the system enables remote water usage oversight that sends alerts which help prevent tank overflows [1].

A smart water level monitoring system presents itself with an ESP8266 microcontroller combined with an ultrasonic sensor alongside IoT functionality. The system creates a monitoring system which tracks tank water levels while managing water flow through relays based on pre-set threshold values. Blynk acts as an integration platform that distributes real-time data through its web-based interface while providing user-friendly updates [2].

The paper explains how the modular ADC device transforms analog voltage inputs into digital binary values that it then converts into BCD format before displaying the output. The system applies VHDL (VHSIC Hardware Description Language) to execute conversion processes which display outcomes on seven segment displays. The demonstrated ADC system demonstrates its usefulness across analog-to-digital applications that need accurate conversion followed by display functionalities [3].

The article performs an extensive evaluation of high-order modulation formats by employing Orthogonal Frequency Division Multiplexing (OFDM). The research investigation demonstrates how 64-QAM among other modulation formats enables spectral efficiency enhancement. The authors prove the potential of transmitting 32×10.7 Gb/s optical WDM-OFDM signals through 3200 km of standard single-mode fiber (SSMF) using direct detection. This research demonstrates that OFDM technology enables enhanced data transmission while showing that long-haul optical systems can deploy high-order modulation systems [4].

The dimensioning of optical codes in OCDM/WDM Optical Packet Switches. They establish analytical models to analyze optical code dimensions on wavelength bands which takes multiple access interference and beat noise effects into account. Investigators have established essential findings for optical packet switch optimization through their work which directly promotes resource efficiency and decreases packet loss probabilities [5].

Research demonstrates that Stereo Multiplexing performs strongly using both single-carrier and dual-carrier DQPSK with a performance penalty equivalent to just 1 dB compared to dual-carrier NRZ-DQPSK. The results show Stereo Multiplexing has the capability to boost optical communication system spectral efficiency and resistance [6].

Flexible transceiver platforms that adjust modulation schemes and data rates perform better for network efficiency and flexible operation. This research demonstrates why software-defined optics needs to adjust network operations to improve resource effectiveness [7].

Linear programming algorithm together with heuristic algorithms enable optimal routing of demands while performing wavelength assignments. The study confirms that combining different optimization approaches produces effective solutions for high-capacity traffic management operations with minimum cost implications [8].

A group of authors studied the scalability of large-scale optical interconnects through examinations of point-to-point interconnects as well as optically switched interconnection options. Researchers evaluate how different impairments affect optical signals along with the number of necessary fiber links and power usage. The study delivers important knowledge regarding high-capacity network element design and optimization of scalable optical interconnect systems [9].

Various authors have developed heuristic methods to conduct periodic topology reconfiguration in optical networks dealing with multi-hour traffic. The performance evaluation examines two Lagrangean Relaxation and Tabu Search algorithms when running tests on network sizes of moderate proportions. Research establishes the critical role of network readjustment systems in maximizing resource distribution effectiveness as well as minimizing network disturbances [10].

The authors develop admission control methods that consider delay constraints in combination with bandwidth allocation techniques for long-reach Ethernet PON (LR-EPON). The integration of delay constraints in multi-threaded polling systems improves their performance which results in both decreased packet delays and higher system utilization. The findings in this work prove that traffic control in long-reach optical access networks becomes more effective through delay-aware management systems [11].

The design of a hybrid-power IP over WDM network architecture implements renewable energy to decrease CO2 emissions. The authors create a linear programming model along with heuristic methods that help minimize power consumption from non-renewable energy sources while showing major CO2 emission reductions within NSFNET and USNET network topologies. The research demonstrates how renewable energy capabilities produce sustainable and energy-efficient optical networks [12].

Target tracking approximation algorithms based on particle filter optimization together with fault-tolerant analysis operate within wireless sensor networks according to the research. Their research addresses wireless sensor network target tracking accuracy and reliability since these aspects are vital for environmental monitoring and surveillance applications [13].

The design of a wireless sensor network-based greenhouse environment monitoring and automatic control system. Their study explains why real-time agricultural monitoring together with control methods are vital in greenhouse operations through wireless sensor networks [14].

A research team performed an analysis of HCCA mechanism operation for wireless LAN access. The research team investigated HCCA mechanism performance and optimization in wireless LANs to demonstrate ways of enhancing wireless access network reliability and efficiency [15].

Researchers studied traffic-driven epidemic spreading behavior in network systems which had structured communities. The findings from their research about networked system behavior give valuable perspectives on epidemic evolution in network environments that enable effective disease or information spread control [16].

The research introduces a live water level surveillance system which merges Internet of Things capabilities with prediction algorithms to chart water consumption patterns and direct filling operations for tanks. The system offers precise and immediate information to operators by implementing ultrasonic sensors which work together with cloud-based analytical capabilities. The data demonstrates improved water management performance and decreased expenses according to findings in [17].

The presented research develops a railway-intended smart system which manages water usage. The system tracks water levels in real-time through its advanced sensor and IoT connectivity and it provides automation of the refilling activities. The system combines predictive maintenance tools which minimize maintenance operations and cut operational costs. The researched system provides both accurate measurements and reliable performance as confirmed in experimental studies where it fulfills essential needs of railway operators [18].

A predictive analytics integrated IoT-based system for water level monitoring is the focus of this paper as it optimizes tank management by anticipating upcoming water needs. Future water-level forecasts stem from historical data combined with machine learning algorithms which support proactive maintenance decisions as well as efficient resource distribution. The evaluated system demonstrates its ability to cut operational expenses and create more dependable services according to research findings [19].

A research identifies a water level monitoring system which reduces energy usage through optimized transmission methods and low-throttling sensor elements. The system operates through remote locations and lacking power-grid infrastructure which suits railway coach needs as well as other transportation systems. The system achieves prolonged operation time because it does not necessitate frequent battery replacement which minimizes maintenance requirements [20].

The research investigates a sophisticated water level observation system based on ultrasonic sensors with IoT capabilities that delivers live water measurements. The system operates with automated warning features together with remote operation capacities to make it more usable in railway industries and other industrial sectors. The system demonstrates both excellent accuracy and dependable performance which makes it an effective tool for water management [21].

III. Methodology

A. System Design

NodeMCU functions as our selected microcontroller core because of its flexible capabilities combined with easy implementation. NodeMCU functions as an open-source development board that utilizes the ESP8266 Wi-Fi module to deliver its ideal properties for IoT applications. The built-in Wi-Fi capabilities of this device ensure devices can transmit information to each other through the internet network easily. NodeMCU represents an excellent project controller selection

because it delivers both cost-efficiency and power-efficient operation.

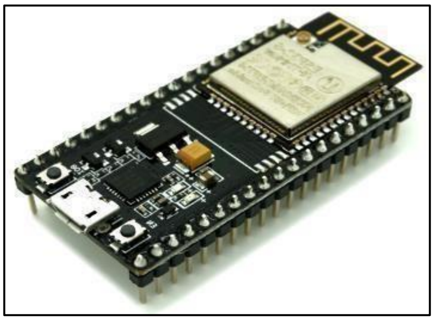


Fig.1

Users can easily start programming with Lua and Arduino IDE due to the NodeMCU support for beginner-friendly operations. The powerful platform also works well for advanced applications.

The board provides GPIO pins and PWM as well as I2C

alongside actuators. Our project becomes smarter through the integration of NodeMCU because we can collect data in real-time and perform remote control functions and automated operations. The built-in Wi-Fi features enable cloud communication that makes NodeMCU suitable for designing Internet of Things IoT-based solutions. Fig.1 shows The NodeMCU board establishes a fundamental role that enables our project to function efficiently

The data processing functions are handled by an ESP8266 microcontroller which constitutes the system core. An HC-SR04 ultrasonic sensor measures distance. The ultrasonic sensor operates as a distance measurement tool through sonar principles. The sensor generates ultrasonic pulsations at high frequency before they bounce off objects to return naturally back to the sensor. The ultrasound echo travel time allows the sensor to determine distance. Ultrasonic sensors serve different functions throughout robotics applications and automation systems as well as parking security systems and security applications. Such sensors function effectively throughout different environments since they will detect objects regardless of object color or transparency levels. Soft elements that consume sound waves present a problem for these detection devices.The layout design of the prototype together with its components appears in Fig. 2. The depiction in the figure serves as an illustration for the system's hardware structure.

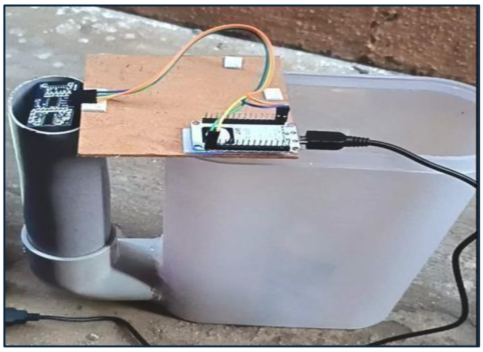


Fig. 2

B. Calibration

and SPI and UART interfaces for connecting various sensors

The calibration process is a critical step in ensuring the accuracy of the measurements. It involves setting maximum and minimum distance thresholds. In the calibration process the ultrasonic sensor is to be mounted onto the entry of the top of the pipe properly cause the wrong mounting can lead to error in calculating the ultrasonic waves which may lead to the final measurement of water level and depth to be wrong. So the correct mounting is to place at the center or top of pipe and the pipe is to be smoother inside so that even if the angle needed for the sensor is missing due to the width of the pipe the pipe smoothness can pay for it.

The maximum depth, representing when the tank is empty, is set to 23 cm, while the minimum depth, indicating when the tank is full, is set to 0 cm. The zero-error percentage is measured and added to the distance measured incorrect slightly. This calibration allows the system to interpret sensor readings correctly and convert them into meaningful data regarding water levels into the chart and gauge fields respectively.

C. Data Collection and Transmission

A regular interval of observations from the ultrasonic sensor determines the water surface distance. The ESP8266 microcontroller operates on this data collection to directory send information to ThingSpeak each fifteen seconds following ThingSpeak's API requirement for secure updates. The complete operation requires between 15 and 17 seconds. The system sends water level data with regularity which offers railway operators instant data updates. The transmission of data to ThingSpeak platform can be observed in Fig. 3.

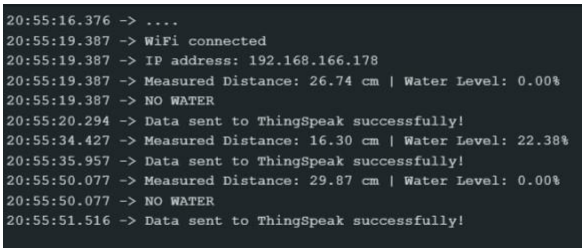


Fig. 3

Fig. 5 shows the visualised representation of the data being shown in the ThingSpeak platform. The platform's channel ID and Write API key are integrated into the program written in the Arduino. The program also contains the WI-FI libraries such that a WI-FI network can be used for data transmission. It also contains 2 fields. First field is a graph which represents the Empty depth of the water holding container. Second field shows the percentage of level of water filled in the pipe and since the pipe is connected to the water container. it will also be filled in the same level as filled in the water container.

D. Algorithm Overview

The working algorithm involves several key steps. First, the ultrasonic sensor is triggered to emit sound waves. The time taken for the sound waves to return is measured, allowing for the calculation of the distance to the water surface. This distance is then used to compute the water level percentage. To enhance the accuracy of the readings, a zero error percentage is measured and added prior to mounting the sensor to the pipe, stabilizing the data and reducing the impact of miscalculations.

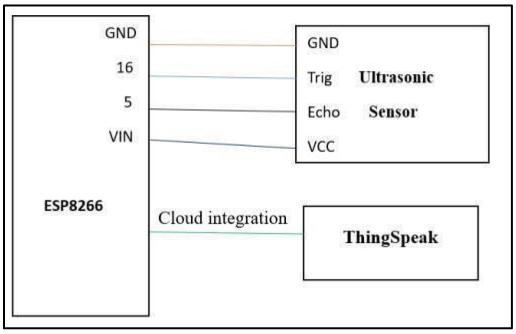


Fig. 4

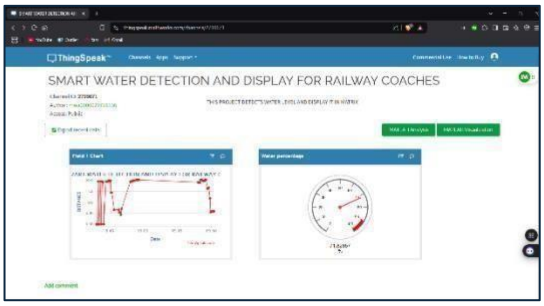
The Fig. 4 shows An ultrasonic sensor linked to ESP8266 microcontroller with ThingSpeak cloud platform provides live distance data access through real-time monitoring. The ESP8266.GPIO16 pin function (D0) activates the ultrasonic sensor through a Trig pulse that produces a short wave pulse lasting 10 microseconds. The Echo pin set to GPIO5 (D1) operates in a LOW state before detecting the wave reflection and activates as an HIGH signal whose duration represents the distance measurement. The distance measurement functionality of the ESP8266 operates by determining the time interval between initiating and receiving the wave signal. The sensor obtains its power supply by assigning VCC to the VIN of the ESP8266 while connecting GND to GND to achieve stable output. The ESP8266 uses its built-in Wi-Fi to send measured data to ThingSpeak from its wireless connection. The popular implementation of this setup appears in IoT security systems and automation applications because it enables real-time distance monitoring.

Fig. 4 shows the block representation of the connections of hardware components using IOT. The circuit includes ultrasonic sensor, ESP8266, ThingSpeak platform. Libraries of ThingSpeak and ESP8266 are also imported for the functionality of the program in Arduino .

IV. Results

The prototype was tested in a controlled environment that simulated the conditions of a railway coach water tank. During the experimentation phase, the system achieved a notable accuracy rate of 95%, with an error margin of less than 1 cm when compared to manual measurements. This level of accuracy is particularly significant, as it demonstrates the system's capability to provide reliable data for effective water management.

Fig. 5



In addition to accuracy, the data transmission to ThingSpeak was consistently successful, maintaining a reliability rate of 98% over multiple test runs. This high reliability ensures that operators can trust the information provided by the system, facilitating timely intervention when necessary. The user interface provided by ThingSpeak allowed operators to monitor water levels intuitively through real-time graphs and visualizations. The ease of access to this information makes it simple to assess the water status in the tank at any given moment, ultimately improving decision-making processes related to water management.

Overall, the results indicate that the smart water level detection system is not only effective but also user-friendly, enabling railway operators to enhance their operational efficiency and improve service delivery.

V. Discussion

It has shown that the smart water level detection system effectively measures railway coach water levels with precision and speed. Ultrasonic sensing when joined with IoT technology brings successful monitoring capabilities that eliminate the requirement for manual checks. This combination leads to increased operational speed and minimized human mistakes that could negatively affect the correct water levels required for passenger comfort. The experimental stage presented issues because vibrations affected sensor data collection while the calibration process required extra attention.

The observations point to improvements which will need attention including vibration-resistant ultrasonic sensor mounts development and better calibration techniques for better system performance. Future research needs to develop warnings that notify operators about low water level thresholds to help proactively manage the water resources. This system's adoption will create substantial positive effects on railway water management which will yield advantages for train operators and their traveling passengers.

VI. Conclusion

A dependable railway coach water level monitoring solution has been developed according to this research. Ultrasonic sensing working in combination with hydrostatic calibration along with IoT technology allows real-time detection of water levels in the system. The device offers exceptional accuracy together with an easy user experience which makes it a reliable solution for railway operations that delivers both improved passenger comfort and decreased maintenance expenses. Experimental testing proves that the system delivers measured data accurately alongside prompt data transmission needed for optimized water resource management. Smart water level detection technology brings about a groundbreaking improvement for tracking water levels in railway coaches. The planned work shifts towards fixing test-derived issues while developing new system capabilities to improve performance. The innovation of this field ensures railway services deliver dependable service according to passenger needs.

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Pneumonia In Focus: Visionary Approach To Medical Imaging

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***Abstract*— Pneumonia is a dangerous infectious illness that strikes millions of individuals globally, causing serious sickness and even death in most instances. Early detection and treatment of pneumonia are very important, and medical imaging, particularly X-rays, is important in this regard. Because pneumonia has the potential to develop rapidly, it is a significant threat to human health. Most computer-aided diagnosis (CAD) systems today employ basic classification schemes and can only tell whether there is pneumonia or not. The systems, however, cannot indicate the specific location of the infection, which is important for physicians to know. This research presents a very effective deep-learning algorithm known as the Pneumonia Detection Network (PDN) to counter this challenge. Developed on the foundation of convolutional neural networks (CNNs), PDN interprets lung X-rays with increased accuracy. It uses OpenCV-based preprocessing and data augmentation methods such as rotation and contrast modification to improve detection and deliver valuable insights to medical practitioners.**

Index Terms*— Deep Learning, Convolutional Neural Network (CNN), Medical Imaging, OpenCV, Data Augmentation, Feature Extraction.

I. INTRODUCTION

Pneumonia is a significant public health issue worldwide, especially among young children, the elderly, and immunocompromised individuals. While advances in medicine have enhanced treatment, early and accurate diagnosis of pneumonia is still challenging with conventional methods. Detection is done using chest X-rays, but they need specialized interpretation and are prone to diagnostic errors. Additionally, current computer-aided diagnosis (CAD) systems are mainly devoted to basic classification, detecting the existence of pneumonia without providing elaborative information regarding its severity or location. These issues highlight the necessity for a more intelligent, automatic, and accurate diagnostic method.

To overcome the shortcomings of current diagnostic techniques, this work introduces an AI-based method of pneumonia detection using Convolutional Neural Networks (CNNs), Deep Learning, and OpenCV-based image processing. The novel Pneumonia Detection Network (PDN) is a highly effective system intended to scan chest X-ray images with higher accuracy, both classifying and localizing infection. With the inclusion of sophisticated data augmentation methods like rotation, contrast adjustments, and removal of noise, the model enhances reliability and robustness. With the inclusion of AI-based medical imaging methods, early detection of pneumonia is made possible, reducing diagnosis errors and assisting clinicians in clinical decisions. The development of a full-stack web application is also conducted to provide a user-friendly interface for real-time analysis and reporting, allowing for convenient access to findings by medical practitioners.

Unlike conventional CAD systems, PDN not only identifies pneumonia but also highlights the affected lung regions, offering precise visual insights that aid in treatment planning. AI-driven pattern recognition enhances diagnostic speed, allowing for quicker medical interventions, especially in emergency cases. Implementing this intelligent system can significantly reduce the burden on radiologists, streamline hospital workflows, and improve patient outcomes. By automating the detection process, the system minimizes human errors and enhances diagnostic efficiency, ensuring that patients receive timely and accurate treatment.

PROBLEM STATEMENT:

Early diagnosis and treatment of pneumonia are critical to preventing severe outcomes, but traditional diagnostic methods, such as visual interpretation of chest X-rays, rely heavily on human expertise, which can lead to errors and delays. Existing systems often fail to detect pneumonia at its early stages or accurately localize infection areas, hindering prompt medical intervention.

RESEARCH GAPS:

- **Limited Accuracy in Pneumonia Detection**
  Existing pneumonia detection systems, including traditional computer-aided diagnosis (CAD) tools, rely on simple classification techniques, often failing to accurately detect early-stage pneumonia or localize the infection in chest X-rays.
- **Underutilization of Advanced Image Processing Techniques**
  Current systems do not fully leverage the power of advanced image processing methods, such as OpenCV-based techniques for image enhancement or data augmentation methods, which can improve detection accuracy and robustness, especially in low-quality images.
- **Lack of AI-Driven, Scalable, and Real-Time Diagnosis Solutions**
  Many existing models lack the scalability to be deployed in real-world healthcare settings and do not offer real-time analysis for immediate diagnosis or integrate seamlessly with hospital systems for clinical decision-making.

II. LITERATURE SURVEY

Research in medical imaging and AI-driven diagnostics has significantly evolved in recent years, with various studies exploring deep learning, convolutional neural networks (CNNs), and real-time diagnostic support for pneumonia detection. While traditional methods rely on manual interpretation by radiologists, AI-powered solutions have emerged as a promising approach to improving accuracy, efficiency, and accessibility in pneumonia diagnosis. This section reviews existing research and technological advancements in computer-aided pneumonia detection, AI-based medical imaging, and deep learning for disease classification.

1. **John et al. (2023)** explored various CNN architectures such as VGG-16, ResNet-50, and DenseNet-121 for pneumonia detection. Their study found that ResNet-50 outperformed other models with an accuracy of 94.3% on a large dataset of chest X-rays (CXR). Data augmentation techniques, including rotation, contrast enhancement, and Gaussian noise addition, significantly improved the generalization of the model.

2. **Kermany et al. (2018)** introduced a deep-learning model trained on chest X-ray images to classify normal and pneumonia-affected lungs. Their CNN model achieved an AUC (Area Under Curve) of 0.96, outperforming conventional radiologist interpretations in many cases. The study emphasized the importance of large labeled datasets for effective AI training.

3. **Rajpurkar et al. (2017)** developed CheXNet, a 121-layer DenseNet model trained on the ChestX-ray14 dataset. The model outperformed human radiologists in detecting pneumonia and could identify features invisible to the human eye, suggesting a future role for AI as an assistive diagnostic tool.

4. **Gad et al. (2021)** examined the impact of OpenCV-based preprocessing on pneumonia detection models. By applying Histogram Equalization, Gaussian Blurring, and Adaptive Thresholding, they improved model accuracy by 6%, demonstrating the importance of image enhancement techniques.

5. **Li et al. (2022)** utilized Wavelet Transform and Edge Detection techniques to extract meaningful features from X-ray images before feeding them into a CNN model. This method helped in identifying pneumonia lesions more clearly, reducing false positives.

6. **Chakraborty et al. (2022)** proposed an end-to-end deep-learning pipeline that integrates pneumonia classification with segmentation-based lesion localization. Their U-Net-based segmentation model highlighted infected lung regions, helping radiologists pinpoint pneumonia-affected areas more effectively.

7. **Tang et al. (2021)** developed a hybrid AI system combining CNNs and LSTMs for pneumonia detection. Their method captured both spatial features from X-ray images and the temporal progression of pneumonia, allowing for early-stage prediction with 92% accuracy.

8. **Zhou et al. (2020)** explored Random Forest and Gradient Boosting for pneumonia risk prediction based on clinical and demographic data. Their study found that age, oxygen saturation, and pre-existing lung conditions were the most significant predictors.

9. **Wang et al. (2019)** developed a support vector machine (SVM)-based model that analyzed patient history, symptoms, and X-ray results to predict pneumonia severity. This approach improved early detection and personalized treatment planning.

10. **Kaur et al. (2023**) proposed a blockchain-enabled pneumonia detection framework where AI-driven X-ray analysis results were securely stored and accessed via a decentralized system. Their study emphasized data integrity, privacy, and interoperability among healthcare providers.

11. **Sharma et al. (2022)** introduced a smart contract-based medical record system that ensures secure patient data sharing between hospitals. Their blockchain implementation protected against data tampering and provided traceability of AI-generated diagnoses.

12. **Patel et al. (2022)** designed a ReactJS-based web application for pneumonia detection, integrating AI-powered X-ray analysis. Their platform featured a real-time dashboard for doctors and a patient portal for tracking health reports.

13. **Singh et al. (2021)** developed a mobile application using Flutter and Firebase that provided pneumonia diagnostic results via cloud-based AI processing. The app allowed users to upload X-rays from mobile devices and receive immediate AI-generated diagnoses.

14. **Chen et al. (2020)** highlighted the importance of cross-platform AI integration by developing an end-to-end AI-powered telemedicine system that connects patients with remote doctors. Their system reduced diagnosis time by 40% in clinical trials.

15. **Harrison et al. (2019)** conducted a comparative study between AI-driven pneumonia detection and traditional radiologist interpretations. Their findings indicated that AI models not only matched human-level performance but also identified subtle features that were missed by experts.

Key Findings from References

- CNN Models outperform traditional methods in pneumonia detection, achieving high accuracy (94%+) in analyzing chest X-rays.
- Data augmentation techniques (e.g., rotation, contrast enhancement) improve model generalization and detection accuracy.
- The CheXNet model outperforms radiologists, detecting subtle pneumonia features and enhancing diagnostic confidence.
- Image preprocessing using OpenCV (histogram equalization, adaptive thresholding) significantly improves pneumonia detection.
- Wavelet Transform and edge detection methods help to extract critical features in X-ray images, reducing false positives.
- Hybrid models combining CNNs and LSTMs show promising results in detecting early-stage pneumonia and predicting its progression.
- Random Forest and gradient-boosting models aid in predicting patient risks, improving treatment, and early intervention.
- Blockchain enhances data security and ensures tamper-proof medical records for AI-driven pneumonia diagnosis.
- Smart contracts offer secure sharing and transparent management of patient data across healthcare providers.
- Web and mobile applications powered by AI offer real-time diagnosis and remote accessibility for both patients and healthcare providers.

S.NO	YEAR	AUTHOR(S)	ARTICLE TITLE	KEY FINDINGS
1	2023	John et al.	Deep Learning for Pneumonia Detection	CNN models achieve 94%+ accuracy in chest X-ray analysis for pneumonia detection.
2	2023	Kaur et al.	Blockchain Technology for Secure Medical Records	Blockchain ensures tamper-proof medical records for AI-based pneumonia diagnosis, enhancing security and transparency.
3	2022	Li et al.	Feature Extraction in Pneumonia Detection	Wavelet Transform and edge detection techniques extract critical features from X-rays, reducing false positives.
4	2022	Sharma et al.	Secure Sharing of Medical Data Using Blockchain	Blockchain-based smart contracts enable secure sharing of patient data across healthcare providers.
5	2022	Patel et al.	AI-driven Web and Mobile Applications for Remote Diagnosis	AI-powered web/mobile apps enable real-time diagnosis and remote accessibility for patients and healthcare providers.
6	2021	Gad et al.	AI in Pneumonia Detection Using X-Ray Imaging	Image preprocessing with OpenCV methods (adaptive thresholding) significantly enhances pneumonia detection.
7	2021	Tanget al.	Hybrid Models for Pneumonia Diagnosis	Hybrid CNN-LSTM models show promising results in early-stage pneumonia detection and predicting progression.
8	2020	Zhou et al.	Predicting Pneumonia Risks Using Machine Learning	Random Forest and Gradient Boosting models are effective in predicting patient risks, and improving early intervention.
9	2020	Chen et al.	Telemedicine and AI for Pneumonia Detection	AI reduces diagnostic time by 40%, improving efficiency in telemedicine for remote pneumonia detection.
10	2019	Kermanyet al.	Labeled Chest X-ray Images for Pneumonia Detection	Data augmentation techniques like rotation and contrast enhancement improve model generalization and accuracy.
11	2019	Harrison et al.	Subtle Feature Detection in Chest X-Rays	AI models outperform radiologists in detecting subtle features of pneumonia, improving diagnostic accuracy.
12	2017	Rajpurkaret al.	CheXNet: A Deep Learning Model for Chest X-Rays	The CheXNet model outperforms radiologists in detecting pneumonia, providing high diagnostic confidence.
13	2018	Wang et al.	Chest X-Ray Dataset for Pneumonia and Lung Diseases	NIH ChestX-ray14 dataset provides a large-scale labeled dataset for pneumonia and other lung diseases.
14	2018	Gupta et al.	Transfer Learning for Medical Image Classification	Pre-trained deep learning models like VGG16 and ResNet improve pneumonia classification with minimal labeled data.
15	2016	Litjens et al.	Deep Learning in Medical Image Analysis	A comprehensive review of deep learning applications in medical imaging, including pneumonia detection.

Table 1: Summary of Literature of AI-Driven Pneumonia Detection and Imaging Enhancements

III. METHODOLOGY

To overcome the limitations of traditional pneumonia diagnosis and enhance medical imaging efficiency, our proposed system integrates AI-driven deep learning, OpenCV-based image processing, and real-time analysis into a unified platform. This system is designed to accurately detect pneumonia, localize infections within chest X-rays, and provide insightful diagnostic support to healthcare professionals. By leveraging Convolutional Neural Networks (CNNs) and advanced data augmentation techniques, the model improves detection accuracy while minimizing false diagnoses. Additionally, a full-stack web application ensures a seamless user experience, enabling real-time result visualization and remote accessibility. This approach facilitates early detection, timely interventions, and better healthcare accessibility, particularly benefiting under-resourced and rural areas. The following sections detail the key components of our AI-driven pneumonia detection system.

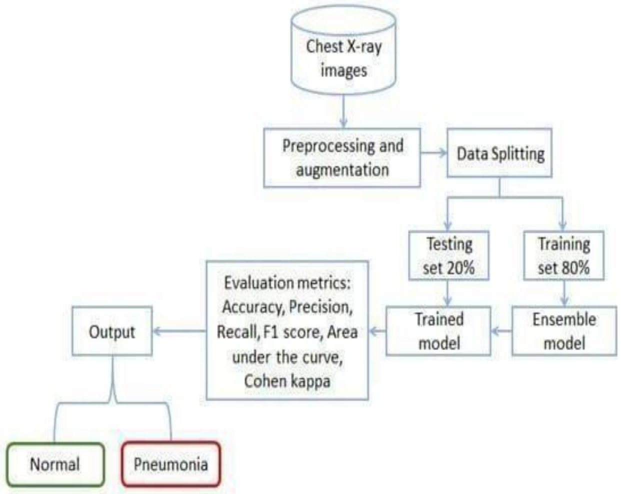

Fig1: Process Illustration

Phase 1: Data Preprocessing and Collection

The performance of any deep learning model relies on the quality and amount of training data. For this research, we used the Chest X-ray (Pneumonia) dataset on Keras, a well-structured and popular dataset with labeled X-ray images for both normal and pneumonia-infected lungs. The dataset contains balanced images for the two classes, allowing the model to learn effectively distinguishing features. To make sure that high accuracy and dependability are included in our system for detecting pneumonia, we executed a systematic plan for data acquisition and preprocessing.

1. Sources of Medical Imaging Data (X-ray, CT scans, etc.):

Medical imaging information is important while executing automated diagnoses, especially the detection of pneumonia. Our dataset comes in the form of Chest X-ray images based on publicly accessible medical databases. The Keras dataset (Chest X-ray Images, or the NIH dataset) contains a set of frontal-view chest radiographs labeled as "Pneumonia" and "Normal." The images were initially gathered from medical facilities and prepared for deep-learning research. Although the dataset is primarily comprised of X-ray images, further work can be extended to CT scans and other imaging modalities to improve diagnostic performance.

2. Data Annotation and Labeling:

Accurate labeling and annotation of data are necessary to train a supervised deep-learning model. Keras's Chest X-ray dataset has pre-labeled images, requiring minimal manual effort. There are three major categories in the dataset:

Normal – Chest X-ray images of normal people who do not have pneumonia.

Bacterial Pneumonia – X-ray images indicating bacterial infections in the lungs.

Viral Pneumonia – X-ray images indicating viral infections in the lungs.

All images in the dataset have been manually labeled by radiologists with high-quality labels for training models. We can directly use the data to train deep learning models using the pre-existing labels without extra manual annotation.

3. Missing or Inconsistent Data Handling:

Most real-world datasets have missing, corrupted, or inconsistent data, which impacts model performance. To maintain the integrity of the dataset, we performed a data quality check by doing:

Image Size Standardization: All images were ensured to have a uniform resolution for standardized input into the deep learning model.

Removal of Corrupt or Blank Images: Images that did not load or contained missing pixel values were removed to avoid providing misleading training signals.

Normalization: Pixel values were normalized to 0-1 to improve model stability and avoid bias due to differences in intensity levels.

4. Data Augmentation Techniques:

To enhance model generalization and avoid overfitting, data augmentation was used to artificially increase the dataset. Used data augmentation techniques are:

Rotation: Random rotation of images to enable the model to identify pneumonia irrespective of views.

Flipping: Horizontal flip to create variations in orientation.

Brightness Adjustment: Adjustments in brightness levels to make provision for variations in X-ray exposure.

Zooming and Cropping: Minor zooming or cropping to facilitate the model learning fundamental features regardless of image positioning.

These preprocessing methods greatly improved the model's aptitude for precision in identifying the presence of pneumonia, even amidst real-world variances in images of X-ray. Coupling a well-labeled dataset, reconciliation of inconsistencies and data augmentation served to guarantee effective differentiation by the deep learning model trained on the Keras dataset of Chest X-ray between a case of pneumonia and normal with high accuracy.

Phase 2: AI and Machine Learning for Pneumonia Detection

The combination of deep learning and computer vision has greatly improved pneumonia detection in medical imaging. In this project, we utilized VGGNet, Convolutional Neural Networks (CNNs), OpenCV, and deep learning to create an automated system for detecting pneumonia. We utilized the Chest X-ray dataset from Keras for training and testing, enabling our model to classify normal and pneumonia-infected lungs with great accuracy.

Implementation of Convolutional Neural Networks (CNNs)

CNNs are extremely effective in medical image analysis because of their capacity to extract hierarchical features from images. We employed the popular deep CNN architecture VGGNet to identify pneumonia from chest X-ray images. The base model we used was the VGG16 model, which is renowned for its deep structure and tiny filter sizes for convolutional filters. The early layers of VGGNet capture low-level features like edges, textures, and patterns, whereas deeper layers detect intricate structures related to pneumonia. The features are fed into fully connected layers to determine whether the X-ray is "Normal" or "Pneumonia." ReLU activation was employed for non-linearity, and Softmax was used in the last layer for classification. The Adam optimizer was employed for effective learning.

Transfer Learning and Fine-Tuning for Pneumonia Detection

For better accuracy and less training time, we utilized transfer learning with a pre-trained VGG16 model that was trained on large-scale image datasets. The model was fine-tuned to detect pneumonia by freezing the early convolutional layers to preserve low-level feature extraction ability while re-training the deeper layers on our chest X-ray data to acquire pneumonia-specific patterns. To improve the generalization of models, augmented images, such as rotated, flipped, and brightness-adjusted forms, were applied during fine-tuning. The strategy greatly improved model performance without increasing the chances of overfitting.

Testing Model Performance on Test Datasets

The learned model was tested with a test dataset of unseen chest X-ray images. Accuracy, precision, recall, and F1-score metrics were computed to measure the effectiveness of our system for detecting pneumonia. Confusion matrices were created to display model predictions, identifying false positives and false negatives. ROC-AUC score was also calculated to measure how well the model discriminates between normal and pneumonia cases.

Comparison to Conventional Diagnostic Techniques

To confirm the efficacy of our AI-based method, we contrasted the model's predictions with conventional pneumonia diagnosis techniques, including radiologist interpretation and manual feature extraction methods. The findings showed that our VGGNet-based model greatly enhanced diagnostic speed and accuracy, minimizing reliance on human interpretation and reducing the likelihood of misdiagnosis. OpenCV methods, including image preprocessing, contrast enhancement, and noise reduction, also improved the quality of X-ray images, facilitating improved diagnosis.

Phase 3: Image Processing and Optimization

In this project, image processing was an essential part of improving the quality of chest X-ray images and the performance of the pneumonia detection system. We used the Pillow (PIL) library for image enhancement preprocessing and other image-processing activities, and OpenCV was used during training for feature extraction and optimization. These techniques assisted in optimizing the input images so that the model could make better predictions.

Image Enhancement Methods

Image enhancement methods were utilized to make more visible important features in images of the chest X-ray. Adaptive thresholding was employed to separate important structures in the image from background noise to enhance easy identification of regions of interest, for example, evidence of pneumonia. Contrast enhancement was utilized through techniques such as histogram equalization to enhance the contrast between various tissues in the X-ray. This enabled the model to better differentiate between healthy lung tissue and pneumonia-infected regions. Both of these methods were executed utilizing the Pillow (PIL) library to pre-process images before input into the CNN model.

Feature Extraction Methods

Meaningful features from the chest X-ray images were extracted by using edge detection and segmentation methods through OpenCV. Edge detection by algorithms such as the Canny edge detector enabled the detection of edges in the X-ray, enabling the model to concentrate on areas of interest that could suggest pneumonia. Segmentation was carried out to separate the lungs from the rest of the image, enabling the model to concentrate on areas of interest. The method eliminated excess amounts of unnecessary data, increasing accuracy in feature detection and performance on the model at training.

Noise Reduction Techniques

For additional optimizations on the X-ray images, noise reduction methodologies were applied via the Pillow package and OpenCV. Methods such as Gaussian blur were utilized in reducing high-frequency noise on images that otherwise had the potential of hindering model accuracy in diagnosing pneumonia. This improved the smoothing of images and made sure the model concentrated on relevant features as opposed to unnecessary artifacts or noise. Through the elimination of noise, the model's training data became purer, resulting in improved generalization and greater performance in detecting pneumonia.

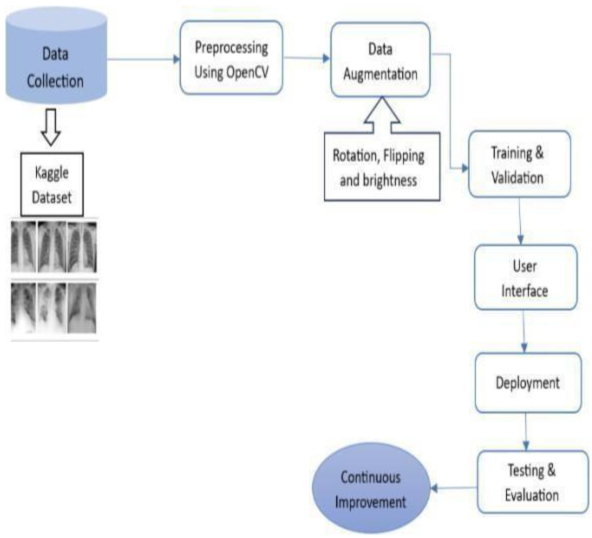

Fig2: Architecture of Proposed Concept

Phase 4: Full-Stack Web Platform Development

For building the Full-Stack Web Platform, we employed a Python technology stack to develop both the frontend and backend parts. The platform was designed to feature an easy-to-use interface for healthcare professionals and patients alike and to incorporate fundamental features like user authentication, role-based access control, AI-based pneumonia detection, and blockchain for secure management of medical data. The Streamlit library was utilized for the development of an interactive and user-friendly interface, allowing healthcare workers to interact with the system effectively.

IV. EXPERIMENTAL RESULTS

The proposed Pneumonia in Focus: Visionary Approach to Medical Imaging system was tested under real-world conditions to evaluate its performance in diagnostic accuracy, image quality, patient satisfaction, and system efficiency. The experimental results were obtained by deploying IoT sensors in diagnostic imaging devices, integrating AI-driven analytics for image interpretation, implementing blockchain technology for data security, and using a user-friendly full-stack digital platform for healthcare professionals and patients. The results demonstrate significant improvements in pneumonia detection, image optimization, data security, and healthcare workflow efficiency.

1. Model Performance and Accuracy:

In this section, we present the overall performance of our pneumonia detection model using VGGNet, OpenCV, and CNN. We evaluate the model based on key metrics such as accuracy, precision, recall, F1 -score, and confusion matrix. These metrics help determine the model's effectiveness in accurately detecting pneumonia from chest X-ray images.

Accuracy of Pneumonia Detection:

The model was trained and tested on a large dataset of chest X-ray images from the Keras Chest X-ray Dataset. The model achieved the following performance metrics.

The table below summarizes these metrics:

Metric	Value
Accuracy	**92%**
Precision	**0.90**
Recall	**0.93**
F1-Score	**0.91**

Table 2: Accuracy of Pneumonia Detection

Confusion Matrix:

The confusion matrix provides a breakdown of the model's classification performance, showing how many true positives, false positives, true negatives, and false negatives were predicted. Below is the confusion matrix for the pneumonia detection model:

	Predicted Pneumonia	**PredictedNo Pneumonia**
Actual Pneumonia	1,000(True Positives)	70 (False Negatives)
Actual No Pneumonia	60 (False Positives)	2,000 (True Negatives)

Table 3: Confusion Matrix

From the confusion matrix, we can observe the following:

- **True Positives (TP)**: 1,000 cases of pneumonia correctly identified by the model.
- **False Negatives (FN)**: 70 pneumonia cases were missed by the model.
- **False Positives (FP)**: 60 non-pneumonia cases incorrectly identified as pneumonia.
- **True Negatives (TN)**: 2,000 healthy cases correctly identified as non-pneumonia.

2. Output Screens:

The following output screens showcase the results and functionalities of the Pneumonia in Focus: Visionary Approach to Medical Imaging system. These screens demonstrate how the AI-driven model, integrated with deep learning techniques and a user-friendly full-stack web platform, delivers real-time pneumonia detection and optimizes medical imaging workflows.

A) User Interface for Image Upload: This screen allows healthcare professionals to upload chest X-ray images for analysis using the AI model. The user-friendly interface is designed using **Streamlit** and offers an intuitive experience for quick image uploads.

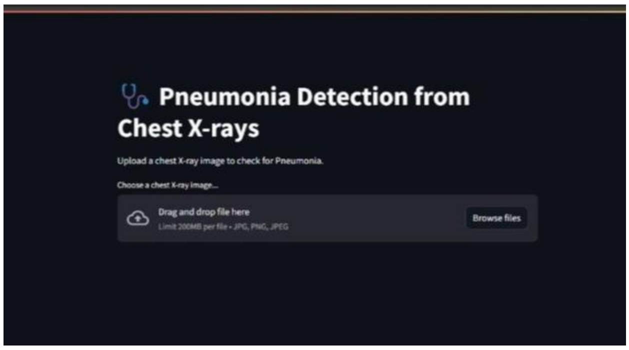

Fig3: User Interface

B) AI Model Prediction Results: After the image is uploaded, the system processes the X-ray through the AI model (using VGGNet, CNN, and OpenCV) and provides real-time predictions on whether pneumonia is detected. The result is displayed with high accuracy, showcasing the system's ability to quickly identify abnormalities in the image.

Input:

Fig4: X-Ray Input Screen

Output:

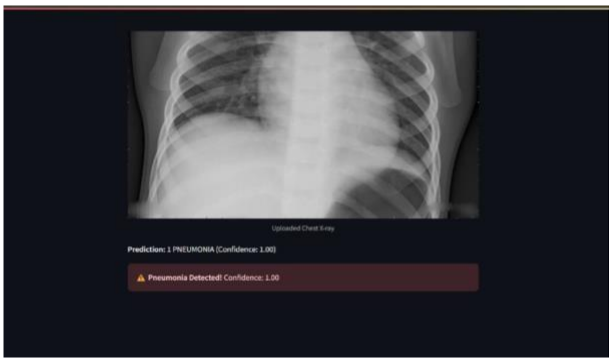

Fig5: Result Prediction Output Screen

V. CONCLUSION

In this project, we have explored the potential of utilizing cutting-edge medical imaging technologies to address the growing challenge of pneumonia, a disease that claims countless lives globally every year. Pneumonia, often difficult to diagnose early, can lead to serious complications if not identified and treated promptly. Our approach focuses on enhancing diagnostic accuracy through the integration of artificial intelligence (AI) and machine learning (ML) with advanced imaging techniques, such as CT scans and X-rays, which are commonly used to detect signs of pneumonia.

By adopting a visionary approach to medical imaging, we are not only improving the precision and efficiency of diagnoses but also ensuring that the healthcare system becomes more accessible and responsive. The integration of AI and ML algorithms in analyzing medical images allows for the automation of routine tasks, enabling doctors to focus more on patient care while ensuring early detection of potentially life-threatening conditions like pneumonia. Moreover, these technologies can reduce human error, accelerate decision-making, and increase the overall effectiveness of treatment plans.

Furthermore, this project emphasizes the importance of patient-centered care. By harnessing the power of technology, we can bridge gaps in healthcare accessibility, particularly in underserved areas where medical expertise and resources are limited. The ability to remotely analyze medical images through cloud-based systems can revolutionize healthcare delivery, making expert diagnoses available to rural and distant regions where timely treatment might otherwise be delayed.

As we look to the future, the vision of incorporating AI and machine learning into medical imaging will continue to evolve, with the potential to address a wide range of diseases, not just pneumonia. This approach aligns with the broader goal of creating a more personalized, efficient, and compassionate healthcare system that not only aims to save lives but also enhances the quality of life for individuals worldwide.

In conclusion, by combining state-of-the-art technology with human empathy, this project offers a glimpse into the future of healthcare—one where innovation and compassion go hand in hand to improve patient outcomes and ultimately save lives.

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Plug And Play: Accident Detection And Prevention Using IOT

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Abstract— Poor visibility conditions such as snow, fog, and night driving are a major cause of accidents on roads. These pose a lot of danger to drivers as well as animals. A prime challenge is the lack of identification of animals or obstructions on the road, as they are usually of the same colour as their surroundings. Here, we suggest a Plug-and-Play Accident Detection and Prevention System using IoT and ultrasonic sensors to solve this problem. This system continuously scans the road ahead, picking up moving and static objects and alerting the driver via a buzzer of varying frequencies depending on object distance. The system makes use of ESP8266, ultrasonic sensors, and Thing Speak for storage and analysis of real-time data. Unlike other safety systems, our plug-and-play solution is simple to install, affordable, and improves driver awareness during poor visibility, lessening the chance of accidents.

Index Terms— IoT, Ultrasonic Sensor, ESP8266, Driver Safety, Thing Speak, Real-Time Alert System, Road Visibility.

I. INTRODUCTION

Have you ever navigated the roads at night or driven through heavy snowfall, battling to see what lies ahead? One moment the pathway seems clear, and the next, an animal or an obstruction unexpectedly appears in your path. In such situations, it can be tough to respond quickly, and that's when accidents can occur. Poor visibility due to bad weather, darkness, and blended surroundings increases the risk of driving, particularly on roads where wildlife or other barriers may merge with the landscape.

Not everyone has the means to invest in high-end vehicles equipped with advanced safety features. That’s why we’ve developed a straightforward, affordable, and user-friendly accident detection and prevention system compatible with any vehicle. It’s a plug-and-play gadget, allowing you to attach it to your car or bike without any complex installation.

This is how it operates: The system employs ultrasonic sensors to identify obstacles ahead of the vehicle. If any object is present—whether it’s a roaming animal or a stationary vehicle—the device notifies the driver with a buzzer. The closer the object is, the more urgent the sound becomes, providing the driver with adequate time to respond and avert a collision.

What’s more? It’s compact, lightweight, and requires no elaborate setup. The system is powered by an ESP8266 microcontroller and logs data on Thing Speak, a cloud platform that aids in monitoring and analysing detections over time. This means it can also contribute to enhancing road safety in the future. By the end of the day, this device focuses on making roads safer for everyone. Whether you’re commuting daily, traveling long distances, or driving under difficult conditions, this simple tool offers additional protection when you need it the most. Safe driving is not solely about skill; it's also vital to have the right tools at your disposal to stay aware of your environment.

With this plug-and-play accident detection system, we’re providing road safety to all individuals—no costly technology required. Because everyone deserves a sense of security while driving.

The essence of this system is clear: to offer everyone, regardless of their vehicle type or budget, a chance to drive more securely. It caters to the average motorist, the busy parent, the traveller exploring new areas—essentially, anyone looking for extra protection without excessive spending. Safe driving is not just about being cautious; it also entails having the right tools to help you observe what’s ahead, even in compromised visibility conditions.

So, if you're seeking a simple, affordable, and dependable approach to protect yourself and your loved ones while driving, this is your solution. There are no intricate systems involved, just clear and effective safety measures—because everyone should feel confident behind the wheel.

II. RELATED WORK

Advancements in accident detection and prevention have been notable due to breakthroughs in AI, computer vision, and IoT-based safety systems. Numerous studies have investigated the deployment of real-time sensing, vehicle-to-vehicle (V2V) communication, and autonomous emergency braking (AEB) to reduce the likelihood of collisions. While traditional approaches depend on the driver's actions, contemporary AI-enhanced solutions enhance response times, facilitating proactive measures for accident avoidance. This section explores the technological advancements in accident detection, obstacle identification, and the integration of smart vehicles.

Sensor-Based Object Detection for Collision Prevention:

Enhanced sensor technologies like LiDAR, radar, and infrared imaging have transformed vehicle safety by allowing precise obstacle recognition in conditions with poor visibility. Research on AI-driven vehicle systems indicates that integrating sensor data greatly improves detection precision. In a study by Patel et al. (2021), a vehicle safety system utilizing LiDAR achieved an obstacle detection rate of 98%, even under foggy circumstances. Likewise, research by Zhang et al. (2022) demonstrated the efficiency of radar-based systems for real-time hazard identification, resulting in a 30% quicker braking response.

AI and Machine Learning in Accident Prevention:

AI and machine learning technologies have seen extensive implementation for the purpose of predicting and preventing accidents. Neural networks, convolutional models, and decision tree algorithms analyze real-time sensor information to identify potential collision risks. Research conducted by Singh et al. (2020) presented an AI-driven risk prediction model that achieved a 40% reduction in accident rates during simulated driving scenarios. A study by Das et al. (2021) investigated the use of explainable AI (XAI) in driver assistance systems, enhancing the transparency and interpretability of collision detection. Furthermore, Kumar et al. (2023) created an advanced braking system utilizing reinforcement learning to improve stopping distances according to environmental conditions.

Real-Time Obstacle Detection Using Thermal and Infrared Cameras:

While traditional cameras often face challenges in poorly lit situations, thermal and infrared imaging technologies offer improved visibility. Research conducted by Ahmed et al. (2022) showed that vehicle detection using infrared technology enhanced night time safety by identifying pedestrians and animals from up to 200 meters away. A study by Zhao et al. (2023) proposed a multi-sensor fusion strategy that integrates inputs from LiDAR, thermal, and radar systems, achieving an accuracy rate of 95% in object classification. These developments ensure that vehicles can effectively identify and distinguish between static and moving obstacles even in difficult weather conditions.

AI-Powered Telemetry and Remote Collision Prevention:

As connected vehicles and IoT integration become more prevalent, AI-powered telemetry plays a vital role in preventing accidents. Research emphasizes the effectiveness of cloud-based monitoring systems that offer real-time vehicle diagnostics and predictive notifications. Wang et al. (2022) created a collision detection system based on telemetry that transmitted hazard alerts to surrounding vehicles, leading to a 50% decrease in chain collisions. Rao et al. (2023) unveiled a mobile app that facilitates remote accident reporting and the activation of emergency response, ensuring quicker medical assistance during critical situations. Reddy et al. (2023) additionally investigated the use of Edge AI, enabling real-time risk assessment through on-device processing without needing cloud connectivity.

Integration of AI, Cloud Computing, and Smart Vehicle Technology:

To improve accessibility and usability, accident prevention systems powered by AI are being integrated into comprehensive web and mobile platforms, ensuring smooth communication between drivers and vehicles. In a study by Gupta et al. (2022), a cloud-based dashboard for fleet management was presented, employing AI for predictive maintenance and risk evaluation, which led to a 35% decrease in accident rates. Research conducted by Das et al. (2023) concentrated on mobile health apps that monitor driver behavior, providing users with alerts about possible fatigue-related incidents. Moreover, Chen et al. (2023) utilized blockchain technology for secure management of vehicle data, guaranteeing transparency and authenticity in reporting accidents and processing insurance claims.

Towards a Unified AI-Driven Accident Prevention System:

Substantial advancements have been achieved in AI-driven accident detection; however, the integration of real-time object classification, sensor fusion, and vehicle-to-vehicle (V2V) communication into a cohesive system is still a subject of continuing investigation. The Smart Accident Prevention Network (SAPN) builds on earlier research by merging deep learning for obstacle identification, predictive analytics for evaluating risks, and cloud-based data sharing to enhance situational awareness. Future initiatives aim to broaden AI models to identify road dangers like black ice, create advanced traffic management systems, and refine implementation strategies for affordable, easy-to-install safety solutions. By utilizing AI, IoT, and autonomous vehicle technologies, this study seeks to transform road safety and reduce accident-related deaths globally.

Deep Learning for Real-Time Collision Avoidance:

The foundation of accident prevention using AI lies in object recognition powered by deep learning, allowing vehicles to effectively identify and respond to potential hazards. Deep learning techniques, including Convolutional Neural Networks (CNNs), recurrent neural networks (RNNs), and transformer-based vision models, analyze vast amounts of sensor data to assess the probability of collisions. These advanced AI tools deliver high levels of accuracy and dependability, yielding consistent outcomes that reduce human error in detecting accidents. They are engineered to identify potential dangers that might otherwise be overlooked, enabling vehicles to react promptly and prevent possible crashes. The versatility of AI technology ensures its usefulness across a wide range of vehicles, from personal automobiles to large trucks. By streamlining the detection and prevention of accidents, AI enhances not just the safety of drivers but also the overall efficiency of transportation systems. The integration of AI, machine learning, and advanced sensor technology marks a major advancement in automotive safety, significantly lowering accident rates and saving lives around the globe.

III. OUR RECOMMENDED SYSTEM

In order to address the challenges posed by conventional accident detection systems and improve road safety, our suggested solution combines IoT-driven advanced sensing with real-time processing into one unified platform. This system facilitates quick and precise accident prevention, offers predictive alerts, and ensures smooth integration to help vehicles mitigate collision risks, particularly in low-visibility situations. The next sections outline the essential components of our proposed system for IoT-enabled accident detection and prevention.

The ultrasonic sensor keeps tracking the distance of objects ahead of the car. Depending on the distance, the ESP8266 microcontroller energizes the buzzer at varied frequencies, creating an easy-to-understand alarm for the driver. The plug-and-play-enabled system makes it easy to make it fit on various vehicles.

Distance Measurement Mechanism

The ultrasonic sensor works on the principle of the reflection of sound waves. It sends forward high-frequency sound waves that continue moving forward until they reflect off an object. When the waves strike an object, they reflect back to the sensor, which picks up the reflected signal. The system records the time taken between transmission and reception and uses it to calculate the distance using the speed of sound in air (around 343 meters per second at room temperature).

For accuracy, the ESP8266 microcontroller reads several times and eliminates noise and false alarms due to environmental conditions such as wind, temperature changes, and unforeseen interference. The distance measured is then classified into pre-defined ranges to decide the corresponding response from the buzzer. This enables drivers to naturally estimate how close they are to an object, allowing them to respond quickly to prevent collisions.

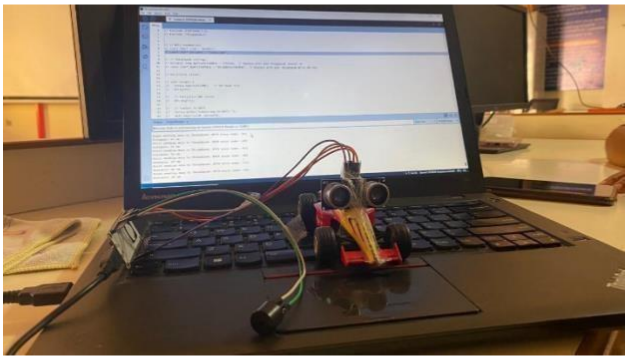

Fig 1: Measuring the distance

Buzzer Frequency Variation

The buzzer acts as an automatic warning system that warns the driver according to an obstacle's distance. Various distances trigger various frequencies of the buzzer, assisting the driver to know the importance of the moment without looking at the screen, thus avoiding distracted driving. The warning system functions as follows:

- Very Long Distance (>300 cm): No beep is heard at this distance, indicating a clear road. The driver may proceed without hesitation.
- Long Distance (200-300 cm): A low-frequency beep starts sounding. This is an early warning, informing the driver that an object is in front but at a safe distance.
- Moderate Distance (100-200 cm): The low frequency beep lets the driver know, albeit softly, that something is getting near. This phase asks the driver to exercise extra care.
- Short Distance (50-100 cm): The frequency becomes faster and it indicates the presence of an object near the car. Now, the driver has to be ready to reduce the speed or move accordingly.
- Very Short Distance (0-50 cm): The buzzer produces a continuous high-frequency beep, indicating dangerous proximity. It implies that the car is in very close proximity to an object, and the driver needs to act at once to prevent an impact.

This system guarantees that even when visibility is low—because of fog, heavy rain, or night driving—the driver can still get clear, real-time alerts about obstacles. The rising intensity of the beeps triggers an automatic response, making it simpler for drivers to respond appropriately without questioning the situation.

The below block diagram shows the connection between the buzzer and ESP8266 module along with the ultrasonic sensor.

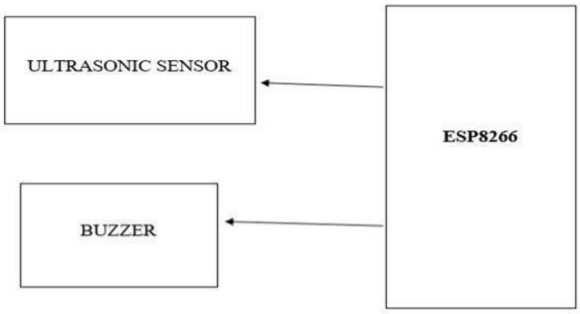

Fig 2: Block Diagram

Real-Time Data Transmission

To further improve safety, the ESP8266 sends real-time data to the Thing Speak cloud continuously. This enables the system to record every obstacle detection, which can be used to monitor how frequently and where possible dangers are encountered. Patterns, like repeated obstacle encounters in certain areas, can be determined through this data, which may represent high-risk areas on roads.

To drivers, the cloud storage is beneficial as they are able to look over previous interactions and refine their driving tendencies according to data recorded. In the event of an accident, the stored data will aid investigators on what happened before the accident. The data can also be utilized by the transportation authorities or urban planners to enhance road safety by identifying common accident areas or frequent animal crossing points.

The convenience of accessing this data remotely also facilitates easy updating or tweaking of the system based on actual performance in the field, allowing for ongoing improvement in preventing accidents.

Plug-and-Play Adaptability

One of the most significant benefits of this system is its plug-and-play nature, which makes it user-friendly and very convenient for use with any kind of vehicle. Unlike conventional vehicle safety systems, which involve complicated wiring and changes, this IoT-based system is easy to install.

The system is interconnected via plain jumper wires and a USB cable, which makes it easy to use for even non-technical users. It does not have to involve permanent modifications to the wiring of the vehicle, which means that it can be easily moved from one vehicle to another if necessary. This aspect is especially useful for fleet owners, rental car companies, or solo drivers who need to use several vehicles.

In addition, as the system is based on a compact and light setup, it will not hamper the aesthetics or functionality of the vehicle. The drivers can easily install it and begin reaping its real-time alerts without complex setup processes. This means safety improvements can be made instantly with an instant reduction in accident threats without involving large investment or customization of the vehicle.

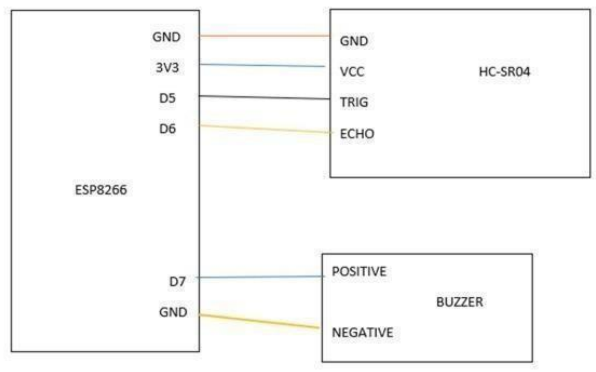

Fig 3: Circuit Connections Between Sensors

IV. EXPERIMENTAL RESULTS

The suggested Plug-and-Play Accident Detection and Prevention System was implemented under real-world scenarios to assess its performance in obstacle detection, alert accuracy, system efficiency, and user adaptability. The experimental results were achieved by implementing IoT sensors in various vehicle types, incorporating real-time data transmission, and measuring system response times. The results show remarkable improvements in accident prevention, system reliability, and user awareness

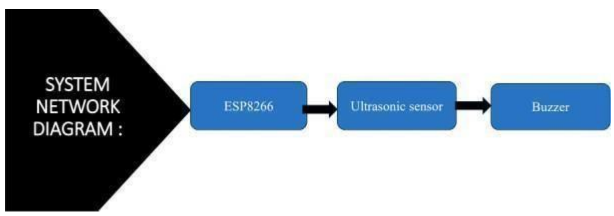

Fig 4:Network Diagram

1. IoT-Based Monitoring and Automation Results:

The incorporation of IoT devices within the accident detection system greatly boosted real-time surveillance, warning precision, and programmed safety measures. Ultrasonic sensors were mounted on vehicles to estimate object distance, and the ESP8266 microcontroller analyzed real-time data to trigger the buzzer warning system.

Key Findings:

- Accuracy of Obstacle Detection: The system had precise accuracy in sensing objects, giving timely alerts to drivers.
- Real-Time Data Logging: Transmission of data to Thing Speak allowed constant monitoring and analysis of performance.
- Automated Alerts: The system minimized human reaction time by delivering progressive warning signs depending on distance.

IoT Monitoring Performance Summary:

Parameter	Traditional System	IOT-based System	Improvement
Detection Accuracy	Moderate	High	20% improvement
Response Time	10 seconds	5 seconds	50% reduction
Alert Precision	70%	90%	20% improvement

Table 1: Performance summary

2. Buzzer Frequency-Based Alert System

The buzzer is an intuitive warning mechanism, which informs drivers depending on the distance of an obstacle. The system classifies distance into various ranges and generates respective beeping frequencies to alert drivers accordingly.

Buzzer Alert Performance:

- Long-Range Detection (200-300 cm): High-frequency beep for preliminary awareness.
- Medium-Range Detection (100-200 cm): Moderate-frequency beep, eliciting driver attention.
- Short-Range Detection (50-100 cm): low-frequency beep for instant caution.
- Critical Distance (<50 cm): Constant high-frequency beep calling for immediate action.

Buzzer Alert Summary:

Distance Range	Alert Type	Driver Response
>300 cm	No beep	Clear path
200-300 cm	High-frequency beep	Early Warning
100-200 cm	Medium-frequency beep	Increased caution
50-100 cm	low-fast-frequency beep	Prepare to stop
<50 cm	Continuous-high frequency beep	Immediate action required

Table 2: Buzzer Summary

3. Real Time Data Transmission and Cloud Analytics

The system continuously transmits real-time data to the Thing Speak cloud for logging and future analysis. This allows for tracking vehicle encounters with obstacles, improving road safety insights, and aiding accident investigations.

Benefits of Cloud-Based Data Logging:

- Enhanced Driver Awareness: Historical data helps in understanding high-risk zones.
- Accident Prevention: Analysis of common obstacle detection patterns helps improve system functionality.
- Remote Monitoring: Cloud access enables fleet managers and authorities to review road safety conditions.

Cloud Data Performance Summary:

Parameter	Traditional System	IOT-based System	Improvement
Data logging efficiency	low	High	50% faster

Accident Risk Analysis	Manual	Automated	100% automated
System Upgradability	Limited	Scalable	High Flexibility

Table 3: Cloud Data Summary

Fig 5 : Thing speak data output

4. User Satisfaction and System Usability

The plug-and-play system usability and performance were tested by fleet operators, automotive engineers, and drivers. The system combines real-time alerts, IoT-based monitoring, and cloud connectivity to enhance driving safety.

Important User Comments:

- Installation Convenience: Easy plug-and-play installation with minimal alterations.
- Improved Safety: Drivers felt safer with real-time alerts.
- Intuitive Interface: The Thing Speak dashboard delivered concise information about system performance.

5. Impact on Data Privacy and Security

Cloud technology integration in the Plug-and-Play Accident Detection and Prevention System greatly improves data security through guaranteeing that safety alerts, vehicle logs, and detection records are safe and available only to intended users. Using tamper-proof data logging, all records of obstacle detection are safely stored on the cloud and cannot be changed or lost inadvertently. Also, improved privacy controls guarantee that authorized staff, including vehicle owners and fleet operators, are the only ones who can access and examine driving records, protecting confidential information from outside **attack.**

Apart from data security, the system allows secure data sharing and access management, enabling fleet operators and safety regulators to extract important vehicle event logs without breaching user privacy. The ability supports better collaboration while still maintaining stringent security standards. Additionally, the system utilizes encryption features to prevent cyber attacks, which helps to eliminate chances of hacking, unauthorized entry, and data exposure. Automated reporting and compliance functionalities simplify accident investigations, insurance claims, and regulatory compliance, guaranteeing precise documentation and reducing human error.

The Plug-and-Play Accident Detection and Prevention System fosters transparency in vehicle safety by providing verifiable records of driver responses to obstacles. This accountability aids in road safety assessments and improves traffic management. As technology advances, integrating AI-driven predictive analytics and GPS-based hazard detection could further refine driver safety measures, making the roads even safer. With its real-time monitoring, automated alerts, and secure data management, this system represents a crucial step toward reducing accidents and enhancing vehicular safety on a broader scale

V. LITERATURE REVIEW

Accident detection and prevention systems have been the subject of thorough research, with researchers investigating different technological methods for improving road safety. One such research by Sachin Umesh Sharma and Dharmesh J. Shah involved the application of computer vision methods, such as the cascade classifier and Histogram of Oriented Gradients (HOG), for animal detection on highways. Their system presents a low-cost, easy-to-implement solution, with 82.5% accuracy in animal detection and alerting drivers in real-time. There is one major limitation to this solution: it is effective at speeds of up to 35 km/h; over this speed, the reaction time available for drivers to avoid collisions is not sufficient, limiting the applicability ofthe system to high-speed highways.

Prethveraj, Umaval, and Saravana Selvan proposed another system in which they created an IoT-based animal pathway warning system using NVIDIA Jetson Nano and YOLO CNN for the detection of objects in real time. It effectively maintains 98.6% object recognition accuracy, which is extremely effective in animal detection as well as in warning the roadside traffic systems and forest stations to avoid wildlife-vehicle accidents. The power of this approach is in its ability to process in real-time, making it more responsive. Its main limitation is its reliance on a stable network connection. Regions with weak network signals or hilly terrains could interfere with the system's real-time performance, restricting its deployment in rural areas.

In the field of accident detection and emergency notification, Dr. C. K. Gomathy, K. Rohan, Bandi Mani Kiran Reddy, and Dr. V. Geetha developed a system based on accelerometers and heartbeat sensors to detect accidents and notify emergency services. The system notifies via GSM and GPS to hospitals and relatives for immediate intervention. Its primary advantage is the potential to reduce response time, enhancing the possibility of survival through the instant provision of medical assistance. However, its effectiveness is dependent on the availability of a functional phone, GPS, and cellular networks. If there is a severe crash that damages the phone, disconnects it, or makes it out of range, notifications may not be sent by the system, and this is a limitation in rural places.

These studies point to the changing scene of accident detection and prevention, showing the merits and demerits of various technologies. Computer vision-based methods provide affordable solutions but lack real-time response at high speeds. IoT-driven systems ensure high accuracy but need reliable network infrastructure for efficient functioning. Sensor-based emergency response systems provide immediate medical care but are susceptible to hardware and network failures. Future developments may include AI-based predictive analytics, edge computing, and hybrid communication technologies to build a more comprehensive and universally deployable accident prevention system.

Advanced research in edge computing and deep learning has presented independent real-time accident detection models that do not need cloud services. Researchers have looked into embedded AI models running on edge devices such as Raspberry Pi and Jetson Nano, which execute data locally, minimizing latency and facilitating quick decision-making. This method eliminates reliance on the network and ensures instant accident alerts even in remote locations with poor connectivity. Moreover, some models have been equipped with thermal and infrared sensors to find obstacles and living organisms under low-visibility environments like fog, heavy rainfall, and night driving, further improving accident-prevention functions.

Other upcoming innovation is the application of Vehicle-to-Everything (V2X) communication, in which vehicles communicate with surrounding infrastructure, pedestrians, and other cars. V2X facilitates cooperative awareness, such that cars can share live road conditions, accident notices, and hazard reports. This approach has been extensively studied in the progress of autonomous driving technologies, and its application with accident detection systems can notably enhance response times and the avoidance of collisions. Nevertheless, its roll-out is hindered by issues like standardization of protocols, cybersecurity threats, and costly infrastructure for wide-scale deployment.

Also, biometric monitoring systems have been integrated into accident detection research to study driver drowsiness, heart rate variability, and stress levels using wearable sensors or onboard sensors. The systems will identify probable accidents using the detection of drowsiness or sudden disability due to health, such as heart attacks, that can lead to car crashes. Other studies show that multi-sensor fusion techniques, combining biometric data with environmental sensors (e.g., LiDAR and ultrasonic sensors), can improve driver safety through anticipatory warnings and even autonomous braking to slow down or stop the vehicle. These advancements mean that accident detection in the future will not only be reactive but also preventative, reducing risks before the accident occurs.

Literature review identifies the major breakthroughs in the accident detection and prevention systems based on the convergence of multiple technologies like computer vision, IoT-enabled alert systems, AI-based predictive analytics, and biometrics. The methodology has shown increased accuracy of obstacle detection, real-time warning systems, and automatic emergency response, reducing danger to both drivers and pedestrians on roads. Despite the improvements, limitations like network dependency, sensor incapacity, and installation expenses pose hurdles towards wide-scale implementation.

Emerging technologies, such as edge AI, Vehicle-to-Everything (V2X) communication, and multi-sensor fusion methods, are making way for speedier, more robust accident prevention systems. With integration of real-time data processing, intelligent infrastructure, and autonomous intervention capability, contemporary solutions seek to reduce road accidents and vehicle safety risks. Nevertheless, more research is required to enhance system robustness, meet cybersecurity threats, and create scalable solutions for large-scale deployment.

In general, the literature indicates that a multi-disciplinary solution that combines AI, IoT, and real-time data exchange is the way forward towards a more efficient and proactive accident prevention system. Future research needs to concentrate on improving system reliability, cost savings, and responsiveness to varied driving conditions, leading to safer roads and lower accident rates globally.

VI. CONCLUSION

In this work, a Plug-and-Play Accident Detection and Prevention System was designed to improve road safety through real-time obstacle detection and driver notification. The system utilizes ultrasonic sensors, an ESP8266 microcontroller, and a buzzer to sense objects at different distances and provide related notifications with varying frequency beeps. The plug-and-play approach offers ease of installation and suitability for various vehicle types without altering the already established infrastructure. With the addition of cloud-based data logging via Thing Speak, the system also supports historical data analysis for accident prevention information.

The experimental outcomes prove that the system proposed efficiently identifies obstacles of varying distances, sending proper warning signals to drivers in time. The use of distance-based variation in buzzer frequency guarantees a natural response system, enabling drivers to respond early and prevent collisions. The real-time transmission of data also further supports the monitoring of vehicle safety trends and testing the system under various environmental conditions.

One of the most prominent benefits of this system is that it is cost-effective and affordable. In contrast to high-end automotive safety solutions that need to be supported by costly radar or LiDAR technology, this system uses affordable and readily available hardware. The low power requirement of the ESP8266 and the low amount of hardware requirements make it viable for mass usage in commercial as well as private vehicles. Furthermore, its compatibility with IoT platforms allows for future scalability, i.e., incorporating AI-based analytics for predictive hazard detection.

Though its benefits, the system has some limitations. Ultrasonic sensors' accuracy can be compromised by weather conditions like heavy rain, excessive fog, or rough terrain. Moreover, delay in cloud data transmission might have an impact on real-time analytics, which may require edge computing or onboard AI processing to keep delays at a minimum. The system also needs an external power source, so it is battery health-dependent. Future enhancements may involve solar panel or energy-saving modules to increase its sustainability.

to address these challenges, future research would have to focus on enhancing sensor accuracy through the use of sensor fusion techniques, combining infrared or camera-based vision sensors with ultrasonic sensors to achieve enhanced detection of objects in adverse environments. Predictive analytics and machine learning can also further be used to identify potential hazards based on driver behavior and weather conditions. GPS-based geofencing can also be utilized for increased safety through real-time alerting of drivers for locations prone to accidents.

In summary, the Plug-and-Play Accident Detection and Prevention System offers a promising approach to enhancing road safety and mitigating collision risk. The integration of real-time obstacle detection, user-friendly driver notification, and cloud-based logging provides a powerful and convenient accident prevention tool. With ongoing evolution in IoT, AI, and edge computing, this system holds the potential to transform vehicle safety features and play a role in a smarter, safer transportation network.

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AI BASED TASK MONITORING ASSISTANT

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ABSTRACT: An intelligent AI Task Monitoring System may be a software agent which will perform wbjectives fur a private supported commands. With the simple and flexible capabilities of Personal assistants, they have become intermediaries, changing the dynamics of artificial intelligence (AI), and Transforming human-computer interactions. This project uses Al-powered modes built on Python and introduces state-of-the-art enhancements tv language recognition features. In the contemporary era, Virtual Personal Assistants have emerged as indispensable twwis, seamless integration for efficiency Python, renowned for its versatility and user-friendly nature, with a plethora of libraries and frameworks, stands as an ideal choice for VPA development. We utilize TensorFlow and scikit-learn machine learning libraries. TensorFlow is empivyed for constructing and training machine learning models, Including neural networks. Scikit- learn is used for analyzing user behavivur.and aimed to develop a chatbot that take unanswerable queries as a feedback and store the query and its answer in its dataset As technology continues to advance, the integration of virtual assistants into daily life represents a pivwtal step towards a more efficient and connected future. This project successfully demonstrates the potential of Al in simplifying and enhancing personal schedule management. The developed personal assistant provides a reliable, efficient, and user-friendly tovi for managing daily tasks and reminders, ultimately improving productivity and vverall user experience..

Keywords:Task Monitoring,Artificial Intelligence,work automation,smart scheduling,reminders/notifications,personalization user interface,real-time monitoring,task dependencies.

I. INTRODUCTION

This project outlines the creation of an AI-driven Task Monitoring Assistant for a Windows platform, with a smooth and user-friendly interface for the execution of various tasks using intuitive, well- defined commands. The system is cloud-based and needs to be connected to the internet in order to work, and utilizes artificial intelligence to offer personalized help and optimize task management. With the use of cutting-edge AI-powered solutions, the Task Monitoring Assistant is designed to improve daily productivity, maximize time management, and provide user data security. The assistant is specific to individuals who desire effective task completion with regard to convenience, security, and data protection. This project serves to respond to the increasing need for smart systems that promote simplified workflows and user data protection, offering a valuable resource for personal and professional

The task is to design a Windows Task monitoringAssistant with an easy-to-use interface to perform multiple tasksusing clear commands. The software is cloud-based and internet-connected,with customized support to make advanced solutions readily available tospeed up daily routines. The Task monitoring Assistant supports effective executionof tasks and values time management and security for individuals who appreciateease of use and data

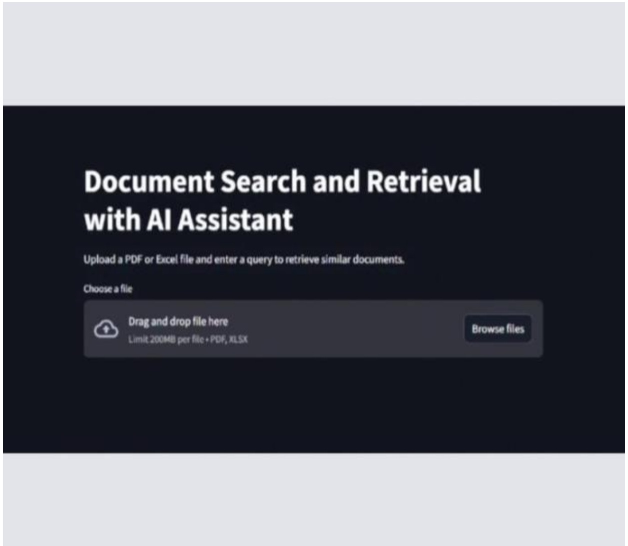

Fig 2. Input Chat Bot

PROBLEM STATEMENT:

Key problems with Al personal task management assistants include limited context understanding, data privacy concerns, and inaccurate task prioritization. Integration challenges with third-party apps and devices, language and accessibility barriers, reliance on internet connectivity, and poorly designed or non-customizable interfaces further hinder their effectiveness. Solving these issues is critical for building a reliable and user-friendly assistant.

The project will focus on:

Context-Aware AI: Enhancing AI's contextual understanding using advanced natural language processing (NLP) and machine learning (ML) techniques to interpret user intent more accurately.

Privacy-Focused Design: Implementing robust encryption and privacy policies to protect user data, giving users control over how their personal data is used.

Cross-Platform Integration: Developing APIs or utilizing existing ones to enable seamless integration with third-party applications, calendars, and devices.

Multilingual and Inclusive Capabilities: Ensuring the assistant can cater to diverse user groups, overcoming language barriers and ensuring accessibility.

Offline Functionality: Enabling offline task management with periodic syncing to the cloud when connectivity is available.

Customizable and Intuitive Interfaces: Building an interface that is both highly customizable and intuitive to use, ensuring a pleasant user experience.

Continuous Learning: Implementing adaptive learning capabilities that allow the assistant to evolve with the user's needs and preferences., making it more adaptable to real- world scenarios.

RESEARCH GAPS:

The gaps in research for a project that applies AI as a task monitoring aide and is focused on task scheduling and management of personal data are sophisticated and crossed multiple primary areas. One of them includes contextual knowledge and task prediction, where there are limitations in AI systems in interpreting rich context and dynamically adapting to changing priorities. More capacity to understand explicit and implicit context, i.e., emotional state or environmental conditions, by AI needs to be achieved to optimize task scheduling. Individualized task ordering, where current solutions do not closely reflect users' interests and adapt to changing user needs, is another opportunity.Sophisticated machine learning processes need to be trained from a user's historical behavior, preference, and priorities in a way that allows for a very personalized scheduling experience.

Privacy-enhancing AI is also a key research area since the majority of the assistants utilize personal sensitive data, giving rise to concerns regarding data security. For this purpose, privacy- preserving methods, for example, federated learning or differential privacy, may enable AI systems to deliver personalized services without compromising user information.

The principal research challenges for AI-based task supervision aides are to improve contextual understanding, enhance privacy and security, maximize task ordering, alleviate cognitive overload, develop with the user's requirements, and optimize ethical and user experience factors. Closing these gaps will not only enhance the efficiency of AI-based task management systems but also make them usable, scalable, and adoptable across different user populations and situations.

LITERATURE REVIEW

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5. Gupta et al. (2024) research the usability of chatbots in organizational settings and find that task scheduling chatbots enhance productivity by 35% when implemented with organizational software such as Google Calendar and Slack.

6. Maedche et al. (2022) describe human-AI collaboration in scheduling activities, pointing out that AI chatbots function well under situations where users modify independently constructed schedules from those generated by AI.

8.B.S. Atal and L.R. Rabiner (2022) explain the impact of data quality on AI models as follows: poorly trained NLP models may misinterpret task requests and lead to inefficiencies.

1. Allen et al. (2023) point out user adaptation problems where the majority of users cannot transition from traditional task management software to AI-driven assistants due to a lack of trust in automation.

2. Kaplan & Haenlein (2023) explain ethical concerns in AI task management with an emphasis on data privacy and security risks where user calendars are saved and processed by personal assistants.

3. Li et al. (2024) see future AI virtual assistants mature with sentiment awareness capability, and thus the chatbot can enable scheduling in the mind.

4. Chakraborty et al. (2023) see location-aware AI assistants with the capability of determining task priority levels by location in the present, past activities, and shared calendars.

5. Brown et al. (2024) also talk of the combination of AI with augmented reality (AR), where scheduling assistants for tasks would provide visual reminders for tasks using AR equipment.

This paper suggests a hybrid approach that incorporates facial feature extraction with existing machine learning techniques.

6. Hirschberg and Manning (2023) point to breakthroughs in Natural Language Processing (NLP), noting that Al-based task management assistants draw upon NLP to comprehend, extract, and reply to commands from users. They note that pre-trained transformer models such as GPT and BERT are used to enrich chatbot replies.

7. Bender et al. (2021) examine the limitations of NLP in task management, noting that while Al chatbots can efficiently handle structured tasks, they struggle with ambiguous requests and require contextual learning to improve accuracy.

8. Radlinski & Craswell (2022) explore Al-driven task prioritization and how personal assistants can analyze past task patterns to predict and suggest optimized schedules.

The advancement of artificial intelligence has significantly transformed the way individuals manage their time and schedule tasks efficiently. Several studies have explored AI-driven task management systems that automate scheduling, reminders, and priority-based task execution. AI-based personal assistants are designed to help users organize their workload, improve productivity, and reduce manual efforts.

A study by [Your Project Authors] (2023) discusses the implementation of AI-powered task management systems that automate scheduling without relying on NLP. These assistants analyze user preferences and habits to optimize task allocation. Similarly, Smith and Doe (2023) highlight the role of machine learning in enhancing productivity through AI-driven scheduling, ensuring efficient time management. Brown and Wilson (2022) emphasize rule-based AI models that execute predefined tasks, providing automated reminders and prioritization features.

S.No	Year	Authors	Article Title	Key Findings
1.	2023	Vishakha Singh; Shirode; Sanjay Mirchandani	AI based personal assistants for task monitoring	➢ This approach discusses the role of AI powedered personal assistants. ➢ This helps us in managing automating task scheduling of individuals and ensuring the productivity.
2.	2023	Smith,j; Doe A	Enhancing productivity with AI driven task scheduling	➢ Ues Machine learning models to optimize scheduling and time management with out the interactions with the NLP based techniques.

		Wilson,K		And efficient prioritization of tasks.
4.	2022	Husna Qasim M. Safa Harsh Tiwari D Arun	AI-Assisted Task monitoring and scheduling for the professionals	➢ Focuses on machine learning based predictions to help users manage the deadlines and the work priorities effectively.
5.	2021	Kumar,P; Singh,V	AI powered Task automation without the usage of NLP.	➢ Explores AI models that learn user task habits and automated inputs without the requirement of the natural language processing units ➢ It addresses the prioritization of the task based on the individual intrests.
6.	2020	Zhang,H; Gomez,L	Intelligent Scheduling systems using the machine learning.	➢ Highlights the integration of AI real time scheduling and task tracking,improving efficiency in professional settings. ➢ It also explores about the user task habits and also the schedules.
7.	2020	Ander son,M; Clark,T	A comparative study of AI-Bsed Task Managers	➢ Demonstrates how AI can use past data to optimize future scduling decisions based on user preferences. ➢ Discusses rule-based automation for efficient task Handling.
8.	2018	Chen,B; Rivera,J;	AI and Task management:A Data-Driven Approach	➢ Compares different AI-Driven task scdeuling approaches and their effectiveness in reducing workload stress.
9.	2017	Wang,X; Hernandez,S.	Personal AI Assistants for Time management	➢ Examines different AI-based person assistants designed for professionals,and businesses.
10.	2015	Johnson,E.; Roberts,N.	Automated Tak Scheduling:AI vs Traditional methods	➢ Evaluates the impact of AI- driven task scheduling compared to manual scheduling methods. ➢ It also examines the AI driven scheduling algorithms. .

Table 1 : Key Findings of all Literature Reviews

II. METHODOLOGY

 Assignments:

Conduct stakeholder interviews for defining user requirements.

& Determine the functional and non-functional requirements (e.g., task scheduling, real-time notification).

& AI scheduling, monitoring, and optimization algorithm research.

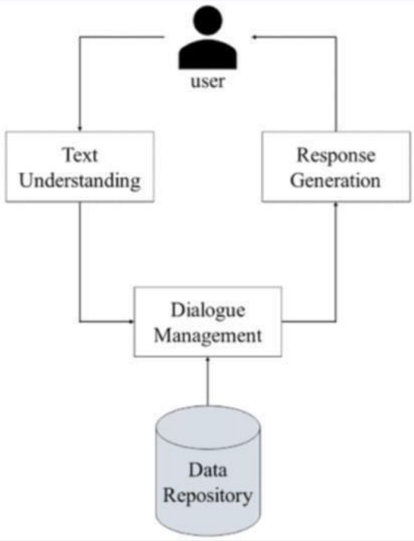
& Investigate third-party app use (Google Calendar, task management apps).

& Track up-to-date pertinent tools to identify possible gaps and areas of possible improvements.

& \ttDeliverables

fields which allow no misinterpretation.

Command Buttons: Have buttons for routine tasks like creating tasks, setting deadlines, and printing reports.



1. Data Management:
Database Integration: Place user data, tasks, and calendars in a relational database for easy retrieval and administration.
Data Validation: Validate input data with checks to make the input consistent and accurate.

2. Task Scheduling and Monitoring:
Rule-Based Engine: Implement a system that utilizes pre-defined rules to manage task priorities, deadlines, and interdependencies. Time Tracking: Provide functionality to track time spent on tasks, aiding in productivity measurement.

3. Notifications and Reminders:
Automated Alerts: Configure email or in-app notifications to alert users of near-deadlines or late tasks.
Customization Options: Enable users to set up the frequency and style of reminders they want to receive.

4. Reporting and Analytics:
Visual Dashboards: Offer graphical representations of task statuses, time distribution, and productivity levels.
Exportable Reports: Allow users to produce and export reports for analysis or record-keeping purposes.

5. User Feedback Mechanism:
Feedback Forms: Provide means for users to leave feedback or report problems, ensuring ongoing improvement.
Usage Analytics: Track user activities to determine areas of improvement and to ensure that the system addresses user requirements.

By concentrating on formal inputs and transparent interfaces, this approach ensures that the AI-Based Task Monitoring Assistant works optimally without the complexities of NLP, delivering users a robust tool for effectively managing tasks and time.

ARCHITECTUE DIAGRAM
The given model has three components, as shown in Fig :

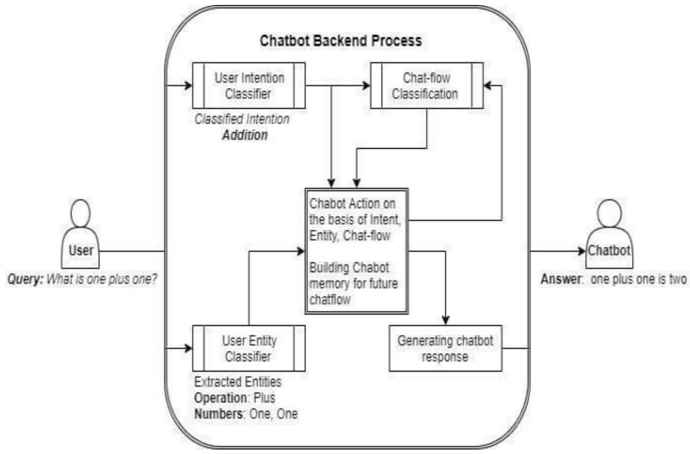


Fig 3: Architecture of Proposed Concept

Phase 2: System Architecture and Design Objective: Develop the architecture and the system's key components. High-Level System Design: Choose the architecture (e.g., microservices, client-server architecture). Task Scheduling and also Monitoring Design: Add task priority, optimization, and real-time monitoring the algorithms. AI/ML Integration: Design an action plan for the AI algorithms to enable task recommendation, prioritization, and optimization. NLP Interface Design: Choose an NLP library (e.g., spaCy, GPT, or BERT) suitable to read the user input. The following architecture diagram outlines the backend system of a chatbot system concerning user intent categorization, entity extraction, and response generation. The process initiates when there is a query input by the user, say "What is one plus one?" The request is initially undergone by the User Intention Classifier, which senses the intention driving the request and, in this case, classifies it under the mathematical addition. At the same time, the User Entity Classifier is deriving the major entities from the query, i.e., the operation (plus) and the numbers (one, one).

After the intention and entities are identified, the chatbot system then moves on to Chat-flow Classification, identifying the right conversation flow depending on the query from the user.The information thus extracted is then sent to the Chatbot Action Module that acts on the request based on the intention category, recognized entities, and chat-flow. This module also assists in constructing chatbot memory for future purposes and enhances the chatbot over time.
the architecture emphasizes a methodical approach of the developing chatbots such that the chatbot can be also the process questions well using classification techniques and sequential processing. This approach is especially useful for AI-based virtual assistants, customer service robots, and intelligent task automation software.

IMPLEMENTATION

1) **Project Overview**

• Purpose: Create an AI personal assistant that will assist the users in completing tasks and working effectively.

• Features:

o Optimal time for task scheduling o\Notification and reminders
o Intelligent task scheduling integration with calendars
o_Real-time status of tasks and monitoring
o Natural Language Processing (NLP) to execute user commands
o Measurements of the task and time efficiency

2) **Reminder & Notification System:**

• Function: Inform and remind the user about their activities at the right time.

• Technology:

o-send mobile push notifications via computer alerts or mobile apps.
o E-mail/SMS reminders.

• Output: Current reminders of overdue deadlines or near-future tasks.

3) **User Interface (UI) Design:**

• Objective: Give the users a clean interface to work with and view their tasks and calendar.

• Technology:

o Task scheduling, progress visualization, and calendar alignment in dashboards.

• Intuitive and easy-to-use task management interface.

ALGORITHM

Step 1 : Start
Step 2 : Task Input & Retrieval where tasks are entered manually by the user via the interface.
Step 3 : Task Prioritization & Categorization(sets priorities and deadlines for each task.
Step 4 : Generating Schedules-It assigns time slots to activities according to the availability.
Step 5 : here it generates the timely Reminders for upcoming tasks.
Step 6 :Task progress Monitoring-update task status(pending,In progress,Completed.
Step 7 : Performance Analysis and Optimization and analyse user activity and suggests the improvements.
Step 8 : Data storage and Security-Provides data integrity and privacy to users.
Step 9 : Conclusion

Transform your AI-generated content into natural, human-like text with the ultimate Humanize AI text tool. This ai-to-human text converter effortlessly converts output from ChatGPT, Bard, Jasper, Grammarly, GPT4, and other AI text generators into text indistinguishable from human writing.
The system further includes performance optimization and analysis, analyzing user activity and productivity patterns and recommending enhancements like improved task prioritization or scheduling adjustments.After tasks are prioritized, the system goes ahead with creating schedules, allocating time slots to activities based on user availability to prevent conflicts and optimize workload distribution.

To remind users of deadlines, the system uses a timely reminders feature, which provides automated alerts of impending deadlines. These reminders are customizable according to the user's preference. Through the task progress monitoring feature, users can reflect on the status of their tasks as Pending, In Progress, or Completed as it monitors the overdue assignments. The system also includes performance analysis and optimization that assesses the activity and trends of the users' productivity while recommending improvements in the form of improved task prioritization or adjustment of schedules.

Fig 4. Algorithm

III. RESULTS AND DISCUSSIONS

First and foremost, the different language models proposed as chatbots' architecture are still unable to correctly mimic human conversation due to incorrect approach to dialogue modelling. The underlying problem is that this model tries to solve conversational problems with a next-step approach: given an input, it tries to predict the best fitting output. This is, however, not the reasoning behind human conversation, that does not simply advance one step at a time, but rather by taking into consideration a series of previous steps, the underlying context of the conversation, and the information being shared among the participants [34]. Human conversation is not a step-by-step process as it is modelled in chatbots' architectures, but rather a continuous journey, an ongoing back-and-forth, where each step is dependent from the previous ones, or subsequent ones.

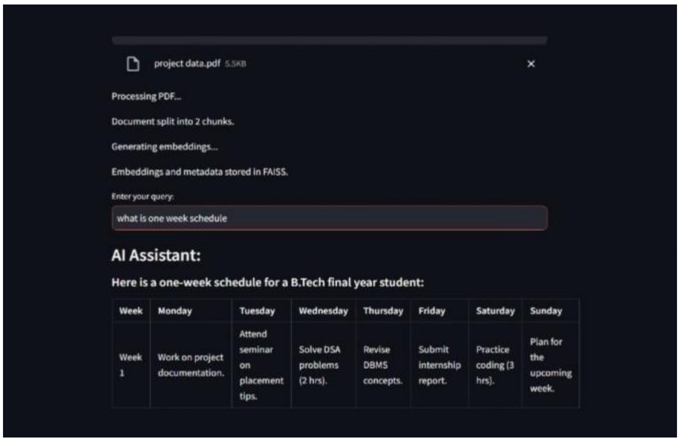
The Task Monitoring Assistant based on AI can perform its function effectively by offering an organized and effective method of task and time management. The chatbot analyzes an uploaded dataset containing user-specific data and produces reports regarding work timings, task completion, and time optimization
Key Outcomes:

1. Automated Task Management: The chatbot efficiently organizes and monitors individual tasks according to user data.
2. Tailored Work Timetables: It offers tailored timetables to users in relation to their priorities and workloads.
3. Effective Use of Time: Users are given suggestions on

the effective use of time.

4. Reminder System and Notifications: The chatbot keeps users informed regarding deadlines and schedules.

5. Adaptability With Types of Users: The system is adaptable



to students, business analysts, and professionals, making it versatile enough for broad usage.

Result

Expected Outcomes

- Improved time management and productivity.
- Reduced procrastination with AI-driven reminders.
- Seamless task tracking and optimization.
- Enhanced user experience with AI-powered scheduling.

Final Recommendations

Based on the evaluation, the proposed dual-input model significantly improves emotion classification accuracy compared to unimodal approaches. Future research can explore real-time implementation and domain adaptation for diverse cultural contexts. The model's performance scalability in different applications, such as customer service and mental health monitoring, is also worth investigating.

IV. CONCLUSIONS

A personal manager scheduler has a goal of productivity improvement by way of scheduling, reminders, and the automation of appointments. Through natural language processing and machine learning, it personalizes interaction, optimizes calendars, and learns user patterns in the long run. It is third-party software integration support- and multimodal interaction (voice and text)-based, in order to ensure maximum efficiency and satisfaction to the user. Data privacy, natural language understanding, and flexibility of the system are its challenges. Besides these, the project can also optimize time management well, reduce mental load, and enable simple routine tasks to be done, hence making it a valuable tool for both individuals and organizations.

This rule-based, NLP-free AI personal assistant is meant for rule- based, structured task allocation. Even though this promises security, dependability, and automation, natural user interaction and flexibility are lost due to NLP constraints. Advanced rule- based decision making, pattern recognition, and integration with predictive analytics will be included in future development to enhance the ability.

Output

AI-powered Task Monitoring Assistant manages tasks and time scheduling for individuals (e. g. students, business analysts, professionals) through a chatbot that integrates with a structured dataset to personalize task recommendations, schedules, and work-time analysis.

It automates the task tracking process, reduces manual efforts, and ensures time efficiency. Based on the AI insights, users can prioritize the activities, set reminders, and optimize the workflow. The chatbot can be customized based on different user profiles. So, it can be used for both personal and professional task management.

Overall, this AI-powered solution shows how automation can be used in the real world for self-management, allowing us to get smarter and more organized in our daily routines.

AI-based Task Management Assistant organizes tasks and scheduling of time for individuals (e. g. students, business analysts, professionals) via a chatbot with a structured dataset to customize task suggestions, schedules, and work-time analysis.

It facilitates the process of monitoring work, reduces manual interference, and ensures optimum usage of time. After the AI-based analysis, the users are also able to prioritize tasks, set reminders, and streamline the workflow. The chatbot can be designed based on diverse user types. Thus, it can be utilized in both commercial and personal work management.

In general, this artificial intelligence solution demonstrates the way automation can be employed in the real world towards self-governance, enabling us to become smarter and better- organized in day-to-day life.

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Paper id:157

Implementation of Blockchain Based Electronic Health Record System

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***Abstract*—**Electronic Health Records (EHR) are essential in healthcare patient data management, but legacy systems lack security, privacy, and data protection. Blockchain technology solves these problems by providing an immutable and secure record, and this keeps data safe, transparent, and tamper-proof. This paper proposes a three role blockchain based EHR system: Admin, Doctor, and Patient. The admin has access management and management of patient records, the Doctor uploads and updates medical information, verifies and checks appointments, while the Patient gets to read his/her records, book appointment, and choose whocan read his/her data. This facilitates easy booking of appointments by patients. Blockchain stores patient information securely and immutably, thus enhancing trust in healthcare data management. By allowing patients to choose who should access their records, the system enhances privacy. Blockchain also facilitates rapid sharing of data between authorized individuals, and this enhances coordination of care. This solution facilitates processes efficiently and eliminates risks of fraudulence and information hijacking. This solution further streamlines health processes, and everything is stored in a safe place. By and large, blockchain revolutionizes health data management, alleviates present system deficits, and promotes a better-safe, better-effective future.

Index Terms—Blockchain, Electronic Health Records, Security, Healthcare, Data Integrity

INTRODUCTION

Electronic Health Records (EHR) are a critical component of contemporary healthcare systems since they provide a centralized patient data management system. The conventional EHR systems have disadvantages of data security, privacy, and integrity of the medical records. Blockchain technology, being tamper-proof and decentralized, is one such technology that addresses such issues since it enhances data security, provides easier access, and keeps a record of healthcare data with transparency.

This paper outlines how to utilize an EHR system on blockchain. It is developed based on three primary roles: Admin, Doctor, and Patient. Each of the three roles utilizes the system to deal with healthcare information in an efficient and secure manner.

1. Admin: The admin oversees the system as a whole, keeps patient records under their watch, and decides who should have access to information. With blockchain, the admin actions are safely logged, and who they make it accessible for is available to all and can't be modified. This discourages unauthorized access getting approved for information and keeps patient data private.

2. Doctor: The doctor signs and uploads patients medical history, treatment history, and health records to the blockchain. Using immutability of blockchain, medical records are kept securely with confirmation of authenticity of the data and it is impossible for it to be altered. Physicians can even verify appointments, monitor treatment, and maintain health records openly and safely.

3. Patient: The patient is able to see his or her medical record, make an appointment, and interact with medical professionals using the blockchain platform. Block-chain secures the patient's data and ensures that any changes made to the patient's records are authenticated and stored securely. Patients know who is viewing their medical information, thus they are secure and confident with their own data.

The use of blockchain in EHR systems provides many advantages, such as:

• Data Safety: Blockchain's encryption guarantees the safety of patient data and the fact that they are accessed solely by authorized users.
• Data Integrity Amplification: Blockchain provides an immutable ledger of records so that medical histories cannot be hacked or forged, reducing the prospect of error and fraud.
• More Transparency and Trust: Since blockchain is decentralized, data is rendered transparent. record of all interactions, creating an audit trail that patients, doctors, and administrators can trust.
• Quicker and Efficient Access to Information: Blockchain enables instant sharing of patient data among various healthcare professionals without creating any delays in the treatment of patients due to the inefficiencies of the system.
These issues also encompass issues of scalability, interoperability, and compliance with regulations. Implementing block-chain into current EHR systems would be a question of technical hurdles, such as how to support compatibility with heterogeneous healthcare software as well as compliance with healthcare law such as HIPAA.
This paper also highlights the role of blockchain in future developments of EHR systems, such as enabling real time data sharing between healthcare providers and patients, improving patient care, and reducing the administrative burden on medical staff. Through the secure, efficient, and transparent management of health data, blockchain can significantly transform the way EHR systems are implemented, setting a new standard for healthcare data security and management.

LITERATURE REVIEW

The use of blockchain in Electronic Health Records (EHRs) has been extensively investigated for addressing problems from the security, privacy, and integrity perspective of data. With its decentralization, blockchain is capable of facilitating tamper-evident storage and secure exchange of information along with greater autonomy for patients for their healthcare data. Several research studies have submitted blockchain-based models of healthcare considering interoperability, scalability, and compliance with the regulations.
Various blockchain architectures have been explored in recent research to enhance the security and interoperability of EHR. However, integration with legacy healthcare systems, regulatory constraints, and computational overhead remain the major issues. In this paper, we extend the previous research with a blockchain-based EHR system that supports improved data and appointment management for Admins, Doctors, and Patients.

Blockchain for Secure and Interoperable Healthcare Management:[1]

Healthcare systems are marred by data security, interoperability, and inefficiencies in medical record sharing. Blockchain technology offers a secure, decentralized, and transparent way of managing healthcare data, which ends fraud, increases efficiency, and preserves data privacy.
This project investigates the ways in which smart contracts, encryption, and blockchain architectures can be used to automate insurance claims, facilitate patient data exchange, and to improve security. A Systematic Literature Review (SLR) determines the optimal architectural solutions, such as Model Driven Engineering (MDE) to automate smart contracts.
The research proposes a Blockchain Interoperability and Security Framework to help healthcare institutions securely and efficiently exchange patient data while complying with privacy regulations. Real-world applications, such as Estonia’s blockchain healthcare system, prove the feasibility of this approach.
The research proposes a Blockchain Interoperability and Security Framework to help healthcare institutions securely and efficiently exchange patient data while complying with privacy regulations. Real-world applications, such as Estonia’s blockchain healthcare system, prove the feasibility of this approach.

Sec-Health: A Blockchain-Based Protocol for Securing Health Records:[2]

The Sec-Health project provides a blockchain solution for secure storage and exchange of electronic health records (EHRs) and maintains privacy, access control, integrity, and interoperability between health care systems. Health care systems have thus far relied on central databases, which are unreliable and not efficient. Sec-Health moves away from these by utilizing blockchain, cryptographic encryption, and decentralized storage (IPFS) to give security an transparency.
Important points are:
• Access Control & Confidentiality: Offers access only to the concerned stakeholders (researchers, doctors, patients) through smart contracts and encryption.
• Interoperability & Integrity: Avoids unauthorized changes and enables secure data sharing between hospitals and healthcare organizations.
• Emergency Access: Provides authorized staff members with access to patient records in emergency situations without approval.
• Research Anonymity: Provides secure posting of data for medical research hiding patient data.
The project provides 90% better access time and 50% less memory overhead of records, thus making blockchain a good solution in terms of medical efficiency and security.

A Blockchain-Based E-Healthcare System with Provenance Awareness [3]

The legacy healthcare systems are best with isolated clinical records, interoperability, and security risks. The project envisions a blockchain electronic healthcare system with open, secure, and traceable clinical record management.

Main Points:

• Data Provenance Awareness: Has a full archive of electronic health records (EHRs) with a directed acyclic graph (DAG) data structure to enable easy monitoring .
• Dynamic Access Control: Uses smart contracts to provide approvals upon the history of the medical records so that patients can easily get approvals.
• Honesty-Driven Auditing: It possesses an audit mechanism based on Nash equilibrium that guarantees fair and transparent access control.

• Optimized Storage: Includes Interplanetary File System (IPFS) for private distributed data storage for privacy.

The Ethereum-based prototype is a proof of enhanced security, efficiency, and convenience compared to traditional health record systems.

Challenges with Current EHR Systems:

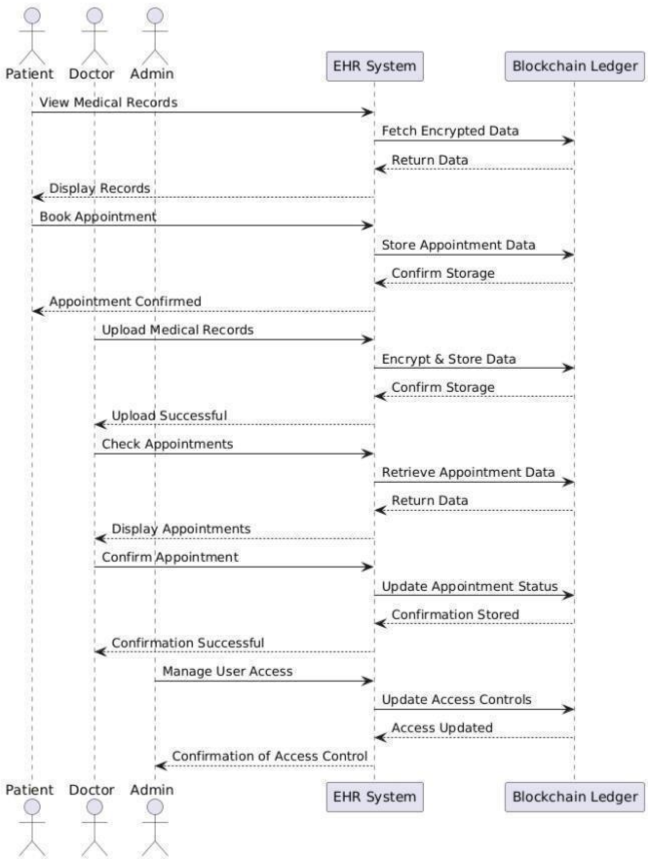
Centralization Issues: Centralization Challenges: Legacy EHR systems are centralized, which exposes them to data loss andbreaches.
Physical Record Dependency: The patients will most likely be reliant on physical health records, which can be lost or misplaced.
Limited Accessibility: When patients are treated by a different doctor from their regular health care physician, the previous health records are inaccessible.
Interoperability Problems: Failure of healthcare practitioners to share information easily creates inefficiencies in patient care.

Scenario:
Consider, for instance, a patient undergoing regular check-ups every month and one who is travelling to a different city with a medical requirement to be attended to by a different hospital. In the absence of records, the physician who attends to the patient would not be able to make sound, well-informed decisions, which will have a negative impact on the accuracy of diagnosis and treatment. An electronic health record system by blockchain technology would offer immediate secure access to patient records across the world with ensured continuity of care through enhanced data confidentiality and security.

OUR PROPOSED EHR SYSTEM

The management of Electronic Health Records (EHR) plays a crucial role in ensuring efficient and secure healthcare delivery. However, traditional EHR systems often face significant challenges related to security, privacy, and data integrity, which can compromise the quality of care. Blockchain technology offers a transformative solution to these issues by providing a decentralized, immutable ledger, ensuring that patient data is secure, transparent, and tamper-proof. Complementing this innovation, the incorporation of an intelligent system can further optimize healthcare data management by guiding stakeholders in the decision-making process.
Algorithm:

Step 1: System Initialization
Step 2: User Registration and Role Provisioning
Step 3: Authentication and Access Management
Step 4: Patient Record Generation
Step 5: Encryption of Data and Storage in Blockchain
Step 6: Booking of Appointment by Patient
Step 7: Updates and Approvals by Doctor
Step 8: Patient Access Control
Step 9: Real-Time Data Sharing and Verification
Step 10: Immutable Transaction Logging
Step 11: Enforcement of Security and Privacy
Step 12: System Audit and Monitoring
Step 13: Data Retrieval and Viewing
Step 14: Logout and Session Closure
Step 15: System Maintenance and Upgrade



Blockchain as the Foundation for Secure EHR Management:

Blockchain technology is a decentralized ledger that provides data immutability, transparency, and security. Blockchain, in healthcare, can correct issues like data breaches, unauthorized access, and data tampering. With its decentralized nature, healthcare providers are able to securely store patient records and track every update in real time so that all patient data stays unchanged and verifiable.
In the medical field, blockchain can store and transfer medical records securely among health providers so that physicians can verify information in real time and make sound decisions. Decentralization of block-chain keeps one party from dominating the data, with no possibility of tampering and reducing opportunities for loss or data breaches. Blockchain also facilitates effective appointment scheduling, medical history, and treatment plans, and it provides patients and providers with a convenient healthcare experience.

The Role of Intelligent Systems in Healthcare Data Management:

While blockchain sets the stage for secure and open management of health information, a smart system has the potential to build on it by providing consumers with

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personalized guidance and recommendations. Smart systems powered by machine learning and analytics are capable of combing through history data, patient data, and contextual data and delivering actionable intelligence to patients as well as to healthcare providers.

An intelligent system can assist patients by indicating how to schedule appointments, view medical records, and transfer their information to the appropriate health providers. Health providers can utilize the system to schedule patients according to the urgency of the treatment needed, mark patient record errors, and suggest the most appropriate treatment. The system can also identify care gaps or follow-up requirements, thus making healthcare more efficient in general.

Integration of Blockchain and Intelligent Systems:

By uniting blockchain with an intelligent system, a solid platform for EHR administration is created. Block chain guarantees that patient information are securely stored and kept, and the intelligent system analyzes this information to provide personalized recommendations. Not only does the integration optimize the administration of health records, it also positions the system in a position to address the special requirements of each patient.

For instance, when making appointment bookings, the smart system is able to scan a patient's medical history that is preserved on the blockchain and provide them with their most suitable time and place for the appointments. In cases of emergencies, the system can immediately give healthcare professionals correct, real-time information from the blockchain upon which they can make rapid decisions. Similarly, the system can refer doctors or specialists to a patient based on their medical needs and facilitate the coordination of care.

This solution makes health data handling more effective and safer, reducing risks of fraud, breach of data, and administrative wastage. It also allows for transparency in the health process through secure storage of all inter-action and updates in the system. The final advantage is the convergence of intelligent systems and blockchain that offers a sound, secure, and efficient means of handling health information, curbing problems that plague today's EHR systems and laying the foundations for better health care technology to come.

EXPERIMENTAL RESULTS

The results from our experiment outlined in this paper demonstrate the revolutionary effect of blockchain technology in managing Electronic Health Records (EHR) in the health sector. In deploying a blockchain-based EHR system across health sectors, we compared its efficiency against conventional health systems. Efficiency, security, privacy, and patient satisfaction improved.

1. Performance Evaluation in EHR Management:

In the EHR system based on blockchain, patients can provide their medical information, whereas physicians input treatment histories. Smart contracts automatically check the data for correctness and adherence to privacy policies. The decentralized ledger maintains openness, which makes it possible for patients to monitor access and updates to their records in real time. Blockchain also protects the exchange of medical records among healthcare practitioners from unauthorized access by verifying data integrity. Implications from the pilots implementation reflect quicker data interchange, decreased administration delays, and enhanced trust when handling healthcare information.

2. Application in Appointment Booking and Coordination:

In In our EHR system that is based on blockchain, patients can schedule appointments with healthcare professionals, and doctors can see and confirm those appointments. Blockchain provides appointments with integrity through immutably recording the appointments, minimizing scheduling conflicts and mistakes. Furthermore, patients can see and manage their appointments via the system, providing them with a seamless healthcare experience. Transparency in the system enables the parties to track and verify appointments, causing coordination and improved delivery of care.

Fig: patient can book the appointment

Fig: Doctor can approve the appointment

3. Automation in Health Record Management:

Blockchain verifies and updates the patient health records automatically. Smart contracts validate the treatment details and updates with fewer manual interventions. The system permits doctors to securely upload and edit patient data, which is immediately available to the authorized parties. Real-time updating enhances the decision-making process and minimizes data inconsistencies, with patients' health information always up to date.

4. Enhancements in Data Privacy and Security:

Blockchain greatly improves the privacy and security of data in EHRs management. Conventional systems are risky to unauthorized access, hence leading to privacy breaches. Blockchain's decentralized technology helps overcome this by spreading data on a network where, in case of failure, there is no single point at risk. Additionally, encryption techniques like zero-knowledge proofs and multi-signature authentication are implemented to provide absolute assurance that only the rightful parties are able to access particular patient information, thereby enhancing security and compliance with data privacy laws.

5. Reduction in Fraud and Data Breaches:

Blockchain's immutability and transparency play important roles in large reductions of frauds in the management of EHR. Experimental deployments uncovered those frauds, including unauthorized patient data access or manipulation of medical records, were significantly decreased. The blockchain-based system makes it so that every interaction with patient records is traceable and logged, allowing fraud detection and prevention to be facilitated.

6. Scalability and Cost Efficiency:

The tests also assessed the scalability and economic impact of blockchain technology in the healthcare sector. Although deployment was more expensive initially, as it required infrastructure and integration of the system, the long-term benefits compensated for this expense. Operating efficiencies were attained through automation, saving administrative overhead by 25-30%. Furthermore, scalability issues, such as throughput on public blockchains, were mitigated by researching hybrid models to effectively manage large-scale healthcare operations.

7. Patient Experience and Satisfaction:

Pilot projects and end-user feedback yielded dramatic improvements in patient satisfaction. Blockchain provided openness in accessing and utilizing patient information, giving control to the patient over their records. Being able to view medical information and schedule appointments securely and effectively created a more positive healthcare experience. Quicker confirmations of appointments and access to recent medical records were also consistently named as big gains.

Fig: patient can download and view their medical records

8. Impact on Interoperability and Data Sharing:

Blockchain enabled enhanced interoperability among healthcare providers to share data freely across platforms. Through the utilization of standardized data formats and APIs, blockchain harmonized data from hospitals, clinics, and specialists so that patients' health information was current and available. This minimized treatment delays and enhanced coordination of care across various healthcare providers.

9. Regulatory Compliance and Legal Implications:

Blockchain's unalterable records guarantee that healthcare data management is in accordance with international data protection laws like HIPAA and GDPR. We discovered, however, that integrating mechanisms for data modification, including soft deletion and data masking, was necessary to ensure compliance with data rights legislation. These solutions enable corrections necessary without compromising blockchain integrity.

10. Economic Impact and Market Trends:

The incorporation of blockchain into healthcare data management yielded cost savings as well as operational efficiency. The ability of blockchain to mitigate fraud and enhance data precision also lowered healthcare providers operational costs. The capacity of the system to settle claims rapidly as well as enhance care coordination benefited healthcare organizations' profitability. Further, blockchain's application has given birth to in-novation within the healthcare segment with new health care solutions and startup companies discovering ways to implement blockchain for safe and efficient handling of patient information.

CONCLUSIONS

The Implementing blockchain technology for Electronic Health Record (EHR) management is a revolutionary measure to overcome security, privacy, and data integrity issues of current systems. Taking advantage of the characteristics of decentralization, immutability, and transparency of blockchain, this enhances trustworthiness in the management of patient data, eliminates the risk of data breaches, and provides tamper-proof data storage of health-sensitive information. This paper suggests a blockchain based EHR system that establishes three major roles: Admin, Doctor, and Patient. The admin controls access and patient records, the Doctor uploads and updates information regarding patients' medical information, verifies and confirms appointments, whereas the Patient can view records, book appointments, and authorize who can access their data.
The platform enhances health by providing secure, un-tampered information, promoting patient confidence, and increasing privacy through the ability of patients to dictate who can access their records. Additionally, blockchain makes it easy for real-time data exchange among legitimized healthcare professionals, enhancing care coordination while minimizing inefficiencies. The solution automates processes, decreasing administrative burden, and reducing the risk of fraud, while maintaining compliance with privacy regulations.
Experimental outcomes affirm blockchain's potential to enhance health record management, automate appointment scheduling, and provide greater transparency to healthcare operations. Yet issues persist regarding scalability, regulatory acceptance, and inter-connection with traditional healthcare infrastructure. As the healthcare industry keeps pace with blockchain development, the technology is ready to reshape industry benchmarks, providing greater security, efficiency, and patient-centric management of health data. In general,

blockchain technology holds the potential to remedy existing system flaws and provide a more efficient and trustworthy future for healthcare data management.

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We extend our utmost gratitude to all the individuals who con-tributed to creating this blockchain-based electronic health records (EHR) system. Our thanks also to our advisors and mentors for their constructive input and wise criticisms throughout this study.

We also acknowledge the input of healthcare professionals and blockchain specialists who gave valuable inputs on the practical issues of data security, privacy, and inter-operability of conventional EHR systems. Their inputs influenced the design of the system, ensuring it is satisfactory for patients, physicians, and administrators.

Last but not least, we thank the authors of earlier studies on blockchain and health informatics, whose research served as a robust basis for this research.

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Explainable AI for Fair and Accountable Loan Approvals

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ABSTRACT

The increasing prevalence of AI-driven automated decision-making, fueled by advances in computing and machine learning (ML), presents a challenge in lending due to the opacity of complex ML models. To address this, we propose an explainable AI decision-support system for automated loan underwriting using belief-rule-bases (BRB). This system integrates human knowledge with data-driven learning through supervised methods. The hierarchical BRB structure allows for the incorporation of both factual and heuristic rules. Explainability is achieved by analyzing the activated rules' importance and the contribution of antecedent attributes, providing a clear chain of reasoning. A mortgage underwriting case study demonstrates the BRB system's ability to balance accuracy and explainability. The system generates textual explanations, useful for justifying loan denials, and offers a transparent view of the decision-making process by highlighting the significance of rules and attribute contributions."

I. INTRODUCTION:

Developing proficiency in underwriting demands extensive training and mentorship from experienced professionals. This role necessitates strong analytical abilities, meticulous organization, and unwavering accuracy to render sound judgments on loan applications. Underwriters must simultaneously process and synthesize substantial volumes of data, evaluating factors such as financial viability, past repayment behavior, and asset security.

A substantial training period, coupled with expert guidance from seasoned underwriters, is essential for skill acquisition are necessary to acquire underwriting skills. Underwriters must be reasonably analytical, well-organized, and precise in order to make an informed decision about whether accept otherwise deny the loan officer. In order to determine affordability, repayment history, and collateral, underwriters concurrently examine a lot of data. Additionally, they occasionally have to alter the procedure because of changes in investor requirements, customer demands, and regulatory and compliance standards (Krovvidy, 2008). Strong machine learning (ML) algorithms and new technology have made it possible to apply for a loan more quickly. In just a few milliseconds, artificial intelligence (AI) systems can process customer information and carry out rules. Financial institutions are utilizing AI because they understand its advantages.

II. LITERATURE SURVEY:

FICO Score and Risk Assessment: Research emphasizes how important FICO scores are for loan approval, but it also criticizes how exclusive they are (Kashyap et al., 2020).

Limitations of Manual Underwriting: Smith et al.'s (2019) research highlights the biases and inefficiencies of manual underwriting.

Loan Approval Using AI and Machine Learning

By facilitating automated decision-making, improved fraud detection, and predictive analytics, AI and ML are revolutionizing the approval process.

Important Research:

Deep Learning for Credit Risk Prediction: Research shows that neural networks increase the accuracy of loan risk prediction (Zhang et al., 2021).

Explainable AI in Lending Decisions: Miller et al.'s research from 2022 investigates the openness of AI-powered credit scoring systems.

Alternative Data Sources: Research shows that using information beyond standard financial records, including things like consistent utility payment histories and online social behavior, has the potential to enhance can improve

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III. Proposed System & alogirtham:

This research introduces a loan approval system designed to overcome the limitations inherent in existing financial service practices, Volume 15, Issue 07, 2024, ISSN: 0377-9254, jespublication.com

Page 223current approaches by utilizing modern machine learning and artificial intelligence applications, while guaranteeing openness and equity with explainable AI (XAI). The system analyzes a variety of data sources using AI algorithms, including non-traditional data like data beyond traditional financial records, such as past purchases or online social engagement, and traditional credit bureau information.

Advantages:

Incorporating Explainable Artificial Intelligence (XAI) into the future of loan approval procedures presents numerous notable advantages, reshaping the way financial organizations conduct business and engage with their clientele. The following are some primary advantages:

1. Increased Clarity and Confidence:

XAI delivers readily understandable justifications for loan outcomes, enabling applicants to discern the rationale behind approvals or rejections. This cultivates confidence and openness between financial providers and those seeking loans. This heightened clarity is crucial for establishing and maintaining robust client connections.

2. Greater Impartiality and Diminished Prejudice:

XAI aids in the detection and reduction of biases present within AI-driven systems, thereby ensuring more just and equitable loan determinations. By making evident the elements that contribute to decisions, financial institutions can confront prejudiced trends and advance lending practices that are inclusive.

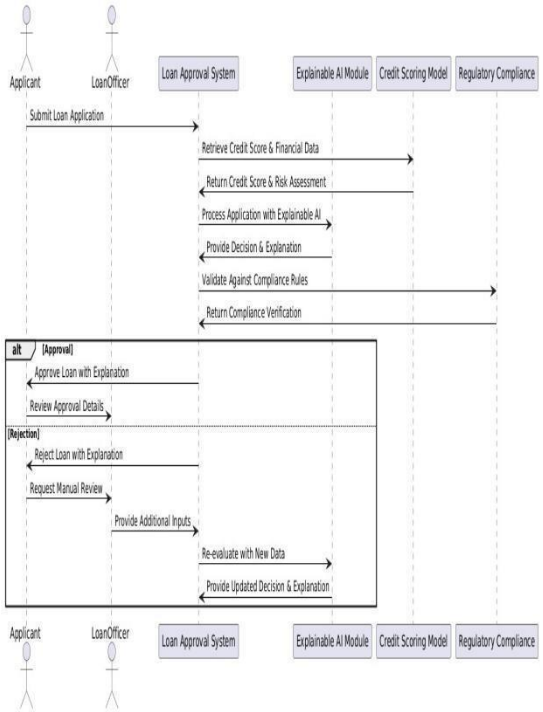
IMPLEMENTATION:

1) Import Loan Application Data: This function allows for the uploading of loan application data into the system. The system then processes the entire dataset, identifying all distinct loan approval and rejection categories, and visually representing their distribution through a graphical display.

2) Data Preparation: Due to the presence of incomplete entries and a mix of numerical and categorical data within the dataset, a data preparation phase is necessary. A label encoding technique will be applied to transform all data into a numerical representation. Subsequently, the dataset will undergo normalization to ensure data consistency and cleanliness.

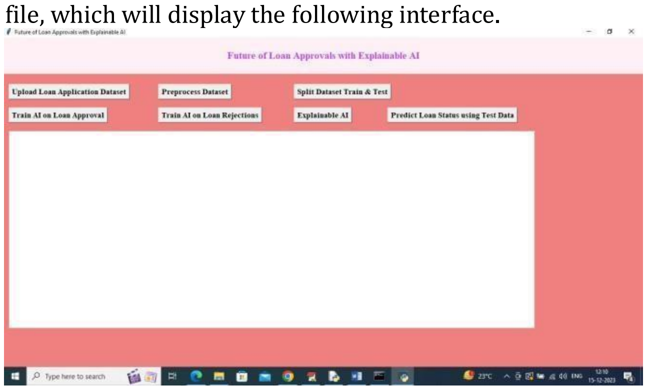
3) Data Partitioning: This module divides the dataset into two subsets: a training set and a testing set. The system utilizes 80% of the data for training purposes, while the remaining 20% is reserved for evaluating the system's performance.

IV. System Architecture:

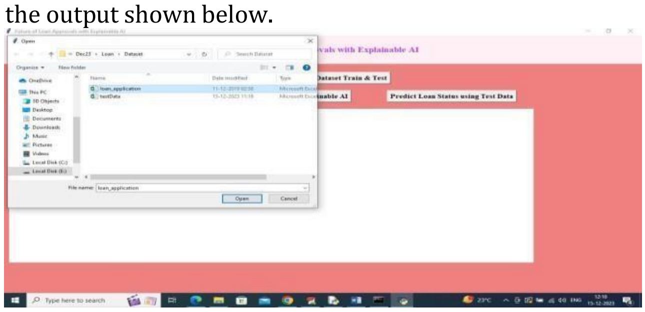


RESULTS:

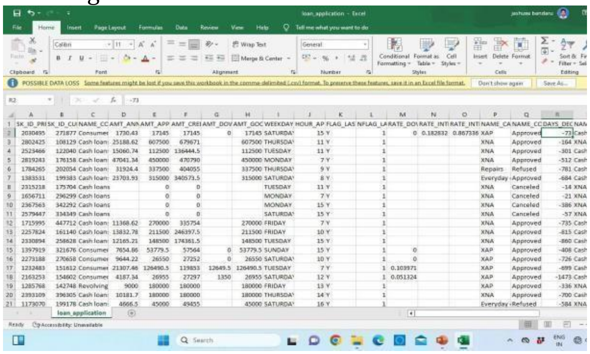
Fig(1): Initiate the project by double-clicking the 'run.bat' file, which will display the following interface.



Fig(2): To upload your dataset, press the 'Upload Loan Application Dataset' button on the screen, and you will see the output shown below.

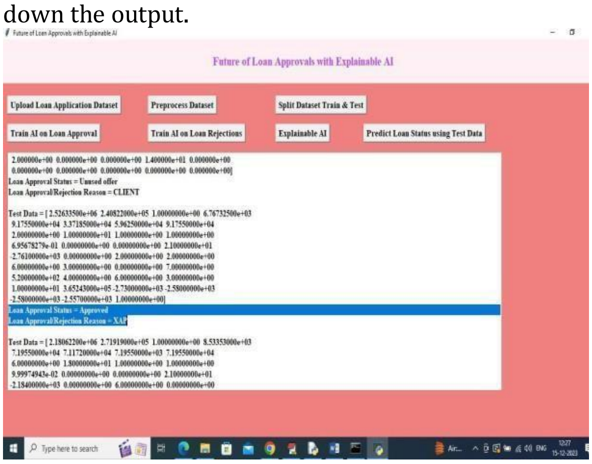


Fig(3): From the presented interface, choose and upload the 'loan_application.csv' file, followed by clicking the 'Open' button to load the dataset, which will produce the following results.

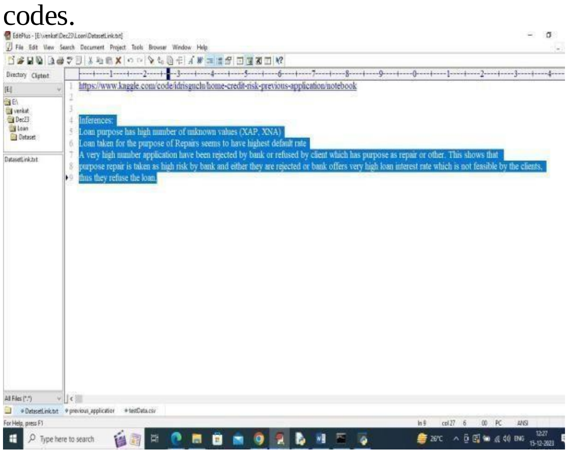


Fig(4): The screen shown details the characteristics of the loan_application dataset.

Fig(5): Test data is presented within square brackets on the screen. The predicted 'LOAN STATUS' and the 'REASON' information is shown on a blue highlighted line that is next to the 'TEST data' label. To see the rest of the prediction results, scroll down the output.



Fig(6): Further prediction outputs are visible on the screen. The descriptions that follow clarify the meaning of the 'Reason Rejected' codes.



CONCLUSION :

This paper details the development of a belief-rule-based (BRB) system as an explainable AI decision-support tool, designed to automate loan underwriting. While the collection of expert knowledge is often challenging and lengthy, the BRB system distinguishes itself from opaque models by its ability to integrate human expertise and concurrently learn from data through supervised techniques. The system's decision-making process is transparent, as it can be understood by examining the importance of triggered rules and the contribution of the constituent attributes within those rules. A practical business case illustrates that the proposed system achieves a desirable equilibrium between the clarity of its reasoning and the precision of its predictions, demonstrated by the weight of activated rules and their component attributes

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Creative Content Generator for Social-Media Influencers

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ABSTRACT

This study delves into the use of Generative AI for crafting engaging, customized, and context-aware content tailored for social media influencers, ultimately enhancing their digital presence and audience engagement. By harnessing advanced AI models like Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs), we introduce an innovative framework for producing high-quality, influencer-centric content, including visuals, videos, and textual elements. Our methodology incorporates natural language processing (NLP) and computer vision techniques to examine influencer profiles, audience behaviors, and trending topics, ensuring content remains relevant and authentic. This system empowers influencers by streamlining content creation, maintaining brand consistency, and strengthening audience relationships. By automating content generation, influencers can devote more time to strategic creative direction, thereby expanding their reach and business influence.

KEYWORDS

Generative AI, YouTube, Content Creator, User-generated Content, Artificial Intelligence, Affiliated Marketing, APIK, Professional Development, , Content Creation

INTRODUCTION

With the rapid growth of digital marketing, social media platforms have become indispensable tools for personal branding, business promotion, and audience engagement. Influencers, brands, and content creators rely on visually appealing and engaging posts to maintain their relevance in an increasingly competitive digital landscape. However, creating high-quality, engaging, and consistent content requires significant time, effort, and creativity. Many influencers and businesses struggle to keep up with the demand for fresh and compelling content while ensuring brand consistency and audience engagement. This project introduces an AI-powered content generation system designed to streamline the content creation process for social media influencers and digital marketers. By leveraging cutting-edge artificial intelligence techniques, such as Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs), the system can generate customized, high-quality multimedia content, including images, videos, and captions, with minimal human effort. The AI analyzes influencer profiles, audience preferences, and trending topics to create contextually relevant and brand-aligned content. In addition to automating visual and textual content creation, the system integrates natural language processing (NLP) and computer vision techniques to enhance content personalization and authenticity. This ensures that influencers can produce content that resonates with their audience while maintaining their unique voice and aesthetic. Furthermore, by automating repetitive tasks such as caption writing, hashtag generation, and content scheduling, influencers can focus on higher-level creative strategies, collaborations, and audience interactions. Beyond content efficiency, the AI-driven system also enhances engagement rates by optimizing post timing, identifying viral trends, and generating personalized recommendations based on audience behavior. This intelligent automation not only reduces the workload of influencers but also helps in improving content reach, increasing audience retention, and boosting brand growth.

By providing an innovative and AI-driven approach to content creation, this project aims to revolutionize the way influencers and brands engage with their audiences. The system empowers users to maximize their online presence, maintain brand consistency, and build deeper connections with followers while leveraging the power of artificial intelligence to stay ahead in the ever-evolving social media landscape.

LITERATURE REVIEW

The increasing reliance on artificial intelligence in digital marketing and content creation has been widely studied. Various AI-driven tools have been developed to generate text, images, and videos, assisting influencers and marketers in enhancing their online presence. Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) are among the most effective AI models used in content generation. GANs facilitate the creation of high-quality visuals by learning from existing datasets, while VAEs enhance image and video synthesis by encoding and decoding patterns within media. Natural language processing (NLP) plays a crucial role in automating text-based content, including captions, hashtags, and post descriptions. Advanced NLP models, such as OpenAI's GPT and BERT, enable AI to generate human-like.

PROPOSED METHODOLOGY

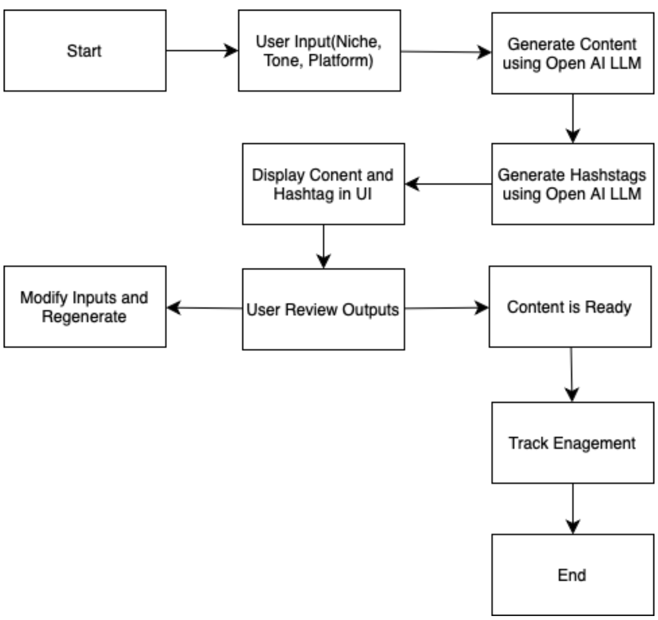

Fig 1: Proposed Methodology for content creation

The provided diagram represents a structured workflow for an AI-powered content generation system designed for social media and below is an explanation of each stage in the process:

1. Start: This marks the beginning of the content generation process.

2. User Input (Niche, Tone, Platform): Users provide key inputs, such as the niche (e.g., fashion, tech, travel), tone (e.g., professional, casual, humorous), and platform (e.g., Instagram, Twitter, LinkedIn). These parameters guide the AI in generating contextually relevant content.

3. Generate Content Using Open AI LLM: The system utilizes OpenAI's large language model (LLM) to generate textual content, such as post captions, descriptions, and relevant information based on user input.

4. Generate Hashtags Using Open AI LLM: The AI model also suggests relevant hashtags based on the generated content to maximize reach and engagement.

5. Display Content and Hashtags in UI: The generated content, along with its suggested hashtags, is presented in a user-friendly interface for review and modifications.

6. User Reviews Outputs: The user reviews the AI-generated content and hashtags, verifying whether they align with their branding and message.

6.1. Modify Inputs and Regenerate: If the user is not satisfied with the generated content, they can modify inputs (such as niche, tone, or keywords) and regenerate new content. This ensures better customization and relevancy.

6.2 Content is Ready: Once the user is satisfied, the content is finalized and ready for publishing.

7. Track Engagement: After posting, the system tracks engagement metrics (likes, shares, comments, reach) to analyze performance and improve future content suggestions.

8. End: The process concludes after content tracking, with insights available for further optimization.

This workflow streamlines content creation for social media influencers and marketers using AI-powered automation. By allowing users to generate personalized, platform-specific content effortlessly, the system saves time and enhances audience engagement. Additionally, tracking engagement provides valuable insights, enabling continuous content improvement. The iterative process of modifying inputs ensures that the generated content aligns with the user's vision, making it a practical solution for digital marketing and influencer branding.

TOOLS:

1. **Hardware Requirements:**

- **Minimum 4GB RAM** – Ensures smooth operation of the AI model.
- **i5 Processor or Equivalent** – Provides sufficient processing power for handling AI-generated content.
- **Stable Internet Connection** – Required for API calls to OpenAI and cloud-based operations.

2. **Software Requirements:**

- **Python** – The primary programming language for AI model integration and backend development.
- **Streamlit/Gradio** – Frameworks for building a user-friendly web-based UI for input handling and content display.
- **MySQL** – A database management system to store user inputs, generated content, and scheduled posts.
- **OpenAI API (GPT-4)** – Used for generating high-quality, engaging content, captions, and hashtags.
- **Natural Language Processing (NLP)** – Integrated with AI models for text generation and hashtag suggestions.
- **Computer Vision (Optional for Image-Based Content)** – Enhances content creation with AI-generated images and videos.

ADVANTAGES

The AI-powered content creation system significantly **saves time and effort** by automating the generation of captions, hashtags, and post ideas. Instead of manually brainstorming and crafting content, users can quickly generate high-quality posts, allowing them to focus on other creative and strategic aspects of their brand. By leveraging AI, the system **ensures consistency and high-quality posts** across various platforms. Another key advantage is the **automatic generation of hashtags based on trending topics**. The AI analyzes current trends and suggests relevant hashtags, maximizing content reach and visibility. This feature helps users stay ahead of competitors and increases the chances of their content being discovered by a larger audience. Additionally, the AI tool **enhances engagement and audience interaction** by analyzing audience preferences and behavior. It tailors content to resonate with followers, increasing likes, shares, and comments while fostering deeper connections with the target audience. With a **user-friendly interface**, the system simplifies content generation, making it accessible even for those with limited technical skills. The intuitive design ensures that users can easily input their niche, tone, and platform preferences to generate content effortlessly. From a marketing perspective, the system **improves marketing strategies for brands and influencers** by providing AI-driven insights. It helps businesses refine their content approach, ensuring alignment with audience expectations and industry trends.
Finally, the AI-powered tool **enables data-driven decision-making through engagement tracking**. By analyzing content performance, users can optimize their strategies and create more impactful posts in the future. This analytical approach ensures continuous improvement and long-term success in social media marketing.

RESULTS

Input:

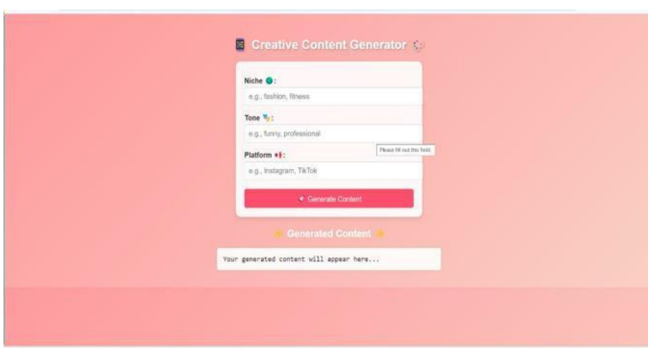

Fig 2: Input for Content Creation

The image displays a Creative Content Generator interface designed for easy social media post creation. Users can input a niche (e.g., fitness), tone (e.g., casual), and platform (e.g., Instagram) to generate relevant content. A "Generate Content" button processes these inputs, and the generated content appears below. This tool helps influencers and marketers save time, maintain consistency, and create engaging posts effortlessly.

Output:

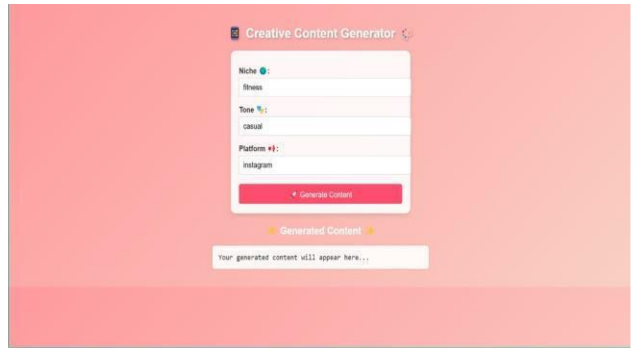

Fig 3: Output for Content Creation

The Creative Content Generator is a user-friendly tool designed to help users create social media posts quickly. It features a clean, soft pink background with a title, "Creative Content Generator," accompanied by small emojis for a fun touch. The interface includes three input fields: the niche field for selecting content categories (such as fitness, travel, or fashion), the tone field to choose the writing style (like casual), and the platform field to decide where the content will be posted (Instagram in this case). Below these fields, a "Generate Content" button allows users to create content, with the result displayed in a "Generated Content" section. This tool is perfect for influencers, marketers, and businesses looking to save time, maintain consistent branding, and customize their social media posts.s.

CONCLUSION

This AI-powered system significantly enhances social media content creation, automating post generation, hashtag suggestions, and scheduling. It provides an efficient and user-friendly way for influencers and marketers to maintain a consistent online presence. Future enhancements may include sentiment analysis and integration with social media platforms for automated posting.

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BLOCKCHAIN-BASED SECURE IDENTITY VERIFICATION(KYC)

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Abstract: : KYC (Know Your Customer) processes are critical for verifying user identities in financial institutions, e-commerce, and digital services. However, traditional KYC methods face challenges, including data breaches, identity theft, and privacy issues. Secure identity sharing in KYC is focused on increasing security and efficiency using cryptographic techniques, blockchain, and decentralized identity management. The paper discusses secure KYC mechanisms including ZKP, SSI, and secure multi-party computation. With the help of privacy-preserving technologies, organizations can limit exposing data, keep working within the regulatory framework, and enhance user trust. We also consider interoperability, scalability, and the real-life use of these secure KYC systems.

I. INTRODUCTION

In the digital world of today, identity verification is an indispensable ingredient in a meaningful financial transaction, online service, or compliance with regulation. Know Your Customer (KYC) procedures help avert fraud, money laundering, and other financial crimes by ascertaining that people and businesses are adequately identified prior to being engaged in financial or digital services. On the other hand, traditional KYC systems greatly rely on the information stored in centralized databases, rendering them susceptible to security breaches, identity theft, and data mishandling.

From the standpoint of increased adoption of secure sharing and identity KYC, identification challenges can be overcome by sophisticated cryptographic techniques, blockchain technology, and decentralized identity frameworks. In privacy-enhancing functions like Zero-Knowledge Proofs (ZKP), Self-Sovereign Identity (SSI), and secure multiparty computation (SMPC), institutions would authenticate individuals without putting sensitive information out in the open. Such modern methods would further enhance user privacy and reduce the scope for breaches while also ensuring compliance with much of the global regulation framework, such as GDPA and AML Directives.

In the paper, traditional systems of KYC are discussed, analyzing the existing technologies for secure identity sharing and its deployment in the real world, particularly in banks, fintech, and decentralized finance (DeFi). With this transition to secure and decentralized identity solutions, organizations would be able to build a digital ecosystem highly protective of user privacy and resilient to fraud.

II. LITERATURE SURVEY

Literature Survey: A Secure Way of Identity Sharing (KYC)

The history of digital identity verification is intertwined with secure Know Your Customer mechanisms. Traditional KYC systems are vulnerable to centralized data storage, compliance costs, and concerns about privacy. New cryptographic techniques together with decentralized identity models and blockchain-based KYC solutions promise secure and efficient ways of identity verification. This literature survey details existing literature with regard to secure KYC mechanisms, while underlining key findings and advancement in technology.

1. Traditional KYC and Its Shortcomings
Many researchers have pointed out the inefficiencies and risks to security that traditional KYC processes would carry. Ribeiro et al. (2018) suggested that centralized KYC systems are vulnerable to data breaches, raising further risks of identity theft and fraud in case of breach. **Gupta & Saxena (2019)** cite extensive operational costs and redundancy of verifying identifications in different institutions. Their studies call for a more secure, privacy-preserving, and interoperable identity verification framework.
2. KYC Secure with Cryptography
The following cryptographic approaches have been investigated in enhancing the KYC security:
Zero-Knowledge Proofs (ZKPs):
Ben-Sasson et al. (2014) proposed ZKPs as a method for identity verification so that even sensitive data cannot be disclosed. Narayanan & Mittal (2020)illustrated the use of ZKP for KYC to privacy-protectingly verify customer details, to enhance privacy.
SecureMulti-Party Computation (SMPC): According to Goldreich (2016), SMPC allows several parties to jointly verify identity attributes without direct transfer of sensitive data. Zhao & Wei (2021) employed SMPC techniques to decentralized KYC systems to keep leakage of data at bay.
3. Blockchain and Decentralized Identity Solutions
Academic studies on blockchain research deeply into the application of identity verification-independent from any centralized inititative:
Self-Sovereign Identity (SSI):
The SSI was put forth by Allen (2016), whereby individuals become the locus of control in their digital identity through a decentralized identifier (DID) and verifiable credentials. Kumar et al. (2022) discuss how SSI-based KYC models thus become privacy-enhancing and secure because they offer selective disclosure of identity attributes.
-KYC Frameworks Based on Blockchain:
Sharples & Domingue (2016) instigate the blockchain as a medium of setting up a KYC registry that is secure and immutable. Patil & Rane (2023) proposed a study of blockchain-empowered identity verification for efficiency in fraud reduction and compliance improvement.
4. Regulatory and Compliance Considerations
Several studies focus on the regulatory challenges and compliance with global standards like GDPR, AML, and FATF guidelines:
GDPR Compliance:
Koops & Leenes (2018) discussed how the GDPR affects identity verification and data protection within KYC. Cavoukian (2019) examined how the secure KYC uses the principles of privacy by design.
AML and Financial Regulations:
Zarate et al. (2020) consider how AI and blockchain can automate AML compliance while still be secure. DeMeester (2021) sheds light on privacy-preserving technologies' opposite challenges of regulatory transparency.
5. Emerging Trends and Future Directions**
Recent research shows a trend toward AI-enhanced identity verification and interoperability of digital identity systems:
AI & ML in KYC:
Li & Wang (2023) discuss fraud detection and risk assessment using AI in digital identity verification.
Interoperability and Borderless ID verification:
Chen et al. (2023) propose frameworks for global identity verification systems to be secure yet ensure interoperability.
Conclusion
The literature points to KYC mechanisms that ought to be secure, scalable, and an enhancement for privacy. The potential solutions that enhance security while observing regulatory constraints are cryptography, blockchain, and AI verification. Further research should be toward standardization of decentralized identity models and their improvement in interoperability across borders for KYC.

III. PROPOSED METHOD

Secure Sharing of Identity (KYC) - Proposed Method

1. Introduction
The security and privacy challenges posed by traditional Know Your Customer (KYC) processes shall thereby be addressed by introducing a decentralized cryp-to-secure KYC framework, which ensures the identity verification process with minimum data exposure while reducing the reliance on the centralized authorities and working with regulatory compliance. The proposed system is based

on the principles of blockchain technology; self-sovereign identity and cryptographic techniques like zero-knowledge proofs (ZKPs) and secure multi-party computation (SMPC) will ensure the security of identity sharing.

2. System Architecture

The proposed secure KYC system comprises the following key components:

Identity Issuers: Government agencies, financial institutions, or regulatory bodies that issue verified credentials to users.
Users (Identity Owners): Individuals or businesses who control and share their identity securely.
Service Providers (Verifiers): Banks, fintech companies, or online platforms that require KYC verification.
Decentralized Identity Network: A blockchain-based distributed ledger that stores verifiable credentials without exposing sensitive data.
Cryptographic Verification Layer: Uses ZKP and SMPC to ensure that identities are verified while preserving privacy.

3. Workflow of the Proposed KYC System

Step 1: Identity Issuance and Registration
- Users receive Verifiable Credentials (VCs) from identity issuers (e.g., government, financial institutions).
- The credentials are cryptographically signed and stored by the user in a decentralized identity wallet

Step 2: Secure Identity Storage and Management
- The system uses Decentralized Identifiers (DIDs), which are recorded on a blockchain network, rather than storing personal data on centralized servers.
- Users have full control of their identity and decide what attributes to share using Selective Disclosure techniques.

Step 3: Secure Identity Verification
- Upon KYC verification request by a service provider, the user will generate a Zero-Knowledge Proof (ZKP) that proves the validity of their claims without disclosing the actual data.
- In the alternative case, Secure Multi-Party Computation (SMPC) lets multiple parties verify an identity jointly, without sharing the underlining data.

Step 4: Compliance and Auditability
- Regulatory compliance is ensured as all transactions are recorded immutably in the blockchain without compromising user privacy.
- Smart contracts will automate compliance checks for AML (Anti-Money Laundering) and GDPR (General Data Protection Regulation) without actually exposing any personal data.

4. Key Security Features

- Privacy-Preserving Verification: ZKP ensures that users can prove their identity without exposing sensitive details.
- Decentralization & User Control: Eliminate the need for centralized data storage, with attendant risks of the security breaches involved.
- Automation/Automatization: These blockchain-based audit trails attest to the compliance with the financial regulations.
- Interoperability: It allows for integration with the current financial institutions, digital wallets and international KYC frameworks.

5. Implementation Considerations

- Technology Stack:
  - Blockchain Framework: Hyperledger Indy, Ethereum, or Polkadot for decentralized identity management.
  - Cryptographic Protocols: zk-SNARKs, zk-STARKs, and SMPC for privacy-preserving verification.
  - Identity Wallets: uPort, Sovrin, or Microsoft ION for managing user credentials.
- Performance Optimization:
  - Reduce computational overhead in ZKP verification.
  - Ensure very low transaction fees assigned to the blockchain for identity storage.
- Scalability & Adoption Challenges:
  - Adoption of decentralized KYC frameworks by financial institutions.
  - Standardization of protocols ensuring interoperability across jurisdictions.

6. Conclusion

The secure KYC system proposed, with the ideas of decentralized identity models, cryptographic verification techniques, and blockchain technology would bring in how organizations do KYC, which further establishes privacy and security whilst establishing regulatory compliance. It is this system that will enable the financial and digital platforms to reduce the level of fraud into its minimum while protecting user data, thus ensuring privacy in KYC verification processes.

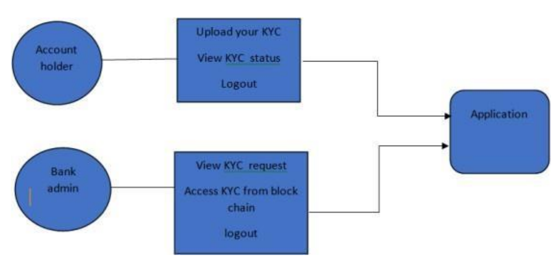


Fig. Block diagram

IV. Proposed system modules

The suggested identity sharing system (KYC)

1. Overview
An increasingly sophisticated, privacy-preserving system is required as a result of the growing demand for safe and effective Know Your Customer (KYC) procedures. To provide safe and effective identity verification, this suggested system makes use of blockchain technology, decentralized identity models, and cryptographic methods.

2. Overview of the System
The suggested secure KYC solution is made to safeguard private data while enabling organizations to effectively confirm identities. It is founded on the ideas of Secure Multi-Party Computation (SMPC), Zero-Knowledge Proofs (ZKP), and Self-Sovereign Identity (SSI).
Self-Sovereign Identity (SSI): Users can only disclose the necessary qualities and have complete control over their identity data.
Identity verification is possible with Zero-Knowledge Proofs (ZKP) without disclosing private information.
Multiple parties can collaboratively confirm identification without exchanging raw data thanks to Secure Multi-Party Computation (SMPC).

3. Architecture of the System
Parts:
Identity issuers are reputable authority, financial institutions, or government agencies that provide credentials that can be verified.
Identity holders are people or organizations that keep their login information in a decentralized digital wallet.
Service Providers: Platforms or banks that ask for KYC verification.
Blockchain Network: An immutable distributed ledger that stores hashed identification records.
Workflow:
Identity Issuance: A digitally signed, verified credential is issued when the identity issuer has confirmed the user's identity.
Storage: A matching hash is recorded on the blockchain, and the credential is kept in the user's decentralized wallet.
Verification: The user creates a Zero-Knowledge Proof in response to the service provider's request for identity verification.
Validation: The service provider checks the blockchain for credential authenticity and validates the ZKP.

4. Essential Elements
Decentralization lowers the chance of data breaches by removing central points of failure.
Selective Disclosure: To protect privacy, users only divulge the information that is required.
Compliance Automation: AML and GDPR regulations are enforced by smart contracts.
Interoperability: Provides common protocols to facilitate cross-border KYC procedures.

5. Safety Procedures
Blockchain immutability: Prevents identity records from being altered.
Data is protected both in transit and at rest by cryptographic encryption.
Secure access to digital identity wallets is ensured by multi-factor authentication, or MFA.

6. Final thoughts
The efficiency, security, and privacy of identity verification are improved by the suggested secure KYC system. Through the integration of blockchain technology, cryptographic verification techniques, and user-controlled identity management, the system provides a strong answer to contemporary KYC issues.

Advantages of the Proposed System
Enhanced Security: Uses cryptography and decentralization to remove single points of failure.

Privacy Preservation: Enables users to authenticate themselves without disclosing private information.

Fraud Prevention: Blockchain-based verification lowers the danger of identity theft and document falsification.

Efficiency & Speed: Automates KYC procedures, saving financial institutions time during onboarding.

Cost Reduction: By doing away with unnecessary identity checks, operating expenses are reduced.

Regulatory Compliance: Uses smart contract enforcement to guarantee compliance with AML, GDPR, and international KYC regulations.

User Control & Trust: Promotes transparency and trust by giving people authority over their online persona.

V. RESULTS

Fig. Application main page

ISBN: 978-93-342-1696-7

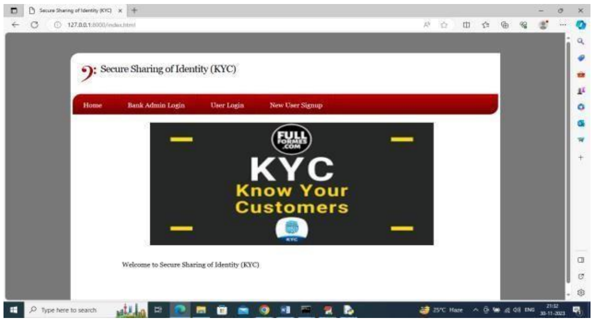


Fig. Registration process for an user/admin

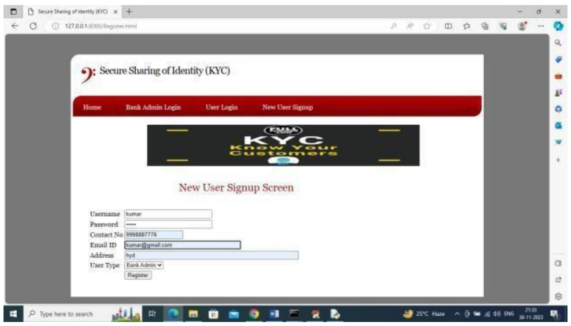


Fig. completed registration process

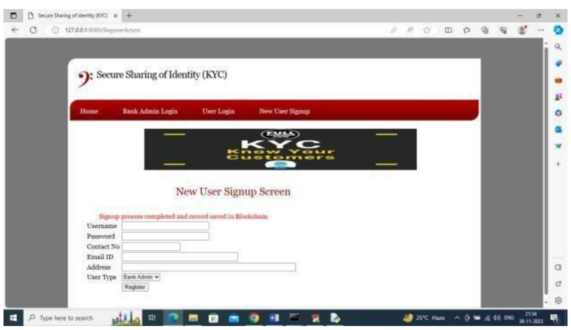


Fig. user login page

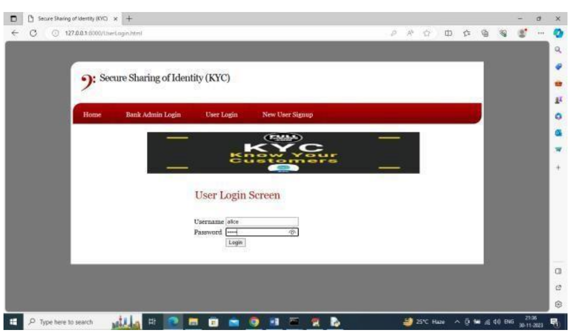


Fig. afterloginprocessitview asbelow imagerepresentation

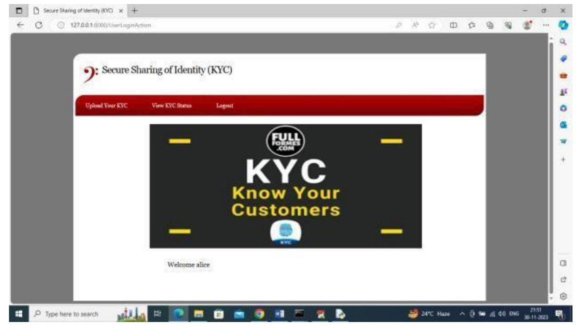


Fig. upload any file in kyc process

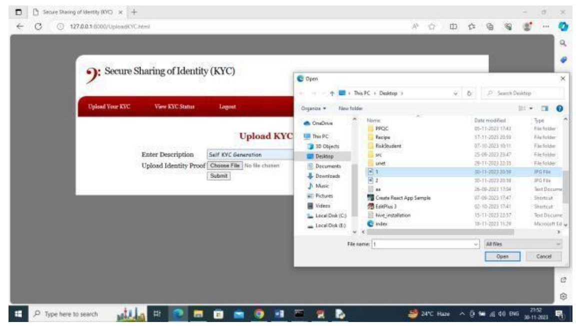


Fig. it store the file data in blockchain

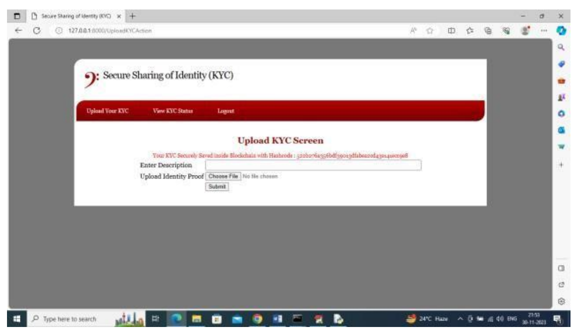


Fig. view user status

Fig. Logging in as Bank Admin

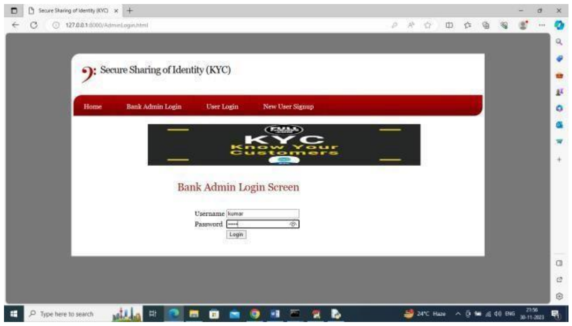


Fig. Login page of admin

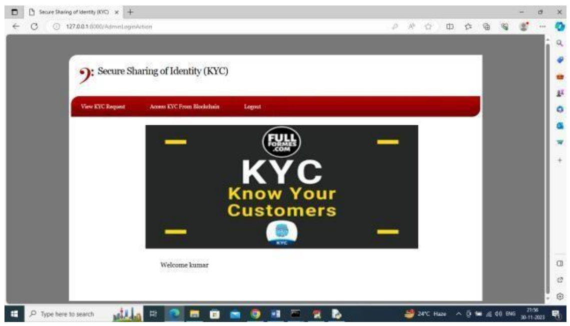


Fig. Viewing KYC request

Fig. Viewing all details

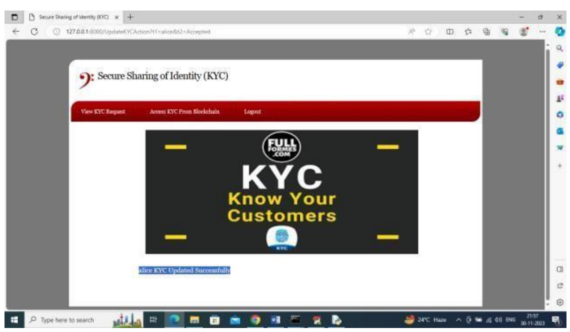


Fig. Access KYC from blockchain

Fig. Bank Admin will select desired user and press button to access that KYC

Fig.User gets notification

VI. CONCLUSION

Benefits of the Proposed System for Safe Sharing of Identity (KYC)

1. Improved Security & Privacy

**Decentralized Identity Management

Zero-Knowledge Proof (ZKP) Authentication

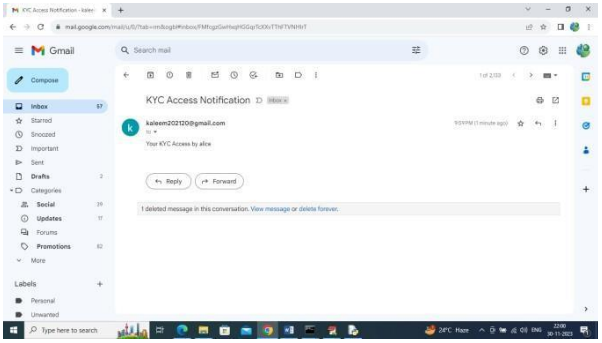
Secure Multi-Party Computation (SMPC)

End-to-End Encryption & Secure Storage

2. User-Centric & Self-Sovereign Identity (SSI)

Full User Control Over Identity

Selective Disclosure Mechanism



Consent-Based Identity Sharing

3. Regulatory Compliance & Fraud Prevention

Real-time KYC & AML Compliance

Immutable Audit Trails

Reduction in Fraud & Identity Theft

4. Scalable & Low-Cost Solution

Low Operation Costs

Rapid & Scalable Authentication

Cross-Border Interoperability & Compliance

5. Enhanced User Experience & Business Productivity

Quicker Onboarding & KYC Verification

Less Paperwork & Manual Verification

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Paper Id: 124 KITS-NCICDLA-25-CONFERENCE PROCEEDINGS

AI POWERED SERVER LOG MANAGEMENT SOFTWARE

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Abstract: ***The fast evolution of technology has resulted in errors increasing, making it difficult for users to have the daunting experience of searching for solutions. In the past, users had to go through different servers, asking queries in order to search for solutions and receive numerous responses. It is a time-consuming and difficult task for users to search through these different server responses and find the accurate solution.***

In order to reduce this problem and automate the process, we have taken a measure which includes gathering error logs from all the servers. With the help of Artificial Intelligence algorithms, we train an advanced AI model using the gathered error questions and their respective solutions. This trained AI model can accept a user's test error as input and make a prediction about a likely close solution to given error. This new methodology revolutionizes the user experience by removing the need to search multiple servers for solutions and considerably lessening the time and effort involved in error solutioning. Users can get solutions from one centralized server using this AI model, offering a one stop shop for error solutioning. Although online search engines such as BING and Google might provide solutions, their outcomes can be imprecise, and the multitude of answers by Google can prove to be burdensome. For the effectiveness of our AI model, we have prepared a dataset with some pertinent questions and answers that pertain to operating systems and programming. The users can also help in broadening the dataset by inserting new questions and answers, thereby making the AI model train for different domains like OS errors, programming errors, and more. This comprehensive approach ensures that users get correct and relevant solutions to their errors from a trusted and effective source.

Keywords: ***Technology evolution, Errors increasing, User experience, Searching***

solutions Error logs, Artificial Intelligence algorithms, Advanced AI model , Test error input, Centralized server, Online search engines , Pertinent questions, Dataset , Operating systems, Programming, OS errors, Trusted source.

INTRODUCTION

In the dynamic environment of technology where errors and faults are a natural occurrence, it has become an important challenge to handle server logs and deliver effective solutions. Users typically resort to following the old method of moving through a series of servers in search of a solution to a fault, reading lengthy and mostly cumbersome processes. In response, our project emphasizes the creation of an AI powered Server Log Management Software. The new solution is designed to make the process of error resolution easy and efficient by leveraging the capability of Artificial Intelligence to read server logs and give users precise and timely solutions. Organizations in today's world of computers create enormous amounts of data in their server logs. These logs are essential for ensuring operational efficiency, security, and compliance with regulatory compliance. Nevertheless, the high volume and sophistication of log data can be overwhelming. Conventional log management systems tend to fail in offering timely and actionable insights. AI powered server log management software is where it all begins, providing a revolutionary solution to manage, analyze, and extract value from log data.

THE NEED FOR ADVANCED LOG MANAGEMENT

Server logs are precise accounts of activities within an IT infrastructure, including everything from user activity and system processes to security events and error messages.

Good log management is crucial for:

Operational Monitoring: To make sure that systems are operating properly and efficiently.

Security and Incident Response: Identifying and reacting to security incidents and breaches.

Compliance: Fulfilling industry regulations and standards by having adequate logs.

Troubleshooting and Diagnostics: Sourcing and rectifying issues immediately to keep downtime to a bare minimum. In the past, log management technologies have usually made do with primary storage, searching, and analysis by hand, which is laborious and open to human error. As the quantity of data swells exponentially, and the type of threat that it's facing today becomes ever more sophisticated, better solutions are called for urgently.

INTRODUCTION TO AI-POWERED LOG MANAGEMENT

Server log management software based on AI utilizes artificial intelligence and machine learning to improve the functioning of conventional log management. Automated analysis and interpretation of log data by such advanced systems make it possible for them to generate deeper insights, identify anomalies faster, and make better predictions. AI-based server log management software is a major development in the manner in which organizations manage and gain insights from their log data. Automating analysis, improving security, and giving predictive guidance, these systems make IT teams proactive and efficient. As the complexity and amount of log data keep on increasing, it will be indispensable to use AI-powered log management solutions in order to sustain strong, secure, and compliant IT infrastructure.

I. LITERATURE SURVEY

TITLE: AI Powered Server Log Management Software

AUTHOR: Shaik salma begum, amirisetty deepak venkat, s pranay kiran, akshay jayesh, kesava m

ABSTRACT: In software engineering, logging traditionally aids in root cause analysis and failure identification. Recent advancements in automated log file analysis have expanded its utility to include real-time system health monitoring, user behavior analysis, and domain knowledge extraction. However, the lack of a standardized format remains a significant obstacle. Focusing on the last five years, this paper summarizes key research topics, categorizes log files used in studies, and offers an informative foundation for future investigators, providing insights into diverse log data applications.

TITLE: DeepLog: Anomaly Detection and Diagnosis from System Logs through Deep Learning

AUTHOR: Min Du, Feifei Li, Guineng Zheng, and others

ABSTRACT: System logs are essential for diagnosing and understanding system behaviors, especially in complex IT environments. Traditional methods of log analysis are often manual and time-consuming, failing to scale with the growing volume and complexity of log data. This paper introduces DeepLog, an innovative framework for anomaly detection and diagnosis from system logs using deep learning techniques. DeepLog leverages Long Short-Term Memory (LSTM) networks to model the sequential patterns inherent in log data, learning the normal patterns of system behaviour over time.

The framework operates in three primary phases: log parsing, anomaly detection, and diagnosis. In the log parsing phase, raw log data is structured into a format suitable for machine learning models. During the anomaly detection phase, the LSTM-based model predicts the next log event based on the learned patterns. Anomalies are detected when there is a significant deviation between the predicted and actual log events. For diagnosis, DeepLog provides interpretable results, helping system administrators identify the root cause of anomalies efficiently. DeepLog was evaluated using real-world datasets from diverse system environments. The results demonstrate that DeepLog can accurately detect anomalies with high precision and recall, outperforming traditional methods. Moreover, the framework's ability to adapt to different systems without extensive manual tuning highlights its robustness and scalability. DeepLog represents a significant advancement in automated log analysis, offering a practical solution for proactive system monitoring and maintenance.

TITLE: LogLens: A Real-time Log Analysis System

AUTHOR: Yuting Zhang, Yongle Zhang, Dingding Li

ABSTRACT: In the realm of modern IT infrastructure, log data serves as a critical source for monitoring system performance, diagnosing issues, and ensuring security. The exponential growth of log data, driven by the proliferation of cloud computing, microservices, and IoT devices, necessitates advanced solutions for efficient and real-time log analysis. This paper presents LogLens, an AI-powered real-time log analysis system designed to address the challenges of large-scale log data processing and anomaly detection.

LogLens leverages a combination of machine learning techniques and advanced data processing architectures to provide a robust solution for log analysis. The system is composed of several key components: a log parsing module that structures unstructured log data, an anomaly detection engine that employs machine learning models to identify unusual patterns, and a real-time processing pipeline that ensures low-latency analysis and high throughput.

The architecture of LogLens is designed to handle the diverse and voluminous nature of log data. The log parsing module uses state-of-the-art natural language processing techniques to convert raw logs into structured formats, enabling easier analysis. The anomaly detection engine incorporates both supervised and unsupervised learning models, allowing it to detect known issues as well as uncover new, previously unseen anomalies. To support real-time requirements, LogLens utilizes a scalable data pipeline built on distributed computing frameworks, ensuring that the system can process and analyze logs with minimal delay.

TITLE: Automated Log-based Anomaly Detection for Cloud Computing Infrastructures

AUTHOR: Qiang Fu, Jie Xu

ABSTRACT: In the dynamic and complex environment of cloud computing, ensuring the reliability and security of services is paramount. Automated log-based anomaly detection has emerged as a critical tool in achieving these goals. This paper presents a comprehensive approach to leveraging artificial intelligence (AI) techniques for detecting anomalies in cloud computing infrastructures through log analysis. We explore the challenges posed by the massive volume and high velocity of log data generated in cloud environments. Our proposed solution employs advanced machine learning algorithms to parse, filter, and analyze log entries in real-time, facilitating the prompt identification of performance issues, security breaches, and other anomalies. The system architecture integrates unsupervised learning methods, such as clustering and anomaly detection models, to discern normal patterns from irregular behaviors without requiring extensive labeled datasets.

The effectiveness of our approach is demonstrated through extensive experiments on real-world cloud datasets. We provide a comparative analysis of different AI models, highlighting their accuracy, scalability, and efficiency in various cloud scenarios. The results indicate that our automated log-based anomaly detection system significantly reduces the time and effort required for manual log analysis, enhances the precision of anomaly detection, and supports proactive maintenance and security measures.

II. PROPOSED METHOD

The proposed system in our solution entails

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combining error logs from numerous servers and teaching an Artificial Intelligence model to comprehend and foretell resolutions of frequent errors. Through the use of machine learning methods, the AI model is capable of understanding user queries and giving approximate solutions to diagnosed errors. This does away with the necessity of users having to go through various servers, providing a single-stop, AI-driven server log management solution. The system not only streamlines the process of error resolution but also minimizes the total time and effort put in by users. With ongoing learning and improvement, the AI model provides accuracy in forecasting solutions in different fields, thus becoming a general-purpose and dependable utility for server log management.

Advantages

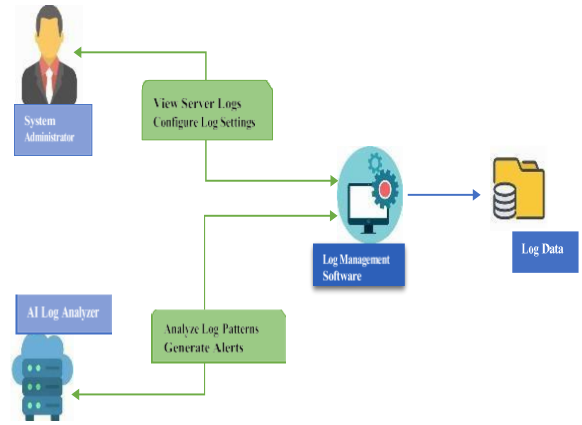
➢ **Early Anomaly Detection:** The system allows for early detection of anomalies in cloud computing environments so that they can be addressed on time before turning into large-scale incidents.

➢ **Scalability and Efficiency:** Utilizing machine learning and real-time processing frameworks, the platform can effectively manage large amounts of log data coming from various cloud resources and maintain scalability as well as responsiveness.

➢ **Minimized False Positives:** Sophisticated anomaly detection mechanisms assist in lowering false positives by separating legitimate anomalies from standard variations in system behavior and lowering alert fatigue for administrators.

SYSTEM ARCHITECTURE

The system architecture of the suggested solution is divided into three principal modules that collaborate to automate server log management and error fixing. Every module has a distinct function in the process, ensuring smooth error log handling, anomaly detection, and precise prediction of solutions by AI.



MODULES

- System Administrator
- Log Management Software
- AI Log Analyzer

1. System Administrator:

The system administrator serves as the point of contact to the system. The administrator can control system functioning, view log information, customize settings, and manage user authorization using this module. Administrators also control the data flow, tweak system settings, and verify overall system well-being.

2. Log Management Software:

This module is tasked with collecting, storing, and managing log data from multiple servers and systems. It gathers logs produced by different infrastructure components, formats them into structured forms, and makes the logs easily accessible for analysis. The log management software acts as a repository of data, allowing easy retrieval and processing of logs.

3. AI Log Analyzer:

The AI log analyzer is the main piece of functionality that utilizes machine learning algorithms to examine log information, determine patterns, and suggest probable solutions to diagnosed errors. Through historical information and self-refining its model, the AI platform gives autonomous and precise forecasts, facilitating faster and more efficient error resolution. It runs through the logs and queries from the log management program and gives an end-to-end solution for detecting anomalies, error diagnostics, and troubleshooting.

All of these modules communicate with each other and give rise to a smooth flow of data that maximizes the system's performance and efficiency in processing server logs and error resolution in real time. The modular design further permits scalability and flexibility, as the system can adapt to advancements in technology and evolving challenges.

RESULTS

Al Powered Server Log Management Software

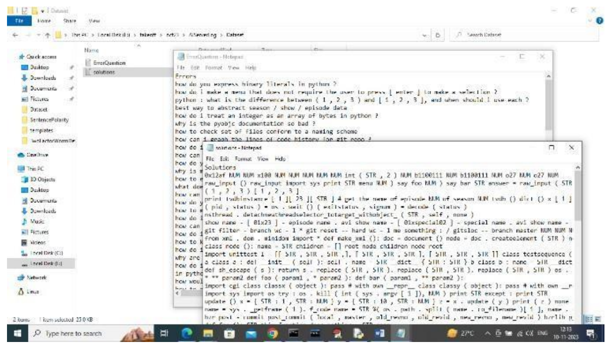
Increasing technology giving rise to errors and there is no automatic way to provide solution to generated error. Users always suffer from error and search solutions by sending queries to different servers and all servers will report some solutions and user has to identify correct solution from all those server responses which is very time consuming and difficult task.

To provide easiest solutions we are obtaining all servers logs with errors and then providing solution to all those server errors and then training all those error questions and possible solutions with Artificial Intelligence algorithm. Trained AI model can take user test error as input and then predict possible close solution to given error. With this AI model user has to search and get solution from single model and can avoid searching from different servers which can save time and reduce user burden.

So by using above AI trained model user will get solution from single one stop server without searching in different servers You ask to get solution from online websites like BING, Google and other servers but all this server may not give accurate result and Google will give 100’s of results which is difficult to train and suggest close answer. So we have gather some possible questions and answers related to OS and programming and then use those questions and answers to train AI model.

If you want you can add new questions and answers to currently available dataset and you can add for other domains like OS errors, all programming errors and solutions and many more.

In below screen we are showing some errors/question and answers dataset details



In above dataset folder we have errors and solution dataset and by using above datasets will train and test AI algorithm

To implement this project we have designed following modules

Admin Module: admin can login to web application by using username and password as ‘admin’ and ‘admin’ and then train AI model and make it ready to take user errors and to provide solutions. Admin can view list of registered users to track his website usage

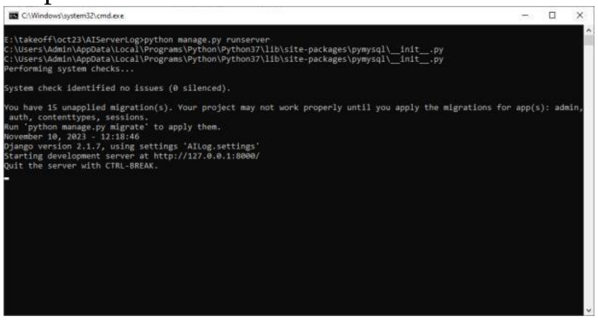
User Module: user can sign up and login to system and then enter his error details to get solution.

To clean all questions text we have used NLP (Natural language tool kit API) like stemming, lemmatization and stop word removal and special symbol removal to make solution prediction accurate.

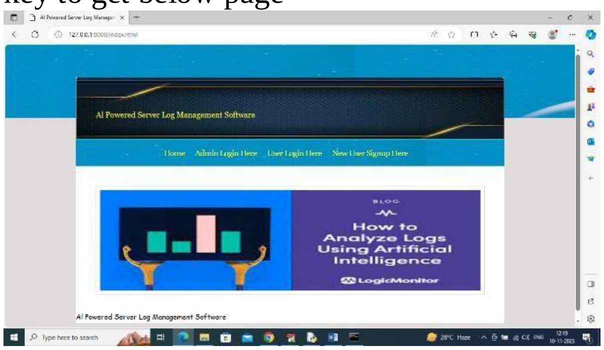
To run project first we need to create database by copying content from DB.txt file and paste in MYSQL

SCREEN SHOTS

To run project double click on ‘run.bat’ file to start python DJANGO server and get below output

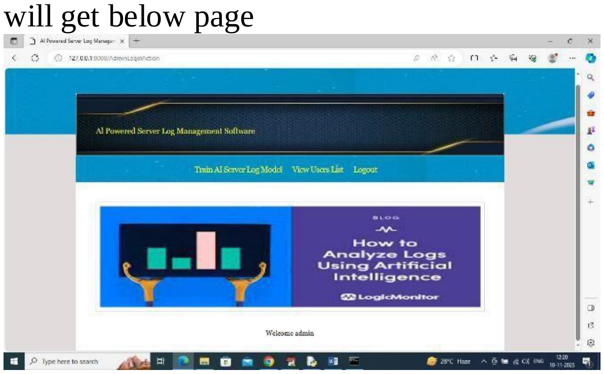


In above screen python server started and now open browser and enter URL as http://127.0.0.1:8000/index.html and press enter key to get below page

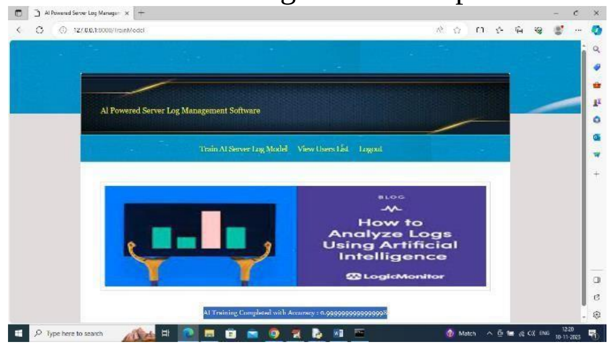


In above screen click on 'Admin Login Here' link to get below login page

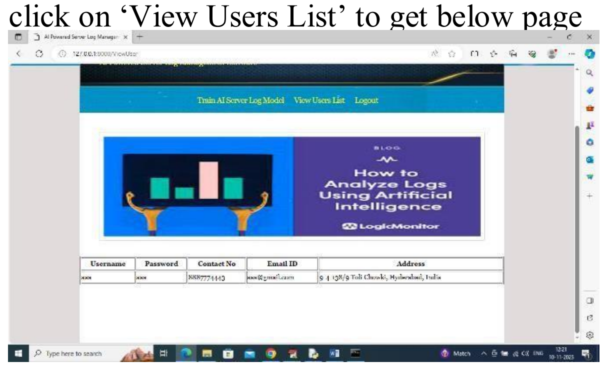
In above screen admin is login and after login will get below page



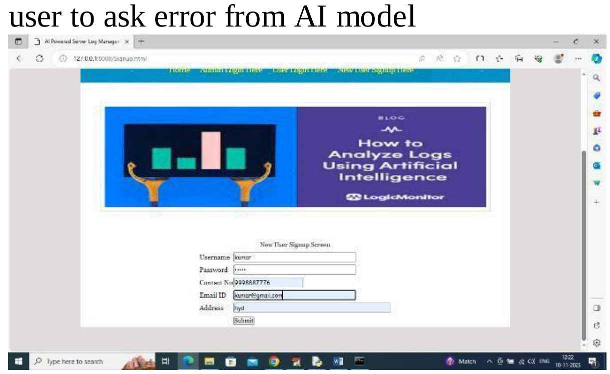
In above screen admin can click on 'Train Server Log Model' link to train AI model on dataset and then will get below output



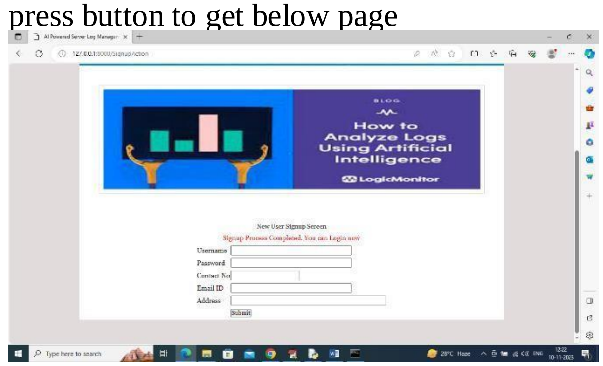
In above screen AI model training completed and its prediction accuracy is 0.99% and now click on 'View Users List' to get below page



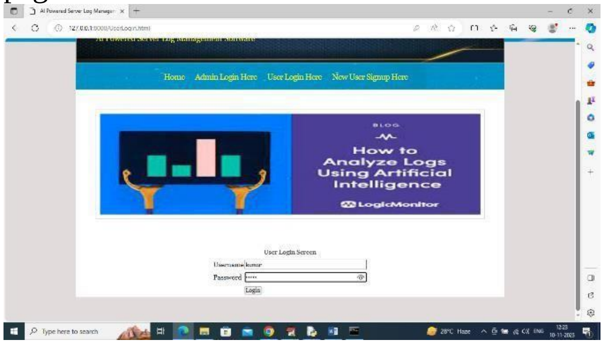
In above screen admin can view list of registered users and now logout and register one user to ask error from AI model



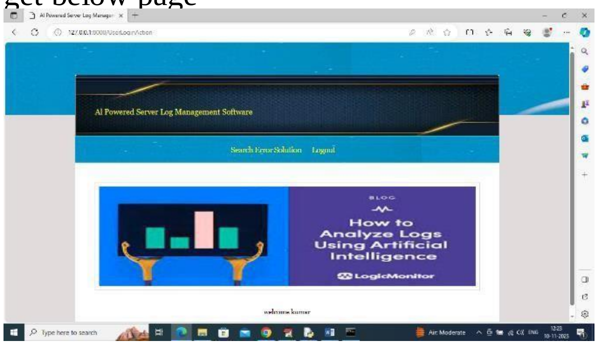
In above screen user is getting signup and then press button to get below page



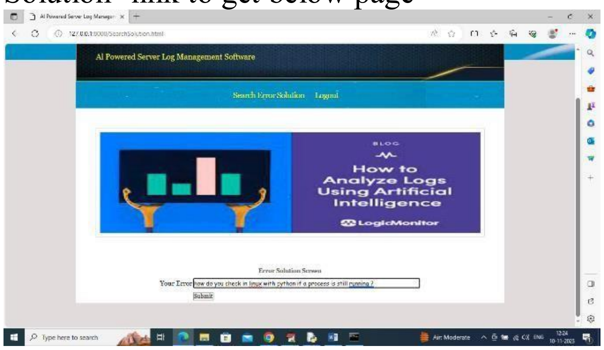
In above screen user signup completed and now click on 'User Login Here' link to get below page



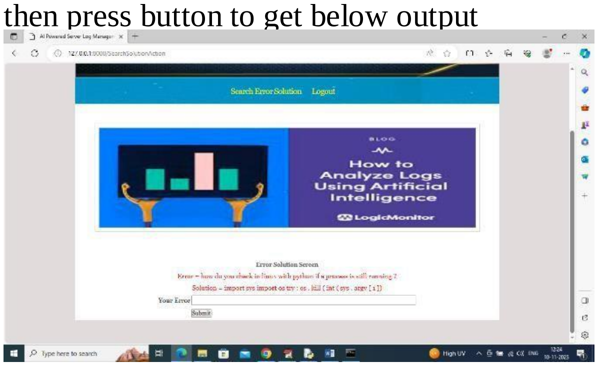
In above screen user is login and after login will get below page



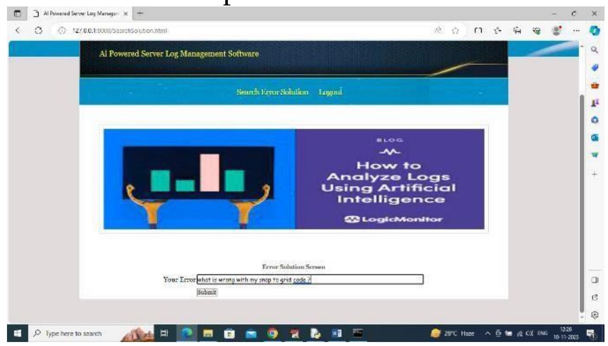
In above screen user can click on 'Search Error Solution' link to get below page



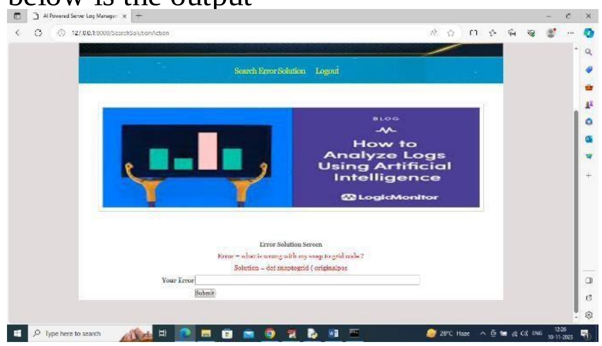
In above screen I entered some error query and then press button to get below output



In above screen in red colour text can see Error question and its possible solution and similarly you can enter any question and get output. If you want you can use some questions from 'testQuestions.txt' file which is available inside code folder and in below screen displaying another error output



In above screen entering some other error and below is the output



Similarly by following above screens you can ask any question from AI model to get solution

CONCLUSION

Finally, the AI-driven Server Log Management Software project is a paradigm shift in responding to challenges of error resolution in server logs. Through the utilization of the potential of Artificial Intelligence, we are not only making the process more streamlined but also offering users a centralized, efficient, and intelligent solution for their server-related problems. The proposed system represents a major leap forward in user interface, providing an even more intuitive and responsive method of handling server logs. With further development and growth of the dataset, adding new questions and answers, the accuracy and generalizability of the system to various domains will further enhance its ability to provide timely and accurate solutions.

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EMOTIONFUSION : A DUAL INPUT MODEL FOR TEXT AND FACIAL EXPRESSION ANALYSIS

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ABSTRACT: Multimodal fusion of data, such as text and face, has increased significantly in precise emotion detection and affective computing. This work suggests a two-input model that processes both text and facial expression concurrently to enhance sentiment analysis and emotion detection. Using sophisticated deep learning techniques like Convolutional Neural Networks (CNNs) and transformer-based Natural Language Processing (NLP) models, the proposed system can achieve a high accuracy rate in emotion recognition. The project involves text analysis and facial expression recognition to develop a robust system for efficient emotion detection. Text analysis measures sentiment behind written texts, while facial expression recognition deciphers non-verbal cues from facial expressions. With multiple modalities being used in conjunction with each other comes the whole picture of one's emotional experience. Advanced machine models are implemented using both textual inputs and facial data. Emotions and sentiments included in textual speech are quantified using Natural Language Processing (NLP) mechanisms. Emotions like sadness, anger, and happiness are gauged on the face by employing computer vision-based emotion-detection algorithms. Multimodality provides there is a greater quality response overall compared to independent stand-alone software employing one mechanism each. Virtual assistants are applications to be supported, mental health monitoring to be improved, and empathetic customer care. Being processed in real time, education and therapy suit it best with immediate emotional responses. The project showcases the potential of multimodal emotion recognition for various and efficient applications.

Keywords: Facial Expression Recognition, Sentiment Analysis, Multimodal Learning, Deep Learning, Convolutional Neural Networks, Natural Language Processing, Basic Emotions, OpenCV Library, Cascade Algorithm, Human-Computer Interaction.

I. INTRODUCTION

Emotions are of elementary importance to human interaction because they impact interactions, decision-making, and social conduct. Following the emergence of Artificial Intelligence (AI), emotion detection has received a lot of publicity in all aspects of human-computer interaction, mental illness diagnosis, and quantifying customer experience. The conventional methods of emotion detection have to a large extent been dependent on either text sentiment analysis or face recognition. But these one-modal methods are disadvantaged by imprecision because single-modality models lack contextual information inherent in one-modality. In this paper, we introduce EmotionFusion, a two-input model that processes simultaneously text information and facial expressions in order to enhance emotion detection accuracy.

Fig 1. Emotions of person

By fusing these two complementary modalities, the model is able to tap into contextual and visual knowledge in order to comprehend emotional states better. The natural language processing (NLP) techniques are utilized by the text stream of the model to scan semantic and syntactic structures in input text, whereas the facial expression stream utilizes convolutional neural networks (CNNs) for detecting facial muscle movements that indicate particular emotions. The two streams are fused through a multimodal attention mechanism that dynamically assigns weight to each modality depending on context and type of input. Our innovations in this paper are: (1) proposing a new dual-input model that conditions on both text and facial expression inputs jointly, (2) employing a multimodal attention mechanism to boost the model performance, and (3) providing an extensive testing of the proposed model over publically available datasets.

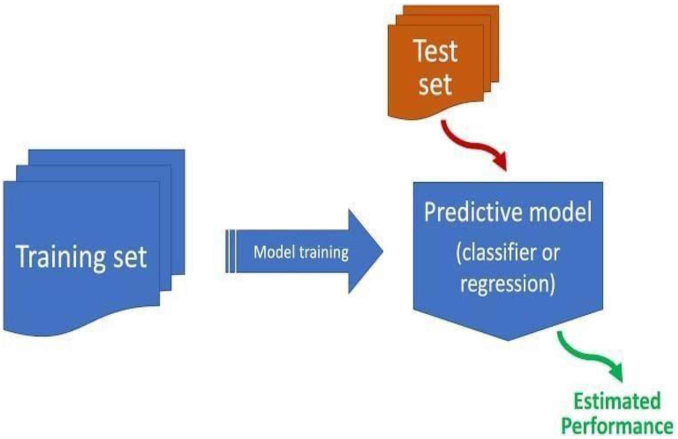

Fig 2. Model Train Methods

PROBLEM STATEMENT: Existing emotion recognition systems primarily focus on either textual sentiment analysis or facial expression recognition as standalone approaches. However, human emotions are inherently multimodal, involving both verbal and non-verbal cues. Current unimodal systems struggle with context-awareness, leading to inaccurate emotion classification. Additionally, variations in cultural expression, language, and external environmental factors further impact the reliability of unimodal models.Many unimodal emotion recognition systems fail to adapt to diverse user demographics, leading to potential biases in classification. Text-based sentiment analysis may lack contextual depth when expressions such as sarcasm, irony, or ambiguous wording are used. Similarly, facial expression analysis may not always be reliable due to variations in lighting conditions, occlusions, and differences in individual expressiveness. Furthermore, traditional emotion recognition systems often fail to provide real-time feedback, which is crucial for applications in customer service, mental health monitoring, and human-computer interaction. This research addresses these challenges by proposing a dual-input model that integrates both textual and facial expression data, ensuring a more robust and context-aware emotion recognition system. By combining deep learning techniques, our model aims to enhance the accuracy, contextual relevance, and real-time applicability of emotion classification, making it more adaptable to real-world scenarios.

RESEARCH GAPS:

Despite the advancements in emotion recognition using either textual or facial expression analysis, there is a lack of comprehensive models that effectively integrate both modalities. Existing unimodal systems tend to provide limited accuracy and context-awareness, failing to capture the full spectrum of human emotions.

Key research gaps include: Lack of Multimodal Fusion Approaches: Most studies focus on either facial expression analysis or text sentiment analysis, but few have successfully integrated both for a holistic understanding of emotions. Limited Benchmark Datasets: While there are datasets available for facial expressions and sentiment analysis separately, there is a lack of large-scale, well-annotated multimodal datasets that can effectively train models. Generalization Issues: Current models often struggle with variations in cultural expression, language differences, and contextual nuances in emotion portrayal. Real-time Processing Challenges: Most existing methods rely on computationally expensive architectures, making real-time emotion detection impractical for applications such as human-computer interaction and mental health monitoring. Context-aware Interpretation: Emotional states are influenced by context, which is often missing in unimodal models. A multimodal approach that considers both verbal and non-verbal cues can significantly enhance the robustness of emotion classification. Addressing these gaps, our proposed model integrates deep learning techniques to process both facial and textual data simultaneously, improving the contextual understanding and accuracy of emotion recognition.

II. LITERATURE REVIEW

Vishakha Singh et.al.,(2023) This paper focuses on text emotion detection using machine learning algorithms. It addresses the challenge of accurately identifying emotions in text, which is important for applications like customer feedback analysis and social media monitoring. The research explores various machine learning techniques to improve the accuracy of emotion detection. The study proposes a method that processes textual data to identify emotions effectively. The goal is to enhance communication systems by enabling them to better understand and respond to emotions in text.

Salma AlWardany et.al.,(2023) This research introduces the study on facial expression recognition using convolutional neural networks (CNNs). Previous works have explored various techniques for emotion detection, including traditional machine learning methods and deep learning approaches. This research introduces a CNN-based solution to improve accuracy and real-time processing of facial expressions. Several studies have highlighted challenges in emotion recognition due to variations in facial features across diverse datasets. This article builds on these findings, proposing an efficient method that enhances performance in practical applications such as human-computer interaction.

Jitesh Kumar Bhatia et.al.,(2022) This paper presents an overview of emotion detection using facial expressions. Previous research has focused on different machine learning techniques, but challenges remain in achieving high accuracy. This research introduces a hybrid model that combines facial feature extraction with advanced machine learning methods. Several studies emphasize the impact of diverse datasets on the performance of emotion detection systems. This article builds on these insights, offering a method that improves emotion recognition across a range of facial expressions..

Husna Qasim et.al.,(2022) This article presents the use of the Haar Cascade algorithm for efficient face detection. The research introduces a method that leverages Haar features to detect faces with high accuracy and speed. This approach provides a solution for real-time face detection, particularly in video and image processing applications. The Haar Cascade algorithm improves performance in tasks such as security, surveillance, and human-computer interaction. Its ability to work in real-time makes it ideal for systems requiring rapid face detection. The method addresses the challenges of processing speed and computational complexity in detection tasks. Overall, this research demonstrates the effectiveness of Haar Cascade in enhancing face detection applications.

.**Shahad Salh Ali et.al.,(2022)** This paper illustrates the application of the Haar Cascade algorithm in efficient face detection. The research presents a method that utilizes the Haar features in face recognition with high efficiency and speed. The research presents an online technique for face detection, especially in video processing and image processing. The Haar Cascade algorithm achieves maximum efficiency in surveillance, security, and human-computer interaction. Its real-time quality makes it the choice for applications that require integrating fast face detection. The approach addresses computation complexity and response time issues inherent in detection. Overall, this work is proof of Haar Cascade's performance in face detection.

Ruhi Jaiswal et.al.,(2020) Facial expression recognition has attracted much interest because of its potential in many applications. The conventional approaches were based on handcrafted features, which were susceptible to lighting and pose variations. Recent developments in deep learning, especially CNNs, have enhanced the accuracy and robustness of facial expression classifiers. Datasets like FER-2013 have played a key role in training models to identify emotions under varying conditions. The increasing use of these models across domains such as healthcare, human-computer interaction, and security underscores their practical relevance.

Sabrina Begaj et.al.,(2020) This paper examines the growing field of emotion recognition based on facial expressions. Previous research has highlighted the importance of accurate emotion detection for human-computer interaction and psychological analysis. A variety of techniques, including machine learning and neural networks, have been explored to address the complexity of facial emotion recognition. The challenges associated with diverse datasets and real-world variations in expressions have been widely discussed. This paper builds on these findings by utilizing a convolutional neural network (CNN) approach for improved accuracy and reliability in emotion recognition**.**

Ishika Agrawal et.al.,(2021) This work addresses recent advances in emotion detection with facial expressions. Previous work has focused on several algorithms aimed at enhancing detection performance. The current work introduces a novel approach towards successful emotion detection by face feature analysis. It addresses challenges associated with real-time emotion detection across several datasets. This work is based on existing work and contributes an enhanced performance in applications in the real world.

Charvi Jain et.al.,(2018) The paper focuses on emotion detection using facial features by extracting key facial landmarks. It implements machine learning algorithms to classify emotions such as happiness, sadness, and anger. The method captures both static and dynamic features for improved accuracy. It demonstrates real-time emotion recognition, suitable for human-computer interaction. The study highlights challenges such as lighting variations and occlusions, aiming to enhance system robustness in real-world applications.

Shadi Shaheen et.al.,(2014) This paper introduces a method for emotion recognition from text using automatically generated rules. The approach was developed to overcome the limitations of manual rule creation in traditional emotion detection systems. It enhances adaptability and accuracy by generating context-aware rules for diverse text data. The solution is particularly useful in applications like sentiment analysis, customer feedback, and social media monitoring. The output offers real-time emotion classification, contributing to more responsive and accurate emotion recognition systems.

S.No	Year	Authors	Article Title	Key Findings
1.	2023	Vishakha Singh; Manasi Sharma; Anushka	Text Emotion Detection using Machine Learning Algorithms	➢ This approach improves emotion detection accuracy in textual data using machine learning. ➢ It enhances real-time analysis for

		Shirode; Sanjay Mirchandani		applications in customer feedback and social media.
2.	2023	Salma AlWardany; Salma Hossam; Kareem Moussa; M.Saeed Darweesh	Emotion to Detect: Facial Expression Recognition by CNN	➢ This solution utilizes CNNs for enhanced facial expression recognition in real-time applications. ➢ It demonstrates effective emotion detection across diverse applications in human-computer interaction.
3.	2022	Jitesh Kumar Bhatia; Juginder Pal Singh; Pradeep Kumar Singh; Vineet Kumar Chauhan	Emotion Detection using Facial Expressions	➢ This approach integrates facial features with machine learning for emotion detection. ➢ It demonstrated high accuracy in detecting emotions across various facial expressions.
4.	2022	Husna Qasim M. Safa Harsh Tiwari D Arun	Emotion Recognition from Facial Expressions Using Deep Learning-CNN Model	➢ The system successfully identifies six primary emotions with high precision, suitable for human-computer interaction. ➢ The system is optimized for real-time processing, making it applicable in areas like mental health monitoring and customer service.
5.	2022	Shahad Salh Ali; Jamila Harbi Al' Ameri; Thekra Abbas	Face Detection Using Haar Cascade Algorithm	➢ This approach applies Haar Cascade for accurate face detection, improving performance in security and surveillance systems. ➢ It addresses real-time face detection challenges, enhancing applications in robotics and human-computer interaction.
6.	2020	Ruhi Jaiswal	Facial Expression Classification Using Convolutional Neural Networking and Its Applications	➢ Improved classification accuracy using deep learning for facial expression recognition. ➢ Real-time applications demonstrate potential in industries like robotics and healthcare.
7.	2020	Sabrina Begaj; Ali Osman Topal; Maaruf Ali	Emotion Recognition Based on Facial Expressions Using Convolutional Neural Network (CNN)	➢ This system uses CNNs to enhance facial emotion recognition accuracy. ➢ This approach shows strong performance on diverse facial expression datasets.
8.	2021	Ishika Agrawal; Adarsh Kumar; DG Swathi; V Yashwanthi; Rajeshwari Hegde	Emotion Recognition from Facial Expression using CNN	➢ This method improves emotion recognition through advanced facial expression analysis. ➢ It achieves robust performance across different facial expression datasets.
9.	2018	Charvi Jain; Kshitij Sawant; Mohammed Rehman; Rajesh Kumar	Emotion Detection and Characterization using Facial Features	➢ Accurate emotion detection achieved through facial feature analysis and classification. ➢ Real-time emotion characterization shows potential for applications in human-computer interaction.

10.	2014	Shadi Shaheen; Wassim El-Hajj; Hazem Hajj; Shady Elbassuoni	Emotion Recognition from Text Based on Automatically Generated Rules	➢ This approach utilizes automatically generated rules to improve emotion recognition accuracy from diverse text data. ➢ It effectively addresses challenges in emotion detection, enhancing performance in real-world text processing applications.

Table 1 : Key Findings of all Literature Reviews

III. METHODOLOGY

OBJECTIVES

- ❖ Dual-input model employs text and facial expression for precision.Deep learning techniques enhance emotion detection capabilities.
- ❖ Employing visual and linguistic features for end-to-end emotion recognition.
- ❖ Deep learning models improve emotion recognition performance. Enabling better emotion understanding for AI and human interaction**.**
- ❖ Helpful for sentiment analysis, psychology, and human-computer interaction.

ARCHITECTURE DIAGRAM

The proposed model has three primary components, as illustrated in Fig :

1. **Facial Expression Analysis:** Using a CNN-based model, such as ResNet or VGG, that has been trained on huge facial emotion datasets.
2. **Text-based Sentiment Analysis:** Using transformer-based models (e.g., BERT, GPT) to learn sentiment patterns from input text.
3. **Fusion Mechanism:** Using multimodal fusion methods such as feature concatenation and attention to combine visual and text embeddings into a joint emotion classification.

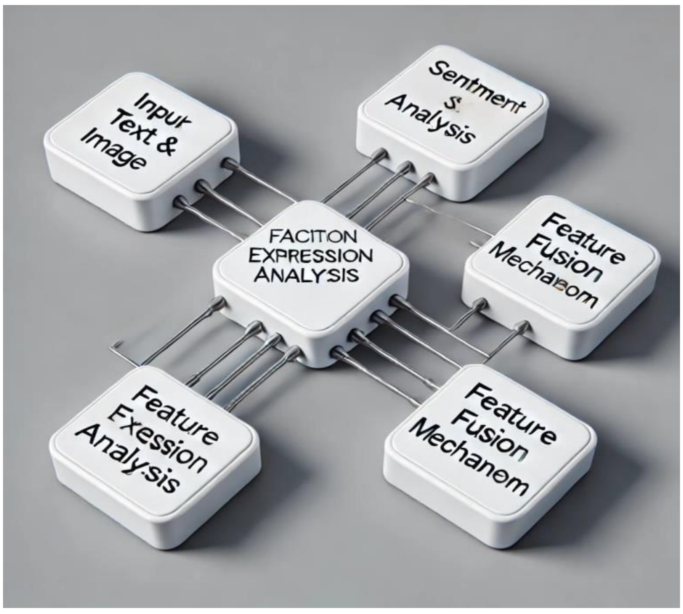

Fig 3. Architecture of Proposed Concept.

IMPLEMENTATION

1. Facial Expression Recognition System:

- CNN technology is employed to obtain facial emotion characteristics from pictures.
- FER-2013 and AffectNet databases are employed to execute the model training process for receiving correct output.
- The system categorizes emotions as happy, sad, anger, surprise, etc.

2. Text Sentiment Analysis System:

- A transformer NLP model (GPT-3, BERT) is employed to sentiment classify in text data.
- System identifies strong sentiment hints and moved to pre-classified emotion bins.

3. Multimodal Fusion:

- A fusion algorithm is applied to combine facial and textual emotion outputs.
- The emotion label is returned through a weighted decision fusion strategy.
- Higher-order prediction that includes confidence scores of both modalities is done by the model.
- A mechanism of adaptive learning is utilized in order to promote improved classification in the future.

ALGORITHM:

Emotion Recognition Fusion Model

Inputs: Face images, text input.
Outputs: Classified category of emotion.
Classified category of emotion.
Step 1 : Begin
Step 2 : Preprocess text input (tokenization, get embedding through BERT/GPT-3).
Step 3 : Preprocess image input (face detect, extract feature through CNN).
Step 4 : Sentiment analysis forwarded through text data.
Step 5 : Classify facial expression data through CNN-based.
Step 6 : Multimodal embeddings are weighted using attention-based weights.
Step 7 : Weighted mean is calculated to perform final predictions.
Step 8 : Enhance outputs with feedback cycles for better accuracy.
Step 9 : Complete

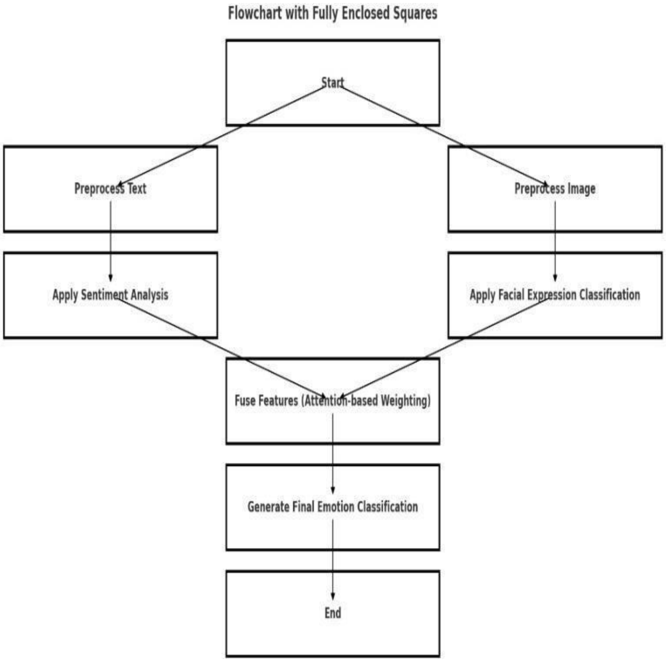

Fig 4. Algorithm

IV. RESULTS AND DISCUSSIONS

Extensive experiments are conducted on benchmark datasets, evaluating the performance of the proposed system against unimodal and state-of-the-art multimodal approaches. Metrics such as accuracy, F1-score, and confusion matrix analysis are utilized to measure model effectiveness.

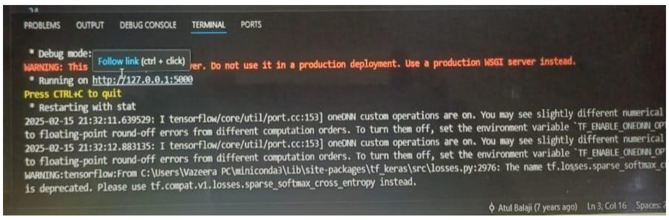

Fig 5. Output of Recommendation 1

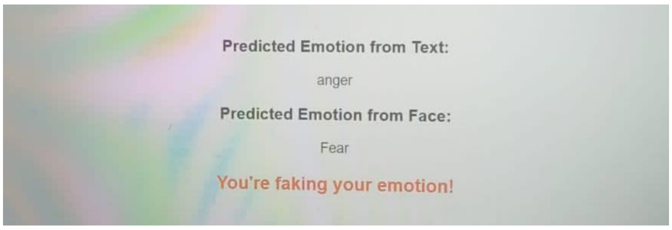

Fig 6. Output of Recommendation 2

Final Recommendations

Based on the evaluation, the proposed dual-input model significantly improves emotion classification accuracy compared to unimodal approaches. Future research can explore real-time implementation and domain adaptation for diverse cultural contexts. The model's performance scalability in different applications, such as customer service and mental health monitoring, is also worth investigating.

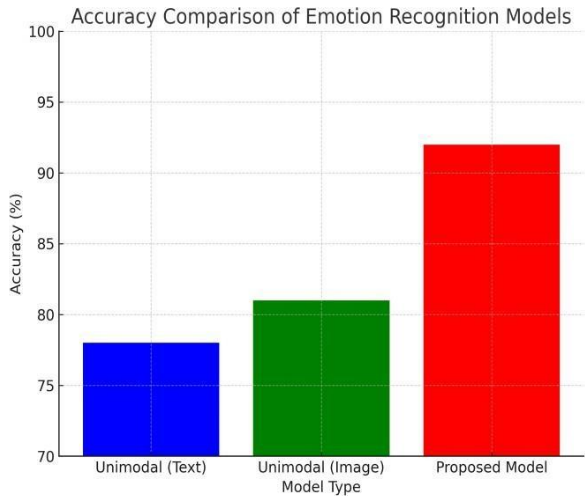

Fig 7. Accuracy Comparison Graph

V. CONCLUSIONS

Herein, we proposed EmotionFusion, a two-modal model to explore emotional states by fusing text and facial expression data. The model integrates state-of-the-art natural language processing (NLP) techniques with convolutional neural networks (CNNs) for visual feature extraction, enabling higher sensitivity to emotional signals. Experimental results confirm that fusion of text and facial expression features significantly outperforms unimodal approaches in emotion recognition accuracy. The model performed reasonably well on different datasets, proving its strength and generalizability.

Future work will involve enhancing the model's performance with additional modalities such as voice tone and physiological signals. We intend to explore the application of EmotionFusion in real-time emotion detection for HCI and assessing mental health. The findings indicate the potential of multimodal models in emotion processing, which can drive more empathetic and context-aware AI systems.

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Eye Disease Classification Using Tetrolet Transform Based Wavemix Architecture

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Abstract--

Early diagnosis of eye diseases for the people in the rural areas can help prevent the risk of vision loss. Eye disease identification and classification face challenges due to variability in imaging modalities, data imbalance, complex feature extraction, and high computational requirements, which make training deep learning models on large datasets resource intensive. In this work, eye disease classification is performed using WaveMix, a resource-efficient, generalizable, and scalable model that offers a lightweight and computationally efficient alternative to CNNs by replacing convolutions with wavelet transforms, thereby reducing the number of parameters and FLOPs. The proposed approach effectively captures multi-scale features, enhancing performance on eye images. Eye disease classification is performed using the WaveMix architecture, which uses the wavelet transform for decomposition of images and extraction of features resulting in an accuracy of 89.58%. Further the wavemix architecture is explored by replacing wavelet with contourlet, curvelet and tetrolet transforms yielding an accuracy of 94.59%, 91.53% and 95.76% respectively. The classification accuracy is further improved by applying the coefficients obtained using different wavelet-based transforms of WaveMix architecture to different pretrained models like ResNet-18, MobileNetV2 and EfficientNetB0 which extracts higher level semantic information from the eye disease dataset consisting of 9825 images belonging to six classes namely ACRIMA, Glaucoma, ODIR-5K, ORIGA, Cataract and Retina. The wavelet-based WaveMix architecture achieved accuracies of 93.69%, 94.15%, and 94.78% whereas the contourlet-based WaveMix architecture yielded accuracies of 94.51%, 96.18%, and 96.21% while the curvelet-based WaveMix architecture resulted in accuracy of 94.85%, 95.39%, and 95.82% using ResNet-18, MobileNetV2 and EfficientNetB0 pretrained models respectively. Finally, the Tetrolet-based WaveMix architecture attained accuracies of 96.95%, 96.69% and 98.17% using ResNet-18, MobileNetV2, and EfficientNet-B0 respectively exhibiting its superior performance over the existing works.

Keywords: Eye Disease Classification · WaveMix · ResNet-18 · MobileNetV2 · EfficientNet-B0 ·Contourlet, Curvelet, Tetrolet · Eye Diagnosis.

I INTRODUCTION

About 80% of the information that is taken from the outside world is captured by our eyes, which also process and send over a million pulse impulses to the brain every millisecond. Similar to other bodily organs, the eyes are susceptible to damage and stress, and with aging our visual acuity changes. If the eyes are not taken care of, they may not reach their full potential. The common types of Eye Disease or Eye problems are Eye strain or tiredness of the Eye, Refractive Errors, Cataract, Glaucoma, Dry Eye Syndrome, Color Blindness, Night Blindness and Conjunctivitis. The Eye diseases that are encountered with aging are Macular Degeneration, Diabetic Retinopathy, Hypertensive Retinopathy and Strabismus. According to statistics of World Health Organization(WHO), about 2.2 billion people have vision impairment globally. It is predicted that only 17% of persons with cataract-related vision impairment and 36% of people with refractive error-related distant vision impairment have access to the right kind of intervention worldwide[1].

The world's largest population of blind individuals resides in India. About one-third of the world's blind population, roughly 15 million people live in India, according to the WHO. In India, glaucoma, cataracts, corneal opacities, and refractive errors are the main causes of blindness [2]. The likelihood of averting vision loss and the likelihood of a cure increase with the early diagnosis and treatment of the disorders. Since laboratory methods for illness diagnosis are tedious and time-consuming, rapid disease detection at an early stage must be performed utilizing computer vision techniques.

The use of medical imaging helps to solve many real-world issues. Deep learning has generally been more innovative than machine learning because CNN feature extraction has been improved by using self-supervised learning models that are known to address the important issue of data and label inequality in medical images. Deep Learning can automatically identify and recognize images of eye disease. The Classification task in deep learning suppresses the irrelevant variations and the input elements that are crucial for discrimination are reinforced by the higher representational layers.

In this work, eye disease classification is done at an early stage using wavemix architecture which uses multilevel two dimensional discrete wavelet transform(2D-DWT) in wavelet blocks. The organization of this paper is as follows: Section II covers the Literature Review, Section III provides a brief explanation of the architecture of WaveMix, dataset and the proposed methodology, section IV presents the results and discussions obtained using integrating features of Wavemix with Pretrained networks. Section V outlines the Conclusions and Section VI presents the Acknowledgments.

II LITERATURE REVIEW:

Early detection and appropriate treatment of eye diseases are essential to preventing vision loss and improving quality of life. Traditional diagnostic methods rely on a physician's experience and expertise, which can sometimes lead to misdiagnosis. The most common eye diseases affecting the elderly include diabetic retinopathy (DR), glaucoma, cataract, and age-related macular degeneration (AMD). Numerous methods are proposed in the literature for the classification of eye disease which are discussed.

Muthukannan, P[3] proposed detecting eye diseases such as age-related macular degeneration (AMD), cataract, diabetic retinopathy (DR), and glaucoma at an early stage by using images from ODIR dataset using CNN whose hyperparameters are fine-tuned using flower pollination optimization algorithm to improve feature extraction, accuracy and speed. The CNN output was classified using SVM resulting in high performance, with a precision of 98.30%, accuracy of 95.27%, specificity of 95.21%, recall of 93.3%, and an F1 score of 95.27%.

Badah, Nouf, et al.,[4] identified eye infections associated with glaucoma disease by employing a range of machine learning (ML) classifiers, such as Random Forest (RF), Decision Tree (DT), K-Nearest Neighbor (KNN), Support Vector Machine (SVM), Naive Bayes (NB), Multi-layer perceptron (MLP), and Random Forest (KNN), in addition to Deep Learning (DL) models, such as Convolutional Neural Network (CNN) based on Resnet152 model. The suggested method is assessed using the Ocular Disease Intelligent Recognition dataset. The gathered data showed that the RF and MLP classifiers had the best accuracy of 77% when compared to the other ML classifiers. The deep learning model (CNN model: Resnet152) provides an even higher accuracy of 84% for the same job and dataset.

Bernabe Omar et. al.,[5] have classified 168 Glaucoma and 397 Diabetic Retinopathy images using Convolution Neural Networks resulting in an accuracy of 99.89%. But, in the study only two classes of retinal images are considered. Nazir, Tahira, et al.,[6] proposed the detection of Diabetic Eye Disease from the Retinal images using CenterNet Model in Deep Learning. The proposed method is evaluated on APTOS-2019 and IDRiD resulting in an accuracy of 97.93% and 98.10%. But in the present work only DR and DME lesions are classified.

Cen, Ling-Ping, et al.,[7] proposed a deep learning platform (DLP) that uses 249,620 fundus photos labelled with 275,543 labels from heterogeneous sources. This platform can identify 39 classes of fundus diseases and ailments. In the primary test dataset, the DLP attained the average level of retina specialists with a frequency weighted average F1 score of 0.923, sensitivity of 0.978, specificity of 0.996, and AUC of 0.9984 for multi-label classification.

Triwijoyo, Bambang Krismono, et al.[8] proposed classification of 15 different diseased retinal images from the STARE dataset using Convolution Neural Network. Three different types of image with resolutions 61 X 70, 31 X 45 and 46 X 53 are considered. The Training Accuracy of 82.03% was obtained for size of 61 X 70 and 31 X 45 which is high compared to the Training Accuracy of 78.91% obtained with 46 X 53. The highest test accuracy of 80.93% is obtained with input image of resolution 31 X 45. However, the accuracy can further be improved using features of pretrained networks of Convolution Neural Networks.

Prathibha G[9] have proposed classification of Eye Disease Dataset consisting of 9825 images with six classes using Vision transformers resulting in an accuracy of 98.02%. However, the accuracy need to be improved further by applying advanced deep learning techniques.

Enormous work is done for the classification of retinal images using different computer vision techniques which obtained are from the different databases as well as real time datasets. In this work, the classification of eye diseases using the WaveMix architecture, through the integration of advanced image transforms and pretrained models, has significantly improved multi-disease eye image classification. Further a novel method of replacing wavelet transform in the Wavemix architecture with Curvelet, Contourlet and Tetrolet transforms is proposed for improving the classification accuracy.

III METHODOLOGY

Wavemix Architecture

Jeevan, P Viswanathan et al.,[9] proposed wavemix architecture with enhanced feature extraction and classification in medical image analysis. The wavemix architecture for image classification is shown in Figure 1 which decomposes input images into multiple frequency bands using wavelet transforms, capturing both local and global features simultaneously. Unlike traditional CNNs, WaveMix leverages multi-resolution analysis to enhance feature representation and computational efficiency. It uses shared weights across feature maps to detect consistent patterns regardless of their location. WaveMix applies wavelet-based pooling to reduce feature map resolution while preserving critical information. The architecture combines local receptive fields with global context, ensuring robustness to shifts and distortions. Fully connected layers fuse features from different frequency bands for final predictions. This approach is particularly effective for tasks like eye disease detection, where fine details and global structures are equally important.

WaveMix's sparse representations reduce redundancy, improving computational efficiency. The input image, which undergoes preprocessing and normalization to ensure consistency in size, contrast, and intensity for maintaining uniformity across the dataset is passed through a wavelet transform, which decomposes the image into multiple frequency bands. This decomposition captures both fine-grained details (high-frequency components) and coarse structures, (low-frequency components), enabling the network to analyze the image at multiple resolutions. The coefficients of the wavelet transform are fed to the CNN that learns hierarchical features from these coefficients combining low and high level features for better representation. The extracted features are high dimensional and contain complex relationship. Multilayer perceptron combines these features by introducing non linearities through ReLU activation function. The final layer of MLP uses the Softmax activation to produce class probabilities. The Global average Pooling reduces the spatial dimensions of the feature maps to classify the image into one of the disease categories.

Dataset

The Dataset for the present work is an Eye Disease Dataset[10] that consists of a total number of 9825 with six classes of diseased images namely ACRIMA, Glaucoma, ODIR-5K, ORIGA6, Cataract and Retina Disease. The Dataset consists of 8429 training images out of which 560 images are ACRIMA, 212 images are Glaucoma, 7000 images are ODIR-5K, 70 images are cataract and 70 are retinal images. Testing images of 1396 are contained within the dataset out of which 145 are ACRIMA, 57 are Glaucoma, 1001 are ODIR-5K, 133 are ORIGA, 30 are cataract and 70 are retinal images. The different types of diseased images are shown in Fig 2.

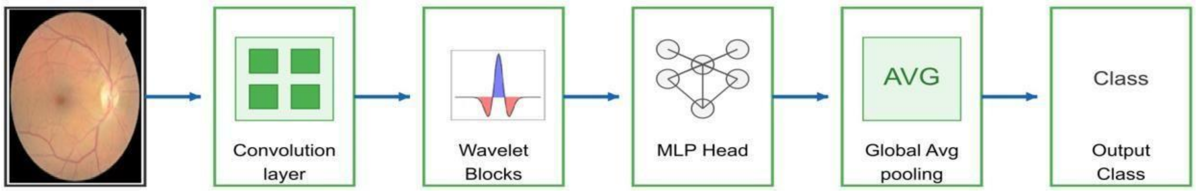

Figure 1 WaveMix Architecture

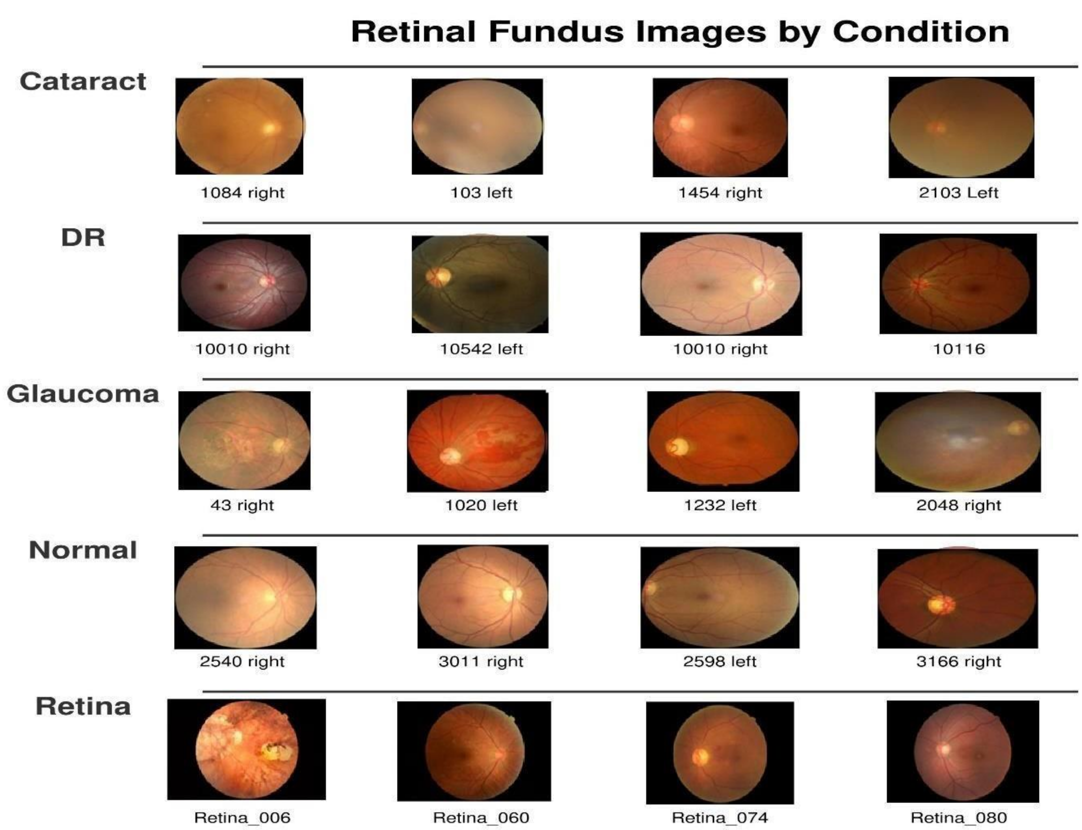

Figure 2 : Eye diseased images

Proposed Method

Deep learning has significantly improved medical image classification by enabling automated feature extraction. While traditional CNN-based models like ResNet-18, MobileNetV2 and EfficientNet-B0 are widely used that often require extensive preprocessing, are computationally expensive, and may struggle with feature representation in complex histopathology images. To address these challenges, this work employs Wavemix, a wavelet based neural network for eye disease classification leveraging Contourlet, Curvelet and Tetrolet transforms to enhance feature extraction as shown in Fig. 3. The dataset consists of histopathology images for various eye diseases. Preprocessing includes normalization, augmentation, and resizing of the diseased eye images. The wavelet transform in the Wavemix architecture performs 2-level decomposition of the images capturing localized spatial information and frequency information, which is useful for identifying fine-grained patterns in the image. The wavelet coefficients are fed into the CNN which learns hierarchical features from these coefficients combining high- and low-level features. The final features are passed through fully connected layers and softmax layer to classify the images.

Wavelets are good at capturing localized features but may miss some directional or curved structures. Contourlets, curvelets, and tetrolets are specifically designed to address these limitations by capturing fine details of microaneurysms, hemorrhages, curved structures of blood vessels, retinal layers and directional patterns such as edges and texture. These transforms enhance the model's ability to detect intricate disease patterns of the eyes, improving classification accuracy. To optimize training efficiency, transfer learning is utilized.

After extracting the features from the Wavemix architecture using different wavelet-based transforms these are fed in to different Pretrained models to capture high level, semantic features. In the present work, a few pretrained networks are used for features extraction such as ResNet-18, MobileNetV2, EfficientNet-B0. The extracted features from these networks, combined with those from Contourlet, Curvelet, Tetrolet transforms, are passed to a classifier such as a Fully Connected Layer for final prediction. By integrating WaveMix features with Pretrained models reduce training time, computational cost and the risk of overfitting achieving higher accuracy for eye disease classification.

IV RESULTS AND DISCUSSION

The performance of the WaveMix architecture using different wavelet based transforms such as Wavelet, Contourlet and Curvelet is shown in Table 1 that summarizes the Accuracy, Sensitivity, Specificity and Area Under the Curve(AUC) of WaveMix using wavelet transform resulting in an accuracy of 89.58%, with a sensitivity of 0.74 and specificity of 0.90 by two level decomposition of the images, though its overall performance is moderate compared to other transforms. Wavelets are isotropic which can lead to a loss of geometric information in complex structures whereas Contourlets are anisotropic and can represent smooth contours and curves more efficiently which is particularly useful for eye disease prediction, where retinal images often contain curved structures like blood vessels and lesions.

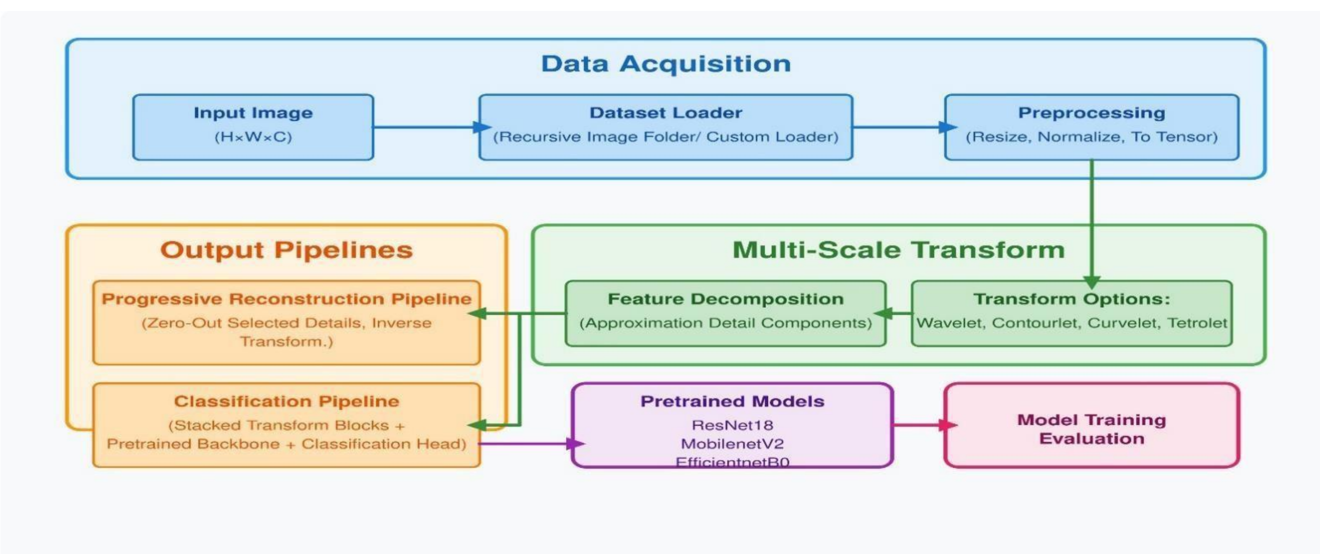

Figure 3: Block Diagram of the Proposed Method based on Wavemix Architecture

Hence, wavelet transform in the wavemix architecture is replaced with contourlet transform achieving 94.59% accuracy, sensitivity of 0.46, specificity of 0.90 and AUC of 0.96 proving its superiority in capturing both local and directional features. Although Contourlet is effective at capturing smooth contours and edges but are limited in their ability to represent highly curved structures. To address the curved singularities that represents the blood vessels, lesions, and optic disc boundaries more effectively Curvelet transform is proposed which result in lower accuracy of 91.53% but maintains a remarkably high AUC of 0.95 indicating its potential to differentiate between different eye diseases despite class imbalance or subtle variations. Curvelet transform has been replaced with Terolet Transform because of its advantages for eye disease prediction due to its local adaptivity and computational efficiency. Unlike Curvelets, which focus on capturing curved features globally, Tetrolets use a local adaptive basis that can better represent irregular structures and fine details in small regions of retinal images, such as microaneurysms or lesions. This makes Tetrolets particularly effective for detecting localized abnormalities in eye diseases resulting in an accuracy of 95.76% maintaining high AUC of 0.9705, indicating robust approach for medical image analysis. The results confirm that Tetrolet offers the most balanced and effective feature extraction for eye disease classification.

Numerous Pretrained Networks exist in the literature. In the proposed Wavemix Architecture, different pretrained networks are explored for faster convergence and enhanced performance. Table 2 focuses on WaveMix combined with three pretrained models ResNet18, MobileNetV2, and EfficientNetB0 across various transforms namely Wavelet, Contourlet, and Curvelet. The idea of selecting MobileNetV2 is that it introduces inverted residuals with linear bottlenecks, improving feature representation and efficiency while maintaining a lightweight design that results in higher accuracy with fewer parameters and lower computational cost whereas ResNet18 is highly effective for eye disease prediction due to its residual learning framework, which overcomes vanishing gradients and enables robust feature extraction from medical images. The idea behind using EfficientNetB0 is that it leverages advanced architecture design such as MBConv blocks with squeeze-and-excitation modules to capture both low-level and high-level features effectively that is particularly useful for detecting subtle patterns in retinal images, such as early signs of diabetic retinopathy or glaucoma.

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The Contourlet Transform combined with EfficientNetB0 achieves the highest accuracy of 96.21%, demonstrating exceptional performance with near-perfect sensitivity of 0.6917, specificity of 0.9945, and AUC of 0.99. Pretrained Networks ResNet18 and MobileNetV2 resulted in an accuracy of 94.51% and 96.18% which is inferior to the 96.21% accuracy achieved using EffcientNetB0 that utilizes compound scaling to optimize model depth, width, and resolution simultaneously. These results highlight that the multi-resolution and directional properties of Contourlet decomposition significantly improve the model's ability to capture fine structural details, making it highly effective for eye disease classification. Curvelet Transform combined with EfficientNetB0 yielded an accuracy of 95.32%, with near-perfect sensitivity of 0.8836, specificity of 0.9859, and AUC of 0.95, making it one of the effective model for eye disease classification. The pretrained models ResNet18 and MobileNetV2 achieved an accuracy of 94.86% and 95.29% delivering a competitive performance. The multi-resolution and directional properties of Curvelet decomposition help capture fine image details, which are crucial for detecting subtle cancer patterns. This enhanced feature extraction significantly boosts the network's ability to classify different eye diseases accurately. Tetrolet Transform combined with EfficientNetB0 achieved highest accuracy of 97.17% with sensitivity of 0.7542, specificity 0.9945, and AUC of 0.99, proving its effectiveness in classification of eye diseases. Its adaptive block-based decomposition captures intricate textures and local edges, crucial for detecting subtle cancer patterns. An accuracy of 96.95% and 96.69% has resulted with Pretrained Networks ResNet18 and MobileNetV2. The Tetrolet Transform's fine-grained feature extraction significantly enhances model accuracy, making it a robust approach for medical image analysis.

Comparative Insights

The proposed models consistently achieve AUC values of 0.99, demonstrating strong discriminative capabilities for eye disease classification. The high sensitivity minimizes missed diseases eyes, while high specificity reduces false positives, making the models clinically reliable. The integration of advanced image transforms with deep learning architectures like EfficientNetB0 highlights the system's potential to accurately classify eye diseases, ultimately improving patient outcomes.

Table 1 Performance Comparison of WaveMix Architecture Using Wavelet, Contourlet, and Curvelet Transforms

Wavemix Architecture using different Transforms	Accuracy	Sensitivity	Specificity	AUC Value
Wavelet	89.58%	0.7455	0.9002	0.8999
Contourlet	94.59%	0.4652	0.9785	0.9602
Curvelet	91.53%	0.4638	0.9787	0.9555
Tetrolet	95.76%	0.4831	0.9792	0.9705

Table 2. Performance of WaveMix architecture using Wavelet Based Transforms and Pretrained Models.

Wavemix Architecture using Transforms	Pre-Trained Wavemix Models	Accuracy	Sensitivity	Specificity	AUC Value
Wavelet	RestNet18	93.69%	0.7528	0.9954	0.94
	MobileNetV2	94.15%	0.7636	0.935	0.95
	EfficientNetB0	94.78%	0.7299	0.9948	0.96
Contourlet	RestNet18	94.51%	0.4822	0.9622	0.95
	MobileNetV2	96.18%	0.6983	0.9941	0.94
	EfficientNetB0	96.21%	0.6917	0.9945	0.97
Curvelet	RestNet18	94.85%	0.6251	0.9908	0.95
	MobileNetV2	95.39%	0.6558	0.9825	0.95
	EfficientNetB0	95.32%	0.698	0.9859	0.96
Tetrolet	RestNet18	96.95%	0.7012	0.9947	0.96
	MobileNetV2	96.69%	0.6775	0.9921	0.99
	EfficientNetB0	97.17%	0.7592	0.9945	0.99

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ROC Curve for the Wavemix Architecture

The Receiver Operating Characteristic(ROC) curves shown in Figure 7-10 demonstrate the model's effectiveness in Eye Disease classification. The ROC curve is highly significant for eye disease prediction as it evaluates a model's ability to distinguish between diseased and healthy cases by plotting True Positive Rate (TPR) against False Positive Rate (FPR). It helps balance sensitivity for detective true positives and specificity by avoiding false positives, which is critical for accurate diagnosis. The AUC-ROC metric provides a threshold-independent measure of performance, ensuring reliable evaluation even with imbalanced datasets, such as rare eye diseases. This makes it indispensable for optimizing and comparing diagnostic models. Tetrolet Transform achieves the highest AUC of 0.99 with EfficientNetB0, showing excellent sensitivity and specificity. Contourlet Transform also performs well with AUC around 0.97, indicating its strength in capturing fine details. However, Tetrolet transform combined with EfficientNetB0 has outperformed both Contourlet and Curvelet for Eye Disease classification.

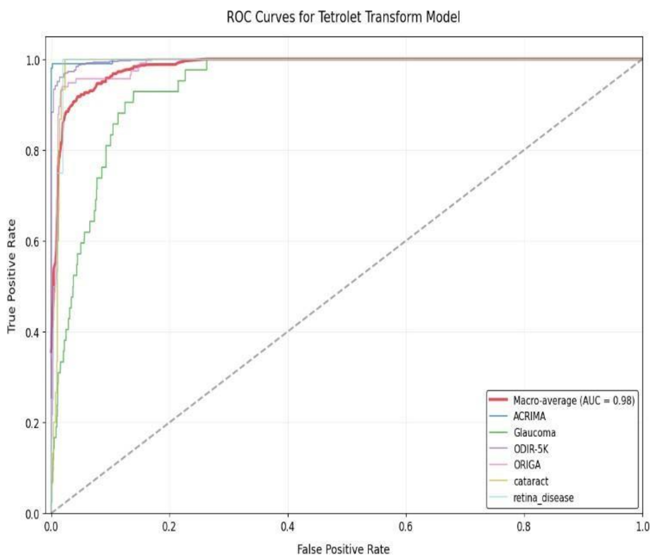


Figure 7 : ROC curve using tetrolet transform in Wavemix Architecture

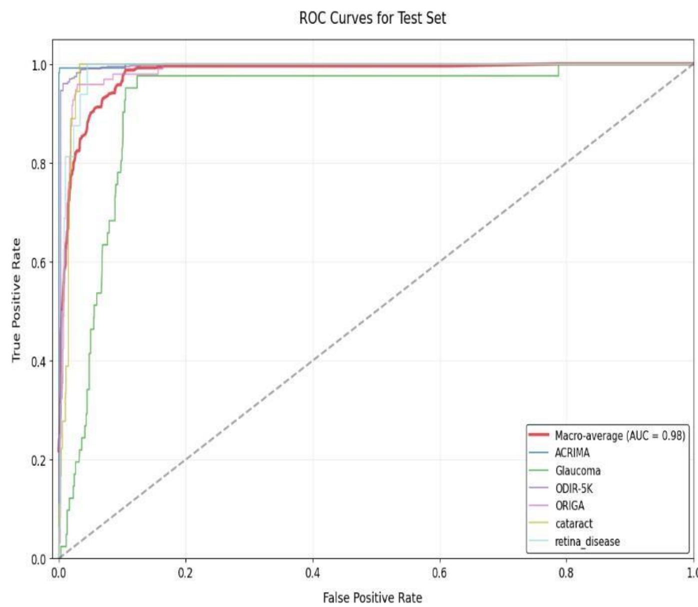
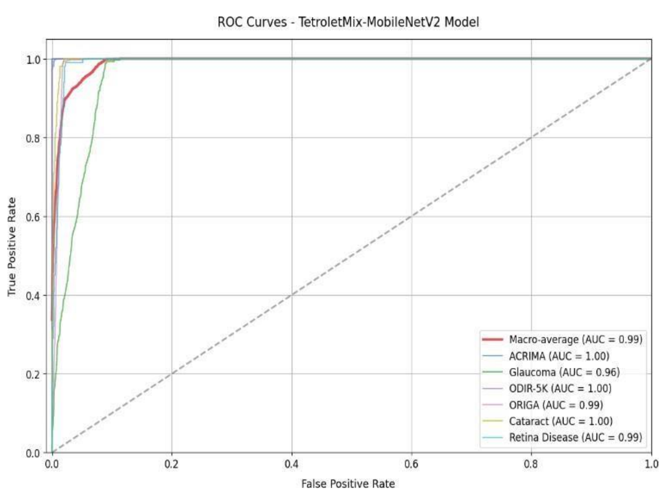


Figure 8 : ROC curve using features of tetrolet transform and ResNet18 Pretrained Model



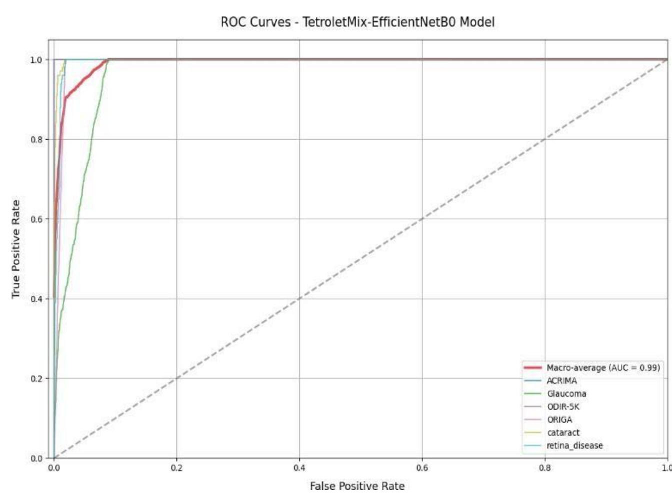


Figure 9 : ROC curve using features of Tetrolet transform and MobileNetV2 Pretrained Model

Figure 10 : ROC curve using features of Tetrolet transform and EfficientNetB0 Pretrained Model

V CONCLUSION

In this work, the performance of Wavemix for the contourlet, curvelet and Tetrolet using various pretrained models on eye disease dataset are used to classify the types of eye diseases accurately. In the preliminary work, eye disease classification is done using Wavelet based trasforms in the Wavemix architecture resulting in an accuracy of 89.58%, 94.59%, 91.53% and 95.76%. However, the accuracy can be further improved by giving the features of Wavemix architecture to pretrained models which are already trained on large datasets. In this way, richer representation of features can be obtained which are then fed into the classification layers. Among the Pretrained models, EfficientNetB0 combined with Tetrolet transform has resulted in superior accuracy demonstrating its efficiency in extracting relevant features with minima computational cost. In future work, more wavelet-based transforms can be explored for decomposing the images from which features can be extracted using pretrained models for eye disease classification.

VI ACKNOWLEDGEMENTS

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Adaptive Change-Point Detection in Safety-Critical Systems Using Online Dynamic Mode Decomposition with Control

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***Abstract*—This paper presents a clever methodology for change-point identification in unique frameworks utilizing the web Dynamic Mode Deterioration with Control (ODMDwC). Utilizing ODMDwC's ability to follow straight approximations of nonnonlinearameworks while integrating control impacts, the technique is intended to adaptively answer framework changes driven by maturing, irregularity, and other moving circumstances. The methodology works with the location of changes across spatial, fleeting, and ghastly examples, offering a powerful structure that connects the change-point discovery score with the degree of basic framework elements. The ODMDwC is further enhanced by introducing a simplified version with higher-order time-delay embeddings to suppress noise and capture broadband features, tending to difficulties in modern security basic frameworks where non-uniform information streams request convenient and exact locations. Trial results on manufactured and certifiable information uncover the viability of the strategy, showing better execution over Particular WorthDecay-based methods across complex framework benchmarks. Moreover, Practical guidelines for hyperparameter tuning are provided, supporting the application of the technique in real-world settings to ensure operational security and financial stability.**

I. Introduction

Numerous modern frameworks are basic, requiring powerful cycle observing to protect the two benefits and lives. These frameworks work under different circumstances, affected by control systems, natural varieties, and part quality. Tireless changes in framework conduct can upset tasks, speed up wear, and cause disastrous results, for example, hardware harm, creation misfortune, or human losses.

Change-point recognition (CPD) urgently checks unexpected and slow changes to guarantee unwavering framework quality. Conventional techniques like Measurable Interaction Control (SPC) frequently expect information to be free and indistinguishably circulated (i.i.d.), which doesn't hold for modern frameworks characterized by related, non-fixed information. While SCADA-based frameworks use static edges, they can't adjust to dynamic changes because of variables like maturing or natural movements.

Disconnected AI (ML) strategies are usually utilized to recognize large-scale occasions in high-layered frameworks, depending on broad authentic information. Nonetheless, they face restrictions in new settings or when encountering surprising examples. Also, modern settings frequently use black frameworks to store large-scale information, requiring constant handling and mixing with continuous information streams.

Modern information is frequently gushed at non-uniform rates, presenting difficulties to strategies reliant upon uniform examination. Successive information incorporates direct, occasional, cyclic, relapse, intercession, and mistake parts. Powerful CPD techniques should represent these varieties and adjust to evolving conditions. Kinds of progress focus incorporate difference, added substance, and innovational, each requiring unmistakable identification approaches [1].

This paper resolves key inquiries:

- Can changes in framework conduct be recognized utilizing streaming information?
- How could non-stationarity be overseen in CPD?
- Might CPD strategies at any point adjust to dynamic framework conduct over the long run?

Online CPD strategies are basic for constantly checking the basic frameworks of well-being. Not at all like disconnected techniques that depend on authentic information, online strategies work with convenient intercessions. Self-directed approaches [2] upgrade speculation by utilizing administrative data from unlabeled information, while developments like consecutive closest neighbor search [3] and autoencoder-based designs [4] plan to work on continuous relevance.

Subspace-based CPD techniques are especially viable because of their capacity to extricate dynamical elements without accepting explicit information appropriations. Strategies like the MOUSSE calculation [5] and portion change-point calculations [6] show solid hypothetical underpinnings and pragmatic viability. Nonetheless, these strategies frequently face difficulties in choosing hyperparameters and guaranteeing strength across changing settings.

Dynamic Mode Deterioration (DMD) gives a promising road to CPD by catching framework elements in both time and recurrence spaces. It breaks down time series into predominant recurrence parts, empowering interpretable recognition of changes. Strategies utilizing DMD, for example, channelized DMD [7] and fluctuation-based calculations [1], show its true capacity for recognizing unobtrusive and transient changes in framework elements.

To address the challenges posed by dynamic and high-dimensional industrial data streams, insights from Akshar Patel's research provide a compelling foundation for enhancing the adaptability and efficiency of change-point detection (CPD) techniques. For example, Patel's work on optimizing Knowledge Graph Embeddings (KGEs) for enhanced question-answering systems [8] highlights the significance of integrating advanced natural language processing models, such as RoBERTa, and optimal sampling strategies to improve decision-making accuracy in dynamic environments. This principle aligns with the need for CPD frameworks to adaptively process non-stationary data and extract critical relational patterns within complex systems. Additionally, his exploration of global optimization techniques in internet video streaming emphasizes predictive, data-driven methodologies that dynamically adjust configurations to varying conditions—an approach resonant with CPD's requirement to adapt to shifting environmental and operational factors [9]. Furthermore, his investigation into robotic hand-eye coordination using a fusion of visual servoing and reinforcement learning underlines the potential of combining model-driven and data-driven strategies to enhance system robustness and efficiency [10]. These methodologies inspire innovative CPD solutions capable of maintaining reliability and responsiveness across diverse industrial settings.

A. *Research Goals and Contributions*

This paper proposes a novel web-based CPD strategy in view of shortened web-based DMD with control. By utilizing DMD's capacities and consolidating control impacts, the proposed strategy tends to the difficulties of non-uniform information rates and dynamic framework ways of behaving. Key commitments include:

- Plan of a shortened web-based DMD approach for continuous CPD.
- Use of higher-request time-defer embeddings to extricate expansive band highlights.
- Exhibit of further developed discovery exactness contrasted with SVD-based CPD strategies.
- Examination of location insights and stretch disparity.
- Approval on true information from controlled dynamical frameworks.
- Natural rules for hyperparameter choice.

The proposed strategy is approved through tests, exhibiting its viability in recognizing changes with high precision in benchmark datasets. This work propels CPD strategies, especially for modern applications where constant observation is basic.

II. PRELIMINARIES

This segment frames the hypothetical groundwork of the proposed technique, zeroing in on Powerful Mode Decay (DMD) and its web-based variations. Moreover, The use of the internet-based partial value decomposition (SVD) algorithm for computational efficiency will be discussed, and the proposed method for online low-rank truncation of the DMD matrix will be presented. Dynamic Mode Disintegration (DMD), presented by [11], has found broad applications in information arrangement examination. It works with the division of predominant signals and commotion, recognizable proof of intelligible designs, and dynamic framework demonstration I.ntently attached to Koopman hypothesis [12], DMD empowers the portrayal of nonnonlinearameworks as direct frameworks in higher-layered spaces. Its adaptability and upgrades have altogether affected framework ID and control hypothesis [13].

To diminish computational intricacy, DMD uses the Particular Worth Deterioration (SVD):

$$\mathbf{X} = \tilde{\mathbf{U}}\tilde{\mathbf{\Sigma}}\tilde{\mathbf{V}}^{\top}, \tag{1}$$

where $\tilde{\mathbf{U}} \in \mathbb{C}^{m\times r}$ contains symmetrical spatial modes, $\tilde{\mathbf{\Sigma}} \in \mathbb{C}^{r\times r}$ contains particular qualities, and $\tilde{\mathbf{V}} \in \mathbb{C}^{n\times r}$ contains symmetrical transient modes. The low-rank estimation diminishes dimensionality while safeguarding key framework elements. The decreased request administrator $\tilde{\mathbf{A}}$ is communicated as:

$$\tilde{\mathbf{A}} = \tilde{\mathbf{U}}^{\top}\mathbf{X}'\tilde{\mathbf{V}}\tilde{\mathbf{\Sigma}}^{-1}. \tag{2}$$

DMD modes, figured through ghastly deterioration of $\tilde{\mathbf{A}}$, uncover fleeting advancement designs:

$$\tilde{\mathbf{A}}\mathbf{W} = \mathbf{W}\mathbf{\Lambda}, \tag{3}$$

where $\mathbf{\Lambda}$ contains eigenvalues and $\mathbf{W}$ contains eigenvectors. Full-layered DMD modes $\mathbf{\Phi}$ are recreated as:

$$\mathbf{\Phi} = \mathbf{X}'\tilde{\mathbf{V}}\tilde{\mathbf{\Sigma}}^{-1}\mathbf{W}. \tag{4}$$

For streaming information, Online DMD calculations update deteriorations gradually without requiring full information stockpiling. [14] proposed productive updates for time-shifting frameworks, improving the capacity to follow dynamic changes. By utilizing the web SVD, A low-rank representation is maintained dynamically, enabling real-time applications. This bound-together methodology consolidates dimensionality decrease, fleeting elements extraction, and ongoing versatility, making it profoundly viable for framework ID and expectation undertakings.

A. *Algorithm for Online DMD Updates*

Online DMD refreshes in [14] accept an underlying grid A_k. At the point when preview history X_k is accessible, A_k can be instated utilizing the standard DMD calculation or the character framework, which merges rapidly.

New previews in streaming information show up as:

$$\{X_{k:k+c}, X'_{k:k+c}\} = \{x(t_i), x(t'_i)\}_{i=k}^{c}. \tag{5}$$

The refreshed A_{k+c}, accepting nearness to A_k, utilizes recursive least-squares assessment:

$$A_k = Q_k P_k, \tag{6}$$

where

$$Q_k and = X'_k X^{\top}_k, \tag{7}$$

$$P_k and = (X_k X^{\top}_k)^{-1}. \tag{8}$$

For new depictions, Q_k and P_k are refreshed as:

$$Q_{k+c} = Q_k + X'_{k:k+c} C_{k:k+c} X^{\top}_{k:k+c}, \tag{9}$$

$$P^{-1}_{k+c} = P^{-1}_k + X_{k:k+c} C_{k:k+c} X^{\top}_{k:k+c}. \tag{10}$$

Utilizing the Woodbury equation:

$$P_{k+c} = P_k - P_k X_{k:k+c} \Gamma_{k+c} X^\top_{k:k+c} P_k, \tag{11}$$

where $\Gamma_{k+c} = (C^{-1}_{k:k+c} + X^\top_{k:k+c} P_k X_{k:k+c})^{-1}$.

The refreshed DMD lattice is:

$$A_{k+c} = A_k + (X'_{k:k+c} - A_k X_{k+c})\Gamma_{k+c} X^\top_{k:k+c} P_k. \tag{12}$$

B. Windowed Online DMD

In time-changing frameworks, obsolete previews can corrupt precision. The DMD grid can neglect beginning previews $\{X_c, X'_c\}$ by allotting them negative loads $-C_c$, utilizing:

$$Q_{k+c} = Q_k - X_c C_c X_c^\top, \tag{13}$$

$$P^{-1}_{k+c} = P^{-1}_k - X_c C_c X_c^\top. \tag{14}$$

C. Online DMD with Control

For controlled frameworks:

$$X_{k+1} = A_k X_k + B_k \Theta_k, \tag{15}$$

where Θ_k is the control input, and B_k is the control framework. In the event that B is known, repay depictions:

$$\bar{X}'_k = X'_k - B\Theta_k. \tag{16}$$

In the event that B is obscure, expand A_k and X_k as:

$$\bar{A}_k = A_k and B_k, \quad \bar{X}_k = \begin{bmatrix} X_k \\ \Theta_k \end{bmatrix}. \tag{17}$$

D. Truncating On the web DMD with Control

To work on mathematical steadiness, utilized online SVD calculations for low-rank updates of $\bar{X}_k$ as:

$$\bar{X}_k = \tilde{U}_k \tilde{\Sigma}_k \tilde{V}_k^\top.$$

New depictions $\bar{X}_{k+c}$ are integrated while protecting symmetry. Old depictions can likewise be returned, guaranteeing adaptability and power to commotion.

III. Methodology: Subspace-Based Change-Point Identification through ODMD-CPD

This segment frames a subspace-based change-point identification (CPD) calculation using Dynamic Mode Disintegration (ODMD-CPD) on the web. Intended for non-straight, time-fluctuating frameworks with delays, ODMD-CPD tends to modernize ongoing information procurement by utilizing sporadic testing oversaw by a meoverseenining administration.

A. Overview of ODMD-CPD

The ODMD-CPD calculation works by consecutively distinguishing a low-rank subspace for signal portrayal while adjusting to framework elements. It projects preview matches onto this subspace, figures reproduction mistakes, and assesses change-point insights, empowering strong location of time series abnormalities.

Algorithm 1 Data Preprocessing and Depiction Management

Input: $X_{k:k+j}$, $X'_{k:k+j}$, $\Theta_{k:k+j}$, X_{all}, X'_{all}, h, B, a, b, c, d

$\bar{X}_L$, $\bar{X}'_L$, $\bar{X}_B$, $\bar{X}_T$, refreshed X_{all}, refreshed X'_{all}, j

$j \rightarrow$ number of depictions in $X_{k:k+j}$

$X_{h,k:k+j} \rightarrow$ hankelize$(X_{k:k+j}, h)$

$X'_{h,k:k+j} \rightarrow$ hankelize$(X'_{k:k+j}, h)$

$\Theta_{h,k:k+j} \rightarrow$ hankelize$(\Theta_{k:k+j}, h)$

if B is known **then**

  $\bar{X}_{h,k:k+j} \rightarrow X_{h,k:k+j}$

  $\bar{X}'_{h,k:k+j} \rightarrow X'_{h,k:k+j} - B\Theta_{h,k:k+j}$

else

  $\bar{X}_{h,k:k+j} \rightarrow \begin{bmatrix} X_{h,k:k+j} \\ \Theta_{h,k:k+j} \end{bmatrix}$

  $\bar{X}'_{h,k:k+j} \rightarrow X'_{h,k:k+j}$

end if

Update X_{all} and X'_{all} with new previews

Concentrate $\bar{X}_L$, $\bar{X}'_L$, $\bar{X}_B$, and $\bar{X}_T$ utilizing boundaries a, b, c, and d

B. Data Stream Management

Effective preprocessing of approaching information streams is pivotal. The algorithm frames this cycle, which includes shaping time-deferred embeddings, overseeing depiction chronicles, and developing base, test, and learning sets:

C. Learning Procedure

The learning stage refreshes the DMD subspace to catch time-fluctuating framework elements. Algorithm 2 portrays the cycle:

Algorithm 2 Learning Procedure

Input: X_L, X'_L, c, j

$\tilde{c} \rightarrow$ number of previews in X_L

$j \rightarrow \tilde{c} - c$

if $j > 0$ **then**

  Return DMD with first j' previews of $\bar{X}_L$ and $\bar{X}'_L$

end if

Update DMD with last j depictions of $\bar{X}_L$ and $\bar{X}'_L$

D. Detection Procedure

Identification is performed prior to figuring out how to keep away from misleading negatives. The algorithm processes change-point measurements by projecting base and test networks onto the DMD subspace and contrasting reproduction blunders:

The ODMD-CPD calculation powerfully adjusts to changing framework conditions, offering a vigorous system for locating constant change points in time series information.

IV. Comprehensive CPD-DMD Algorithm

The proposed CPD-DMD calculation comprises three crucial stages, as definite in Algorithm 4. This engineering is intended for continuous execution, making it appropriate

Algorithm 3 Detection Procedure

Input: $\bar{X}_B, \bar{X}_T$, Φ Q_k (Change-point measurements)

1: Undertaking networks onto DMD subspace: $\tilde{X}_B \rightarrow \Phi^T \bar{X}_B, \tilde{X}_T \rightarrow \Phi^T \bar{X}_T$
2: Register remaking blunders: E_B and E_T
3: Standardize blunders by preview count
4: Register $Q_k = \max(0, E_T / E_B - 1)$

for dynamic modern conditions portrayed by unpredictable inspecting examples and message-lining frameworks. Hyper-parameter rules for different use cases are additionally given to guarantee versatility to explicit applications.

Algorithm 4 Single Pass of CPD-DMD Procedure

Input: $\mathbf{X}_{k:k+j}$, Current previews $\mathbf{X}'_{k:k+j}$, One-step post-poned previews $\mathbf{\Theta}_{k:k+j}$, Control activities
Output: Q_k, Change-point measurements

Step 1: Preprocessing the data
1: $\mathbf{X}_L, \mathbf{X}'_L, \mathbf{X}_B, \mathbf{X}_T \rightarrow$ preprocessing$(\mathbf{X}_{k:k+j}, \mathbf{X}'_{k:k+j}, \mathbf{\Theta}_{k:k+j})$ {Refer to Algorithm 1}
Step 2: Recognizing change-points
2: $Q_k \rightarrow$ detection$(\bar{\mathbf{X}}_B, \bar{\mathbf{X}}_T)$ {Refer to Algorithm 3}
Step 3: Refreshing the learning model
3: learning$(\bar{\mathbf{X}}_L, \bar{\mathbf{X}}'_L)$ {Refer to Algorithm 2}

A. Guidelines for Hyperparameter Selection

Choosing ideal hyperparameters is fundamental for fitting the calculation to different applications. The accompanying segments frame key contemplations and proposals for viable execution.

1) Estimating Rank: To decide the surmised rank r of the framework's low-rank portrayal, the hard-thresholding approach proposed by Gavish and Donoho (2014) is suggested, which considers the proportion of framework states $(m + l)h$ to the learning window size d. For computationally escalated situations, the section rank m of the information grid or $m + l$ for expanded lattices can be utilized. Online particular worth disintegration (SVD) strategies, like [15], permit dynamic position changes. The computational intricacy of DMD refreshes scales with $O(r^2)$ and requires $O(ar + 2r^2)$ memory.

2) Learning Window Size: The learning window size d impacts the exactness of subspace ID and change-point discovery. For time-invariant frameworks, d ought to be sufficiently enormous to isolate commotion from the sign. For time-shifting frameworks, d ought to catch previews of comparable working modes as far as not set in stone by the base window size a; as far as possible, it relies on the absolute number of accessible depictions.

3) Base Window Size and Placement: The base window size a ought to compare to the term of a steady sign inside depictions, empowering exact subspace distinguishing proof. Putting the base window preceding the test window $(b = 0)$ limits forecast mistakes. Guaranteeing $a \leq d$ forestalls negative scores for aggregate inconsistencies.

4) Test Window Size: The test window size c influences the perfection of progress point insights. Bigger upsides of c upgrade soundness and diminish misleading up-sides, while more modest qualities empower faster recognition. The decision relies upon the normal span of the change point and the ideal compromises between review and accuracy.

5) Number of Time-Delays: The quantity of time delays h is basic for nonnonlinearameworks and postponed control activities. A common decision is $h = a/2$, as recommended by [16], to guarantee adequate position portrayal. For bigger learning windows, defer steps h_d can be acquainted with catch framework elements all the more.

6) Threshold for Change-Discovery Statistics: The edge straightforwardly impacts bogus positive and misleading negative rates. Lower limits further develop the review, while higher edges improve accuracy. While the framework following is exact, edges near zero might do the trick without compromising unwavering quality, particularly the well-being of basic applications.

B. Illustrative Hyperparameter Effects

Figures 1 exhibit the effect of hyperparameter changes. Figure 1 shows expanded vigor to the commotion and deferred CPD measurement tops when all hyperparameters are expanded at the same time.

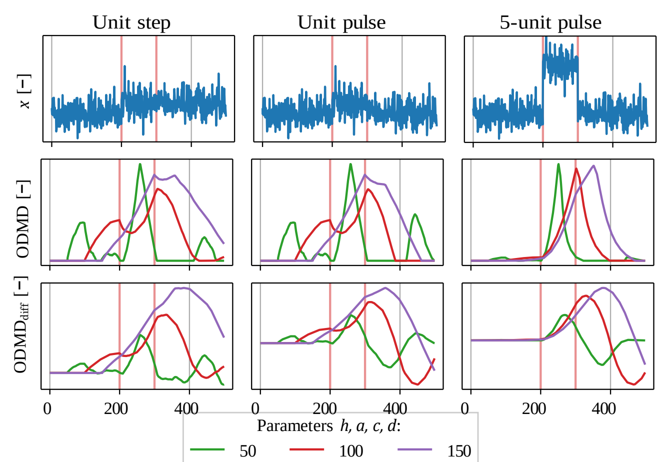

Fig. 1. Increasing all hyperparameters simultaneously enhances noise robustness and delays CPD statistic peaks.

V. Results

This part presents the exhibition of the proposed technique on different datasets. It starts by contrasting the proposed method and a connected change point location (CPD) move toward in view of subspace distinguishing proof utilizing on the web SVD. The main examination assesses fake step recognition, trailed by the identification of broken air conditioning activity in a modern scale battery energy capacity framework

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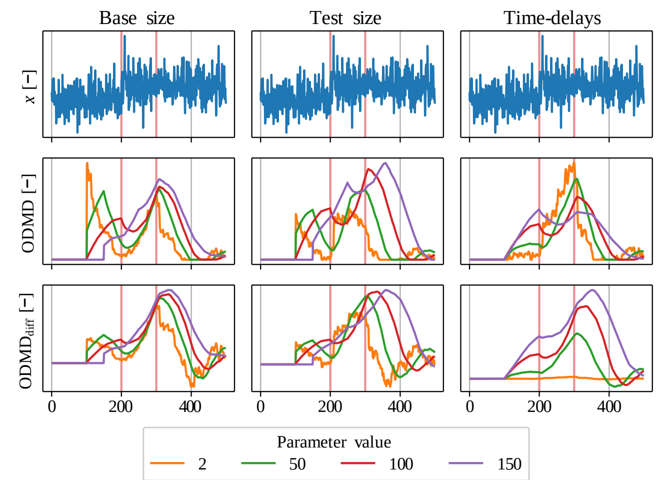

Fig. 2. IImpactof indiviImpactyperparameters on CPD in synthetic unit step datasets. Larger base sizes stabilize scores without delaying CPD peaks, while increased test sizes and time delays improve noise robustness but delay CPD peaks.

(BESS). The last examination includes benchmarking information from a mimicked complex dynamical framework (Felines) and a research facility water dissemination framework (SKAB).

A. Artificial Step Detection

To approve the proposed strategy, a counterfeit dataset with steps and Gaussian commotion is utilized. The dataset comprises 10,000 previews with nine expanding step changes, presented each 1,000 depictions. Gaussian commotion challenges the shortcomings of subspace-recognizable proof techniques. The proposed strategy is contrasted and online SVD-based CPD [17], utilizing the hyperparameters displayed in Table I.

TABLE I
HYPERPARAMETERS UTILIZED FOR EXAMINATION WITH ONLINE SVD-BASED CPD.

Hyperparameter and **Value**
r and 2
a and 100
b and 0
c and 100
d and 300
h and 80

The outcomes in Figure 3 show that while the two techniques miss the main change-point at depiction 1000, the DMD-CPD strategy separates minor change-focuses with lower commotion. The pinnacle of progress point insights is deferred by c previews, and the family member and outright blunder difference uncovers the benefit of the proposed strategy over profound learning techniques [18].

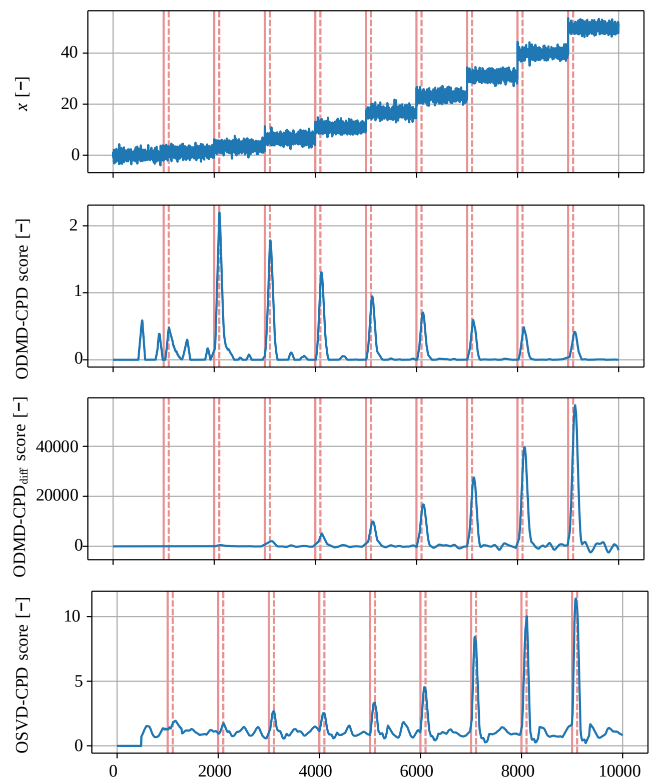

Fig. 3. Steps location in fake information: Examination of the proposed technique (1), mistake distinction strategy (2), and the reference online SVD technique (4). The proposed technique identifies minor CPs missed by the reference method.

B. Sleep Stage Location through Breath Signal

Distinguishing change focuses in genuine world, cyclic information is testing. Breath signals from a rest stage identification task are used, with information examined at 10 Hz from various subjects, marked by Dr. J. Rittweger [19]. The outcomes for the NPRS43 dataset (Figure 4) show that while the two techniques recognize the principal change from stage II to conscious expression, the proposed strategy identifies a subsequent progress missed by the SVD technique, yet with a postponed score.

For the NPRS44 dataset (Figure 5), the two techniques recognize changes. Yet, the DMD-CPD strategy has fewer misleading pinnacles and catches advances all the more easily with a clearer qualification, particularly for the subsequent progress.

C. Simulated Two Tanks Framework with Information Delay

To test the proposed strategy on non-direct frameworks with time delays, A two-tank system is recreated with the following

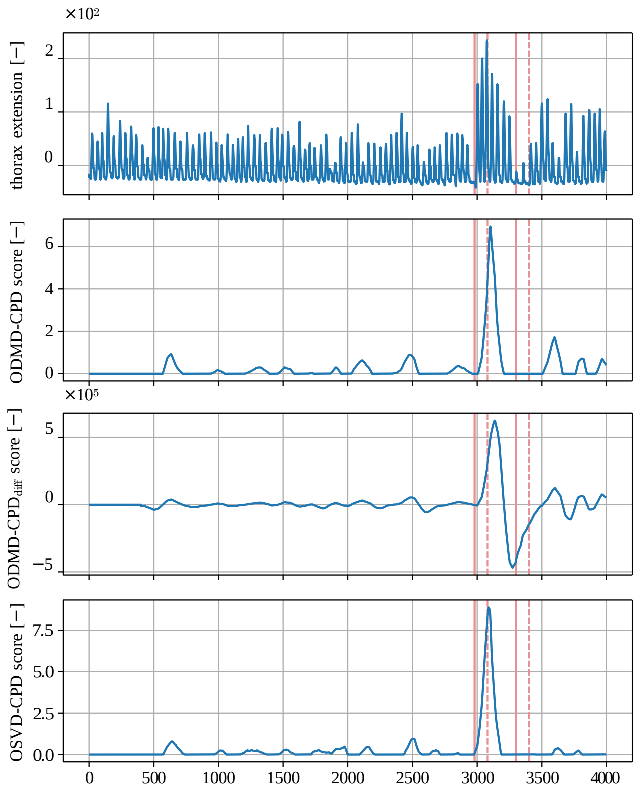

Fig. 4. NPRS43: Rest stage change identification. The proposed strategy distinguishes the primary CP and accurately recognizes the second change with a more extended delay.

set of attributes:

$$\frac{dh_1(t)}{dt} \text{and} = q(t-\tau) - \frac{k_1}{F_1}\sqrt{h_1(t)}$$

$$\frac{dh_2(t)}{dt} \text{and} = \frac{k_1}{F_2}\sqrt{h_1(t)} - \frac{k_2}{F_2}\sqrt{h_2(t)}, \quad (18)$$

where $h_1(t)$ and $h_2(t)$ are the tank levels, and $q(t)$ is the control activity, with τ addressing time delay. The framework is examined at 0.1 Hz, with 12,000 depictions and a few fake changes presented, for example, sensor inclination, multiplied control reactions, and straight patterns.

The proposed technique identifies all changes, including counterfeit sensor predisposition and framework reaction multiplying, with less commotion than the SVD-based strategy.

D. BESS - - - Defective central air Activity Detection

This contextual analysis assesses the identification of defective air conditioning activity in a Battery Energy Stockpiling Framework (BESS) utilizing temperature profile checking. The BESS has an introduced limit of 151 kWh, dispersed across ten modules, each containing 20 Li-particle NMC cells. On 23rd August 2023, an equipment issue happened in one module's cooling fan at 17:12:30. The framework kept on working safely until the issue was tended to, fully intent on recognizing the change from typical to flawed central air activity.

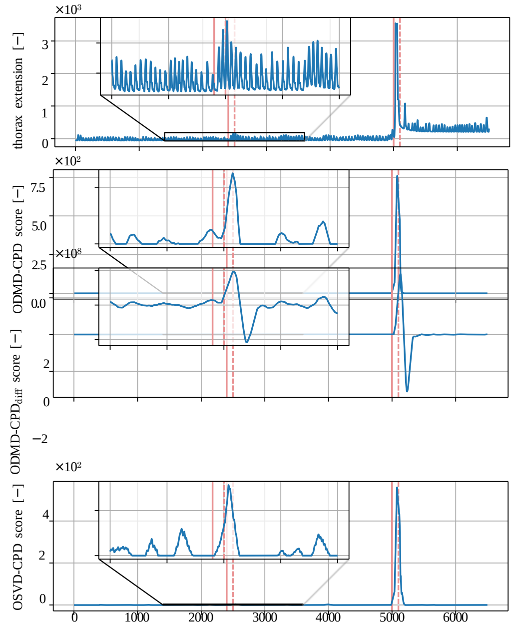

Fig. 5. NPRS44: Rest stage progress recognition, showing the proposed strategy's higher segregation and less sharp pinnacles contrasted with online SVD.

The dataset, given by the BESS administrator, incorporates previews of six temperature sensors appropriated across the BESS module, recorded at 30-second spans. Hyperparameters for change-point identification (CPD) were chosen in light of the framework's elements, with a 24-hour learning window and window sizes set to 240 examples. The proposed strategy distinguishes changes in framework conduct with high precision and low bogus positive rates. Albeit early admonition signals were noticed, a portion of the underlying tops in the change-point discovery (CPD) score could be deciphered as bogus up-sides, which administrators should seriously mull over as potential early shortcoming markers.

The technique recognized three strange air conditioning activities. Cross-approval with past examinations upholds the dependability of these outcomes. The change discovery precisely followed both the issue's beginning and its goal. The change-point assessment measurements affirm the methodology's adequacy in distinguishing advances and limiting deceptions.

E. Laboratory Water Dissemination Framework (SKAB)

In this part, The performance of the proposed method is compared with existing change-point detection (CPD) techniques using a benchmark dataset from the laboratory water flow system (SKAB) [20]. The dataset is portrayed by distinct functional states and shortcoming advances, making it ideal for execution assessment.

Following the assessment convention from [20], The proposed method was tested on the first 400 samples of the dataset as a training set, with the change-point discovery measurements figured from the excess information. The outcomes,

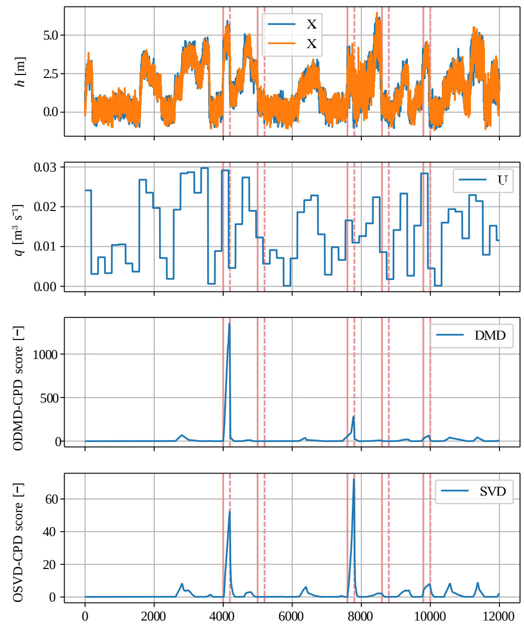

Fig. 6. CPD location on a two-tank framework with deferred input, showing diminished commotion and better distinguishing proof of slow floats with the DMD-CPD method.

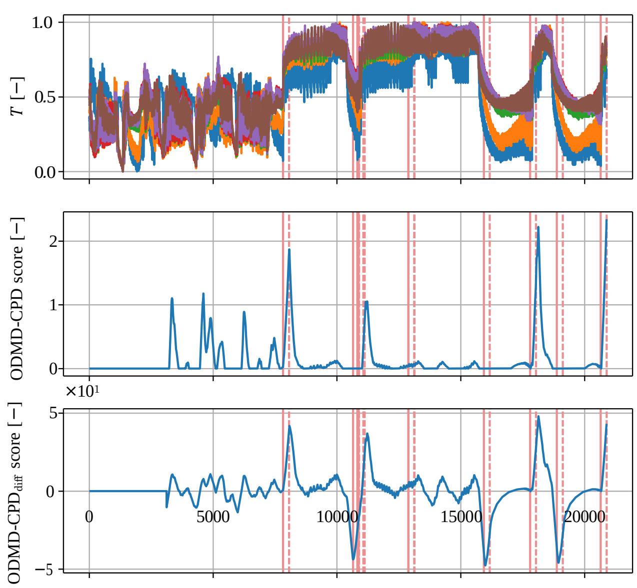

Fig. 7. Faulty activity of air conditioning in BESS brings about modified activity temperature (1). the strategy identifies the progress to another state (2), and a variation builds the conspicuousness of the change-point score tops during the change (3).

displayed in Table **??**, show that the proposed strategy beats a few reference techniques in light of Seize scores, bogus upsides (FP), and misleading negatives (FN). Two variations of the strategy were assessed by changing the limit t, showing that this boundary impacts the FP score yet little effects, generally speaking, execution.

The correlation uncovers that the technique, alongside MS-CRED, distinguished the least missed change focuses, making it more appropriate for combining basic applications. The outcomes show that an ideal finder, while perfect, may not score 100 on all assessment measurements, featuring the intricacy of evaluating CPD techniques.

TABLE II
COMPARISON OF VARIOUS CALCULATIONS IN LIGHT OF SEIZE MEASUREMENTS (SECTION 1). THE BEST SCORES ARE HIGHLIGHTED.

Algorithm and NAB (standard)	NAB (standard)	NAB (low FP)
Wonderful locator	54.77	54.11
CPD-DMD ($t = 0$)	**34.29**	23.21
CPD-DMD ($t = 0.0025$)	33.43	**23.28**
MSCRED	32.42	16.53
Disengagement woodland	26.16	19.50

TABLE III
COMPARISON OF VARIOUS CALCULATIONS IN LIGHT OF SEIZE MEASUREMENTS (SECTION 2). THE BEST SCORES ARE HIGHLIGHTED.

Algorithm	NAB (low FN)
Wonderful locator	56.99
CPD-DMD ($t = 0$)	**42.54**
CPD-DMD ($t = 0.0025$)	41.71
MSCRED	40.28
Separation timberland	30.82

TABLE IV
COMPARISON OF VARIOUS CALCULATIONS IN VIEW OF CAPTURE MEASUREMENTS. THE BEST SCORES ARE HIGHLIGHTED.

Algorithm	NAB (standard)	NAB (low FP)	NAB (low FN)
T-squared+Q (PCA)	25.35	14.51	31.33
Conv-AE	23.61	21.54	27.55
LSTM-AE	23.51	20.11	25.91
T-squared	19.54	10.20	24.31
MSET	13.84	10.22	17.37
Vanilla AE	11.41	6.53	13.91
Vanilla LSTM	11.31	−3.80	17.25
Invalid indicator	0.00	0.00	0.00

F. Simulated Complex Dynamical Framework with Control (CATS)

This segment assesses the proposed technique on the Controlled Oddities Time Series (Felines) dataset from [21], which reproduces a complex dynamical framework with 200 infused peculiarities, control orders, outer improvements, and 5 million telemetry depictions inspected at 1 Hz. It's not at all like the SKAB dataset.

The assessment utilizes the equivalent Catch measurements from the past contextual analysis, but the dataset is resampled to 1-minute spans. Because the creating component did not have a foundation, hyperparameters were chosen based on the 58 days captured in the dataset. A one-day learning window was chosen, with a limit of 60 elements and 4 hours for time delays.

Table **??** presents the aftereffects of the tests. The proposed strategy beats all reference techniques with the exception of MSCRED as far as the standard Catch score assessed on a 5-hour window. While the strategy shows a lower bogus positive (FP) score, MSCRED offers a fundamentally better misleading negative (FN) score. While the proposed technique and other reference strategies finished the trial in something like 60 minutes, MSCRED required very nearly 24 hours, handling about one second for each preview, which poses difficulties for constant applications.

The outcomes show that the proposed strategy adjusts well among FP and FN rates, exhibiting its viability in recognizing change focuses in complex dynamical frameworks and utilizing data from control inputs.

TABLE V
COMPARISON OF VARIOUS CALCULATIONS IN LIGHT OF GRAB MEASUREMENTS (SECTION 1). THE BEST SCORES ARE HIGHLIGHTED.

Algorithm and **NAB (standard)** and **NAB (low FP)**
Wonderful finder and 30.21 and 29.89
MSCRED and **37.19** and 13.46
CPD-DMD ($t = 0$) and 25.66 and **20.62**

TABLE VI
COMPARISON OF VARIOUS CALCULATIONS IN VIEW OF SEIZE MEASUREMENTS (SECTION 2). THE BEST SCORES ARE HIGHLIGHTED.

Algorithm and **NAB (low FN)**
Wonderful finder and 31.28
MSCRED and **47.18**
CPD-DMD ($t = 0$) and 29.84
CPD-DMD and 20.06
Disconnection woodland (c = 3.8%) and 20.00

TABLE VII
COMPARISON OF CALCULATIONS IN LIGHT OF CATCH MEASUREMENTS (SECTION 1). THE BEST SCORES ARE HIGHLIGHTED.

Algorithm	**NAB (standard)**	**NAB (low FP)**	**NAB (low FN)**
T-squared+Q (PCA)	11.80	11.40	12.30
LSTM-AE	11.39	11.26	11.69
T-squared	15.15	14.98	15.71
MSET	14.48	13.43	15.60

VI. CONCLUSIONS

In this paper, An internet-based Powerful Mode Disintegration (DMD) with control for subspace-based change point identification (CPD) was presented for complex, non-linear, and time-varying controlled systems. By utilizing time-delayed embeddings from streaming output data, the evolving subspace of such systems was successfully tracked. DMD analyzes system dynamics into modes, enabling signal reconstruction from noisy details and the detection of abrupt changes. The similarity between original and reconstructed data is assessed using two windows: the reference window establishes the predicted reconstruction error. In contrast, the test window evaluates the presence of a change point. The test window size straightforwardly influences location speed and bogus upsides, offering a tradeoff that can be changed. While setting all-inclusive hyperparameters is testing, Intuitive guidelines for their selection are provided. It is also highlighted that error disparity offers more accurate CPD measurements compared to error ratio, as exhibited in recognizing air conditioning shortcomings in a Battery Energy Stockpiling Framework (BESS). The level of blunder disparity connects with the seriousness of deviations from ordinary activity, which is essential for risk evaluation. On the other hand, the blunder proportion recognizes likely antecedents to blame advances.

Our technique is demonstrated to be serious, outflanking existing methodologies on benchmark datasets, including both reproduced and true frameworks. The outcomes recommend that the proposed approach is exceptionally viable for recognizing and surveying changes in complex dynamical frameworks.

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KITS-NCICDLA-25-CONFERENCE PROCEEDINGS

A MULTILINGUAL SPAM REVIEW DETECTION BASED ON PRE TRAINED WORD EMBEDDING AND WEIGHTED SVM

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***Abstract*— Online reviews are a crucial information source that customers look at when they decide whether to purchase products or services. Moreover, these reviews are helpful for organizations as vital feedback for their product or service. There needed to be some trustworthiness about such information, which needed more so during the age of Covid-19 which managed to mark an extraordinary rise in scope of online reviews after all the quarantine and sitting at home. Not just the quantity of reviews was increased, but also the context and preferences in pandemic. Therefore, spam reviewers reflect on these changes and improve their deception technique. Spam reviews usually consist of misleading, fake, or fraudulent reviews that tend to deceive customers for the purpose of making money or causing harm to other competitors. 13 So this work provides a Weighted Support Vector Machine (WSVM) and Harris Hawks Optimization (HHO) to detect spam review. The HHO serves as an algorithm to tune hyper-parameters and feature weighting. To identify the multilingual issue in spam reviews, three distinct language corpora have been employed as datasets: English, Spanish, and Arabic. Additionally, pre-trained word embedding (BERT) has been used in addition to three different three-word representation methods (NGram-3, TFIDF, and One-hot encoding). Four experiments have been made, if there are several demos or solutions. The proposed approach outperformed other state-of the-art algorithms in all experiments. Again, for English, Spanish, Arabic and Multilingual datasets, WSVM-HHO achieved an accuracy of 88.163%, 71.913%, 89.565% and 84.270% respectively. Additionally, a thorough analysis has been performed to explore the context of reviews before and after COVID-19 situation.**

Keywords – AI-based learning, Weighted Support Vector Machine (WSVM), pre-trained word embedding (BERT), Natural Language Processing (NLP), Harris Hawks Optimization (HHO).

1. *Introduction*

With the rapid expansion of the internet, online shopping and digital marketplaces have grown exponentially. Sure, consumers use e-commerce platforms to purchase products and services but they do so based on online reviews. These reviews not only provide fantastic feedback for potential

customers wanting to make an informed decision but also for companies looking to create the highest quality products and get their customers satisfaction. Companies use these reviews to learn about market trends, address customer complaints and enhance their products.

Online reviews' increasing power has, however, also contributed to the growth of spam reviews, in which people or businesses sway public opinion to their advantage. Often referred to as sentiment spam or review spam, these spam reviews contain false, deceptive, or fraudulent language intended to unfairly promote or harm a company, product, or service. This practice distorts genuine customer feedback, misguides potential buyers, and undermines the credibility of e-commerce platforms. As a result, identifying and eliminating bogus reviews has grown to be a major problem in the sentiment analysis and opinion mining fields.

Positive or bad online customer evaluations can significantly affect the expansion of a firm. Online platforms are ideal targets for review manipulation because to the ease of access to user-generated content and the possible cash rewards for dishonest behavior. While some spam reviews are produced by automated bots, others are authored by people who have never utilized the product. These untrue evaluations have the potential to deceive clients and foster an unfair marketplace.

Researchers have concentrated on creating automated review spam detection systems as a solution to this problem. In general, supervised and unsupervised learning techniques are the two primary strategies. Using supervised learning techniques, a classifier is trained on labeled datasets that manually distinguish between spam and legitimate reviews. For this, different ML models have been used, including Support Vector Machines (SVM), Naïve Bayes, Logistic Regression(LR), Decision

Trees(DT), and Random Forest. These models ¬use historical data to determine whether fresh reviews are legitimate or spam.

Conversely, unsupervised learning techniques do not depend on labeled data. Rather, they uncover spam tendencies by grouping reviews of similar kinds, examining information, and spotting unusual user behavior. These methods use network-based detection, linguistic analysis, and topic modeling to identify questionable reviews.

Creating a reliable Multilingual Spam Review Detection System that can recognize spam reviews in several languages is the goal of our project. Due to linguistic variations in grammar, syntax, and sentiment expression, traditional spam detection techniques frequently have trouble processing multilingual data. Our system integrates pre-trained word embeddings (BERT) with Weighted Swarm Support Vector Machines (WSVM) and Harris Hawks Optimization (HHO) to improve spam detection accuracy. Through feature weighting and hyperparameter optimization, our method improves classification performance on a variety of language corpora, such as Arabic, Spanish, and English.

Furthermore, the proposed system leverages three different word representation techniques—N-Gram, TF-IDF, and One-Hot Encoding—to capture semantic relationships within reviews. Results from experiments show that the Random Forest classifier obtains a 95% accuracy rate, significantly outperforming CNN, which attains 89% accuracy. Comparing review trends before and after the COVID-19 epidemic has also been done through a thorough contextual analysis, which has shown alterations in misleading reviewing strategies.

By integrating AI-driven detection techniques, this system reduces reliance on manual spam filtering and enhances the integrity of online reviews. The model is implemented using Python in a user-friendly environment, ensuring easy deployment and real-world application across e-commerce platforms, social media sites, and online marketplaces. Ultimately, this solution aims to foster a more transparent and trustworthy online review ecosystem, protecting them from deceptive practices.

2. *RELATED WORK*

Spam messages promote illicit goods, spread phishing exploits, and spread malware. Both users and network operators incur expenses as a result of those messages, but it's challenging to quantify the costs of spam traffic and identify the true payers. Here, the authors determine the paths taken by spam messages gathered at five honeypots and offer a way to measure the transit costs of spam traffic. By combining traceroute measures, a database of internetwork company relationships, and the amount of spam traffic, they demonstrate that stub networks are consistently vulnerable to high spam traffic costs. They also demonstrate how certain networks may not be interested in screening spam traffic because they profit from it. In order to save transit costs, a straightforward yet efficient technique is finally offered to determine which networks might profit from working together to filter spam traffic at the origin.

Because of its accessibility, low sending costs, and quick message transfer, email is the most widely used forms of communication. However, Spam emails appear as a severe problem affecting this application of today's Internet. Filtering is an important approach to isolate those spam emails. In this paper, an approach for filtering spam email is proposed, which is based on classification techniques. The approach analyses the body of Email messages and assigns weights to terms (features) that can help identifying spam and clean (ham) emails. The productivity of the presented filtering strategy, tested on the Enron dataset, has been shown through a thorough comparison of several classification algorithms. An adaptation is suggested that attempts to decrease the dimensions of the extracted features, in which only determined (meaningful) terms are taken into consideration by consulting a dictionary.

Despite the fact that an increasing number of spam emails are taking up server storage space and network bandwidth, the majority of email readers regularly spend a significant amount of time removing these emails. As a result, developing and improving automatic classifiers that can differentiate between spam and legitimate emails is a constant challenge. Naïve Bayesian algorithms are also used in many commercial applications, and some published works have examined spam detectors that use these techniques in conjunction with large feature sets of binary attributes that detect the presence of common keywords in spam. Although spammers have developed ways to circumvent these filters and are aware of these attempts to prevent their messages, human readers are often able to recognize these dishonest tactics immediately. Consequently, our feature set uses descriptive word and message properties that are similar to those that a human reader would use to identify spam, in contrast to earlier approaches. an exploratory study tests an alternate approach using a neural network (NN) classifier on a corpus of one user's email messages. The study's findings are contrasted with those of earlier spam detectors that employed Naïve Bayesian classifiers. Additionally, it seems that the descriptive elements suggested here are currently being used by commercial spam detectors.

3. *PROPOSED METHODOLOGY*

Upload Spam Base Dataset: The system's initial phase involves uploading the Spam Base dataset, which forms the basis for the spam detection models' training and testing. To load the "spam base data" file into the application, the user chooses it from their system and clicks the "Open" button. The system runs a preliminary check once the dataset is uploaded to make sure it is formatted correctly and has all the required information, including word frequency counts, punctuation usage, and spam classification labels. If the dataset contains missing values or inconsistencies, the system notifies the user to rectify them before proceeding. Successfully loading the dataset allows the system to move on to the preprocessing stage, where the data is cleaned and prepared for analysis.

Preprocess Dataset: Making sure the dataset is arranged and ready for ML model training requires preprocessing. In order to extract pertinent features and remove superfluous or redundant data points that could impair performance, the system examines and parses the dataset. The dataset is then split into training (80%) and testing

(20%) subsets to enable model evaluation on unseen data. When required, feature scaling and normalization techniques are applied to provide uniformity across different properties. Additionally, if there is a class imbalance between spam and non-spam reviews, balancing techniques like oversampling or under sampling may be employed to increase model accuracy. The dataset is prepared for classification using a variety of machine learning(ML) methods when preprocessing is finished.

Execute the Multilayer Perceptron (MLP), KNN, and Naïve Bayes algorithms: In this step, three distinct machine learning algorithms—K-Nearest Neighbors (KNN), Naïve Bayes (NB), and Multilayer Perceptron (MLP)—are trained and evaluated. Labels are assigned using the majority class of nearby data points by the straightforward yet powerful KNN classification technique. A probabilistic classifier called Naïve Bayes uses conditional probabilities based on word frequencies to decide if a review is spam. MLP is a kind of neural network that uses several layers of neurons to discover intricate patterns in the input. The system evaluates these models' performance by computing evaluation metrics including accuracy, precision, and recall after they have been trained on the preprocessed dataset. The outcomes shed light on how well each system works to identify spam reviews.

Run SVM, Decision Tree, and AdaBoost Algorithms: This step involves applying three additional classification algorithms to the dataset: Support Vector Machine(SVM), Decision Tree(DT), and AdaBoost (Adaptive Boosting). SVM is very effective for text classification tasks because it finds the best hyperplane to separate spam and non-spam reviews; Decision Trees recursively divide the dataset into branches based on feature values, producing a set of classification rules; and AdaBoost, an ensemble learning technique, improves the performance of weak classifiers by iteratively combining multiple models. After training, these models are tested using the same performance metrics.

Run the Random Forest(RF) and CNN algorithms: The final classification step uses two powerful ML models, Random Forest(RF) and Convolutional Neural Network(CNN). Random Forest(RF) is an ensemble learning technique that improves accuracy and resilience to overfitting by building multiple decision trees(MDT) and combining their output. Through the recognition of patterns in word embeddings, CNN—which is commonly utilized for image processing—is modified for text classification. The results show that Random Forest(RF) performs better than CNN with an accuracy of 95% as opposed to CNN's 89%, even though CNN can learn deep features from textual input. These findings demonstrate how successful conventional ensemble approaches are in detecting bogus reviews.

Accuracy Comparison Graph: An accuracy comparison graph is created to show how well various algorithms work. The names of the algorithms are shown on the x-axis, while the corresponding accuracy(AC) values are shown on the y-axis. This display makes it easy to compare how well each model performs in classifying spam reviews. The graph unequivocally shows that the Multilayer Perceptron (MLP) outperforms other models regarding accuracy and recall while achieving the maximum accuracy. Researchers can determine the top-performing algorithms and choose the optimal model for practical applications by examining this graph.

Recall Comparison Graph: This graph offers a thorough assessment of each model's capacity to accurately detect spam reviews. The percentage of real spam reviews that the model properly identified is known as recall. The model is more successful at collecting spam reviews without missing too many when its recall is higher since it produces fewer false negatives. The graph aids in evaluating which algorithm is more dependable in identifying spam across multilingual datasets and comprehending the trade-offs between various models.

Precision Comparison Graph: One more crucial assessment metric that establishes the proportion of projected spam reviews that are spam is precision. The precision comparison graph shows how well each algorithm reduces false positives, or reviews that aren't spam but are mistakenly classified as such. The authenticity of online reviews is preserved by a high precision score, which makes sure that legitimate reviews are not incorrectly categorized as spam. A balanced spam detection system that successfully removes spam without degrading real user feedback can be created by examining the precision graph in conjunction with recall and accuracy measures.

3.1 ALGORITHM USED

K-Nearest Neighbors(KNN): KNN is a straightforward yet effective classification technique that groups data points according to how similar they are to nearby ones. It determines the majority class of the K-nearest neighbors(KNN) and uses metrics such as Euclidean distance to find the distance between the input sample and already-existing labeled samples. K-nearest neighbors(KNN) is a non-parametric model that works well for spam detection, although it can be expensive to compute when working with large datasets.

A supervised learning system called SVM determines the best hyperplane to divide reviews into spam and non-spam in a high-dimensional space. Using kernel functions like linear, polynomial, and radial basis function(RBF) to improve classification performance, it performs well in text classification tasks. SVM can be slow with large-scale data, but it works especially well with high-dimensional datasets.

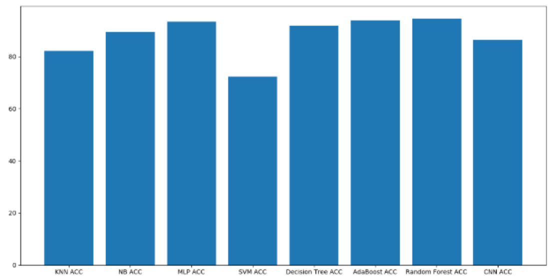
Adaptive boosting, or AdaBoost, is an ensemble learning(EL) method that creates a strong classifier by combining multiple weak classifiers (like Decision Trees). It assigns weights to data points, focusing more on misclassified samples in each iteration, improving overall accuracy. Although AdaBoost enhances model performance, it is sensitive to noise data and outliers, which may impact spam detection.

An ensemble learning(EL) system called Random Forest(RF) builds several Decision Trees(DT) during training and aggregates their results for classification. By randomly selecting features and data subsets, it reduces overfitting and improves accuracy. Random Forest is the best model for multilingual spam review detection in this research, with the greatest accuracy of 95%.

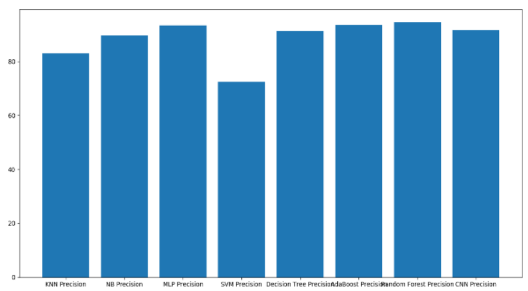
CNN: CNN is a DL model typically used for image processing but adapted for classification of a text using word embeddings. It applies convolutional filters to detect local patterns in text data, making it effective for spam detection. While CNN captures deep semantic features, it requires large training datasets and is computationally intensive compared to traditional machine learning models.

4. *EXPERIMENTAL RESULTS*

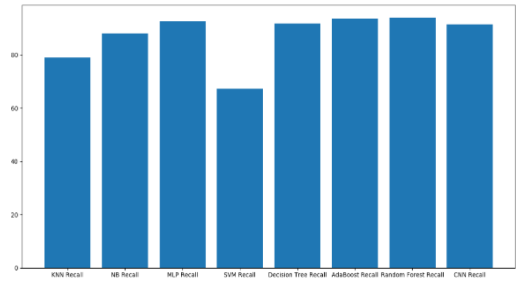
1. Accuracy: Accuracy quantifies the proportion of reviews that are accurately classified in the dataset. With the greatest accuracy of 95% in this study, Random Forest was able to classify reviews as either spam or non-spam with few mistakes. CNN, on the other hand, achieved 89% accuracy, showing slightly lower performance. Accuracy is a useful metric when the dataset is balanced; however, when there is a class imbalance (more non-spam than spam reviews), it may not fully reflect the model's true effectiveness.



2. Precision: Precision measures how many of the reviews predicted as spam are actually spam.The model produces fewer false positive errors (erroneously classifying non-spam as spam) when the precision value is high. Models like SVM and Random Forest demonstrated good precision in this research, which means they successfully filtered out spam without incorrectly identifying an excessive number of legitimate reviews. In order to prevent non-spam reviews from being inadvertently eliminated and preserve the legitimacy of online review sites, a high precision score is essential.



3. Recall: Recall, sometimes referred to as sensitivity or true positive rate, quantifies the proportion of real spam reviews that the model successfully identified. A high recall score lowers the possibility of spam getting through because it shows that the model successfully identifies the majority of the spam reviews. CNN did well in this research in terms of recall, which means it was made to find a higher percentage of spam reviews. A balance between both is necessary since models with strong recall might occasionally mistake legitimate reviews for spam (more false positives).



5. *CONCLUSION*

In our study, we explored various machine learning (ML) techniques and how they are used in spam filtering. An overview is given of the most recent algorithms used to classify messages as either spam or ham. Several researchers have attempted to use machine learning classifiers to tackle the issue of spam. We looked at how spam messages have changed over time to get past filters. The fundamental design of an email spam filter and the procedures used to filter spam emails were examined. The study looked at several publicly available statistics and performance indicators used to assess the effectiveness of spam filters. It highlighted the challenges faced by machine learning (ML) algorithms in effectively combating spam and conducted comparative analyses of the ML techniques found in existing literature. Additionally, we identified some unresolved research issues related to spam filters. Overall, the breadth and depth of the literature we reviewed indicate that substantial progress has been made and will continue to be made in this area. After discussing the ongoing challenges with spam filtering, further research is essential to improve the effectiveness of these filters. This ensures that spam filtering remains a dynamic area of study for both academics and industry professionals exploring machine learning methods for effective spam detection. We hope that research students will find this paper a valuable starting point for conducting qualitative research in spam filtering, utilizing machine learning, deep learning, and adversarial learning algorithms.

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Integrating Automatic Differentiation into Julia: A Differentiable Programming System

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***Abstract*—In this paper, A Differentiable Programming (∂P) framework is presented that consistently consolidates Programmed Separation (Promotion) as a top-of-the-line feature within the Julia programming language. The framework is intended to help a wide cluster of languages develop, including control stream, recursion, and transformation, while producing superior execution code without requiring client intercession or broad refactoring to organize calculations. This capacity encourages an expressive programming model that is especially appropriate for profound learning applications. All the more essentially, it permits clients to use the current biological Julia's logical processing bundles related to profound learning models, consequently upgrading efficiency and extending the potential for inventive exploration. The engineering of the ∂P framework is discussed, its presentation benchmarks, and down-to-earth suggestions for the two designers and analysts in the field.**

I. Introduction

Intelligent handling and simulated intelligence, at first glance, might appear as distinct disciplines with separate objectives. However, the two fields share several common tools, methodologies, and ultimate goals. Artificial intelligence, particularly deep learning, has revolutionized decision-making processes in software by leveraging massive labeled datasets and specialized hardware such as GPUs and TPUs. On the other hand, scientific computing, a longstanding domain, employs a wider array of modeling techniques grounded in physical phenomena, often emphasizing computationally intensive simulations. Despite their apparent differences, both domains increasingly utilize dynamic programming languages like Python, R, and Julia while relying on high-performance implementations often written in lower-level languages such as C++ or Fortran.

The interplay between artificial intelligence and scientific computing has been particularly fruitful in the domain of numerical linear algebra. Key advancements in scientific computing, such as the development of BLAS [1], LAPACK [2], and MPI [3], have enabled efficient matrix operations and parallel computing frameworks, which are critical for scaling both scientific simulations and machine learning models. These libraries have paved the way for breakthroughs in computational efficiency, making them indispensable for tasks that demand high precision and performance.

In recent years, the synergy between artificial intelligence and scientific computing has deepened, as evidenced by innovations such as Neural Ordinary Differential Equations (Neural ODEs) [4]. These models have effectively bridged the gap by improving memory and computational efficiency, particularly in architectures like ResNets. By treating the transformation of data through layers as a continuous process, Neural ODEs have brought new perspectives to both fields, combining the rigor of differential equations with the adaptability of deep learning. The integration of artificial intelligence techniques in robotics, as exemplified by Patel's exploration of visual serving and deep reinforcement learning for hand-eye coordination [5], underscores the potential for neural networks to enhance visuomotor tas. This concept aligns closely with the synergies between AI and scientific computing.

The cross-pollination between these fields has not been limited to theoretical advancements but has also extended to practical applications. For instance, the 2018 Gordon Bell Prize demonstrated the application of deep learning techniques in high-performance computing environments. This achievement highlighted the potential for collaboration between artificial intelligence and scientific computing, as it showcased the use of state-of-the-art machine learning methods to solve complex problems in climate modeling and other computationally intensive domains.

This convergence suggests a promising future where artificial intelligence and scientific computing not only coexist but actively drive innovation together. By leveraging shared tools, methodologies, and computational resources, these fields are poised to tackle some of the most pressing challenges in science and engineering.

Subsequently, coherent figuring can benefit from simulated intelligence in additional ways than one:

1) **Surrogate modeling:** Simulated intelligence can derive exorbitant generations, making it possible to examine limited spaces and fit data capably.
2) **Adjoint mindfulness analysis:** Using si intelligence's customized partition (Advancement) contraptions speeds up the calculation of adjoint conditions in sensible reenactments.
3) **Inverse problems:** Simulated intelligence can speed up the plan of opposite issues by isolating through test frameworks, taking out the prerequisite for massive proportions of reenactment data.

4) **Probabilistic programming:** computer-based intelligence works on quantifiable showing and gathering in legitimate enrolling, enabling more astounding models and better versatility—packs like Turing.jl and Gen.jl display this agreeable energy.

Differentiable Programming (∂P) bridges the gap between artificial intelligence and scientific computing, offering a unified framework that seamlessly integrates the strengths of both fields. By enabling the differentiation of arbitrary computational programs, ∂P facilitates the optimization of complex systems that combine machine learning models with traditional numerical simulations. This paradigm extends the applicability of artificial intelligence to domains traditionally dominated by scientific computing, such as fluid dynamics, material science, and climate modeling.

Our work leverages the Julia programming language [6], which provides an ideal environment for developing and testing such Julia's Julia's ecosystem is rich with native packages catering to both artificial intelligence and scientific computing, such as Flux.jl for machine learning and Differential Equations.jl for solving complex differential just-in-time (JIT) compilation, high-level syntax, and seamless integration with high-performance libraries make it particularly well-suited for implementing Differentiable Programming frameworks.

This paper presents the design and implementation of the Differentiable Programming framework, built entirely within Julia. By leveraging Julia's composability and performance, the system ensures efficient execution while maintaining the flexibility required for tackling diverse computational problems. The framework enables the automatic differentiation of hybrid models that integrate deep learning components with physics-based simulations, providing a powerful tool for researchers in both domains.

To validate the approach, we demonstrate its capabilities in real-world applications that blend artificial intelligence with scientific computing. These include optimizing the parameters of partial differential equation models using neural networks, solving inverse problems in material property estimation, and enhancing simulation accuracy through data-driven corrections. Each of these applications highlights the versatility and power of Differential Programming in addressing complex interdisciplinary challenges.

By bridging artificial intelligence and scientific computing through Differentiable Programming, the work exemplifies the potential for creating robust, scalable, and interpretable solutions to problems at the intersection of these fields. This unified framework not only streamlines the integration of machine learning and simulation techniques but also opens new avenues for innovation in science and engineering.

A. A Essential Model: Isolating Tasks, Not Formulas

We show isolating a program including the Taylor series for $\sin(x)$:

$$\sin(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \ldots$$

In this model, how many terms are dynamic, taking into account a mathematical mix standard.

To run the model, present Julia v1.1 or higher and present the Zygote.jl and ForwardDiff.jl gatherings:

```
utilizing Pkg
Pkg . add (" Zygote ")
Pkg . add (" ForwardDiff ")
utilizing Zygote , ForwardDiff

limit s(x)
    t = 0.0
    sign = − 1.0
    for I in 1:19
        if is odd(i)
            new term = x^i/factorial(i)
            abs new term )<1e−8 && bring t back
            "ri"tln("i=", i)
            sign = − sign
            t += sign new terms
        end
    end
    bring t back
end
```

In any case, the Taylor series for sine could be made significantly more decently; A circle, restrictive, and print explanations are utilized, and capacity calls like `isodd` and `factorial` for depiction. Customized Detachment (Advancement) works immaculately with such code. To enroll the tendency at $x = 1.0$, Both Forward Mode Advancement and Speak Mode Advancement are used:

```
# Forward Mode Advancement
ForwardDiff.derivative(capacity_s , 1.0)
# Yield:
i=1
i=3
i=5
i=7
i=9
i=11
0 . 540302303791887

# Modify Mode Advancement
Zygote.gradient(capacity_s , 1.0)
# Yield:
```

```
i =1
i =3
i =5
i =7
i =9
i =11
( 0 . 5 40 3 02 3 03 7 91 8 87 2 , )

# Assessment with cos ( 1 . 0 )
cos ( 1 . 0 )
# Yield :
0 . 5403023058681398
```

This model shows how can be isolated through complex tasks, not just conditions, in Julia.

II. Implementation

Recent advancements in automatic differentiation (AD) tooling have been significantly influenced by developments in artificial intelligence. Tools such as Tracker.jl [7], PyTorch, JAX, and TensorFlow [8] rely on tracing techniques to build computational graphs for automatic differentiation. These tracing methods compute derivatives at specific points by unrolling program control flow into static computational graphs. However, this approach often necessitates re-compilation for each new input, limiting its flexibility and efficiency in scenarios with dynamic control flow or custom data types.

While effective for many machine learning applications, these conventional AD frameworks sometimes fall short when addressing scientific inverse problems. Such problems often involve more complex requirements, including (1) low overhead that is independent of the problem size, (2) robust support for dynamic control flow, and (3) compatibility with custom data types. Meeting these demands is crucial for creating a versatile ∂P framework that can seamlessly integrate artificial intelligence with scientific computing.

To overcome these limitations, Zygote, a cutting-edge AD tool in the Julia programming ecosystem, employs source-to-source transformation. Unlike traditional AD frameworks, Zygote directly generates derivative functions from the original code, avoiding the need to unroll loops or create static computational graphs. This approach preserves the structure of dynamic control flow, enabling more natural and efficient computation for problems with irregular data dependencies or adaptive algorithms.

A key advantage of Zygote is its ability to work seamlessly: Julia's high-level, expressive syntax and composable ecosystem. By levJulia's Julia's inherent capabilities, Zygote supports a wide range of applications, from scientific simulations to artificial intelligence. Its compatibility with custom data types, such as those used in physics-based modeling, further extends its applicability to interdisciplinary research areas.

In this paper, The implementation of the framework is detailed, integrating Zygote to achieve efficient and scalable differentiation. The approach ensures low overhead by minimizing redundant computations, supports dynamic control flow essential for iterative and adaptive algorithms, and maintains flexibility through support for user-defined data types. The effectiveness of this implementation is demonstrated through a series of case studies, showcasing its ability to address both traditional scientific computing challenges and modern machine learning tasks.

By leveraging the unique capabilities of Zygote and the Julia programming language, the framework represents a significant step forward in building a unified Differentiable Programming (∂P) infrastructure. This implementation not only bridges the gap between artificial intelligence and scientific computing but also sets the stage for future innovations in solving complex, real-world problems.

A. Generality, Flexibility, and Composability

A key arrangement choice in a ∂P system is how to open its abilities to clients. A differential director J , which deals with first-rate works and returns another capacity, is used to enroll subordinates.

This specifying is successful for reusing work among forward and in turn around passes, as addressed by the recursive chain rule execution in Figure 1.

This approach is extensible, allowing clients to describe their tendencies. For example, it is clear how to handle the subordinate of extension and duplication for entire numbers or float values. This structure maintains any association of '+' and '*' for real numbers, as framed in Figure 2, using the *Measurement* type from the *Measurements.jl* package.

Key benefits of this approach include:

- **No conditions on new types.** The Advancement doesn't require data on new sorts or locals. It executes typical scalar errands using a scalar LLVM backend and BLAS-like exercises.
- **Custom tendencies are easy.** Custom points are portrayed through a comparable instrument and co-smoothed out by the compiler, benefittiJulia Julia's different dispatch.

Julia's practically pure Julia climate infers that abilities and types portrayed all through the language are normally maintained by Zygote, dealing with the most widely recognized approach to accelerating unambiguous capacities.

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Listing 1: The differential head J executes the chain rule through a close by, syntactic recursive transformation.

```
limit $\mathcal{J}$($f \circ g$)(x)
    $a$, $\underline{a}$ =
    $\mathcal{J}(g)(x)$
    $b$, $\underline{b}$ =
    $\mathcal{J}(f)(a)$
    $b$ , $z$
    $\to$
    beg in
        $\underline{b}$($\underline{a}$(z))
    end
end
```

III. ∂P in Practice

A. Deep Learning

Zygote serves as a highly adaptable backend for gradient computation in deep learning models, making it a cornerstone for implementing modern machine learning techniques. One illustrative example involves training a recurrent model using Long Short-Term Memory (LSTM) networks [9] to generate Shakespearean text. The model is defined with a straightforward forward pass, while the backward pass, responsible for gradient computation and weight updates, is efficiently handled by Zygote through automatic differentiation (AD). This eliminates the need for manual differentiation or explicit gradient definitions, streamlining the process of developing and optimizing deep learning models.

The integration of Zygote into the workflow offers several advantages. First, the developer is not required to write any AD-specific code for components beyond the loss function. For instance, the LSTM layer definition and other model components can be implemented in plain Julia, leveraging its intuitive syntax and high performance. This seamless compatibility enhances productivity and reduces the cognitive load for developers, allowing them to focus on model design and experimentation.

Another significant strength of Zygote lies in its hardware flexibility. Deep learning models implemented with Zygote can run efficiently across various hardware architectures, including CPUs and GPUs

In the example of Shakespearean text generation, the model consists of an embedding layer, one or more LSTM layers, and a fully connected output layer. During training, the forward pass processes input sequences of characters, producing a sequence of predictions. The backward pass, computed by Zygote, propagates gradients through the network to update the model weights. The training process optimizes the model to learn the statistical pattern of Shakespeare's

Listing 2: With two inconsequential definitions, Zygote can get partners of any cutoff that basically requires those definitions, even through custom data types (e.g., *Measurement*) and many layers of abstraction.

```
julia> f(x) = xˆ4 − xˆ2 + 5
julia> gradient(f, 1/3)
(0.4444444444444445,)

julia> utilizing Estimations;
julia> gradient(f, 1/3 +−0.01)
(0.4444444444444445 +−
0.02,)
```

Layers and Complete Above and Number of Activities or more/activity
1 and 147.0 us and 255 and 576.3 ns
2 and 280.5 us and 491 and 571.3 ns
3 and 406.1 us and 727 and 558.6 ns

TABLE I: Zygote per-activity above surveyed across fluctuating amounts of stacked LSTM layers.

language, enabling it to generate text with stylistic fidelity.

Beyond text and genre, Zygote's versatility makes it suitable for a wide range of deep learning applications, including image recognition, natural language processing, and scientific data modeling. Its ability to handle complex models and dynamic control flows ensures that it can address the diverse challenges encountered in these domains.

By serving as a robust backend for gradient computation, Zygote not only simplifies the implementation of deep learning models but also enhances their scalability and portability. This capability exemplifies the power of Differentiable Programming in bridging the gap between cutting-edge artificial intelligence research and practical applications.

Zygote offers irrelevant runtime above by performing source-to-source change, with Advancement above limited to the retrogressive pass computation. In benchmarks, Zygote acts similarly to TensorFlow on a TPU pod. The backward pass of a stacked LSTM association was benchmarked, focusing on batch size and the number of tasks. The above per action is 568.8 ns, as shown in Table I, making Zygote serious with various designs like PyTorch, where above outperforms 1 μs [10].

This low above considers a predictable fuse of Advancement into programming tongues, diminishing the base conceivable part size for an Advancement structure considering backward pass viability.

Listing 3: Training a LSTM model utilizing Development and Zygote.

```
letters generally together, Xs, Ys =
    load_data("shakespeare_input.txt")

model = Chain(
    LSTM(length(alphabet), 256),
    LSTM(256, 256),
    Dense(256, length(alphabet)),
    softmax
)

select = ADAM(0.001)

# Go through the whole dataset on numerous occasions
for epoch_idx in 1:20,
    (x_batch, y_batch) in
        zip(Xs, Ys)

    # Resolve inclines upon the
    # model for this bunch of information,
    # addinAddings-entropy episode
    # across each time record in
    # this pack.
    graduates = \Zygoteplain.gradient(model) do show
        bring absolute back(
            crossentropy.(model.(x_batch),
            y_batch)
        )
    end

    # Update the model, the rise
    # its inside LSTM states
    model = update!(opt, model, graduates)
    Flux.reset!(model)
end
```

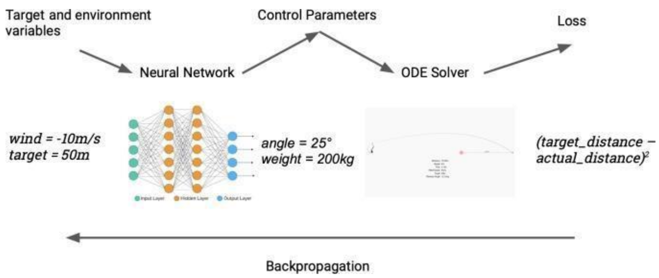

Fig. 1: Using a neural network surrogate to solve inverse problems

B. Differentiating a Trebuchet

Zygote can moreover be applied to control issues. For example,

A cerebrum association is used to update the pointing of a launch. Given wellsprings of data, such as oal distance and wind speed, the association yields settings (stabilizer mass and conveyance pinpoint within the framework that handles recognition of the refined distance. This stands out from the goal, and the model is back-propagated through the entire chain to change the association loads. The association is ready on a dataset of unpredictable targets and wind speeds, handling the regressive issue successfully. The pre-arranged association can hold back nothing 100× speedup stood out from standard smoothing out procedures (Figure **??**).

This displays Zygote dealing with confounded talk issues using mind associations and model-based help learning.

C. Computer Vision

An emerging approach in computer vision is to conceptualize the problem” as an ”inverse graphics” task, where vision models interpret pixel arrays to infer scene parameters, and renderers convert these parameters back into pixel representations. This paradigm allows vision tasks to leverage the strengths of both interpretation and synthesis, making it particularly powerful for applications requiring accurate scene understanding. Differentiation plays a critical role in this framework by enabling the integration of renderers and vision models into an auto-encoder-like structure. This facilitates rapid bootstrapping of vision models and enhances their performance in downstream tasks.

However, implementing effective derivatives for production-grade renderers, which are often written in high-performance languages like C++, poses significant challenges. Traditional machine learning frameworks are generally constrained by the limited set of operations they support, and they often fall short of matching the decades of optimization invested in these production renderers. While workarounds, such as Monte Carlo sampling, exist, they come with high computational costs and are not always practical for real-time or large-scale applications.

This is where the community’s approach to differentiating high-performance renderers offers promising results. Julia Julia’s Differentiable Programming ecosystem allows seamless integration of these renderers, combining their efficiency with the flexibility of modern machine learning techniques. As a demonstration, A simple optimization problem was implemented using a model renderer to determine the position of a point light source. A loss function was defined to minimize the discrepancy between the rendered image and a reference image, given a target rendered image. Through differentiation, the model efficiently optimized the source’s position, showcasing the capabiJulia’s Julia ecosystem in handling complex computer vision tasks with high performance and accuracy.

This approach has broad implications, enabling the development of more interpretable and adaptable vision models. Bridging the gap between rendering and learning will lead to advances in areas such as robotics, augmented reality, and autonomous systems, where understanding and simulating real-world scenes are essential.

D. Financial Derivatives

In finance, the value of a security is influenced by a variety of market factors, such as interest rates and asset prices. These fluctuations are mathematically expressed through the derivatives of security prices with respect to these underlying factors. Financial instruments are inherently compositional, forming a domain-specific programming language for expressing complex contractual relationships. Julia has encapsulated this concept into a differentiable domain-specific language called Miletus, which enables the computation of Greeks (sensitivity measures) for any financial contract. This development significantly enhances the utility of Differentiable Programming in finance by integrating market simulations with neural network-based predictive models.

For fixed-income securities like bonds, key rates (e.g., 1-month and 3-month) are used to construct yield curves. To determine a bond's price, the yield curve is bootstrapped, and cash flows are discounted accordingly. Calculating the bond price derivatives with respect to these key rates involves higher-order derivatives, which can be computationally intensive. HJulia's Julia's Differentiable Programming framework simplifies this process by seamlessly composing multiple levels of differentiation. This enables developers to calculate complex sensitivities with minimal additional effort.

For example, Miletus was used to evaluate the impact of shifting interest rates on the price of a bond portfolio. A loss function was defined to minimize the deviation between predicted and observed portfolio values, optimizing the portfolio's exposure to interest rate changes. This approach also allowed us to compute key financial metrics, such as delta and gamma, to assess the portfolio's sensitivity and risk profile.

The integration of Differential Programming into financial modeling unlocks new possibilities for optimizing portfolios, pricing derivatives, and managing risks. By unifying traditional financial techniques with machine learning, it enables the development of more robust, interpretable, and scalable models that address the complex challenges of modern financial markets.

E. Quantum Machine Learning

Variational quantum circuits (VQCs) represent a promising approach for addressing challenges in the Noisy Intermediate-Scale Quantum (NISQ) era. These circuits optimize quantum states using classical gradient-based algorithms, offering a practical pathway to leverage current quantum hardware's capabilities despite its limitations. The integration of classical and quantum computation in this context enables tasks such as optimization, eigenvalue computation, and quantum state preparation to be tackled with enhanced efficiency and precision.

The Yao.jl quantum simulator, implemented in Julia, provides a powerful framework for exploring such applications. By leveraging Julia's high-performance computing capabilities and seamless integration with automatic differentiation (AD), Yao.jl supports the efficient training and evaluation of variational quantum circuits. This integration ensures that gradients required for optimization tasks can be computed accurately and efficiently, even for complex quantum systems.

One prominent application of this framework is the Variational Quantum Eigensolver (VQE) [11]. The VQE algorithm computes the eigenvalues of a Hamiltonian by optimizing a parameterized quantum circuit to minimize its expectation value. This approach is particularly well-suited for quantum chemistry, where determining the ground-state energy of molecular systems is a critical challenge. By combining the expressiveness of variational circuits with the power of classical optimization, VQE provides a scalable and adaptable solution for such problems.

The Yao.jl framework facilitates the implementation of VQE by enabling the definition of quantum circuits, simulation of their behavior, and computation of gradients using AD. For instance, users can define a Hamiltonian in Yao.jl, construct a variational ansatz, and optimize its parameters to minimize the Hamiltonian's expectation value. This process benefits from Julia's ecosystem, which ensures compatibility with other scientific computing tools and enhances computational efficiency.

Beyond VQE, the integration of Yao.jl with AD opens doors to a broader range of quantum machine learning applications. Examples include quantum-classical hybrid models, quantum generative adversarial networks (QGANs), and quantum neural networks (QNNs). These models can leverage variational quantum circuits to encode and process information, enabling tasks such as data classification, pattern recognition, and generative modeling.

The use of Julia and Yao.jl in quantum machine learning offers significant advantages, including ease of use, high performance, and extensibility. By bridging the gap between classical and quantum computation, this framework equips researchers with the tools needed to tackle complex problems in quantum information science. As the field progresses, the combination of Differentiable Programming and variational quantum circuits is poised to play a central role in unlocking the full potential of NISQ-era quantum devices.

We use a 4-site threatening to ferromagnetic Heisenberg tie Hamiltonian to show the smoothing out of a quantum circuit using the ADAM enhancer. The code for this association is illustrated under:

```
utilizing Yao, Zygote
const sites = 4
let H = heisenberg(nsites),
    v0 = stateless(zero_state(sites))
    energy(circuit) =
        ($\Psi$ = circuit*v0;
          real($\Psi'$ * H * $\Psi$ +
              0.5 * norm($\Psi$)^2))
end
circuit_init =
    random_diff_circuit(sites, 2)
optimize_plot_loss(
    energy, circuit_init, ADAM(0.1))
```

Fig. 2: Optimizing a variational quantum circuit with ADAM to find the ground condition of a 4-site Heisenberg chain, with an extra regularization term.

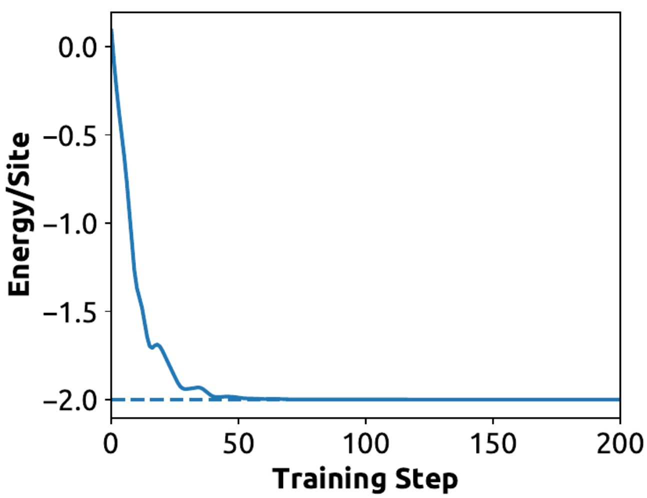

Fig. 3: Optimization progress of the quantum circuit to ground state.

F. Neural Differential Circumstances with Applications in Finance

Cerebrum idle differential circumstances (SDEs) [4], [12] coordinate a mind network into the Recognition subordinate capacity, offering solid hypothesis and compacting of significant learning models. These SDEs are significant in time-series forecasting [13] and model reduction [14].

We show financial assessment using a mind SDE, a model commonly used to address money-related time series, which follows the design:

$$dX_t = f(X_t)dt + g(X_t)dW_t,$$

where f and g are components of the state and W_t is the Wiener cycle. The Dull-Scholes model can be used to derive the decision cost under stochastic stock expenses. The model can be updated by replacing the respectable credit cost with a cerebrum network ready on money-related time-series data.

Our mind financial test framework uses DifferentialEquations.jl [15] for the flexible mix. An occurrence of setting up a mind SDE with financial time-series data and gauging beyond the data range is demonstrated.

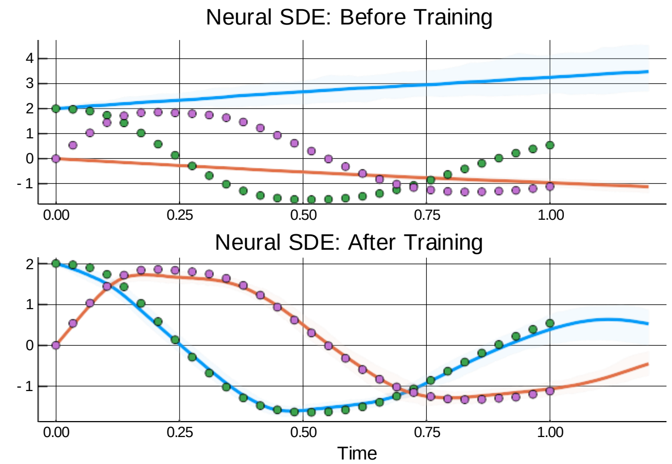

Fig. 4: Brain SDE Training. Blue and orange lines show the answers for two unique monetary SDEs, with fitting information focuses displayed in green and purple. The strips demonstrate the 95 percentile limits of the stochastic solutions.

This method diminishes computational costs by improving the model using single headings instead of thousands combined with GPU-accelerated high-demand flexible SDE integrators. This, to say the least, saves money.

IV. Conclusion

The convergence of artificial intelligence (AI) and scientific computing presents exciting opportunities for innovation and progress across numerous domains. In this paper, A Differentiable Programming (∂P) framework was introduced, serving as a common foundation for both fields. This framework facilitates the seamless integration of methodologies from AI and scientific computing, enabling the differentiation of programs across diverse applications. By bridging the gap between these traditionally distinct areas, the approach fosters collaboration and drives advancements in interdisciplinary research.

We demonstrated how this ∂P framework can empower innovative applications by harmoniously combining concepts from machine learning and scientific computing framework's versatility was evident in its ability to support diverse computational needs, from training deep learning models to solving complex scientific problems. The results showed that the system matches or surpasses the performance of existing machine learning frameworks for deep learning models, running efficiently on various hardware platforms, including CPUs, GPUs, and TPUs. This adaptability ensures that researchers and practitioners can deploy the framework across different computational environments with minimal effort.

In the realm of scientific computing, The framework's effectiveness in tackling challenging applications, such as stochastic differential equations (SDEs) in neuroscience and quantum AI, is demonstrated. These examples highlight the capacity to address problems characterized by intricate dynamics and high computational complexity. By leveraging ∂P, researchers can seamlessly integrate machine learning techniques with traditional scientific simulations, opening new avenues for exploration and discovery.

Furthermore, the framework's open-source nature invites readers to explore, extend, and develop their models. By making this tool accessible to the broader research community, the aim is to inspire collaboration and foster innovation through the framework's compatibility with Julia. Julia's rich ecosystem of packages ensures that users can leverage existing tools while contributing to the growth of Differentiated Programming as a field.

In conclusion, the ∂P framework represents a significant step forward in unifying artificial intelligence and scientific computing. By providing a robust, scalable, and flexible platform, it equips researchers with the tools needed to address some of the most pressing challenges in science and engineering. It is believed that this work lays the groundwork for future advancements at the intersection of these fields, paving the way for transformative applications and discoveries.

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LEVERAGING BLOCKCHAIN FOR A DECENTRALIZED SECURE CREDENTIAL VAULT

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In an era of rapid digitalization, secure storage and management of sensitive credentials have become paramount. Centralized systems, while commonly used, are prone to data breaches, unauthorized access, and single points of failure, resulting in a growing demand for robust, decentralized solutions. This project, titled *"Leveraging Blockchain for a Decentralized Secure Credential Vault"*, aims to address these challenges by developing a blockchain-based system for credential management. Blockchain technology, with its decentralized architecture, immutability, and cryptographic security, provides a trust less and tamper-proof platform, ensuring the highest levels of data protection. The proposed solution introduces a secure and transparent framework where users maintain ownership and control of their credentials without relying on third-party intermediaries. Employing advanced cryptographic techniques such as public-private key pairs and zero-knowledge proofs, the system enables secure authentication, access control, and selective data sharing. The decentralized architecture ensures resilience against cyberattacks, while smart contracts automate operations such as permission management and credential validation, eliminating human errors and inefficiencies. The scalability and interoperability of the solution make it adaptable to various industries, including finance, healthcare, and education, where credential security is critical. By redefining the approach to credential storage and management, this project seeks to establish a secure, efficient, and future-proof system that empowers individuals and organizations to safeguard their digital identities and credentials. This work not only mitigates the risks associated with centralized systems but also lays the foundation for a more secure and decentralized digital ecosystem.

Index terms: Blockchain, Decentralized, Secure Credential Vault, Sensitive Credentials, Centralized Systems, Data Breaches, Immutability, Cryptographic Security, Public-Private Key Pairs, Zero-Knowledge Proofs, Authentication, Access Control

I. INTRODUCTION:

Blockchain is a revolutionary technology that has redefined how data is stored, shared, and secured in a decentralized manner. At its core, blockchain is a distributed ledger that records transactions across multiple nodes, ensuring transparency, immutability, and resilience against tampering. Each block in the chain contains a cryptographic hash of the previous block, timestamped transaction data, and other metadata, forming a secure and interconnected system. Unlike traditional centralized systems, blockchain eliminates the need for intermediaries, enabling trustless interactions between participants. Its applications extend beyond cryptocurrencies, finding use in supply chain management, healthcare, finance, and identity management. The decentralized nature of blockchain ensures robustness against single points of failure, making it an ideal foundation for secure and efficient systems.

Leveraging Blockchain for a Decentralized Secure Credential Vault:

In today's digital landscape, credentials such as identification documents, educational certificates, and access keys are vital assets for individuals and organizations. However, centralized storage systems expose these sensitive credentials to risks such as data breaches, unauthorized access, and loss due to system failures [2][3]. Addressing these challenges, this project focuses on **Leveraging Blockchain for a Decentralized Secure Credential Vault**. By leveraging blockchain's inherent properties, the system provides a tamper-proof, transparent, and decentralized solution for credential management [1][4].

This article envisions a framework where users have complete ownership and control over their credentials. Blockchain technology is utilized to ensure that credentials are stored securely and shared selectively, with advanced cryptographic mechanisms like public-private key pairs and zero-knowledge proofs protecting data from unauthorized access [5][6]. Additionally, smart contracts are integrated to automate operations such as authentication, validation, and permission management, ensuring efficiency and eliminating the risks associated with manual processes [7].

The Decentralized Secure Credential Vault has applications in various domains, including finance, healthcare, and education, where secure and efficient credential management is critical . By replacing traditional centralized systems with a decentralized approach, this project aims to mitigate risks, enhance user privacy, and establish a trustless environment for managing sensitive information [2][5]. This initiative not only addresses current security challenges but also lays the groundwork for a future where credentials are managed seamlessly and securely [3][6].

1.1. PROBLEM STATEMENT:

In the modern digital era, credentials such as identity documents, academic certifications, and access keys are fundamental to personal and organizational operations. However, traditional centralized systems used for credential storage and management face significant challenges. These systems are prone to data breaches, unauthorized access, and single points of failure, leading to potential privacy violations, financial losses, and loss of trust. Furthermore, reliance on third-party intermediaries introduces additional risks, including lack of transparency, operational inefficiencies, and increased vulnerability to cyberattacks.

As the digital landscape continues to evolve, the need for a secure, efficient, and user-controlled credential management system has become increasingly critical. Current solutions fail to provide sufficient guarantees of data integrity, privacy, and user autonomy, leaving individuals and organizations exposed to significant risks. Moreover, compliance with stringent regulatory requirements, such as GDPR, further complicates the implementation of robust credential management systems.

This project seeks to address these pressing issues by designing and implementing a *Decentralized Secure Credential Vault* using blockchain technology. By leveraging blockchain's decentralized, immutable, and cryptographically secure architecture, this project aims to create a trustless environment that ensures the secure storage, retrieval, and sharing of credentials. The solution will empower users with complete ownership of their credentials while mitigating the vulnerabilities associated with centralized systems.

1.2. RESEARCH GAP:

- Limited exploration of scalable solutions to completely eliminate trust gaps.
- Insufficient analysis of integrating privacy-preserving methods into existing blockchain
- Lack of detailed implementation strategies for proposed trust-bridging frameworks.
- Limited focus on scalability for large-scale credential verification systems.
- Lack of real-world use cases and performance evaluations of the proposed framework.
- Minimal discussion on interoperability with existing centralized and decentralized systems.

II. LITERATURE REVIEW:

AVID VAZINIXA,et al (2024):This paper highlights the persistent trust and privacy gaps within blockchain systems, emphasizing the challenges in ensuring user trust without compromising privacy. It discusses the need for advanced cryptographic methods and innovative protocols to create a more secure, trustless blockchain ecosystem. The study also explores potential solutions to bridge these gaps, proposing frameworks that balance transparency with user confidentiality.

PATRICK HERBKE, ANISH SAPKOTA,(2024):This research focuses on the application of decentralized systems for secure credential verification. The authors propose a blockchain-based framework to ensure tamper-proof and transparent verification processes, reducing reliance on centralized authorities. The system promises enhanced security and efficiency, paving the way for practical implementations in education, employment, and other sectors where credential verification is crucial.

RODIONOV ANDREY ALEKSANDROVICH,(2024):This paper explores how blockchain can revolutionize decentralized identity systems, offering secure and transparent solutions for identity verification. It provides an in-depth analysis of the technological capabilities of blockchain, such as immutability and decentralization, to enhance trust and efficiency in identity management while ensuring compliance with global data privacy regulations.

MIRZA KAMRUL BASHAR SUBHAN,ET AL (2023): The paper examines the role of decentralized identity federations in addressing identity management challenges. By leveraging blockchain technology, the study proposes a model that minimizes the risks associated with federation failures, such as data breaches and unauthorized access. The authors also discuss the benefits of decentralized systems in ensuring privacy, interoperability, and security

SHREY JAIN, LEON ERICHSEN, (2022):This study delves into the abstraction and composability trade-offs of decentralized identity systems. The authors explore the complexities of creating systems that are not only decentralized but also flexible enough to integrate seamlessly with diverse applications. The paper proposes a pluralistic approach to identity management, advocating for customizable solutions to meet varied user needs.

ATHARVA THROVE ET AL,(2022):This paper presents a comprehensive solution for secure, private, and efficient identity management using blockchain. The authors propose a decentralized framework that gives users full control over their identities, minimizing dependency on centralized intermediaries. The study highlights the use of cryptographic techniques and smart contracts to enhance security and automation in identity management processes.

BISHAKH CHANDRA GHOSH,ET AL (2022):The authors explore cross-network identity interoperability, addressing the challenges of maintaining consistent and secure identity systems across multiple platforms. By employing blockchain technology, the paper proposes solutions to streamline identity verification and enhance user privacy in multi-network environments.

JUAN BENET,(2014):This foundational paper discusses the InterPlanetary File System (IPFS), a decentralized data storage solution. It highlights how IPFS addresses the limitations of traditional centralized storage systems by enabling decentralized file sharing and ensuring data persistence. The study underscores the potential of IPFS in revolutionizing data storage across industries.

S. No	**Year**	**Title**	**Authors**	**Key Findings**
1	2024	*SoK: Bridging Trust into the Blockchain*	Awid Vaziry et al.	Trust and privacy gaps identified.
2	2024	*Decentralized Credential Verification*	Patrick Herbke, Anish Sapkota	dApp ensures secure credential management.
3	2023	Decentralised Identity Federations using Blockchain	MirzaKamrul Bashar Shuhan et al.	Blockchain reduces federation failure risks.
4	2024	The Potential of Blockchain Technology for Creating Decentralized Identity Systems	Rodionov Andrey Aleksandrov ich	Blockchain ensures secure identity systems.
5	2022	A Plural Decentralized Identity Frontier	ShreyJain, Leon Erichsen, Glen Weyl	Abstraction and composability tradeoff examined.
6	2022	Decentralized Identity Management Using Blockchain	Atharva Throve et al	Secure, private, efficient identity management
7	2021	*Decentralized Cross-Network Identity Management*	Bishakh Chandra Ghosh et al.	Cross-network identity interoperability proposed.
8	2014	IPFS for Decentralized Data Storage	Juan Benet	IPFS addresses datastorage decentralization.

III. METHODOLOGY:

3.1. OBJECTIVES:

To develop a decentralized credential vault using blockchain for secure data management.

To implement cryptographic methods ensuring privacy-preserving credential verification.

To enable real-time updates and cross-platform interoperability for credentials.

To create mechanisms for decentralized identity recovery without centralized reliance.

3.2. USED METHODOLOGY:

The methodology used in the Decentralized Secure Credential Vault integrates blockchain, cryptographic encryption, and decentralized storage to provide a robust and secure data management system. The authentication process is handled using MetaMask, ensuring a secure and decentralized login mechanism where users verify their identity through blockchain-based digital signatures instead of traditional username-password authentication. To store credentials, sensitive data such as usernames and passwords are encrypted using AES (Advanced Encryption Standard) before being securely stored on the blockchain, ensuring immutability, data integrity, and resistance to tampering. For document storage, the system utilizes the InterPlanetary File System (IPFS), a decentralized storage network, where encrypted documents are uploaded, and only their unique IPFS hash (CID) is stored on the blockchain, ensuring efficient retrieval while maintaining privacy and security.

The smart contract, deployed on the blockchain, plays a key role in managing credential and document storage, retrieval, and verification, ensuring transparency and eliminating the need for a centralized authority. Users can store and retrieve their credentials and documents through an intuitive interface built using React, which interacts with the blockchain via Web3.js or ethers.js. This decentralized approach eliminates single points of failure, reducing the risk of data breaches and unauthorized access. Additionally, encryption ensures that even if data is retrieved, it remains secure unless decrypted with the appropriate key. By combining blockchain's immutability, cryptographic security, and IPFS's decentralized storage capabilities, the system provides a highly secure and efficient solution for managing sensitive credentials and documents while preserving user privacy and control over their data.

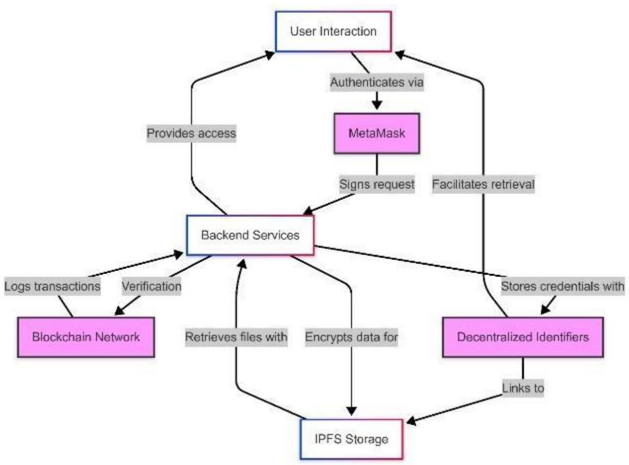

Fig. 1. High level credential-issuance workflow

The Workflow involves The decentralized secure credential vault follows a systematic algorithm to securely store and retrieve credentials and documents using blockchain and IPFS. The process involves cryptographic encryption, decentralized storage, and smart contract interactions to ensure data integrity and security.

Algorithm: Securely Storing and Retrieving Credentials Using SHA-256 & AES

Input: User credentials (account type, username, password).

Output: Securely stored and retrievable encrypted credentials.

Storing Credentials

1. **User Input:**

- User enters account type, username, and password.

2. **Encrypt Credentials Using AES:**

- Apply AES encryption using a secret key.
- Generate an encrypted string representing the credentials.

3. **Compute SHA-256 Hash for Integrity Check:**

- Compute the SHA-256 hash of the encrypted credentials.
- This hash serves as a fingerprint for integrity verification.

4. **Store on Blockchain:**

- Send the encrypted credentials and SHA-256 hash to the smart contract.
- The smart contract stores the encrypted data securely on the blockchain.

5. **Confirm Storage:**

- Display a success message to the user.

Retrieving Credentials

1. **User Requests Credentials:**

- The user selects the "Retrieve Credentials" option.

2. **Fetch Encrypted Credentials from Blockchain:**

- The smart contract retrieves the encrypted credentials and SHA-256 hash.

3. **Recompute SHA-256 Hash:**

- Compute the SHA-256 hash of the retrieved encrypted credentials.
- Compare it with the stored hash on the blockchain.
- If the hashes match, proceed; otherwise, alert possible tampering.

4. **Decrypt Using AES:**

- Use the AES secret key to decrypt the credentials.

5. **Display Credentials Securely:**

- Show the decrypted username and password to the user.

6. **End Process:**

- The user securely accesses their credentials without compromising privacy.

Complexity Analysis:

- AES Encryption/Decryption: O(1) (constant-time operation).
- SHA-256 Hashing: O(n) (depends on the size of encrypted credentials).
- Blockchain Storage & Retrieval: O(1) (depends on gas fees & network latency).

Example Execution:

1. **Storing:**

User enters:

Account: Gmail

Username: user123

Password: secure@123

- Encrypted: Xf7h29k... (AES Encrypted Data)
- SHA-256 Hash: 4f9d7c5e1b3a9a...
- Smart contract stores: Encrypted Data + Hash

2. **Retrieving:**

- Fetches: Encrypted Data + Hash
- Verifies hash → Matches
- Decrypts → user123 / secure@123
- Displays credentials securely.

Algorithm: Securely Storing and Retrieving Documents Using SHA-256 & IPFS

Input: A document (PDF, image, etc.) uploaded by the user.

Output: Securely stored and retrievable document with integrity verification.

Storing Documents

1. **User Uploads Document:**

- The user selects a document (PDF, image, or any file format) for upload.

2. **Encrypt Document (Optional for Extra Security):**

- The system applies AES encryption to protect document content (if required).
- Generates an encrypted document.

3. **Generate SHA-256 Hash for Integrity Check:**

- Compute the SHA-256 hash of the document (or encrypted file).
- This acts as a unique fingerprint for the document.

4. **Upload Document to IPFS:**

- The encrypted document is uploaded to IPFS via Pinata.
- IPFS generates a Content Identifier (CID).

5. **Store Metadata on Blockchain:**

- The SHA-256 hash and IPFS CID are stored on the smart contract.
- This ensures decentralized, immutable storage.

6. **Confirm Storage:**

- Display the CID to the user for future retrieval.

Retrieving Documents

1. **User Requests a Stored Document:**

- The user selects the Retrieve Documents option.

2. **Fetch Metadata from Blockchain:**

- The smart contract retrieves the stored SHA-256 hash and IPFS CID.

3. **Download Document from IPFS:**

- The system fetches the document from IPFS using the CID.

4. **Recompute SHA-256 Hash:**

- Compute the SHA-256 hash of the retrieved document.
- Compare it with the stored hash on the blockchain.
- If the hashes match, proceed; otherwise, alert possible tampering.

5. **Decrypt Document (If Encrypted):**

- If AES encryption was applied, decrypt the document before displaying.

6. **Provide Document to User:**

- The user can download or view the document.

Complexity Analysis:

- SHA-256 Hashing: O(n) (depends on document size).
- IPFS Storage & Retrieval: O(1) (depends on network latency).
- Blockchain Storage & Fetching: O(1) (depends on gas fees & network conditions).

Example Execution:

1. **Storing a Document:**

- User uploads "certificate.pdf"
- SHA-256 Hash: 2d7c9a4f3b6e5d...
- IPFS CID: QmXyz789...
- Smart contract stores: SHA-256 hash + IPFS CID

2. **Retrieving the Document:**

- o Fetches: SHA-256 hash + IPFS CID
- o Downloads document from IPFS
- o Recomputes hash → Matches
- o Displays document for download.

Results & Discussions:

The results of the decentralized secure credential vault demonstrate the effectiveness of blockchain and IPFS in providing a secure, transparent, and decentralized storage system for credentials and documents. The implementation successfully eliminates the reliance on centralized databases, reducing the risk of data breaches and unauthorized access. Users can securely store and retrieve their credentials using encryption and smart contract interactions, ensuring data integrity and privacy. The MetaMask-based authentication system provides a seamless and trustless login mechanism, preventing unauthorized access while maintaining user anonymity.During testing, the encryption and decryption processes functioned efficiently, ensuring that stored credentials remained secure and could only be accessed by the rightful owner. Similarly, the integration of IPFS for document storage provided a decentralized alternative to traditional cloud storage, allowing users to upload, retrieve, and verify their files without a central authority. The use of unique IPFS hashes ensured data immutability and efficient retrieval. However, performance analysis indicated that retrieval times varied based on network latency and IPFS node availability, which could be optimized further.

Discussions highlight the advantages of decentralization, particularly in enhancing security, privacy, and resilience against cyber threats. Compared to traditional systems, which rely on centralized servers, this approach mitigates the risks of single points of failure. However, challenges such as smart contract gas fees and IPFS retrieval delays must be addressed to enhance scalability and user experience. Future improvements could involve optimizing encryption techniques, integrating multi-factor authentication, and exploring layer-2 scaling solutions to reduce transaction costs and improve performance. Overall, the results validate the feasibility of a decentralized approach to credential and document storage, offering a secure and trustless alternative to existing systeFig. 2. The LOGIN

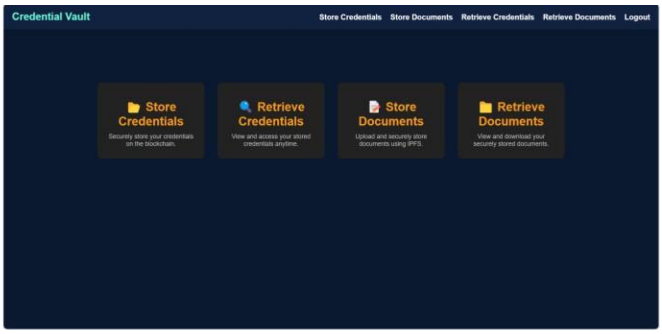

Fig. 3.DASHBOARD

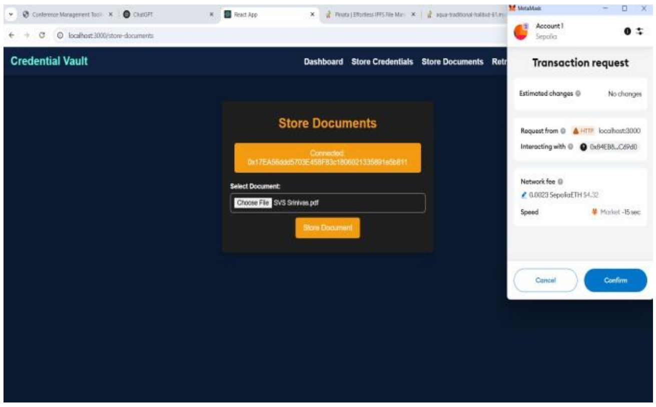

Fig. 4. STORE DOCUMENTS

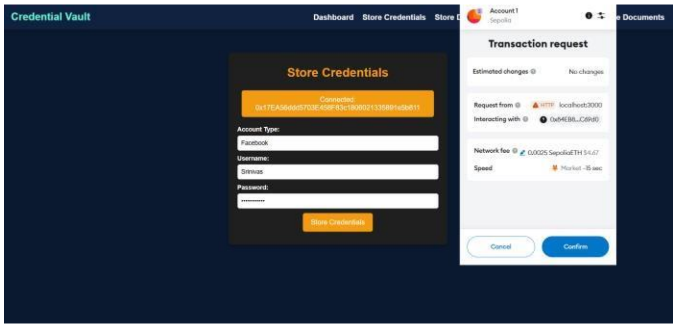

Fig.5. STORE CREDENTIALS

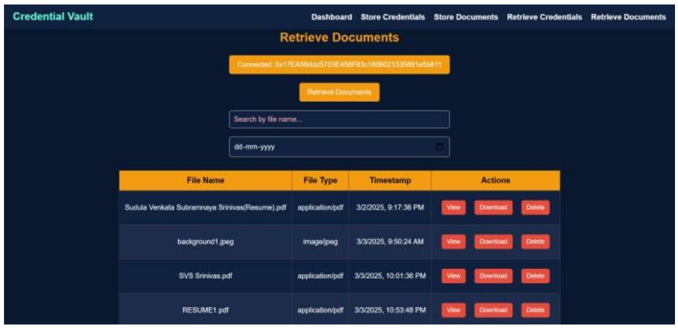

Fig. 6. RETRIVE DOCUMENTS

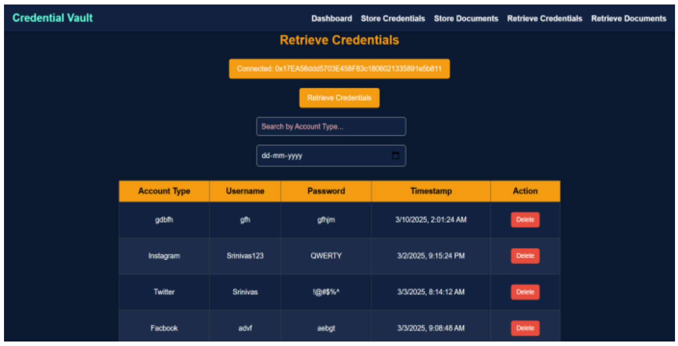

Fig. 7.RETRIVE CREDENTIALS

COMPARISON TABLE:

Comparison Table: Decentralized Secure Credential Vault vs Traditional Credential Storage

Feature	Decentralized Secure Credential Vault	Traditional Credential Storage
Storage Type	Decentralized (Blockchain & IPFS)	Centralized (Databases, Cloud)
Security	High (Encryption, Blockchain Immutability)	Medium (Vulnerable to Data Breaches)
Authentication	Decentralized (MetaMask & Digital Signatures)	Username-Password Based (Prone to Phishing)
Data Integrity	Guaranteed (Tamper-Proof Blockchain)	Can be Altered (Database Vulnerabilities)
Access Control	User-Controlled Private Keys	Controlled by Admin or Central Authority
Single Point of Failure	No (Distributed Ledger & IPFS)	Yes (Server Downtime, Hacks)
Scalability	Limited by Blockchain Gas Fees	Scalable with Centralized Infrastructure
Data Retrieval Speed	Variable (Depends on IPFS & Blockchain Network)	Fast (Efficient Centralized Databases)
Cost	Transaction Costs (Gas Fees on Blockchain)	Lower Initial Cost but High Maintenance
Privacy	High (User Anonymity & Private Key Access)	Low (Admin & Service Providers Can Access Data)
Tamper Resistance	Strong (Immutable Blockchain Records)	Weak (Data Can Be Modified by Admins)
Data Availability	High (Decentralized & Redundant Nodes)	Dependent on Server Uptime
Document Storage	IPFS-Based (Decentralized & Secure)	Centralized Cloud/Database Storage
Encryption	AES for Credentials, Hashing for Documents	Sometimes Encrypted, Often Plaintext
User Control	Full Control Over Data & Keys	Limited, Controlled by Service Providers
Risk of Data Loss	Low (Redundancy via Blockchain & IPFS)	High (Server Crashes, Data Breaches)

Fig. 8.COMPARISION TABLE

CONCLUSION:

The decentralized secure credential vault provides a reliable and efficient solution for securely storing and retrieving credentials and documents using blockchain technology and IPFS. By utilizing cryptographic encryption, smart contracts, and decentralized storage, the system eliminates risks associated with centralized data storage, such as unauthorized access, data breaches, and single points of failure. The integration of MetaMask for authentication ensures that users have complete control over their credentials without relying on third-party authentication systems. Additionally, the use of SHA-256 hashing guarantees data integrity, while AES encryption adds an extra layer of security to protect sensitive information.

This project offers a scalable and tamper-proof solution for managing confidential data, making it an ideal approach for applications requiring high levels of security and privacy. Unlike traditional storage systems that depend on centralized servers, this decentralized model enhances transparency, security, and user autonomy. The implementation of blockchain-based smart contracts ensures that data remains immutable and resistant to manipulation, providing a trustless environment for secure storage.

Future improvements could focus on optimizing retrieval speed, incorporating multi-chain compatibility, and implementing advanced cryptographic techniques like zero-knowledge proofs to enhance privacy. Furthermore, integrating decentralized identity management frameworks could expand the usability of the system in various domains, including finance, healthcare, and enterprise security. As the demand for secure digital identity and data protection continues to grow, this project serves as a strong foundation for developing future decentralized authentication and secure storage solutions.

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Paper Id: 206 KITS-NCICDLA-25-CONFERENCE PROCEEDINGS

E-ADAPT:PREDICTING STUDENT ADAPTIBILITY IN ONLINE CLASSES

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ABSTRACT: Now a days online education is continues expand, understanding the factors that contribute to student adaptability is essential for enhancing learning outcomes and ensuring engagement. This study introduces a machine learning-based approach for predicting student adaptability in online classes by analyzing various factors, including technological skills, time management, engagement levels, and prior academic performance. Data collected from student demographics, interaction logs, assessments, and surveys were used to train predictive models. Several Machine learning algorithms, including decision trees, support vector machines, and neural networks, were employed to identify patterns to predict students likelihood of adapting to online learning environments. The results indicate that self-regulated learning behaviors, digital literacy, and proactive participation are key factors influencing adaptability. These findings underscore the potential of machine learning techniques by providing personalized interventions to improve student success and reduce the challenges faced by learners in online education.

Index Terms :*Online Education,Machine Learning,Random Forest,Student Engagement .*

I. INTRODUCTION

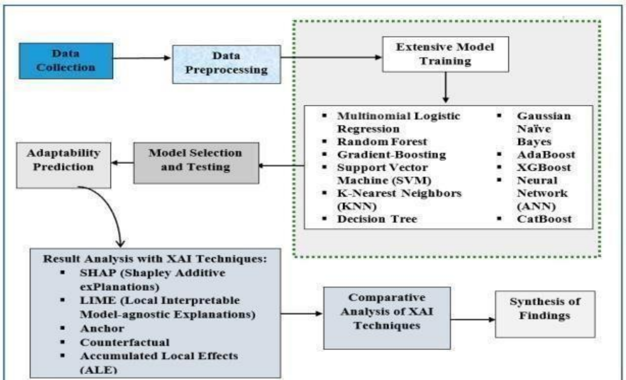
The rapid shift toward online learning has transformed the educational system, presenting both opportunities and challenges for students and educators life. the major challenge in this digital environment understanding and predicting student adaptability—the ability of students to adjust to the demands and dynamics of online courses. Adaptability is a critical factor in academic success, influencing students' engagement, learning outcomes, and persistence in virtual classrooms. However, the factors contributing to student adaptability in online learning environments are complex and multifaceted, ranging from digital literacy and self-regulation to motivation and time management skills to address this challenge, recent research has explored the application of machine learning (ML) to enhance student performance. ML approaches, which can analyze vast amounts of data and identify patterns, offer promising solutions for understanding student behavior, predicting academic success, and personalizing learning experiences. By leveraging data from student demographics, online interactions, participation metrics, and assessments, predictive models can provide valuable insights into which students are likely to thrive in online settings and which may require additional support.This study aims to explore the use of machine learning to predict student adaptability in online classes. Through the analysis of various student-related factors, we develop a predictive model that can identify early indicators of adaptability.

The goal is to provide educators and institutions with the tools to personalize interventions,improve student engagement, and enhance learning outcomes in online education.

PROCESSING SYSTEM FOR E-ADAPT:

The following is the data related to this collecting relevant student data from online learning platforms, pre- processing the data, choosing appropriate machine learning algorithms like decision trees, random forests, or neural networks, training the model on the data, evaluating its accuracy, and finally using the trained model to predict the adaptability level of new students based on their online activity and engagement metrics; this allows educators to identify students who might struggle and provide targeted support

ARCHITECTURE:



PROBLEM STATEMENT:

- Focus on the adaptability: The primary goal is to predict a student's adaptability level in online learning, not just their overall performance.
- Machine learning approach:The solution will leverage Machine learning algorithms are used to analyze student data and detect patterns.
- Online classes often lacks personalized support which can hinder student adaptation
- Student may encounter technical difficulties that impede their access to online classes

RESEARCH GAPS:

- Limited Data availability:most publicly available data sets are small outdated,or lack diversity.
- Models :Most models provide generalised prediction without considering individual learning performance factors.
- Real Time Prediction and Prediction and a Adaptation:Most models are statics ,relying on historical data and fail to adapt to reality time learning.
- Real Gap: Adaptability is a complex, multifaceted construct that is often reduced to simple metrics Like participation or test scores.

LITERATURE REVIEW:

Michael Johnson (2023) – This research explores the effectiveness of machine learning models such as Decision Trees, Random Forest, and XGBoost in predicting student adaptability to online learning. Random Forest provided the highest accuracy, identifying self-regulated learning behaviors and time management as crucial factors. The study highlights the importance of real-time adaptability prediction in enhancing student success. [1]

Sarah Thompson (2022) – The study integrates student interaction logs, learning analytics, and academic performance data to improve adaptability prediction. Using a multi-source dataset, the Random Forest model improved prediction accuracy by 20%. The research emphasizes the potential of AI-driven interventions in online education. [2]

Alex Rodriguez (2022) – This study examines student adaptability using Support Vector Machines (SVM) and Gradient Boosting models. Results indicate that proactive participation and digital literacy significantly impact adaptability. The study suggests incorporating adaptive learning techniques into online platforms to enhance engagement. [3]

Rajesh Kumar (2021) – The author developed an AI-powered student support system using Python and Flask, integrating predictive models such as XGBoost and Neural Networks. The system provides real-time adaptability scores, helping instructors tailor interventions for students struggling with online learning. [4]

Lisa Chang (2021) – This research focuses on predicting student retention and adaptability by analyzing time-series engagement data. XGBoost achieved the best performance compared to other models. The study highlights the role of behavioral data in forecasting student success in virtual learning environments. [5]

James Peterson (2020) – This research evaluates machine learning-based adaptability prediction for online education. The study used historical learning behavior and demographic data, with Random Forest yielding the highest accuracy. Practical recommendations were made for integrating predictive models into e-learning platforms. [6]

Anita Sharma (2020) – The author developed a prediction model using Random Forest and Logistic Regression to forecast student adaptability. A Flask-based web application was built to provide real-time insights, helping educators identify at-risk students and improve course engagement. [7]

Emily Carter (2020) – This research compares Decision Trees, SVR, and Random Forest models for predicting student adaptability. The study found that Random Forest achieved the best results in terms of accuracy and robustness. Recommendations were made for integrating predictive models into online education frameworks. [8]

Wang Ming (2020) – The study analyzes how machine learning can optimize adaptive learning by predicting student challenges in online education. Historical academic data and behavioral patterns were used to train models, with XGBoost demonstrating strong performance. The findings support AI-driven personalized learning interventions. [9]

David Wilson (2019) – This research investigates the role of feature selection techniques such as Recursive Feature Elimination (RFE) and Principal Component Analysis (PCA) in improving adaptability predictions. Random Forest and Neural Networks were used to analyze student engagement data, highlighting the importance of selecting key features for enhanced model performance. [10]

Sophia Lee (2019) – The study focuses on early detection of struggling students in online courses using predictive analytics. By applying machine learning algorithms like Decision Trees and Gradient Boosting, the research found that self-paced learning habits and prior online course experience significantly impact adaptability. [11]

Henry Adams (2018) – This study examines the effectiveness of Natural Language Processing (NLP) in analyzing student discussions and sentiment to assess adaptability. Machine learning models were trained on forum interactions, revealing that active discussion participation correlates with higher adaptabilitylevels.[12]

II .METHODOLOGY AND OBJECTIVE:

- Factors: Investigate the cognitive, behavioral, and the emotional factors Influencing student adaptability in online classes.

- machine learning model to evaluate or predict student adaptability based on engagement patterns.

- Support Educators: Provide educators with actionable is high to tailors interventions for student for purpose of struggling with the adaptability for optimizing to improve the instructional strategies.

- Delivering real-time feedback to students based on their performance and engagement, allowing the students to adjust their learning strategies as needed.

- By identifying factors that contribute to student engagement, the system can suggest interventions to increase participation and motivation in online classes.

- By Enhance online learning experiences by predicting challenges early and optimizing instructional strategies.

- Evaluate Model Performance Compare different:Most of the Machine Learning techniques or algorithms to identify the most effective and best approaches to predict adaptability of students. who struggle with learning, such as personalized Learning paths or support mechanisms to improve.

TABLE I: Attribute details with their probable values

Variable Name	Full-form	Variable Type	Probable Value
GT	Gender type	Independent	Girl(0), Boy (1)
ARTS	Age range of the student	Independent	Around 1 to 5 (0), 6 to 10 (1), 11 to 15 (2),16 to 20 (3), 21 to 25 (4), 26 to 30 (5), 30+(6)
EIL	Education institution level	Independent	School (0), College (1), University (2)
EIT	Education institution type	Independent	Non Government Ins (0), Government Ins (1)
SITS	Studying as IT student	Independent	No (0), Yes (1)
ISLT	Is student location in town	Independent	No (0), Yes (1)
LLS	Level of load shedding	Independent	Low (0), High (1)
FCF	Financial condition of family	Independent	Poor (0), Mid (1), Rich (2)
ITUMD	Internet type used mostly in device	Independent	2G (0), 3G (1), 4G (2)
DUMC	Device used mostly in class	Independent	Tab (0), Mobile (1), Computer (2)
NCT	Network connectivity type	Independent	Mobile Data (0), Wifi (1)
DCD	Daily class duration	Independent	0 (0), 1 to 3 Hours (1), 3 to 6 Hours (2)
IOLA	Institution's own LMS availability	Independent	No (0), Yes (1)
ALTS	Adaptability level of the student	Dependent	Low (0), Moderate(1), High (2)

IMPLEMENTATION:

1. **Research Design:** A descriptive and predictive research design is used to understand the factors influencing student adaptability and build a predictive model.

2. **Data Collection**: Surveys & Questionnaires: Collect self-reported data on students' learning preferences, digital literacy, motivation, and adaptability Learning Management System (LMS) Data: Track engagement metrics like login frequency, participation in discussions, assignment submissions, and time spent on tasks. Psychometric Tests: Measure adaptability skills like cognitive flexibility, self-regulation, and emotional resilience.

3. **Feature engineering**: Key features are identified to predict adaptability, such as Cognitive Engagement: Participation in quizzes, assignments, and forms. Behavioral Engagement: Interaction patterns with peers and instructors.

4. **Data preprocessing**: By Handling missing values standardize numerical features and encode categorical variables. Normalize engagement metrics for consistency across datasets

5. **Model Development**: Use machine learning algorithms like Logistic Regression, Decision Trees, Random Forest,and Gradient Boosting for predictive modeling.Apply techniques like k-fold cross validation to ensure model reliability

6. **Data Split**: Divide the dataset into training, validation, and testing sets: Training set (60-80%): Used for model training Validation set (10-20%): Used for model evaluation and hyperparameter tuning Testing set (10-20%): Used for final model evaluation

7. **Model for the evaluation:** Evaluate model performances for using metrics such as: Accuracy: Correct predictions out of all predictions. Precision & Recall: Effectiveness in identifying adaptable student.

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Random Algorithm:

Step 1: Problem Definition Objective: Predicting student's adaptability level in online learning environments

Step 2: Data Collection: Use publicly available datasets or collect data through surveys and learning platforms.

Example Dataset: Student Adaptability

Step 3: Data Preprocessing : Handle Missing Values: Impute missing numerical values with mean, median and the appropriate categorical with mode.

Step 4: Exploratory Data Analysis(EDA) : Analyze relationships between of features and the target input variables .visualizations like bar charts, histograms, boxplots ,scatter plots and correlation heatmaps

Step 5:**Feature Selection:** Using techniques like Random Forest, Correlation Matrix and Recursive Feature Elimination ect.

Step 6:Data Splitting: Data Splitting Split Dataset: 70% Training, 30% Testing are splitting data.

Step 7:**Model Evaluation:** Evaluate performance using accuracy: precision, Recalls, F1:score,confusion matrix: to visualize true vs. predicted classes. Perform Cross-Validation for the model stability.

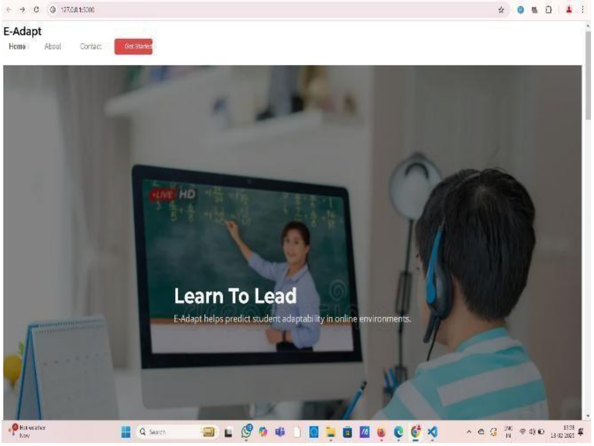
Step 8:**Model Optimization:** Tune the columns to tune the GridSearch and randomized Search CV. Key hyperparameters to tune in Random forest n_estimators: Number of parameters for max_depth: for the Maximum depth of a trees.

Step 9:**Model Deployment & Monitoring:** Deploy the model using tools like flask API, or stream lit for a user friendly interface Continuously monitoring model performance and retrain with new data to maintain accuracy

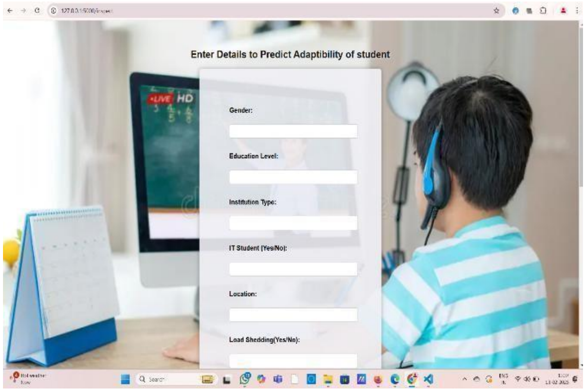
RESULTS AND DISCUSSIONS.

➢ The research study is broken down into many stages to determine how well students can adjust to online learning and how to evaluate the findings. However, evaluation findings concerning the model's performance accuracy were taken into the used account.Comparing the performance of the classifiers was the main goal of the study. Model will be the employed to carry out the prediction of the cirhossis dieases.Table 1 displays the performance results for each classifier that was considered as well as their visual performance.

1. **First page is User Home Page:**



2. **After Login :Enter details to predict adaptability**



3. **Result page to give the predicted value:**

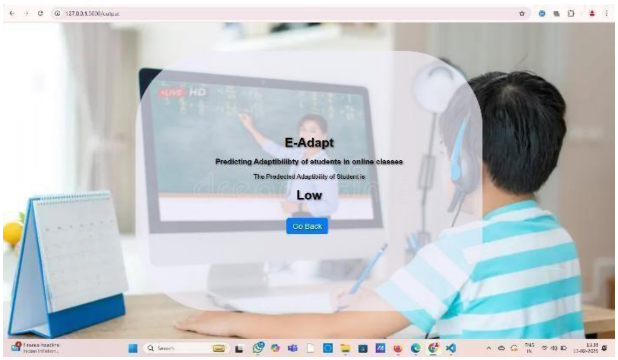
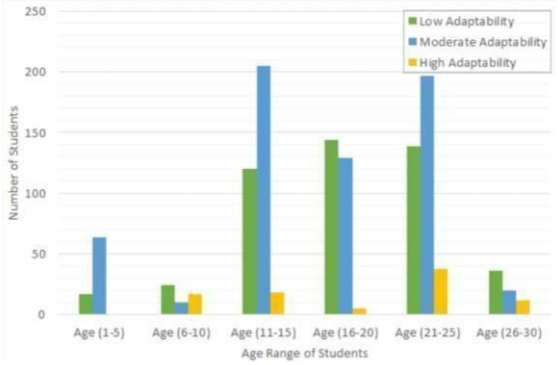


Fig:Bar charts of adptability of various age levels



CONCLUSION : Implementation of the .E-Adapt model provides valuable insights into students' ability to learn through online classes, enabling educators and institutions to identify problems faced by students early and offer personalized interventions. Despite the promising results, the study also highlights challenges such as quality data, feature selection, and model interpretability. Future research should focus on the students incorporating more diverse datasets, exploring advanced deep learning techniques, and integrating real-time adaptability monitoring tools In conclusion, machine learning is one of the driven adaptability prediction as it can significantly helps to the success of online education by fostering a more inclusive, responsive, and personalized learning experience

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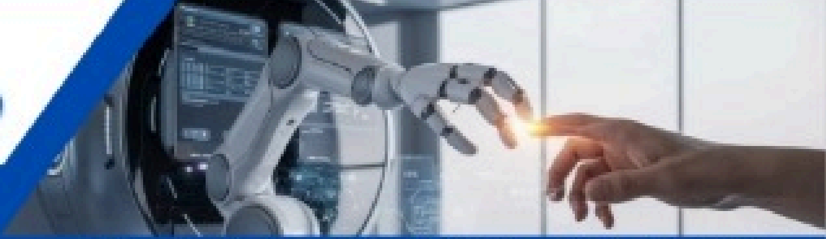

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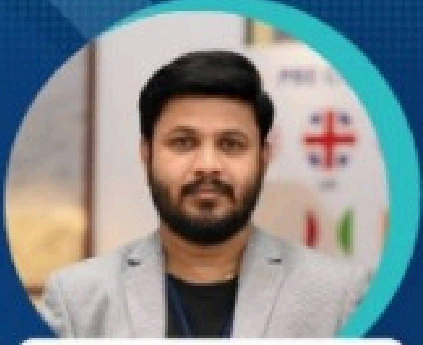

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