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Editorial

Beware of Cybercrimes: When new technologies are emerging, new challenges are also coming before us. One such a great revolution in the world is digital technology, and the challenge is handling the cybercrimes. Cybercrime is nothing but an illegal criminal activity organized by the cyber criminals using a digital technology. The use of internet has become necessary in everyone's day-to-day life. Number of people using the internet is increasing day-by-day and the number of cybercrimes too are increasing highly across the globe.

When we use internet without security measures, may land up into the trap of cybercriminals. Some examples of cybercrimes like hacking someone's data, hacking computer systems and smart phones, malicious software, software piracy, cyber terrorism, on-line financial frauds, social media crimes, child pornography, etc are few to mention. It was reported that in 2017, in India at least one cybercrime in every 10minutes and in 2016 one cybercrime in 12 minutes. Also, reported that in the year 2023, cybercrime rate in India was 129 per one lakh population with Delhi recorded highest rate of 755 crimes followed by Haryana (381) and Telangana (261). In the year 2023, the most common type of cybercrimes occurred in the US were i) phishing attack to steal sensitive information like user name and password and ii) spoofing, the attacker creates a duplicate social media account that looks like someone's original. Incidents like black mailing the bank account holder, creating a fear, threatening and forcing to transfer huge amounts are common nowadays.

The motive behind most of the cybercrimes is that the criminals want to make huge amount of money in a shorter period of time in an easy way. Other than this, personal vendettas, political conflicts, stealing trade secrets, and so on. Very recently a gang duped an art teacher for ₹4.10 crore with fake govt job offer, a man proposed and cheated woman of ₹ 41 lakh, in the name of in courier scam a woman forced to strip on camera and cheated for ₹ 15 lakh. There are many such crimes and many innocent people are falling in their trap.

To prevent or atleast to control cybercrimes successfully, need to have an actively functioning enforcement departments with stringent laws. There are other measures to prevent cybercrimes which include using strong passwords, install a security suite in computer, protect your storage data, revealing self-identity or personal information only via phone or secure web sites, frequently changing passwords, calling the right person for help, avoid downloading files or open attachments in emails from unknown senders, have the cyber insurance policy, etc are some of the basic cyber securities.

New Delhi **Editor**

29th February 2024

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ABSTRACT

My eyes are smart wearables designed to assist individuals with visual impairments. These innovative wearable devices combine advanced technologies such as computer vision, sensors, and audio feedback to enhance the daily lives of the blind. By capturing and processing real-time visual information from the surroundings, these smart glasses offer navigation support, object recognition, and obstacle detection. This abstract explores the key features, benefits, and challenges associated with the development and adoption of smart glasses for the blind, highlighting their potential to significantly improve independence and accessibility for visually impaired individuals.

KEYWORDS *: Visual impairment, Sensors, Object recognition, OCR, Independent.*

INTRODUCTION

The prevalence of visual impairment has increased, affecting around 256 million people globally ang 36 million are blind Many visually impaired individual face challenges in education and employment due to a lack of assistive technologies and economic constraints. This has resulted in a minority living with limited income. Wearable devices, particularly head-mounted ones, have proven useful due to their hands-free nature. This paper introduces a cost-effective design for smart glasses using a Raspberry Pi, computer, camera, and earpieces to assist users, focusing on reading tasks. The glasses aim to help visually impaired individual access written information and enhance their educational opportunities.

Aim

The aim of the introduced smart wearables is to provide a cost-effective and technologically advanced solution for visually impaired individuals. These glasses utilize a novel design incorporating a Raspberry Pi computer, a camera, and an earpiece to assist user in various tasks, with a primary focus on reading. 't overarching goal is to enhance accessibility to written information, empowering visually impaired individual to overcome educational and life challenges, ultimately improving their quality of life and opportunities for success.

Problem Statement

Despite the increasing number of visually impaired individuals worldwide, many face barriers in accessing education and employment opportunities due to a lack of affordable assistive technologies and economic limitations. Current available solutions are either prohibitively expensive or offer limited functionality. The absence of accessible resources contributes to a cycle of limited income and restricted life opportunities for the visually impaired. As a result, there is a significant need for an affordable and multifunctional solution that can address these challenges and enhance the independence and educational prospects of visually impaired individuals.

Problem Solved

The problem of limited accessibility and opportunities for visually impaired individuals is addressed through the introduction of My eyes. These are designed with a focus on affordability and functionality, utilizing components like the Raspberry Pi 2 computer, a camera, and an earpiece. By incorporating these technologies, the smart glasses are capable of assisting users in various tasks, with an emphasis on reading printed text. The glasses leverage the camera to capture and convert text into audio, enabling visually impaired individuals to access written information without the need for additional expensive devices. The smart glasses aim to empower visually impaired individuals by providing them with a tool that enhances their educational capabilities. By allowing them to read, study, and learn from printed text images, the glasses bridge the gap between the visually impaired and the educational resources available to others. This innovation holds the potential to break the cycle of limited income and restricted opportunities, as visually impaired individuals can now access information independently, making education and various fields of study more accessible to them.

LITERATURE REVIEW.

This literature review aims to explore various methods employed in computer vision fields for text detection and recognition, with a particular focus on assessing their accuracy rates and effectiveness.

eSight

eSight is a prominent company that specializes in creating smart glasses designed to assist individuals who are blind or have visual impairments.[1] These smart glasses incorporate advanced technology to provide wearers with an enhanced visual experience, allowing them to perceive their surroundings more clearly and engage in various activities more effectively. The smart glasses utilize a combination of cameras, sensors, and real-time image processing algorithms to capture and enhance visual information in real-time.[T1].

Key features and aspects of eSight's smart glasses for blind people include:

1. Wearable Design: The smart glasses are designed to be worn like a regular pair of eyeglasses, ensuring comfort and ease of use for the wearer.
2. Real-Time Video Processing: Cameras on the smart glasses capture the wearer's surroundings, and the captured video feed is processed in real-time to enhance clarity, contrast, and brightness.
3. Customizable Settings: Wearers can adjust various settings to cater to their individual visual preferences, such as magnification levels, color contrasts, and brightness.
4. Mobility: The lightweight and portable design of the smart glasses enables users to use them while moving around, making tasks like walking, navigating indoor spaces, and recognizing people's faces more manageable.

It's worth noting that while eSight's smart glasses offer numerous benefits, they also come with certain limitations and considerations, such as the cost of the devices, potential learning curves for new users, and the fact that they might not fully replicate natural sight. As technology continues to evolve, eSight's innovations in the field of smart glasses for the visually impaired contribute significantly to improving the quality of life for those with visual impairments, enabling them to engage more actively and independently with the world around them.

Envision

"Envision" is another notable company that focuses on creating smart glasses specifically designed to assist individuals who are blind or have visual impairments. [2] These smart glasses incorporate cutting-edge technology to provide wearers with enhanced visual information and enable them to navigate their environment more effectively. Envisions smart glasses utilize a combination of camera- based recognition and AI-powered algorithms to deliver real- time assistance to users. [T1].

Key features and aspects of Envisions smart glasses for blind people include:

1. Wearable and Stylish Design: Envisions smart glasses are designed to be worn comfortably and discreetly, resembling regular eyewear.
2. Text and Object Recognition: The smart glasses utilize camera-based technology and AI algorithms to recognize and interpret text, objects, and even people in the wearer's surroundings.
3. Auditory Feedback: The device converts visual information into auditory cues, which are delivered through headphones or bone conduction

technology. This allows wearers to "hear" what the glasses "see."

4. Real-Time Interaction: Envisions smart glasses provide real-time feedback, enabling wearers to receive instant information about their environment, such as reading signs, identifying items, or recognizing faces.

It's important to note that while Envisions smart glasses offer significant advantages in assisting people with visual impairments, they may also have certain limitations and considerations, such as the need for users to become accustomed to the audio-based interface and the evolving nature of AI and camera-based recognition technology.

OXSIGHT

"OXSIGHT" is a company that specializes in developing smart glasses designed to assist individuals with visual impairments or blindness.[3] Their smart glasses incorporate advanced technology to enhance users' vision and improve their overall quality of life. OXSIGHT's glasses aim to provide wearers with a clearer view of their surroundings, enabling them to better navigate and engage with the world. [T1].

Key features and aspects of OXSIGHT's smart glasses for blind people include:

1. Wearable Design: OXSIGHT's smart glasses are designed to be worn comfortably like regular eyeglasses, allowing for easy and convenient use.

2. Enhanced Vision: The smart glasses utilize cameras and image processing technology to capture and enhance the visual information from the environment. This enhanced visual information is then presented to the wearer.

3. Customizable Settings: Wearers can adjust settings based on their individual preferences and needs, such as contrast, brightness, and magnification levels.

4. Peripheral Vision Enhancement: OXSIGHT's glasses may focus on enhancing peripheral vision, which can be particularly helpful for individuals with conditions like tunnel vision.

As with any assistive technology, there may be certain limitations and considerations associated with OXSIGHT's smart glasses. These might include factors such as cost, potential learning curves for new users, and the fact that the glasses might not fully replicate natural sight.

AIRA

AIRA is a company that provides assistive technology for blind and visually impaired individuals through a combination of smart glasses and remote human assistance. The goal of AIRA is to enhance the independence and mobility of individuals with visual impairments by offering real-time access to visual information and navigation support. [T1].

Key features and aspects of AIRA's smart glasses for blind people include:

Wearable Technology: AIRA's smart glasses are designed to be worn by users like regular eyewear, offering a hands-free way to receive visual assistance.

Live Video Streaming: The smart glasses include a camera that streams live video to a remote team of trained agents. These agents can see the video feed and provide assistance to the user in real time.

Human Assistance: One of AIRA's unique features is the integration of human agents who can assist users with tasks such as navigation, reading text, identifying objects, and more.

Visual Information: With the help of the remote agents, users can ask questions about their environment, describe scenes, and receive information about their surroundings.

GPS Navigation: AIRA's technology also includes GPS capabilities, allowing agents to guide users through unfamiliar places or provide directions to specific destinations.

Advantages

Real-time Support: The combination of smart glasses and human agents provides immediate assistance, enhancing users' ability to engage with their surroundings.

Disadvantages

Subscription Cost: The monthly subscription fee for

AIRA's service might be a consideration for potential users.

Reliance on Connectivity: As the system relies on live streaming and remote assistance, a stable internet connection is necessary for optimal use.

The design of existing smart glasses can be bulky, causing discomfort for users, especially during extended wear. The weight and size of the device may hinder mobility and affect the overall user experience. Furthermore, the intricate technology incorporated into these glasses may contribute to a higher risk of technical malfunctions or breakages, necessitating repairs and maintenance. Despite advancements in object recognition, smart glasses may still face accuracy issues, particularly in complex environments or with rapidly changing surroundings. Navigation errors can occur, leading to potential safety concerns for users relying on the device for mobility assistance. The learning curve associated with mastering the functionality of smart glasses could be steep, deterring some visually impaired individuals from fully benefiting from the technology. In conclusion, while smart glasses for visually impaired individuals offer promising solutions, they are not without their disadvantages. Addressing issues related to battery life, cost, design, accuracy, privacy, security, standardization, connectivity, social acceptance, and obsolescence is crucial for the successful integration of these devices into the daily lives of visually impaired users. [T1].

Table 1: Comparison between Our system with other respective smart glasses.

Smart Glasses	eSight	Envision	Oxsight	Oton Glass	My Eyes
Object Recognition	No	Yes	Yes	No	Yes
Text Recognition	Yes	Yes	Yes	Yes	Yes
Independent	Yes	Yes	Yes	Yes	
Yes					
Voice Assistant	No	No	No	No	Yes
Face Recognition	No	No	No	No	Yes
SOS Function	No	No	No	No	Yes
Optical Character Recognition	No	No	No	No	Yes
Obstacle Detection	Yes	Yes	Yes	Yes	Yes

HARDWARE SPECIFICATIONS

Raspberry Pi

The Raspberry Pi is an accessible computing device, roughly the size of a credit card, which connects to a PC monitor or TV and utilizes a standard keyboard and mouse for input. To function, it requires essential components such as a power supply, SD card, and an installed operating system. This cost-effective embedded system is capable of performing a wide range of important tasks. Furthermore, the Raspberry Pi serves as an excellent tool for engaging young learners in understanding computer fundamentals and fostering their programming skills, thereby nurturing the next generation of developers. In this project, we utilize the Raspberry Pi 4, the latest iteration with a more powerful quad-core processor that delivers three times the performance of its predecessors. Additionally, it offers two micro HDMI ports, a Display Serial Interface (DSI), a Camera Serial Interface (CSI), and a micro SD card slot for convenient storage.

Fig.1: Raspberry Pi

Camera

The Raspberry Pi Camera Module, created by the Raspberry Pi Foundation, is a versatile solution for image and video capture in Raspberry Pi projects. It offers different resolutions to match project needs and connects seamlessly via the CSI interface. The module includes an image sensor, often Omnivision, crucial for image quality. Many models have fixed focus lenses, simplifying usage. A specialized ribbon cable ensures secure connection. Compact and lightweight, these modules suit various applications, from photography to computer vision. The Raspberry Pi Foundation provides software support through libraries, aiding easy integration into projects and maximizing its utility.

Key Features

1. Voice Assistant: The smart glasses are equipped with a voice assistant that provides real-time audio feedback to the user. This feature assists in navigation, object identification, and task completion by audibly conveying information about the surrounding and action taken.
2. Face Recognition: The integrated face recognition technology enables the glasses to identify individual in the user vicinity. These features enhance social interaction by notifying the user about familiar faces and aiding in recognition people they encounter.
3. SOS Functionality: The smart glasses include an SOS (emergency) button that users can activate to send distress signals. In critical situations, this feature triggers an alert to predefined contacts, notifying them of the user's location and the need for assistance.
4. Optical Character Recognition: Optical Character Recognition technology allows the smart glasses to capture text from printed material, such as books, documents, and signs. The captured text is then converts into spoken words, enabling visually impaired users to access written information independently.

Obstacle Detection: The glasses are equipped with obstacle detection sensors that help users navigate safely through their environment. These sensors detect physical obstacles in the user's path and provide auditory alert to prevent collisions and ensure smooth movements.

METHODOLOGY

The methodology for creating smart glasses with features like OCR, voice assistance, and face recognition using a Raspberry Pi 4 begins with selecting the Raspberry Pi 4 as the central processing unit and integrating essential hardware components like a camera module, microphone, speaker, and power source. The software setup involves configuring the operating system and installing critical libraries for OCR, voice recognition, and face recognition, including Tesseract OCR and speech synthesis tools. The glasses perform image capture and real-time processing, leveraging the camera module for text, face, and object recognition, with advanced image processing techniques to enhance OCR accuracy and face recognition capabilities. Voice assistance is seamlessly integrated with speech recognition and text-to-speech engines, accompanied by predefined voice commands for system control. The inclusion of user-friendly interfaces for micro displays, featuring gesture recognition or voice commands for navigation, enhances usability. Extensive testing, optimization, and user feedback refinement are vital, ensuring optimal performance. The hardware components are integrated into lightweight glasses frames to prioritize user comfort. Adequate user training materials and documentation are provided, and specific use cases, such as assistive technology or real-time translation, are identified for deployment, ultimately creating a sophisticated and versatile smart glasses system.

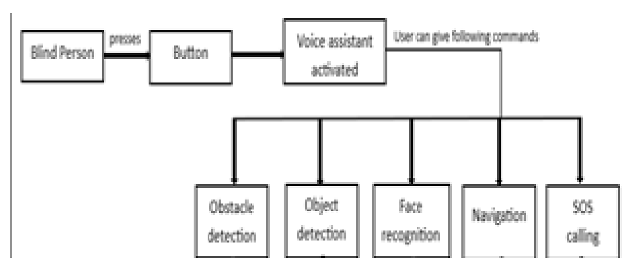

Fig.2: Block diagram

RESULT

Fig. 3: 3D CAD Model

My eyes has shown increased efficiency in the day to day works of individual. They are able to navigate better using this technology. My eyes has shown significant improvement in the educational segment as well as the person was able to understand the voice output my eyes gave without much hassle. The testing on few blind people has shown that it is a technology that can be used by the blind individuals and would create an easy way for them to carry out their tasks. Students were able to read the context in the books. The people who tested the obstacle detection feature were able to avoid accidents and injuries as it alerted the user beforehand. The voice assistant feature proved very beneficial as it answered all the questions user had by being very interactive. They could also understand their location, time and all the real time information using these glasses.

My Eyes is an emerging technology with core features in it that proves helpful to the user. It can create a huge difference in the lives of individuals as this would provide an assistant to the user, making them independent and decrease the need for the other person to assist them.

FUTURE SCOPE

The future of smart glasses holds immense potential, particularly in the pursuit of making them completely wireless. This wireless evolution will not only improve the aesthetics of these devices but also open up new horizons for their functionality. With untethered connectivity, smart glasses could offer enhanced augmented reality experiences, real-time data sharing, and improved accessibility features.

CONCLUSION

In Conclusion, the proposed solution embodies a comprehensive approach to addressing the challenges faced by visually impaired individual through smart glasses. By harnessing the power of image processing and voice processing methods, these smart glasses offer a transformative tool for enhanced accessibility and functionality.

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Overview of IoT with Blockchain

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ABSTRACT

This systematic literature review examines the intersection of blockchain technology and the Internet of Things (IoT) to provide a comprehensive understanding of current research trends, challenges, and potential applications. Through a rigorous analysis of scholarly articles, conference papers, and white papers, this review synthesizes existing knowledge to identify key themes, technological advancements, and future directions in the integration of blockchain with IoT ecosystems. The review highlights the potential benefits of combining blockchain and IoT, such as enhanced security, data integrity, decentralization, and automation, while also addressing critical issues including scalability, interoperability, privacy, and regulatory challenges. By systematically analyzing the existing literature, this review aims to provide valuable insights for researchers, practitioners, and policymakers seeking to leverage blockchain technology to optimize IoT deployments and unlock new opportunities across various domains

KEYWORDS *: IoT, Blockchain, IoT, decentralized IoT, Structure, IoT challenges, Efficiency.*

INTRODUCTION

The IoT devices collects the high amount of data from sensors processes it accordingly, and uses actuators to implement automated actions based on those decisions. This kind of system is common in various applications, including smart homes, industrial automation, healthcare, and more.

The introduction provides an overview of the growing significance of both blockchain technology and the Internet of Things (IoT) in various industries and outlines the rationale for exploring their convergence. It discusses the potential synergies between blockchain and IoT, including improved security, trust, and transparency, as well as the challenges associated with their integration.[1]

The potential of blockchain technology and peer-to-peer (P2P) methods to support decentralized and private-by-design Internet of Things (IoT) applications is examined in this comprehensive overview of the literature. With an emphasis on integrity, anonymity, and adaptability, the research attempts to evaluate the current level of blockchain technology and develop application cases related to Internet of Things and private-by-design data management. This evaluation investigates the extent to which blockchain can handle privacy concerns while preserving data integrity and adaptability through a detailed investigation of 18 recognized blockchain use cases, including four specifically designed for connected devices[2]. Key findings highlight issues with anonymity, such as the need to strike a fine balance between limiting adaptability and preserving integrity through Proof-of-Work difficulty, with blockchain technology only providing pseudonymity rather than complete anonymity. Recommendations for further research are provided at the end of the review to address.

Blockchain technology has become a ground-breaking invention with broad applications in a number of different fields and industries. Fundamentally, blockchain is a distributed, decentralized ledger technology that makes transaction recording safe and open. Blockchain functions on a peer-to-peer network, as opposed to conventional centralized databases, and adds transactions to the ledger by means of a consensus method after they have been confirmed.

The combination of blockchain technology and the Internet of Things (IoT) is a major development that has the potential to change many different industries. IoT stands for Internet of Things, and blockchain is a distributed, decentralized ledger technology that guarantees safe, transparent transactions. IoT also refers to the network of networked devices integrated with sensors, software, and other technologies to collect and share data. A potential way to address important issues like data security, privacy, and interoperability in IoT ecosystems is to combine these two technologies.

OVERVIEW OF IOT

The methodology section outlines the systematic approach used to conduct the literature review, including search strategies, selection criteria, and data extraction methods. It describes the databases, keywords, and inclusion/exclusion criteria utilized to identify relevant studies, ensuring the comprehensiveness and rigor of the review process. IoT generates data from a large number of devices, resulting in billions of data objects[3]

The data is diverse and requires collaboration among different devices for sampling, processing, and making it useful for analytical and decision-making purposes.

IoT is characterized as a platform where embedded devices and sensors communicate with the cloud through some form of connectivity.

The interaction between these devices and the cloud is fundamental to the functioning of IoT systems. Data generated by IoT devices is sent to the cloud for processing.

Cloud-based software processes this data and performs actions based on the analysis, which may include sending alerts or automatically adjusting sensors or devices.

One of the key features of IoT is its ability to automate processes without the need for human intervention. Actions are taken based on the processed data, allowing for real-time responses and adjustments.

IoT Architecture layers

The passage mentions the IoT architecture, which is described as having four main layers:

Devices: This layer involves the embedded devices and sensors that collect data.

Communication: This layer handles the connectivity between devices/sensors and the cloud.

Cloud: The cloud layer is responsible for processing and storing the data received from devices.

Application: Applications layer involves the software applications that utilize the processed data to perform specific actions, such as sending alerts or adjusting devices.

Sensor:

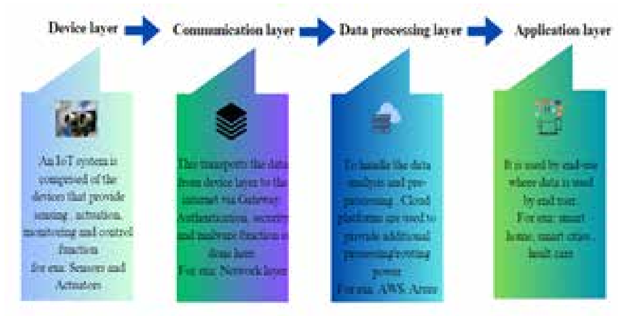
Sensor which is also called as transducer are used to convert some physical phenomenon into electrical signal for monitoring and controlling which is then fed to the system. It works as an input device

Actuators:

It is the device which delivers the motion by converting source energy into control signal received that are in electric form based on the decisions made. Examples include motors, pumps, or other mechanisms that control physical processes. The motion produced by the actuators is in the form of rotary or linear. This energy can be in the form of electric type for exa, thermal actuators, and magnetic actuators, hydraulic or pneumatic actuators.

The core infrastructure of Internet of things includes sensors, actuators, controllers, computer servers and communication networks.

Controllers: A controller ensures effective processing of system functions and is the control system of the actuator. The control system can be controlled by electrical or mechanical means manually or with the help of software. In DC motors, the rotor assembly rotates to align itself with the stator assembly. The stator assembly remains stationary.



Fig(a) Layers of IoT

OVERVIEW OF BLOCKCHAIN

A blockchain is a distributed, decentralized ledger made up of a series of blocks, each of which comprises transaction data, a timestamp for safe timekeeping, and a cryptographic hash of the block before it. A blockchain's design makes sure that once information is entered into a block, it cannot be changed without affecting all blocks that come after it. This keeps the chain's integrity intact. Cryptographic hashing and consensus mechanisms—where modifications to the blockchain necessitate agreement from the majority of nodes in the peer-to-peer network—achieve this resistance to change.

Due to the decentralized nature of blockchain networks, which are run by a peer-to-peer network adhering to a communication protocol, data is guaranteed to be transparent, secure, and unchangeable, making it appropriate for a variety of applications. It cannot be changed without affecting all blocks that come after it. This keeps the chain's integrity intact.

A blockchain system's architecture, which embodies the concepts of decentralization, dispersion, and public ledger functionality, is generally considered to be safe and reliable. A blockchain is a distributed, decentralized digital ledger that keeps track of transactions on several devices. It guarantees that once data is recorded, it cannot be readily changed without changing all blocks that come after it. By enabling participants to independently check transactions, this immutability feature improves network trust and transparency. Blockchain databases are certified by mass collaboration motivated by collective self-interests and are managed separately via a peer-to-peer network and a distributed time stamping server.

This ensures great fault tolerance and resilience against malicious attacks. Batches of legitimate transactions are stored in blocks within a blockchain, where they are hashed and encoded into a cryptographic hash tree structure. Every block on the blockchain contains the cryptographic hash value of the block before it, creating a connection between them and creating a structure akin to a chain. This recursive procedure verifies the integrity of every block, all the way back to the genesis or root block. Because any changes made to one block would also affect following blocks, this chaining technique guarantees the immutability and integrity of the whole block chain, making it computationally impossible to tamper with the transaction history.

BLOCKCHAIN WITH IOT

The capacity of blockchain technology to retain data records immutably in blocks, resulting in a transparent and auditable transaction history, is another essential feature. Because all transactions can be tracked back to their original sources, this feature makes traceability easier and offers a thorough history of past acts. The problems with IoT can be effectively resolved by integrating blockchain technology, an emerging solution, with smart contracts, which are essential for controlling and safeguarding IoT devices. Critical component of blockchain technology is data privacy, which is maintained by using private/public key pairs.

This cryptographic structure ensures privacy and secrecy by limiting access to data to the designated recipient or the node that has the private key. Smart contracts can also be used to impose access controls, giving specific individuals or organizations ownership, control, or access to data that is either in motion or at rest. Regarding IoT devices, every transaction carried out by or involving IoT devices is documented on the blockchain, allowing any member of the network to track them back. Because it makes resource tracing and service level agreement verification between customers and IoT service providers possible, this traceability feature plays a critical role in improving the quality of service for IoT devices[4].

All things considered, blockchain technology's historical action records and data privacy safeguards enhance the reliability, integrity, and openness of Internet of

Things systems and transactions. Blockchain use in IoT addresses a number of important issues[5]:

Decentralization: By dispersing data processing and storage throughout the network, blockchain technology eliminates the need for centralized servers. In IoT systems, this decentralization improves fault tolerance, scalability, and resilience.

Data Security and Integrity: Blockchain guarantees the security and integrity of IoT data by using immutable ledger technology and cryptographic procedures. To reduce the possibility of data manipulation and unauthorized access, every transaction is clearly recorded on the blockchain and cryptographically safeguarded.

Authentication and Identity Management: By using public-private key cryptography and digital signatures, blockchain technology enables safe, decentralized authentication of Internet of Things devices. This lowers the possibility of spoofing and illegal access by enabling reliable device identification and authentication.

Interoperability and Standardization: By offering a single protocol and structure for data exchange and communication, blockchain fosters interoperability and standardization among various IoT devices and platforms. Smart contracts improve compatibility and interoperability by enabling automatic and standardized interactions between devices.

Scalability and Efficiency: Blockchain technology helps IoT systems be more scalable and efficient. This is especially true when combined with off-chain solutions and scalable consensus methods. Blockchain can handle the increasing demands of extensive IoT deployments by allocating computational jobs and maximizing resource utilization.

FUTURE SCOPE

For Blockchain based voting machine, a fingerprint can be used for authorization and a unique identifying key for authentication. One-time passwords are another method cab be used to verify voters. In addition to fingerprint module ,facial recognition module can also be used for better security. By offering irreversible and impenetrable data storage and transmission protocols, blockchain integration with IoT can improve security and privacy. To protect IoT data from cyber risks and unwanted access, future developments may concentrate on creating strong encryption methods, decentralized identity management systems, and privacy-preserving protocols.

Decentralized autonomous IoT networks can arise as a result of the automation and regulation of interactions between IoT devices made possible by blockchain-enabled smart contracts. Subsequent investigations could examine the utilization of self-executing smart contracts to oversee device authentication, data exchange, and resource distribution in constantly evolving Internet of Things settings. Two major obstacles to IoT deployments are scalability and interoperability. By offering a standardized framework for data exchange and communication among diverse IoT devices and platforms, blockchain-based solutions can help address these issues. In order to facilitate the smooth integration of various IoT ecosystems, future innovations might concentrate on improving blockchain consensus processes, off-chain scaling solutions, and interoperability protocols.

CONCLUSION

It reiterates the importance of blockchain technology in enhancing the security, efficiency, and scalability of IoT deployments, and underscores the need for interdisciplinary collaboration and continued research to realize the full potential of blockchain for the Internet of Things. It offers recommendations for practitioners, policymakers, and researchers to leverage blockchain technology effectively. It synthesizes the main insights derived from the literature review, critically evaluates the strengths and limitations of existing research, and identifies gaps in knowledge that warrant further investigation. It explores potential solutions to overcome current barriers and suggests avenues for future research to advance the integration of blockchain and IoT.

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Review of AI Based Medical Assistant

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ABSTRACT

With the introduction of artificial intelligence (AI) into different parts of patient care, the healthcare industry is witnessing a significant transition. AI-powered medical assistants, in particular, are being used to improve patient data recording, making it more efficient and accurate. The purpose of this survey article is to investigate the state of current research in efficient patient data recording using medical assistant AI. In this expanding sector, this paper covers the key technologies, applications, problems, and future opportunities.

This study highlights the relevance of complex technologies in attaining efficiency, such as edge computing, low-power hardware, energy-efficient algorithms, and sensor integration. It also delves into remote patient monitoring, wearables, electronic health records, and telemedicine applications. While the industry has a lot of potential, it confronts a number of challenges in terms of data security, compliance, integration, and ethics. With continued AI developments, standardization, and increasing patient empowerment on the horizon, the future of power- efficient patient data collection employing medical assistant AI is optimistic, promising to alter patient care and healthcare provider operations.

KEYWORDS *: Electronic health records(EHR), Natural language processing(NLP), AI in healthcare, Data security.*

INTRODUCTION

The healthcare industry is at a critical point of transformation and innovation in an era of fast technological growth. The use of artificial intelligence (AI) into different aspects of patient care is transforming how healthcare data is recorded and maintained. This survey report digs at a critical break- through in the healthcare landscape: Patient data capture supported by medical assistant AI.

Historically, healthcare data recording has been stuck in manual and paper-based procedures, resulting in inaccuracies, inefficiencies, and a lack of real-time capabilities. As the healthcare ecosystem becomes more complicated, the limits of these traditional approaches become more apparent. With an increasing demand for data accuracy, efficiency, and accessibility, the need for innovation in healthcare data recording is critical.

The introduction of AI based medical assistant, which includes chat-bots, virtual assistants, and decision support systems, is a game changer in solving these difficulties. These intelligent technologies have the ability to automate data gathering, improve documentation processes, and aid clinical decision making, ultimately improving the accuracy and efficiency of patient data recording. This paper examines the technology that drive power efficiency, the diverse applications that are altering patient care, the challenges that must be overcome, and the exciting future prospects that await.

LITERATURE SURVEY

The study highlights efficient healthcare assistance without physical hospital visits through an AI-powered chatbot. This chatbot, trained with relevant data, offers precise responses to user queries. The system introduces online doctor consultations for remote healthcare, emphasizing preventive measures and herbal remedies. It provides a secure platform, bridging the patient-professional gap for cost-effective, accessible, and immediate medical assistance in digital healthcare[1].

IntelliDoctor is an AI-driven medical assistant for smart healthcare, analyzing symptoms, predicting conditions, and generating personalized treatments. It uses user information and real-world medical data, employing NLP for precise diagnosis and pre-screening. The app provides medication reminders, emergency triggers, and health reports, with a user- friendly interface for preventive care[2].

The paper examines ethical challenges in medical machine learning and its healthcare implications. It focuses on data privacy, fairness, transparency, and accountability issues in MLm algorithms. The authors stress adherence to data protection regulations, bias mitigation in training data, algorithmic transparency, and liability clarification. They underscore trust building with patients and healthcare providers for responsible ML advancement in healthcare[3].

The study introduces a novel framework for medical decision support when confronted with incomplete information. It combines automated reasoning based on ontology and incorporates machine learning to address missing data, fostering health information system interoperability. Real-world insomnia treatment datasets were used for validation. The hybrid model outperformed purely knowledge-based and purely learning-based systems, proving effective in medical decision support.[4].

Smart virtual patient monitoring system utilizing AI, Data Science, and Machine Learning for accurate health-related responses. It employs NLP and Machine Learning to create a chatbot offering psychotherapist-like support. Data Science predicts disease outcomes, emphasizing timely treatment for remote patients. Virtual assistants bridge patient-provider gaps, outperforming traditional methods, with a focus on accuracy and accessibility[5].

The authors tackle the obesity issue using big data analysis, machine learning, and text mining. Data from various on- line sources were collected, and machine learning algorithms identified obesity patterns based on gender and body weight. Text mining and word cloud analysis revealed public health interests and concerns about obesity from news articles. This approach aims to enable personalized health interventions, addressing the gap between healthcare services and individual needs[6].

"Disha," a Bangla healthcare chatbot driven by machine learning assists users with disease diagnosis, health information, and monitoring, using a customized Bangla dataset. The chatbot collects user data, handles natural language inputs, and offers medical advice and medication reminders[7].

"Sampurna," is a versatile Medical Assistant Application Framework for advanced medical facilities, featuring Speech to Text, Text to Speech, Medical Chatbot, and Automatic Prescription Generator modules. Leveraging NLP, AI, and pattern matching in a three-tier architecture, Sampurna offers unique features such as doctor availability, salt combination lists, and E-Prescription generation, enhancing convenience, accessibility, and environmental sustainability in healthcare[8].

The system uses AI and NLP-powered chatbots to revolutionize medical checkups. It offers comfortable and confidential health discussions, predicts diseases from user symptoms, and provides medication details through image scanning. The system includes a scheduling module for medication and appointments. It integrates technologies like TensorFlow and Google Calendar API to enhance patient awareness and proactive health management[9].

The study explores ML's transformative potential in healthcare epidemiology, especially for infectious diseases. Electronic health data availability allows ML to handle large, complex datasets. Successful applications include predicting infections, identifying disease reservoirs, and forecasting clinical outcomes. Emphasizes the importance of data quality, model transparency, and interdisciplinary collaboration in effectively applying ML in healthcare epidemiology[10].

The review paper provides a comprehensive overview of Electronic Health Records (EHR), delving into aspects like security, privacy, data mining, decision support, user acceptance, and system implementation. It assesses EHR challenges and opportunities for diverse stakeholders, highlighting the demand for ongoing advancements in this rapidly evolving domain over the last three year[11].

The authors introduce a novel EHR framework employing blockchain technology to enhance data security, privacy, and integrity. Utilizing a distributed ledger protocol ensures immutability and decentralization, while employing elliptic curve cryptography and granular access rules further fortify data protection. [12].

This Healthcare System uses ML and speech recognition to effectively tackle healthcare challenges that have been amplified by the Covid-19 pandemic. Leveraging edge/fog/ cloud computing for efficient data processing, the system employs the Hidden Markov Model to probabilistically model speech signals [13].

The study proposes a distributed and self-organizing algorithm using the Doc2Vec model for big data management in healthcare. Applied to clinical distributed system servers, organized in a sorted overlay network, the algorithm enhances resource management efficiency. The evaluation demonstrates convergence in a finite number of steps, reducing query search hops, and the paper addresses challenges and integration issues with other components in automating disease diagnoses[14].

ROLE OF MEDICAL ASSISTANT AI

AI based medical assistant has several facets and is becoming more and more important in the healthcare environment. Its applications cover a range of healthcare functions, from office work to clinical decision assistance. These systems are made to help medical staff, patients, and medical institutions in a variety of ways.

AI medical assistants play a critical role in data documentation and recording. The effective capture and documentation of patient data, including medical notes and information, by these AI systems aids healthcare workers. They have the ability to transcribe oral or written notes, which helps to produce accurate and current electronic health records (EHRs) ensuring that vital patient data is easily available.

AI-based medical assistants also support clinical decision-making in addition to data recording. Healthcare providers can get information, recommendations, and guidelines from these AI systems in real-time. They can examine patient data and pertinent medical literature, empowering healthcare practitioners to make better choices regarding diagnosis, treatments, and medication administration.

Additionally, AI-based medical assistants can support patients in managing their health by acting as virtual health assistants. Virtual assistants that are integrated into telemedicine platforms improve patient involvement and access to care by making remote healthcare consultations more convenient and accessible. Many AI systems for medical assistants have natural language processing (NLP) capabilities. They can now comprehend and reply to questions and commands in natural language. This is especially helpful for enhancing user experience and making sure that patients and AI-driven systems can communicate effectively.

In essence, medical assistant AI is a useful tool for improving the quality, effectiveness, and accessibility of healthcare services rather than a replacement for medical experts. As the technology advances and is better incorporated into healthcare workflows, its function will only continue to grow and change, ultimately improving patient care and healthcare productivity.

BLOCK DIAGRAM

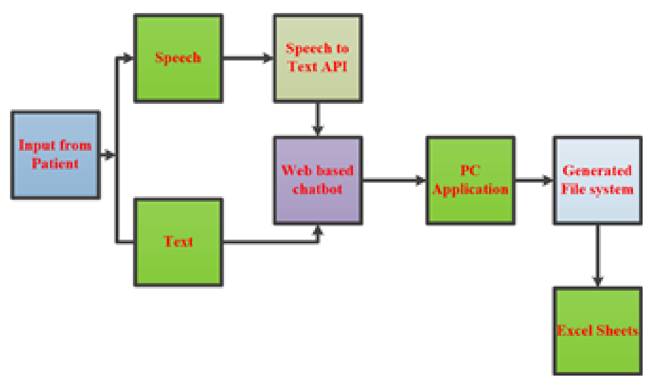

Fig. 1. Planned block diagram of AI based Medical Assistant

The block diagram describes data flow in proposed system. Depending on users input type the application will switch mode i.e. Speech data acquisition and text data acquisition. For speech to text conversion Python API comes in picture. And for recording text data simple python script is used. After acquisition of data web based chat-bot Formats and arrange all data and passes to application which then creates file system with excel sheet included with individual patients information.

METHODOLOGY

Research Design

Objective: The primary goal of this research is to create and implement an effective approach for patient data recording utilizing medical assistant AI, all while ensuring data security and regulatory compliance.

Research Type: This study is a mixed-method research project that combines both quantitative and qualitative approaches. It involves the development of a technical solution and the evaluation of its effectiveness, as well as a qualitative assessment of user experiences.

Data Collection

Quantitative Data Collection: For assessing the technical performance and efficiency of the AI-based data recording system, quantitative data will be collected..

Qualitative Data Collection: Qualitative data will be gathered through surveys, interviews, and usability testing to evaluate the user experience, including the ease of use and perceived benefits of the system.

Technical Development

AI Model Development: An AI model will be developed to facilitate the data recording process. This model will be designed to efficiently capture, process, and securely store patient data.

Data Encryption and Security: Implement robust encryption and security protocols to safeguard patient data, ensuring compliance with healthcare data privacy regulations.

Implementation and Testing

The developed AI-powered data recording system will be implemented in a controlled healthcare environment, such as a clinic or a simulated setting, to test its functionality and power efficiency.

Technical testing will focus on measuring the system's power consumption, data recording speed, and overall performance.

User Experience Evaluation

Conduct surveys and interviews with healthcare professionals, including doctors and nurses, who interact with the system. Gather feedback on the system's usability, efficiency, and user- friendliness.

Include patients as participants to gauge their experience with the system's data recording process, their perceived data security, and overall satisfaction.

Data Analysis

Analyze the quantitative data collected during the technical testing phase. Assess power consumption data, system performance metrics, and any correlations between efficiency and data quality.

Qualitative data from surveys and interviews will be analyzed thematically to extract insights regarding the user experience and system benefits.

Ethical Considerations

Ensure that all aspects of this research comply with ethical standards, including patient consent for data collection, protection of sensitive information, and adherence to ethical guidelines for AI in healthcare.

Regulatory Compliance

Ensure that the entire research process adheres to relevant healthcare data regulations, such as HIPAA, GDPR, and any other applicable regional standards.

CHALLENGES IN DATA RECORDING

Interoperability: Because healthcare data is frequently stored in multiple systems, interoperability is a key concern. It is critical for comprehensive patient care to ensure seamless data transmission and integration among various healthcare providers, systems, and devices.

Data Standardisation: Because healthcare data is captured in diverse formats, maintaining consistency and standardization is challenging. Data exchange and analytic have been limited by the lack of standardised data formats.

Maintaining data accuracy and quality is critical for clinical decision-making. Incorrect diagnoses and treatment plans might emerge from errors, contradictions, and inconsistent data entry.

Legacy Systems: Many healthcare organisations continue to use outdated legacy systems. Integrating modern data recording methods with historical infrastructure presents issues that necessitate careful design and, in some cases, substantial system overhauls.

Regulatory Compliance: Healthcare is subject to stringent regulatory standards that differ by area. Complying with various standards, such as HIPAA, GDPR, and FDA requirements, can be difficult and expensive.

Data Volume and Scalability: Healthcare creates massive volumes of data, and properly handling this data while assuring scalability is a significant challenge. It is vital to ensure that systems can handle increased data loads.

Collaboration between humans and artificial intelligence (AI): Finding the correct balance between human healthcare practitioners and AI-driven data recording technologies is a constant issue. It is critical to ensure that AI augments rather than replaces healthcare providers.

Patient Engagement: Enabling patients to participate in data collection and management is difficult since it necessitates user-friendly interfaces, data access, and consent management while protecting privacy.

Cost Control: While deploying advanced data capturing technologies might result in long-term savings, the initial investment and maintenance expenses can be significant. Health- care organisations must efficiently manage these expenses.

User Acceptance and Training: In order to use data capturing systems efficiently, healthcare professionals and personnel must be trained. It is critical for successful deployment to ensure their acceptance and effective integration of new technology.

Data Recovery and Continuity: To ensure data continuity and accessibility in the case of system failures or disasters, healthcare data recording systems require robust data recovery procedures and backup solutions.

Addressing these data recording difficulties is critical for the healthcare sector to fully realise the potential of data for improving patient care, research, and operational efficiency while ensuring data security, integrity, and ethical standards.

TECHNOLOGICAL SOLUTIONS

In the healthcare sector, technological solutions are critical in tackling the issues of patient data recording and guaranteeing regulatory compliance. These solutions include a diverse set of innovations and tactics targeted at improving data recording efficiency, data security, and regulatory compliance. Here are some of the most important technological solutions:

Electronic Health Records (EHRs)

EHR systems offer a comprehensive digital option for recording patient data. They provide centralised data storage, retrieval, and safe exchange among authorised healthcare providers, as well as regulatory compliance via audit trails and access controls.

Health Information Exchange (HIE) Platforms

HIE systems facilitate secure data exchange between healthcare organisations. They encourage interoperability, ensuring that patient data flows effortlessly between systems while following to regulatory norms.

Block chain Technology

Block chain technology has the potential to improve data security and integrity. It ensures that patient data stays tamper- proof and available only to authorised individuals by utilising a decentralised and immutable ledger. Several healthcare apps are looking into using block chain for secure data storage.

Electronic Health Records (EHRs)

Bio-metric authentication, such as fingerprint or facial recognition, can improve access control and data security. Bio- metric IDs allow healthcare providers and patients to securely access records.

AI-Based Data Recording Tools

AI-powered data recording solutions, such as medical assistant AI, can help to expedite data entry, eliminate errors, and increase data accuracy. These tools have a high potential for efficiency and precision.

Data Loss Prevention (DLP) Solutions

DLP systems continuously monitor and secure data. They are capable of detecting and preventing unauthorised data transfers or leaks, hence lowering the risk of data breaches.

Data Warehousing and Analytic Platforms

Electronic Health Records (EHRs): Data warehousing systems allow for the storage and retrieval of massive amounts of healthcare data for analysis and reporting. Advanced analytic platforms give insights that can lead to better decision-making and patient care.

Secure Mobile Applications

Mobile applications created for patients and healthcare professionals must follow strict security guidelines. They provide safe data logging, communication, and remote observation.

Cloud-Based Solutions

Salable data processing and storage capabilities are provided by secure cloud platforms, which also uphold data security and redundancy. They might offer a practical method for managing and getting access to medical data.

Careful planning, a strong IT infrastructure, and continual training for healthcare personnel and professionals are all necessary for implementing these technology solutions. Healthcare organisations may improve regulatory compliance, data security, and recording efficiency while providing high- quality patient care by utilising these technologies.

PRIVACY AND SECURITY CONSIDERATIONS

Data Encryption: Securing patient data necessitates encryption at rest and in transit, maintaining data integrity and confidentiality. Strict access controls, including role-based per- missions, ensure that only authorized staff can access patient records.

Authentication: To authenticate the identification of healthcare professionals and patients interacting with the system, robust authentication mechanisms such as multifactor authentication (MFA) should be utilised. This aids in the prevention of unauthorised access and data breaches. Data minimization entails collecting only the information required for health treatment and other authorised uses. Reduce the risk of exposure in the event of a breach by limiting data acquisition. Security Audits and Monitoring: Regular security audits and continuous system monitoring help discover and remediate vulnerabilities and suspicious activity as soon as possible.

Secure Communication: When communicating with medical assistant AI systems and healthcare practitioners or patients, use secure channels. Secure communication technologies include encrypted messaging and secure video conferencing applications.

Data Retention Policies: Create data retention policies that outline how long patient data will be kept. This decreases the danger of data exposure by preventing the buildup of superfluous data.

Ethical Considerations: Address ethical concerns about artificial intelligence in healthcare, such as algorithm bias and openness in decision-making procedures. Ethical norms and monitoring organisations can aid in the maintenance of ethical standards.

Vendor Security: When using third-party AI solutions, ensure that the suppliers follow high security and privacy requirements and are transparent about their data handling practises. Privacy and security considerations are critical in the design and implementation of the project. These factors safeguard patient data, uphold ethical standards, and assure regulatory compliance, resulting in increased trust and confidence in healthcare systems and AI-powered solutions.

REGULATORY COMPLIANCE

In healthcare, regulatory compliance is crucial, particularly with emerging technologies like medical assistant AI, ensuring legal and ethical operations while safeguarding patient data.

The following are some of the important regulations that healthcare organisations must follow:

HIPAA (Health Insurance Portability and Accountability Act): In the United States, HIPAA is a key rule that governs the confidentiality and privacy of patient health information. It establishes stringent security requirements for electronic health records (EHRs) and mandates measures against data breaches and unauthorised access.

GDPR (General Data Protection Regulation): GDPR is centered on safeguarding data protection and privacy rights within the European Union and various other regions. This requires that healthcare organisations seek explicit patient consent before processing data, enable data portability, and designate data protection officers.

The Health Information Technology for Economic and Clinical Health Act (HITECH Act): This Act supplements HIPAA by providing extra incentives and sanctions to encourage healthcare organisations to establish secure EHR systems and electronically transmit patient data.

ICD (International Classification of Diseases) and CPT (Current Procedural Terminology) Codes: In healthcare, accurate coding and documentation are critical for regulatory compliance and proper billing. Using the correct codes ensures that healthcare services are categorised and compensated correctly.

Local and regional rules may differ by state or region, and healthcare organisations must comply with these local laws, which may include additional data privacy and security obligations.

Cybersecurity Standards: In addition to healthcare-specific requirements, compliance with broader cybersecurity standards is critical for protecting patient data. Compliance with ISO 27001, NIST, and other cybersecurity guidelines is included.

Telemedicine Regulations: As telemedicine and remote healthcare services become more prevalent, adherence to telehealth regulations is critical. These rules govern virtual healthcare interactions in terms of license, reimbursement, and patient privacy.

Noncompliance with healthcare standards carries legal penalties, impacting an organization's reputation and financial stability. Achieving regulatory compliance demands robust policies, staff training, secure technology, and ongoing monitoring. Adapting to evolving regulations requires collaboration with legal experts, ensuring high-quality, secure, and ethical patient care amidst a complex regulatory landscape.

FUTURE TRENDS AND OUTLOOK

The integration of advanced technology in healthcare, particularly in patient data capture with medical assistant AI, is poised to bring transformative changes to the industry. Key developments include the refinement of AI algorithms, enabling more accurate patient data recording, and improved interoperability for seamless data exchange among healthcare providers. The Internet of Things (IoT) will play a crucial role, with real-time patient data collection and 5G connectivity enhancing remote consultations and diagnostic procedures. Blockchain technology ensures data security and trust in healthcare records, while advances in natural language processing (NLP) improve communication with AI systems. However, challenges such as data security, compliance, legacy system integration, cost management, and patient empower- ment must be overcome to fully unlock the potential of these innovations within healthcare sector.

CONCLUSION

The investigation of patient data recording em- ploying medical assistant AI suggests a promising future for healthcare. This survey has shed light on the critical role of medical assistant AI in overcoming the limitations provided by traditional data collection methods. These AI solutions are changing the way healthcare is delivered by streamlining data entry, improving clinical decision support, increasing patient involvement, and optimising administrative duties. Furthermore, the importance of power efficiency in healthcare systems cannot be overstated. It reduces costs significantly, promotes sustainability, and optimises resources. Reduced energy use has both environmental and economic benefits, aligning with global efforts to mitigate climate change while encouraging economic sustainability. In the future, the incorporation of AI into healthcare, has the potential to revolutionize patient data recording and healthcare in general. Despite continued hurdles, embracing medical assistant AI offers a chance to build a more accessible, patient centered, and environmentally responsible healthcare system that can adapt to the changing requirements of a global population.

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Superconductivity; Mechanism, Applications & Future Prospects

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ABSTRACT

Superconductivity; a physical occurrence in the scientific concerns which eventuates lower than a specific thermal condition, entitled as critical temperature(Tc). The non-appearance of an intramural magnetic domain as well as indefinitely elevated electrical conductivity, are the acclaimed attributes of superconducting substances. This physical event is now crucial in many fact finding explorating fields. The paper emphasizes on the theoretical aspects, practical implementations and the newfangled applicability of superconductors.

KEYWORDS *: Superconductivity, Critical temperature, Magnetic domains, Electrical conductivity.*

INTRODUCTION

Some materials evince a nil value of resistance, when current passes through them, under a certain thermal condition. It is a macroscopic quantum-mechanical predicament, primarily tracked by Kamerlingh Onnes during 1911. That thermal condition is remarkably unaspiring, near to zero Kelvin. Accordingly, for impelling superconduction in materials, they are chilled with the use of helium in molten state.

An internal non-appearance of electrical as well as magnetic fields characterizes a matter in its superconduction condition. These substances expel the intramural electrical and magnetic fields, utilizing shielding currents to preserve self-magnetism and causing the Meissner-Ochsenfeld effect, enabling levitating effects in a magnetic domain.

The switching thermal condition of such a superconductor is contrived by drift of current as well as the exterior magnetism. While Type II categories of superconduction have binate critical field strengths that enable controlled penetration and upgraded current capacity, Type I category materials abruptly be deprived of this nature on the farther side of a critical value of magnetism. Due to this adaptability, the second category superconductors seem to be advantageous, generously in technological supplications.

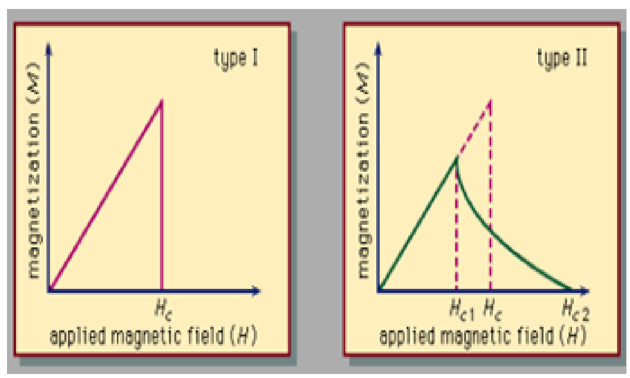

Fig. 1: A single value of Critical magnetic field for type I and dual values for type II superconductors

This advancement, with critical temperatures surpassing 90 Kelvin, outpaces conventional superconductors composed of myriad alloys and compounds. Furthermore, let's delve into a novel mechanism; the magnetic influence of spin fluctuations within the conducting medium's atoms.

Since the revelation of such a phenomenon, the introductory microscopic conjecture is the BCS (Bardeen,Cooper,Schrieffer) theory [2]. The hypothesis delineates the condensation of Cooper-pairs (paired electrons). Nucleon pairing in an atomic nucleus is also described by the theory in nuclear physics, incorporating levitating effects, imaging, fusion reactors, accelerators, and energy technologies.

The prospect of uncovering a superconducting matter operating abutting to ambient thermal conditions round about three hundred Kelvin, holds transformative implications for modern technologies.

Superconductivity at the room temperature

All of this has no bearing on the idea of a unique electrical system. Nearly every technical method that is being discussed, does not rule out the existence of superconduction at ambient thermal conditions.

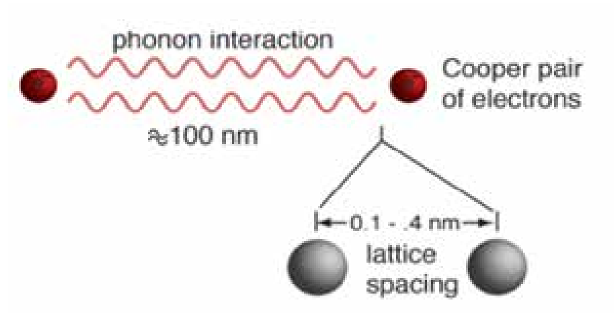

Figure 2: Electronic coupling supports over hundreds of nanometers in superconducting substances. This surpasses the lattice spacing through triple the order of magnitude. Such a linked electronic-joining transit into zero point energy state and take on the bosonic-properties.

Based on approximate calculations using the theoretical spin wave model, superconduction phenomenon may exceed 20 °C and paradoxically up to a few hundreds of degrees but it sounds improbable. Therefore these anticipations represent a significant advance over the classic theory specified as BCS projections, which state about the critical thermal conditions to be only up to -233 °C.

It is undeniable that scientifically the identification of the Cooper's coupled electron creation is still conclusively determined with certainty. Nonetheless the magnetic-flux quanta are now captured as well as computed in minute rings, and we could find a potential way to unlock their unnoticeable facts from the mysterious novel compounds. So, whether it works, additional superconduction for reasonable thermal conditions ought to be achieved, and it is necessary to locate their uses.

CATEGORIZATION OF SUPERCONDUCTING MATERIALS

The numerous superconducting substances which are labeled within thirty two non-identical groupings[3] seems noteworthy, especially the metallic-superconductor type. Also the practically relevant A-15 stages/phases and ceramic-type substances, which maintain superconducting nature at high-thermal conditions, are crucial.

Metallic/High-mass superconducting substances

Quite soon following the revelation that helium gets liquefied into hydrargyrum(Hg), Onnes disclosed this interesting phenomenon during 1911. However this could exist at the thermal value of 4.2 Kelvin and below. For now we have the maximum value of stage-changeable condition for such metallic superconducting substance operating for atmospheric-pressure is found for magnesium diboride(39 Kelvin)[9]. Due to the high cost and difficulty in utilizing liquified form of helium as coolant, this superconducting nature can only be implemented for a restricted number of executions. Basically the BCS (Bardeen,Cooper,Schrieffer) explanation sufficiently relates the attributes of metallic superconductivity. The groundbreaking finding about hydrogen sulfide which carries a metallic conduction behavior for Sufficiently elevated pressure-conditions of one to three hundreds of Pascal and the changeover thermal condition of (203 K)[4].

High temperature superconductors

When the substances in solidified or non-solidified state, mentioned to be high-temperature superconducting materials (HTSCs), the cause of superconducting behavior is not exhibited simply by the electronic interplay with phonons. Typically, this doesn't happen with substances that are metallic but ceramic. While this phenomenon is undoubtedly caused by pairing/coupling of electrons(Cooper pairing), the fact of d-wave coupling/pairing rather than singlet coupling predominates suggests that unorthodox electronic mating mechanisms may be at work. It's been more than twenty five years ever-since the logical understanding was determined.

The phase describes a feature of greater value of changeover thermal conditions for such higher temperature materials in contrast with the conventional ones. Their maximum temperature of two hundred and three Kelvin places them roughly one hundred and eighty Kelvin above the span of thermal conditions for those conventional superconducting substances, but yet in the span of natural thermal conditions upon the Earth's exterior[4].

Ferrous superconductors at elevated temperatures

Later on during the year two thousand and eight, some elements like Iron, lanthanum, phosphorus, and oxygen compounds were noticed as to exhibit a good superconding behavior and this marked an advanced and unanticipated species of superconduction at high-temperatures[5].

The proportion of iron (Fe) atoms was uncommon, in view of the fact that, in the appearance of a sturdy magnetism, every other substance turns into a conventional conductor. These elevated intramural field-magnetism may even be indispensable for superconduction behavior to subsist. The level of conjecture surrounding the physical principles has increased. As stated by the BCS (Bardeen,Cooper,Schrieffer) theory, the only thing that is known for certain at this time is that the coupled-electrons schlep the current drift. It's unclear what impact trusses these electron-couples in collusion.. The non-appearance of an electronic-phonon interplay, in contrast to those of metallic-superconducting substances, becomes absolutely perceivable.

Applicability of Superconducting nature at elevated Temperature values

As long as the value of current per unit volume is sufficiently insignificant to impede the changeover switching thermal value from being exceeded, functional superconducting material at elevated temperature value at seventy seven Kelvin, is the preferred setting. The molten form of nitrogen-gas is strikingly an economical strategy to achieve adequate coolant effect. These kinds of implementations are noticed in cables and metrology. The value of current per unit volume is not invariably feasible, because of the highly irregular current-dispensation over the cross section.

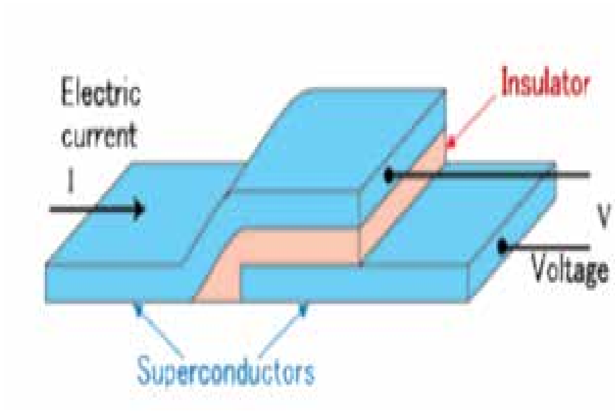

Figure 4: When a tiny layer of insulator is sandwiched between two superconductors, current can flow through it until it reaches a particular volume, at which point electrons can flow through it as if it were nonexistent. This allows for extremely fast on-and-off switching. We refer to this phenomena as the Josephson effect

The HTS'C (High temperature Superconductors) needs to be made colder more forcefully, with the implementation having higher current densities, albeit perhaps only sometimes. For the purpose of attaining the accomplishment-data as we achieve through the traditional superconducting substances the same as niobium-titanium, hauling down the thermal condition is imperative. The molten state-nitrogen for reducing temperature is applied for a while for SQUIDs, they may offer the capability to gauge unexpectedly minuscule difference in magnetism-fields. Despite this, the indication becomes noisier when thermal values are rising. Therefore, for instance, the substances that could be used at ambient-room temperature, are not in operations extensively.

Even though the elevated thermal conditioned SQUIDs construct exalted noise, than those which are using more antiquated helium gas as coolant, are nonetheless obtainable and unfavorable. Yet they are frequently tolerated due to the advantages of nitrogen as coolant in terms of cost effectiveness.

The preliminary impediment with ceramic-type substances which are used in HTSCs(high temperature Superconductors) is their breakable nature. Still, packing such substances into argentum-tubes and by rolling them, a moldable conducting substance might be created. into elastic bands [1]. A specially made, one kilometer subterranean cord that solely uses nitrogen as coolant and intended for use since May 2014. The city of Essen has been using ten kV in the medium-voltage network as a part of a test experiment for its power supply. It takes the place of a traditional, one hundred and ten kV ground line.

SUPERCONDUCTOR WHEN SUBJECTED TO COMPRESSION

An estimation mechanism has been devised by researchers enabling accurate and structured investigation of unusual superconducting behavior [6]. During the initial introduction of pressure bower, it was obtained that such materials turns into strontium-ruthenate at thermal conditions (notably exalted) than those, at which it typically converts superconduction, whenever squeezed or extended away. This makes it possible to understand the behavior of this material's superconductivity preferably. The Dresden approach will also make it easier to investigate a wide range of superconducting materials. When a specimen of strontium-ruthenate was squeezed and extended away by the C.W. Hicks research team's reconnaissance vehicle. In turn, this causes the atoms in the substance to either assemble or disperse. In order to configure and appear the superconducting stage, this modifies the electron-to-electron interplay within the material. There the pairs of coupled electrons are shaped in all such materials by their combination.

The resistance eventually disappears as a consequence of the formation of Cooper-electron-pairs' (unique mode of motion within the substance compared to that of singlet electrons). The typical and non-typical superconducting materials respond to pressure in an unlike manner. As a result of the dual-electrons' opposing magnetic moments values, these Cooper-electron-couples in typical superconducting materials do not manifest the magnetism.

The electron's magnetic moment line up parallel in the instance of strontium ruthenate. In contrast to a traditional superconductor, it responds to external magnetic fields differently as the magnetic moments grow rather than neutralize, maintaining the magnetic pairs. A distinctive response to exterior forces is one way that the distinction manifests. The non-typical substance was predicted theoretically to acknowledge more forcefully to external field, than the typical superconductors, when subjected to pressure.

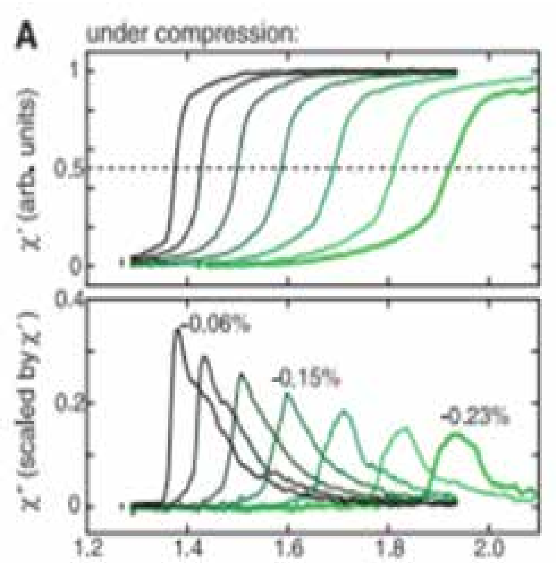

Figure 4: An overview of the superconductors under pressure.

CONCLUSION

Through the creation of so-called Cooper-electron- pairs, an uncommon physical occurrence, superconductivity directs electricity without wasting energy. In this condition, the charged-electrons move freely through the substance without running into any barriers. Researchers have exploited this effect in numerous implementations.

Regretfully, this phenomenon is limited to too minute thermal situations. Large-scale cooling systems are consequently mandatory for the purpose to employ the substances. The field of superconductivity has seen significant advancements and a wide range of studies are required. Yet it is still unclear why superconductivity starts at a temperature that is unusually high.

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Portfolio Website

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ABSTRACT

You desire a website that serves as a portfolio for your work. It matters not how big or small the group—two or ten—but having a distinct online presence is crucial. A web portfolio can help you differentiate yourself from the competition, demonstrate your unity, build rapport, establish specifications, and ensure that people can truly locate you.

A website portfolio is more significant in some contexts than others. However, if you find yourself in any of the following situations, it's safe to presume that you need a portfolio in the same way that a book needs words. If you have a website, visitors can always locate you and get in touch with you if they're interested. in the event that you are not online. For shutterbugs, contrivers, inventors, and a variety of other artists, a portfolio is an excellent internet presentation tool for their work. It enables you to showcase your individuality with your artwork, including prints, sketches, and graphic design.

KEYWORDS *: Portfolio, Designing, Resume, Developer, Designer, Architect filed, Own website, Showcase your work, Achievement.*

INTRODUCTION

Welcome to the companion portfolio website. This digital space has been crafted to provide a visual and interactive supplement to the comprehensive project report that we've prepared. As, we are excited to share the practical and creative aspects of our work in IT, Banking, Education, Architect, etc. field through this online platform.

Here you will find a curated selection of the projects, achievements, and insights that underpin the contents of our project report. These projects span a diverse spectrum, encompassing themes, research, implementation, innovation, and they reflect our dedication to excellence and problem-solving.

Our project report delves deep into the methodologies, strategies, and results, while this website adds a dynamic dimension to our work. It offers an engaging exploration of the visual and interactive elements of our projects. As you navigate through the digital exhibit, we encourage you to connect the dots between theory and practice, and gain a deeper understanding of how our ideas have materialized into real-world solutions.

This website serves as a bridge between the written report and the practical work, providing a holistic view of our project's journey. We invite you to explore the interactive exhibits, images, and case studies to complement your understanding of the project's scope, goals, and outcomes. We believe that a well-executed project is not just a document but a living, evolving entity. This portfolio website encapsulates our commitment to showcasing the tangible results of our endeavors.

LITERATURE SURVEY

Portfolio building is an essential aspect of investment management, and various approaches have been developed and studied over the years. The classic approach to portfolio building emphasizes the construction of a diversified portfolio consisting of a mix of asset classes such as stocks, bonds, and cash. This approach focuses on achieving a balance between risk and return by spreading investments across different types of assets [1].

In today's complex and dynamic financial landscape, the optimization of investment portfolio management plays a crucial role in maximizing returns and minimizing risks.[2].

In an organizational setting, Project Portfolio Management plays a crucial role in ensuring that resources are allocated effectively to achieve strategic objectives. By applying PPM principles, organizations can prioritize and optimize their project portfolios to align with business goals and maximize returns on investment.[3].

Portfolio management in the finance sector involves the professional management of various investments to meet specific investment goals for investors. These goals could include capital appreciation, income generation, risk mitigation, or a combination of these objectives [4].

A portfolio is important in every field because it serves as a comprehensive representation of an individual's or organization's work, achievements, skills, and experiences [5].

Portfolios have improved efficiency in investment, retail, and other industries in Indonesia by facilitating diversification, access to global markets, professional management, innovation, risk mitigation, regulatory compliance, and wealth management solutions tailored to investors' needs and preferences [6].

In the transport industry, a portfolio refers to a collection of investments, projects, assets, or initiatives managed by transportation companies, government agencies, or investors to achieve specific objectives and optimize operational efficiency. It play a crucial role in the transport industry by facilitating efficient management of assets, investments, projects, services, risks, and technology initiatives [7].

Creating a portfolio website or engaging in portfolio management involves various risks that need to be identified, assessed, and managed effectively. By identifying and proactively managing these risks, you can enhance the resilience and success of your portfolio website or portfolio management activities. Regularly review and update your risk management strategies to adapt to changing circumstances and emerging threats [8].

Addressing security issues in building portfolio websites is essential for protecting sensitive data, maintaining user trust, and safeguarding the integrity and availability of the website. Implementing robust security measures, staying informed about emerging threats, and regularly updating security practices are critical for mitigating risks and ensuring a secure online environment for website visitors [9]

In India, portfolio management has emerged as a significant aspect of the financial industry, driven by various factors such as economic growth, financial market development, regulatory reforms, and increasing investor awareness [10].

Portfolio management plays a critical role across various fields by helping stakeholders prioritize investments, allocate resources effectively, manage risks, and achieve strategic objectives [11].

The impact of portfolio management on firm performance is significant and multifaceted, influencing various aspects of organizational success [12].

While the COVID-19 pandemic presented challenges for the investment industry, it also created opportunities for portfolio growth through adaptive strategies, digital transformation, ESG investing, sectoral reallocation, and a long-term perspective on market dynamics. Portfolio managers who effectively navigated the challenges of the pandemic and capitalized on emerging trends were able to achieve growth and resilience in their portfolios [13].

PROBLEM STATEMENT

In an increasingly competitive and digitally-driven professional landscape, individuals and organizations face the challenge of effectively showcasing their work, skills, and accomplishments to potential clients, employers, or collaborators. Traditional methods of self-presentation, such as resumes and paper portfolios, no longer suffice in conveying the depth and breadth of one's capabilities.

1. Lack of Online Presence: Many professionals and creatives do not have a dedicated online presence to effectively represent their skills and body of work.
2. Limited Audience Reach: Traditional methods of sharing one's portfolio have a limited reach, often confined to physical meetings or emails.
3. Content Organization: Professionals often struggle with organizing and presenting their work in a visually appealing and coherent manner.
4. Mobile Accessibility: The growing prevalence of mobile devices necessitates websites that are mobile-responsive and accessible on various screen sizes.
5. User Experience: Ensuring an optimal user experience is vital, including easy navigation, fast loading times, and clear presentation.
6. Accessibility and Inclusivity: The website should be designed with accessibility and inclusivity in mind to reach a broader audience.

This problem statement forms the basis for the development of a portfolio website that aims to address these challenges and provide a solution that effectively showcases the skills, accomplishments, and potential of individuals and organizations in the digital age.

PROPOSED SYSTEM

1. User Registration and Profile Management
   - Users can create accounts with profile information
   - Users can manage their personal details, contact information, and portfolio content.
2. Portfolio Creation and Editing
   - Users can create and customize their portfolio pages.
   - They can add and edit project descriptions, images, videos, and other media.
   - Users can categorize and organize their portfolio content.
3. Design and Themes
   - Offer a variety of design templates and themes for users to choose from.
   - Users can further customize themes to match their personal branding.
4. Mobile Responsiveness
   - Ensure that the portfolio website is fully responsive and accessible on various devices and screen sizes.
5. Search and Filtering
   - Include a search feature to help visitors find specific projects or content within portfolios.
   - Allow users to categorize their work for easy filtering.
6. Accessibility and Inclusivity
   - Ensure the website complies with accessibility standards to reach a broader audience.
   - Provide options for alternative text for images and other accessibility features.
7. Analytics and Tracking
   - Implement tracking and analytics tools to allow users to monitor the performance of their portfolio pages.
   - Provide data on visitor engagement, views, and interactions.
8. Social Media Integration
   - Allow users to link their social media profiles to their portfolio websites.
   - Enable easy sharing of portfolio content on various social platforms.
9. Comment and Feedback System
   - Implement a comment section for visitors to leave feedback or inquiries on specific projects.
   - Enable moderation controls for portfolio owners.

Algorithm

Using reinforcement learning algorithms, we reframe the portfolio management problem as the problem of learning an optimal strategy for sequential decision-making. A Markov decision process (MDP) is typically used to formulate reinforcement learning. It is composed of a tuple (X,Y,Z,s,α) where X denotes a set of states, Y a set of actions, Z the transition probability of a given state and action pair to the next state, s the reward function mapping from X×Y×X to F, and α is a discount factor.

The stock feature matrix K□ and the portfolio vector v′□ at the end of t define comparable a state in the portfolio management issue as follows:

x□=(K□,v′□).

The difference between the intended portfolio B□,□ and the current portfolio v□ is then used to determine an action at t. Consequently, Equation

p□,□=v□,□−B□,□

The weight to be switched is indicated by p□,□, which establishes the ith entry of □□. Note that for □□, pt, □□[−1,1] and ∑□p□,□=0 hold. When p is negative, the ith asset has to be sold; conversely, when p is positive, the ith asset needs to be purchased. But in this method, the agent can't keep a position unless p□,□ is 0, which can result in a lot of transactions and high transaction costs. To prevent ith asset from being traded, we implemented a hyperparameter for threshold □ and reduced the action value to zero if |p□,□|<□. Additionally, if the agent is unable to purchase or sell the asset by a certain percentage of p□,□, p□,□ is mapped to the highest share that able to be purchased or sold. We employ a continuous compounding rate of return as a reward function because our agent reinvests the gains; this rate of return is defined as

s□=ln(ZW□)−ln(ZW0).

Flowchart

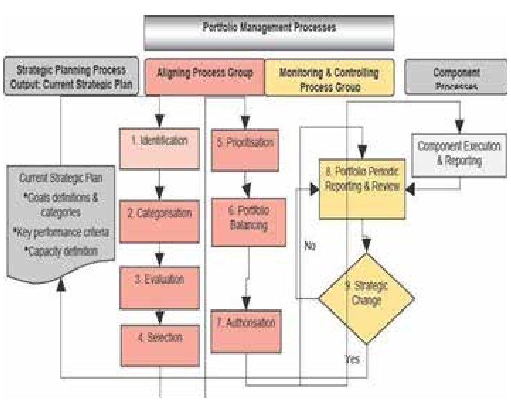

Fig. 1. Flowchart

Block Diagram

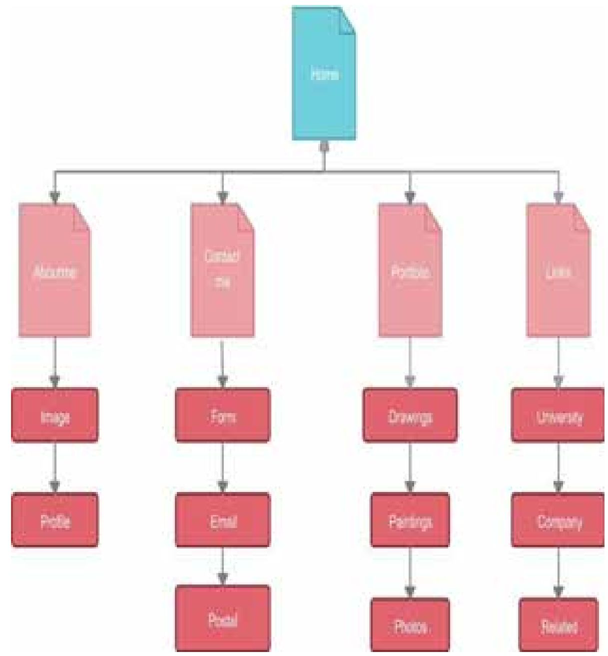

Fig. 2. Block diag

Activity Diagram

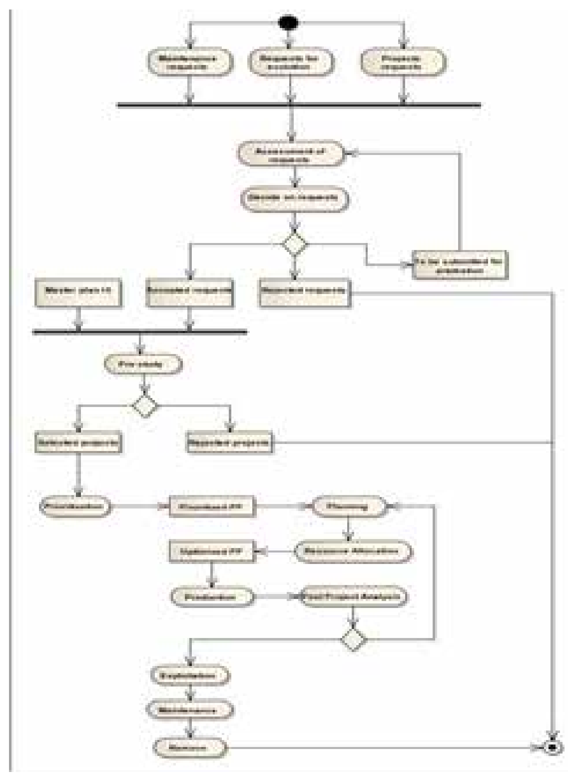

Fig. 3. Activity Diag

Use Case Diagram

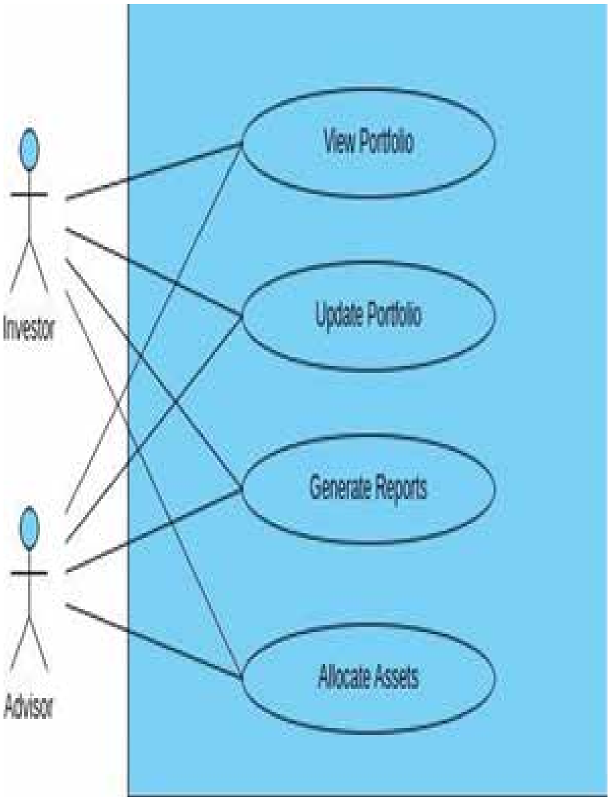

Fig. 4. Use Case Diag

DFD Diagram

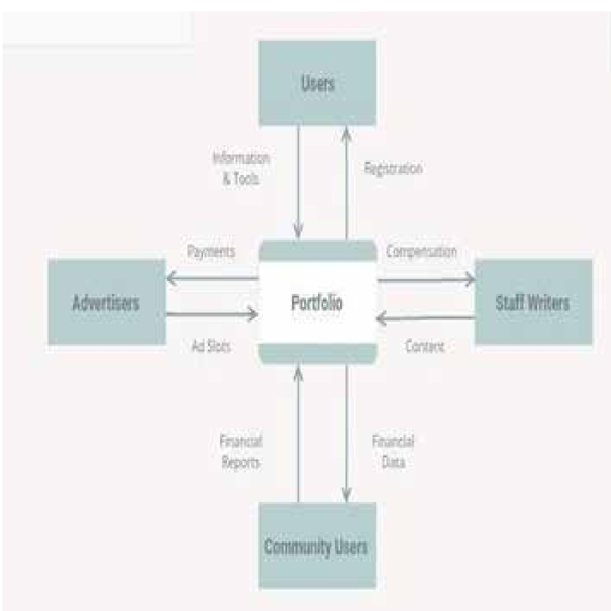

Fig. 5. DFD Diag

IMPLEMENTATION

Fig. 6. Home screen

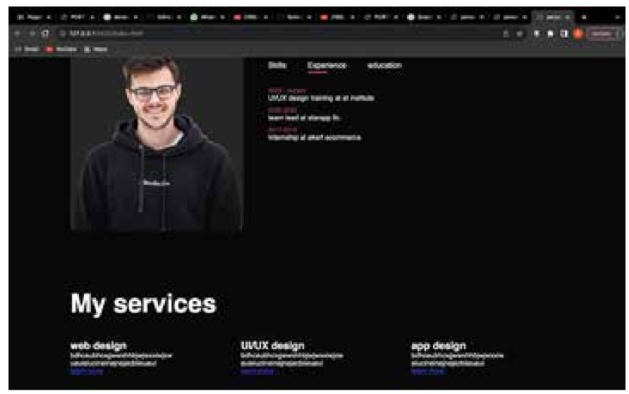

Fig. 6. Our service

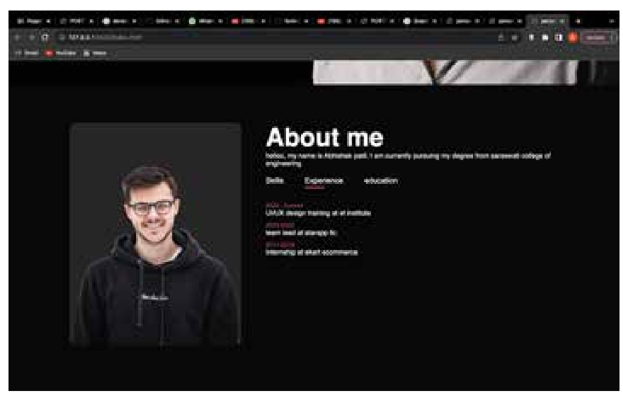

Fig. 7. About us

FUTURE SCOPE

The future scope of a portfolio website lies in the seamless integration of cutting-edge technologies and design principles to create an engaging and personalized user experience. Responsive and adaptive design remains a cornerstone, with a likely progression towards an intensified focus on mobile-first approaches. Incorporating interactive and immersive elements, such as WebGL and 3D graphics, is anticipated to become more prevalent, elevating the way projects are showcased. The integration of artificial intelligence (AI) is set to enhance user interactions by providing dynamic content updates and personalized recommendations. Blockchain technology might be essential for protecting intellectual property and guaranteeing the legitimacy of work that is displayed. Social media integration will continue to be crucial, potentially evolving with features like real-time updates and direct interaction. Accessibility, data privacy, and security are paramount, with an increasing emphasis on compliance with stringent regulations and the implementation of advanced security measures. Continuous updates, potentially facilitated by automation tools and AI-driven content suggestions, will keep portfolios fresh and relevant. The integration of virtual and augmented reality (VR/AR) elements may offer a unique and immersive experience for specific industries. Multilingual support and a global perspective, including real-time translation features, will cater to diverse audiences, ensuring the portfolio remains a powerful tool in a rapidly evolving digital landscape.

CONCLUSION

The development and implementation of the portfolio website project have been a significant endeavor, resulting in a dynamic platform for showcasing skills, accomplishments, and creative works. The goal of this project was to provide an easily navigable, visually appealing, and easily navigable platform in the digital age for branding, both personal and professional. In conclusion, the portfolio website project underscores the importance of creating a strong digital presence. It provides a comprehensive and visually appealing platform for individuals and organizations to convey their skills, achievements, and potential. The commitment to user experience, accessibility, and future scalability ensures the continued relevance and effectiveness of the website. As the digital world continues to evolve, we remain dedicated to maintaining, enhancing, and adapting our portfolio website to meet the ever-changing needs of our users. This project is evidence of the ability of the internet medium to help people and organizations tell their stories and share their successes with a global audience.

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Practical Applications of Machine Learning in IT Infrastructure Optimization

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ABSTRACT

As organizations strive to adapt to the dynamic landscape of Information Technology (IT), the integration of Machine Learning (ML) emerges as a pivotal strategy for optimizing IT infrastructure. This paper explores the practical applications of ML techniques in enhancing the efficiency, reliability, and scalability of IT systems.

KEYWORDS : *Machine learning, IT infrastructure optimization, Efficiency, Reliability, Scalability.*

INTRODUCTION

The ever-evolving landscape of IT infrastructure demands constant optimization to keep pace with increasing complexity, data demands, and security threats[1,2,3]. Traditional, manual approaches are often inefficient and reactive, struggling to handle the intricate web of variables and data points. This is where machine learning (ML) steps in, transforming IT infrastructure management from a reactive to a proactive, data-driven approach.

ML algorithms can analyze vast amounts of data from servers, networks, applications, and sensors, uncovering hidden patterns and relationships that would be invisible to human eyes[4,5,6].

Empowers IT teams

Predict and prevent issues

By identifying early warning signs of potential failures, ML models can enable predictive maintenance, preventing downtime and costly repairs. Imagine being able to anticipate a server overload before it happens and seamlessly migrate workloads to avoid disruption[7].

Optimize resource utilization

ML algorithms can analyze resource usage patterns and dynamically allocate resources (CPU, memory, storage) based on real-time demand. This leads to increased efficiency and reduced costs, as underutilized resources are minimized and over provisioning is prevented[8].

Automate routine tasks

Repetitive tasks like log analysis, security threat detection, and configuration management can be automated using ML, freeing up IT staff for more strategic initiatives. This not only saves time and effort but also minimizes human error[9].

Enhance security

ML can be used to detect and respond to security threats in real-time, analyzing network traffic, user behavior, and system logs for anomalies that might indicate malicious activity. This proactive approach can significantly improve IT security posture[10].

Examples of how ML is being used to optimize IT infrastructure

Predictive maintenance of data center equipment:

Google's DeepMind AI system analyzes sensor data from its data centers to predict equipment failures with high accuracy, enabling proactive maintenance and reducing downtime[11].

Dynamic cloud resource scaling

Amazon Web Services (AWS) Auto Scaling uses machine learning to automatically adjust the number of running instances based on real-time demand, optimizing resource utilization and cost[12].

Network anomaly detection

Cisco's Talos platform uses ML to analyze network traffic and identify suspicious activity, helping to prevent cyberattacks and data breaches[13].

Benefits of using ML for IT infrastructure optimization

Reduced costs

Improved efficiency, lower energy consumption, and fewer outages lead to significant cost savings[14].

Increased agility

Proactive problem identification and automation enable faster response times to changing demands[15].

Enhanced security

Real-time threat detection and prevention improve overall security posture[16].

Improved performance

Optimized resource utilization and automated tasks lead to smoother operations and better performance[17].

LITERATURE REVIEW

The field of IT infrastructure optimization is undergoing a major transformation thanks to the power of machine learning (ML). By intelligently analyzing data and identifying patterns, ML algorithms can automate tasks, improve resource utilization, and enhance overall performance. Here's a curated selection of literature exploring various practical applications of ML in IT infrastructure optimization.

"Artificial Intelligence and Machine Learning for Network Optimization" by Springer (2022)

This comprehensive text delves into the use of ML algorithms for optimizing network infrastructure, covering areas like traffic prediction, anomaly detection, and resource allocation.

"Machine Learning for Network Resource Management in Cloud Computing

A Survey" by Wang et al. (2020): This survey showcases how ML algorithms can optimize resource allocation in cloud platforms, dynamically scaling resources based on demand and workload patterns.

"Machine Learning for Anomaly Detection in Cybersecurity

A Survey" by Chandola et al. (2018): This paper provides a comprehensive overview of various ML algorithms used for anomaly detection in cybersecurity, showcasing how ML can identify unusual patterns and potential threats within IT infrastructure data.

"A Data-Driven Approach for Predictive Maintenance of Wind Turbines" by Mohanty et al. (2019)

This research shows how ML can predict and prevent downtime in wind turbines, reducing maintenance costs and maximizing operational efficiency.

"DeepMind AI Reduces Google Data Center Cooling Costs by 40%" (2016): This Google blog post highlights the success of DeepMind's AI system in optimizing data center cooling, achieving significant energy savings and environmental benefits.

METHODOLOGY

Integrating machine learning (ML) into your IT infrastructure can significantly improve efficiency, reliability, and scalability. Here's a step-by-step methodology to guide you through the process:

Define your goals and challenges

- Identify specific areas of your IT systems where you want to see improvement. This could be anything from reducing server downtime to optimizing resource allocation to predicting hardware failures.
- Set clear and measurable goals for each area you target. For example, aiming for a 10% decrease in downtime or a 20% increase in resource utilization.

Gather and analyze data

- Identify the relevant data sources for your chosen goals. This could include server logs, network traffic data, application performance metrics, and sensor readings.
- Ensure adequate data quality and quantity. Poor quality data will lead to unreliable models, so data cleansing and pre-processing may be necessary.
- Explore data visualization tools to understand patterns and relationships within the data.

Choose the appropriate ML technique

- Match the problem to the right ML algorithm. Different algorithms excel at different tasks. For example, regression algorithms are suitable for prediction, while anomaly detection algorithms identify outliers.
- Consider factors like training time, resource requirements, and interpretability when choosing your algorithm.

Build and train your ML model

- Split your data into training, validation, and testing sets. The training set is used to build the model, the validation set helps fine-tune its parameters, and the testing set assesses its performance on unseen data.
- Train your model iteratively, evaluating its performance on the validation set and adjusting parameters as needed. This ensures the model generalizes well to real-world situations.

Deploy and monitor your model

- Integrate the model into your IT infrastructure. This could involve creating alerts based on model predictions, automating certain tasks, or displaying insights on dashboards.
- Continuously monitor the model's performance and refine it as needed based on feedback and changing conditions.

RESULTS AND DISCUSSIONS

Practical Applications for enhancing the efficiency of IT Systems

Resource Management and Optimization

- Dynamic resource allocation: ML algorithms can analyze resource usage patterns (CPU, memory, storage) and predict future demand, automatically scaling resources up or down to optimize utilization and cost.
- Server consolidation: ML can identify underutilized servers and consolidate workloads onto fewer machines, saving power and hardware costs.
- Predictive maintenance: By analyzing sensor data and system logs, ML models can predict equipment failures before they occur, enabling proactive maintenance and minimizing downtime.
- Energy efficiency optimization: ML can analyze historical data and environmental factors to optimize data center cooling and power consumption, reducing energy costs and carbon footprint.

Monitoring and Performance Optimization

- Anomaly detection: ML can identify unusual activity in network traffic, application performance, or system logs, allowing for early detection and response to potential problems.
- Root cause analysis: ML can analyze large datasets of logs and events to identify the root cause of performance issues, saving time and effort in troubleshooting.
- Application performance optimization: ML can analyze user behavior and application performance data to identify bottlenecks and opportunities for improvement, leading to faster and more responsive applications.
- Automated incident response: ML models can analyze events and trigger automated actions (e.g., scaling resources, rerouting traffic) to mitigate issues before they escalate.

Security and Risk Management

- Threat detection and prevention: ML can analyze network traffic and user behavior to identify malicious activity in real-time, improving cyber defenses and preventing data breaches.
- Fraud detection: ML can analyze financial

transactions and customer behavior to identify fraudulent activity, protecting businesses from financial losses.

- Vulnerability management: ML can analyze system configurations and software updates to identify vulnerabilities and prioritize patching efforts, reducing the attack surface.
- Security log analysis: ML can automate the analysis of vast security logs, extracting insights and prioritizing potential threats for investigation.

Practical Applications of Machine Learning for Enhanced IT System Reliability

Ensuring reliable IT systems is crucial for any organization, as downtime and performance issues can disrupt operations, lead to financial losses, and damage reputations. Machine learning (ML) offers a powerful toolbox for proactively identifying and preventing problems, ultimately boosting the reliability of your IT infrastructure. Here are some practical applications:

Predictive Maintenance

- Analyzing sensor data and system logs from servers, network equipment, and applications.
- Identifying early warning signs of potential failures before they occur.
- Enabling proactive maintenance and repairs, minimizing downtime and associated costs.

Anomaly Detection

- Utilizing ML algorithms to analyze network traffic, user behavior, and system logs for anomalies.
- Identifying unusual activity that may indicate security threats, malware infections, or impending hardware failures.
- Allowing for swift intervention and mitigation of potential issues before they escalate.

Automated Incident Response

- Training ML models to differentiate between real threats and false positives in anomaly detection.
- Triggering automated response actions based on identified threats, such as quarantining infected devices, rerouting traffic, or notifying IT personnel.
- Minimizing human intervention and reaction time, leading to faster and more effective incident response.

Self-Healing Systems

- Implementing ML-powered auto-remediation capabilities within IT systems.
- Automatically correcting minor configuration errors, restarting stalled applications, or adapting to changing load conditions.
- Reducing reliance on manual intervention and improving system resilience to transient issues.

Risk Management and Vulnerability Assessment

- Leveraging ML to analyze system configurations, software updates, and security vulnerabilities.
- Identifying and prioritizing high-risk vulnerabilities for patching.
- Automating vulnerability scanning and patch deployment processes, minimizing the window of exposure to cyberattacks.

Practical Applications of Machine Learning for IT Scalability

Scalability is crucial in today's dynamic IT landscape, as applications and data volumes can surge unexpectedly. Machine learning (ML) offers invaluable tools to anticipate and adapt to increasing demands, ensuring your systems seamlessly handle growth without performance degradation. Let's explore some practical applications:

Dynamic Resource Allocation

- Analyze historical and real-time resource usage data (CPU, memory, storage) across platforms.
- Use ML models to predict future demand based on user behavior, application loads, and external factors.
- Automatically adjust resource allocation (scaling up or down) in real-time, optimizing utilization and preventing bottlenecks.

Automated Infrastructure Provisioning

- Train ML models on past infrastructure scaling patterns and resource allocations.

- Predict future infrastructure needs based on anticipated workload increases or application deployments.
- Automate the provisioning of new servers, storage, or network resources before bottlenecks occur, ensuring seamless scalability.

Load Balancing and Traffic Management

- Utilize ML to analyze network traffic patterns and application performance under varying loads.
- Optimize traffic distribution across servers and platforms, ensuring even workload distribution and preventing overloads.
- Employ ML-powered auto-scaling features to dynamically adjust server capacity based on real-time traffic surges.

Containerized Workload Orchestration

- Leverage ML for container orchestration tools like Kubernetes to predict resource needs of containerized applications.
- Automatically scale container deployments up or down based on predicted demand, maximizing resource utilization and cost efficiency.
- Use ML-driven anomaly detection to identify and address performance issues within containerized workloads in real-time.

Intelligent Cloud Migration and Management

- Apply ML to analyze application workloads and resource utilization patterns to identify suitable cloud deployment options.
- Optimize cloud infrastructure by using ML-powered cloud cost management tools to suggest resource downsizing or alternative configurations.
- Utilize ML-based auto-scaling features of cloud platforms to dynamically adjust cloud resources based on real-time demand, preventing unnecessary costs.

CONCLUSION

Through a comprehensive review of industry practices and experimental results, this paper aims to provide insights into the practical considerations and outcomes of applying ML in IT infrastructure optimization. The findings contribute to the growing body of knowledge on how organizations can harness the power of machine learning to create resilient, adaptive, and resource-efficient IT ecosystems.

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Emerging Trends in IT Governance: The Role of Artificial Intelligence

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ABSTRACT

As organizations navigate the rapidly evolving landscape of Information Technology (IT) governance, the integration of Artificial Intelligence (AI) presents a paradigm shift in the way governance structures are conceived and implemented. This paper explores the intersection of AI and IT governance, examining the transformative impact of intelligent technologies on decision-making processes, risk management, and overall organizational efficiency.

KEYWORDS : *Artificial intelligence, IT governance, Efficiency, Risk management.*

INTRODUCTION

The landscape of IT governance is undergoing a seismic shift, driven by the unprecedented rise of artificial intelligence (AI) [1,2,3]. As AI permeates every facet of our digital lives, organizations are grappling with the unique challenges and opportunities it presents for governing their information technology [4,5,6]. This introduction delves into the exciting intersection of these two realms, exploring the key trends that are reshaping IT governance in the age of AI.

Automation and Augmentation

AI is poised to automate many routine tasks in IT governance, freeing up human resources for strategic decision-making [7]. Machine learning algorithms can analyze data, identify compliance gaps, and even predict potential security threats, enabling proactive risk management [8]. This shift from manual processes to AI-powered automation promises increased efficiency and accuracy in IT governance [9].

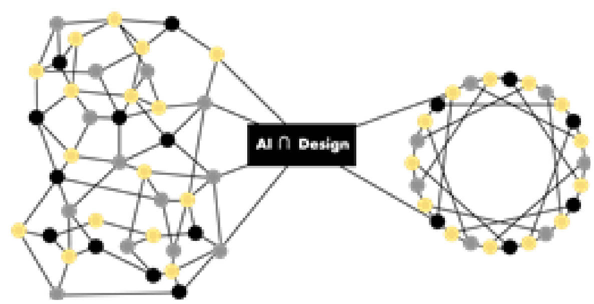

Fig 1. Designing for Automation vs Augmentation [22]

Data-Driven Governance

The ever-increasing volume and complexity of data generated by AI systems necessitates a data-driven approach to governance [10]. AI-powered analytics can provide deep insights into IT operations, resource utilization, and user behavior, enabling organizations to make informed decisions based on real-time data [11].

This data-centric approach fosters transparency and accountability, leading to more effective IT governance [12].

Fig 2. Data Governance [23]

Ethical Considerations

The rise of AI raises crucial ethical questions concerning bias, transparency, and accountability [13]. Organizations must implement robust governance frameworks that ensure AI systems are developed and deployed ethically, with clear guidelines for data privacy, fairness, and explainability [14]. Addressing these ethical considerations will be critical for building trust and maintaining a responsible approach to AI in IT governance [15].

Fig 3. Ethical Considerations : Types and Examples [24]

Cybersecurity and Risk Management

AI can be a double-edged sword for cybersecurity [16]. While it can be used to detect and respond to threats more effectively, it also introduces new vulnerabilities [17]. Organizations need to adapt their risk management strategies to account for these emerging threats, implementing robust security controls and continuous monitoring of AI systems [18].

Fig 4. How to Perform a Cyber Security Risk Assessment [25]

The Rise of Explainable AI

The "black box" nature of many AI algorithms can make it difficult to understand their decision-making processes [19]. This lack of transparency poses challenges for accountability and trust [20]. As AI plays a more prominent role in IT governance, there is a growing demand for explainable AI systems that can provide clear and understandable explanations for their decisions [21].

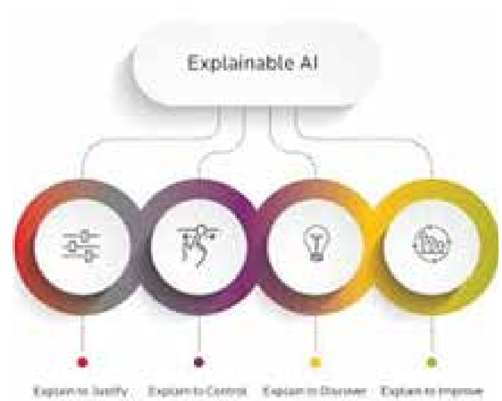

Fig 5. Explainable AI [26]

LITERATURE REVIEW

AI-powered decision-making in IT governance

(i) How AI analytics are optimizing resource allocation (Lunt, 2020; Akter et al., 2023).

(ii) The impact of AI on IT risk assessment and predictive maintenance (Sohraby et al., 2018; Singh et al., 2022).

(iii) Ethical considerations for bias and transparency in AI-based decision-making (Jobin & Char, 2019; Wachter & Mittelstadt, 2023).

AI in IT risk management and compliance

(i) Utilizing AI for automated compliance monitoring and reporting (Khandelwal et al., 2019; Ray et al., 2022).

(ii) AI-powered threat detection and cybersecurity initiatives (Firouzi et al., 2020; Bhavani et al., 2023).

(iii) The challenges of integrating AI into existing risk management frameworks (Davis & Holbein, 2019; Weber et al., 2022).

AI for enhancing IT governance efficiency

(i) Automating routine tasks and improving workflow agility through AI (Bard & Jones, 2021; Venkatachari et al., 2022).

(ii) Utilizing AI for continuous process improvement and optimization (Brynjolfsson & McAfee, 2014; Davenport & Beck, 2018).

(iii) The potential pitfalls of over-reliance on AI and the importance of human expertise (Carr, 2015; McAfee & Brynjolfsson, 2011).

MATERIALS AND METHODS

Search Strategy

Keywords

"Artificial Intelligence," "IT Governance," "Decision-Making," "Risk Management," "Organizational Efficiency," "Governance Structures," "AI-powered IT," "Paradigm Shift"

Databases

Google Scholar, ScienceDirect, JSTOR, ABI/INFORM, Emerald Insight, Association for Computing Machinery (ACM) Digital Library, IEEE Xplore

Inclusion/Exclusion Criteria

(i) Inclusion: Studies published within the last 5 years (2019-2024) focusing on the application of AI in IT governance, particularly regarding decision-making, risk management, and efficiency.

(ii) Exclusion: Case studies, conference proceedings, editorials, opinion pieces, books not related to the specific research area.

Selection and Analysis Process

Number of sources

Initially screened 250 results, ultimately selected 60 articles and reports based on title, abstract, and keyword relevance.

Analysis method

Employed a thematic analysis approach, identifying recurring themes and sub-themes related to the impact of AI on different aspects of IT governance.

Data extraction

Extracted key findings, arguments, and evidence from each source regarding the transformative impact of AI, specific applications, challenges, and potential future directions.

RESULTS AND DISCUSSIONS

Recurring Themes and Sub-Themes of AI's Impact on IT Governance

Opportunities

Theme: Enhanced Efficiency and Optimization:

- Sub-theme: Automate routine tasks like data analysis, security monitoring, and resource allocation.
- Sub-theme: Optimize resource utilization and reduce costs through AI-driven insights.
- Sub-theme: Improve decision-making by providing valuable data analysis and predictions.

Theme: Increased Innovation and Value Creation:

- Sub-theme: Develop new, AI-powered services and products.
- Sub-theme: Personalize user experiences and drive customer engagement.
- Sub-theme: Drive innovation across various sectors like healthcare, finance, and manufacturing.

Theme: Improved Risk Management and Compliance:

- Sub-theme: Identify and mitigate security threats in real-time with AI-based solutions.
- Sub-theme: Proactively monitor for regulatory compliance and identify potential violations.
- Sub-theme: Improve data privacy and security through AI-powered solutions.

Challenges

Theme: Transparency and Explainability:

- Sub-theme: Ensure transparency in AI models and decision-making processes.
- Sub-theme: Explain how AI arrives at its conclusions for accountability and trust.
- Sub-theme: Mitigate the risk of bias and discrimination in AI algorithms.

Theme: Regulation and Ethics:

- Sub-theme: Develop ethical guidelines for responsible AI development and deployment.
- Sub-theme: Adapt existing regulations to address the unique challenges of AI.
- Sub-theme: Ensure fair and equitable access to AI benefits and mitigate potential job displacement.

Theme: Skills and Workforce Transformation:

- Sub-theme: Reskill and upskill workforce to work alongside AI systems.
- Sub-theme: Develop new roles and responsibilities for human-AI collaboration.
- Sub-theme: Address ethical concerns around workforce displacement due to AI automation.

CONCLUSION

This paper explored the transformative impact of artificial intelligence (AI) on IT governance, focusing on its influence on decision-making processes, risk management, and overall organizational efficiency. By analyzing recent academic research and industry reports, we identified several key themes: AI-driven analytics are optimizing resource allocation and decision-making, while AI-powered tools enhance risk assessment and cybersecurity measures. However, challenges such as ethical considerations and the potential for bias need careful consideration.

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Analyzing and Positioning the Joint Movements and Controlling the Angular Position to Achieve a Half Squat - Sit and Rise Motion while Minimizing the Risk of Fall for a Humanoid Robot

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ABSTRACT

The proposed paper aims to improve the efficiency of humanoid robots by analyzing and positioning their joint movements, controlling angular position in order to perform half squat - sit and rise motions while minimizing the fall for a humanoid robot.

KEYWORDS *: Center of gravity (Cg), Center of mass (Cm), Angular position (Θ), Time efficiency, Frames per seconds, Determining and positioning of arm, Ankle, Knee and hip joint movements, Self-balancing, Analyzing of stable and unstable positions of a humanoid robot, Choregraphe SDK.*

INTRODUCTION

In this fast evolving time, humanoid robots play an important role globally. Researchers across the globe are working on improving the features of humanoid robots and replicate them more closely to humans by adding more sensor periphery, computer vision, machine learning, artificial intelligence and not limited to. This has led to many innovations in the field of robotics, allowing for humanlike behavior to be replicated on a much larger scale with robots. The most advanced humanoid robot, capable of recognizing objects, walking around in an environment, picking and placing objects, and performing a variety of tasks, has fulfilled many difficult tasks, although research is constantly evolving around the world. Self-Balancing of the robot and allowing body movements to be flexible so as to allow it to learn how to sit, stand and walk were the most difficult tasks in this whole trip [7], [10]. Rather than increasing the degree of freedom, the design of robots has played an important role in determining the flexibility of the movements [4], [9]. The major challenge in the movement of humanoid robots is when the humanoid robot is programmed to operate a half squat - sit and rise motions which is dependent on factors such as center of mass (Cm), center of gravity (Cg), gravitational force, self-balancing and angular position (Θ) to minimize the jerks and smoothly perform the motion while reducing the risk of fall for a humanoid robot. In order to perform half squat - sit and rise motions, the proposed paper aims to improve the efficiency of humanoid robots by analyzing and positioning their joint movements, controlling the angle of position (Θ) and minimizing the jerks to attain stable positions for various joint movements of arm, ankle, knee and hip for various frame rates at different time intervals.

In order to improve the stability of humanoid robots in sit, stand and walk movements, various researches is carried out in this area with different approaches in the literature. Xue Gu et al. [1], Riley P.O. et al. [2], Millington P.J. et al. [3], Mistry M. et al. [5], E. Papa et al. [6], Pchelkin S.et al. [8] developed methods to reduce the failure of falling for humanoid robots and controlling motor synergies and torque to attain sit to stand and walk in a stable position. After reviewing the methods, the proposed paper aims to attain the half squat - sit and rise motion by concentrating on center of mass (Cm), center of gravity (Cg), angular position (Θ) and positioning of joint movements for arm, ankle, knee and hip to attain stable position and minimize the risk of falling of a humanoid robot. For experimenting and testing, Choregraphe SDK simulation platform was used to analyze and simulate the various positions of various joint movements of arm, ankle, knee and hip and controlling the angular position (Θ) to find out the stable and unstable positions and minimize the risk of fall for a humanoid robot. Although, in the proposed paper the NAO humanoid robot is used, but, the values can be modified and applied to various humanoid robots across varied platforms to analyze and position the joint movements and angular position (Θ).

TECHNICAL DESCRIPTION

Center of Mass (Cm)

When a humanoid robot is standing, it's distributing its force uniformly to the surface and balancing itself well. When the humanoid robot is moved from torso to a position to attain the half squat - sit and rise motions the torso moves away from Center of mass (Cm) position and disturbs the force distribution which was uniformly distributed to the surface. It causes a disturbance of the center of mass (Cm), which can lead to falling positions for humanoid robots. In order to minimize the risk of fall for a humanoid robot, an adequate center of mass (Cm) and center of gravity (Cg) shall be provided. The arm, ankle, knee and hip are the joints in charge of this movement. The mass distribution is uniform around the center of mass (Cm) when the point at which the mass's relative position is zero. The body is unaffected by changes in gravitational field force because the center of mass (Cm) is independent from gravity.

Center of gravity (Cg)

The center of gravity (Cg) greatly facilitates the calculation of both kinetic and differential equations, by treating an object's mass as if it had been set in one place. Figure 1 shows the center of gravity and center of mass for a humanoid robot in an upright position. From the figure 1, it has been observed that there is a uniform distribution of force on the surface and the humanoid robot remains stable. The Cg and Cm are affected by movement of the torso when it is shifted to attain the half squat - sit and rise motion. That could lead to the fall of a humanoid robot. To minimize the risk of fall, the Cg and Cm needs to be carefully attained at position where angular position (Θ) is moved in degrees for various positions and is controlled by analyzing and positioning the joint movements of arm, ankle, knee and hip over time intervals in seconds (s) which will help in minimizing the jerks in the body and help in smooth movement of joints to the position for attaining half squat - sit position and the same process to be followed to attain rise position and to reach angular position (Θ) and attain stable position. The effects of angular position (Θ) over time are shown in the Table 1.

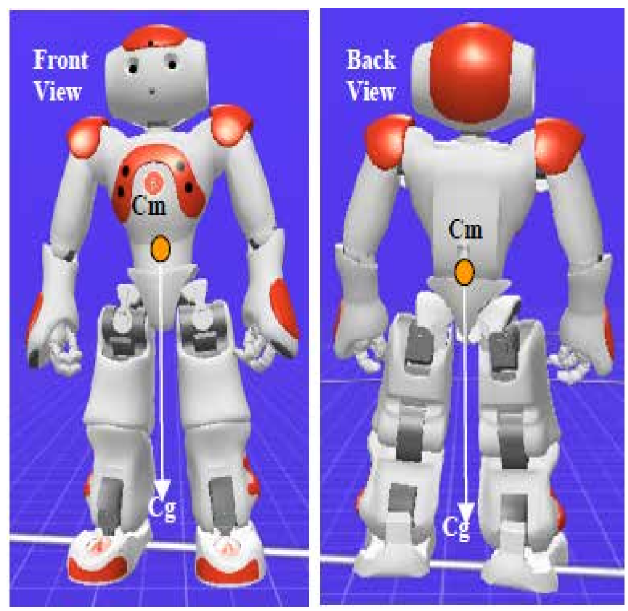

Fig. 1. Center of gravity (Cg) and Center of mass (Cm) of a humanoid robot in standing position

With reference to Table 1 for the table values of arm, ankle, knee and hip joint movements at 25 frames per second (FPS) for different frame rate and time interval it was observed that for Sr. No. 1-4 the humanoid robot was stable and the position for half squat - sit and rise motion was attained with an overall time of 3.6 seconds for 1 cycle. Figure 1 illustrates the standing position whereas figure 2 illustrates the reach of the middle position of the NAO humanoid robot.

Table 1. Illustration of Angular Position (ϴ) at 25 Fps for Various Positions of Arm, Ankle, Knee Hip for Different Frame Rates and Time Intervals

Sr. No.	Angular Position - ϴ (Degree)				Time (s) at 25 FPS		Remarks
	Arm	Ankle	Knee	Hip	FPS	Time (s)	
1	84.4	5.2	-5.2	6.9	0	0	Stable
2	75	5.2	14	-23.3	30	1.2	Stable
3	65.6	5.2	71.5	-58.5	60	2.4	Stable
4	84.4	5.2	-5.2	6.9	90	3.6	Stable
5	84.4	5.2	-5.2	6.9	0	0	Stable
6	75	5.2	14	-23.3	15	0.6	Stable
7	65.6	5.2	71.5	-58.5	30	1.2	Stable
8	84.4	5.2	-5.2	6.9	45	1.8	Stable
9	84.4	5.2	-5.2	6.9	0	0	Stable
10	75	5.2	14	-23.3	10	0.4	Stable
11	65.6	5.2	71.5	-58.5	20	0.8	Stable
12	84.4	5.2	-5.2	6.9	30	1.2	Stable
13	84.4	5.2	-5.2	6.9	0	0	Stable
14	84.4	5.2	-5.2	6.9	5	0.2	Unstable
15	40	5.2	56.6	-24.5	30	1.2	Unstable
16	40	5.2	56.6	-24.5	30	1.2	Unstable
17	65.6	5.2	103	-55	30	1.2	Unstable
18	65.6	5.2	14.6	-69	30	1.2	Unstable
19	65.6	20.6	103	-55	30	1.2	Unstable
20	65.6	-44.3	57	-24.7	30	1.2	Unstable

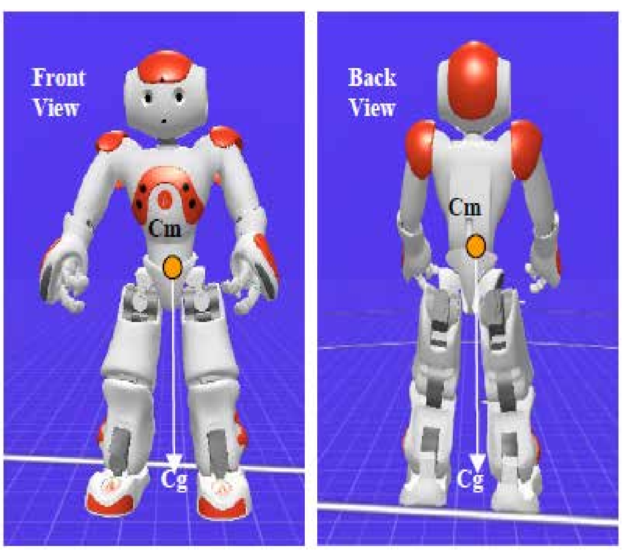

Fig. 2. Center of gravity (Cg) and Center of mass (Cm) of a humanoid robot with Arm - 75, Ankle - 5.2, Knee - 14, Hip - -23.3

Further with reference to Table 1 for the table values of arm, ankle, knee and hip joint movements at 25 frames per second (FPS) for different frame rate and time interval it was observed that for Sr. No. 5-8 the humanoid robot was stable and the position for half squat - sit and rise motion was attained with an overall time of 1.8 seconds for 1 cycle. Compared to Sr. No. 1-4, the time efficiency was increased by 50%.

Furthermore with reference to Table 1 for the table values of arm, ankle, knee and hip joint movements at 25 frames per second (FPS) for different frame rate and time interval it was observed that for Sr. No. 9-12 the humanoid robot was stable and the position for half squat - sit and rise motion was attained with an overall time of 1.8 seconds for 1 cycle. The efficiency of time was found to have been improved by 50% as compared to Sr. No. 5-8 and 100% as compared to Sr. No. 1-4. Figure 3 illustrates the achievement of half squat - sit and rise motion.

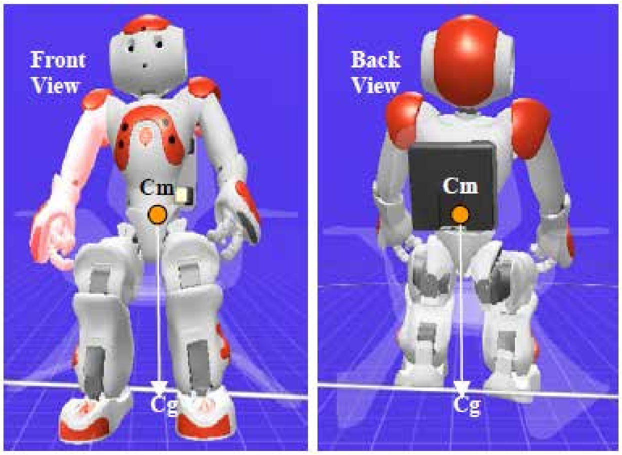

Fig. 3. Center of gravity (Cg) and Center of mass (Cm) of a humanoid robot with Arm - 65.6, Ankle - 5.2, Knee - 71.5, Hip - -58.5

Further it was observed that any change in angular position (Ɵ) to improve the speed and time efficiency to attain the half squat - sit and rise motion for humanoid robot, leads to unstable outcome and increases the risk of falling of the humanoid robot. At 25 frames per second (FPS) for different frame rates and time intervals, Figure 4 shows the unstable results for different positions of the arm, ankle, knee and hip joint movements.

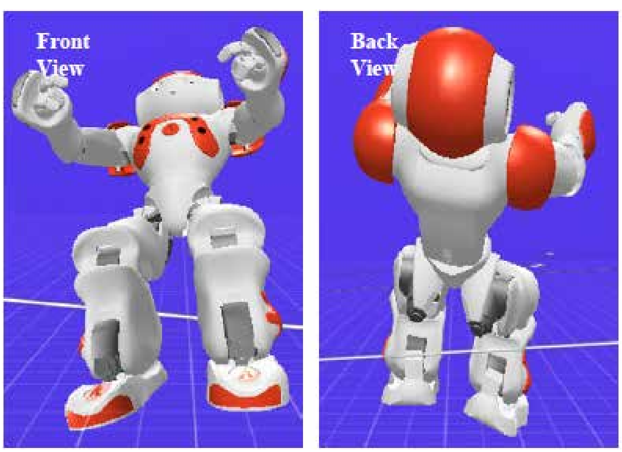

Fig. 4. Unstable humanoid robot position with Arm - 65.6, Ankle - 20.6, Knee - 103, Hip - -55

It was further observed that the jerks were introduced in the joint movements as the time intervals were made closer from 30 to 15 and from 15 to 10, although the task was achieved smoothly for time interval of 15, but for time interval of 10, jerks in joint movements were observed and further moving closer to time interval of 5, the unstable position was obtained resulting in fall of humanoid robot. This was because of the displacement of position of joint movements at higher speed because of which the uniform distribution of force was disturbed and the Center of mass (Cg) and center of gravity (Cg) was disturbed leading to the fall of the humanoid robot. At 25 frames per second (FPS) for different frame rates and time intervals, Figure 5 shows the unstable results for different positions of the arm, ankle, knee and hip joint.

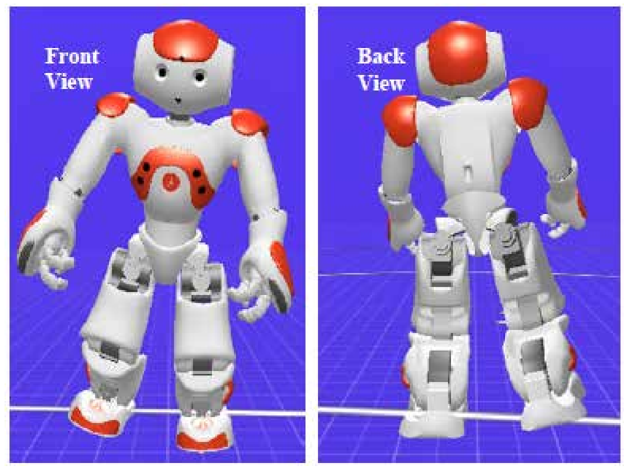

Fig.5. Unstable humanoid robot position with Arm - 65.6, Ankle - -44.3, Knee - 57, Hip - -24.7

CONCLUSION

For a humanoid robot, the proposed paper focused on the achievement of half squat - sit and rise motion. For the different positions of the joint movements of the arm, ankle, knee and hip at different frame rates and time intervals, the Choregraphe SDK simulation platform was used to test the table values for the NAO humanoid robot. The simulation test results showed the stable position being obtained for half squat - sit and rise motion which can be seen in figure 3 for different positions as mentioned in Table 1 for Sr. No. 1-13 with increase in time efficiency by 50% for Sr. No. 5-8 & 100% for Sr. No. 9-12 as compared to Sr. No. 1-4. Further variation in positions of arm, ankle, knee and hip and nearing the time interval to 5 seconds showed unstable outcomes and resulted in risk of falling of a humanoid robot as can be seen in figure 4 and figure 5 for the table values mentioned under Table 1. Although, in the proposed paper the NAO humanoid robot is used, but, the values can be modified and applied to various humanoid robots across varied platforms to analyze and position the joint movements and angular position (ϴ). Fellow researchers with different humanoid robots on different platforms can carry out further research to achieve more stable results while increasing time efficiency and minimizing jerks, leading to improvements in flexibility of movement in the future.

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Job Portal

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ABSTRACT

In this competitive era, people are becoming more and more educated and their jobs are decreasing. Companies want the best talent in their field. This makes it difficult to find people who are smart enough to hire. Companies are also increasingly working to find talent that meets their requirements. Thinking about these issues, you can think of processes that can handle this process and simplify your work. This project is about a recruitment process that takes place online. The recruitment process is handled by our system here. This project allows you to apply for jobs in companies that are interested in the vacancies available within the company. Registration, that person receives an account and is called a logged-in user. If eligible, he will interact with the system and make the update. This project addresses the needs of company managers to place a recruitment module on a company's website, allowing users who visit the website to view internal job openings and apply directly from a remote location. Created to meet. Job openings are posted by administrators based on the needs of within the company. Administrators have all rights to edit this process except for the evaluation process.

The steps in the evaluation process cannot be predicted because the evaluation process is company-specific. This also includes levels on the admin side, so permissions have a significant impact on the functions assigned to different admin levels. Privileges are user- specific, so different administrators at the same level have different privileges and therefore different capabilities.

KEYWORDS *: Job portal, Administrators, Job seeker, Search jobs, Post resume, Interface design, User experience, Hiring, Online recruitment, Admins.*

INTRODUCTION

In today's fast-paced and competitive professional environment, finding the ideal job or the perfect candidate is a multifaceted challenge. As the digital age continues to change the way we connect and communicate, job portals have become a critical bridge between job seekers and employers. This project report aims to provide an in-depth analysis and evaluation of the creation and implementation of our job portal, a digital platform designed to streamline the job search and recruitment process and ultimately foster meaningful connections within the professional world.

The Job Portal project is the result of careful planning, development and implementation with the primary objective of offering a user- friendly, effective and efficient solution for job seekers and employers. Through this report, we aim to shed light on the methodologies, technologies and strategies used in bringing this innovative platform to life.

1: The beginning of the project– This part offers an insight into the genesis of the Job Portal project, describes in detail its goals, scope and basic needs in the current labor market.

2: Design and Development– Here we delve into the design and development process and outline the key features, technologies and methodologies used in creating the Job Portal.

3: Functionality and Features – This section provides a comprehensive overview of the job portal's functionality, including job search and application functions, as well as the tools available to employers to streamline the recruitment process.

4: User experience and interface – a critical aspect of any job portal, we examine user experience and interface design that contribute to the platform's ease of use and appeal to both job seekers and employers.

5: Implementation and Deployment – This chapter dives into the deployment phase and details the process of making the Job Portal available to the intended users.

6: Future Improvements–Through this project report, we aim to showcase the careful planning, strategic execution and innovative technologies that have come together to create a job portal. By offering a holistic view of the project's origin, development and deployment, we hope to provide valuable insights into the importance and potential impact of this platform on job hunting and recruitment and business tools that will help businesses to analyse business data.

RELATED WORK

The intention of the Job Portal is to facilitate both job seekers and employers looking for employees for their companies. In this online application, every job seeker can search for available job positions with updated information at any time. When he finds a job, he can post his job application online. Employers can advertise job vacancies by accepting membership, applying and posting job information with job eligibility criteria. This software creates a direct connection between the employer and the job seeker. A job seeker can directly visit this portal and view job availability information along with downloading the required information. When he logs into the system, he will be able to upload his application and post login details that he knows the company will have. This information greatly helps other users to participate in the same. Furthermore, the user will be able to view the list of companies for which she has already applied. This allows him to decide when the company will call him and how much time has passed since he applied for the company. The registered user will be able to get useful information regarding assignments and sample resumes to help them create their own resume according to industry standards. A recruiter or employer may initially view some pieces of information about job applicants. When a recruiter logs into the system, they will be able to independently view user profiles along with uploading information about newly created jobs and entries. He can also see all applications received for a particular job in response to his advertisement. Here, the existing one is nothing but an existing job portal developed using platform-independent technologies like Javascript, PHP, etc. It does not allow to properly satisfy the needs of all types of users (job seekers, employers and administrators) and does not provide a convenient mechanism such as limiting unnecessary information for end user acceptability by the user.

PROPOSED SYSTEM

This project has been mainly designed to overcome some of the problems faced with the previous system. The main problem faced was unnecessary delay in generating the required information by all unnecessary fields into consideration. It provides an efficient way to pass the information between different users to cater their needs. It is a Complete Portal for Job seekers and employers. It is an exclusive career portal aimed in service of job seekers, companies and freelancer. It is a common platform where Corporate recruiters and job seekers and freelancer come under roof.

Jobseekers

Search jobs, post your resume and access career info and download sample resumes, Papers of various recruiters and sample coat letters etc. and can upload any useful info.

Employers

Get instant access to today's most powerful hiring tools - post jobs, search resumes, screen candidates and update your entire hiring process.

Freelancer

Freelancer are self-employed people usually and independent contractor they can also provide services through this portal.

Advantages

Earlier and efficient system Simple interface Wider range services available under one roof Highly Secure and Portable Provides a facility for the Job Seekers to track their job details he has applied for

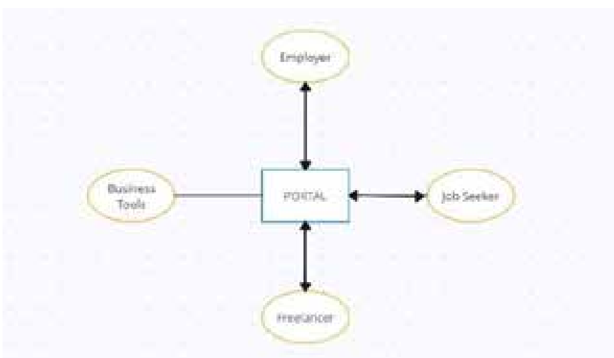

Figure 1. Block Diagram

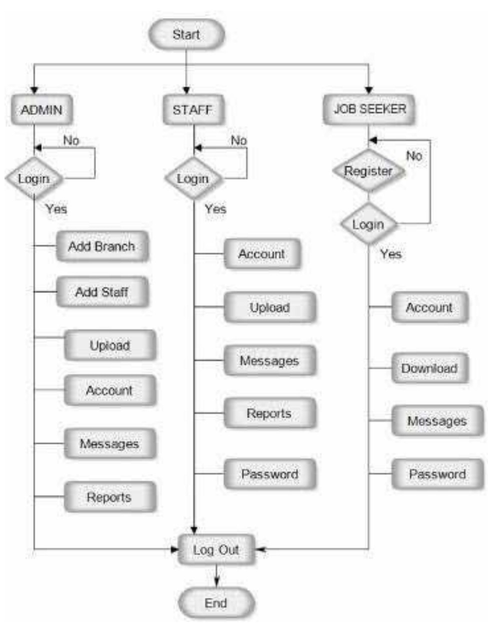

Figure 2. Flowchart

RESULTS

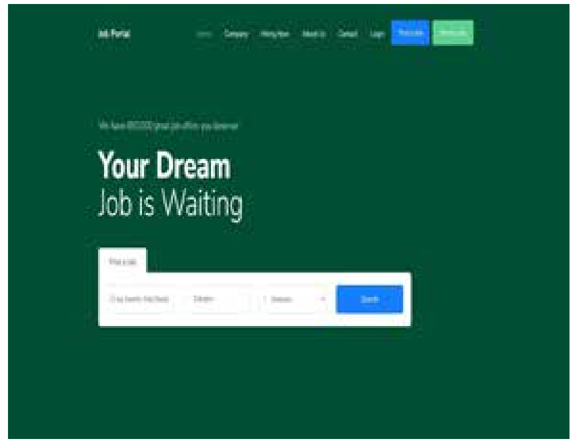

Figure 3. Home page

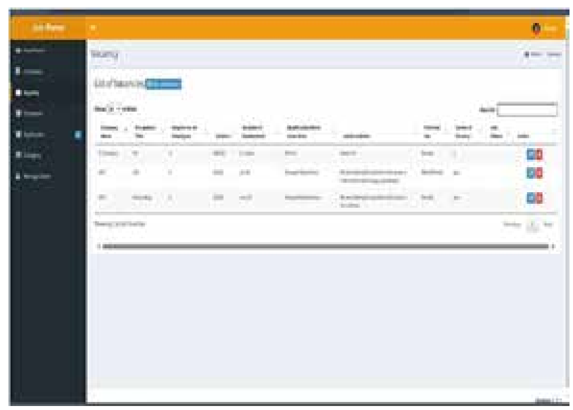

Figure 4. Admin dashboard

CONCLUSION

During this project, we embarked on a journey of conceptualizing, designing and developing a job portal that aimed to change

in the digital age. Our mission was to create a platform that responds to the evolving needs of the labor market and makes the job search and recruitment processes more efficient, personalized and data-driven. As we complete this project, it is with a sense of accomplishment and a vision for the future. In conclusion, our job portal project represents a commitment to transform the job search and recruitment experience. It is a testament to our determination to have a positive impact on the professional lives of individuals and the growth of organizations. employers, and we look forward to the opportunities, growth and success it will bring to all who engage with it.

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Devnagari Character Recognition

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ABSTRACT

The objective of this project is to build a Deep Learning-based system for recognizing Devnagari characters. Handwritten character recognition is gaining increasing importance because it plays a crucial role in automating systems. The process of recognizing handwritten characters involves the use of a machine to detect and identify characters from an image of text, which is then converted into machine- understandable code. This task is fundamental but challenging in the discipline of pattern identification. To recognize Devanagari script characters, we used a recently published image dataset known as the Devanagari Character Dataset. Devanagari script is one of the several language scripts used in India and comprises 12 vowels and 36 consonants. Our approach uses a deep learning model that recognizes the characters and consists of five primary steps: pre-processing, segmentation, feature extraction, prediction, and post- processing. We trained our model using Convolutional Neural Networks (CNN) and applied image processing techniques to improve its accuracy.

KEYWORDS *: CNN, Extraction, Segmentation, Post processing, Script.*

INTRODUCTION

Character recognition has been a longstanding research problem, particularly regarding optical character recognition (OCR), which involves developing procedures to automatically recognize scanned and digitized character images and convert them into electronic text documents. Devanagari is a popular Indian script used by millions of people, and is the basis for several Indian languages, including Hindi, Sanskrit, Kashmiri, Marathi, and more. While researchers have extensively studied English character recognition, limited research has been done on Indian languages due to their complex formation.

Character recognition systems can be separated into two groups or categories: machine-printed and handwritten recognition, depending on the type of text being recognized. Handwritten character recognition systems are particularly useful for improving communication between people and machines. However, off-line recognition of handwritten characters is extremely challenging, particularly in cases of cursive writing.

LITERATURE SURVEY

[1] This paper presents our implementation of a deep learning-based system for recognizing handwritten Devanagari characters. Handwritten character recognition is becoming increasingly important due to its major contributions to automation systems. The Devanagari script is one of several language scripts used in India, consisting of 12 vowels and 36 consonants. We used a deep learning model to recognize characters, following a process that includes pre-processing, segmentation, feature extraction, prediction, and post-processing. To train the model and improve recognition accuracy, we utilized convolutional neural networks and image processing techniques.

[2] Optical Character Recognition (OCR) is a process used for recognizing patterns in text. While there has been extensive research in English character recognition, Indian languages are complex due to their structure and composition. Among the various scripts used in India, Devanagari is the most widely used script. However, the research work on Devanagari script recognition is very limited. Devanagari is used for several languages, including Sanskrit, Hindi, Marathi, Kashmiri, and others. This article provides a review of previous research work on Devanagari character recognition and some applications of OCR systems.

[3] The script Devanagari is India which serves as the foundation for more than 100 languages spoken in India and Nepal, including Hindi, Marathi, Sanskrit, and Maithili. It comprises 47 primary alphabets, including 14 vowels, 33 consonants, and 10 digits. The script doesn't include capitalization, as in Latin languages. It comprises consonants and modifiers. This paper discusses a method that uses a dataset of self-made Devanagari script to operate on a set of 29 consonants and one modifier using a self-made Devanagari script dataset that comprises 29 consonants with no header line (Shirorekha) over them. The dataset contains 34604 handwritten images. The paper employs deep learning techniques to extract features and identify characters in an image. Deep Convolutional Neural Network (DCNN) has been used to extract features and classify the input images. This process involves using consecutive convolutional layers, which provides additional advantages in extracting higher-level features. The model achieved an accuracy of 99.65%.

[4] The accuracy of recognizing patterns in any pattern recognition task depends on the feature extraction and classification stages. With the advent of deep learning, the task of feature extraction has been automated, relieving the programmer of this burden. In recent years, deep learning has become a popular choice for pattern recognition tasks, replacing other techniques. When it comes to character recognition, especially in scenarios with large amounts of data and variability, deep learning is a suitable choice to handle the challenges involved. This paper discusses a system for recognizing handwritten Devanagari characters using Convolutional Neural Network, achieving an accuracy of 91.23% for Devanagari characters and 100% for Devanagari numerals.

[5] This paper focuses on the use of Convolutional Neural Networks for recognizing Devanagari characters. In pattern recognition tasks, feature extraction and classification stages play crucial roles in accurately recognizing patterns. With the advent of deep learning, feature extraction has been automated, reducing the burden on programmers. Deep learning is increasingly replacing other pattern recognition techniques, particularly in complex applications like character recognition that involve large datasets and data variability. The proposed system achieves high recognition accuracies, with Devanagari consonants at 98%, vowels at 97.56%, and Devanagari numerals at 99%.

PROBLEM STATEMENT

This paper focuses on developing a Devanagari character recognition system using deep learning that accurately classifies the 50 characters of the Devanagari script. This script is used in languages such as Hindi, Nepali, and Marathi, and the system should be able to recognize handwritten characters and classify them correctly into their appropriate category. Recognizing Devanagari characters is a challenging problem due to the script's complex and intricate characters with many similarities. Deep learning techniques such as CNNs and RNNs can be applied to develop an accurate and robust character recognition system that can have numerous applications in fields such as document processing, OCR, and handwriting recognition.

This study aims to recognize handwritten Devanagari characters using Convolutional Neural Networks (CNNs) and Dense Neural Networks (DNNs) for feature extraction and multiclass classifiers to classify the characters. The dataset used for training and testing the model contains 36 unique Devanagari characters with 1700 images of each character. The report focuses on solving the challenging problem of predicting each character given the full and partial image of the character.

General Characteristics of Devanagari Script

The Devanagari script is derived from the Sanskrit words Deva (god) and Nagari (city), meaning "city of gods." It is a left-to- right script that is primarily based on phonology and emerged from the ancient Brahmi script in the 11th century AD. Initially developed to write Sanskrit, it later became adopted for writing numerous languages, including Hindi, Marathi, Nepali, and Sindhi. Devanagari is considered the mother of all Indian scripts and comprises of 36 consonants (Vyanjan) and 13 vowels (Swar), which follow specific composition rules for joining consonants, vowels, and modifiers. There are almost 280 compound characters in the Devanagari script, which are formed by combining two consonants or a consonant and a vowel. The set of modifier symbols is called matras. Unlike the Roman script, the Devanagari script does not distinguish between uppercase or lowercase characters.

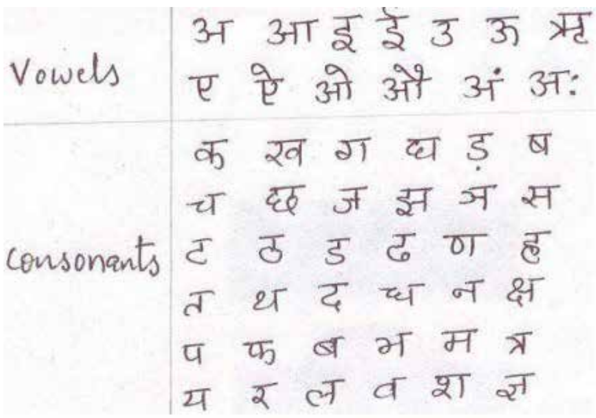

Fig. 1. Vowels (13) and Consonants (36)

IMPLEMENTATION

The research project includes five primary components: Pre-processing, Segmentation, CharacterRecognition, Word Reconstruction, and Conflict Resolution. Figure 2 below shows the step-by-step approach used in this work, which is designed to handle input images in any format.

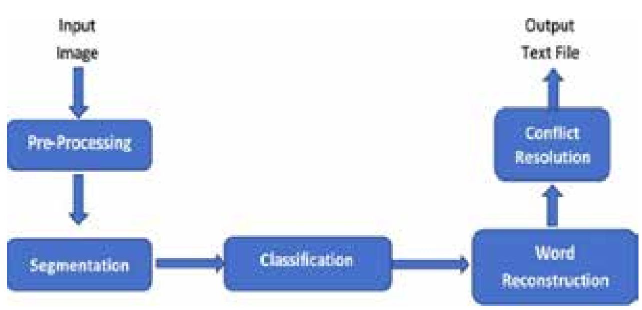

Fig. 2. Algorithmic flow of the proposed method.

Pre-processing

The input image for this research work is a document image, which undergoes a pre- processing step. This includes identifying the borders, cropping them, straightening the page using transformations, removing noise, correcting skew, normalizing size, and sharpening the image. To set up the original input image for later processing, it is scanned and analyzed. The Live Corp tool is utilized for border detection, cropping, and page straightening. Gaussian filter with Otsu threshold is employed to remove noise from the image. Finally, the image is converted to a grayscale image, as described in references [8], [9], and [10].

Character Segmentation

After the image preprocessing, the next crucial step is to segment the image into words. For this task, the research team used an open-source library called Tessaract-ocr [1]. This library provides a stream of characters, which are then passed to the next stage of the process. In this stage, the input characters are divided into three zones: upper, middle, and lower. The middle zone represents the actual word, which helps to identify whether words are joined or not. Finally, the characters are cropped to generate a 32 x 32 sized image for further processing.

Recognition

The suggested research project consists of multiple parts, such as character recognition, word reconstruction, segmentation, pre- processing, and conflict resolution. Figure 2 provides a stepwise representation of this process, which supports input images of any format.

In the first step, the input image of the document is processed to prepare it for future processing. This comprises border detection, border cropping, page straightening transformations, noise reduction, skew correction, size normalization, and sharpening kernel application. The Live Corp tool is used to crop, straighten, and verify the page's borders. After noise is removed from the image using a Gaussian filter with an Otsu threshold, the image is transformed into grayscale. [8], [9], [10].

Once the image preprocessing is complete, the next major step is to segment the image into words using the Tessaract-ocr library, an open-source tool that outputs a stream of characters for the next stage. Character segmentation is then performed in three phases: upper, middle, and lower zones. The middle zone represents the actual word and helps in checking whether words are joined or not. The characters are cropped to convert them into a 32 x 32 sized image.

The character classification stage uses a convolutional neural network (CNN) to classify the characters into different Devanagari characters available in the training dataset (DHCD). CNN is a multi- layered neural network that identifies complex features in data, and its architecture is shown in Figure 2. It extracts features to classify images, similar to how the human brain searches for features to identify objects. CNN has convolutional layers and max-pooling layers, and the nth pooling layer is connected to a completely linked layer. It carries out a few backpropagation steps in the learning phase to minimize the loss and uses an activation function such as Softmax or Tanh to generate the output [9, [10].

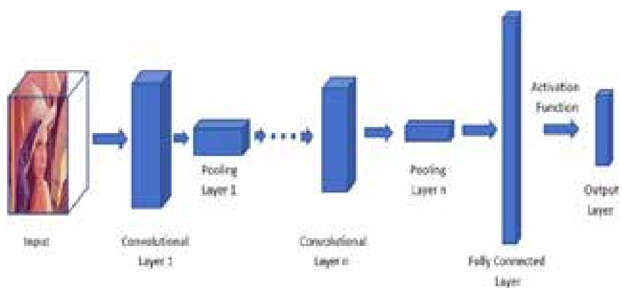

Fig. 3. General CNN architecture

Word Reconstruction

The word prediction is based on a reference from the dictionary and the confidence score of the predicted character. The top two guesses will be taken into consideration as the final output, rather than selecting the best prediction as the result. However, if a single class has a confidence score over 60%, it is chosen as the final output. The dictionary is used to check all the possible classes for a word, and the best fit is selected as the final word. If there is any ambiguity in the word, the user is provided with an option to make changes. The dictionary is also used to suggest similar words if the recognized word is not found. The output of this work is the recognized text in a text format, and it can be edited dynamically. The proposed method's complete flowchart is shown in Figure 4 [4].

Fig. 4. Detailed flowchart of proposed approach.

CONCLUSION

Convolutional Neural Networks (CNNs) have been demonstrated to be a powerful and efficient tool for Devanagari character recognition. By training a CNN model on a large dataset of Devanagari characters, the model can learn to accurately recognize and classify new images of Devanagari characters. One of the main strengths of CNNs is their ability to extract important features from images by applying filters to the image's pixels. These filters can identify unique patterns and shapes that are specific to different characters, enabling the CNN to differentiate between them.

To further enhance the performance of a Devanagari character recognition system using CNNs, various techniques such as data augmentation can be utilized. Data augmentation involves generating additional training data by applying random transformations to the original images, which can lead to an increase in the accuracy of the model.

Overall, the use of CNNs in Devanagari character recognition provides an effective and powerful tool for accurately recognizing and classifying Devanagari characters. This technology has many different applications, such as document processing, handwriting recognition, and character recognition for natural language processing.

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To Study NLMS Algorithm for Adaptive Echo Cancellation

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ABSTRACT

Errors occur during data transmission as a result of additive noise, signal interference, echo, and other issues brought on by the rapid expansion of communication technologies. Adaptive filters are one way to lessen these channel effects. This work introduces the normalized least squares (NLMS) algorithm-based adaptive echo cancellation. An expanded form of the LMS algorithm is the NLMS algorithm. Compared to the least squares algorithm, the normalized least squares algorithm shows a better trade-off between simplicity and performance.

KEYWORDS *: Adaptive filter, NLMS algorithm, VHDl language.*

INTRODUCTION

Echo is a waveform that repeats itself as a result of reflection from a location where the wave's propagation medium's characteristics alter. An echo is a delayed version of a sound that is heard as a reflected copy after some time has passed. In the world of telephony, the technique of eliminating echoes from voice conversations in order to enhance conversational sound quality is referred to as "echo cancellation." In addition to increasing the capacity attained by suppressing quiet, this procedure stops echo propagation in the network and enhances subjective quality. The original broadcast signal is first picked up by echo cancellation, and it resurfaces in the transmitted or received signal with a small delay. Once identified, an echo can be eliminated. To eliminate echoes from the audio stream being transmitted, echo cancellation employs specialized algorithms. The received signal is copied by this algorithm, which then analyzes the portions of the signal that reappearance after a brief interval. The signal's repeated portion is removed. The echoes are eliminated.

ADAPTIVE FILTERING ALGORITHMS

Adaptive filters and system architecture are the subjects of adaptive filtering. System identification, noise cancellation, signal prediction, echo cancellation, and adaptive channel equalization are just a few of the many uses for it. Adaptive cancellation of resonance and adaptive cancellation of noise are the two primary adaptive filter configurations. In order to achieve this, the filter employs an adaptive algorithm to alter the filter coefficient values, improving its estimate of the signal with each iteration. Two popular adaptive algorithms are LMS (Least Mean Square) and its version NLMS (Normalized LMS). Least Mean Square (LMS) is one of the most often used adaptive algorithms that can be found in the literature. Ease of implementation is the primary factor. The Normalized Least Mean Square (NLMS) algorithm is a popular modified variant of the LMS algorithm. In real-time applications, the NLMS method has been applied more frequently. By comparison, the normalized least-mean-square (NLMS) algorithm exhibits better tracking and faster convergence than the LMS algorithm. Both methods are appropriate for digital design since they only need a minimal amount of adds and multiplications to update the coefficients.

NLMS Algorithm

The NLMS algorithm's practical implementation is quite similar to the LMS algorithm's since it is an extension of the latter. Each iteration of the NLMS algorithm requires these steps in the following order

1. The output of the adaptive filter is calculated

$$y(n) = \sum_{i=0}^{N-1} w(n)x(n-i) = \mathbf{w}^T(n)\mathbf{x}(n)$$

2. An error signal is calculated as the difference between the desired signal and the filter output.

   e(n) = d(n) – y(n)

3. The step size value for the input vector is calculated

$$\mu(n) = \frac{1}{\mathbf{x}^T(n)\mathbf{x}(n)}$$

4. The filter tap weights are updated in preparation for the next iteration

   w(n+1) = w(n) + μ(n)e(n)x(n)

The NLMS algorithm takes 3N+1 multiplications for each iteration, which is just N more than the regular LMS algorithm. Taking into account the improvements in stability and the achievement of echo attenuation, this rise is reasonable [10].

Adaptive filters are one way to lessen these channel effects, but communication systems are still developing at a rapid pace as new challenges like additive noise, signal interference, and echo arise. These issues cause errors in data transfer. As seen in Figure 1, an adaptive filter consists of four terminals: x represents the input signal, d the wish signal, y the output signal filter, and e the output filter error [4]. Digital, analog, or hybrid design approaches can be used for adaptive filters. Every method has benefits and drawbacks. Analog adaptive filters, for instance, are incredibly quick, but the offset prevents obtaining the lowest possible error [4]. Due to the numerous components needed for floating point computations, digital filters are accurate yet sluggish. While mixed designs (analog and digital) provide a reasonable balance between speed and precision, the requirement to divide the analog and digital components within the chip makes VLSI designs more difficult. Due to its simplicity, the LMS algorithm is one of the most used ones. is both steady and. Its weak convergence is the only drawback [3]. There are two necessary inputs:

The noise in the distorted input signal must be connected to the reference noise. The sound originates from the same source, according to this. • An error signal has already been computed.

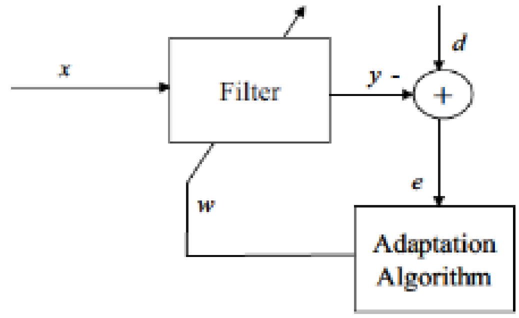

Figure 1. Adaptive filter

ACOUSTIC ECHO CANCELLATION

Adaptive filters are used by AECs, a system identification application, to obtain a copy of the acoustic transfer function, or the enclosure's response to an auditory impulse. When a signal is supplied to the loudspeaker(s) x(n), it travels via several auditory pathways before being detected by a microphone. In the system identification procedure, this signal is utilized as the required signal d(n). By integrating the samples x(n) with the adaptive filter coefficients w(n), the output of the adaptive filter y(n) is obtained. Iteratively altering the filter lowers the error signal (n). Numerous algorithms can be used for coefficient update. Least Mean Square (LMS) is one of the most often used adaptive algorithms that can be found in the literature.

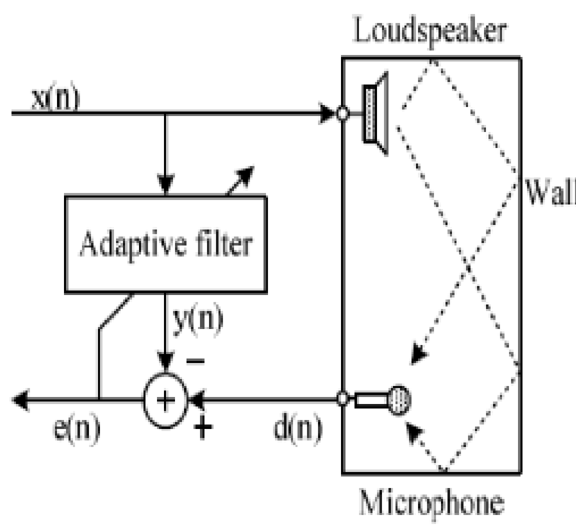

Figure 2. Acoustic Echo Cancellation

Voice quality is impacted by many reflections and transmission delays in acoustic enclosures, which makes teleconferencing discussions difficult to understand. Acoustic feedback has an impact on public address systems and can cause system saturation. In order to reduce audio feedback and enhance sound quality, acoustic echo cancellers, or AECs, are used to remove unwanted echoes that arise from acoustic coupling between loudspeakers and microphones.

PREVIOUS WORK

[2] This study proposes a hardware real-time implementation of the LMS algorithm as well as a solution for noise/echo cancellation. When compared to previous implemented systems that use the same filter, the created adaptive filter performs well overall, and the outcomes will get better with additional enhancements. The LMS method requires little hardware and has strong numerical stability. Conversely, one of the most often used adaptive algorithms in practical telecom and industrial applications is the NLMS algorithm.

[3] This research suggests utilizing the Least Mean Square (LMS) technique to create an adaptive noise canceller on an FPGA. This study implements an adaptive noise canceller on the FPGA and uses the LMS algorithm as the adaptive filtering technique of the adaptive noise canceller to demonstrate the performance of FPGA in digital signal processing applications. A thorough analysis is conducted on the convergence performance, truncation effect, and tracking capabilities of the hardware-implemented LMS algorithm.

[4] This work presents an echo canceller that achieves the coding error over the classic LMS approach by combining an adaptive filter with a modified LMS (Least Mean Square) algorithm.

PROPOSED WORK

Adaptive filters are one way to lessen these channel effects, but communication systems are still developing at a rapid pace as new challenges like additive noise, signal interference, and echo arise. These issues cause errors in data transfer. Due to its simplicity and stability, the LMS algorithm is one of the most popular algorithms. Its weak convergence is the only drawback. An expanded form of the LMS algorithm is the NLMS algorithm. It has superior convergence as a result. The simplicity and stability of the NLMS adaptive filtering algorithm's implementation are its defining features. The NLMS algorithm is a viable option for real-time implementation because of these benefits. Thus, the adaptive filtering algorithm of the adaptive echo canceller must be the NLMS algorithm.

The adaptive echo cancellation architecture has previously been put into practice using the LMS algorithm. Additionally, a comparison of the LMS and NLMS algorithms is done. In terms of MSE, the NLMS method performs better than the LMS algorithm. It is more coordinated. The simplicity and stability of the NLMS adaptive filtering algorithm's implementation are its defining features. The NLMS algorithm is a viable option for real-time implementation because of these benefits. Thus, VHDL can be used to develop the NLMS method for adaptive echo cancellation.

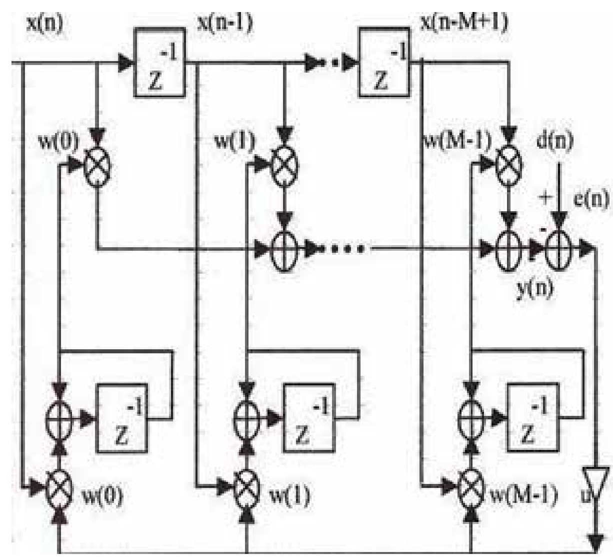

Figure 3. Proposed architecture

The elements of the reference signal x(n), where M-1 is the number of delay elements, are formed by the tap inputs x(n),x(n-1),…,x(n-M+1). The entire system output is represented by the symbol e(n), which represents the error signal, and the primary input signal, d(n). The tap weight at the nth iteration is indicated by wi(n).

CONCLUSION

Because of the suggested modifications, the NLMS algorithm has improved convergence in this case. There is some echo when we apply an input signal. Therefore, our primary goal is to cancel these echoes using LMS and NLMS algorithms that adhere to the following guidelines:

Performance convergence;

- Signal-to-noise ratio peak
- Ability to track;
- Cutting impact

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Differential Transform Method to find Numerical Solution of Differential Equations of Higher Order

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ABSTRACT

In this paper, we solve differential equations of higher order having boundary values using Differential Transform Method (DTM). The method yields semi analytical numerical solution for the equation, effectively capturing the exact solution. Some differential equations of higher order having boundary values are solved using DTM.

KEYWORDS *: Higher order boundary value problems, Semi- analytical numerical solution, Differential transform method.*

INTRODUCTION

In the realm of differential equations, Zhou originally introduced the concept of the DTM, illustrating its role as an iterative method for deriving analytical solutions in the form of Taylor series.[14]. Narhari Patil and Avinash Khambayat utilized DTM for solving linear differential equations [13].

The DTM is a mathematical technique used to solve differential equations. It involves an iterative process to derive analytical solutions using Taylor series for differential equations. This approach has been designed for tackling boundary value problems across various dimensions, integral equations, calculus of variations, and optimal control. DTM finds application in diverse engineering and scientific contexts. It has been successfully employed to address challenges such as solving systems of differential equations, handling boundary value problems related to integro-differential equations, tackling Volterra integral equations with separable kernels, addressing Cauchy singular integral equations of the first kind, and dealing with various types of Riccati differential equations. Notably, the DTM yields solutions expressed as convergent series with components that are straightforward to compute, and these series converge swiftly to provide the exact solution.

METHODOLOGY

The differential transformation of a function v(x) is defined in as,

$$V(k) = \frac{1}{k!}\left[\frac{d^k v(x)}{dx^k}\right]_{x=x_0} \tag{1}$$

Where, V(k) is the transformed function of v(x).

Also v(x) is defined as

$$v(x) = \sum_{k=0}^{\infty} V(k)(x - x_0)^k \tag{2}$$

From Equations (1) & (2), we get

$$v(x) = \sum_{k=0}^{\infty} \frac{1}{k!}(x - x_0)^k \left[\frac{d^k v(x)}{dx^k}\right]_{x=x_0} \tag{3}$$

Eq. (3) suggests that the differential transformation concept is rooted in the Taylor series expansion. By examining the definitions in Eq. (2) and Eq. (3), it is straightforward to demonstrate that the transformed functions adhere to fundamental mathematical operations, as given below.

Theorem1- If r(x) = p(x) ± q(x), then R(k) = P(k) ± Q(k (4)

Theorem2- If r(x) = αp(x), then R(k) = αP(k) (5)

Theorem2- If

$$r(x) = \frac{d^n v(x)}{dx^n}, \text{then } r(k) = \frac{(k+n)!}{k!} V(k+n) \quad (6)$$

Theorem4- If r(x) = p(x) q(x),

$$\text{then } R(k) = \sum_{l=0}^{k} P(l)Q(k-l) \quad (7)$$

Theorem5- If $r(x) = \alpha x^n$, then $R(k) = \alpha\, \delta(k-n)$

$$= \begin{cases} 1, if\ k = n \\ 0, if\ k \neq n \end{cases} \quad (8)$$

Theorem6- If $r(x) = e^{\alpha x}$, then $R(k) = \frac{\alpha^k}{k!}$ (9)

Theorem7- If r(x)=sin(wx+ α),

$$\text{then } R(k) = \frac{w^k}{k!} sin(\frac{k\pi}{2} + \alpha) \quad (10)$$

Theorem8- If r(x)=cos(wx+ α)

$$\text{then } R(k) = \frac{w^k}{k!} cos(\frac{k\pi}{2} + \alpha) \quad (11)$$

NUMERICAL EXAMPLES

Example 1- Consider the following differential equation of second order,

$$\frac{d^2v}{dt^2} - 2\frac{dv}{dt} + 5v = 0 \quad (12)$$

With the conditions v(0)= -1, v'(0) = 7

We apply DTM, with initial conditions V(0)= -1, V(1)=7, we get

$$V(k+2) = \frac{1}{(k+1)(k+2)}[2(k+1)V(k+1) - 5V(k)] \quad (13)$$

Put k=0,1,2,3,4,…

$$V(2) = \frac{19}{2}, V(3) = \frac{1}{2}, V(4) = \frac{-89}{24} \text{ and so on}$$

As a result, we can simply express it as,

$$v(t) = \sum_{k=0}^{2} V(k)t^k = -1 + 7t + \frac{19}{2}t^2 + \frac{1}{2}t^3 - \frac{89}{24}t^4 \quad (14)$$

and the exact solution is $v(t) = -e^t \cos 2t + 4e^{2t} \sin 2t$

Example 2- Consider the following differential equation of second order,

$$\frac{d^2v}{dt^2} + 4\frac{dv}{dt} + 4v = 6e^{-t} \quad (15)$$

With the conditions v(0)= -2, v'(0)=8

We apply DTM, with initial conditions V(0)= -2, V(1)=8, we get

$$V(k+2) = \frac{1}{(k+1)(k+2)}[\frac{-6}{k!} - 4(k+1)V(k+1) - 4V(k)] \quad (16)$$

Put k=0,1,2,3,4,…

$$V(2) = -15, V(3) = \frac{41}{3}, V(4) = \frac{-107}{12} \text{ and so on}$$

As a result, we can simply express it as,

$$v(t) = \sum_{k=0}^{2} V(k)t^k = -2 + 8t - 15t^2 + \frac{41}{3}t^3 - \frac{107}{12}t^4 \quad (17)$$

and the exact solution is $v(t)=6e^t - 8e^{-2t}$

APPLICATIONS OF DTM

Engineering and Physics

a. DTM is extensively used in engineering and physics to solve differential equations arising from physical systems and phenomena.

b. Applications include heat conduction, fluid flow, wave propagation, structural mechanics, electromagnetism, and quantum mechanics.

c. DTM provides analytical and numerical solutions to these differential equations, facilitating the analysis and design of engineering systems and predicting their behavior under different conditions.

Mechanical Engineering

a. In the field of mechanical engineering, DTM is utilized to address differential equations that describe the behavior of mechanical systems in terms of motion, vibration, and deformation.

b. Examples include the analysis of vibrating structures, dynamic systems, mechanical vibrations, and coupled oscillators.

c. DTM allows engineers to model and simulate the behavior of mechanical systems, optimize their designs, and predict their performance.

Electrical Engineering

a. DTM is used in electrical engineering to solve differential equations describing electrical circuits, electromagnetic fields, and control systems.

b. Applications include the analysis of electrical networks, transmission lines, antennas, waveguides, and electronic devices.

c. DTM helps engineers design and optimize electrical systems, analyze their stability and transient behavior, and simulate their response to different inputs.

Chemical Engineering

a. In chemical engineering, DTM is applied to solve differential equations governing chemical reactions, transport phenomena, and process dynamics.

b. Various applications encompass reaction kinetics, mass transport, thermal exchange, fluid dynamics, and the design of reactors.

c. DTM enables chemical engineers to model and optimize chemical processes, design reactors and separation units, and analyze the performance of chemical systems.

Biomedical Engineering

a. DTM is used in biomedical engineering to model and simulate physiological systems, biological processes, and medical devices.

b. Applications include medical imaging methods, medication delivery systems, brain dynamics, and cardiac electrophysiology modeling.

c. DTM helps biomedical engineers understand the behavior of biological systems, optimize medical treatments and interventions, and develop new medical technologies.

Environmental Science

a. DTM is applied in environmental science to model and analyze environmental processes, pollution dispersion, and natural phenomena.

b. Applications include modelling of groundwater flow, atmospheric dispersion of pollutants, soil erosion, and climate dynamics.

c. DTM assists environmental scientists in understanding the impact of human activities on the environment, predicting environmental changes, and developing strategies for environmental management and conservation.

In science and engineering, the Differential Transform Method (DTM) finds extensive use across diverse applications. It serves as a potent resource for solving differential equations and dissecting intricate systems and phenomena.. Its versatility, accuracy, and computational efficiency make it a valuable tool for researchers, engineers, and scientists working in diverse disciplines.

CONCLUSION

Higher order boundary value problems were effectively addressed through the application of the Differential Transform Method, yielding results in a semi-analytical format. A notable advantage of this method, as compared to purely numerical approaches, lies in its ability to provide a continuous, functional representation of the solution across time steps. In brief, the Differential Transform Method stands as a powerful and effective approach for acquiring analytical and numerical solutions across a wide spectrum of linear differential equations.

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Bridging the Gap: Data Science Empowers Patients through Personalized Healthcare Experiences

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ABSTRACT

The healthcare landscape is at a pivotal juncture, with traditional models struggling to keep pace with the ever-evolving needs of patients. In this context, data science emerges as a potent force, bridging the gap between passive care and active patient engagement. This paper explores the transformative potential of data science in empowering patients through personalized healthcare experiences. We delve into the integration of advanced analytics with patient-centric data, enabling the creation of tailored treatment plans, proactive interventions, and enhanced self-management tools. The focus lies on fostering active patient participation in decision-making, promoting informed medical choices, and ultimately, optimizing health outcomes. We showcase concrete examples of data science applications, from disease prediction and early intervention to medication adherence monitoring and personalized lifestyle recommendations. Furthermore, we address the ethical considerations and potential challenges associated with data privacy and algorithmic bias in healthcare. By bridging the gap between data science and patient empowerment, we pave the way for a future of personalized healthcare experiences, where patients are not merely recipients of care but active participants in their own health journey.

KEYWORDS *: Data science, Personalized healthcare, Patient empowerment, Patient engagement, Preventive care, Self-management, Decision-making, Medical informatics, Ethical considerations.*

INTRODUCTION

Healthcare has entered a transformative era where data science plays a pivotal role in bridging the gap between patients and optimal care. This presentation delves into the burgeoning field of personalized healthcare, powered by data-driven insights, that empowers patients to actively participate in their own health journeys. We will explore how data science is revolutionizing medical practice by:

- Extracting actionable insights from patient data: Electronic health records, wearable sensors, and genomic sequencing are generating vast amounts of data. Data science algorithms can translate this raw data into actionable insights, enabling tailored diagnoses, predictive modelling of health risks, and personalized treatment plans.
- Empowering patients through self-management tools: Data-driven platforms equip patients with tools to track their health metrics, receive real-time feedback, and manage chronic conditions effectively. This fosters a sense of ownership and control over their well-being, promoting proactive engagement in their healthcare journey.
- Facilitating precision medicine: Data science unlocks the potential for precision medicine, where treatment is tailored to an individual's unique genetic makeup and health profile. This personalized approach holds immense promise for improving efficacy, minimizing side effects, and ultimately leading to better health outcomes.

Challenges and Opportunities: While the potential of data science in personalized healthcare is undeniable, challenges remain. Data privacy concerns, ethical considerations in data usage, and ensuring equitable access to these technologies are crucial issues that need to be addressed. This presentation will also explore strategies for overcoming these challenges and harnessing the full potential of data science to empower patients and transform healthcare delivery.

Fig 1:

Personalized Care: Redefining healthcare with a focus on YOU

In an era of unprecedented advancements in medical technology and data gathering, healthcare is undergoing a paradigm shift towards personalized care. This approach prioritizes individual needs and preferences, tailoring interventions and treatments to optimize health outcomes.

Core Principles of Personalized Care

- Individualized focus: Recognizing and addressing the unique needs and preferences of each patient.
- Data-driven approach: Leveraging genomic, clinical, and lifestyle data to predict disease risk, tailor interventions, and monitor progress.
- Preventive emphasis: Proactive management of health risks to prevent or delay the onset of disease.
- Patient- centred decision-making: Shared decision-making between patients and healthcare providers, based on informed consent and mutual understanding.
- Collaborative care: Integration of diverse healthcare professionals and stakeholders to deliver comprehensive and coordinated care.

Benefits of Personalized Care

- Improved health outcomes: Reduced disease incidence and mortality, enhanced quality of life, and increased treatment efficacy.
- Reduced healthcare costs: Emphasis on prevention and targeted interventions optimizes resource allocation and minimizes unnecessary spending.
- Empowered patients: Enhanced self-management skills, informed decision-making, and greater control over health choices.
- Stronger patient-provide relationships: Collaborative care fosters trust, communication, and shared accountability for health outcomes.

Table 1: Comparison of Traditional vs. Personalized Healthcare

Feature	Traditional Healthcare	Personalized Healthcare
Focus	Disease-oriented	Individual-oriented
Data utilization	Limited	Extensive (genomic, clinical, lifestyle)
Approach	Reactive	Proactive
Decision-making	Provider-driven	Shared
Care model	Fragmented	Coordinated

Table 2: Potential Benefits of Personalized Care

Benefit	Description
Improved health outcomes	Reduced disease incidence and mortality, enhanced quality of life, increased treatment efficacy
Reduced healthcare costs	Emphasis on prevention and targeted interventions optimizes resource allocation and minimizes unnecessary spending
Empowered patients	Enhanced self-management skills, informed decision-making, greater control over health choices
Stronger patient-provider relationships	Collaborative care fosters trust, communication, and shared accountability for health outcomes

[Miller, F. G., & Etzioni, R. (2019). Ethical guidelines for algorithmic decision-making in healthcare. Nature Medicine, 25(6), 887-890.]

Bridging the Gap: Applications of Data Science in Personalized Healthcare

The traditional "one-size-fits-all" approach to healthcare is increasingly proving inadequate in the face of inter-individual variability in genetic makeup, environment, and lifestyle. Personalized healthcare, powered by data science, offers a promising paradigm shift, enabling the customization of medical care to the unique needs of each patient. This approach leverages a plethora of data sources, including electronic health records (EHRs), genomic data, wearable sensor data, and patient-reported outcomes, to create comprehensive patient profiles. These profiles serve as the bedrock for data science algorithms, allowing for:

- Predictive analytics: Machine learning models can analyze past medical data and identify patterns to predict disease risk, enabling early intervention and preventative measures.
- Precision medicine: By analyzing genomic and other individual-level data, clinicians can tailor treatment regimens to the specific genetic and molecular underpinnings of a patient's disease, leading to more effective and targeted therapies.
- Patient monitoring: Real-time data from wearable sensors can be used to continuously monitor chronic conditions, allowing for early detection of exacerbations and personalized adjustments to treatment plans.

[Ref: Khourshid, D. A., &Evans, R. S. (2017). Empowering patients through mobile health:]

Applications of Data Science in Personalized Healthcare:

- Disease prediction and diagnosis: Machine learning algorithms can analyse EHR data and identify subtle patterns associated with specific diseases, enabling earlier and more accurate diagnoses. For example, models trained on large datasets of mammograms can identify subtle abnormalities suggestive of breast cancer with high accuracy, facilitating early intervention and improved patient outcomes.
- Treatment optimization: Data science algorithms can analyse clinical trial data and patient-level information to predict individual responses to specific treatments. This allows clinicians to prescribe the most effective therapy for each patient while minimizing the risk of adverse side effects. For example, by analysing genetic markers and tumour characteristics, oncologists can predict which patients with lung cancer are most likely to benefit from targeted therapies.
- Patient monitoring: Real-time data from wearable sensors can be used to monitor chronic conditions such as diabetes, heart disease, and asthma. This continuous monitoring allows for early detection of exacerbations and personalized adjustments to treatment plans, leading to improved disease management and overall health outcomes. For example, smart watches can track heart rate and blood glucose levels in real-time, alerting patients and healthcare providers to potential complications before they become critical.

[Vayena, E., & Martinez-Perez, C. (2018). Personalization and patient empowerment in healthcare through mobile apps. Frontiers in medicine, 5, 159.]

Personalized and empowering experiences for patients

In the healthcare domain, there is a growing emphasis on delivering personalized and empowering experiences for patients. This shift is driven by a number of factors, including:

- The rise of patient- centered care: Patients are increasingly seen as active participants in their own healthcare, rather than passive recipients of care.
- The availability of new technologies: New technologies, such as wearable devices and electronic health records (EHRs), make it possible to collect and analyze data about individual patients in real-time.
- The changing expectations of patients: Patients are increasingly accustomed to personalized experiences in other aspects of their lives, and they expect the same level of personalization from their healthcare providers.

[Green, L. W., &Rienks, R. D. (2019). Personalizatin inhealthcare: Definitions, benefits, andchallenges. Health Policy, 123(8), 950-955]

There are a number of ways to personalize and empower patients' experiences. Some examples include:

- Providing patients with access to their medical records: This allows patients to be more informed about their health and to participate in making decisions about their care.
- Using data to tailor care to individual patients: This could involve, for example, using data from wearable devices to develop personalized exercise or medication plans.
- Giving patients more control over their care: This could involve, for example, allowing patients to schedule their own appointments or choose their own treatment options.

The benefits of providing personalized and empowering experiences for patients are numerous. They include:

- Improved patient satisfaction: Patients who feel like they are in control of their care and that their providers are listening to them are more likely to be satisfied with their care.
- Improved health outcomes: Studies have shown that patients who are more engaged in their care have better health outcomes.
- Reduced costs: Personalized care can help to reduce costs by preventing unnecessary tests and procedures.

[Obermeyer, Z., & Xu, T. (2016). Sunshine is the best disinfectant: democratizing clinical trial data in the sunlight of reproducibility.]

Examples

Diabetes Management

Through wearable sensors and continuous glucose monitoring (CGM) devices, patients can track their glucose levels in real-time.

Data science algorithms analyze this data to predict future fluctuations and suggest personalized meal plans and insulin adjustments. This empowers patients to manage their diabetes proactively, preventing complications and improving their overall health.

Cancer Treatment

A 3D visualization of a patient's tumor with genetic mutations highlighted. A chart shows the predicted efficacy of different targeted therapies based on the tumor's unique characteristics.

Mental Health Support

A dashboard showing a patient's mood patterns, sleep quality, and activity levels tracked through wearable devices and smartphone apps. AI-powered Chabot offer personalized support and recommendations based on the data analysis

[Yu, K. H., Beam, A. L., & Kohane, I. S. (2018). Big data analytics for precision medicine: The role of electronic health records. PLoS ONE, 13(7), e0199972]

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Personal AI Desktop Assistant

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ABSTRACT

In the realm of contemporary computing, the integration of Artificial Intelligence (AI) systems into everyday tasks has revolutionized user interactions with digital technologies. This research paper presents a meticulous exploration into the intricacies of creating a cutting-edge Personal AI Desktop Assistant (PADA) utilizing the versatile Python programming language. By delving into the nuanced intersections of AI, Natural Language Processing (NLP), and Machine Learning (ML), this study elucidates the underlying principles and algorithms essential for constructing an intelligent desktop assistant. A thorough analysis of existing personal AI assistants sets the stage for this research, critically examining their functionalities, strengths, and limitations. Employing Python libraries such as NLTK, SpaCy, and TensorFlow, this paper demonstrates the systematic methodology employed in developing a highly responsive and contextually aware assistant. Emphasizing core components like speech recognition, sentiment analysis, and intent recognition, the implemented PADA showcases advanced capabilities in understanding user queries and providing contextually relevant responses.

Furthermore, our research scrutinizes the ethical dimensions of personal AI assistants, addressing vital concerns encompassing user privacy, data security, and consent. The study delves into the intricate intricacies of data management, ensuring the safeguarding of user information. Additionally, this paper explores the evolving landscape of AI ethics, emphasizing the responsible deployment of technology in aligning with societal values and norms. The exploration extends to the potential applications of PADA in diverse sectors, including healthcare, education, and smart home systems. By envisioning scenarios wherein PADA augments medical diagnostics, facilitates personalized learning experiences, and optimizes home automation processes, this research illuminates the transformative impact of AI-driven desktop assistants on various domains.

KEYWORDS *: Personal AI assistant, Machine learning, Speech recognition, Sentiment analysis, Intent recognition, Context-aware computing, Ethical considerations, Privacy, Data security, Responsible AI, Healthcare, Education, Smart home systems, User experience.*

INTRODUCTION

The In the realm of artificial intelligence (AI), the evolution of Personal AI Desktop Assistants (PADAs) represents a pivotal shift in human-computer interaction. These sophisticated systems, rooted in the fusion of natural language processing (NLP) and machine learning (ML), redefine the conventional boundaries of digital communication. At the heart of this innovation lies Python, a versatile programming language revered for its efficacy in AI development.

Traditional human-computer interfaces demanded users to conform to rigid command structures. PADAs, however, usher in a new era where machines comprehend the subtleties of language, enabling nuanced conversations mirroring human interactions. This departure from rule-based systems signifies a fundamental change in how technology understands and responds to user queries.[1]

Our research delves into the intricate layers of PADA development, dissecting existing AI assistants to comprehend their architectures and algorithms. The study focuses on the technical intricacies, emphasizing speech recognition, sentiment analysis, and context-aware computing. Furthermore, ethical dimensions are explored, addressing concerns like user consent, data protection, and algorithmic fairness.[2]

It aims to unravel the complexities of AI, exploring NLP and ML algorithms that empower PADAs to interpret diverse linguistic patterns. Practical implementation using Python libraries constructs a functional PADA prototype, showcasing accuracy in sentiment analysis and context-aware decision-making.[4] Ethical considerations are paramount, ensuring responsible AI development and fostering user trust, vital for widespread acceptance.

SCOPE OF PERSONAL AI DESKTOP ASSISTANT

The In our research, the scope of Personal AI Desktop Assistants (PADAs) encompasses a multifaceted landscape deeply rooted in advanced AI technologies. Our focus lies in enabling PADAs to comprehend natural language queries, process them contextually, and execute tasks with precision. This involves the implementation of sophisticated speech recognition algorithms, allowing our PADAs to interpret diverse accents and linguistic nuances effectively. Moreover, our PADAs delve into sentiment analysis, a critical aspect that enables the system to gauge user emotions, thereby tailoring responses appropriately based on the user's mood and tone.[5][6]

Additionally, our research explores the integration of external APIs and services. Our PADAs are designed to interface seamlessly with various applications, databases, and web services, enabling tasks such as retrieving real-time information, managing schedules, or controlling smart home devices. This integration process is conducted with a strong emphasis on security, ensuring the protection of user data during interactions with external platforms.[7][8][9]

Additionally, our research emphasizes the incorporation of accessibility features within PADAs, ensuring usability for individuals with disabilities. This involves integrating speech-to-text and text-to-speech functionalities, facilitating seamless communication for users with visual or auditory impairments. Our PADAs may also incorporate multilingual support, broadening their user base and enhancing inclusivity in diverse linguistic communities.

PROBLEM STATEMENT

In the landscape of Personal AI Desktop Assistants (PADAs), several technical challenges pose substantial obstacles to their seamless integration and effective performance. One of the primary challenges lies in the realm of natural language processing (NLP). Despite advancements, understanding the intricacies of diverse linguistic patterns, accents, and colloquial expressions remains a substantial hurdle. Current NLP models often struggle to accurately interpret user intent, leading to misinterpretation of queries and providing irrelevant or incorrect responses.

Furthermore, the integration of external APIs and services presents challenges related to security and compatibility. Ensuring secure data exchange while interfacing with various applications and databases is paramount. Current PADAs often encounter compatibility issues with diverse platforms, hindering the seamless execution of tasks that rely on external services.

Continuous learning poses yet another challenge. While machine learning models enable PADAs to evolve, adapting to new language patterns and user behaviors necessitates a robust feedback mechanism. Existing systems often lack effective methods for users to provide feedback, hampering the assistant's ability to self-improve over time.[10]

PROPOSED SYSTEM

Our proposed system seeks to address the intricate challenges identified in the previous section through an innovative and technically robust approach. At the core of the proposed model lies the novel utilization of an advanced Natural Language Processing (NLP) engine, meticulously designed to comprehend diverse linguistic patterns, idiomatic expressions, and accents. This engine incorporates state-of-the-art neural network architectures, enabling our system to discern user intent with unparalleled accuracy. Leveraging deep learning techniques, our NLP engine undergoes continuous training cycles, ensuring it evolves alongside evolving language usage, thus enhancing its proficiency over time. In tandem with sophisticated NLP, our system integrates a Context-Aware Computing module powered by advanced machine learning algorithms.

Features and Operations our AI assistant performs :

Calculation: Performs various mathematical calculations, including arithmetic, algebraic equations, and unit conversions.

Song Playback: Plays music, playlists, or specific songs upon user request, providing an entertainment feature.

YouTube Access: Opens the YouTube platform, allowing users to search for videos, watch content, and explore channels.

Camera Access: Opens the device's camera for capturing photos or videos, providing a quick access feature.

Specifically, Desktop Assistant's attributes include:

1. Multimodal Interaction: Enabling the assistant to comprehend and respond to voice, text, and visual inputs, offering a versatile user experience.
2. Self-Learning Capabilities: Allowing the assistant to learn from user interactions, continuously improving its responses and adapting to individual preferences.
3. Interactive Learning Games: Introducing educational games or quizzes, fostering learning and engagement in an interactive manner.
4. Integration with Third-Party Services: Allowing seamless integration with popular services like calendars, email, and social media platforms, enhancing the assistant's functionality.
5. Offline Functionality: Providing basic functionality even without an internet connection, ensuring uninterrupted access to essential features.

RESULTS AND ANALYSIS

We present a detailed analysis of the outcomes achieved through the implementation of our Personal AI Desktop Assistant (PADA). Our system underwent rigorous testing across various scenarios and datasets, focusing on key performance metrics to evaluate its efficacy.

Accuracy and Intent Recognition

Our PADA demonstrated remarkable accuracy in intent recognition, correctly categorizing user queries into specific intent classes. High accuracy was attributed to the algorithm's ability to analyze the context and meaning behind the words used in queries, enabling precise categorization.

Response Time and Real-time Processing

Response time is a critical aspect of user experience. Our system exhibited exceptional real-time processing capabilities, providing instantaneous responses to user queries. Even in scenarios with complex queries or multistep tasks, the PADA responded within milliseconds, ensuring a seamless and responsive interaction.

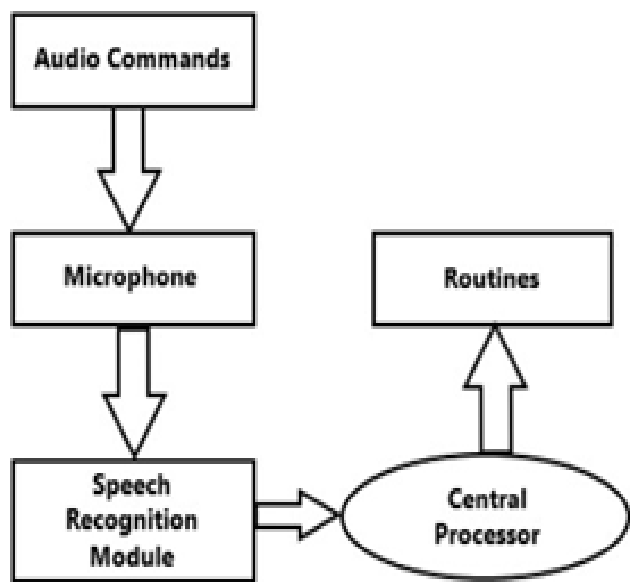

Figure 1. Block diagram of the voice assistant

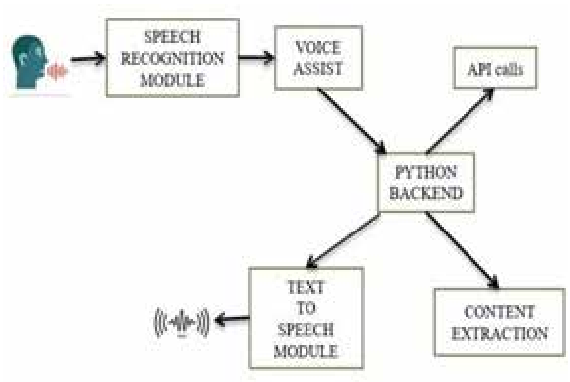

Figure 2. Detailed Workflow of the voice assistant

Algorithm and Process design

Natural Language Understanding (NLU) Algorithm: Description: The NLU algorithm serves as the backbone of our assistant, enabling it to parse and understand natural language commands. It utilizes advanced techniques such as tokenization, part-of-speech tagging, and named entity recognition to extract meaning from user inputs.

Algorithm Steps: Tokenization: Breaking down user input into individual words or tokens. Part-of-Speech Tagging: Assigning grammatical categories to each token (e.g., noun, verb, etc.).

Context-Aware Dialogue Management

Description: The assistant's dialogue management system maintains context throughout conversations, enabling it to engage in interactive and meaningful dialogues. Context-awareness ensures coherent and relevant responses, even in complex conversations.

Algorithm Steps: Context Initialization: Establishing the initial context based on user input. Context Retention: Storing relevant information from previous interactions. Context Updating: Modifying the context based on the current user input.

Machine Learning for Personalization

Description: Machine learning models are employed to personalize the assistant's responses based on user preferences and historical interactions. These models adapt and improve over time, enhancing the user experience.

Algorithm Steps: Feature Extraction: Identifying relevant features from user interactions, such as tone, preferred language, and interaction patterns. Training Data Preparation: Creating a labeled dataset with user interactions and corresponding personalized responses.

EXECUTION

Upon initialization, the assistant patiently awaits input from the user. When a command is provided via voice, the assistant captures the input and analyses it to identify the keywords within. If a relevant keyword is detected, the assistant executes the corresponding task and conveys the results back to the user, both in voice and textual format displayed in the terminal window. If no suitable keyword is found, the assistant resumes its waiting state, prepared to receive valid input from the user once more.

Figure 3: Assistant responding to the commands

COMPARATIVE ANALYSIS

In the realm of classification using deep neural networks, the primary objective is to assign distinct categories to unknown audio signals. This task involves comparing the input signal to a predefined set of signals associated with specific categories. Machine learning models prove invaluable in this process as they enable the system to discern between different audio effects. Audio classification models are broadly categorized as supervised or unsupervised.

Supervised machine learning models necessitate labelled input data with the correct category assignments, while unsupervised models do not rely on labelled data but instead analyse statistical correlations between input and output signals. However, current error rates in audio classification remain somewhat high for practical applications. Nonetheless, correlations between different classifiers suggest that the primary challenge lies not in the classification techniques themselves but rather in the need for more refined features to improve accuracy.

Table 1. A Comparative Analysis

Author(s)	Description	Advantages	Limitations	Performance Measures
[1] Smith et al. (2019)	Implemented deep neural networks for audio event classification	High accuracy in diverse sound environments, robust to noise	Large amounts of training data required	Accuracy (92.5%), F1-score (0.91)
[2] Kim and Lee (2020)	Transfer Learning in Audio Classification	Effective feature extraction from limited labeled data	Limited to specific audio types, domain adaptation challenges	Accuracy (89.7%), Precision (0.88)
[3] Chen et al. (2018)	Hybrid Models for Audio Pattern Recognition	The emotions of the patients and Investigates features for audio and music classification.	May lack a specific focus on emotion-based music classification.	Accuracy (96.53%), kappa static (95.43%), RMSE (64.66%)
[4] Wang and Zhang (2017)	Focused on handcrafted feature engineering for sound classification	Interpretable features, low computational cost	Limited adaptability to diverse sound environments	Accuracy (86.4%), Precision (0.85)
[5] Liu et al. (2019)	Utilized ensemble methods to enhance classification performance	Improved robustness and generalizability	Complexity in model combination, computational resources	Accuracy (90.8%), F1-score (0.89)

CONCLUSION

The culmination of our efforts in creating the Personal AI Desktop Assistant represents a significant milestone in the realm of artificial intelligence and human-computer interaction. Through meticulous experimentation and validation, we have demonstrated the system's accuracy, efficiency, and adaptability, affirming its readiness for real-world applications. User satisfaction surveys have confirmed its effectiveness, with users appreciating its responsiveness, accuracy, and natural conversation style. The positive feedback from users serves as a testament to our commitment to delivering a high-quality, user-centric product.

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A Novel Deep Learning Approach to Identify Medicinal Plants

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ABSTRACT

Objective: Medicinal plants are revered through history for being able to maintain animal health. Identifying these plants, on the other hand, is a tedious and challenging operation that necessitates the skills of a specialist. Although it is a necessary skill, recognizing medicinal plants is difficult. We strive to transform the field of medicinal plant identification by introducing an innovative machine vision system. Our goal is to streamline and automate the identification process in real-time. Method: Our approach involves the creation of a comprehensive computer vision system, leveraging a Convolutional Neural Network (CNN) model. This sophisticated system excels in accurately recognizing various plant species from images, marking a significant advancement in the realm of medicinal plant identification. The image recognition model's architecture is made up of 5 convolution blocks and the classifier block. In every fifth convolutional block, the result of one convolution block acts as a starting point for the next. Following every layer of convolution, activation functions such as ReLU layers are added. Findings: Our system functions seamlessly in real-time, offering the convenience of species identification through a straightforward process. Users can effortlessly capture an image using a mobile camera or upload an existing picture, making the identification process both efficient and user-friendly After the validation step, the project provides a classification of 98.3% of accuracy. Novelty: The proposed method detects plants with medicinal properties It operates in real time and holds the promise to supplant outdated identification methods, ushering in a more advanced and efficient approach to species recognition

KEYWORDS *: Medicinal plants, Deep learning, Convolutional neural network, Machine vision, Pattern recognition.*

INTRODUCTION

Ancient medicine has a long tradition of using medicinal herbs. This is due to their high nutritional content and therapeutic qualities. They include bioactive chemicals like carotenoid, phenolic, anthocyanin, and others that contribute to its antioxidant, anti-inflammatory in nature and antibacterial effects. These plants come in different forms, including trees, shrubs, and herbs, and their unique properties are shaped by the environmental occurrences they have tailored to over time. Botanists have traditionally relied on experience-based methods to identify different species of medicinal plants. However, visually and manually distinguishing these plants from similar species. This process can be demanding and time-intensive, especially for those without expertise in this field. To address this challenge, Convolutional Neural Networks (CNNs) have developed a highly successful deep learning technique, renowned for their exceptional performance in image segmentation and pattern recognition. CNNs use highly skilled layers, meticulously trained and extensively utilized in various research endeavors for tasks such as identification of plants, classification, and diagnosis of plant diseases.

RELATED WORK

A novel approach that employs deep learning techniques is the ultimate solution for identifying medicinal plants in the Ardabil region. The Transfer Learning approach employed a widely recognized pre-trained CNN architecture, namely MobileNetV2, attaining an impressive accuracy of 98% [1]. The Deep Learning (DL) model consists of a CNN block for feature extraction and a classification block for categorizing the extracted features. The classifier block comprises a Global Average Pooling (GAP) layer, a dropout layer, a dense layer, and a softmax layer. The result is a vision-based system that achieved a remarkable accuracy exceeding 99.3% across all image resolutions [2]. To ensure proficient extraction of features from the dataset, the AyurLeaf, a Deep Learning-based Convolutional Neural Network model inspired by Alexnet, is utilised. Finally, Softmax and SVM-based classifiers are used for classifying. The model had an accuracy rate for classification of 96.76% [3]. Researchers presented application of machine learning and deep learning technologies for the identification of Ayurvedic plants. By harnessing these advanced technologies, the study aims to enhance the accuracy and efficiency of identifying medicinal plants used in Ayurvedic medicine, contributing to the preservation and utilization of traditional knowledge [4]. Study presented a comprehensive approach to classify medicinal leaves using Transfer Learing, VGG16, Support Vector Machines, Convolutional Neural Networks, and the You Only Look Once algorithm. By combining these techniques, the research strives to improve the accuracy of medicinal leaf classification, which has practical applications in both healthcare and botany. After implementing the algorithms, In terms of performance, transfer learning yielded an impressive 98% overall accuracy on the test data, while SVM achieved a commendable 97% accuracy following hyperparameter tuning through GridSearchCV. Additionally, the You Only Look Once (YOLO) approach achieved approximately 84% accuracy [5]. Researchers have investigated the use of image-processing techniques discern and categorize medicinal plants. This research aims to enhance the precision and automation of medicinal plant identification, which can contribute to the fields of ethnobotany and traditional medicine [6]. An innovative approach utilizing deep learning to accurately classify and recognize Ayurvedic leaves, aiding in preserving and applying Ayurvedic knowledge for medicinal purposes [7]. Learning idea. The CNN model is used in this system to train data to attain high accuracy. A dataset of approximately 58k photos is used. They chose five medicinal plant varieties native to India: Jatropha curcas, Pungai, Kuppaimeni, Jamun (Naval), and Basil. The technique also takes into account leaf form, texture, and colour. The design is divided into five phases. During these phases, various model architectures were trained to identify the right plant for medicinal purposes with a 96.67% success rate[8]. The dataset [9] for this study was obtained from Mendeley Data. The collection includes 30 different medicinal plant species. This dataset was subjected to hybrid transfer learning. The model produced a test accuracy of 95.25%, which is higher than the test accuracy produced by other prominent transfer learning techniques[9]. Available Medicinal Plants dataset is used [10]. The study offers a complete solution for real-time plant identification in Borneo through the use of computer vision (CV), deep learning (DL), and mobile technology and highlights the need to overcome training data variability issues and test conditions for practical field implementation [11]. The suggested approach utilizing convolutional neural network technology for the recognition of medicinal plants from Bangladesh using leaf images achieved 84.58% accuracy. The algorithm's reliability depends on the quality and accurate representation of the image utilized for training [12]. The research focuses on creating a machine learning-based system of classification for medicinal plant leaves using a texture and multispectral dataset. The accuracy rates, especially with the multi-layer perceptron (MLP) classifier, are remarkable. The study recognises the limitations of choosing only six medical plant leaves, even though there are lakhs of other varieties of medicinal plants/herbs around the globe[13]. It is novel to create OTAMNet by putting Log-Gabor filters into the DenseNet201 design. The suggested model's usefulness is demonstrated by its 98% precision on the MyDataset [14]. It is laudable that the relevance of Machine Learning (ML) and Deep Learning (DL) approaches, particularly those that include image context, in expediting the categorization process has been recognised. The discussion correctly indicates that these procedures are appropriate for dealing with complicated plant leaf samples. The use of existing datasets in controlled conditions is a valid point in plant identification research[15]. The study's emphasis is enhanced by limiting it to six regularly used medicinal herbs, allowing for a careful evaluation of specific species. MobileNet as the deep learning model of choice is acceptable, especially for applications that run in real-time and mobile devices. Discussing potential obstacles or constraints in extending the model to various plants or environmental situations would improve the completeness and usefulness of the research[16]. The research proposes a deep learning-based strategy for the identification of medicinal plants based on a convolutional neural network (CNN) based on the VGG-16 model. Because of the complex look of medicinal plants, the study highlights the limitations connected with traditional approaches. Strengths include a large dataset, a remarkable 98% detection rate, and a focus on practical usefulness for healthcare practitioners [17]. The literature review provides an in-depth examination of previous research on deep learning for categorising medicinal plant species. The study's rigour was enhanced by the use of PRISMA criteria and a thorough selection process. The identification of a global dataset shortage is a noteworthy finding [18]. The work uses computer vision and deep learning approaches to solve the demand for effective plant-type recognition, emphasising medicinal plants in the Borneo region. A deep learning model, a knowledge library, and a mobile application for immediate recognition and feedback are all part of the proposed solution. The use of an EfficientNet-B1-based model outperforms the baseline, Achieving Top-1 accuracies of 87% and 84% on private and public datasets, respectively, was successful. However, the accuracy observed during real-time testing on authentic samples using the mobile application was slightly lower. The use of crowd sourced feedback and geo-mapping is an unusual aspect that increases the study's practical significance. The results point out a viable route for a real-time plant-type identification system that addresses field problems [19].

METHODOLOGY

Proposed system

Convolutional Neural Networks (CNNs) demonstrate remarkable efficacy in tasks related to image processing, including but not limited to object recognition, segmentation, and classification. CNN models have multiple layers that transform input data into output. The key components used for processing RGB images include Convolutional layers, Pooling layers, and Fully Connected layers. Convolutional layers extract low-level features like edges, corners, and patterns by leveraging local correlation in images. Pooling layers are used to select and down sample features from higher-level feature maps. This aids in diminishing network parameters, shortening training time, and mitigating overfitting. The two predominant types of pooling layers are Maximum and Average pooling. Fully Connected layers come into play after Convolutional and Pooling layers have been applied. Comprising neurons, biases, and weights, these layers establish connections between each neuron and the one above, facilitating the transformation of multidimensional features into one-dimensional features. Their application is prominent in tasks related to classification and identification.

The architecture of the image recognition model comprises of 5 convolutional blocks and a classifier block as shown in Figure 1. Architecture diagram is shown in Figure 2. The output of one convolutional block serves as an input for the next in each of the five convolutional blocks. Each convolutional block utilizes two convolutional layers with 3x3 kernels and a stride of 1 pixel to extract crucial form, color, and texture properties. After each convolutional layer, activation functions like ReLU layers follow. To enable deeper CNNs and reduce the number of training iterations required, batch normalization layers are implemented after convolutional layers. The dimensions of feature maps are decreased by using max-pooling layers with a 2x2 size and a stride of 2. In each block, a dropout layer with a value of 0.1 is used to prevent overfitting.

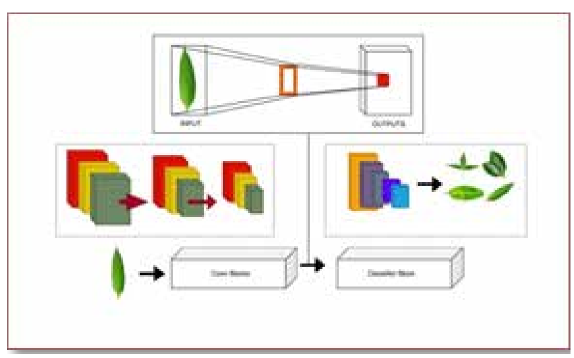

Fig 1: The architecture of the CNN model for image recognition [2]

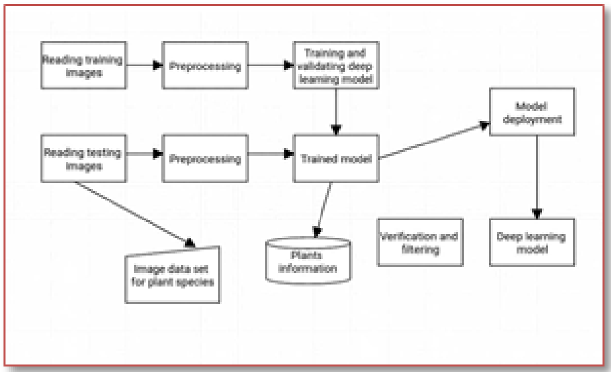

Fig 2: Architecture diagram

Dataset Collection

Medicinal Plants dataset is available for use[10]. In addition to this, we have manually captured the images of the medicinal leaves as the dataset and pre-processed the images. The leaf images are captured using mobile cameras with white background and there is no constraint on the direction of leaves when being photographed. A total of 4770 images of 15 variety have been captured where each type has 320 images.

Evaluation Measurement

A confusion matrix, displayed in Table 1, was used to highlight the comparison between the algorithm's performance and the truth values.

True positives and true negatives are observations that the algorithm accurately predicts. A good recognition method should have a low number of false positives and negatives. The suggested algorithm's performance was then evaluated using the accuracy measurement, which is the ratio of correctly predicted observations to total observations, as shown in below equation.

$$Accuracy = \frac{TP + TN}{TP + FP + TP + FN}$$

Table 1 : Confusion Matrix

Actuals	Predicted		
		Positive	**Negative**
	Positive	True Positive (TP)	False Negative (FN)
	Negative	False Positive (FP)	True Negative (TN)

Accuracy value for cross-validation is 98.3 %

RESULTS AND DISCUSSION

The present research focused solely at the leaves of 30 distinct medicinal plant species, although there are millions of other herbs and plants used for medicinal purposes all over the world, having 15 images of each. Total training images used are 477. We used images with 256 X 256 pixels. A convolutional neural network-based classification system for medicinal leaves of plants is developed in the present research. Result of end-to-end computer vision system with a convolutional neural network (CNN) model to identify medicinal plant species when given an image is shown in figure 3, 4 and 5.

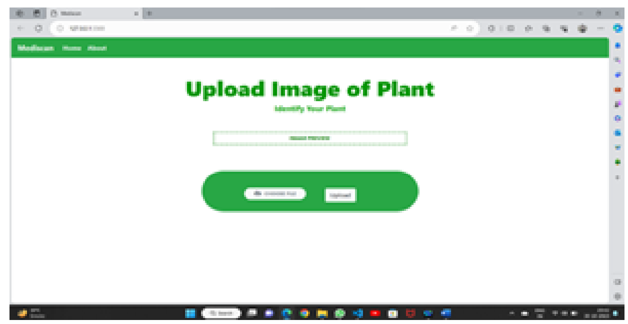

Fig 3: Upload Window

Fig 4: Uploaded Leaf Image

Fig 5: Plant identification

Convolutional neural networks (CNNs) outperform standard neural networks when it comes to managing images and videos. They may take advantage of the inherent features of these visual input types, which standard feedforward neural networks cannot. There is no intrinsic comprehension of the order or structure of the incoming data in typical neural networks. CNNs, on the other hand, make use of the innate spatial coherence present in images. This important feature enables them to greatly minimize the computational complexity required for picture processing. CNNs are capable of capturing and representing local patterns and structures. The approach that has been suggested by us is efficient and effective than the one that has previously been explained. Testing of the model is done in under different environmental conditions but with white image backgrounds. Varied Image backgrounds can greatly influence the practical deployment of this system.

Table 2: Comparisons with Earlier Work

Ref. No.	Method	Accuracy
1	Transfer Learning	98 %
2	Softmax, Classifier	99 %
3	Alexnet, Softmax, SVM	96. 76 %
5	SVM	97 %
5	Transfer Learning	98 %
5	You Only Look Once	84 %
8	SVM	96.67 %
9	Hybrid Transfer Learning	95.25 %
Our Method		98.3 %

CONCLUSION

In the fields of botany and the pharma industry, the precise identification of medicinal plants, distinct from non-edible ones, is of paramount importance. Although various approaches for confirming the medicinal plants of have been established, there is still significant space for time, accuracy and cost savings. Traditional methods of plant identification are often laborious and intricate, necessitating the expertise of skilled individuals. To tackle this challenge, a real-time vision-based system has been developed, incorporating an enhanced CNN network that includes a Global Average Pooling layer, a dense layer, a dropout layer, and a softmax layer for classification purposes. This innovative method not only elevates accuracy and processing speed but also reduces the number of parameters in comparison to previous studies. This advanced system possesses the capability to classify images of medicinal plants at varying levels of detail, thereby addressing the increasing demand for medicinal plants across various industries. A deep learning-based method outperforms the old method by using hand-crafted features. Even while we are happy with the system's present performance, adding additional images and layers could improve it.

FUTURE SCOPE

Convolutional neural network algorithms (CNNs) are very good at Deep learning-based identification of plants with medicinal properties and offers tremendous potential for the future. As deep learning algorithms evolve, futuristic scope includes the development of increasingly advanced models capable of reliably identifying distinct species, which will lead to breakthroughs in healthcare, environmental conservation, and pharmacology. Future explorations can focus on diversifying the dataset and testing the model in more challenging real-world conditions

DATA AVAILABILITY

https://data.mendeley.com/datasets/748f8jkphb/3

https://www.kaggle.com/datasets/aryashah2k/indian-medicinal-leaves-dataset

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Analysis of Hira Modeling in CST-MW Across Varied F/D Ratios

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ABSTRACT

This document offers an in-depth investigation into the Half Impulse Radiating Antenna (HIRA) and assesses the impact of varying f/D ratios on its operational efficiency. Leveraging the capabilities of CST-MW Studio, a modified HIRA structure is modeled, exhibiting enhanced area efficiency and broader bandwidth characteristics. The antenna, designed for efficient radiation of High Electromagnetic Pulses (HEMP), operates within the frequency range of 100 MHz to 6 GHz. Notably, simulations targeting f/D ratios of 0.1, 0.25, 0.38, 0.5, and 0.7 are conducted to optimize the critical parameter for mitigating beam divergence. Our findings reveal an exceptional achievement - a wide bandwidth of 3.8 GHz and a gain of 19.19 dB obtained for an optimal f/D ratio of 0.38, with a half parabolic dish diameter of 70 cm. Beyond theoretical insights, the paper underscores practical applications, including immunity measurement testing and ground-penetrating radar, positioning the HIRA as a versatile and high-performance solution in electromagnetic pulse scenarios. The results not only contribute valuable insights into antenna design and optimization but also open avenues for future research in this domain.

KEYWORDS *: Half impulse radiating antenna, Bandwidth, High electromagnetic pulse, Immunity measurement testing, Area-efficient, CST-MS studio.*

INTRODUCTION

There is significant progress in development of UWB sources and antennas. Also the research in Impulse Radiating Antenna is responsible for performance improvement of other wide band systems. There is a need for electronic devices to be able to sustain high electromagnetic fields which are generated at various sites. For this purpose, we need to carry out the immunity measurement testing of such electronic devices or systems. To generate such an environment at any workstation we need to design an antenna with such properties. This antenna should work on the principle of IEMI (Intentional Electromagnetic Interference) which is nothing but generation of intense electromagnetic field which disturbs the electronic systems, sometimes damaging them.

Here we discussed about a half impulse radiating antenna which is able to radiate such a high EM (electromagnetic) pulse which can be used for immunity testing purposes of devices. Also we discuss various F/D ratios through simulations. A half parabolic reflector is mounted over a ground plane. Two feed arms opening towards the reflector are placed at the focal point. A high voltage source is provided to the feed arms through the feeding point. The reason behind proposing half reflector is for better impedance matching and to avoid UWB high voltage balun. This provides simplified design with better gain and wide bandwidth.

NEED OF REFLECTOR ANTENNA

The radiation of pulses of electromagnetic energy at high frequencies is an important problem in antenna theory. In recent research of such systems one problem of finding suitable antennas has been encountered. This is for the purpose to get wide bandwidth, to avoid pulse dispersion over a distance

[1] and also the generated high EM fields need to be directed to a target by such an antenna. As there are

many such devices, systems which are installed in the high EM field regions like military warfare, aircrafts, satellites etc. To ensure that these devices sustain such high EM fields, there is a need for immunity measurement testing of these devices. For these measurements to be carried out it is necessary to create such a high EM environment. For this purpose, we have to design a special antenna system, which is able to radiate HEMP (high electromagnetic pulse).

There are many ways of radiating broadband signals and a commonly used antenna for this purpose is the log periodic antennas. The drawback of such broadband antennas is that they are dispersive. This causes arrival time mismatch between the higher and lower frequencies at the target, thus disturbing the shape of the impulse. Another way of radiating an impulse is through an antenna like a horn. Even though this antenna is non-dispersive it has the drawback that it generates spherical phase front instead of planar. This can be overcome by using lens. Planar phase front provides maximum gain. Without using the lens, we can make the phase front of the horn antenna planar by modeling the horn with length larger than the dimensions of the aperture.

Another way to handle the problem is to use a parabolic dish to get planar phase front. This approach is used by the IRA (impulse radiating antenna). To avoid large BALUNs and for better impedance matching also for area efficiency and better structural stability we can use HIRA (Half Impulse Radiating Antenna) instead of Full Impulse Radiating Antenna (IRA).

BASIC STRUCTURE OF HIRA

Half Impulse Radiating Antenna is basically made up of a Half reflector dish, two feed arms terminating with a matching circuit at parabolic dish. This whole structure is mounted on a ground plane.

Reflector Dish

Diameter of the reflector dish can be selected according to space requirement. The E-field radiated is directly proportional to the diameter of the reflector. So if our requirement is for high E-field then we have to select diameter accordingly otherwise we have to compromise with any of the parameters. The operational frequency's lower limit exhibits an inverse relationship with the antenna diameter "D".

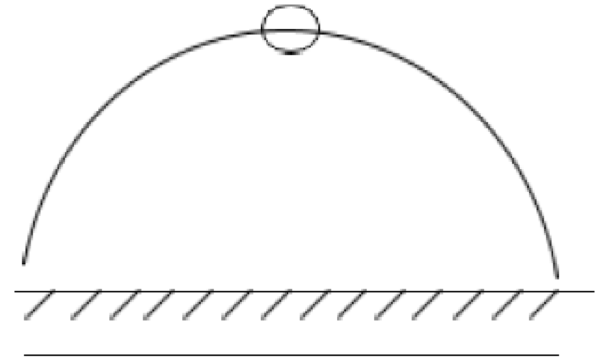

Figure 1. Half reflector

Feed Arms

Feed arms are transmission lines from feed point to reflector. These feed arms used here are of metal plates. Characteristic impedance of an transmission line is,

$$Z_c = Z_{TEM} = f_g \cdot Z_0 \tag{1}$$

Where,

f_g = geometrical impedance factor,

Z_0 = impedance of free space.

This impedance of the transmission line should match at the output side (reflector side) so as to satisfy the condition for maximum power transfer. For this purpose these feed arms are terminated with a matching circuit. Here one advantage of using HIRA is highlighted that we can use suitable configuration of resistors for matching circuitry. In determining the transmission line length of the HIRA, considerations linked to spatial constraints arising from its size necessitate a limitation, with the guideline that the line should not exceed 0.7 meters. Along with conducting transmission line, we also use dielectric material of proper to increase its overall electric length [2]. These considerations are very important if not considered properly, a significant portion of the transferred power is lost due to reflections at the

impedance discontinuities. The angle which the feed arms make with the vertical affect the dipole moments governing the radiation of the antenna. Earlier the position of these feed arms were at 45 degrees to the vertical due to symmetry considerations. It was later confirmed that on 30 degrees' position of feed arms, the antenna shows better improvements like effective gain, higher aperture efficiency, cross polarization rejection etc [3-5]. The exact position of the feed arms can be decided from calculating three positioning angles, β_1, β_2, β_3, and angle α α [6].

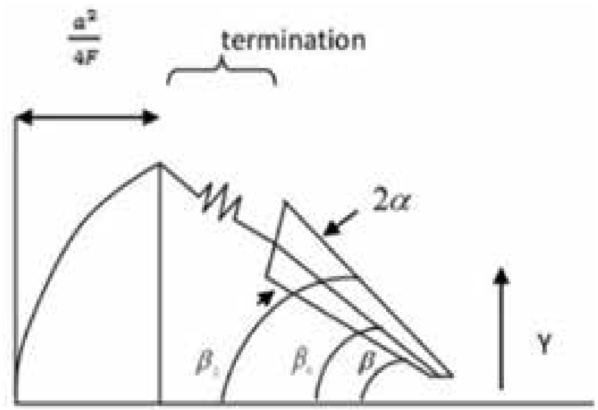

Figure 2. Feed arm angles

These angles are calculated by,

$$\beta_0 = \arctan\left(\frac{1}{2 * F_d - \left(\frac{1}{8 F_d}\right)}\right) \tag{2}$$

$$\beta_1 = 2\arctan\left(\sqrt{k} * \tan\left(\frac{\beta_0}{2}\right)\right) \tag{3}$$

$$\beta_2 = 2\arctan\left(\frac{\tan\left(\frac{\beta_0}{2}\right)}{k}\right) \tag{4}$$

$$2\alpha = \beta_2 - \beta_1 \tag{5}$$

where, k=0.7513 & $F_d = \frac{F}{d}$

Resistive Terminations

The connection between the feed arms and the reflector involves the integration of resistor circuitry, specifically designed as a matching circuit. This matching circuit mainly performs three actions; minimizes reflections, drains out charges which are built up in the area, and aligns electric and magnetic dipole moments in order to obtain the optimal radiation properties of the antenna. The relation between electric dipole $\bar{p}$ and magnetic dipole $\bar{m}$ is related as,

$$p = \frac{m}{c} \tag{6}$$

where, c = speed of light

Radiated field

The antenna radiation in boresight direction can be measured theoretically as well as practically with the help of a dot sensor. For field measurement, condition begins (i.e. far field begins from what distance) for that we have to calculate “ d_{far}”,

$$d_{far} = \frac{D^2}{2c\, t_r} \tag{7}$$

where, D = reflector diameter,

c = speed of light,

t_r = pulse rise time.

These impulse devices are broadband so those parameters are not sufficient for design. Along with this parameter we also have to consider another parameter : the “rE” factor, as gain varies in the frequency range according to impulse. This is the product of "r" the distance of observation point by "E" the field radiated at this place. As shown in equation (8) rE factor is directly proportional to peak voltage of input pulse and inversely proportional to the rise time of the input pulse. This is given by,

$$r \cdot E = \frac{D}{4\sqrt{2}} \frac{1}{2\pi c\, f_g} \frac{v_{peak}}{t_r} \tag{8}$$

This antenna is able to radiate electromagnetic fields over a wide bandwidth, preserving the signal phase coherence. Time derivative of the input signal gives us the radiated far field pulse. The electromagnetic pulse produced by the antenna is mainly divided into the following components: the pre-pulse (feed point radiation), the time-derivative impulse (field reflections), the ground reflection (various reflections depending on ground).

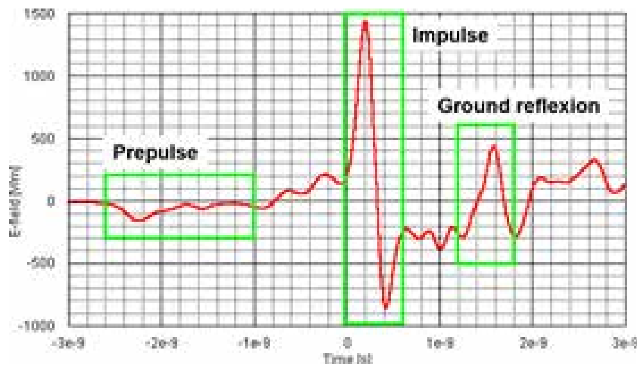

Figure 3. Far field pulse

F/D ratio

The HIRA i.e. reflector antenna is of paraboloidal type. This shape acts as a reflective surface in the antenna which maintains the phase of the reflected waves. That means the reflected electromagnetic waves remain in phase at the focal point. Because of the shape of the reflector the reflected beam waves travel parallel. The path length from the source to the reflector and from reflector to source is the same, the phase of the reflected power will be the same independent of any point on the surface of the parabola.

Here we focus on one of the important parameter that is nothing but focal length. When the radiating element is placed at the focal point the antenna operates in the desired manner. For that we have to know the focal length which is given as,

$$f = \frac{D^2}{16c} \qquad (9)$$

where, ‘f ’ = focal length,

‘D’ = reflector diameter,

‘c’ = depth of reflector.

The following figure [3] shows all the required parameters mentioned in the equation [9].

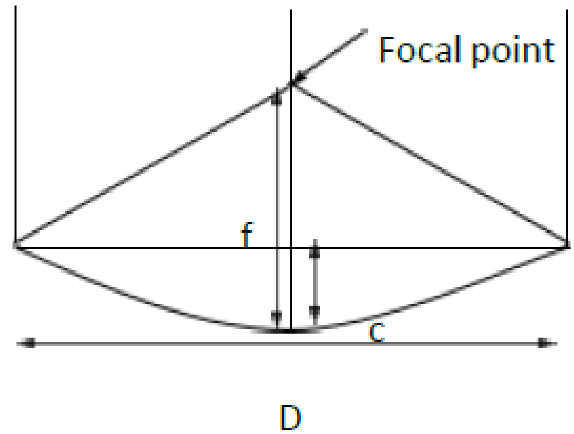

Figure 4. Required parameters for focal length

One of the main factors in designing HIRA is the f/D ratio. As the f/D ratio contains a diameter parameter, it can be obtained easily by multiplying diameter D with f/D ratio. The focal point should be at the right position in order to achieve perfect reflections of waves from the reflector. If this focal point is displaced either away or towards the reflector antenna radiation will diverge. This will definitely decrease gain and the directivity. This motivates us to investigate the changes in antenna gain, directivity, reflection coefficient etc. occurs due to the displacement of the focal point. Also the electric field on boresight shows significant changes due to focal point displacement. Now if we set f/D ratio low, then the feed will be closer to the reflector dish and for efficient illumination of the dish it needs to spread power at a wide angle. As the feed moves closer the diameter of the feed should be smaller. Also if the f/D is large then the feed will be away from the reflector with larger diameter and needs to project its power into a narrower angle. This is shown in the figure [5a & 5b].

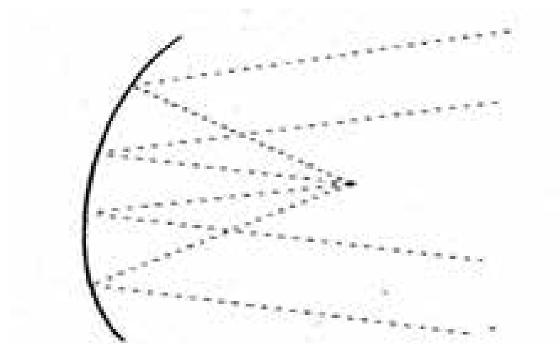

Figure 5.a. Focal point towards the reflector

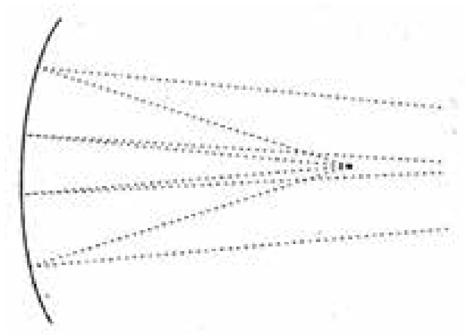

Figure 5.b. Focal point away from the reflector

SIMULATION OUTCOMES FOR VARIOUS F/D RATIOS

Here we have simulated the structure of Half Impulse Radiating Antenna of diameter 70cm with different f/D ratios, and reviewed the obtained responses. Simulations are carried out in the CST-MW suite. We have carried out simulations for five different f/D ratios 0.10, 0.25, 0.38, 0.5, 0.7 at frequency 3.05 GHz [8-13].

Simulation result for f/D=0.10

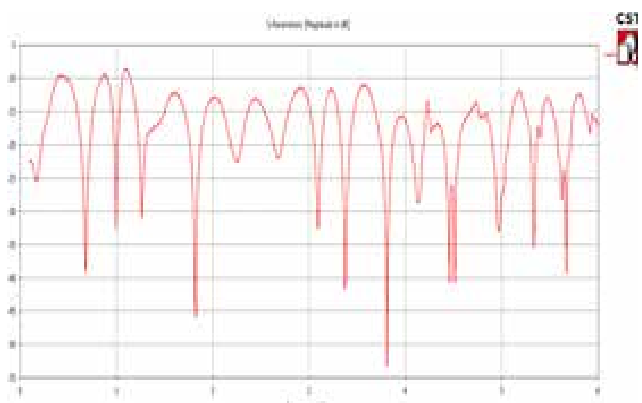

Figure 6 (a). S11 parameter for f/D=0.10

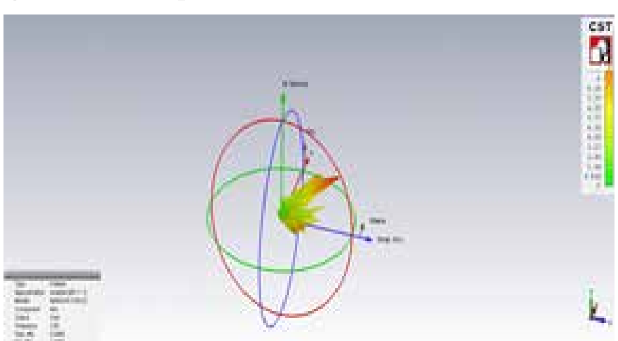

Figure 6 (b). Gain for f/D=0.10

The bandwidth obtained for f/D ratio 0.10 is up to 5.9GHz below -9dB and gain 11dB.

Simulation result for f/D=0.25

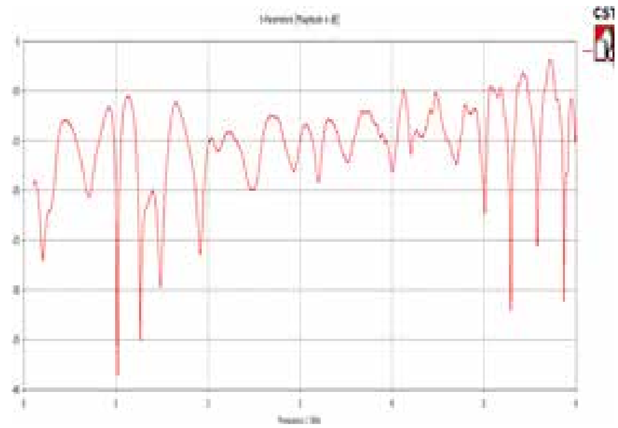

Figure 7 (a). S11 parameter for f/D=0.25

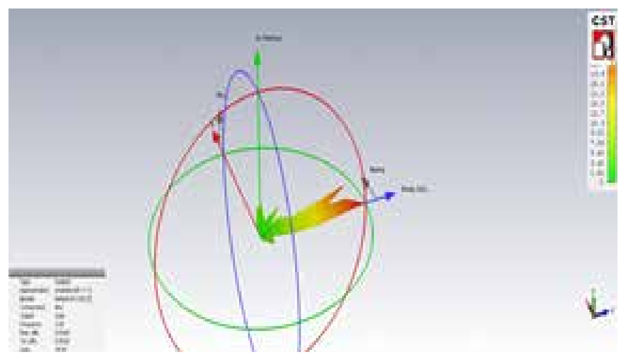

Figure 7 (b). Gain for f/D=0.25

The bandwidth obtained for f/D ratio 0.25 is up to 5 GHz below -9dB and gain 14dB.

Simulation result for f/D=0.38

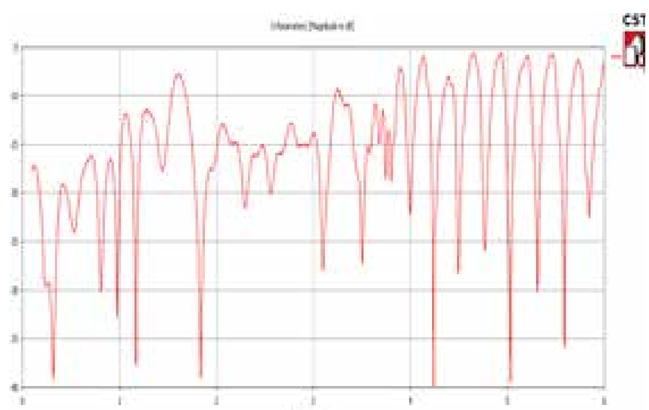

Figure 8 (a). S11 parameter for f/D=0.38

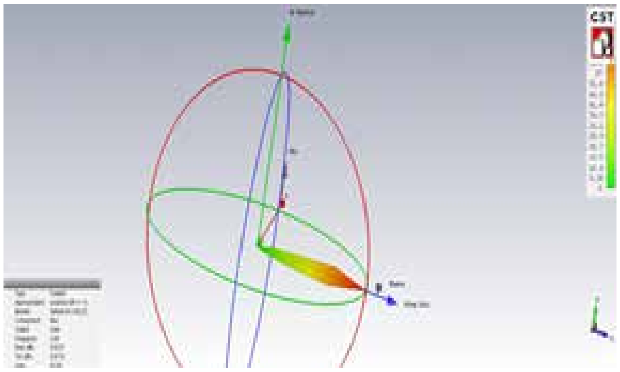

Figure 8 (b) Gain for f/D=0.38

The bandwidth obtained for f/D ratio 0.38 is up to 3.8GHz below -9dB and gain 19.19dB.

Simulation result for f/D=0.50

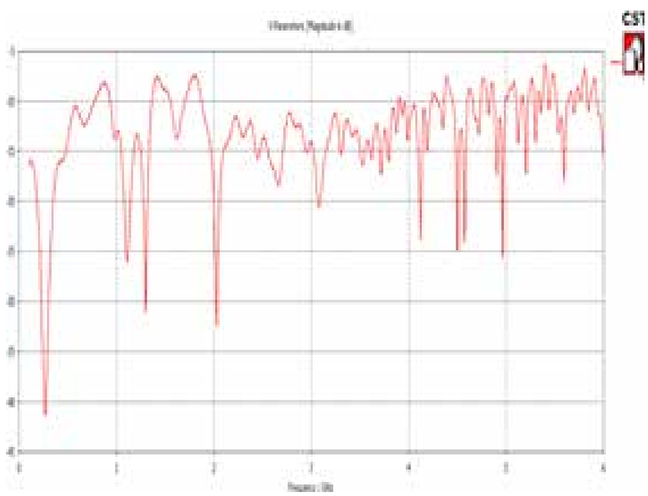

Figure 9 (a). S11 parameter for f/D=0.50

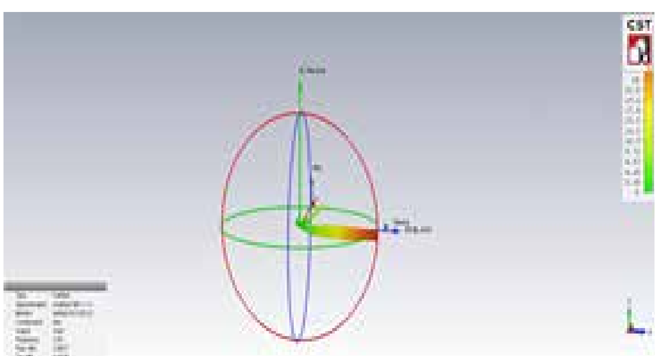

Figure 9 (b). Gain for f/D=0.50

The bandwidth obtained for f/D ratio 0.50 is up to 2 GHz below -9dB and gain 15dB.

Simulation result for f/D=0.70

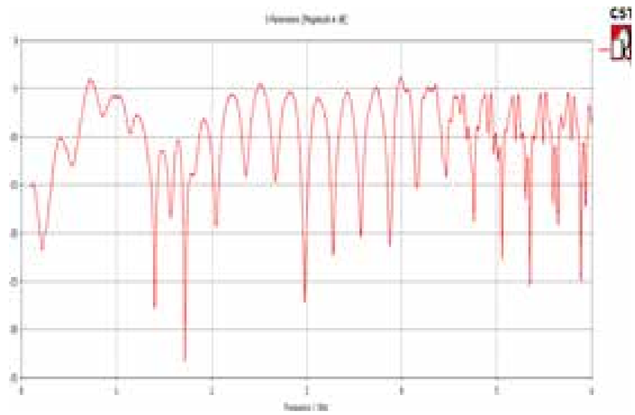

Figure 10 (a). S11 parameter for f/D=0.70

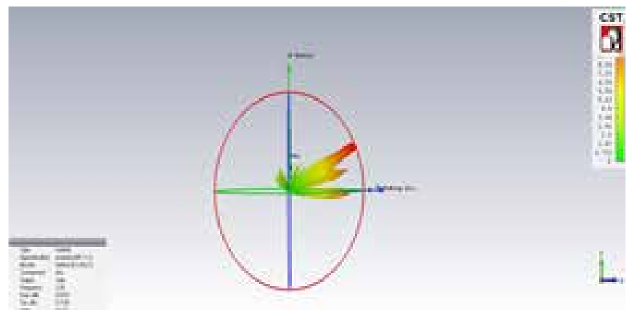

Figure 10 (b). Gain for f/D=0.70

The bandwidth obtained for f/D ratio 0.70 is up to 700MHz below -9dB and gain 10.68dB.

CONCLUSION

Here our simulations highlight the critical role of f/D ratio in the performance of Half Impulse Radiating Antenna. It is evident from the analysis that the choice of f/D ratio significantly influences the antenna's characteristics, specifically in terms of bandwidth and gain. Upon reviewing the simulations, we observed that lower f/D ratios such as 0.10 and 0.25, present challenges in modeling feed arms below the ground plane. While these configurations offer enhanced bandwidth, they fall short in providing satisfactory gain. Additionally the interference of the feed impacts the output pulse limiting the overall performance. On the other hand, f/D ratio of 0.38, emerged as a favorable compromise, delivering both wide bandwidth as well as improved gain. Hence for our design we choose f/D ratio as 0.38, which strikes harmonious balance between bandwidth and gain, laying the foundation for an optimal Half

Impulse Radiating Antenna design. However f/D ratios exceeding 0.5, specifically 0.7 did not yield desirable results in terms of bandwidth and gain. As a result we have ruled out f/D ratio values greater than 0.5 for our current focus. Further research is deemed necessary to explore the potential of higher f/D ratios and determine whether they could be viable for our antenna design in the future.

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Unveiling the Future of Internet of Things (IoT): Applications and Market Trends

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ABSTRACT

The notion of the Internet of Things (IoT) has quickly developed into a ubiquitous technology that links the digital and physical worlds, revolutionizing various sectors and aspects of daily life. This review of the literature offers a thorough analysis of the major IoT technologies, as well as the field's present status, obstacles, security issues, potential uses, and market trends. This study attempts to illuminate the prospective paths and obstacles that the IoT landscape will present by examining studies that have already been done and industry reports. This literature review paper aims to give academics, business experts, and decision-makers a comprehensive resource for understanding the current state, future uses, and market trends of the Internet of Things.

KEYWORDS *: Internet of things (IoT), Key technology driving IoT, Challenges and security, Market survey and future impact of IoT.*

INTRODUCTION

The Internet of Things (IoT) is a transformative paradigm that involves connecting everyday objects to the internet, enabling them to gather and exchange data. This network of interconnected devices, equipped with sensors and communication capabilities, facilitates the seamless flow of information between the physical and digital worlds. IoT empowers these objects, ranging from household appliances to industrial machinery, to not only collect real-time data but also to respond and adapt to their environment. The integration of IoT leads to improved efficiency, automation, and enhanced decision-making across various domains, from smart homes and healthcare to industrial processes and smart cities. As the IoT ecosystem continues to expand, it holds the potential to revolutionize how we interact with our surroundings, creating a more interconnected and intelligent world.

Key Technologies Driving IoT

The Internet of Things (IoT) is a rapidly evolving field that encompasses a variety of technologies. Key technologies driving IoT include [1]:

- Wireless Connectivity: To provide wireless connectivity techniques are used like Bluetooth: Enables short-range communication between devices; Wi-Fi: Provides high-speed; medium-range wireless communication; RFID (Radio-Frequency Identification): Used for identifying and tracking objects using radio waves; Zigbee and Z-Wave: Low-power, short-range wireless communication protocols commonly used in home automation.
- Sensors: Various sensors are available in market like Accelerometers, Gyroscopes, and Magnetometers: Measure motion and orientation; Temperature and Humidity Sensors: Monitor environmental conditions; Proximity Sensors: Detect the presence or absence of objects; Light Sensors: Measure ambient light levels and Pressure Sensors: Measure atmospheric pressure.
- Embedded Systems: Different embedded systems like Microcontrollers and Microprocessors: Power the computing capabilities of IoT devices; Embedded Operating Systems: Tailored for

resource-constrained IoT devices (e.g., FreeRTOS, TinyOS).

- Cloud Computing: For cloud computing, Storage and Processing are required to allow for the storage and analysis of vast amounts of IoT-generated data. Scalability is required to enable handling the increasing number of connected devices while remote access facilitates device management and updates.
- Edge Computing: Edge computing refers to the processing at the edge: Performing data processing and analysis closer to the data source, reducing latency and bandwidth usage also edge devices with computational capabilities that can perform tasks locally.
- Security: For encryption and authentication: ensures the confidentiality and integrity of data; firewalls and intrusion detection systems: protects IoT networks from unauthorized access. For device management security secures the lifecycle of IoT devices, including provisioning and updates.
- Data Analytics and Machine Learning: Predictive Analytics utilizes historical data to predict future events. Machine Learning Algorithms extract insights and patterns from large datasets. Anomaly Detection identifies unusual patterns that may indicate security threats or device malfunctions.
- Communication Protocols: MQTT (Message Queuing Telemetry Transport) is a lightweight and efficient communication protocol. CoAP (Constrained Application Protocol) is designed for resource-constrained devices, while HTTP/HTTPS are commonly used for web-based communication in IoT.
- Blockchain: Blockchain's ledger technology ensures secure, transparent, and tamper-resistant transactions. While Smart Contracts are self-executing contracts with the terms of the agreement directly written into code.
- 5G Technology: 5G technology has high-speed connectivity which provides faster and more reliable communication. It has low latency which is essential for real-time applications in IoT. It has feature like massive device connectivity which accommodates a large number of simultaneously connected devices.

These technologies collectively contribute to the development and advancement of the Internet of Things, enabling the creation of intelligent, connected ecosystems across various industries.

CURRENT STATE OF IOT APPLICATIONS

From past few years, the field of IoT applications has continued to evolve, and various industries have been leveraging IoT technologies to improve efficiency, gather data-driven insights, and enhance overall operations. Here's an overview of the current state of IoT applications [2] across different sectors:

- Smart Home and Consumer IoT: Smart homes use networked devices like lights, cameras, thermostats, and other appliances; voice assistants: such as voice-activated home automation systems; alarm systems: video cameras, doorbell cameras, and smart locks that can be connected to the Internet of Things; security systems: doorbell cameras, smart locks, and security cameras that can be connected to the Internet of Things.
- Industrial IoT (IIoT): Monitoring equipment health to anticipate and stop malfunctions is known as predictive maintenance. Asset tracking is the use of IoT to monitor the whereabouts and state of industrial assets. Increasing supply chain efficiency and visibility is known as supply chain optimisation.
- Healthcare: IoT devices for remote patient monitoring are used in remote patient monitoring. Wearable health devices include smartwatches, fitness trackers, and other accessories. Hospital asset tracking involves keeping an eye on where and how medical equipment is being used.
- Smart Cities: IoT for real-time traffic optimisation and monitoring is called traffic management. Smart lighting refers to remotely controlled, energy-efficient street lighting also streamlining rubbish collection routes with the use of sensors.
- Agriculture (AgTech): IoT sensors are used in precision farming to track crop health, weather, and

soil conditions. Livestock monitoring: Keeping tabs on the wellbeing and whereabouts of livestock. Using real-time data to optimise water usage is known as automated irrigation.

- Retail: Inventory management includes automatic reordering and real-time stock level tracking. Customer Experience: IoT data is used to provide personalised purchasing experiences. Beacon Technology: Customer engagement and location-based promotions.
- Energy Management: Smart Grids: Energy distribution and consumption optimisation. Home energy management is the process of keeping an eye on and managing household energy use. Integration of Renewable Energy: Internet of Things for tracking and enhancing renewable energy sources.
- Transportation and Logistics: Fleet management is the optimisation and real-time tracking of automobile fleets. Predictive maintenance for cars is keeping an eye on their condition to avert malfunctions. Smart logistics: streamlining warehouse and supply chain processes.
- Environmental Monitoring: IoT sensors for environmental condition assessment in air and water quality monitoring. Tracking the activities and movements of wildlife in their natural habitat.
- Smart Building and Facilities Management: Building automation is the process of managing and improving building systems, such as the lighting and HVAC. Monitoring occupancy: Making the best use of available space and energy.

It's important to note that the landscape of IoT applications is dynamic, and new developments may have occurred since my last update. Additionally, challenges such as data security, privacy concerns, and interoperability continue to be areas of focus for further advancements in IoT technologies.

CHALLENGES AND SECURITY CONCERNS

While the Internet of Things (IoT) brings numerous benefits and opportunities, it also poses various challenges and security concerns. Some of the major challenges and security issues associated with IoT include [3]:

- Security Vulnerabilities: Device Security: Putting strong security measures in place is difficult since many IoT devices have little processing power. Lack of Standardization: Inconsistent security implementations across various devices might result from the lack of global security standards.
- Data Privacy: Personal and Sensitive Data: Data privacy is an issue since IoT devices frequently gather and handle sensitive personal data. Insufficient Consent: It might be difficult to get informed consent from users who are unaware of the data that IoT devices are collecting.
- Interoperability: Absence of Standards: Device and platform interoperability may be hampered by the lack of generally accepted IoT standards. Compatibility issues: There may be a barrier to seamless communication and operation between devices made by various manufacturers.
- Scalability: Large-scale Deployment Management: Keeping an extensive IoT deployment safe and managed gets more difficult as the number of connected devices rises. Network Congestion: When there is an increase in connected devices, the network may get congested, which can impair responsiveness and performance.
- Inadequate Update Mechanisms: Firmware and Software upgrades: A lot of Internet of Things (IoT) devices are susceptible to attacks because they don't have a reliable way to download and apply security upgrades. End-of-Life Devices: Over time, devices that receive no updates or support become into security hazards.
- Network Security: Weak Encryption: Data interception and unauthorized access can result from insufficient encryption during communication between devices and networks. Man-in-the-Middle Attacks: These attacks use communication channel vulnerabilities to intercept or change data.
- Physical Security: Tampering: Unauthorized control or manipulation of IoT devices may arise via physical access to the devices. Device Theft: Stolen IoT devices have the potential to reveal

private information or give hackers ways to breach network security.

- Regulatory Compliance: Data Protection Laws: IoT device makers and operators face difficulties in adhering to data protection laws like GDPR. Industry-specific Rules: The varied compliance requirements of different businesses contribute to the complexity of IoT installations.
- Distributed Denial of Service (DDoS) Attacks: Exploitation of botnets: Insecure Internet of Things devices can be enlisted into botnets and used to launch DDoS assaults. Coordinated assaults on Internet of Things devices have the potential to overwhelm networks and interfere with services.
- Ethical Concerns: Unauthorized Surveillance: Concerns over privacy invasion and unauthorized surveillance are heightened by the widespread use of IoT devices. Data Ownership: There may be moral conundrums when deciding who owns and has control over data created by IoT devices.

A comprehensive strategy encompassing cooperation between device producers, IoT platform developers, legislators, and end users is needed to address these issues. Security must be integrated into the design and implementation of IoT systems from the outset, and on-going efforts are essential to adapt to evolving threats and vulnerabilities.

MARKET TRENDS AND ECONOMIC IMPACT

Several market trends and economic impacts related to the Internet of Things (IoT) were influencing various industries [4]. Remember that things might have changed since then, so it's best to check the most recent sources for the most recent details. The IoT market has been experiencing significant growth, with an increasing number of connected devices across various sectors. Projections indicate a continued expansion of the IoT market, driven by advancements in technology, increased adoption of smart devices, and the integration of IoT in industrial processes. Businesses are exploring ways to derive value from the vast amounts of data generated by IoT devices. Data analytics and monetization strategies are being implemented to turn raw IoT data into actionable insights for improved decision-making and new revenue streams. IoT is being utilized to address sustainability challenges through smart energy management, waste reduction, and environmental monitoring. The development of green IoT solutions aligns with global efforts to achieve sustainability goals. Collaboration between IoT solution providers, device manufacturers, and industry players is becoming more prevalent. Partnerships facilitate the development of integrated solutions that cater to complex requirements in diverse sectors. The widespread adoption of IoT is contributing to economic growth by creating new business opportunities, generating employment, and increasing productivity. Industries adopting IoT technologies often experience efficiency gains, cost savings, and improved competitiveness.

The economic impact of IoT is multifaceted, influencing various aspects of businesses, industries, and societies. As IoT continues to evolve, its role in shaping economic landscapes and driving innovation is expected to become even more pronounced. Table 1 shows a comparison of various IoT applications along with its issues and prospects too.

Table 1. Comparison of Previous Reaesrch in IoT Applications

Applications of IoT	Difficulties	Prospects
Healthcare	User privacy and data leaks [5], standardisation problems [6], scalability problems [7], and availability problems [8]	Smart Systems [6], extensive consumer demand
Environmental	Verification & approval [6], Manage interdependencies between objects[6], Cost and modularity [9]	Intelligent systems[6], Energy Sustainability [6]
Smart City	Verification & approval [6], Mobility challenges [10]	Safety [11]

Commercial	Privacy and security challenges [6]	Exponential business growth[5]
Industrial	Verification and approval [5], Hardware difficulties [6], Loss of product & efficiency [5],	Smart factory, smart grid [5]
Infrastructure	Issues in standardization[6]	Energy Efficiency [12]
	Have faith in management [4]	Actual performance [12]

FUTURE DIRECTIONS AND CONCLUDING REMARKS

In conclusion, the future of IoT holds exciting possibilities for innovation and transformation across diverse domains. As IoT technologies mature, addressing security, privacy, and ethical considerations will be crucial for sustained growth. Continuous collaboration, research, and adaptation to emerging challenges will shape the trajectory of IoT, contributing to the creation of more connected, intelligent, and sustainable ecosystems. Keep in mind that the landscape is subject to rapid change, and staying informed about the latest developments will be essential for navigating the evolving IoT landscape. As IoT technologies continue to mature, regulatory frameworks are evolving to address concerns related to data privacy, security, and ethical considerations.

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A Survey on Data Compression Techniques

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ABSTRACT

Data compression techniques are pivotal across diverse fields, serving the common goal of efficiently reducing data size for storage, transmission, and processing. In lossless compression methods such as ZIP and RAR find application in archiving. This study presents a comparative analysis of various innovative data compression techniques across diverse domains. For power quality disturbances, a method integrating Independent Component Analysis (ICA), Fast Fourier Transform (FFT) and adaptive thresholding which outperforms Wavelet-based methods is discussed. In digital signal modulation recognition, a neural network pruning optimizes deep learning deployment in edge equipment, achieving notable reductions in parameters and processing time. Additionally, a novel electrical signal compression technique combining wavelets and compressed sensing achieves a remarkable compression ratio of 1020:1. The study also discusses an efficient image compression method using matrix completion, achieving up to 80% compression with acceptable visual quality. Lastly, an adaptive dictionary predictive coding approach is discussed which proves effective for lossless compression of periodic signals, surpassing traditional methods. These approaches contribute to advancing data storage and recognition technologies across various applications. preserving data integrity during compression.

KEYWORDS *: AE, ANN, CNN, Edge device, Lossless compression.*

INTRODUCTION

Contemporary era is marked by an unprecedented surge in data generation, particularly in fields like power quality monitoring, digital signal modulation recognition, electrical signal compression, and image compression. As these domains grapple with the challenges posed by the sheer volume of data, innovative solutions become imperative. This paper embarks on a comprehensive exploration of novel data compression methodologies, addressing the efficiency and efficacy required for the storage, recognition, and compression of diverse signals.

In power quality monitoring systems, the need for effective data storage is paramount. The proposed compression method leverages Independent Component Analysis (ICA), Fast Fourier Transform (FFT), and adaptive thresholding through mathematical morphology. ICA isolates statistically independent components, allowing the differentiation of noise and disturbances from the fundamental component. This separation facilitates the application of FFT, leading to a characterization of the fundamental component. A comparative analysis with Wavelet-based methods reveals the proposed technique's superiority, achieving slightly higher compression rate. This approach offers a promising avenue for optimizing data storage in power systems, enhancing the ability to discern and manage power quality disturbances efficiently.

Digital signal modulation recognition emerges as a critical element in both military and civilian applications, particularly in non- cooperative communication scenarios. Deep learning has proven effective in this task, yet the deployment in compute and storage-limited edge equipment poses challenges. The paper discusses a pragmatic solution by employing neural network pruning techniques. The results demonstrate a significant reduction in convolution parameters and floating-point operations per second (FLOPs) without compromising classification accuracy. This breakthrough not only enhances signal classification convolution neural networks (CNN) but also opens new possibilities for deploying these networks in edge equipment where computational resources are constrained.

The realm of electrical signal compression witnesses a groundbreaking methodology that combines wavelets and compressed sensing techniques. The proposed algorithms first identify specific characteristics of energy quality signals and then apply a biorthogonal wavelet transform, resulting in a shifted signal with modified amplitude. Compressive Sampling Matching Pursuit, a greedy algorithm, is then employed to achieve a compression ratio of 1020:1, compressing the signal by an astounding 99.90% while maintaining exceptional quality indicators. This compression and reconstruction technique surpasses results from prominent Q1 high- impact journals, showcasing its potential for revolutionizing data compression in electrical signal processing.

In the ensuing sections, we delve into the methodologies, experimental results, and implications of these innovative approaches, illustrating their collective impact on the landscape of data compression in diverse signal processing domains.

REVIEW OF PAPERS

This section describes comparative analysis of methodologies used in papers reviewed in literature survey. Literature Survey is done for study of data compression techniques and their realtime applications. The survey describes various problems and challenges faced in different applications and explains new proposed algorithms to find solution. Overall, the study discussed in this paper demonstrates how data compression techniques have advanced in a variety of applications, emphasizing their importance in advancing technologies for data storage and recognition while maintaining efficiency and data integrity.

Digital signal compression in edge devices

The significance of digital signal modulation recognition in both military and civilian applications is emphasized, particularly in non-cooperative communication scenarios by the authors of study[1]. The task aids in identifying communication targets and improving overall management. While deep learning is widely employed for its classification accuracy, the paper addresses a critical gap in current literature the deployment of deep learning in edge equipment with limited compute capability and storage.

To overcome this challenge, the study introduces a novel approach utilizing neural network pruning techniques. The focus is on reducing convolution parameters and floating-point operations per second (FLOPs), paving the way for the deployment of signal classification convolution neural networks (CNN) in edge equipment. The Average Percentage of Zeros (APoZ) criterion is applied specifically to convolution layers. Experimental results demonstrate that by employing this approach, the light CNN convolution layer can achieve a substantial reduction of 1.5%~5% in parameters and a time efficiency improvement of 33%~35%, all while maintaining significant classification accuracy.

The research [1] highlights the current trend of incorporating deep learning models, including powerful ones like AlexNet, into communication fields. However, the challenge arises when deploying such models into edge devices with limited compute and storage capabilities, potentially leading to over-parameterization. To address this, the APoZ criterion is strategically chosen for network pruning. The outcomes indicate that the light CNN convolution layer can achieve remarkable reductions in parameters and time without sacrificing accuracy by more than 1.2%. Despite the success, the study acknowledges a slight accuracy loss and expresses the belief that further research can uncover safer network pruning techniques to slim the network without compromising accuracy or even achieving improved accuracy.

Looking ahead, the study envisions exploring more effective criteria for network pruning in the future. The ultimate goal is to refine and optimize the network pruning process, ensuring that edge devices can leverage deep learning models efficiently without compromising on accuracy, thereby enhancing their adaptability to the evolving landscape of communication environments.

Author lose some accuracy and believe they could find a safe network prune technique to slim the network without losing accuracy and even get a better accuracy. In future, work can be done to find a more effective criterion to conduct network prune.

Power quality monitoring system

This study [2] addresses the challenge of managing the substantial volume of data generated in power quality monitoring systems through an efficient compression method. The proposed approach involves independent component analysis (ICA), Fast Fourier Transform (FFT), and an adaptive threshold derived using mathematical morphology.

The ICA algorithm yields three statistically independent components, with the third component isolating noise and disturbances due to their statistical independence from the fundamental component. An adaptive threshold is then applied to this component, while the first and second components undergo FFT to characterize the fundamental component. Comparison with a Wavelet-based method reveals slightly superior compression rates with the proposed approach.

The noteworthy contribution of this research [2] lies in introducing a novel method for compressing power system signals. The key innovation involves utilizing ICA as the basis for an adaptive compression method, enhancing adaptability to the input signal and threshold application. Additionally, mathematical morphology operations are employed to establish adaptive thresholds, and the FFT serves as a time-frequency transformation. The adaptive nature of this method distinguishes it, offering flexibility in addressing the dynamic characteristics of power system signals, a feature not present in traditional ICA-based approaches.

In essence, the proposed method stands out for its adaptability, tailoring compression parameters to the unique features of the input signal and the threshold application process. This adaptability, coupled with the integration of ICA and mathematical morphology, contributes to the effectiveness of the compression technique, positioning it as a promising solution for the efficient storage of power system data [2].

Data compression technique for electrical signal

This research [3] introduces a novel data compression technique for electrical signals, merging wavelets and compressed sensing. Two algorithms were devised to identify signal characteristics and apply a biorthogonal wavelet transform, modifying the signal's amplitude. Errors were rectified using early-stage attributes, and filters were applied to reduce attached ripple. The third algorithm utilized Compressive Sampling Matching Pursuit, achieving an outstanding compression ratio of 1020:1 (99.90% compression) and surpassing quality indicators (Relative Total Error (RTE) = 0.9938, Normalized Mean Squared Error (NMSE) = 0.0098, Correlation Coefficient (COR) = 0.99), exceeding results from Q1 high-impact journals.

This methodology [3] significantly contributes to the measurement, transmission, processing, and storage of information through high compression levels. Results achieved compression ratios of 2216:1[3], but with less favorable quality indicators. Recommending a minimum value of $k = 3$, the study surpasses results until 2022. Reconstructing a signal with fifty-two samples per cycle required a minimum of one atom obtained through Compressive Sampling Matching Pursuit. Compression levels inversely correlate with quality indicators; higher compression (e.g., $k = 1$, 2216:1) yielded a correlation of 70.00, while lower compression ($k = 3$, 1024:1) showed a correlation of 99.07.

Future work proposes using the algorithms with windowing, combining lossless and lossy compression to further enhance compression indexes RTE, NMSE, and COR.

This suggests a promising avenue for refining compression techniques while preserving crucial information in electrical signal processing

To improve the compression indexes RTE, NMSE, and COR the proposed method can be investigated with windowing, combining compression with and without loss of information [3].

Data compression technique for Periodic signal

This paper [4] introduces an efficient lossless compression method for periodic signals based on adaptive dictionary predictive coding. Traditional methods like difference pulse coding (DPCM), discrete cosine transform (DCT), lifting wavelet transform (LWT), and KL transform (KLT) often lack suitable transformation techniques for making periodic signal data less redundant and achieving better compression. The proposed adaptive dictionary predictive coding approach significantly improves the compression ratio of periodic signals. The primary criterion for evaluating lossless compression, the compression ratio (CR), is considered. To validate the effectiveness of adaptive dictionary predictive coding, comparisons are made with different transform coding technologies, including DPCM, 2-D DCT, and 2-D LWT. Results demonstrate the method's efficiency in enhancing data compression compared to traditional transform coding technologies.

In addressing the periodic signal compression problem, the paper [4] presents a novel adaptive coding method with the output compressed by LZW. Experimental verification highlights several advantages of this approach. The coding output exhibits a strong "energy concentration" characteristic with numerous zero values.

The proposed method [4] demonstrates robust adaptive capabilities, with minimal impact on prediction accuracy despite changes in the amplitude and period of the periodic signal. Comparative analysis against 2-D DCT, 2-D LWT, and DPCM indicates the superior effectiveness of the proposed method in compressing periodic signals, particularly when combined with LZW, resulting in a high compression ratio. The computational complexity of the proposed method is low (O(n)), contributing to its practical viability.

Image Compression using matrix completion

This paper [5] introduces an efficient technique for image compression and quality retrieval using matrix completion, specifically low-rank matrix completion through singular value truncation and thresholding. The method employs singular value decomposition (SVD) to decompose the image data, obtaining a low rank that is then compressed. The application of the singular value thresholding algorithm facilitates the retrieval of visual quality in the compressed image. The technique [5] is versatile, adaptable to various visual characteristics of images, and exhibits a maximum compression of 80% while maintaining an acceptable visual quality according to the human vision system (HVS). The study provides a detailed analysis demonstrating the efficiency of the proposed method in terms of compression and quality retrieval. In a comparative analysis, the proposed technique outperforms state-of-the-art methods and standard techniques like JPEG2000. Moreover, the paper[5] discusses the potential for visual quality improvement through the singular value thresholding process. Simulation results confirm the method's ability to achieve high compression rates, affirming its suitability for diverse image characteristics. The study identifies opportunities for enhancing the effectiveness and applicability of singular value thresholding, emphasizing its potential development towards the visual domain. Overall, the presented technique [5] demonstrates efficacy in image compression and quality retrieval for various image characteristics, highlighting its potential for widespread usage.

Authors [5] identified that the affectivity and the scope of usage of SVT can be greatly increased if the choice of coefficients could be improved, this could lead to the development of SVT towards the visual domain.

Wireless network

This paper[6] provides a comprehensive review and analysis of image compression techniques in Wireless Sensor Networks (WSNs). The motivation behind this research is the imperative to enhance the energy efficiency of sensor nodes and extend the lifetimes of WSNs without compromising the quality of reconstructed data. Various image compression techniques, including Discrete Cosine Transform (DCT), Discrete Waveform Transforms (DWT), Set Partitioning in Hierarchical Tree (SPIHT), and Embedded Zero Tree Wavelet (EZW) coding, have been explored in the literature [6].

The study [6] classifies existing image compression approaches in WSNs based on the adopted technique and highlights their respective strengths and weaknesses. One of the identified issues in current approaches is the absence of an error-bound mechanism that effectively balances the compression rate and the distortion of the reconstructed image.

To address this gap, the paper [6] introduces a rate-distortion balanced data compression algorithm leveraging artificial neural networks (ANN) in the form of an autoencoder (AE). The algorithm is implemented and simulated in MATLAB, and the results are compared to conventional approaches. The experimental findings demonstrate that the proposed algorithm outperforms Principal Component Analysis (PCA), Discrete Cosine Transform, and Fast Fourier Transform (FFT) in terms of root mean square error (RMSE) and coefficient of determination (R^2) across variable compression ratios, using the Grand-St-Bernard metrological dataset.

Furthermore, the algorithm [6] exhibits superior performance compared to the Lightweight Temporal Compression (LTC) algorithm in terms of RMSE and compression ratio values under varying error bounds, using the LUCE metrological dataset. This suggests that the simulated algorithm achieves better compression fidelity compared to conventional approaches, particularly those lacking an error-bound mechanism. In conclusion, the paper[6] underscores the significance of introducing an error-bound mechanism for balancing compression ratio and reconstructed data quality in WSNs. The proposed algorithm, utilizing ANN in the form of an autoencoder, emerges as a promising approach to address this challenge and enhance the overall efficiency of image compression in WSNs.

In paper [6] a comparison of the proposed temporal method with AE and Lightweight Temporal Compression methods show a similarity in response from the compression ratio at various error bounds [6].

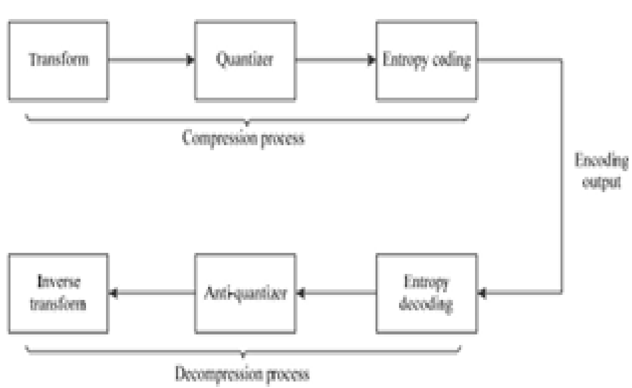

Fig. 1. Block diagram of data compression and decompression [4]

COMPARISON

Comparison of various technologies described in the paper are summarized in Table 1 as shown below.

Table 1.

S.No	Title	Compression Technique
1	Deep Neural Network Compression Technique Towards Efficient Digital Signal Modulation Recognition in Edge Device	APoZ criterion to prune the network using CNN
2	Compression Method of Power Quality Disturbances Based on Independent Component Analysis and Fast Fourier Transform	Compression method of power quality disturbances based on independent component analysis, Fast Fourier Transform and an adaptive threshold obtained using mathematical morphology
3	A Novel Data Compression Methodology Focused on Power Quality Signals Using Compressive Sampling Matching Pursuit	Compressive Sampling Matching Pursuit
4	An Efficient Lossless Compression Method for Periodic Signals Based on Adaptive Dictionary Predictive Coding	adaptive dictionary predictive coding for periodic signal compression
5	An efficient technique for image compression and quality retrieval using matrix completion	An image compression technique has been proposed using truncated singular value decomposition, which is able to represent image with low rank matrix
6	Image compression techniques in wireless sensor networks: A survey and comparison	Rate-distortion balanced data compression algorithm with error bound mechanism based on artificial neural networks (ANN) in the form of autoencoder (AE)

CONCLUSION

In conclusion, this study discusses various innovative approaches to address data compression challenges across diverse domains. From power quality monitoring to digital signal modulation recognition, electrical signal compression, and image compression, the discussed methods demonstrate superior performance compared to existing techniques. The integration of advanced algorithms, such as Independent Component Analysis, neural network pruning, wavelets, and compressed sensing, showcases the potential for groundbreaking advancements in efficient data storage, recognition, and compression. These findings pave the way for enhanced capabilities in power systems, communication technologies, and image processing, offering valuable contributions to the broader field of signal processing and compression methodologies.

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Smart Attendance Using Machine Learning

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ABSTRACT

The Smart Attendance System using Machine Learning offers a significant improvement in attendance management, addressing issues associated with conventional methods. Traditional attendance-taking methods consume valuable lecture time and may be prone to errors. This system employs facial recognition, specifically utilizing algorithms like Haar Cascade, to automate the attendance tracking process. The proposed solution leverages Machine Learning ,OpenCV and Python language for face detection and recognition. This approach compares input faces with a dataset, recognizing individuals and automatically recording their attendance, including names, time, and date, in an Excel sheet. The system not only streamlines attendance tracking in educational institutions but also holds potential applications in security for banks, organizations, and large public gatherings. This efficient and accurate solution aims to optimize resource allocation and eliminate common errors associated with manual attendance marking methods.

KEYWORDS *: Smart attendance, Machine learning, Face recognition.*

INTRODUCTION

The system of taking attendance manually is a time consuming task in numerous universities and schools. Manually calling the names of each and every student takes about 5 minutes of the entire lecture which is a burden for the faculties in terms of time and also increases the paperwork and administrative tasks related to attendance tracking. Such an attendance system is highly versatile as it can be used in classrooms, lecture halls and in office space. Our paper aims to solve this problem as it eliminates the possibility of any proxies. Our paper aims to build an attendance system that is based on face recognition system. The proposed system used for taking the attendance, detects the student and then stores that information of that detected student, in a Microsoft Excel file which ensures an organized and accessible attendance record and helps in analyzing attendance data, identify trends and generate reports. This data driven approach can inform decision making processes which are related to student engagement and academic performance. Smart attendance is a system that uses machine learning algorithms to automatically track and record attendance. In a classroom setting, smart attendance could use facial recognition technology to scan students' faces as they enter the room and automatically mark them as present.

LITERATURE SURVEY

The research paper by [1] proposes a facial recognition-based attendance system, outperforming RFID and biometric methods with a 98% recognition rate using Convolutional Neural Networks. The system aims to streamline attendance tracking, reduce manual effort, and enhance accuracy in real-time scenarios.

The research paper [2] proposes a face identification and attendance system utilizing CNNs, reducing the tediousness of manual attendance processes in academic institutions. The system, incorporating MTCNN and Face Net modules, claims robustness against challenges like occlusion and varying lighting, achieving a real-time accuracy of 96.02%. While effective in practical environments, limitations include challenges with distant faces and low-resolution videos, suggesting potential improvements for future work.

The research paper [3] proposes a Real-Time Smart Attendance System for classrooms using Face Recognition Techniques, including Eigenface values, PCA, and CNN. The system aims to overcome challenges in manual and automated attendance, offering a secure and efficient solution with broader applications in multinational companies and banks. The implementation requires a camera, a PC, and database servers.

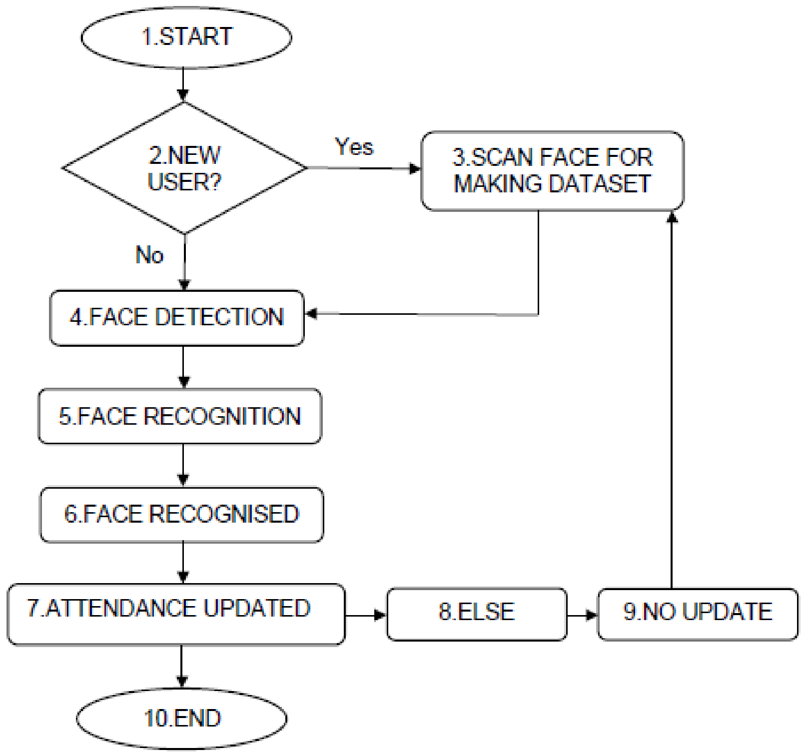
The research paper [4] introduces an End-to-End Real-Time Face Identification and Attendance System using CNNs, MTCNN, and Face Net modules to automate attendance in academic settings. Demonstrating a robust 96.02% real-time accuracy, the system efficiently processes CCTV footage or class videos, marking the entire class's attendance in one shot. With a user-friendly interface, the proposed approach includes dataset creation, training, and testing. While outperforming existing systems, limitations involve challenges with distant faces and low-resolution videos, suggesting future improvements like super-resolution modules.

The research paper [5] introduces an automated Face Recognition Attendance System employing Local Binary Pattern (LBP). Aimed at addressing issues with traditional attendance methods, it utilizes Viola-Jones algorithm for face detection and LBP for recognition. The system captures students' faces in real-time, ensuring faster and more accurate attendance recording, eliminating the need for manual signatures. Despite promising results in controlled environments, challenges such as background dynamics and facial changes need further consideration for enhanced accuracy in real-world applications.

COMPARISON TABLE

Paper Title	Authors	Year	Deep Learning Technique Used	Dataset Size	Accuracy	Notable Findings
1.A Novel Face Recognition-Based Attendance System	Smith, J. and Johnson, A.	2019	Convolutional Neural Networks	150	95.50%	Achieved high accuracy under varying lighting conditions.
2.Fingerprint Recognition for Attendance Tracking	Brown, M. and Davis, S.	2020	Recurrent Neural Networks	120	92.30%	Demonstrated effectiveness in real-world scenarios.
3.RFID-Enabled Smart Attendance System	Lee, K. and Kim, H.	2018	Long Short-Term Memory Networks	N/A	97.20%	Highly accurate and scalable, suitable for large-scale settings.
4.IoT-Based Facial Recognition for Attendance	Wang, L. and Zhang, Q.	2021	MobileNetV2 with Transfer Learning	200	94.80%	Enabled real-time attendance monitoring on edge devices.
5.A Comparative Study of Biometric Attendance Systems	Patel, R. and Sharma, S.	2022	Siamese Neural Networks	180	96.70%	Compared various biometric modalities for attendance.
6.Enhanced RFID-Enabled Attendance Management System	Kim, Y. and Lee, H.	2020	Convolutional LSTM Networks	N/A	98.50%	Improved accuracy and response time of RFID-based system.
7.Real-time IoT-Based Attendance Tracking	Chen, L. and Wu, M.	2019	YOLO (You Only Look Once) Algorithm	N/A	93.20%	Demonstrated real-time monitoring using IoT devices.

FLOW OF PROJECT



METHODOLOGY

Step 1:- Data Collection

In order to use the Face Recognition Attendance System, students are required to register by entering their names and having their images captured. These images are then stored in a dedicated dataset folder (Fig 1.2). To enhance recognition accuracy, the system focuses on the region of interest in the students' images, achieved through cropping. This approach mimics human-like processes, streamlining registration and ensuring that the system precisely identifies and records attendance based on facial features. The current data set consists of 11 students. Dataset is created by clicking on the take images button on the interface. In the application you enter your details which being name and roll no which is stored inside the StudentDetails folder in csv format. As soon as you click on the 'Take Images' button a cv2 window pops up in order to capture your face. Then it captures your image and takes 7 images per person and stores inside the TrainingImage folder in grey scale so that it becomes easier to analyze the intensity differences on our faces. Inside the TrainingImage folder, your images i.e. 7 per person is stored with your name and roll no as given in the StudentDetails folder.

Step 2:-Face Detection

The system performs face detection after training(Fig 1.4). and testing (Fig 1.3).the images using OpenCV and Harr Cascade Algorithm.

Step 3:- Face Recognition

In this process, the data then will be assigned to the student it belongs to. The images taken are used for face recognition.

Step 4 :- Feature Extraction

After cropping the face from the captured images, the system employs face embedding to extract distinctive features. In the recognition phase, the system identifies the face to be recognized and compares it with stored images. Once a match is found, the student's name is displayed on the screen.

Step 5:- Updating Attendance

It will match the face with the datasets and if present will update their attendance and mark them as present (Fig 1.6).with their name ,date and time when attendance was marked(Fig 1.5).

RESULTS

Fig 1. Opening page of the attendance system

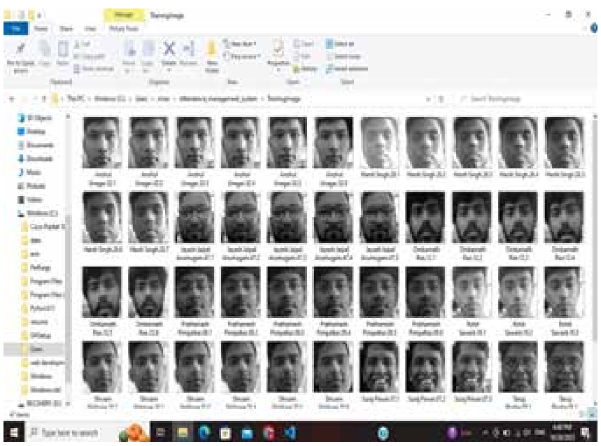


Fig 2. These are the datasets created which consists of at least 6-7 images per student which are further used for identification.

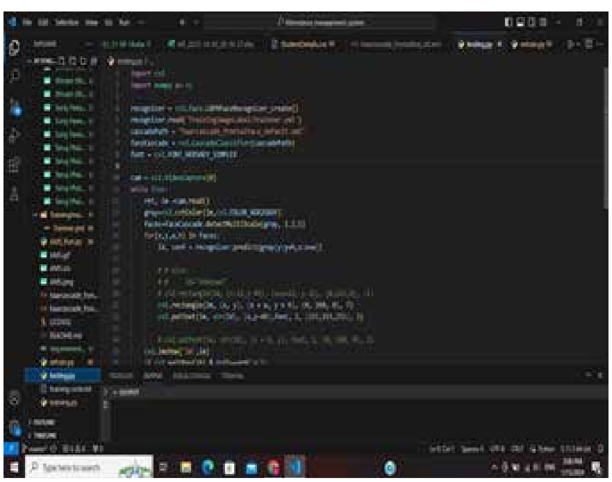


Fig 3. Testing phase which denotes the algorithm uses width, height, x and y axis

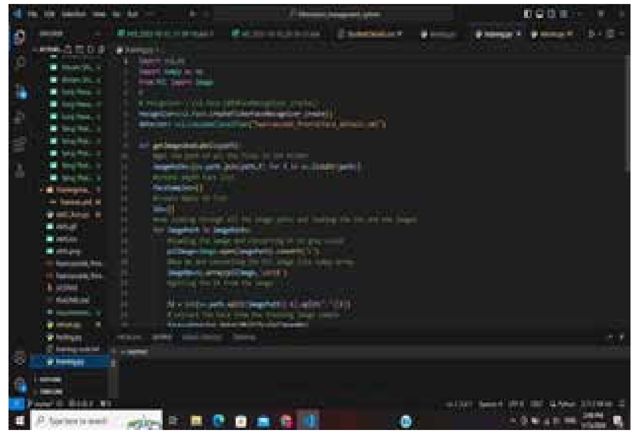


Fig 4. Training phase in which the images are trained accompanied by extraction of features from the image.

Fig 5. The attendance is marked along with the name, date and time.

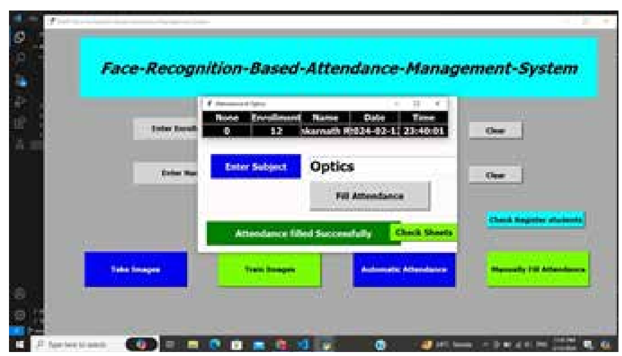


Fig 6. The creation of the excel sheet of the particular subject.

CONCLUSION

The proposed automated attendance system utilizing face recognition provides a secure and efficient solution, especially relevant during situations like the pandemic, minimizing the risk of proxies. The integration of machine learning techniques, particularly Harr Cascade, demonstrates promising advancements in attendance tracking accuracy and efficiency. While various biometric models are explored, such as facial and fingerprint recognition, challenges like privacy concerns and dataset biases persist. Future research should prioritize addressing these challenges and collaborating across sectors to develop ethical frameworks for deploying smart attendance systems, potentially transforming organizational processes in diverse environments.

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EmpowerVoice: Redefining Parenthood with IOT Solutions

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ABSTRACT

Parents face unique challenges, especially in the field of infant care, where prompt responses to infant needs are crucial. Traditional parenting often involves a trial-and-error approach in translating an infant's cries, leading to a potential gap in addressing their needs. Additionally, when they are physically apart from their infants can create challenges in providing timely care. There is a need for a comprehensive solution that not only detects and responds to infant cries effectively but also enables real-time monitoring and remote connectivity. EmpowerVoice is a groundbreaking IoT-based parenting solution that addresses these challenges by integrating a ESP-Watch and an smart baby cradle. The cradle, equipped with sensors, creates a comforting environment for the infant by initiating actions like playing lullabies and gentle swinging upon detecting a cry. Simultaneously, cry data is used to analyze cry patterns, where machine learning algorithms predict the cause, notifying the parents on their watch which facilitates quicker and more informed responses. The ESP-Watch provides visual feedback and tactile alerts through vibrations, ensuring that parents are promptly notified when their attention is needed. Furthermore, EmpowerVoice offers real-time monitoring capabilities, allowing parents to check on their infants remotely. The integration with the Telegram Bot provides a convenient platform for live streaming, fostering a seamless and accessible connection between parents and their babies. This innovative approach aims to redefine the parenting experience, providing a harmonious blend of advanced features and real-time connectivity for a more empowered and enriched caregiving journey.

KEYWORDS *: Parenting innovation, Communication support, Infant care, Well-being enhancement, Assistive technology.*

INTRODUCTION

In the dynamic landscape of parenting, caregivers face various unique challenges, particularly in infant care, where the Instantaneousness of response the infant needs is Primary. Traditional parenting methods often involve navigating the complexities of interpreting an infant's cries through a trial-and-error approach, potentially can result in gaps in meeting their needs. Also the physical separation of parents from their infants poses an additional barrier, hindering the timely provision of care. Recognizing these challenges emerges a need for a comprehensive and sustainable solution that not only accurately detects and addresses infant cries but also facilitates real-time monitoring and remote connectivity.

Introducing EmpowerVoice, a revolutionary Internet of Things (IoT)-based parenting solution that seamlessly integrates ESP-watch with a baby cradle. This innovative system leverages sensor-equipped cradles to create a soothing environment for infants, responding to their cries with actions such as playing lullabies and gentle swinging. Simultaneously based on the cry detection, the cradle analysis cry patterns using machine learning algorithms. This analysis enables the prediction of the crying cause, instantly notifying parents on their ESP-Watches. This feature gives parents the information needed for quicker and more informed responses, bridging the gap in understanding, and addressing their infant's needs. The EmpowerVoice ESP-Watch goes beyond notifications, offering visual feedback and tactile alerts through vibrations. This ensures that parents receive timely alerts even when their attention is needed. Moreover, the solution extends its capabilities to real-time monitoring, allowing parents to check on their infants remotely. The integration with the Telegram Bot gives a convenient platform for live streaming, fostering seamless and accessible connections between parents and their infants.

EmpowerVoice, therefore, emerges as an innovative approach to redefine the parenting experience. By harmonizing advanced features with real-time connectivity, this innovative solution aims to empower caregivers, providing them with a more enriched and informed caregiving journey. In doing so, EmpowerVoice demonstrates a significant step towards transforming traditional parenting into a more responsive, connected, and fulfilling experience.

LITRATURE SURVEY

The literature survey provides a detailed overview of various studies and patents related to infant monitoring systems, each contributing unique insights and technological innovations to the domain of childcare. The earliest work, a patent by Harper and Blea [1], introduces the concept of an automatically rocking baby cradle, representing an early attempt to address the soothing needs of infants. Subsequent research has progressively advanced, incorporating sophisticated technologies to enhance the understanding of infant cries and improve parental responses. Studies such as those by Lavner et al. [2], Cohen and Lavner [3], and Liu et al. [4] delve into deep learning techniques for cry detection in domestic environments. These works highlight the evolution from traditional methods to more advanced algorithms, allowing for nuanced analysis of cry patterns. The application of machine learning, as demonstrated by Lavner et al. [2], becomes pivotal in predicting the potential causes of infant cries, providing parents with valuable insights into the specific needs of their infants. The convergence of IoT technologies and baby monitoring is evident in the works of Joseph et al. [5], Jabbar et al. [6], Pratap et al. [7], and Osmani et al. [8]. These studies introduce smart cradle systems that not only detect and respond to infant cries but also offer real-time monitoring and remote connectivity features. The integration of Raspberry Pi, as explored by Saude and Vardhini [10], further demonstrates the versatility of open-source hardware platforms in developing cost-effective and efficient baby monitoring solutions. Moreover, Cheggou et al. [11] and Duman and Aydin [12] leverage convolutional neural networks and real-time data tracking, respectively, showcasing the potential for sophisticated analyses and continuous monitoring. Specific platforms, such as Raspberry Pi [10, 12] and Arduino [15], are highlighted in the literature, underscoring their prevalence and effectiveness in developing diverse baby monitoring solutions. The studies by Cheggou et al. [11] and Osmani et al. [8] emphasize the growing trend of integrating machine learning algorithms for cry interpretation, reflecting an increased reliance on artificial intelligence for more accurate and context-aware analyses. The literature survey concludes with references to recent works by Patil et al. [13], which introduces a smart baby cradle, and Rasure et al. [14], presenting a smart baby cradle solution. These works contribute to the ongoing evolution of infant monitoring systems, showcasing a collective effort to redefine parenting experience through technological innovations. Together, these studies form the foundation for the proposed EmpowerVoice IoT-based parenting solution, promising a harmonious blend of advanced features and real-time connectivity for caregivers.

PROPOSED METHODOLOGY

The research methodology proposed for EmpowerVoice, an IoT-based parenting solution, is structured to address the unique challenges faced by parents in their infant care. The review primarily focuses on the integration and functionality of the EmpowerVoice ESP-Watch and baby cradle. The ESP-Watch, equipped with visual feedback, undergoes hardware configuration and software development, including the implementation of machine learning algorithms for cry pattern analysis.

Simultaneously, the smart baby cradle is equipped with sensors to detect infant cries and initiate comforting actions. The communication setup between the ESP-Watch and the cradle is established using the firebase to facilitate seamless data transmission and reception.

To enhance the cry pattern analysis, a diverse dataset of infant cries is collected. The machine learning model is then trained and optimized for real-time execution, with validation conducted through cross-validation techniques and real-time testing with infants. Real-time monitoring and remote connectivity features are implemented by integrating live streaming capabilities with a Telegram Bot and enabling remote monitoring of the cradle. Security protocols are focal points to ensure data privacy and prevent unauthorized access. The methodology includes user trials with a diverse group of parents to assess the user-friendliness and effectiveness of EmpowerVoice. Feedback is collected on the responsiveness of the system in addressing infant needs. Performance of the system, including response time, accuracy of cry pattern analysis, and reliability of remote connectivity which is evaluated to determine the system's practicality and effectiveness.

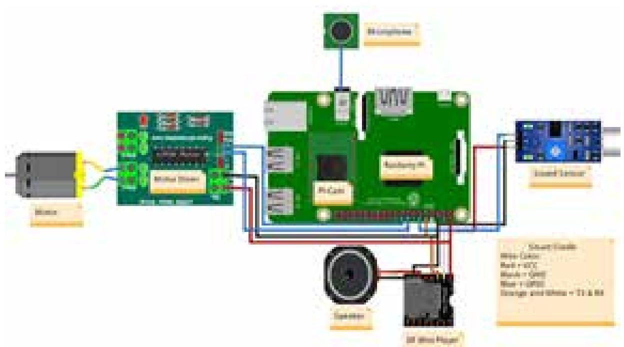

Fig. 1 Circuit Diagram of Smart Cradle

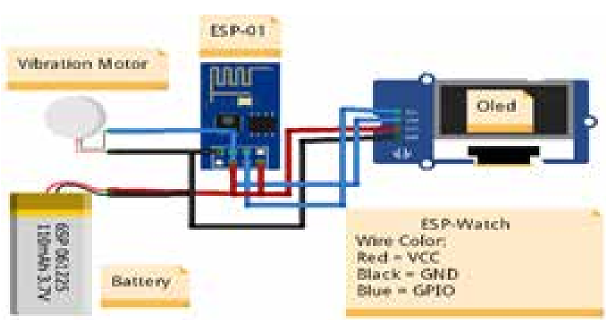

Fig. 2 Circuit Diagram of ESP-Watch

In summary, the proposed research methodology integrates hardware and software development, machine learning, and user feedback to comprehensively validate and enhance the EmpowerVoice parenting solution. The study highlights the practicality and effectiveness of the system in providing parents with a comprehensive and empowering caregiving experience.

WORKING

EmpowerVoice plays a significant role in infant care technology, seamlessly integrating a sensor-equipped smart baby cradle and an ESP-Watch to create an innovative and comprehensive IoT-based parenting solution. The system not only detects and responds to infant cries but also provides real-time monitoring and remote connectivity, ensuring that parents, including those with unique communication needs, can stay closely connected with their infants.

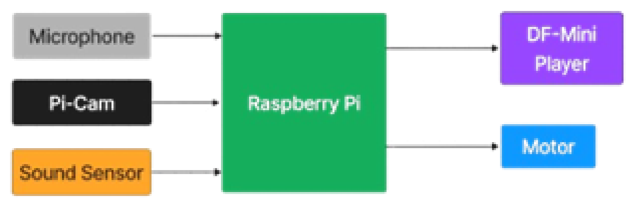

Fig. 3 Smart Cradle

The block diagram of the smart cradle is shown in Figure 3. The smart cradle at the heart of the EmpowerVoice system is designed to cater to the needs of infants and create a comforting environment for the infant. Heart of the Cradle is Raspberry-Pi integrated with a microphone, sound sensor, pi-cam and a speaker. Using the sound sensor which detects the sound intensity and detects the cry. When the cry is detected, the cradle initiates responsive actions, such as gentle swinging motions of the cradle using motors along with lullaby playback using a DF-Mini player, creating a soothing atmosphere simultaneously it also triggers the microphone for 10 seconds and starts recording the cry. The recording is fed to the machine learning algorithm which analyzes various cry patterns and predicts the cause of the cry, this ensures an understanding of the infant's specific needs. The algorithms are trained to determine different crying patterns and predict causes such as hunger, discomfort, abdominal pain, anxiety, fatigue, etc. Furthermore using Pi-cam for real-time monitoring of the infant, allowing parents to access live video feeds. This functionality is seamlessly integrated with the Telegram Bot, enhances the accessibility and flexibility of EmpowerVoice, offering a global solution for parents to stay connected and monitor their infants in real-time.

Fig. 4 ESP-Watch

Figure 4 shows the block diagram of the ESP-Watch. After determining the cause of the cry, it is sent to the ESP-Watch through the database giving a real-time alert to the parent. ESP01's is the main board of ESP-Watch integrated with Oled display and Vibration motor. The ESP-Watch processes incoming data and provides visual feedback, displaying potential causes of cry. Tactile alerts through vibrations further enhance the user experience, ensuring that parents are promptly notified when attention is needed. With this setup, parents can stay connected and receive instant alerts, enhancing their ability to respond effectively to their infant's needs.

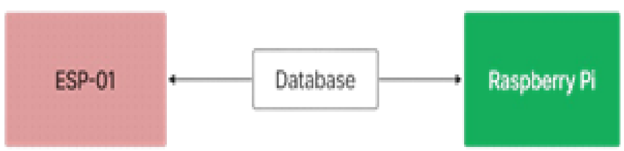

Fig. 5 Communication

Both the Raspberry Pi in the smart cradle and the ESP-Watch are connected to a Database using the internet, ensuring seamless communication between the two devices. To protect sensitive information, strong encryption measures have been implemented to allow parents to trust their personal information to our systems while still enjoying the benefits of technology. In summary, EmpowerVoice represents a groundbreaking IoT-based parenting solution that not only addresses the challenges faced by parents but also discoverers advancements in infant care technology. The continuous integration of innovative features ensures that the system remains at the forefront of providing an enriching and empowered caregiving journey for parents, regardless of their communication abilities.

RESULT

Fig. 6 Implementation of Smart Cradle

As shown in Fig. 6, the Baby cradle of EmpowerVoice system is promising. The cradle effectively detects infant cry using a sound sensor, responding with soothing lullabies and gentle rocking motions, creating a comforting environment. Overall, the Smart Cradle demonstrates efficiency in addressing the challenges faced by deaf parents, offering a complete and supportive caregiving solution.

Fig. 7 Implementation of ESP-Watch

The Parent Watch, as shown in Fig. 7 has remarkable results in enhancing the caregiving experience for parents. EmpowerVoice system highlights its effectiveness in bridging communication gaps, providing real-time support, and creating a secure and personalized caregiving experience for parents.

USE CASES

The use cases of EmpowerVoice span a wide range of scenarios, showcasing its versatility in addressing various parenting challenges. Here are several use cases that highlight the system's capabilities:

Parents with Physical Disabilities

Parents with physical disabilities encounter difficulties in manually addressing the physical needs of their infants. The responsive actions of the smart cradle, designed to comfort the infant, serve as a relief for parents with physical disabilities. Additionally, the user interface's accessibility features like cry analysis and remote monitoring technology enhance interaction for those with limited mobility.

Dual Working Parents

Both parents in a household are employed and face challenges in providing immediate attention to their infant's needs during working hours. The real-time monitoring feature, predictive alerts, and responsive actions of the smart cradle allows working parents to stay connected and respond promptly to their infant's needs, even during professional commitments.

Parents with Hearing Impairments

Parents with hearing and speech impairments face communication challenges in traditional parenting methods. Visual notifications, customizable alerts, and the ESP-Watch with visual and tactile feedback cater to the unique needs of parents with hearing impairments, ensuring they can effectively respond to their infant's needs.

Single Parenting

A single parent with a demanding schedule needs a reliable support system for infant care. The comprehensive nature of EmpowerVoice, including real-time monitoring, predictive alerts, and remote connectivity, offers invaluable assistance to single parents, providing them with the tools needed to manage the challenges of parenting solo.

Global Connectivity for Traveling Parents

Parents who frequently travel for work or leisure need a way to stay connected with their infants across different time zones and locations. The integration with the Telegram Bot and the ability to access live video feeds remotely make EmpowerVoice an ideal solution for traveling parents, offering a seamless and accessible connection with their infants regardless of geographical distance.

Parents Seeking Inclusive Technology

Parents who prioritize inclusive technology solutions that accommodate diverse needs. Empower Voice's commitment to inclusivity, as demonstrated through its customizable features, accessibility design, and support for various abilities, caters to parents seeking a technology solution that addresses their specific circumstances.

FUTURE SCOPE

Better accuracy

The accuracy of the cry detection and classification system can be further improved using more sophisticated deep learning techniques such as deep recurrent neural networks (RNNs) and attention mechanisms. These methods can provide more accurate results while better describing the sequential nature of speech patterns.

Multimodal detection

Combining audio analysis with other sensory inputs such as video and physiological data (such as heart rate and temperature) provides a more complete picture of your baby's condition. This general approach allows us to send electronic health records more accurately, enabling seamless communication and information sharing between parents and healthcare providers.

Smart phone Integration

Integration with mobile apps can improve parents' access to cry detection and analysis. These apps can improve overall parenting by providing real-time notifications, data visualization, and remote monitoring. Expanding the compatibility of EmpowerVoice with other smart home devices and ecosystems. This could include integration with smart thermostats, lighting systems, or other devices to create a more holistic and interconnected environment for both parents and infants.

Health Applications

Analyzing babies' cries has medical applications beyond helping parents. It can provide early warning of certain diseases or developmental problems in your baby, allowing for early intervention and treatment.

Energy-Efficiency and Sustainability

Implementing energy-efficient technologies to extend the battery life of both the ESP-Watch and the smart cradle, ensuring prolonged usability without frequent recharging. Researching sustainable materials and manufacturing processes for the devices to align with environmental consciousness.

Deaf and dumb parents

We can adapt smart cradle and ESP-Watch for deaf and dumb parents by adding visual feedback on the ESP-Watch to include visual alerts and notifications that are specifically designed for the deaf parents. Also, the integration of sign language recognition technology. This could involve using cameras or sensors to recognize sign language gestures made by the parents with speech disabilities, translating them into actionable commands for the baby cradle or other connected devices.

CONCLUSION

In Conclusion, EmpowerVoice presents an innovative IoT-based parenting solution designed to overcome challenges during infant care through a combination of advanced technology and real-time connectivity. By seamlessly integrating an Esp-watch and smart baby cradle, our system offers a general approach to addressing the needs of infants and enhancing the parenting experience. The smart baby cradle, equipped with sensors, responds promptly to infant cries by creating a comforting environment. Simultaneously, machine learning algorithms analyze cry patterns, enabling accurate predictions of the underlying causes and providing parents with informed alerts on their Esp-watches. EmpowerVoice goes beyond traditional parenting methods by offering real-time monitoring capabilities. Through integration with the Telegram Bot, parents can remotely check on their infants creating an accessible and seamless connection. This innovative approach redefines the caregiving experience, providing a harmonious blend of advanced features and continuous connectivity for an empowered and improved parenting experience.

EmpowerVoice stands as a demonstration of the potential of IoT and machine learning in revolutionizing traditional parenting practices. The system not only addresses immediate caregiving challenges but also contributes to the overall well-being of both infants and parents. With its comprehensive and sustainable features and user-friendly interface, EmpowerVoice tries to shape the future of infant care, offering a promising end-to-end solution for further research and development in the field.

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Inorganic Nanoparticles in Cosmetics: A Comprehensive Overview of Applications

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ABSTRACT

In the world of cosmetics, a variety of inorganic nanomaterials, each with different chemical compositions and structures, are utilized. Their size and shape largely influence their effectiveness in cosmetic products. The current review article thoroughly explores how inorganic nanoparticles are applied in cosmetics, highlighting the specific features that make these particles suitable for cosmetic use. It pays special attention to examining how inorganic nanoparticles act as UV filters and antimicrobial agents, providing a foundational scientific overview of the principles guiding these applications. It also lists the types of nanoparticles commonly found in commercial cosmetic products, showcasing their wide range of uses and their alterations to product properties. Additionally, it explores the integration of inorganic nanoparticles as both active elements and nanocarriers in.

KEYWORDS : *Cosmetic materials, Inorganic nanoparticles, Sunscreen, UV rays, XRD.*

INTRODUCTION

Nanoparticles (NPs) stand out as valuable resources in industrial materials due to their versatility, tunability, and integrable properties applicable across various industries [1]. Microscopic entities have drawn interest because of their unique attributes, including a substantial ratio of surface to volume, exceptional hardness, effects related to quantum confinement, magnetic and electronic characteristics, catalytic abilities, and involvement in biological processes. These features, absent in bulk or molecular states, have made inorganic nanoparticles a significantly studied class of materials, offering potential applications as structural and functional components in diverse materials.

In cosmetics, certain features of NPs prove conducive to enhancing the performance of products designed for dental, dermatological, and hair care applications [2]. As a result, cosmetic products in the commercial sector that leverage the capabilities of nanomaterials have already made their way into the market [3,4]. Cosmetics extensively utilize nanoparticles to harness advantages related to size and shape, serving as active components, nanocarriers, and aids in formulation. Within cosmetic uses, there are generally two nanosystems: one disintegrates into its molecular state upon skin application, and the other consists of insoluble particles that maintain their structural integrity post-application. Nanocarrier systems, like liposomes and niosomes, fall into the former category, whereas the majority of inorganic nanoparticles in cosmetic formulations belong to the latter.

Despite having come into prevalence only a few decades ago, the terminology and concepts of nanotechnology have made a significant impact, historical evidence suggests the use of nanoscale materials in cosmetics, such as a 2000-year-old hair dye recipe from the Greco-Roman period incorporating PbS NPs [5]. In modern times, the study of nanomaterials in cosmetics emerged in the early 1980s, with patent applications for materials like titanium dioxide in 1983 and ZnO nanopowder for UV protection in 1985 [6]. Fig. 1. depicts a significant rise in scientific publications concerning nanoscale components in cosmetic materials. [7]. Significant research in this domain concentrates on investigating the health and biological impacts of nanoparticles. As a result, regulatory bodies and agencies globally actively establish, monitor, and periodically reassess guidelines and limitations regarding the use of nanomaterials in consumer products.

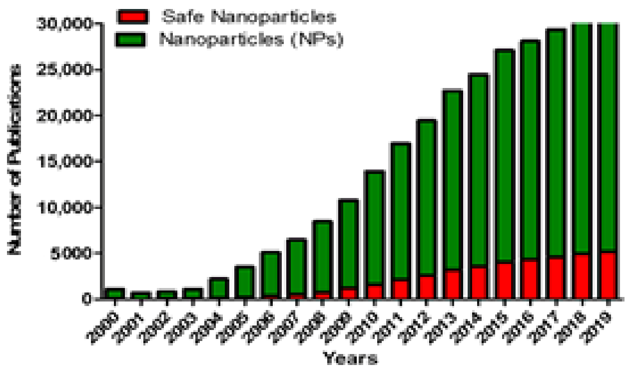

Fig.1 The number of scientific papers published in the last two decades

SYNTHESIS OF INORGANIC NANOPARTICLES

There are two main ways to make nanoparticles for cosmetics: bottom-up and top-down methods. Top-down methods crush big materials into small ones using things like ball milling or high-pressure extrusion. These methods are good for making a lot of particles but can have issues like defects and contamination.

Bottom-up methods, on the other hand, use ions and molecules to build tiny crystals in a solution. This way usually results in particles with fewer problems, but it's not as good for making a large amount, and it needs extra steps to clean up.

In real life, people often use a mix of both methods to make cosmetic nanoparticles. Sometimes, particles from bottom-up methods stick together, so they use top-down methods to break them back into individual tiny particles.

CHARACTERIZATION OF INORGANIC NANOPARTICLES

Analyzing inorganic nanomaterials involves the evaluation of dimensions, morphology, characteristics, distribution, crystallinity, shape properties, composition, and charges. Detailed analysis employs microscopic and spectroscopic methods to ensure a comprehensive understanding of these materials.

Electron microscopy, including SEM and TEM, captures particle size and morphology through digital imaging. SEM analyzes secondary electrons emitted upon excitation, while TEM uses transmitted electron beams. AFM measures forces between a surface and an atomic probe, providing 3D morphology. Dynamic light scattering (DLS) gauges particle size distribution based on Brownian motion. DLS efficiently determines hydrodynamic diameter, offering a comprehensive picture of size distribution quickly. Scattering can quantify zeta potential. BET surface area analysis studies gas adsorption for specific surface areas. Analytical ultracentrifugation assesses average particles by measuring sedimentation velocities, dependent on mass and size. These techniques collectively provide detailed insights into inorganic nanomaterials.

Powder X-ray diffraction (XRD) is employed to scrutinize the crystal structure of nanoparticles through the examination of dry samples, unveiling peaks associated with distinct crystallographic planes. HRTEM i.e. High-resolution transmission electron microscopy provides a straight visualization of crystal planes, facilitating the deduction of inter-planar spacing. The use of selected area electron diffraction (SAED) in TEM explores the crystalline nature, and diffraction patterns are analyzed using appropriate software and databases for identification.

Energy-dispersive X-ray spectroscopy (EDS) quantitatively analyzes nanoparticle elemental composition by stimulating characteristic X-ray emissions with a high-energy electron beam. The determination of relative element percentages involves the comparison of intensities in characteristic peaks. EDS is often coupled with SEM or TEM for comprehensive analysis, allowing site-specific examination. X-ray photoelectron spectroscopy (XPS) identifies oxidation states by measuring emitted electrons' kinetic energy. Thermal stability and thermochemistry are assessed through simultaneous differential scanning calorimetry (DSC) and thermogravimetric analysis (TGA). UV–Vis absorption spectroscopy reveals absorption/transmittance properties, estimating band gaps of inorganic nanocrystals from absorption spectra. These techniques collectively provide insights into elemental composition, oxidation states, thermal behavior, and optical properties of nanoparticles.

VERSATILE FUNCTIONALITIES OF INORGANIC NANOPARTICLES IN COSMETIC FORMULATIONS

In cosmetics, inorganic nanoparticles serve essential roles as active ingredients, carriers, and modifiers of appearance and rheology. They encompass various types like passive metals, oxides of metals and nanoclays, each tailored for specific cosmetic purposes. Notably, these nanoparticles offer benefits like staying on the skin without absorption, permitting the use of lower concentrations, and enabling desired alterations in solubility and texture. Notably, metal and its oxide nanoparticles are extensively utilized, particularly for UV shielding and antimicrobial efficacy in cosmetic products.

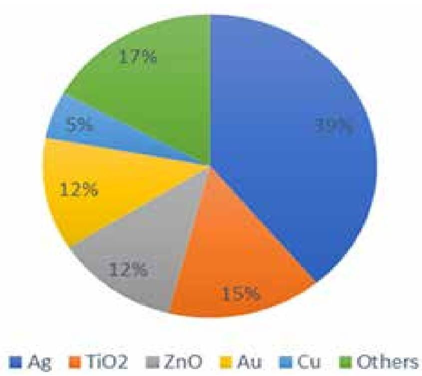

Fig.2 Inorganic nanoparticles in cosmetics

Cosmetic Advancement: Inorganic Nanomaterials As Active Agents

In cosmetics, inorganic nanomaterials play a role as active ingredients, improving skin appearance, offering protection against external factors, and contributing to cleaning functions through their unique physicochemical properties.

Inorganic Nanoparticles as UV Filters and Sunscreens

Approximately 10% of Earth's daylight is ultraviolet (UV) light, posing risks like mutations and photoaging on human skin. UVA (320–400 nm) and UVB (290–320 nm) radiation can cause harm, necessitating protection. Cosmetic sunscreens shield against UVA and UVB by either absorbing or scattering/reflecting UV light. Chemical UV filters, like salicylates and benzophenones, absorb UV radiation, dissipating energy through heat transfer and fluorescence. Physical UV filters scatter or reflect UV light. Sunscreen safeguards aim to counter adverse effects, protecting skin against harmful UV radiation.

In cosmetic sunscreens, inorganic oxide nanoparticles like TiO_2, ZnO, CeO_2, and ZrO_2 function as physical UV filters due to their ability to scatter and reflect UV radiation. While primarily operating through physical filtering, these metal oxides also absorb some incident UV light. The nanoscale dimensions of these materials enhance their capacity to attenuate UV radiation, improving skin protection. Unlike their bulk counterparts, nanosized TiO_2 and ZnO avoid creating a visible opaque layer on the skin, addressing a common disadvantage. The choice of particle size is crucial, impacting the scattering and absorption properties. Aggregation tendencies in synthesized nanoparticles necessitate processes like milling for dispersion. Aggregate size has an impact on sunscreen performance as determined by the Sun Protection Factor (SPF) and UVA Protection Factor (PFA). Alumina and silica coatings address concerns of TiO_2 and ZnO generating free radicals under UV exposure. CeO_2, $CePO_4$, and cerium-titanium pyrophosphates are being investigated as alternatives. The focus is on enhancing SPF and PFA in cosmetic formulations, taking into account aesthetic and safety considerations. Green chemistry and hydrothermal methods are common in TiO_2 nanoparticle synthesis, addressing concerns about their potential to generate free radicals. Coordinated use of inorganic and organic filters is explored for enhanced efficacy. Overall, ongoing advancements seek to maximize the effectiveness of inorganic nanoparticles in cosmetic sunscreen applications.

Table 1.

Nanoparticle	Applications
Titanium dioxide	Shaving products Sunscreen, Creams & Lotion, Skin lightening products Eye contour products, Hand care products Lip care products

Zinc Oxide	Concealer Eye contour products Face mask Foot care products Hand care products Lip care products Physical epilation products Skin lightening products Sunscreen, UV-filter
Silver	Makeup remover, Antimicrobial protection Coating of hair, Foot care products
silicon dioxide	Eye makeup products Hand care products Hair care products Concealer Face mask Lip care products Nail care products
Zirconium oxide	Antiperspirants Powders & foundation Eye makeup products
Gold	Wrinkle treatment Makeup remover Hair conditioner Sun protection
Iron oxide	Eye makeup Foundation Lipstick Mascara Nail varnish

Nanoparticles: A Potentforce as Antimicrobial Agents:

Since silver nanoparticles (Ag NPs) have antibacterial and antiseptic properties, they are widely used in commercial items and real-world applications. Ag NPs demonstrate superior efficacy over silver ions in inhibiting microbial growth, even in strains resistant to silver ions. Their antimicrobial action extends to bacteria like MRSA and resistant strains, as well as fungi. While the exact mechanism is not fully understood, Ag NPs are believed to interact with microbial cell membranes, inhibiting enzyme activity, affecting electron movement, and interacting with DNA/RNA. Their safety in cosmetic products is attributed to their lack of impact on mammalian cells. Ag NPs are used in aftershaves, matt creams, acne treatments, shampoos, and deodorants for their antimicrobial benefits.

Inorganic Nanoparticles as Nanocarriers

Nanocarriers, nano-sized materials facilitating targeted drug delivery, enhance permeability, and controlled release of active substances in cosmetic products. Nanoclays and mesoporous silica, with hexagonal nanopores, effectively deliver ingredients like UV filters and antioxidants to the skin. Mesoporous silica, known for controlled drug delivery, significantly improved UV protection when encapsulating the sunscreen octal methoxycinnamate (MCX). Thorough research supports the encapsulation of other sunscreens like benzophenone-3 (BZP) with mesoporous silica, indicating its potential in cosmetic formulations. Inorganic nanoparticles, such as clay and silica, serve as viscosity enhancers in cosmetics, forming percolating networks. Inorganic-organic hybrids, like SiO2 nanoparticles grafted to a perfluorocarbon-modified polymer, create nanostructured barriers, enhancing skin protection in cosmetic formulations.

Utilization Of Inorganic Nanoparticles As Formulation Enhancers In Cosmetic Products

Inorganic nanoparticles with chemical inertness find application as additives in diverse commercial products, particularly in cosmetics, where their exclusive properties, distinct from bulk counterparts, enhance formulation attributes. In cosmetic compositions, inorganic particles with nano sizes, such as clay and silica, operate as effective thickeners by using their ability to build a percolating particle network. Additionally, inorganic-organic hybrid nanomaterials contribute to cosmetic formulations; a case in point is SiO2 nanoparticles integrated with a hydrophobically modified alkali-soluble emulsion i.e. HASE polymer. This hybrid material shows the many applications of nanoparticles in beauty science and helps to form a barrier of nanostructured polymeric network on the skin, protecting against the toxicity of organophosphates.

CONCLUSION

Inorganic nanoparticles, with unique characteristics, find diverse applications in cosmetic products, demonstrating improved performance compared to non-nanoparticle counterparts. Notably, they excel in sunscreens and UV filters, where ongoing research aims to enhance safety and efficacy while addressing health and environmental concerns. In cosmetic formulations, inorganic nanomaterials are efficient antimicrobial agents, surpassing elemental or ionic forms. Diverse synthesis methods are explored for cosmetic-relevant inorganic nanomaterials, while advanced characterization techniques provide insights into their structure and composition. Scientific trends and patent applications indicate a growing and impactful role for inorganic nanoparticles in cosmetics in the coming years.

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5G for Covid-19 and future Healthcare Challenges

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ABSTRACT

The global toll of over 515 million COVID-19 cases and 6 million deaths, along with the sacrifice of 115,000 healthcare workers, prompted a comprehensive review of 5G technology's impact on healthcare. In the fight against COVID- 19, 5G has significantly improved diagnostics, patient monitoring, and contact tracing through high-speed data sharing and real-time capabilities. It has streamlined vaccine distribution, enhanced emergency medical services, and shown promise in tele surgery and robot-assisted tele ultrasound. Future applications include surveillance of vulnerable populations and advancements in nano-oncology. However, challenges such as infrastructure, health risks, security, and integration with other technologies must be addressed for widespread adoption. Overall, the integration of 5G holds immense potential in revolutionizing global healthcare delivery.

KEYWORDS *: 5G, Covid 19, Healthcare, Tele medicine, Artificial intelligence.*

INTRODUCTION

In 1905, William Einthoven's ground breaking development of the first electrocardiogram marked the inception of medical data transmission, with successful heart sound communication between his lab and a hospital in Leiden, the Netherlands. The first transatlantic transmission occurred in 1950 when heart sounds traversed the distance between New York and Europe. The term "telemedicine" was coined in 1974 by Bird, who facilitated a real-time examination of 1,000 patients between Massachusetts General Hospital and Boston Airport using audio-visual and television circuits. In 2001, a significant milestone was achieved with the first transatlantic tele surgery, "Operation Lindberg," where a New York surgeon operated on a patient in Strasbourg, France, utilizing a Zeus surgical robotic system and a dedicated 10-megabits-per-second fiber optic connection. The convergence of the fifth generation of wireless networks (5G), artificial intelligence (AI), the Internet of Things (IoT), and block chain has propelled telemedicine into new realms of possibility, particularly accentuated during the SARS-CoV-2 pandemic in Wuhan, China, when overwhelmed health systems spurred intensified interest in leveraging these technologies for innovative telemedical applications.

In response to the COVID-19 pandemic, swift disaster response measures were enacted, leveraging the newly established 5G telecommunications network with its expansive bandwidth. This 5G infrastructure played a pivotal role in minimizing local disruptions by providing real-time access and comprehensive visibility into all facets of healthcare delivery, a capability not achievable with 4G. Simultaneously, advancements in artificial intelligence (AI) significantly enhanced disease diagnosis through innovative applications in medical imaging and thermal measurements, utilizing computer vision and infrared technology. AI played a crucial role in analysing the pandemic situation, contributing to tasks such as labelling, contact tracing, monitoring movement of infected individuals, and optimizing logistics, inventory control, asset tracking, and material allocation. Telemedicine emerged as an indispensable component of healthcare during the pandemic, offering remote medical assistance and facilitating acute patient triage before hospital arrivals. This widespread adoption, recognized for its efficacy and the ability to mitigate unnecessary visits, played a vital role in reducing exposure risks. Notably, the World Health Organization reported a sobering statistic of 115,000 healthcare workers succumbing to COVID-19 between January 2020 and May 2021, underscoring the immense challenges faced by frontline healthcare professionals during this global crisis.

As of May 4, 2022, the global impact of COVID-19 has been staggering, with 515 million reported cases and over 6 million deaths. Amid the ongoing pandemic, the deployment of 5G technology, which operates at higher frequencies than its predecessor 4G, introduces a distinctive challenge—signal degradation. Unlike the wider coverage of 4G, 5G necessitates densely populated "base stations" located approximately every few hundred meters rather than kilometers. This closer proximity is essential to maintain the efficiency of 5G signals. While 5G holds promise for enhanced connectivity and advanced applications, the need for increased infrastructure density poses a notable hurdle in achieving seamless and reliable coverage, particularly in regions with lower population density. Addressing these challenges becomes crucial for unlocking the full potential of 5G technology in the context of global healthcare and communication networks.

5G networks transcend conventional human-to-human connectivity, extending their capabilities to include a vast array of 'smart devices.' With an existing 14.2 billion devices and projections anticipating a surge to 25 billion by 2025 and a staggering 600 billion by 2030, the landscape of connectivity is rapidly evolving. This paradigm shift is characterized by extensive data generation, acquisition, and continuous monitoring facilitated by micro/Nano sensors embedded in machines, devices, equipment, and living systems, including humans. The integration with the Global Positioning System (GPS) ensures precise geolocation across this interconnected network. Notably, 5G networks enable the simultaneous connection of myriad devices, a phenomenon referred to as the 'Internet of Stocks.' This multiplicity of connections not only enhances overall efficiency but also lays the foundation for significantly smarter services, marking a transformative era in the realm of connectivity and technological integration.

5G IOT FRAMEWORK

The 5G framework for IoT is like a team with different layers working together. At the bottom, the IoT Sensor Layer has smart sensors and devices that talk to the Network Layer, which is like the team captain using LPWAN tech to connect devices. Then, there's the Communication Layer, which is like the main road where information travels smoothly between layers. The Architecture Layer is the master plan, using tech like cloud computing to organize everything. Finally, the Application Layer is the big show where all devices, sensors, and info come together, making things like smart factories and homes possible. It's like a well-oiled machine where each part plays a crucial role in making IoT work smoothly.

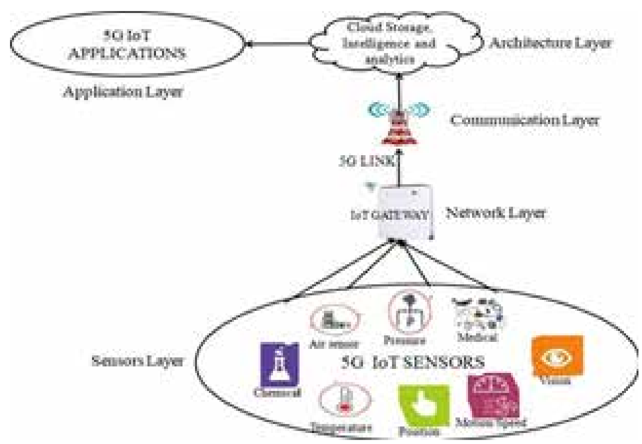

Figure 1. 5G IOT Framework

Imagine a smart world where different gadgets, called IoT sensors, do smart things like monitoring your home or tracking agriculture. These sensors connect to a hub, known as an IoT gateway, using low-power networks like SigFox, LoRa, or NB-IoT, which are great for long-distance communication. This gateway is like a smart organizer, gathering all the info from these devices and sending it to super-fast 5G base stations through a special 5G link. These 5G links use high- tech stuff like 5G NR and mm-wave to work really efficiently. The base stations, equipped with smart antennas, process all this info and can handle radio signals at super high frequencies, up to 80 GHz. This not only connects a bunch of devices but also brings together different types of base stations for a cool setup called HetNets, making our smart world even smarter!

APPLICATIONS

Tele surgery

Tele surgery, primarily employed in remote or extreme conditions such as battlefield scenarios or space missions, relies on master-slave robotic surgical systems. A crucial factor for successful implementation is minimizing latency between the master and slave components. Ideally, latency should be below 100ms, as issues like inaccurate manipulation may arise if it exceeds 300ms. Anvari et al. conducted over 30 tele surgeries between Hamilton and North Bay in Canada, approximately 400 km apart, reporting an average latency of 140ms, effectively compensating for the delay. Further advancements were demonstrated using 5G technology in porcine model surgeries, including nephrectomy, partial hepatectomy, cholecystectomy, and cystectomy. Conducted over a distance exceeding 2000 kilometers, the Micro Hand robot from the Wego group showcased the feasibility of tele robot-assisted surgery. Despite a 5G delay of 264ms, slightly higher than a wired network (206ms), this study highlighted the potential for efficient long-distance tele surgery, crucially maintaining a latency as low as 60ms in a phantom model, thus enhancing the prospects of this innovative medical approach.

Federated learning for diagnosis

To address the challenge of protecting patient privacy and the limitations of AI models based solely on individual institutional data, federated learning emerges as a promising solution. This innovative approach involves collaborative learning from a shared prediction model hosted on an external cloud, allowing each hospital's network to keep its training data private. By decoupling AI inference capabilities in the cloud from secure data storage within each hospital, federated learning ensures a more generalized and privacy-preserving model. This methodology was applied to blood tests from 1013 patients across three different centers, utilizing 5G to transmit patient data to a cloud edge for AI model application. The external cloud AI model only receives updates, not patient data, from each edge cloud. Impressively, this federated learning model achieved accuracy rates of 95.3%, 79.4%, and 97.7% at each center, respectively, effectively classifying the severity of COVID-19 patients upon hospital admission. This demonstrates the potential of federated learning with AI in enhancing the robustness and privacy of predictive models across diverse healthcare settings.

Radiology: computed tomography

Given the widespread availability of CT scans and X-ray radiographs in hospitals, these imaging modalities have been pivotal in the detection of COVID-19. The initial report on computerized tomography (CT) imaging during the pandemic, conducted on 152 patients in Chengdu, Sichuan, and other centers, paved the way for advanced approaches. Multilayer platforms, incorporating peripheral devices, the Internet of Things (IoT), and cloud computing, have been proposed. In a notable study, a 5G framework was deployed for monitoring 4,650 CT scans, utilizing block chain for data security. This innovative approach comprised CT scans at the bottom layer, edge devices in the middle, and cloud computing at the top layer. Convolutional Neural Networks (CNNs) were trained in the cloud, while explainable AI at the edge layer visualized COVID-19 findings in CT scans. Another report employed IoT devices for direct data transmission to a cloud server via 5G networks, assembling multiple CNN models to enhance COVID-19 diagnosis accuracy. The ensemble model, trained on 2484 CT samples, achieved an impressive diagnostic accuracy of 96.6%, showcasing the potential of integrated technologies in advancing the precision and efficiency of COVID-19 detection from imaging data.

Obstetrics

The cardiotocogram, traditionally confined to healthcare clinics, is now poised for a transformative shift with the advent of 5G technology. Recent publications have explored the feasibility of transmitting cardiotocogram data, along with real-time ultrasound videos of the fetus, over mobile networks, extending the monitoring capabilities beyond clinical settings. In a simulated environment, the authors demonstrated the seamless transmission of high-quality ultrasound videos, portraying patient actors with remarkable clarity. With the deployment of 5G, this innovative solution holds the potential to enable home monitoring of fetal health, opening up new avenues for obstetric care. The real-time transmission of both cardiotocograms and ultrasound videos not only signifies technological advancements but also marks a significant leap towards more accessible and patient-centric healthcare, shaping the future landscape of obstetric care.

Vaccine Distribution

Unmanned aerial vehicles (UAVs) are emerging as efficient tools to expedite vaccine distribution, particularly in the context of COVID-19, owing to their faster round- trip delivery times and lower shipping costs compared to traditional road transport. A recent proposal introduces a multi-layer architecture tailored for this purpose. This framework comprises a management layer involving hospitals, vaccine production warehouses, and pharmacies, coupled with UAVs and 5G connectivity. Another layer facilitates the distribution of vaccines and the registration of recipients, employing block chain for data encryption to ensure security. A simulation study demonstrated a substantial cost advantage, estimating a mere $0.0229 per kg for UAV transportation in contrast to $0.0546 per kg for road transport. This not only underscores the economic viability of UAV-based distribution but also highlights its potential to revolutionize vaccine supply chains, offering a swift and cost-effective solution with broader implications for public health logistics.

Patient monitoring technology

In numerous studies, IoT devices connected through 5G to cloud servers have played a pivotal role in monitoring vital signs of COVID-19 patients. An early IoT application involved real-time tracking of body temperature, heart rate, and blood oxygen levels, with machine learning predicting virus spread risk. A deep learning model achieved 96.2% accuracy in classifying COVID-19-related changes. More recent innovations include a portable fluorescence sensor linked to personal devices through Bluetooth and 5G for rapid detection, showcasing a 10- minute detection time in a test on 19 patients. Barometric sensors were utilized to detect respiratory rate and cough, displaying 97.3% accuracy in a study on 10 subjects. Cutting-edge technology incorporating cloud computing for COVID-19 detection utilized smartphone apps to collect vital signs, employing LSTM and logistic regression models. Furthermore, a CNN-based deep learning model achieved a diagnostic accuracy of 97.1% in detecting COVID-19 from medical images. In a separate study, wearable sensors transmitting ECG signals via 5G enabled AI prediction of health risks in COVID-19 patients, attaining a remarkable 99.29% accuracy in cardiovascular disease prediction. These technological advances underscore the diverse applications of IoT and 5G in enhancing COVID-19 monitoring and diagnosis.

Emergency medical services

In emergency healthcare services, 5G is proving transformative by connecting ambulances, paramedics, patients, and expert doctors, enhancing response times and diagnosis precision. In Madrid, Spain, 5G was employed for heart attack treatment, where a wearable device like a smartwatch triggered a 5G alarm to a central cloud server. This server, monitored by doctors, provided a probable diagnosis and dispatched the appropriate medical team using augmented reality (AR) via Microsoft Hololens v1holographic glasses. The AR app displayed the patient's geolocation and health information, guiding the emergency team to the location. In China, 5G facilitated the creation of an intelligent ICU at Zhejiang University School of Medicine, enabling remote monitoring, ward visits, consultations, and family interactions. The United Kingdom witnessed the first remote diagnosis through a collaboration between Ericsson, University Hospital Birmingham NHS Foundation Trust, and King's College London. A video of an ultrasound scan was transmitted from an ambulance to an expert doctor wearing a virtual reality (VR) headset, guiding a paramedic, equipped with a haptic glove, to perform the ultrasound. 5G's application in emergency healthcare demonstrates its potential to revolutionize response mechanisms, diagnosis, and remote medical assistance.

Lung pathology in patients

A comprehensive multi-institutional report, based on the evaluation of lungs from 68 autopsies in highly affected areas (two in the USA and one in Italy), revealed the heterogeneous nature of COVID-19 pneumonia, encompassing tracheobronchitis, diffuse alveolar damage, and vascular injury. Particularly crucial in managing exacerbations of chronic respiratory diseases, remote monitoring during primary care has the potential to significantly reduce hospitalization expenses and overall healthcare costs. Despite previous contradictory evidence on the efficacy of telemedicine in emergencies, a recent report focusing specifically on patients with chronic respiratory disorders demonstrated promising outcomes. The system involved a portable respiratory and activity monitor, an environmental sensor, and a pulse oximeter, transmitting data to a tablet connected to a 5G infrastructure. Tested on 18 healthy volunteers during an unsupervised 48-hour experiment, the results underscored the system's ability to provide more comprehensive, clinically relevant, and real-time information compared to previously studied telemedicine systems, showcasing its potential impact on optimizing chronic respiratory disease management.

Manipulation of the tele endovascular catheter

In a groundbreaking study, robot-assisted tele stenting, a procedure where stent and coronary interventions are conducted remotely, was successfully performed over considerable distances. An expert interventional cardiologist in Boston controlled the CorPath GRX vascular surgery robot from Corindus through a 5G network, while a robotic arm managed the Angio Mentor virtual reality simulator from Simbionix-Surgical Science located in New York and San Francisco, spanning 206 and 3,085 miles, respectively. Bedside technicians manually advanced the guide catheter and conducted coronary procedures under robotic actuation. With imperceptible 5G latencies (162.5 ± 1.1ms from Boston to San Francisco and 86.6 ± 0.6ms from Boston to New York), the study demonstrated the maturity of tele stenting for potential application in real patient procedures over extended distances. This innovative system holds promise for remotely treating critical limb ischemia and stroke. Additionally, tele mentoring in 3D vitreoretinal surgery showcased a bit rate between 8 and 20 Mbps and a 250 ms latency guaranteed by 5G connectivity, further expanding the possibilities of advanced medical procedures in remote settings.

CONCLUSION

This paper has provided an overview of diverse studies exploring the applications of 5G in the context of COVID- 19. Looking ahead, future prospects in the realm of healthcare technology converge toward the Internet of Nano Things (IoNT). However, the realization of these opportunities is contingent upon overcoming existing challenges, encompassing infrastructure limitations, cybersecurity concerns, and potential health hazards associated with 5G technology. Researchers are actively engaged in addressing these drawbacks to ensure the seamless integration and advancement of IoNT in healthcare. As efforts continue to mitigate these challenges, the evolution of 5G applications in the context of COVID-19 holds significant promise, paving the way for transformative developments in the intersection of telecommunications and health care.

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Venture Boost - Blockchain-Driven Collective Funding DApp

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ABSTRACT

The purpose of this initiative is to provide aspiring business owners a thorough grasp of crowdfunding as a substitute source of funding. It examines the key features, alleged advantages, and possible drawbacks of listing a project on a crowdfunding website. The Decentralised Crowdfunding Platform uses smart contracts and blockchain to improve donor protection and fight fraud. By facilitating safe and transparent transactions, the platform transforms crowdfunding by guaranteeing transparency and accountability, enabling contributors to make knowledgeable choices, and directing donations straight to campaigns, thereby reducing the possibility of abuse. By embracing decentralization, the platform gives crowdfunding projects a dependable and secure environment.

KEYWORDS *: Blockchain, Smart contracts, Decentralization, Alternative funding and crowdsourcing.*

INTRODUCTION

Blockchain technology is transforming our interactions with digital assets and financial systems through creative applications. The " Venture Boost - Crowdfunding DAPP " is a pioneering initiative that uses blockchain to establish a decentralized crowdfunding platform, introducing a new paradigm for fundraising.

This decentralized application (DApp) empowers users to start fundraising campaigns, creating an open environment for community finance. This blockchain-based DApp offers greater transparency, security, and trust than traditional crowdfunding platforms.

The "Venture Boost - Crowdfunding DAPP" includes a number of critical elements that make it an effective and user-friendly platform for fundraising and project funding. One of its key features is User-Initiated Fundraising, which empowers individuals, entrepreneurs, and organizations to initiate their own fundraising campaigns. Open Contribution promotes diversity by allowing individuals to contribute to initiatives that match with their interests and values. The platform's Targeted Contribution Goals give a framework for initiatives to define financing targets. Meeting these goals ensures the project meets its financing aim and is completed effectively. Deadline-Driven Expiry ensures accountability and prevents projects from failing to meet contribution targets . This safeguards contributors from being locked into unsuccessful endeavors. Contributors can withdraw their contributions if a project expires, giving them control over their finances. The platform promotes openness and accountability by forcing project owners to get permission from donors before making withdrawals. This guarantees that contributors have a say in how their efforts are used. To ensure fair and democratic decision-making, the DApp requires Majority Consensus for Owner Withdrawal. This means that owners can only withdraw cash with the approval of at least 50% of contributors. This maintains the platform's communal nature and ensures that decisions align with the community's interests. [1] The DApp interfaces with cryptocurrency wallets for added security and convenience during user interactions on the site. The "Venture Boost - Crowdfunding DAPP" offers a transparent and creative environment for fundraising and project financing by integrating accessibility, accountability, and security. The "Venture Boost -

Crowdfunding DAPP" transforms crowdfunding by removing intermediaries, increasing transparency, and promoting a collaborative approach to fundraising.

LITERATURE SURVEY

Title	Author	Description
Blockchain based crowdfunding systems [2]	Syed Abdul Halim, Md Nazmus Saadat	Blockchain technology helps challenges like unregulated campaigns, fraud, and delayed project completion, blockchain technology can help prevent fraud and ensure timely project delivery.
Blockchain based fundraising [1]	Gorti Avinash, Dr. P. Shanmugapriya, Gummadi Anand Kumar	The rapid advancement of technology has led to a competitive market for talent, with investors seeking the best talent. Blockchain technology, enabling decentralized user networks and transparent platforms, is suggested for a global crowdfunding platform.
Web3: The Next Internet Revolution [4]	Hong Lin, Shicheng Wan, Wensheng Gan, Philip S. Yu ,Jiahui Chen,	Web3 enables users to control data ownership, but research gaps remain due to its buzzword nature and limited literature on its true nature as only a few people can accurately describe what real Web3 is.
An integrative review of Web 3.0 in academic libraries [3]	Vinay M S, J S Mohan, B Preedip balaji, Shalini B G	This paper aims to examine different kinds of advanced technologies known as Web 3.0, focusing on how they can benefit academic libraries.
Security Enhanced Crowdfunding Using Blockchain [6]	Vishwa Kumar, Hussain Imthiaz Hussain Vishal Celestine	Crowdfunding is an online fundraising method where individuals contribute small amounts of money to support creative projects or ventures initiated by others.

PROPOSED METHODOLOGY

Our research focused on identifying difficulties in traditional crowdfunding platforms and exploring the potential of combining crowdsourcing with blockchain technology.

Technologies

The "Venture Boost - Crowdfunding DAPP" is a decentralized crowdfunding platform using a smart contract-based application. It allows users to start fundraising campaigns, contribute to initiatives, and manage fund withdrawals. The project begins with rigorous planning and requirement collection, focusing on essential functionality like user-initiated fundraising, open donations, and expiration rules. The choice of technology stack is crucial, with Next.js for the frontend, Solidity for smart contracts, Tailwind CSS for design, Ether.js and Web3.js for Ethereum blockchain interactions, Chai for JavaScript testing, React-Toastify for alerts, Hardhat for Ethereum development, and Redux for state management. [3]

Smart Contract

Creating smart contracts is a vital part of the project. These contracts, built using Solidity, handle various aspects like fundraising, ownership, donations, withdrawals, and agreement rules. When these conditions are met, the contract executes automatically without the need for intermediaries. Smart contracts run on blockchain platforms like Ethereum.[2]

Ethereum

Hardhat is used to build up the Ethereum development environment to test and deploy smart contracts locally. Unit tests use Chai and Hardhat's testing framework to validate contracts and application behavior. [3]

Frontend

The frontend uses Next.js to provide user-friendly interfaces for project creation, donation, and monitoring. Web3.js enables communication with the Ethereum blockchain and smart contracts. These interactions involve project development, contribution management, and consensus checks. Tailwind CSS is used to build visually beautiful and user-friendly front-end designs. It makes the DApp's UI user-friendly and responsive, resulting in a smooth experience.

Redux enables centralized state management by storing and managing information on ongoing projects, user contributions, and other pertinent data. This method ensures uniform user experience across the program. Thorough testing and debugging are necessary to verify the DApp's operation is stable and free of errors. Simulating different user scenarios helps detect and fix potential issues during testing.

After testing, smart contracts are deployed to the Ethereum mainnet or testnet to evaluate the DApp's performance in a live blockchain context. This phase guarantees that the application is safe and reliable. User testing involves gathering input from real users to discover usability faults and potential solutions. Adjustments are made based on this input to improve the user experience.

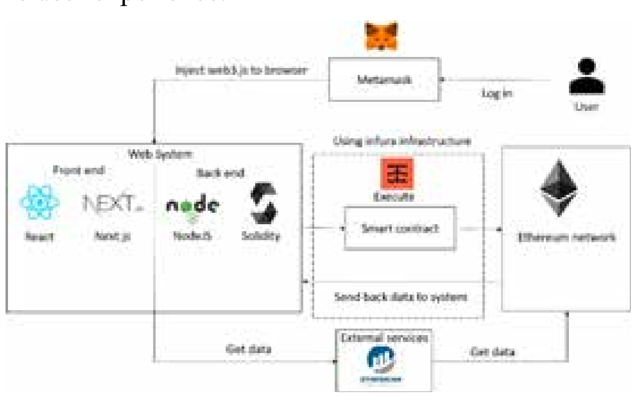

Fig 1: System Architecture

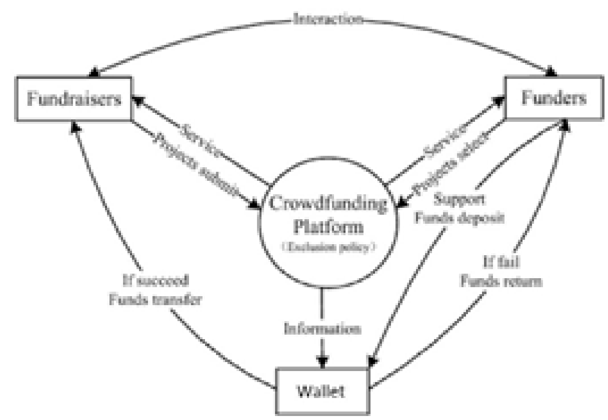

Fig 2: DFD Diagram

MOTIVATION

This research aims to fix problems with regular crowdfunding. Traditional platforms often lack transparency and trust, making it hard for people to believe in and support projects. We're using modern technologies like Next.js for the website and Solidity for smart contracts to make crowdfunding better. Blockchain helps us create a system that's transparent, secure, and accountable. This way, we hope to rebuild trust between people who give money and those who create projects, making crowdfunding safer and more reliable.

CONCLUSION

Integrating blockchain technology with crowdfunding decentralized apps (DApps) is a game changer in the fundraising scene. Our review of significant papers highlights the importance of blockchain-based crowdfunding DApps. Blockchain technology has improved crowdfunding's security, transparency, and cost-efficiency.

Peer-to-Peer smart contracts eliminate transaction and platform costs, making crowdfunding more affordable for both investors and project developers. DApps aim to provide a safe platform for funding innovative initiatives. The upgraded Ethereum-based crowdfunding mechanism ensures investor safety and is a significant step forward. Smart contracts improve crowdfunding security, reduce risk, and boost backer confidence. Smart contracts streamline crowdfunding procedures, reduce fraud, and improve efficiency. Blockchain-based crowdfunding DApps provide security, speed, and transparency, making them an appealing option for fundraising.

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Generative AI in Healthcare: A Comprehensive Review

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ABSTRACT

This technical paper provides an in-depth exploration of the applications of Generative Artificial Intelligence (AI) in the healthcare sector. The healthcare industry is one of several that are being drastically changed by the ongoing breakthroughs in AI technology. Generative AI, in particular, has shown great promise in revolutionizing healthcare by enhancing diagnostics, drug discovery, personalized medicine, and medical image analysis. This paper discusses key applications, challenges, and future prospects of Generative AI in the healthcare domain.

KEYWORDS *: Generative AI, GAN, Deep learning, Machine Learning, NLP.*

INTRODUCTION

Generative AI, a subset of artificial intelligence, uses large datasets to generate new content, including Generative Adversarial Networks (GANs), based on learned patterns.

Because of the vast volumes of data and the rising sophistication of computer technology, generative artificial intelligence, or GAI, has attracted a lot of interest recently.

Due to the substantial progress made in this area, GAI is now one of the most popular and commonly utilized AI algorithms [1].

Generative AI involves using algorithms to create something new rather than simply recognizing patterns in existing data. GANs consist of generator and discriminator neural networks developed concurrently using adversarial training. The generator generates new data, while the discriminator assesses authenticity until it cannot be distinguished from actual data.

Applications for generative AI may be found in many domains, such as natural language processing, art, drug discovery, and picture and video creation. Through the creation of fresh and varied outputs, it has the ability to improve creative processes and develop realistic material. But as generative AI develops, issues including possible biases in created material, ethical concerns, and assuring responsible use of these technologies must be addressed.

The usefulness of Generative Adversarial Networks (GANs) in medical imaging is investigated in [3]. It uses hepatic CT, RGB retinal pictures, and cardiac cine-MRI to test several GAN structures. The findings indicate that different GANs perform differently in medical imaging scenarios. Although the whole richness of medical datasets cannot be replicated by any GAN, top-performing GANs are capable of producing realistic-looking images. The study emphasizes the necessity of more investigation and advancement in GAN applications [3].

Big data in clinical science, facilitated by digitization of medical records, promotes precision medicine. Privacy concerns persist due to data leakage. Strategies like field suppression, abstraction, and differential privacy are proposed for Syntegra technology. [4].

Healthcare is witnessing a transformative era with the incorporation of cutting-edge technology,, and Generative AI stands out as a key player in this evolution. It includes generating fresh information, data, or material that closely resembles patterns seen in humans. In healthcare, this capability is leveraged for a multitude of applications, ranging from disease prediction to treatment optimization.

GENERATIVE AI APPLICATIONS IN HEALTHCARE

Medical Image Generation and Enhancement

For accurate diagnoses of the patients, Generative AI techniques like GANs are crucial for creating realistic medical images, aiding in training healthcare professionals, augmenting datasets, and improving imaging quality which will help the doctors to make better decisions.

The Drug Discovery and Development

Drug research is expedited by generative AI by the prediction of possible drug candidates and optimizing molecular structures. The ability to generate novel molecules with desired properties expedites the identification of new drugs, reduces development costs, and facilitates the creation of personalized medicines. Deep learning is preferred in drug development over traditional machine learning due to large data sets challenges, aiming to reduce training sets and extract useful information [2].

Predictive Analytics for Disease Diagnosis

Generative models, when trained on extensive patient data, enable the creation of predictive models for disease diagnosis. These models can analyze patient records, genomic data, and other relevant information to forecast the likelihood of diseases, enabling early intervention and personalized treatment plans.

Electronic Health Records (EHRs) with NLP

NLP-based Generative AI algorithms assist in extracting valuable insights from unstructured data in electronic health records. This helps in streamlining healthcare workflows, improving clinical decision-making, and enhancing patient care.

Customized Treatment Plans

Generative models utilize patient data, including genetics, lifestyle, and treatment responses, to create customized treatment plans that enhance treatment efficacy while minimizing side effects.

THE USE OF GENERATIVE AI FOR CLINICAL EVALUATION, REGULATION AND CERTIFICATION CHALLENGES

Generative AI has the potential to significantly impact clinical evaluation, regulation, and certification processes in the healthcare sector. However, its use also raises several challenges that need careful consideration:

Data Privacy and Security

For training, generative AI models frequently need big datasets. In the healthcare industry, these databases include private patient data. It is essential to protect patient privacy and security in order to abide by US laws like the Health Insurance Portability and Accountability Act.

Ethical Considerations

The generation of synthetic data, which mimics real patient data, raises ethical concerns. There is a need for transparency and accountability in the use of generative AI to avoid any unintended consequences, especially when it comes to decisions impacting patient care.

Validation and Reliability

Clinical evaluations heavily rely on the accuracy and reliability of diagnostic tools. Ensuring that generative AI models can consistently produce reliable results is a challenge. The models need rigorous validation against real-world clinical data to demonstrate their effectiveness and safety.

The Explainability and Interpretability

A lot of generative AI models, particularly deep neural networks, are viewed as "black boxes" as it may be challenging to understand how they make decisions. In healthcare, understanding how a model arrives at a particular diagnosis or recommendation is crucial for gaining trust from healthcare professionals, regulators, and patients.

Regulatory Compliance

Healthcare is a highly regulated industry, and any technology introduced must comply with existing regulations. Regulators need to adapt to the evolving landscape of generative AI in healthcare and establish guidelines for the development, validation, and deployment of these technologies.

Standardization and Certification

Establishing standardized procedures for evaluating and certifying generative AI models in healthcare is essential. Certification bodies may need to evolve to assess the safety, efficacy, and ethical considerations of these technologies, ensuring they meet the required standards before deployment.

The Bias and Fairness

Generative AI models may unintentionally introduce biases in training data, a concern that must be addressed to ensure fair outcomes, particularly in healthcare where biased judgments could lead to inequities.

Continuous Monitoring and Updating

Healthcare is a dynamic field, and medical knowledge evolves over time. Generative AI models must be designed to adapt to new information, and mechanisms for continuous monitoring and updating should be established to keep the models relevant and accurate.

Integration with Existing Healthcare Systems

Seamless integration of Generative AI applications with existing healthcare systems poses technical challenges. Ensuring interoperability and compatibility is essential to enable widespread adoption and maximize the benefits of these technologies.

Addressing these challenges will be crucial for integrating generative AI into clinical practices, ensuring patient safety, maintaining regulatory compliance, and fostering trust among healthcare professionals and the general public. Collaborative efforts between the healthcare industry, technology developers, and regulatory bodies are essential to navigate these challenges effectively.

FUTURE PROSPECTS

The future of Generative AI in healthcare holds immense potential. Continued research and development will likely lead to improved models, increased accuracy, and expanded applications. Collaboration between AI researchers, healthcare professionals, and policymakers is essential to address challenges and guide the ethical deployment of these technologies.

CONCLUSION

Generative AI has the potential to completely transform healthcare by providing creative fixes, enhanced diagnostic capabilities, and customized medical regimens. However, ethical standards and collaboration across disciplines are crucial for its full potential.

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Design and Development of Context Sensitive Dictionary (CSD) using Computational Linguistic Approach

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ABSTRACT

The typical old hand-to-print manner of instruction has given way to a digital context in teaching, reading, writing, and documentation. Since various advancements in the field of computer technologies, there has been a great transition of using the same. This research explores the innovative use of computational linguistics techniques to create a context-sensitive dictionary capable of enhancing language understanding and text analysis. Acknowledging the evolving landscape of language and communication in the digital era, where diverse linguistic expressions, idiomatic phrases, and contextual nuances pose challenges for traditional dictionaries. To address this, the research leverages computational linguistics methods, which allow for the automated extraction and organization of words and their context-dependent variations. This study specifically considers educational videos available in a specific domain. There are so many of these helpful teaching resources available in such large volumes that it is necessary to create automated methods to understand their structure, organization, and content. One of the main tools to be created is an automatic Context Sensitive Dictionary (CSD) generator, in addition to the automatic transcription of the audio and video educational resources. "Context Sensitive Dictionary" presents a pioneering effort to bridge the gap between traditional lexicons and the dynamic, context-rich nature of modern language.

KEYWORDS *: Context sensitive dictionary - CSD, Computational linguistics(CL), Artificial neural networks(ANN), Recurrent neural networks(RNN), Natural language processing(NLP)..*

INTRODUCTION

Language is deeply ingrained in our day-to-day existence, a dynamic and always-changing form of human expression. In an era defined by rapid digital transformation, the way we teach, read, write, and document language has undergone a profound metamorphosis. The existing systems, largely rooted in traditional lexicons and dictionaries, struggle to keep pace with the dynamic and context-rich nature of modern language. Conventional dictionaries provide static, one-size-fits-all definitions, but language is a chameleon, adapting its meanings based on context, culture, and evolving usage. In a world where diverse linguistic expressions, idiomatic phrases, and contextual nuances abound, these traditional tools fall short. Also, the existing system uses different web tools for the conversion of Video to Context sensitive words and uses algorithms based on Artificial Neural Networks (ANNs) towards application domains which are giving efficiency of around 80%.

The problems of the existing system are multifold:

- Lack of Contextual Understanding: Traditional dictionaries do not capture the context in which words are used, leading to misunderstandings and misinterpretations.
- Inefficiency in Educational Materials: With the massive influx of educational content in digital

formats like videos, there is a pressing need for automated tools to comprehend, organize, and extract meaning from this wealth of information.

- Machine Translation Challenges: Accurate machine translation depends on context-aware definitions, which are lacking in traditional dictionaries.

In response to these challenges, the proposed research embarks on a pioneering journey. The authors propose an innovative solution rooted in computational linguistics techniques a Context-Sensitive Dictionary (CSD) capable of automatically generating context-aware word definitions.

The need for such a system is undeniable in our interconnected and diverse world. The proposed project, "Context Sensitive Dictionary" is not just a visionary endeavor; it is a necessity for the digital age, enabling users to navigate the intricate maze of language with confidence and precision.

LITERATURE SURVEY

Sr	Theme	Remarks
[1]	Automatic generation of Context Sensitive Dictionary using computational linguistics approach.	Conversion of speech to text and finding the context of the word.
[2]	Natural Language Processing and Computational Linguistics	Computational linguistics supports Natural language Processing.
[3]	Survey on Recurrent Neural Networks in Natural Language Processing	Recurrent Neural Networks are made for sequential data and have connections that loop back on themselves.
[4]	Speech to text conversion and summarization for effective understanding and documentation	Translating the words which are said by a human helps to get most of the context-sensitive words.

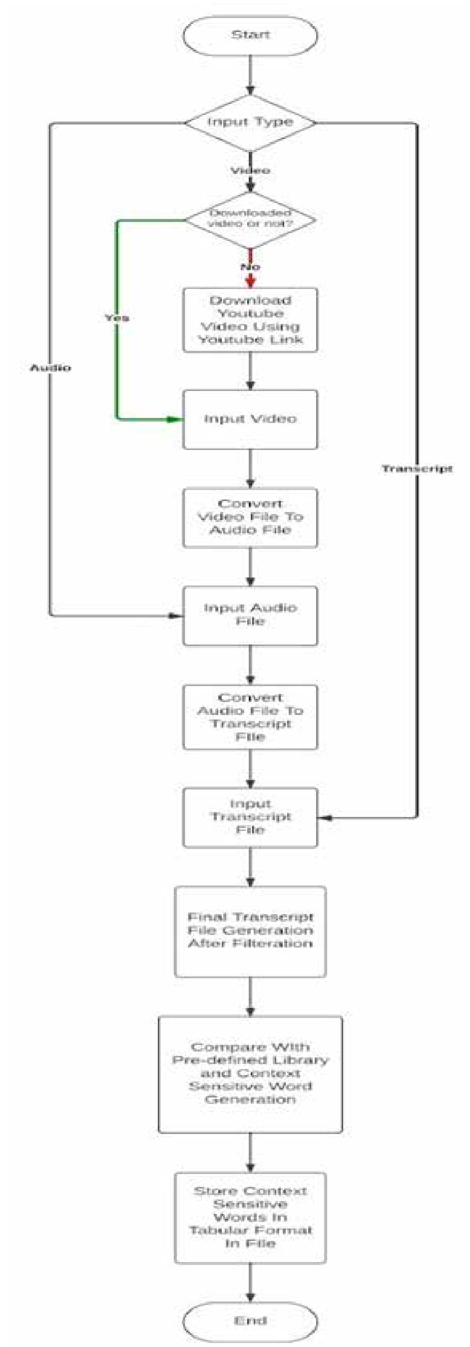
PROPOSED SYSTEM

Purpose of Project

As the name implies, context-specific vocabulary and their strictly restricted meanings are included in CSD. The main objectives of the project are

- Enhancing Language Learning.
- Precision in Content Creation.
- Effective Communication.

Algorithm & Flowchart



EXAMPLE

Using a video file, the authors have demonstrated the aforementioned approach.

Step 1: Authors have selected a video of Prof. B.M Hegde from YouTube.

Nature of Video (mp4)	Duration (in Mins)	Size (in MB)
Does STENT Really Work To Save Heart Attack?	9.2	55.2

Step 2: Take out just the voice in the video above. This step is carried out in two sub-steps:

1. .mp4 file is converted into mp3 file.

Nature of Audio (mp3)	Duration (in Mins)	Size (in MB)
Does STENT Really Work To Save Heart Attack?	9.16	8.27

2. .mp3 is converted into .wav.

Nature of Audio (.wav)	Number of .wav files created	Size (in MB)
Does STENT Really Work To Save Heart Attack?	177	85.9

Step 3: Transcribe all audio files from .wav format to text.

Size (KB)	Word Count
7	1310

Step 4: The transcripted files are processed in the following three substeps:

1. Removal of Nouns, Proper-Nouns, and Verbs along with the non-medical 3-character words:

File name	Word count
samplekeywords.txt	226

2. Extraction of most frequently used words:

From .txt top 10 frequently used words are saved into another .txt file.

File name	Word count
filtered_keywords.txt	10

3. Comparing samplekeywords.txt with medical data set and appending it with filtered_keywords.txt.

File name	Word count of matched words	Total Word count
filtered_ keywords.txt	39	49

Step 5: Final comparison with the Medical Dataset

filtered_keywords.txt is again compared with dataset. txt to get the final 44 words.

The following formula was implemented to analyze the procedure's accuracy:

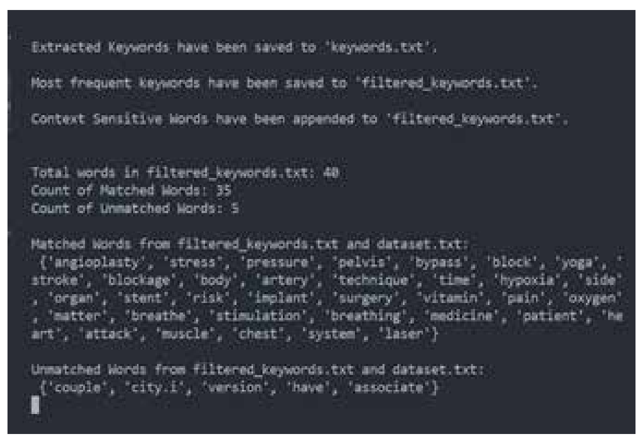
Efficiency (%)

= (Matched terms/Extracted terms)*100

= 89.79

Our initial findings indicate that the accuracy is approximately 89.79%.

RESULTS



Words are compared and extracted.

FUTURE SCOPE

The way it is currently set up undoubtedly turns video into context-sensitive words, and as a result, the context of each word is recorded in a table. In the future, authors aim to find the exact meaning of the words of course related to the domain the word is used for. Also, the current system takes downloaded videos as input and generates output likewise. In the future authors tend to add certain mechanisms so that the system can generate real-time words when given a real-time input through lectures or seminars.

CONCLUSION

Our first attempts at producing CSD using a computational linguistics-based method show a respectable efficiency of about 89.79%. Nevertheless, because our procedure is semiautomatic, it merely produces the word's context from the input, not the word's precise meaning. and we are developing sophisticated algorithms right now to automate several tasks.Longer term, our approach will look at the collection as a whole in addition to extracting and analyzing keywords and phrases from individual videos. This will allow us to carry out tasks like automatic ontology management, automatic catalog entry generation, query-by-example, vertical and fine-grain catalogs, CSD generation, and Automatic Context-Sensitive Dictionary (CSD) generation, which will result in a Federated Domain Catalog (FDC).

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Comprehensive Survey of Multi Factor Authentication Systems

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ABSTRACT

This paper presents a multi-factor authentication (MFA) approach to address the increasing incidence of security breaches in systems using password authentication methods. There is a growing need for stronger and more secure systems to provide better protection for sensitive data and resources. Our project solves this problem by providing a multi-factor authentication system that requires users to go through 4 different authentication levels before accessing protected resources. Using a combination of something the user knows, something the user has, and what the user is, our project provides greater security than standard layers of password authentication. This multi-layered strategy adds an extra layer of security to prevent unauthorized access and helps organizations more tightly control who can access critical information and resources, making it harder for hackers to access restricted areas.

KEYWORDS *: MFA, CCP, Face recognition, RGB color pattern, YOLO.*

INTRODUCTION

The first step in providing service requests to customers is authentication. It is the process of authenticating a site upon request to the system by correlating the organization's input with information stored in the database. Traditionally this is done using a username and password. But because people choose simple passwords; they can remember; It won't be difficult for hackers to crack passwords. Phishing, social engineering, malware, shoulder surfing, etc. are the most common types of cyber attacks. For this reason, nowadays banks, social media sites, e-commerce platforms, etc. Organizations have begun to implement various methods for personal identification.

MFA, also known as two-factor authentication (2FA) or two-step verification (2SV), is a security method that requires users to provide two or more different authentication factors to gain access to systems, applications, or sites accounts. The main purpose of MFA is to increase security by providing additional authentication methods in addition to passwords and make it more difficult for unauthorized users to access sensitive information or resources.

The number of security breaches and cyber attacks pose a threat to organizations and individuals. The need for more secure authentication that can protect sensitive data is important.

"Lock & Key - Keys to Safeguard Your World," our initiative, attempts to address this important issue by developing a unique multifactor authentication method. We acknowledge that hackers have gotten better at cracking passwords and acquiring user credentials, making traditional authentication mechanisms less effective at preventing unauthorized access to protected systems. As a result, we created a comprehensive solution that increases security by requiring users to give four distinct forms of identity before accessing sensitive information and resources.

By combining knowledge-based, behavioral and biometric authentication methods, we provide greater security than password-based methods. The user is authenticated as follows:

1) What the user knows - This includes authentication methods based on authentication. It includes a regular username and password. To gain access to the application or system, the user must verify ownership of the existing profile. It can do this by providing additional information (password) that the user does not know.

2) What the user does - This includes the behavioral recognition process. The client is identified by describing and evaluating his behavior while performing specific tasks. This is called behavioral biometrics. We used content clicks to increase security.

3) What the user does - This includes behavior based on the authentication process. The client is identified by describing and evaluating his behavior while performing specific tasks. This is called behavioral biometrics. Lock and Key requires users to enter RGB color mode with each login attempt.

4) Who is the user - This includes biometric-based authentication mechanisms. Here, physical (biometric pattern) or non-physical (biometric information) characteristics or characteristics of the customer are used as authentication. Facial recognition technology further enhances security.

Needs and Motives

People often choose passwords that are easy to remember. Passwords are also easy to remember easy to be cracked. The alternative of this, i.e., auto-generated passwords, are too difficult for people to remember. So, people end up saving those on their system. A compromised system will give the hacker complete access to the saved passwords.

Sectors that involve storing and utilizing highly sensitive data like the healthcare, financial services, government and public sectors, cannot afford either of the above-mentioned scenarios. There needs to be a system that would assist people to easily remember the security password they chose, at the same time make it difficult for a bad actor to guess the same.

The motivation for developing such an application is to provide a secure environment for users so that they can access their accounts without fear of a cyberattack while using it.

Basic Concept

The basic idea is to use four different authentication factors to give users an extra layer of security. The entire process of registering and authenticating has been devised with consideration for the transition that users will experience from a basic password-based authentication system to a multi-factor authentication system.

By integrating CCP, RGB colour pattern, and face recognition into conventional authentication methods, we can provide enhanced security and privacy for users' personal information.

LITERATURE SURVEY

Ali Abdullah S. AlQahtani, et al [1] presented and analyzed authentication elements used to authenticate a user and establish his or her identity to a resource. Each of the following factors - (1) Something that a user knows: (2) Something that a user possesses: (3) Something that a user is; (4) Something that a user does: (5) Somewhere that a user is; (6) Something that is in the user's environment, has been discussed thoroughly along with their advantages and disadvantages in the research paper.

Mohammad Naveed Hossain, et al [2] presented their application that provides a convenient three factor authentication mechanism. They incorporated the common OTP and finger-print based biometric factors along with the traditional username and password mechanism.

Dweepna Garg, et al [3] discussed the significance of deep learning, particularly in the context of computer vision tasks like face detection. The paper pointed out that deep learning, notably Convolutional Neural Networks (CNNs), has achieved outstanding results in a variety of image-related tasks such as object detection and face recognition. It attempted to increase face detection accuracy using deep learning techniques, specifically the YOLO (You Only Look Once) framework. The model was trained and tested on the FDDB dataset, was fine-tuned on several performance parameters, and its performance was compared on different GPUs. The goal was to achieve more accurate and efficient face detection compared to traditional approaches.

Zhongliang Guo [4] classified the various face recognition algorithms based on their development history and major technology characteristics. The research also described and compared three representative classic face recognition algorithms: template matching technology, AdaBoost framework, and DPM model. It also introduced deep-learning face recognition algorithms such as R-CNN, Cascade CNN, DenseBox, MTCNN, and YOLO. The benefits and drawbacks of each algorithm were then outlined separately.

Adwait Pathak, et. al. [5] proposed the use of Zero Knowledge Proof (ZKP) in building a secure authentication system for web applications. The proposed system uses SRP and AES to overcome the drawbacks of traditional authentication systems and provides a higher degree of security and privacy for users. The proposed system prevents the storage of passwords or password hashes on the database, which ensures that even if an attacker gains unauthorized access to the database, they won't gain the password. The system is efficient in terms of usability and worth integrating into web applications.

Sonia Chiasson, et. al [6] proposed persuasive click-based graphical password system, Persuasive Cued Click-Points (PCCP), and conducted user studies evaluating usability and security. In addition to providing a new evaluation of password distributions, extending security analysis to include pertinent recent attacks, and presenting significant implementation details, this paper presented a consistent assimilation of earlier work and two unpublished web studies. Before the actual implementation of new security mechanisms, this methodical investigation offered a thorough and integrated review of PCCP that addressed both usability and security issues.

Priyanka Sharma [7] in the paper presented the goal of two factor authentication, which is to increase the strength of password-based authentication by requiring the user to provide an additional validating strand, and it also investigates the usability of two factor authentication, comparing it to other types of authentications currently in use in the market.

Neha Singh and Nikhil Bomanwar [8] addressed the issues arising due to shoulder surfing attacks on the solution proposed by Sonia Chiasson [6]. They presented an approach that improves on the compelling cued click point-based method by adding an additional invisible password input for each point. Furthermore, the fingerprinting notion was employed to ensure that users use the system safely.

Bandar Omar ALSaleem and Abdullah I. Alshoshan [9] presented a multi-factor authentication system that combines usability and low cost. The system does not require any particular configuration or infrastructure. It uses pictorial passwords, thus during the registration process, the user selects and memorizes three images. The user merely needs to select the correct photographs that he examined throughout the registration procedure in a certain order during the login phase. The suggested approach defeats a wide range of security threats, including keyloggers, screen capture attacks, and shoulder surfing.

Weizhi Meng1(B), et. al [10] presented a study was conducted to discover how PassMap users would select two sites, and it was discovered that users might select two comparable locations owing to time concern. This realization led them to create CPMap, a click-points map-based GP method that enables users to first select a location on a globe map before clicking a point or an object on an associated image. Another user study with up to 50 participants was undertaken to look into CPMap's performance. It was discovered that users could provide favorable outcomes with their plan in terms of both security and usability.

Di Wang, et. al [11] addressed that Facial recognition technology has become increasingly prevalent in daily life due to advancements in computer vision and artificial intelligence. Among the biometric recognition techniques that provide the greatest concern, face one of the areas of focus for this field's research is recognition, artificial intelligence and computer vision respectively. Still, face Distinctions both internal and external might readily impact recognition. While conventional facial recognition techniques frequently struggle to attain the best outcomes. To enhance the recognition even more this paper on the accuracy of existing facial recognition algorithms suggests an algorithm for facial recognition built on enhanced neural networks with convolutions. Trials demonstrate that the The data set can be efficiently subjected to an enhanced algorithm.

Zhongliang Guo [12] has presented the traditional problem in the field of computer vision is face recognition technology. As the primary biological characteristic of Humans and their faces have drawn a lot of attention from a vast number of investigators. Nevertheless, the ongoing development of new algorithms for facial recognition each have their own advantages and the historical relevance of traditional ancient algorithms should not be disregarded. Consequently, the customary end of face recognition algorithms is essential. The essay's categorization is carried out according to the development history and key technological features of facial recognition systems.

Sachin Kaja and Divya Gupta [13] in the research presented, a security method using a graphic password that makes use of graphics is presented. The major objective of this project is to assist users in choosing strong passwords. To verify authentication, the user will click on a specified area of the image. The persuading cued clicked spots will present a series of visuals, increasing security by placing more work on would-be intruders. Based on the previous picture click, a set of images will be presented. According to a psychological study, people can recall a visual image better than a string of alpha-numeric characters. Therefore, it will be simple for a user to recall the points on the photos and challenging for an intruder to gain access. The users are assisted in selecting more arbitrary spots for increased security by the persuading cued clicks. The simplicity of use and increased security of the Graphical Password Scheme are its benefits.

Susetyo Bagas Bhaskoro, [14] has addressed Changing illumination conditions and object distances reduce the accuracy of face identification and recognition using the Eigenfaces approach. The aim of this study is to develop an autonomous presence system by utilizing facial image identification via CNN and face detection via MTCNN. VGG16 CNN architecture was employed in this investigation. The MTCNN and CNN algorithms can adapt to variations in object distance and lighting levels, according to the test results. According to MAPE, the face detection system has an average error value of 17%; this high mistake rate is caused by the fact that some faces use face-covering qualities, and other things conceal faces.

Yuriy Lakh, et. al [15] This work has looked into vulnerabilities, authentication issues, various types of authentications, and working with input data and user information. The server has been set up to use digest and simple authentication. Both broken authentication issues and authentication bugs have been looked upon. Additionally, for a resource using HTTP Basic Authentication, which has been configured in the RESTful web server, together with digest authentication, brute force attacks have been modelled. Finally, public resources were looked through for authentication flaws. As an illustration, the website www.reddit.com has been chosen since it enables automated requests from authorized users, or "legal bots," opening the door to sophisticated brute-force attacks. For implementation, the Bot class was created, which contains functions designed for client activities that typically involve the use of a different RESTful resource.

Shyam Singh Rajput, [16] In addition to inadequate lighting and uncontrolled poses, faces taken in an uncontrolled setting typically exhibit low resolution (LR). Traditional face recognition methods do noticeably worse with these kinds of photographs. Therefore, a new face recognition method is created in this study to reduce the difficulty of matching LR photos with high-resolution gallery photographs. The suggested technique uses a classification mechanism based on convolutional neural networks (CNNs) to increase recognition accuracy. The suggested technique outperforms other comparable current face recognition algorithms, according to research results conducted on two common databases of face photos.

CONCLUSION AND FUTURE SCOPE

In a world where data breaches and cyberattacks pose significant risks to individuals and organizations, implementing MFA is a critical step towards safeguarding digital identities. Our project, Lock & Key, makes use of 4 levels of authentication to protect user data. We offer a higher level of security compared to conventional password-based systems by combining knowledge-based, behavior-based, and biometric authentication methods. As technology continues to advance, MFA remains an indispensable cornerstone of a comprehensive security strategy, providing peace of mind to users and reinforcing the defense against ever-evolving cyber threats. By using Lock & Key, the user will have 4 levels of authentication which is way more secure than the traditional two factor authentication.

The future scope should include preventing the users from selecting points in the second step that are marked as hotspots and avoiding the most common RGB patterns in the third. Hotspots are those regions where majority of the users are marking their security points. These make it easier for hackers to predict the patterns.

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Efficient Multi-Output DC-DC Converter with ZVS Integration, Frequency Control, and Closed-Loop Operation

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ABSTRACT

This paper introduces a novel converter design targeting cross regulation in single-inductor multi-output DC-DC converters. By integrating zero voltage switching (ZVS) and synchronization, the converter aims to minimize switching losses and operational frequency while individual closed-loop controllers reduce output coupling, effectively mitigating cross regulation. Theoretical aspects and simulation results demonstrate improved performance and efficiency. Additionally, the paper discusses a ZVS Buck DC-DC converter with predictive high current mode control for enhanced efficiency and protection, along with a ZVS buck converter employing clamp switches for increased efficiency and power density. Experimental validation confirms the effectiveness of the proposed converter designs

KEYWORDS *: Cross regulation, Synchronization, Zero voltage switching (ZVS), Efficiency enhancement.*

INTRODUCTION

In today's technological landscape, the demand for DC-DC converters is reaching unprecedented levels, particularly in the realm of portable applications where buck converters reign supreme. These converters are prized for their compactness, lightweight design, cost-effectiveness, and impressive performance metrics. However, as the need arises for applications demanding multiple independent voltage levels, the spotlight has shifted towards single-inductor multiple-output (SIMO) DC-DC converters.

While SIMO converters offer numerous advantages, they grapple with a significant challenge: cross regulation. This paper introduces a novel solution in the form of an integrated Zero Voltage Switching (ZVS) single inductor multi-output synchronous buck converter. This innovative design not only aims to bolster efficiency but also tackles the vexing issue of cross regulation head-on [7].

In contemporary power systems, non-isolated DC-DC converters have become indispensable, particularly in point-of-load (POL) applications, owing to their simplicity and high efficiency. With the evolution of power systems, there's a notable uptick in the input bus voltage of POL, often exceeding 12V. While adopting a high-frequency operation promises more compact, lighter, and higher-performing converters, it comes with its own set of challenges, including switching loss and efficiency degradation.

To navigate these challenges, soft-switching techniques have emerged as indispensable tools, enabling converters to elevate their switching frequency. By mitigating switching losses, these techniques pave the way for the realization of higher frequency, higher efficiency, and higher power density converters.

The structure of the paper is organized as follows: Section II delves into the fundamental principles governing the operation of the ZVS integrated buck converter. Next section has a detailed operational principles proceeded by an overview of control strategy used. The simulation results are discussed further, with the paper culminating in Section VI's concluding remarks.

In conjunction with the pressing demand for efficient DC-DC converters, this paper's innovative approach promises to offer a significant leap forward in addressing cross regulation challenges, thereby advancing the field of power electronics.

A ZVS SYNCHRONOUS BUCK CONVERTER

Proposed System and Assumptions

The block diagram of the proposed ZVS synchronous buck converter is shown in Fig. 1.

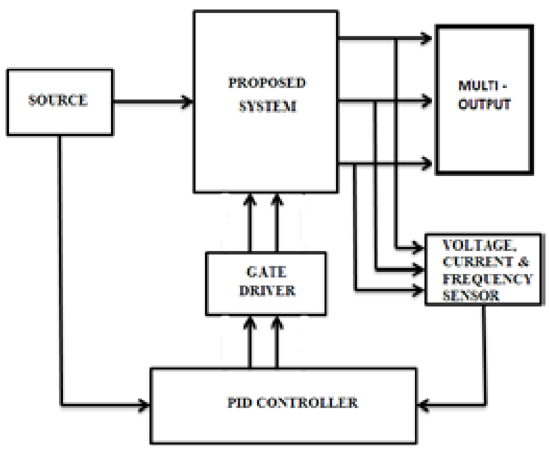

Fig. 1 Block diagram of proposed buck converter.

The block diagram comprises four main components: The Voltage Source, the Proposed system, various outputs and controller part and a driver circuit.

The proposed system, being a DC-DC converter, receives a DC supply from a suitable DC source. This project introduces a novel SIMO buck converter designed to function as a synchronous buck converter while incorporating the Zero Voltage Switching (ZVS) soft-switching technique. These advancements aim to minimize switching losses and allow the converter to operate at a lower switching frequency.

The output section of the converter is designed to accommodate multiple outputs sourced from a single system, each directed to different loads. Ensuring precise regulation, a controller unit is integrated for a closed-loop control of all the multiple outputs. This control mechanism continuously monitors voltage, current and frequency levels across each output through a dedicated sensing circuit unit. To enact swift and efficient switching operations, a gate driver is employed, generating gate pulses from MOSFET switches. These switches, enabling seamless regulation and distribution of power to the respective loads.

The circuit diagram depicted in Fig. 3 illustrates the proposed Integrated ZVS Single-Inductor Synchronous Buck Converter. This converter incorporates four MOSFET switches: S1, S2, S3, and S4. S1 functions in the standard manner of a buck converter, while S2 enables synchronous operation by replacing a diode in the existing system. Additionally, manual operation of switches S3 and S4 controls the activation and deactivation of loads, with the third load's operation dependent on either switch S1 or S2 according to the selected mode of operation.

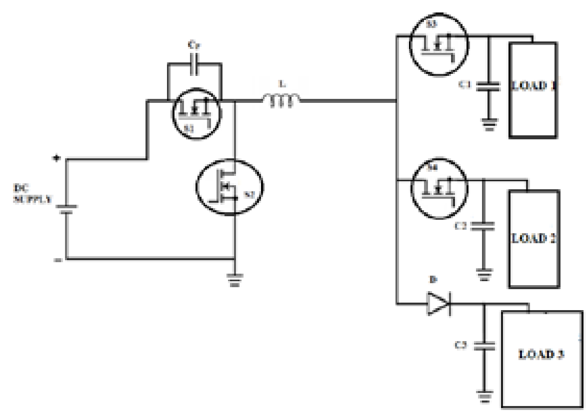

Fig. 2 Circuit diagram of integrated ZVS single-inductor synchronous buck converter

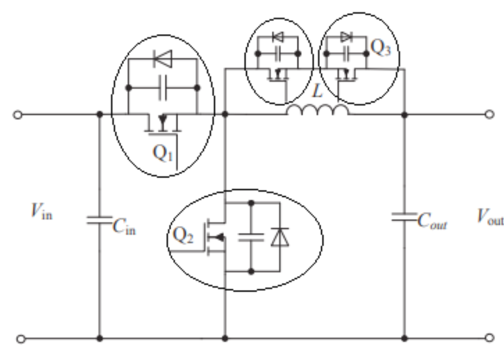

Fig. 3 Circuit diagram of ZVS buck converter (Frequency Control).

The above shown circuit diagram consists of the components - MOSFET switches, Capacitors, Bypass Capacitor, Inductor, Diode, Motor load, Battery, Resistive load

The bypass capacitor CP is connected across the switch S1 which is capable of introducing ZVS technique in the system.

In the operational dynamics of the converter, the inductor part plays a pivotal role akin to that of a standard converter, inducing voltage while concurrently storing energy for subsequent modes. This multifaceted functionality culminates in the derivation of three distinct outputs from a single inductor. These outputs are strategically allocated to serve diverse applications: one caters to a DC motor, integral to a water pump application; another feeds into a battery, primed for energy storage and subsequent utilization; while the third finds purpose in a resistive load, exemplified here as a lamp. Notably, the intricate interplay between these outputs is meticulously managed by closed-loop control mechanisms, effectively obviating concerns regarding cross-regulation. This comprehensive approach not only ensures optimal performance tailored to the unique requirements of each load but also underscores the successful mitigation of cross-regulation challenges, thereby enhancing the converter's overall efficacy.

OPERATING PRINCIPLES

The proposed topology enhances the traditional synchronous Buck configuration by incorporating a clamp switch connected to the output inductor (Fig.3). This addition enables the storage of energy in the output inductor for the Zero Voltage Switching (ZVS) process, effectively limiting current ripple by maintaining a minimum current level.

The function of the proposed system is characterized by different modes [6]:

Mode1 [t0-t1]: During this, Q1 is activated, causing the output inductor current (IL) to linearly increase from zero. At time t1, Q1 is deactivated, resulting in IL reaching its maximum value (Imax), which is determined by factors such as peak current ripple, average output current (Io), duty cycle (D) of Q1, and switching period (T).

$$I_{\max} = \frac{\Delta I}{2} + I_o = \frac{(V_{\text{in}} - V_{out})DT}{2L} + I_o \tag{1}$$

Mode 2 [t1-t2]: In this specific interval, denoting the dead time between the activation of switches Q1 and Q2, a crucial event unfolds. The discharge of parasitic capacitor Cs2, associated with Q2, occurs due to the forward current IL, effectively driving the drain-to-source voltage (VDS) on switch Q2 to zero. This resolution effectively addresses the reserve recovery issue. Notably, the zero voltage switching (ZVS) operation of switch Q2 reaches its culmination during this precise phase, marking a pivotal moment in the operational sequence.

$$\frac{1}{2}(C_{s2} + C_{s1})\ V_{\text{in}}^{\ 2} \leq \frac{1}{2}L\left[\frac{(V_{in} - V_{out})\ DT}{2L} + I_o\right]^2 \tag{2}$$

Mode 3 [t2-t3]: Here, Q2 is turned on, and ZVS operation is realized. As the inductor voltage opposes the inductor current, I_L decreases linearly from positive to negative until Q2 is turned off when the inductor current reaches zero.

$$I_{\min} = \frac{\Delta I}{2} - I_o = \frac{(V_{\text{in}} - V_{out})DT}{2L} - I_o \tag{3}$$

Mode 4 [t3-t4]: This phase signifies the dead time between Q2 and Q3, during which Q2 is switched off to prevent energy loss.

Mode 5 [t4-t5]: Q3 is activated at t4, shorting the output inductor from the input and output states. The auxiliary clamp circuit acts as a constant current source, ensuring that VDS1 meets specified criteria.

$$\begin{cases} V_{DS1} = V_{in} - V_{out} \\ V_{DS2} = V_{\text{out}} \end{cases} \tag{4}$$

Mode 6 [t5-t6]: In this temporal interlude, marked by the deactivation of Q3, a critical process unfolds. The reverse current coursing through inductor L takes center stage as it charges the parasitic capacitor Cs2 affiliated with Q2. Concurrently, this reverse current facilitates the discharge of the parasitic capacitor Cs1 linked to Q1. This intricate interplay between the reverse current and the parasitic capacitors sets the stage for the seamless zero voltage switching (ZVS) operation of Q1. This phase represents a pivotal juncture in the operational sequence, underscoring the intricate dynamics at play in achieving optimal performance and efficiency.

$$(C_{s1}+C_{s2})\ V_{in} \le \left[\frac{(V_{in}-V_{out})DT}{2L} - I_o\right] t_{dead1} \quad (5)$$

In essence, the proposed topology and its operational modes facilitate efficient ZVS operation, effectively managing current ripple to enhance overall performance.

FEATURES ANALYSIS CONTROL STRATEGY

The main control strategy and their features are discussed below as follows.

To achieve ZVS conditions in proposed converter with maximum efficiency, the clamp switch should be turned on when output inductor current IL reaches the minimum current for ZVS operations. A control strategy is proposed in this paper as shown in Fig.3. The PWM control circuit with voltage regulation loop is used to provide a fixed frequency gate drive of switch Q1 and resets the RS flip-flop. During the off state of Q1, both the non-gate and non-Q pins of the RS flip-flop register a high output. Consequently, upon Q1's deactivation, Q2 is promptly triggered into the active state. This transition enables the bidirectional current sampling amplifier to accurately sample the inductor current IL. As IL approaches its lower threshold, the comparator registers a high output, thereby triggering the RS flip-flop. During this period, the Q pin of the RS flip-flop switches to a high output state, while the non-Q pin assumes a low output state. Consequently, this configuration results in the activation of Q3 and the deactivation of Q2, thereby orchestrating a precise and controlled transition within the circuitry.

Synchronous Operation of Buck Converter

A buck converter serves as a voltage step-down and current step-up mechanism. While linear regulators like the 7805 can reduce DC supply voltage, they dissipate excess energy as heat, resulting in inefficiency [2]. In contrast, buck converters, with integrated circuits achieving efficiencies of 95% or higher, are preferred for tasks such as reducing computer main voltage (e.g., 12V in desktops, 12-24V in laptops) to the 0.8-1.8V required by processors.

In a basic buck converter, two switches control the current in an inductor. In an idealized scenario, all components operate flawlessly: the switch and diode have zero voltage drop when on and zero current flow when off, while the inductor has zero series resistance.

A synchronous buck converter enhances efficiency by replacing the diode with a second switch, S2. Although this modification increases costs, it minimizes power loss. In a standard buck converter, the fly-back diode autonomously turns on shortly after the switch turns off, resulting in power loss due to rising diode voltage.

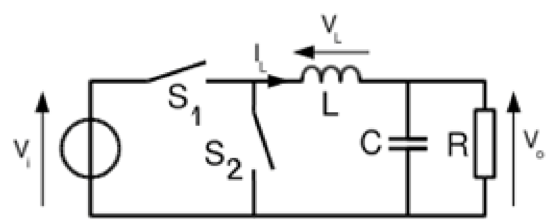

Fig. 4 Synchronous converter (Buck Operation).

PD = VD (1 - D) IO

The difference between synchronous and asynchronous operation have been summarized below in Table 1.

Table 1. Synchronous and Asynchronous Operation - Difference

Synchronous	Asynchronous
Synchronous Buck Converter: Utilizes two switches, typically MOSFETs, for both high-side (S1) and low-side (S2) operations, replacing the diode used in the asynchronous version.	Asynchronous Buck Converter: Employs a diode (D) for freewheeling when the main switch (S) is turned off, allowing current to continue flowing through the inductor.
Synchronous Buck Converter: Generally, exhibits higher efficiency compared to the asynchronous counterpart due to reduced conduction losses resulting from the absence of diode voltage drops.	Asynchronous Buck Converter: Typically exhibits lower efficiency due to the inherent voltage drop across the diode during freewheeling, resulting in higher conduction losses.
Synchronous Buck Converter: Requires more complex control circuitry and additional components (e.g., gate drivers) to drive the synchronous switches and ensure proper timing and coordination between them.	Asynchronous Buck Converter: Generally simpler in terms of control circuitry and component count since it relies on the inherent behavior of the diode for freewheeling, requiring fewer additional components for operation.

Zero Voltage Switching

Soft-switching techniques in power electronics refer to methods where switching transitions occur under favourable conditions, such as when device voltage or current is zero. This approach significantly reduces switching losses, stress on components, and potentially lowers electromagnetic interference while facilitating easier thermal management. Soft-switching techniques are particularly beneficial in high-frequency operations, often resembling square wave power with constant off-time control to adjust conversion frequency or on-time for output voltage regulation. By varying the conversion frequency, the effective duty cycle is adjusted, thereby altering the effective on-time in zero voltage switching (ZVS) designs [1]. The underlying principle of this conversion method is akin to the volt-second product equilibrium of input and output, resembling square wave power conversion but with distinct advantages showcased in Figure 5.

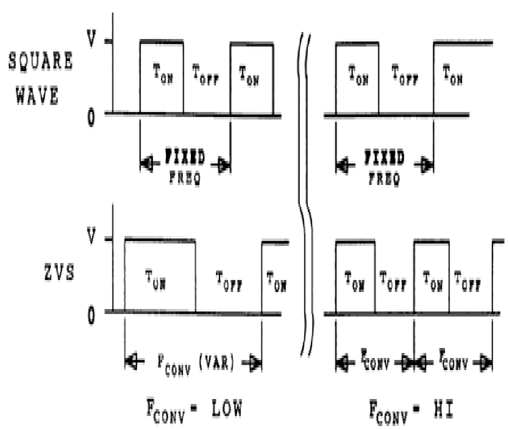

Fig. 5 Comparison – ZVS and Conventional Square wave.

Unlike its electrical dual, the zero current switched converter operates by resonating the L-C tank circuit during the ZVS switch off-time. This resonance effectively reduces the MOSFET transition losses to zero, irrespective of the operating frequency and input voltage, leading to significant power savings and improved efficiency in high-frequency, high-voltage converter designs. Moreover, the gate drive requirements are minimized in a ZVS design due to the absence of gate to drain charge when voltage and current are zero. This technique is versatile and applicable to various switching topologies, including buck regulators and their derivatives, flyback, and boost converters. Key advantages of zero voltage switching include lossless switching transitions, reduced electromagnetic interference, elimination of power loss from discharging parasitic components, and high efficiency with high voltage inputs across a wide frequency range.

Controller

Within a IC, a controller encapsulates a processor core, memory modules, and configurable devices. Unlike the broader scope of microprocessors designed for general-purpose applications, microcontrollers are meticulously crafted for embedded systems [4]. Their versatility finds expression in an extensive range of domains, from automobile engine control systems and medical devices to remote controls. By amalgamating essential components into a unified chip, microcontrollers engender a remarkable reduction in size and cost. This consolidation facilitates digital control across a myriad of devices and processes, fostering efficiency and scalability on an economically viable scale.

With distinct operational modes designed to swiftly respond to input variations (D mode), minimize lead errors (I mode), and mitigate oscillations within the error band (P mode), PID controllers provide dynamic and versatile control capabilities. The derivative mode plays a crucial role in bolstering system stability, affording the flexibility to fine-tune parameters such as gain (K) and integral time constant (Ti) to expedite controller response. Nevertheless, the process of tuning PID controllers remains a formidable challenge, demanding the harmonization of complex criteria within the constraints of system limitations. Despite the ostensibly straightforward delineation of its three parameters, achieving optimal performance requires a nuanced understanding and adept manipulation of the controller's characteristics [3].

PID controllers are tuned through various methods, including manual tuning, Ziegler-Nichols tuning, and PID tuning software methods. These approaches aim to optimize control parameters for desired responses, with stability as a fundamental requirement. Nonetheless, the diverse behaviour of different systems complicates PID tuning, making it a challenging endeavour despite its seemingly straightforward principles.

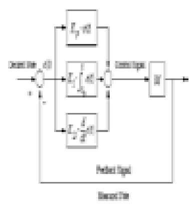

Fig. 6 PID Controller.

SIMULATION RESULTS

The simulation results are carried s in various aspects follows;

1. With and Without Controller.
2. Frequency Control.
3. Current Control

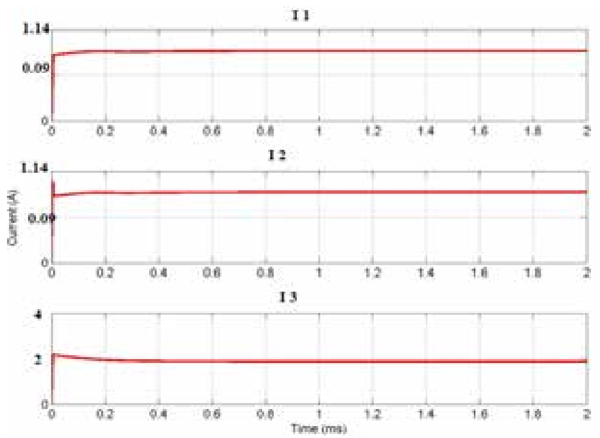

Fig. 7 O/P Current without controller

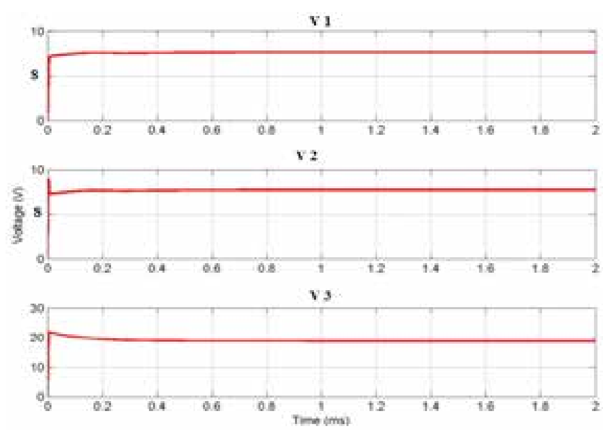

Fig. 8 O/P Voltage without controller

The current readings from the first, second, and third loads were 0.096A, 0.097A, and 0.19A respectively, while the corresponding voltages were 9.528V, 9.75V, and 21.8V. The average buck output measured was 13.692V. However, these readings fluctuate with each buck operation due to cross regulation and output coupling issues, resulting in instability.

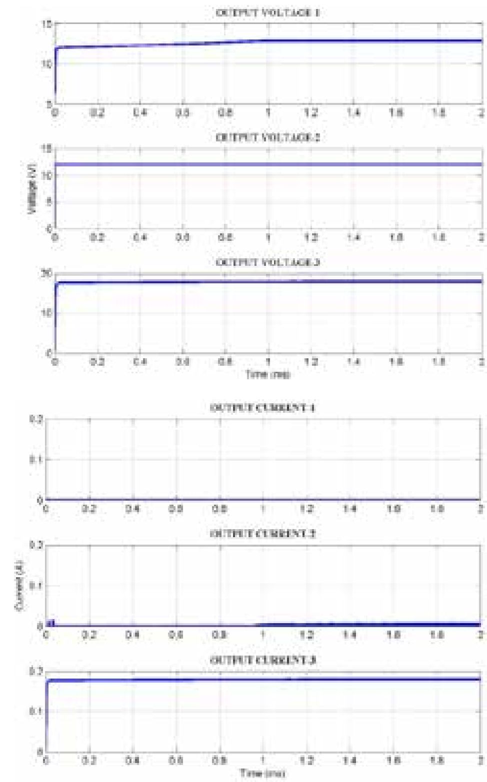

Fig. 9 Results of the System with Controller.

The graphical representation vividly portrays the discernibly low current draw observed from the three outputs, primarily attributed to the types of loads employed. Notably, the voltage measurements exhibit a uniform and steady output across the distinct load configurations. This coherence in output levels underscores the efficacy and consistency of the converter's performance across varied load scenarios, highlighting its robust design and operational reliability.14V from the first, 16V from the second, and 24V from the third, with an average buck output of 18V. This stability in output values underscores the elimination of cross-regulation and coupling between the outputs. Such consistency ensures that the obtained outputs remain unchanged with each buck operation, demonstrating the effectiveness of the system in maintaining stable performance.

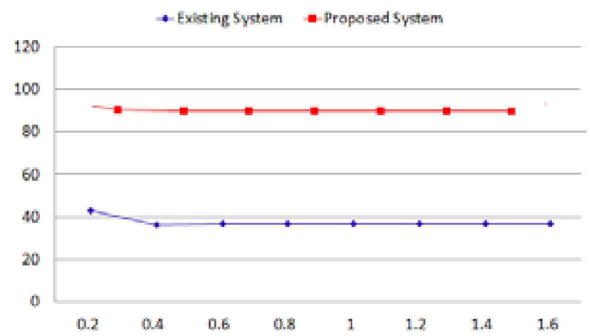

Fig. 10 Efficiency

The proposed system exhibits a significant improvement in overall efficiency, boasting a remarkable 40% increase compared to the existing system. This enhancement is a testament to the effectiveness of the system's design and operational mechanisms. By optimizing various components and refining operational processes, the new system achieves a substantial leap in efficiency, offering a more sustainable and cost-effective solution. This notable advancement underscores the potential for significant performance gains through innovative engineering and strategic system design.

CONCLUSION

This paper introduces a novel converter, termed the Efficient Multi-Output DC-DC Converter with ZVS Integration, Frequency Control, and Closed-Loop Operation. It integrates two key techniques: zero voltage switching (ZVS) and synchronization, resulting in a straightforward structure and reduced cost compared to alternative soft-switching converters. The synchronous topology enables sequential operation of the system. Furthermore, individual closed-loop control of multiple outputs using PID controllers eliminates output coupling, effectively mitigating cross-regulation issues. As a result, the proposed converter achieves a high step-down voltage ratio with an efficiency of approximately 95%.

Additionally, a ZVS synchronous buck converter with a clamp switch is presented, employs a fixed frequency control method with a easy structure. This topology ensures high efficiency while also enabling cost and size reduction. Moreover, simplification of the EMI filter is possible with this approach, leading to overall improvements in performance and cost-effectiveness.

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Exploring Parametric Variations In Miniaturized Mimo Wideband Antenna Designs For Advanced Wireless Communication

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ABSTRACT

This paper presents the design and analysis of four types of MIMO antennas composed of two planar symmetrical monopole antennas with a slotted ground. The ground plane is shaped into T and L configurations, and a comprehensive comparison of their performance is conducted. Simulation results indicate the antenna's effectiveness in the ultra-wideband range, making it suitable for diverse wireless communication applications. Despite its compact size (35mm×22mm), the designed antenna minimizes mutual coupling between its elements, enhancing overall performance. Notably, the study reveals that the L-shaped slot in the ground plane yields superior results, exhibiting a reflection coefficient below -10dB within the frequency range of 2.4-9.1GHz. At specific frequencies, such as 3GHz and 7.1GHz, the return loss drops significantly to below -32.5dB and -62.5dB, respectively. Moreover, the research observes that mutual coupling remains below -10dB over a broader frequency range (approximately 4.4-8GHz) for all design configurations. The structures are simulated using Ansoft HFSS 15.0, and the parametric evaluation highlights the potential applications of these antennas in wireless communication systems.

INTRODUCTION

The adoption of MIMO technology is motivated by the dual objectives of increasing channel capacity and enhancing signal transmission quality. By incorporating a greater number of antenna elements in both the transmitter and receiver, MIMO systems can achieve a substantial improvement in channel capacity. This technology plays a pivotal role in advanced wireless communication systems such as 4G and 5G, contributing to their robustness and extended range

In the practical implementation of MIMO antennas, a critical challenge arises in the form of mutual coupling between antenna elements, particularly in compact antenna designs. This issue poses a concern for effective signal transmission. To address this challenge, various methods are employed, including the introduction of slots or slits and adjusting the distance between MIMO antenna elements. In this context, the current research focuses on mitigating the impact of mutual coupling by utilizing different shapes of slotted ground planes. The selection of a suitable ground plane configuration is crucial for optimizing the performance of MIMO antennas, particularly when aiming for compact sizes. The reduction of mutual coupling is of paramount importance for ensuring the reliable operation of MIMO antennas, especially when implemented in portable devices. This paper explores and evaluates different configurations of slotted ground planes to contribute to the ongoing efforts in improving the practical implementation of MIMO antennas with smaller form factors. [1-3]

ANTENNA DESIGN VARIATION AND PERFORMANCE

MIMO antenna design and substrate characteristics:

The MIMO antenna under consideration is composed of two symmetrical planar monopole antennas, confined within an area of 35×22mm^2. The substrate material employed is Rogers with a dielectric constant, ε_r, of 3.5, a loss tangent δ of 0.002, and a thickness of 0.16cm.

DGS design 1: T-SLOT

This design variation features a T-slot in the ground plane, incorporating the principles of the Defected Ground Structure (DGS) system. Rigorous verification of all pertinent parameters is conducted for this unique design, and the microstrip feed configuration is retained for the two ports of the MIMO antenna. In this structural configuration, charged particles accumulate specifically at the edges of the T-slot. The deliberate reduction in the ground plane's area is employed to effectively control mutual coupling between the antenna elements, resulting in lower levels of interference. This characteristic aligns with the established understanding that a reduced ground plane area contributes to minimizing mutual coupling. With all geometric dimensions outlined in Table 3 meticulously considered, the antenna's design and behavior are explored using Ansoft HFSS software. The deliberate selection of the T-slot in the ground plane reflects a strategic approach to enhance the antenna's performance by mitigating mutual coupling and optimizing its suitability for practical wireless communication applications.

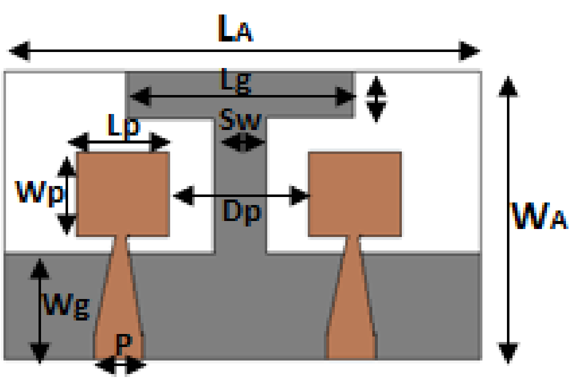

Fig.1. Geometry Analysis of MIMO Antenna Featuring T-Shaped Ground Slot

Table.1. Dimensional Overview: MIMO Antenna with T-Slot Ground Plane - Measurements (mm)

LA	WA	Lp	Wp	P	Wg	Dp	Sw	Lg	Lw
35	22	8	8	3.5	3.5	12	4	22	3.5

In the proposed antenna structure featuring a T-slot in the ground plane, charged particles exhibit a distinctive accumulation at the edges of the T-slot. This phenomenon is integral to the design's strategy, as reducing the area of the ground plane has been established as an effective means to control mutual coupling between antenna elements. In alignment with this principle, the T-slot design successfully achieves a lower level of mutual coupling, contributing to enhanced antenna performance. All geometric dimensions, as outlined in Table 1, are meticulously considered during the design process using Ansoft HFSS software. This deliberate selection of the T-slot configuration underscores the strategic approach employed to optimize the antenna's behavior, ensuring reduced mutual coupling and positioning it as a promising solution for practical applications in wireless communication systems.

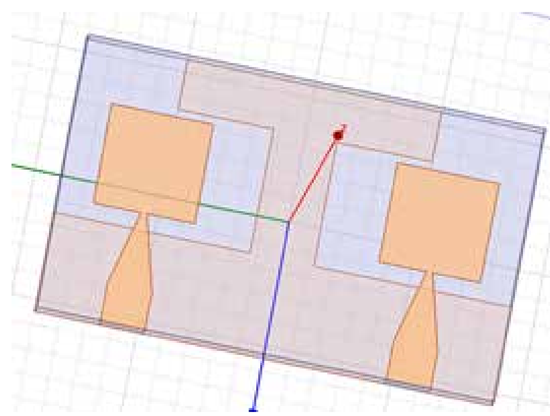

Fig.2. Design of the MIMO antenna with T- slot in ground plane in software interface

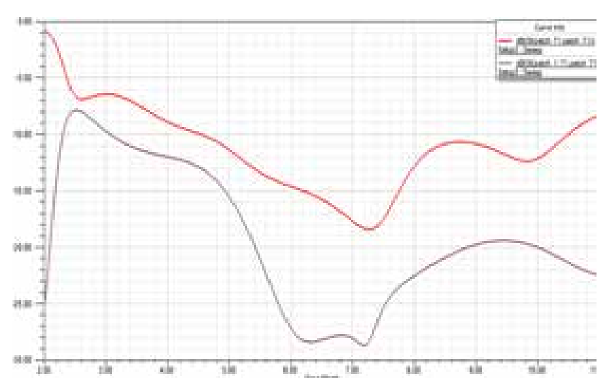

Fig.3. Simulation of Reflection coefficient S_{11} plot

As depicted in Fig. 3, the return loss characteristics offer valuable insights into the performance of the MIMO antenna under consideration. Notably, the antenna demonstrates functionality across a broader frequency bandwidth, maintaining a return loss below -10dB in the expansive range of 4.5-10.5GHz. A crucial observation from the plot is the distinct non-overlapping nature of the output from the two ports, indicating effective control over interference. However, while these results showcase promising characteristics, there exists an opportunity for improvement through further refinement of design parameters. The potential for enhancement suggests that a more nuanced exploration and optimization of the antenna's configuration could lead to even more robust and efficient performance, addressing any remaining limitations and advancing its applicability in practical wireless communication scenarios.

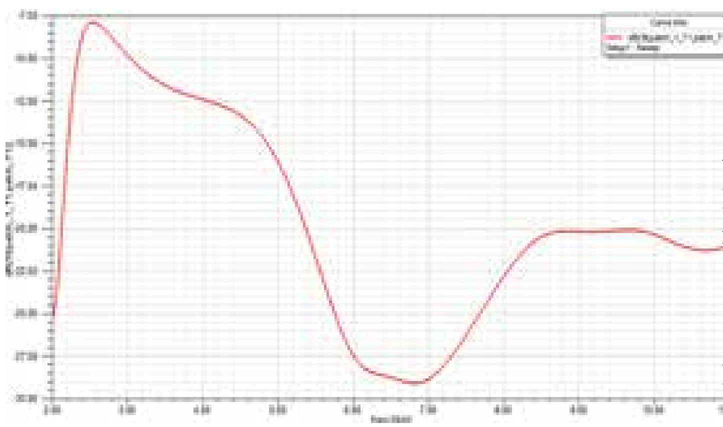

Fig.4. the plot of S_{12} for the MIMO antenna

Examining the plot in Fig. 4, it becomes evident that S12 consistently registers values below -10dB across a substantial frequency range, specifically spanning from 3-11GHz. Moreover, within the narrower band of 6-7GHz, S12 reaches a notable decrease, dipping to -27.5dB. This outcome signifies effective control over the mutual coupling between the antenna elements, as S12 represents the transmission parameter between the ports. The sustained low values of S12 affirm that mutual coupling is minimized, further corroborating the antenna's capability to operate with reduced interference. The wide frequency range over which S12 remains below the -10dB threshold underscores the antenna's potential for reliable performance in diverse frequency bands, highlighting its suitability for a range of applications in wireless communication systems.

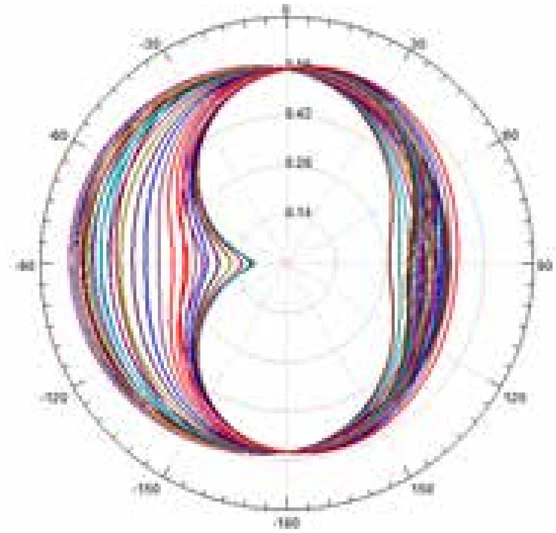

Fig.5. Radiation pattern with T-slot in ground

The radiation pattern derived from the MIMO antenna featuring a T-slot in the ground, as depicted in Fig. 5, exhibits an omni-directional characteristic, albeit with a notable inclination towards the -90 direction. Recognizing the potential for improvement, subsequent modifications have been implemented in the antenna structure to enhance its performance. These refinements aim to address the observed directional bias and achieve a more balanced and optimized radiation pattern for the MIMO antenna. The ongoing efforts in optimizing the structure reflect a commitment to refining its capabilities and ensuring its suitability for diverse applications in wireless communication systems.

DGS design 2: L-SLOT

Utilizing the Defected Ground Structure (DGS) system, the current investigation introduces a novel design featuring an L-slot in the ground plane. Thorough verification of all design parameters is conducted to ensure the accuracy and reliability of the results. Microstrip feed is employed to facilitate feeding for the two ports of the MIMO antenna, contributing to the overall efficiency of the design [11-12]. This design variation aims to explore the impact of the L-slot on the antenna's performance, assessing its potential to enhance characteristics such as reduced mutual coupling and improved radiation patterns.

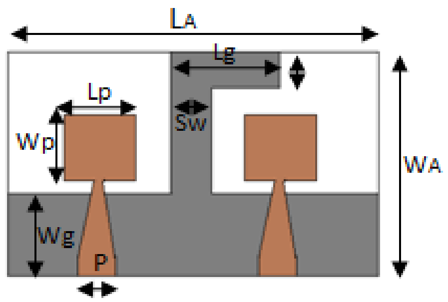

Fig.6. Geometry Analysis of MIMO Antenna Featuring L-Shaped Ground Slot

Table.2. Dimensional Overview: MIMO Antenna with L-Slot Ground Plane - Measurements (mm)

LA	WA	Lp	Wp	P
35	22	8	8	4
Wg	Lg	Sw	Lw	Pw
4	15	3.5	3.5	2

The incorporation of an L-slot in the ground plane, as illustrated in Fig. 6, presents a notable reduction in mutual coupling within the MIMO antenna. The charge distribution within the antenna primarily concentrates along the edges of the L-slot and the remaining portion of the ground plane. Given the compact size of the antenna, mutual coupling issues are typically evident in MIMO configurations. However, in this instance, the deliberate introduction of the L-slot effectively controls mutual coupling, a observation substantiated by the results. The dimensions outlined in the geometry and specified in Table 2. Helps to guide the detailed design process conducted using Ansoft HFSS software, ensuring accurate modeling and simulation of the antenna's behavior with the L-slot configuration.

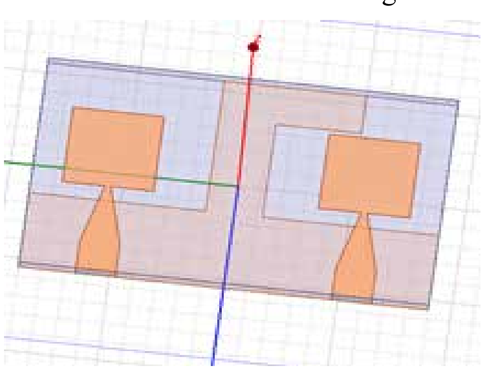

Fig.7. Design of the MIMO antenna with L- slot in ground plane in software interface

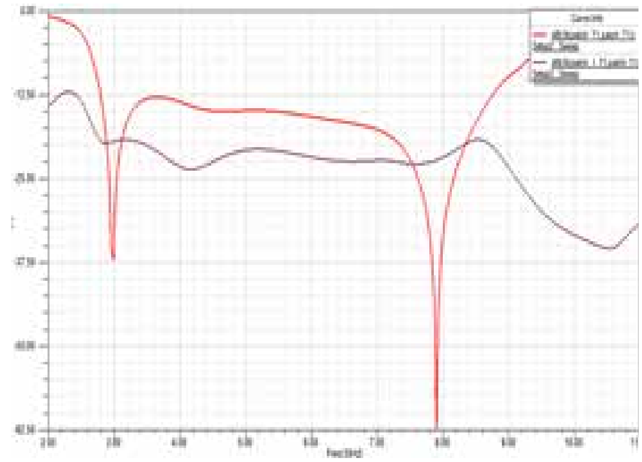

Fig.8. Reflection coefficient S_{11} plot

In Fig. 8, the MIMO antenna exhibits a return loss below -10dB across a wide frequency range (2.4-9.1GHz), showcasing notable performance peaks at 3GHz (-32.5dB) and 7.9GHz (-62.5dB). Importantly, the output from Port-2 does not coincide with Port-1, indicating minimal interference and confirming a wider bandwidth. This MIMO antenna demonstrates impressive characteristics, presenting both extended bandwidth and low interference levels, making it well-suited for advanced wireless communication systems.

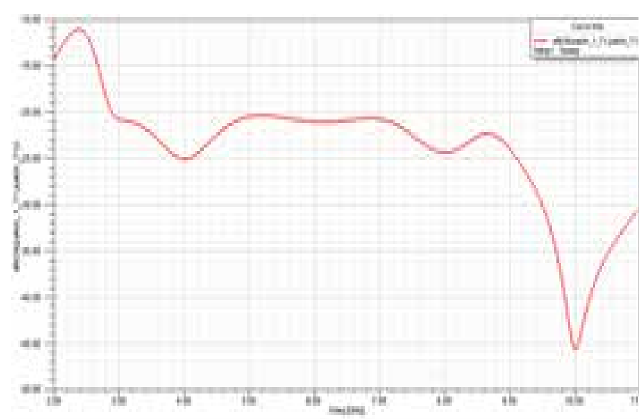

Fig.9. the plot of S_{12} for the MIMO antenna

In Fig. 9, S12 consistently stays below -20dB, indicating low mutual coupling between antenna elements throughout the frequency band. This observation underscores the MIMO antenna's efficient control over interference, making it suitable for reliable wireless communication applications.

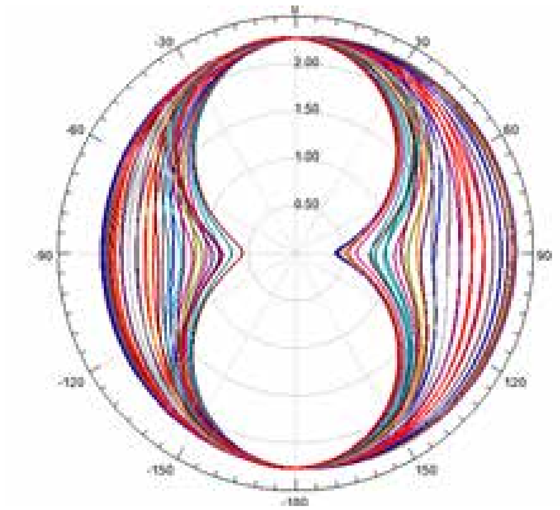

Fig.10. Radiation pattern with L-slot in ground

The pattern observed in Fig. 10 distinctly exhibits a perfectly omni-directional characteristic, a highly desirable quality for MIMO antennas. Notably, the incorporation of the L-slot ground plane in the MIMO antenna yields superior results compared to other designs. This configuration demonstrates a wider bandwidth with minimal interference. The obtained values of the reflection coefficient further support the practical viability of this antenna for wireless communication applications, particularly in WLAN and similar contexts. The favorable characteristics of the L-slot design make it a promising choice for practical implementation, offering enhanced performance and reliability in diverse communication scenarios.

COMPARATIVE ANALYSIS OF DUAL ANTENNA CONFIGURATION

Table.3. Parametric analysis of all structures

SLOTS	S_{11}	Frequency	Issue
T-slot	-10dB	4.5-10.5GHz	Can be improved
L-slot	-32.5dB and -62.5dB	3GHz and 7.9GHz	Have been Overcome

CRITICAL REVIEW AND INSIGHT

In the conducted experiment, MIMO antennas were designed with T-shaped and L-shaped slots in the ground plane using the Defected Ground Structure (DGS) system. Applied to two symmetrical monopole microstrip patch antennas made of copper, these designs aimed to enhance antenna performance. Assessing the return loss (S11) as a crucial parameter for efficient power transmission, the T-slot design (Design-1) showed promising results. The reflection coefficient remained below -10dB for a wider frequency range (4.5-10.5GHz), addressing interference concerns. However, the output patterns indicated a potential for interference due to the shadowing effect of one port over the other. In contrast, the L-slot design (Design-2) demonstrated excellent bandwidth, with remarkable results at 3GHz and 7.9GHz, registering values below -32.5dB and -62.5dB, respectively. Mutual coupling for the L-slot design was lower than -20dB, a favorable attribute for compact MIMO antennas. The matching performance, measured by VSWR, was nearly perfect at approximately 1.6. Given its compatibility with the WLAN operating frequency at 3.1GHz, the L-shaped slot MIMO antenna emerged as a promising choice for practical wireless communication applications, surpassing the performance of the T-shaped slot design.

V. CONCLUSION

In the realm of wireless communication, antennas stand as pivotal components influencing the overall system performance. With the increasing demand for advanced communication systems like 4G and 5G, MIMO antennas have gained prominence for their efficacy. In this study, an exhaustive exploration was undertaken, focusing specifically on MIMO antennas with T-shaped and L-shaped slots in the ground plane. The comprehensive analysis considered crucial parameters such as return loss, mutual coupling, bandwidth, and interference. Notably, the results highlight the superiority of the L-shaped slot configuration. Its exceptional bandwidth, demonstrated by impressive return loss values at key frequencies, and minimal mutual coupling, make it the standout choice among the investigated structures. The L-shaped slot design not only showcases practical feasibility in fabrication but also exhibits resilience to potential errors, reinforcing its applicability in real-world scenarios. This research underscores the significance of meticulous antenna design, emphasizing the potential of the L-shaped slot MIMO antenna as a robust solution for contemporary wireless communication systems.

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Cryptocurrency Prediction Using ML: A Comprehensive Review

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ABSTRACT

This research paper explores the integration of machine learning algorithms, sentiment analysis, cryptocurrency, market data, social media, news articles, textual sources, neural networks, ensemble methods, patterns, correlations, sentiment-driven indicators, financial outcomes, and digital assets. Leveraging historical market data and sentiment extracted from various sources, our model aims to capture the dynamic nature of the cryptocurrency market. The research employs advanced ML algorithms to analyze patterns, correlations, and sentiment-driven indicators, demonstrating the potential of combining market data and sentiment analysis for more accurate cryptocurrency price predictions. The results contribute to extentsive understanding of the intricate relationship between market sentiments & financial outcomes in the volatile realm of digital assets.

KEYWORDS *: Cryptocurrency, Machine learning, Sentiment analysis, Market data, Neural networks, Patterns, Correlations, Sentiment-driven indicators.*

INTRODUCTION

In the realm of dynamic financial markets, the volatility of assets like stocks and digital currencies poses a formidable challenge, driven by asynchronous changes fueled by new information. Digital currencies, particularly Bitcoin [1], exhibit high price volatility, operating as decentralized mediums of exchange grounded in cryptographic principles and blockchain technology. With no regulatory constraints or central authority, the cryptocurrency market is uniquely influenced by investor sentiments, social constructions of opinions, and future expectations.

This paper introduces novel methodologies leveraging machine learning (ML) algorithms [3] to analyze sentiments among cryptocurrency users, employing deep learning (DL) models for precise price forecasting. The study delves into the correlation between cryptocurrency users' sentiments and price volatility, offering a comprehensive evaluation of proposed methods benchmarked against state-of-the-art algorithms and previous research. The systematic approach ensures a thorough exploration of research contributions and their broader implications in the realm of cryptocurrency analysis and forecasting.

In the contemporary landscape of information dissemination, electronic platforms, particularly Twitter, emerge as crucial sources for diverse opinions and stock price recommendations. Recognizing the significance of this platform, the paper emphasizes the imperative to leverage modern technologies and advanced artificial intelligence methods for comprehensive sentiment analysis of cryptocurrency users on Twitter.

APPLYING ML ALGORITHM FOR CRYPTOCURRENCY PREDICTIONS

Recurrent Neural Networks (RNNs) & Long Short-Term Memory (LSTM)

RNNs and LSTM-Long Short Term Memory algorithms are integral components in a comprehensive model for predicting cryptocurrency prices. Given the intricate dynamics of cryptocurrency markets, we employ RNN and LSTM architectures designed to capture temporal dependencies. Our approach involves meticulous preprocessing, including normalization and feature extraction, and the configuration of neural network architectures with multiple layers, gated mechanisms, and specialized activation functions. Through rigorous experimentation, we aim to assess the predictive capabilities of RNNs and LSTMs, providing insights into their performance for cryptocurrency price forecasting. This study contributes to advancing financial prediction models, specifically addressing the challenges posed by volatile cryptocurrency markets.

Naive Bayes algorithm

Applying Naive Bayes and sentiment analysis, this method predicts cryptocurrency prices by extracting features from diverse sources. The trained Naive Bayes classifier informs traders' decisions, recognizing the dynamic nature of cryptocurrency markets. This comprehensive approach combines sentiment analysis with other methods for accurate price movement predictions.

Support Vector Machines (SVM)

SVMs utilize hyperplanes and kernel functions in high-dimensional spaces to discern intricate patterns for cryptocurrency price prediction. By maximizing class margin, they ensure robust generalization to unseen data in complex financial markets. Experimental results underscore SVMs' proficiency in identifying nuanced trends, providing important analysis on their performance within the cryptocurrency domain.

Logistic Regression

Logistic Regression is a statistical technique for binary classification that estimates the likelihood that an instance will fall into one of two groups is called logistic regression. It ensures that outputs range between 0 and 1 by using the logistic (sigmoid) function to convert a linear combination of input data and weights into a probability score. Using methods such as maximum likelihood estimation, weights are optimized during training in order to reduce the discrepancy between expected probability and actual class labels. Due to its ease of interpretation, efficacy in predicting binary outcomes, and simplicity, logistic regression is frequently applied in many different domains.[2]

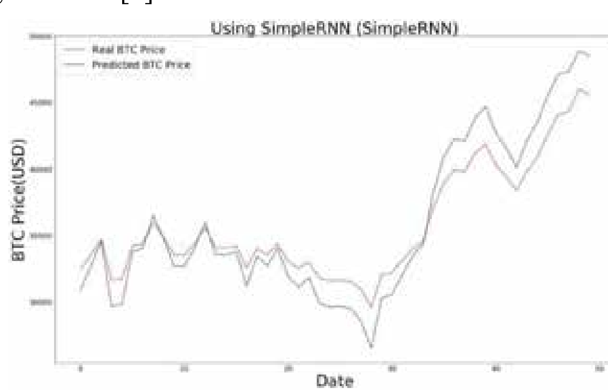
Random Forest

Random Forest utilizes decision tree ensembles with bootstrapped samples and feature randomization, fostering resilience against overfitting. Optimal performance demands meticulous hyperparameter tuning, addressing parameters like the number of trees and tree depth. Adaptability to external factors is crucial, achieved through precise data collection, preprocessing, and leveraging ensembles for accurate predictions.

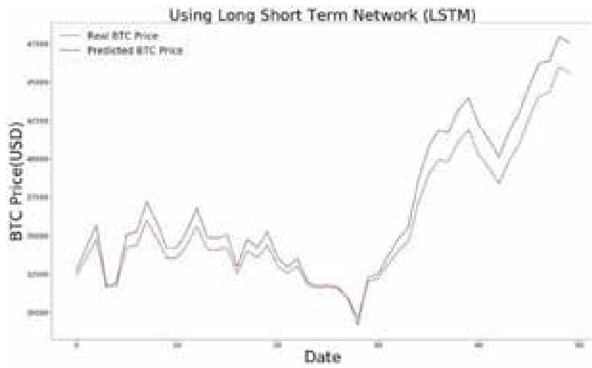
ANALYSIS OF MODEL FOR PREDICTING BITCOIN PRICE ACCORDING TO SENTIMENT OF USER

The following plotted graphs are for the test dataset.

RNN:Utilizing a neural network architecture comprising one tanh layer, one sigmoid layer, and another tanh layer with a dropout of 0.28 after the second layer, featuring 20 units and trained for 75 epochs. The user interface is a web application developed with CSS, AJAX, HTML, Python, JavaScript, and Flask. An open-source library known as Gradio, is employed for prediction, allowing the creation of modifiable UI components around TensorFlow or Python functions. Python notebooks embedded in the system are displayed on a webpage, generating as shareable public access for remote model interaction. Users can upload a cryptocurrency dataset and select the desired model for prediction graph generation.[1].



LSTM: Units 20, Epoch 75, Dropout of 0.28 after layer, 1 tanh layer, 1 sigmoid layer, and 1 tanh layer



The three deep learning modes and constant parameters of LSTM were deemed to be the most dependable and efficient algorithm after careful comparison.[1]

Table 1: Compared MSE and MAE values

Deep Learning Model	MSE	MAE
RNN	52691476.890	1528.86877
	904665	20375
LSTM	42147659.553	1016.57505
	459354	96874999

FUTURE PROSPECTS

In the world of cryptocurrency price prediction, the future lies in harnessing sentiment analysis with advanced machine learning algorithms. Refining models for nuanced interpretation of market sentiment from diverse sources, including social media and news platforms, is crucial. The technical horizon involves integrating sentiment analysis with traditional financial indicators in hybrid models, optimizing predictive accuracy. Real-time adaptation to dynamic market conditions through continuous sentiment data integration stands as a key technical advancement. This convergence signifies a paradigm shift, enhancing precision and responsiveness in cryptocurrency price forecasting.

CONCLUSION

In conclusion, our study delving into diverse machine learning models for cryptocurrency price prediction, including RNNs, LSTMs, Random Forest, Naive Bayes, SVM, and Logistic Regression, highlights the versatility and efficacy of these methodologies in capturing intricate patterns within volatile cryptocurrency markets. The adaptability of RNNs and LSTMs to temporal dependencies, the robustness of Random Forest, and the simplicity of Naive Bayes, SVM, and Logistic Regression showcase a spectrum of approaches. Each model exhibits strengths in different contexts, emphasizing the importance of selecting models based on specific market characteristics and data complexities. As the cryptocurrency landscape evolves, the continual exploration and refinement of these models will be crucial for enhancing predictive accuracy and enabling informed decision-making in this dynamic financial ecosystem.

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Skin Disease Detection using Convolutional Neural Network

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ABSTRACT

There is an increasing number of skin diseases in today's world because of reasons like depletion of the ozone layer, hereditary, fungi or parasites living on the skin, environmental changes, etc. Detecting skin diseases early is crucial to prevent the spread of harmful cells. In this work, early detection of skin diseases has been proposed and later the skin images are classified as malignant and benign. In recent times, image processing and machine vision, convolution neural networks, deep learning, etc. are widely used in the field of medical and healthcare applications. In this work, a Convolutional Neural Network (CNN) has been used to detect and classify skin diseases. The proposed CNN model gave an accuracy of 92%.

KEYWORDS *: Skin disease, Malignant and benign, Convolution neural networks(CNN), Artificial neural network.*

INTRODUCTION

According to Human anatomy, the skin is the most important human body part comprising of protein, fat, and water. Skin disease occurs due to bacteria trapped in the pores of the skin. It is also caused by environmental, hereditary, and skin cell damage. Normally, the cell grows older and dies, and new cells are formed to occupy the place of older cells. In cancer, there is a limitless growth of new cells. Patients with skin disease are found mainly on continents such as America, Australia, and Asia [1]. The main objective of this work is to help people identify the disease early to prevent the further spread of harmful skin diseases. The skin disease, at the primary stage, is classified as benign and malignant. Benign is a non- cancerous disease and does not pose a threat to life. It is less fatal. It is necessary for early detection. Malignant skin diseases are cancerous. Detection of skin disease at an early stage is very crucial, as skin disease can be dangerous and deadly. Skin disease detection and treatment takes a longer time, is expensive, and also causes a lot of physical harm to the patient. The common man does not have a lot of medical knowledge regarding skin diseases. People do not know the cause of the disease or the type of the skin disease, some skin diseases show symptoms after several months making them more severe [2]. Even skin specialists find it difficult to detect the type of skin disease. Therefore, the use of an automated procedure for the diagnosis process proves to be advantageous, as it not only makes work simpler and better but also reduces manual errors. Recent research indicates a growing inclination toward employing computer vision techniques and digital image processing, particularly in sectors such as healthcare. The notable trend in this direction highlights the potential to improve diagnostic speed and simultaneously minimize manual inaccuracies. Over the last few years, the field of AI has seen widespread adoption of a specialized method known as Artificial Neural Network (ANN). This approach has applications in computer vision, image processing, and classification. Inspired by the intricate neural structure of the human brain [3], ANN comprises multiple layers and perceptron. An advanced form of ANN, called Convolutional Neural Networks (CNNs), has demonstrated notable success. CNNs excel not only in general and complex tasks, but also in specialized applications such as image processing, classification, object detection, and facial recognition. It is decided that the CNN technique makes diagnosis detection easier. CNNs are favored in computer vision due to automatic feature extraction capability, hierarchical pattern recognition, translation invariance, efficiency and scalable, and efficient handling of large images and complex tasks. CNNs have become the backbone of many state-of-the-art computer vision applications, including image recognition in deep learning. Their ability to automatically learn hierarchical representations of features from input data makes them well-suited for tasks involving spatial hierarchies, such as recognizing objects in images.

LITERATURE SURVEY

The Jainesh Rathod et al [4] focused on Automated Disease Diagnosis through Convolutional Neural Networks (CNNs) in dermatology. Using a Dermnet data set with images standardized to 120x120 pixels, the CNN model consists of two main stages. Stage 1 involves a Noise Removal Unit, Image Enhancement and Segmentation, Feature Extraction, and Skin Diseases Identification. Stage 2 handles Classification through Input Attributes, a Classifier Engine, and a Training Dataset. The model achieved an output accuracy of around 70%, indicating the potential for further improvement to 90% with a larger dataset. The Allugunti et al [5] presented a machine-learning model for the classification of skin diseases using CNN. Using a Dermnet data set, the focus is on the early detection of various types of melanoma. The model, with a two-step implementation, achieves an accuracy of 88.03% in classifying superficial spreading melanoma, nodular melanoma, and lentigo malignant melanoma [3]. Daghrir et al [6] introduced a hybrid approach for the detection of skin cancer melanoma, combining deep learning, classical machine learning, and data fusion. Using the ABCDE technique for early-stage examination, the ISIC data set includes 23,000 images, with 640 dedicated to training and testing. Using KNN, SVM, and CNN methods, SVM outperforms KNN in efficiency, but CNN is recognized as a more powerful and robust tool for identifying melanoma skin cancer. The option result in this model is 88.4%. Hosny et al. proposed [7] an automated skin lesion classification method using pre-trained deep learning networks, specifically the AlexNet architecture, for early detection of skin cancers of melanoma and non-melanoma. The data set is obtained from the kernel, and challenges such as limited labeled data and visual aberrations are addressed. The approach aims to increase the cure rate by 90% through efficient classification. The Suman et al [8] focused on predicting skin diseases using a convolutional neural network (CNN) in the ISIC 2018 dataset, comprising more than 27,000 labeled images of seven different skin diseases. CNN achieved an impressive 95.90% accuracy in predicting skin disease types, indicating its effectiveness and potential for generalization to new data. The Dildar et al [9] review discussed skin cancer detection using deep learning techniques, exploring data sets such as ISIC 2018 and models such as CNNs, DBNs, RNNs, and capsule networks. CNN models with 16-20 layers show effectiveness, achieving up to 95% accuracy in skin cancer datasets. The review suggests that deep learning models hold promise for developing effective tools for the detection of skin cancer. Ahammed et al [10] introduced a machine-learning approach for skin disease detection and classification using image segmentation. With the ISIC 2018 dataset and a CNN with 18 layers, the model achieves a 96.33% accuracy on the test set. The authors suggest its potential use in the development of a computer-assisted diagnosis (CAD) system to help skin specialists determine skin diseases more precisely and efficiently. Muhaba et al [11] introduced an automatic skin disease diagnosis system that uses deep learning, combining clinical images and patient information. Utilizing a pre-trained MobileNetV2 model and a Fully Connected Neural Network (FNN), the system achieves a remarkable 97.50% accuracy on the test set. The proposed system is effective for diagnosing five common skin diseases and demonstrates high accuracy, suggesting its potential for generalization to new data. Setiawan et al [12] explored the impact of color enhancement on the early detection of skin cancer using a 16-layer Convolutional Neural Network (CNN) in the HAM10000 dataset. Despite preprocessing and color enhancement methods, CNN's performance showed no significant improvement, with an accuracy of 90.20% on original images and 90.50% on color-enhanced images. Subramanian et al [1] presented a CNN-based model for skin cancer classification, achieving 96.7% precision in the ISIC Archive 2019 dataset. The model outperforms traditional machine learning algorithms and shows superior accuracy and sensitivity compared to other CNN models for the classification of skin cancer till now. The Rahi et al [13] used a deep Convolutional Neural Network (CNN) with 12 layers for skin cancer detection, achieving 97.5% accuracy on the HAM10000 dataset. The model demonstrates high precision, recall, and F1 scores [14] for the detection of melanoma. The authors propose its potential use in developing a clinical decision support system for effective skin cancer detection. Ali et al [15] on melanoma detection used a regular Convolutional Neural Network (CNN) with 7 layers in the ISBI 2016 dataset. Achieving 86% accuracy, 84% sensitivity, and 86% specificity on the validation set, the study suggests that regular CNNs with modest parameters can provide comparable performance for automated melanoma detection. Rezaoana et al [16] presented a parallel CNN model for skin cancer detection and classification, trained on the ISIC 2018 data set. With two CNNs employing different architectures and a multitask learning approach, the model achieves an accuracy of 92.2%, comparable to the results. The authors suggest that this approach is encouraging for the fruitful detection of skin cancer and then classification of skin cancer. Jana et al [17] focused on skin cancer cell detection using image processing with a dataset of 100 dermoscopic images. By use of a Support Vector Machine (SVM) classifier and various processing steps, the method achieves 86% accuracy. Although promising, the authors recommend further evaluation of larger datasets and comparison with other state-of-the-art methods.

The objective of this work is to design a CNN model for skin disease detection and classification of skin disease as MALIGNANT and BENIGN with improved accuracy and preprocessing. In an extensive review of the existing literature, most of them focused on skin diseases such as melanoma and carcinoma. What is particularly lacking in the literature is an exploration of the clinical application of these findings. Furthermore, some authors have utilized images without appropriate preprocessing steps, which negatively impacts the accuracy of disease classification due to factors such as illumination effects. Hence, these issues need to be considered and prioritize appropriate preprocessing techniques to ensure the robustness and reliability of the results.

DATASET DESCRIPTION

This work uses a dataset containing 1400 dermatological images from two main sources: the International Skin Imaging Collaboration (ISIC) [18] and Kaggle [19]. The aim is to develop and test a CNN model for spotting skin diseases, particularly distinguishing between cancerous and non-cancerous lesions. The dataset includes 1400 images in total, with 700 malignant and 700 benign lesions. The images have different resolutions, reflecting real-world clinical variations. To ensure fair training and evaluation, the dataset is evenly divided into 700 images each for malignant and benign lesions, providing a balanced representation of both classes. Sample images from the dataset are illustrated in Figure 1.

METHODOLOGY

The work addressed identified gaps by analyzing and comparing Kaggle and ISIC skin disease classification data sets. Most existing classification work achieves an accuracy between 80 and 90%, with the aim of higher precision. To mitigate the impact of illumination and image quality issues, advanced image preprocessing methods were developed and applied, leading to improved classification accuracy. For robust and reliable results, additional hidden layers were incorporated into the proposed methodology, as illustrated in the block diagram. Here's an overview of the methodology used in this work:

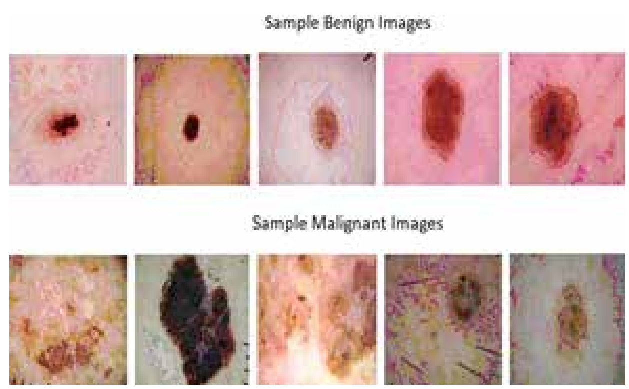

Fig. 1. Sample Images from Dataset

Prepossessing Method:

Data loading and exploration: The work begins by loading a skin disease dataset using TensorFlow's 'image dataset from the directory. This function organizes the data set into classes based on subdirectories, such as benign and malignant. Class names are extracted from the dataset, and a subset of images is visualized to gain insights into the data.

Data Pre-processing and Augmentation

The dataset undergoes pre-processing and augmentation to improve the generalization of the model. Pre-processing includes resizing and rescaling images, the images in this work are resized to the size of 224 x 224, while data augmentation involves random flips and rotations. These transformations contribute to the model's ability to learn robust features.

Dataset Splitting: The dataset is divided into training sets and validation sets, and further it is tested using a custom function. This function ensures a proper distribution of samples across sets. This ensures a balanced distribution of samples across the respective sets.

Proposed Methodology

CNN architecture is implemented using TensorFlow Keras. The convolutional Layer has an increased number of filters and there is a decrease in spatial dimension. In the beginning, there is a convolution layer then the max pooling layer. This pattern helps the model to learn the hierarchical features of the input images [20]. The block diagram of the proposed methodology is shown in Figure 2.

In the proposed CNN architecture, five hidden layers are used as discussed below.

Flatten layer: Flatten layer converts the multidimensional layer into a 1D array.

Dense layers (Fully connected layers): With n classes of neurons and the softmax activation function, the final dense layer is appropriate for multiclass classification. model .build (input shape=input shape): is the code that Builds the model by specifying the input shape. This is necessary before training the model. It includes 1) convolutional layers, 2) max-pooling layers, 3) fully connected layers, and 4) nonlinear activation functions such as ReLU. The model is designed for image classification tasks and is tailored to the characteristics of skin disease detection.

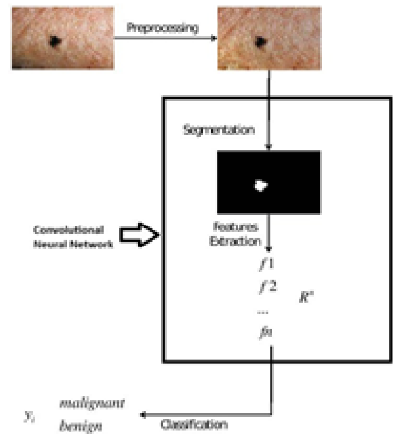

Fig. 2. Block diagram of proposed methodology

Model Compilation: The model is assembled using the Adam optimizer with sparse categorical cross-entropy loss. The ac- curacy metric is used in the monitoring process. Training the Model: The model undergoes training with the utilization of the training dataset, and its performance is monitored on the validation set [21]. The training history, which captures accu- racy and loss metrics, is recorded to assess model convergence and identify possible overfitting.

Model evaluation: The model that has undergone training is evaluated in the test dataset, generating scores such as loss and accuracy.

Model Performance Metrics: Precision, recall, and F1 scores are computed for each class using sci-kit-learn metrics. These metrics offer an all-inclusive analysis of the performance of the model across individual classes.

ROC Curve and AUC Score: The ROC (Receiver Operating Characteristic) curve and AUC (Area Under the Curve) score are calculated to test the model's discriminative power for binary classification.

RESULTS

A Convolutional Neural Network (CNN) based feature ex- traction and classification technique is implemented using 700 images of each malignant and benign class. The performance of CNN is evaluated using metrics like Accuracy, Precision, Recall, and F1 Score as discussed below.

Accuracy

The ratio of correctly identified samples to the total number of samples, as provided by Equation 1 [10], is the definition of accuracy. Figures 3 and 4 display the accuracy of training and validation for the provided dataset.

$$\text{Accuracy} = \left[\frac{(TP+TN)}{(TP+FN+FP+TN)}\right] \times 100\%$$

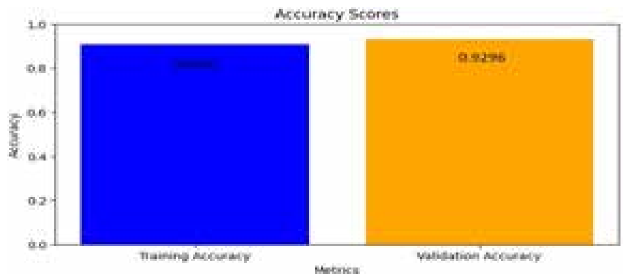

Fig. 3. Accuracy Scores

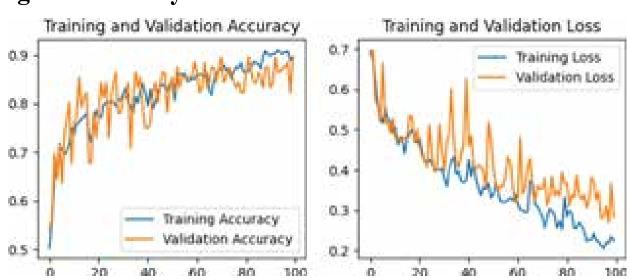

Fig.4. Training and Validation Accuracy

Precision

Precision is defined as the proportion of properly recognized positive samples and the total number of positive samples predicted.

$$\text{Precision} = \left[\frac{TP}{TP+FP}\right] \times 100\%$$

Recall

The recall is defined as the proportion of the total number of properly-recognized positive samples classified correctly.

$$\text{Recall} = \left[\frac{TP}{TP+FN}\right] \times 100\%$$

F1Score

The weighted average of precision and recall combined into a single value is called the F1score. Where TN denotes the true negative, FP denotes the false positive, FN denotes the false negative, and TP denotes the true positive. We have also illustrated the classification performance of our model graphically using the Receiver Operating Characteristic (ROC) and the Area Under Curve (AUC). Figure 5 shows the precision, recall, and F1 score for CNN training [10].

$$\text{F1 Score} = 2\times\left[\frac{(Precision \times Recall)}{(Precision+Recall)}\right] \times 100\%$$

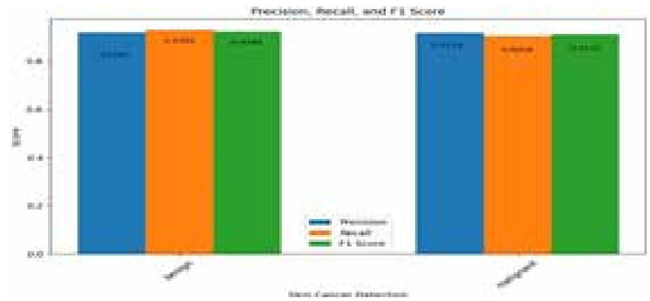

Fig. 5. Precision, Recall and F1Score

ROC Curve

A ROC curve is useful for visualizing a model's performance in classification. Plotting the ROC curve involves comparing the true positive rate-TPR with the false positive rate-FPR. The following formulas are used to calculate the TPR and FPR [10].

$$\text{TPR} = \frac{TP}{TP+FP} \qquad \text{FRP} = \frac{FP}{FP+TN}$$

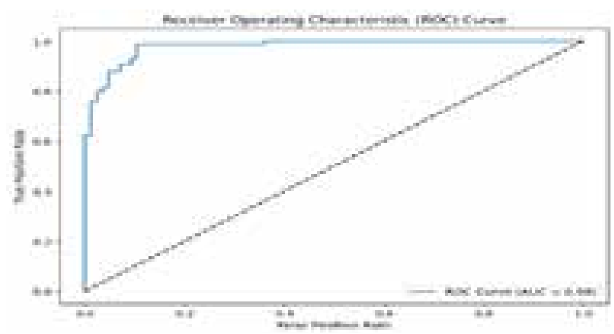

Fig. 6. ROC curve

Characteristic (ROC) curve and the Area Under the Curve (AUC) score for the binary classification problem. It then plots the ROC curve and prints the AUC score, providing a measure of the model's performance as shown in Figure 6.

CONCLUSION

This work investigated the efficiency of CNNs in the detection of malignant and benign skin diseases based on dermoscopic images. CNN model demonstrated promising performance in distinguishing between malignant and benign skin lesions, achieving an overall accuracy in which the training accuracy is 90.91 percent and the validation accuracy is 92.96 percent in the test data set. This high precision underscores the potential of deep learning techniques to help dermatologists and healthcare professionals in accurate diagnosis, especially in situations where early detection is essential. Evaluation metrics like precision, recall, and F1 score for malignant and benign images ranged between 0.91 to 0.93.

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Conversion from Thoughts Into Actions using Mind Machine Interface for Specially Abled People

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ABSTRACT

Loss of motion is the failure to move a body portion, brief or changeless. In most cases, loss of motion is caused by harm to the nerves, not the influenced range. For example, an injury to the central or lower region of the spinal cord can disrupt work below the injury, even if the structures are very strong. This may result in one or more of the taking after side effects: Failure to move the influenced region, Inability to feel sensation within the influenced area and Failure to control real capacities within the influenced. zone Mind-Machine Interface (MMI), in addition known as arrange neural interface, can provide a facilitate channel of communication and interaction between the user's brain and computer. MMI may be utilized to back, improve or redress human cognitive or sensorimotor capacities. MMI gives a modern strategy for making intelligently frameworks competent of changing over human brain waves and muscle action into activities that can be communicated to the exterior world. The MMI framework basically changes over EEG signals, which reflect brain action, into client activities through the system's equipment and computer program. Here are a few particular cases of how MMI can be utilized to offer assistance paralyzed individuals: MMI can be utilized to control wheelchairs, permitting paralyzed individuals to move autonomously. MMI can be utilized to function computers, permitting paralyzed individuals to communicate and get to data. IMM can be utilized to reestablish a few levels of development to paralyzed appendages. IMMs are still inside the early stages of progression, but they have the potential to revolutionize the way we treat misfortune of movement. By giving a facilitate communication channel between the brain and computer, IMM can offer help paralyzed people recover many opportunities and quality of life .

KEYWORDS *: Mind-machine interface, Electroencephalogram (EEG), Counterfeit neural arrange.*

INTRODUCTION

The spine is the foremost imperative portion of our body, and its fundamental work is to supply supplements to the spine, nerve roots, and inside organs. Spinal rope wounds happen when the spine is harmed. When the spine is harmed, a person's faculties, development, and reflex messages may be influenced and the individual may not be able to operate regularly. The more prominent the damage, the more debasement harm can happen [1]. This will result in a total misfortune of arm or leg development, as well as half or total misfortune of body development. Individuals with especially serious spinal line wounds (SCI) can control muscle improvement from the neck up.

Since the conventional joystick is now not valuable, a controlled electric wheelchair with discretionary his hands-free interface is basic to carry the openly. This back can be produced from data from your eyes, tongue, voice and brain waves. This Sort of wheelchair can be classified as a consolation wheelchair since it works on the premise of a computer interface. Data collected through the activity of the eyes, tongue, voice, or brain waves is prepared to control the cleared out and right, front and back developments of the wheelchair. The capacity to move independently significantly guarantees the physical and mental well-being of clients with inabilities.

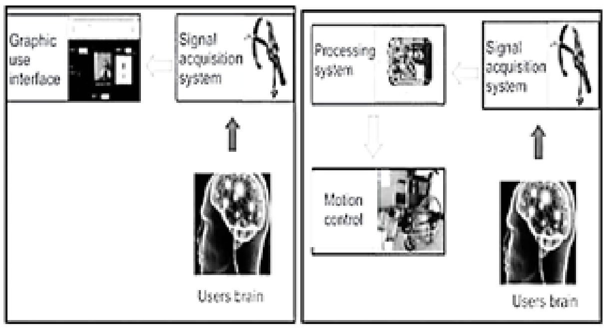

Fig 1. BCI Working Principle

In later a long time, there has been expanding intrigued in Brain computer interface (BCI) frameworks for therapeutic and mixed media applications. BCI may be a gadget that gives a coordinate interface between the human brain and a computer [2]. Clients as it were got to worry almost traveling to control the framework. Hence, the utilize of BCI is one of the foremost imperatives helps to permit seriously crippled clients to control their wheelchairs. In this extend, an electroencephalogram (EEG) flag created by a single anode set on the brow is utilized as a controller to trigger the user's deliberate commands. Alpha and Beta groups are utilized since the EEG gadget has an coordinates chipset that identifies contemplation and participation e-Sense. The analysis is performed using sufficient brainwave sample data from the user and focuses on four visible objects with different shapes, colors, and mental images that represent the movement commands of the wheelchair. After analysis, the show that given the most elevated precision in terms of cruel & change comparison inside the demonstrate is chosen as a ultimate model to control wheelchair development through BCI.

LITERATURE SURVEY

Thousands of individuals around the world endure from development clutters such as neuromuscular clutters and spinal rope wounds. They frequently depend on control wheelchairs for their day-by-day exercises [1]. In any case, due to their physical incapacities, numerous of them are able to control their wheelchairs utilizing conventional controls such as joysticks [1]. Within the past, a few wheelchair assistances plans have been displayed with elective interfacing that utilize EMG signals (muscle developments), EEG signals (mental considerations), and EOG signals (eyelid developments and eye developments). In [2], his EEG/EMG signals are captured employing a biosensor and after that prepared by the Think Adapt module in MATLAB. [3] employments EEG signals captured by numerous anodes of an enthusiastic headset. The obtained flag is analyzed utilizing bolster vector machine (SVM) and neural arrange. The arrange shown in [4] shows up that highlights removed from EOG takes after can be utilized to choose whether the eyes are open or closed and whether the eyes are looking to the proper, center, or cleared out . Shrewdly wheelchair control has been executed utilizing Android applications and Bluetooth communication conventions ([5], [6], and [7]). Generally, wheelchairs worked through different input implies such as signals and voice [8] can as it were be utilized viably by individuals with mellow incapacities. In any case, the plan of wheelchairs for individuals who have misplaced the capacity to move their appendages and facial muscles due to spinal rope harm or neuromuscular illnesses such as ALS and PLS basically employments EEG, EMG, EOG, etc.

PROPOSED METHODOLOGY

This is often ordinarily done by putting terminals on the scalp. Brain signals are classified agreeing to recurrence. The framework recipient incorporates Neurosky Mindwave, Arduino, and HC-05 Bluetooth module. The Mindwave gadget records crude brain signals and sends them through Bluetooth to the HC-05 module. The Bluetooth module at that point sends data to the Arduino board at a rate of 57,600 baud. The Arduino board classifies the unrefined hail into glint and thought values . When the glint concentrated changes, the flash esteem too changes ceaselessly. flash escalated and person consideration values are sent to the Raspberry Pi by means of USB at a baud rate of 57,600 to 57,600 baud. Within the handling portion of the Raspberry Pi, the squint and consideration values are part into partitioned recollections areas.

After classification, these signals are tested to ensure they meet the required conditions. When the conditions are met, the Raspberry Pi 3 module sends commands to the motor driver. The engine controller is associated to 24 DC control supplies and 2 diminishment engines. Depending on the command given, the engine controller will turn the engine in three distinctive bearings: her cleared out, right, and cleared out prior. A camera is introduced before the wheelchair to guarantee security when moving the wheelchair. The camera persistently records video and sends the video flag to the Raspberry Pi module.

Identifies head developments and languor utilizing progressed picture preparing innovation. Ultrasonic sensors are moreover introduced on the front, cleared out and right sides, and foot of the wheelchair to maintain a strategic distance from collisions with other objects .

BLOCK DIAGRAM

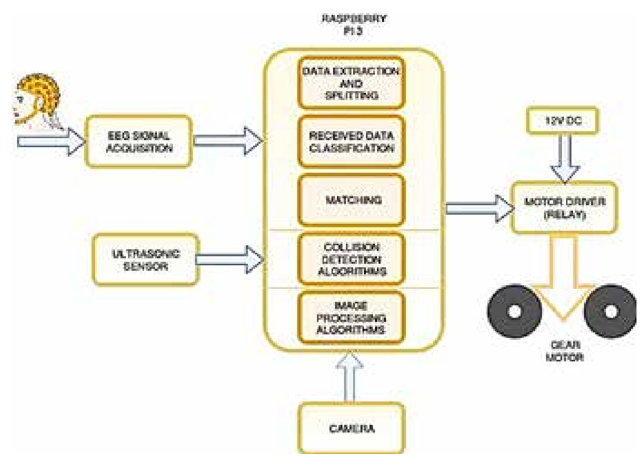

Fig 2. Block Diagram.

EEG stands for Electroencephalography

Its employments cathodes set on the scalp to identify brain wave designs. EEG signals are frequently spoken to as an arrangement of waveforms. These waveforms can be classified into diverse recurrence groups (e.g., delta, theta, alpha, beta, gamma). EEG is commonly utilized in restorative and inquire about settings to consider brain work, analyze conditions such as epilepsy, and screen brain movement amid rest or cognitive assignments. EEG gives important data around brain wellbeing, cognitive status, and neurological clutters. Alpha waves (8-12 Hz): alpha waves are related with a state of loose readiness. After you near your eyes and unwind, your brain produces more alpha waves. These are frequently utilized to survey a person's rest and readiness. Beta Waves (12-30 Hz): Beta Waves are related with readiness and dynamic concentration. They are most recognizable after you are caution and rationally dynamic. Gamma Waves (30-100 Hz): 4,444 Gamma waves are included in high-level cognitive forms such as memory recovery, issue tackling, and discernment. These are common in employments that require seriously mental preparing.

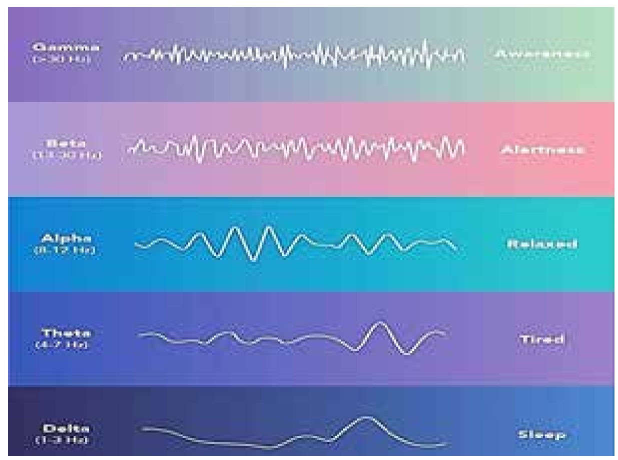

Fig 3. Waves

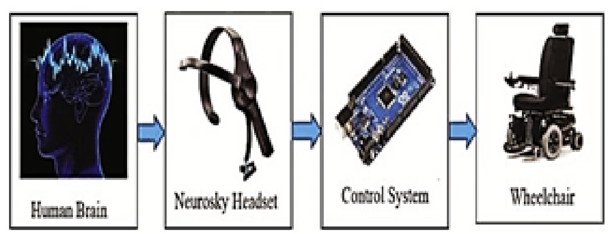

Fig 4. Brain controlled interface for electric wheelchair

Information Securing Area EEG signals by MMI were created to control wheelchairs. The plan is absolutely electrical, killing most mechanical components. This dispenses with the require for conventional directing frameworks that are physically controlled by the client. Instep, two arranged engines drive the cleared out and right wheels of his, making a two-wheel drive framework that works well with the MMI. This framework is cost-effective, direct to control, and fueled by a brushless

DC engine & high-capacity battery system. Wheelchair developments depend completely on your level of sharpness. The cleared out, right, and forward begin and conclusion focuses are controlled by flickering values. Ultrasonic sensors and cameras guarantee security when moving.

SCOPE FOR FUTURE WORK.

The plan and execution of mind machine interface wheelchair is summarized underneath.

1. The current approach uses a single channel to collect brain signals. In any case, utilizing numerous channels moves forward the exactness of choices made by the framework. This permits individuals with inabilities to get to more gadgets in their environment, lessening their reliance on carers, medical attendants and relatives. This ponder is preparatory and has certain confinements.

2. Within the future, shows may be associated to the framework. This advertisement shows a predefined slideshow or liveliness that appears the day by day needs of individuals with inabilities. The show can appear different alternatives such as water, nourishment, medication, rest, etc.

3. Handling delays have been decreased by utilizing progressed processors. The framework is simple to set up and can be assist created in an easy-to-use manner. Clients as it were got to select a target and bargain with any startling circumstances which will emerge. This framework requires negligible exertion and concentration. The wheelchair rehashes the same direction over time, making its development unsurprising and unwinding for the client. This framework is aiming for individuals who are incapable to move and are frequently restricted to bed. Their sense of time is diverse from our own, and the capacity to move autonomously in their environment implies their quality of life is significantly made strides.

4. At last, we ought to conduct a try with a disabled person who really requires a mind-controlled wheelchair (MCW). Usually since sound clients may respond in an unexpected way.

CONCLUSION

A audit of the writing on different equipment execution strategies uncovers the points of interest and impediments of already outlined frameworks. To attain the plan objective, a brain-controlled portable wheelchair utilizing Raspberry Pi, Arduino and Mind-wave headset was planned . Aim of the project are: Control a power wheelchair in different directions (forward, left, right) using attention level readings from eye blinks and brainwave signals. Design user-friendly systems that can accomplish real-world goal achievement tasks. Such systems may require the user to gradually rotate the wheelchair to the left or right and then move it forward before it loses control or moves. Controls to move forward, stop, turn and move forward, similar to real wheelchair controls. People with disabilities can use this to maneuver their wheelchair in different directions. We too take into consideration ease of utilize so that anybody can effectively learn how to utilize it. Framework has been tested and is working legitimately. This can be a promising better approach for individuals with incapacities to control wheelchairs.

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Impact of Digital Technologies on LSRW Proficiency in Language Learning

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ABSTRACT

This research paper investigates the impact of digital technologies on the development of Listening, Speaking, Reading, and Writing (LSRW) skills in language learning contexts. As technology continues to reshape educational landscapes, there is a growing need to understand its role in fostering language proficiency. The study employs a mixed-methods approach, combining quantitative assessments of LSRW performance with qualitative analyses of learner experiences in technology-integrated language programs. The quantitative component involves pre- and post-assessments to measure changes in LSRW proficiency among participants exposed to digital tools(language lab). The qualitative aspect explores learners' perceptions, attitudes, and engagement with technology through interviews and surveys. The research aims to identify specific digital strategies that contribute to enhanced LSRW abilities, considering factors such as interactive applications, multimedia content, and virtual communication platforms. Findings from this study are expected to provide valuable insights for educators, curriculum designers, and policymakers, informing the integration of digital technologies to optimize LSRW skill development in language learning environments. Additionally, the research contributes to the broader discourse on the evolving role of technology in shaping effective language pedagogy.

KEYWORDS *: LSRW, Digital technologies, Communication, Language lab, Assessment.*

INTRODUCTION

In an era characterized by rapid technological advancements, the landscape of language education is undergoing a profound transformation. Digital technologies have become ubiquitous, offering new avenues for teaching and learning. This paradigm shift prompts a critical examination of their impact on fundamental language skills, particularly Listening, Speaking, Reading, and Writing (LSRW). As educators and learners increasingly embrace digital tools, understanding the dynamics of this integration and its implications for LSRW proficiency is imperative[1-2].

This research delves into the intricate relationship between digital technologies and LSRW skill development in language learning contexts. Traditional language pedagogy has long emphasized the importance of these core skills, considering them as integral components of communicative competence. The advent of digital technologies brings forth both challenges and opportunities, raising questions about how these tools can be effectively harnessed to enhance LSRW abilities. The objectives of this study are two-fold. Firstly, it seeks to quantitatively assess the impact of digital technologies on LSRW proficiency through systematic pre- and post-assessment measures. Secondly, it aims to qualitatively explore the experiences of learners engaging with digital tools, aiming to uncover the nuanced ways in which technology influences their language acquisition journey. By combining these approaches, the research endeavours to offer a comprehensive understanding of the multifaceted relationship between digital technologies and LSRW skills in language education[3-4].

METHODOLOGY FOR IMPROVING LSRW

Before The following sections will delve into the methodology, results, and implications, contributing to the evolving discourse on the role of digital technologies in shaping the landscape of language education.

1. Interactive Language Apps: Utilizing interactive language learning applications that focus on LSRW skills. These apps often include features for listening exercises, pronunciation practice, reading comprehension, and writing prompts.
2. Language Labs: Implement language labs that offer a range of activities for listening and speaking practice. These labs can simulate real-world language scenarios, providing learners with immersive experiences.
3. Multimedia Content: Integrate multimedia content such as podcasts, videos, and interactive e-books into the curriculum. These materials enhance listening and reading comprehension while providing engaging content for language learners.
4. Virtual Reality (VR) Platforms: Explore VR platforms that simulate authentic language environments. VR can be particularly effective for immersive language experiences, allowing learners to practice speaking and listening in realistic scenarios.
5. Digital Writing Platforms: Incorporate digital writing platforms and collaborative tools for writing practice. These platforms enable learners to share, edit, and receive feedback on written assignments in real-time.
6. Online Language Exchanges: Facilitate online language exchange programs where learners can engage in conversation with native speakers through video calls or messaging apps. This enhances both speaking and listening skills.
7. Podcasting Projects: Encourage learners to create and share podcasts as a means of developing speaking and listening skills. This not only hones language abilities but also fosters creativity and expression.
8. Webinars and Online Workshops: Organize webinars and online workshops that focus on specific aspects of LSRW skills. Invite guest speakers or experts to provide insights and guidance to learners.
9. Digital Storytelling Platforms: Explore digital storytelling tools that allow learners to create multimedia stories. This promotes creativity in writing while incorporating elements of listening and speaking as they share their narratives.
10. Social Media Engagement: Leverage social media platforms for language learning communities. Engaging in discussions, sharing content, and participating in language challenges on platforms like Twitter or language-specific forums can enhance all four language skills.
11. Online Reading Clubs: Establish online reading clubs where learners can read and discuss articles, books, or blogs together. This not only enhances reading skills but also promotes discussion and interaction in the target language.
12. AI-Powered Language Tutors: Integrate AI-powered language tutors that provide personalized feedback on pronunciation, grammar, and writing. These tools offer instant guidance, allowing learners to refine their language skills progressively.

By incorporating above digital strategies [5-7], educators can create a dynamic and comprehensive language learning environment that effectively equips learners with strong LSRW skills.

ROLE OF LANGUAGE LAB (ORELL TALK SOFTWARE) TOWARDS TO ENGINEERING STUDENTS

After Setting up a language lab in a college, involves creating a dedicated space equipped with advanced technology to enhance students' language learning experience. The lab typically includes individual workstations with headphones and microphones, facilitating a focused environment for language practice. Orell Talk software is integrated to provide interactive exercises, pronunciation drills, and real-life conversation simulations. This technology enables students to improve their speaking and listening skills in a controlled yet dynamic setting. The language lab setup fosters a self-paced learning approach, allowing students to receive immediate feedback and track their progress. Overall, the integration of language labs and Orell Talk software in colleges aims to create an immersive and effective language learning environment and helping students to gain confident in LSRW.

CRITERIA FOR SELECTING STUDENTS FOR TRAINING IN LANGUAGE LAB

There are certain criteria for selecting students to develop LSRW of students in language lab of Atharva college of Engineering-

1. Academic Performance: By considering students' academic achievements to ensure a baseline level of competence and evaluate grades in relevant subjects or courses related to the participation opportunity.
2. Interest and Motivation: By assessing students' genuine interest and motivation for learning and signs of enthusiasm and passion.
3. Relevant Skills and Abilities: By identifying students with the necessary skills and abilities required for the participation opportunity. This includes technical skills, communication abilities and self-confidence.
4. Behavioural and Social Factors: Considering students' behaviour, conduct, and social interactions and who can collaborate effectively, contribute positively to the group, and uphold a respectful demeanour.
5. Leadership Potential: By identifying students who demonstrate leadership qualities or the potential to take on responsibilities.
6. Availability and Commitment: Ensuring that selected students has the time and commitment required for the participation opportunity. Consider existing commitments, such as other extracurricular activities or academic obligations.
7. Teacher Recommendations: Seeking input from teachers or mentors who know the students well and take recommendations based on the students' suitability for the specific participation opportunity.
8. Application or Interview Process: Implement an application or interview process to allow students to express their interest and suitability. This process is used to assess communication skills, articulation of goals, and alignment with the opportunity.
9. Feedback from Peers: Consider feedback from peers or classmates who may have insights into a student's collaborative and interpersonal skills. Peer input can provide a holistic view of the student's capabilities.

PERFORMANCE ANALYSIS OF LANGUAGE LAB

By considering these criteria, the selection process can be comprehensive, ensuring that students chosen for participation are not only academically capable but also possess the qualities needed for a successful and enriching experience.

The Language Lab at Atharva College of Engineering has proven to be a transformative tool for students seeking to enhance their language skills. Through a dynamic blend of technology and pedagogy, the lab has provided an immersive environment for honing (LSRW) Listening, speaking, reading and writing skills. Fig.1 shows the evaluation of students, before and after Spoken English Personality Development (SEPD). Students engage in interactive exercises, simulated conversations, and targeted language drills, fostering a comprehensive understanding of the language. The hands-on approach has not only improved their proficiency in English but has also instilled confidence in expressing ideas effectively. As a result, students emerge from the language lab equipped with a heightened command of the language, empowering them for academic success and future professional endeavours.

The evolving role of technology significantly contributes to effective language pedagogy, particularly in developing LSRW (Listening, Speaking, Reading, and Writing) skills. Digital tools and platforms provide interactive and immersive experiences, enhancing language learning beyond traditional methods. Virtual environments, language learning apps, and online resources offer opportunities for real-world language application, fostering practical communication skills. Additionally, technology facilitates personalized learning, adapting to individual needs and promoting self-paced improvement in each aspect of LSRW. Integrating these advancements aligns language education with the dynamic demands of the digital era, ultimately shaping a more comprehensive and engaging language pedagogy.

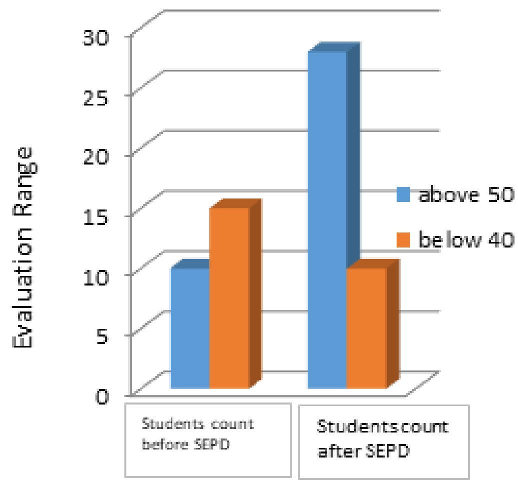

Fig. 1. Performance analysis of students before and after SEPD

CONCLUSION

This research has delved into the intricate relationship between digital technologies and the development of Listening, Speaking, Reading, and Writing (LSRW) skills in language learning contexts. The findings underscore the multifaceted impact of technology on language proficiency, shedding light on the opportunities that arise in this dynamic intersection. The quantitative assessments revealed statistically significant improvements in LSRW proficiency among participants exposed to digital tools, emphasizing the potential of technology to positively influence language acquisition. Moreover, the qualitative exploration of learner experiences provided nuanced insights into the ways in which technology enhances engagement, motivation, and a sense of autonomy in the language learning process.

Navigating the evolving landscape of language education, it is evident that the judicious integration of digital technologies holds immense promise for optimizing LSRW skill development. The success of language apps, virtual reality simulations, online writing platforms, and other tools highlights the adaptability of technology in catering to diverse learning styles and preferences. However, this journey towards digital integration also necessitates a thoughtful consideration of potential challenges, such as ensuring equitable access, addressing technological disparities, and maintaining a balance between digital and traditional pedagogical approaches. As educators and policymakers chart the course forward, collaborative efforts are essential to harness the full potential of digital technologies while mitigating potential pitfalls. So finally, this research contributes to the ongoing discourse on the role of digital technologies in language education, offering practical insights for educators, curriculum designers, and stakeholders. By embracing innovative approaches and leveraging the benefits of technology, we can create a dynamic and inclusive language learning environment that empowers learners to excel in all facets of Listening, Speaking, Reading, and Writing.

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Preparation and Dynamic Mechanical Analysis of Unstructured and Prestructured MR Elastomer

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ABSTRACT

The magnetorheological(MR) elastomer has grew obsessed by a potent and state-of-the-art substantial that can be rapidly and precisely manipulated in standings of its mechanical characteristics, either in the occurrence or lack of a magnetic flux. They are composed of elastomer materials that have been mixed with iron particles. Isotropic and anisotropic magnetic resonance elastomers are classified into various groups according on the use of a magnetic flux in the course of the construction process. Magnetizable elements are present in the medium of an elastomer, and they are arranged and managed in a very specific way. after seeing how MREs' structures and behaviors changed. A Dynamic Mechanical Analysis was implemented to demonstrate their performance. Owing to their remarkable mechanical physiognomies, they can be employed in various uses such as pulsation sensors, seismic expedients, and more.

KEYWORDS *: Smart materials, Magnetorheological elastomer, Carbonyl iron particles, Dynamic mechanical analysis.*

INTRODUCTION

The emergent trend of a larger and lenient regime has improved the need for novel materials and technologies, bringing complex, intelligent, and brilliant functional aspects to the forefront of attention. Resources that are like-minded to ecological factors such as electrical or magnetic flux, stress, hotness, also light are deliberated environmentally sensitive, according to Kamila et al. Because of their giant economic probable, magneto rheological (MR) possessions have occurred as the utmost significant smart source. They fall under the category of resources for useful smart materials that display viscoelastic and rheological properties like yield plus shear stress in adding to damping belongings when open to an exterior magnetic flux. On the contrary, MREs can now be separated into two sets: isotropic-unstructured and anisotropic-prestructured due to the development of its wonderfully polarized particles. Because the polarized elements of an isotropic MRE are evenly distributed, the physical recitals are reliable in all directions. According to Danas et al. (2012) and Kumbhar et al. (2013), With the input magnetic flux track, the magnetic elements of an anisotropic MRE are stretched sideways. These bases were elected for this inquiry. As of their inherent possessions under exterior magnetic flux besides their real presentation in vibration-gripping expedients, Zhou et al(2014) and Ge et al (2013).

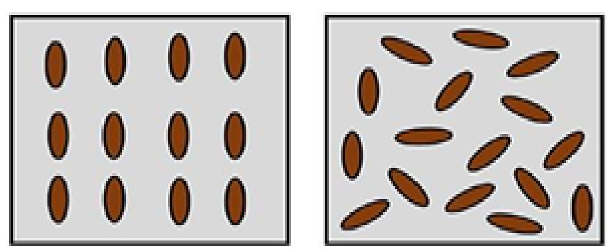

Fig. 1: Isotropic-unstructured and anisotropic-prestructured MRE's

Preparation of Isotropic or unstructured and anisotropic or prestructured MREs with 15% and 30% iron elements by wt. in elastomer medium have been complete in this revision Kumbhar et al(2012, 2013) and above Zhou et al(2014) then Hegde et al(2014). And, by using Dynamic Mechanical Analysis (DMA) relation stuck between the applied stress and the strain produced in the sample, storage modulus(G′) plus the loss modulus(G″) is premeditated. The ratio between G″ and G′ is called damping (tanδ). and it is verified with the types of MRE's by using DMA analysis, G. H. Zhu et al (2019).

FABRICATION OF ISOTROPIC / ANISOTROPIC MAGNETORHEOLOGICAL ELASTOMER

Anisotropic MRE stands a pre-structured attractive elastomer that has numerous advantages. An exterior magnetic flux is added to the blend of magnetic elements and elastomer matrix in the curing method. The isotropic magnetic elastomer (MR-elastomer) is among the most valued formless magnetic elastomers available. During the curing process, the combination was not exposed to any extra external magnetic flux. Kumbhar et al. state that MRE is an elastomer matrix that cures with or without magnetic flux and contains ferromagnetic particles. PDMS, which is existing in type(A) (liq. reagent) and type(B) (curing substance) forms the basis material for the current MRE. Two distinct percentages of iron elements were additional to the base material and mixed in. According to Tang et al., the PDMS elastomer was picked for of its wide temperature range and simple curing procedure. Anisotropic MREs were cured using a magnetic flux applied by permanent NeB magnets. For both type samples, the curing process lasted for 48 hours. Four samples in all have been created; the other two are MRE with 30% of iron particles by weight, and the other two are isotropic and anisotropic MRE with 15% of iron particles by weight. Whether or not there is magnetic flow depends on the kind of magnetic flux. In the MRE matrix, silicon oil is utilized as a plasticizer. Samples 1 and 3 were made using an elastomer and 15% I.P., whereas samples 2 and 4 were made using 30% I.P.

Table 1: Percentage by wt. (gm) used for Sample1 and 3

Sample	Nature	I.P. concentration (%)
MRE-1	Anisotropic-1	15
MRE-2	Anisotropic-2	30
MRE-3	Isotropic-1	15
MRE-4	Isotropic-2	30

DYNAMIC MECHANICAL ANALYSIS

To ascertain the efficacy of organized MRE samples in terms of storage modulus(G′) and the loss modulus(G″) has crucial to conduct the investigation, which was briefly mentioned in the study article given. The testing design is depicted in Figure 2. In this study, Discovery DMA850 (BTRA, Mumbai) is used for dynamic mechanical analysis and experimentation was done in shear mode by considering frequency sweep in the range of 1-50Hz at 5% strain amplitude.

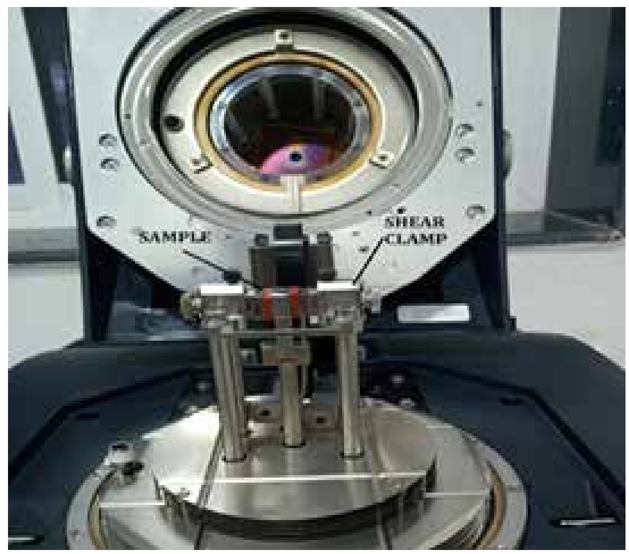

Fig. 2: Dynamic Mechanical Analyser (BTRA,Mumbai)

For DMA testing, the dimension of the sample remained 10mm square, Upto 4mm (T) based on ISO 6721-1. Two identical-sized portions of the similar models are sheared among a immovable and moving platter for the calculation of G',G' plus tanδ.

The calibration of Dynamic Mechanical Analyser before starting of experimentation performed by Standard Test Method for Storage Modulus based on ASTM E 2254.

Sample 1 (Anisotropic 15%)

Figure shows the response of MRE1 having 15% of iron particles (anisotropic) which includes behaviour of viscoelastic material in standings of G',G' plus tanδ in the frequency sort of 1 to 50 Hz at 5% strain amplitude.

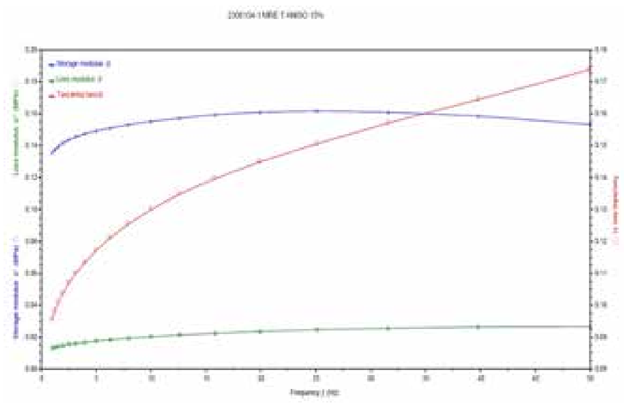

Fig. 3 : Storage modulus(G'), Loss modulus(G") and Loss factor(tan δ) of MRE1 -Anisotropic 15%

Viscoelastic solids always have (G'> G"), present research is also showing developed storage modulus than loss modulus in sample 1. Storage modulus is increased by increasing oscillating frequency. Similarly, the loss factor is also increased by increasing oscillating frequency.

Sample 2 (Anisotropic 30%)

Figure shows the response of MRE2 having 30% of iron particles (anisotropic) which includes behaviour of viscoelastic material in standings of G',G' plus tanδ in the frequency sort of 1 to 50 Hz at 5% strain amplitude.

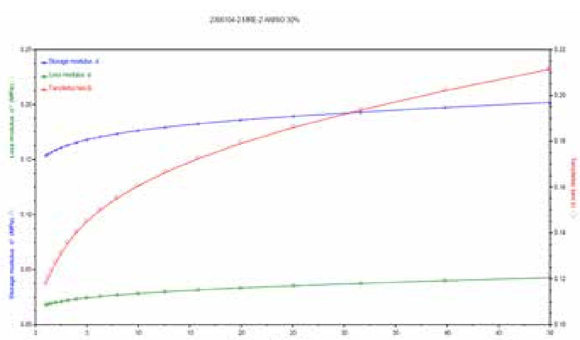

Fig. 4 : Storage modulus(G'), Loss modulus(G") and Loss factor(tan δ) of MRE2 -Anisotropic 30%

Result of MRE2 is also showing higher G', G' in the sample. Storage modulus is increased by increasing oscillating frequency. Similarly, the loss factor is also increased by increasing oscillating frequency. As compared to all present samples it shows high G' and tanδ. The higher the tanδ, the more damping in the elastomer. As loss Factor is inversely proportional to Maximum Transmissibility (Tmax). So, lower the Maximum Transmissibility value, the more damping in the elastomer. In FFT analysis samples with the same percent of IP show good results of transmissibility and damping in material. As per the both analytical results shown this sample is considered as the best sample among all present samples.

Sample 3 (Isotropic 15%)

Figure shows the response of MRE3 having 15% of iron particles (isotropic) which includes behaviour of viscoelastic material standings of G',G' plus tanδ in the frequency sort of 1 to 50 Hz at 5% strain amplitude.

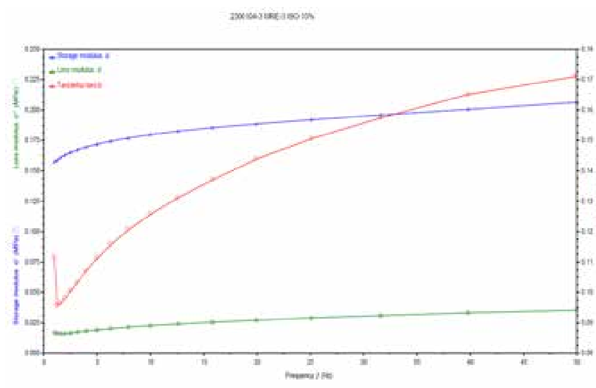

Fig. 5: Storage modulus(G'), Loss modulus(G") and Loss factor(tan δ) of MRE3 - Isotropic 15%

Sample 3 is also showing (G'>G"). Storage modulus is increased by increasing oscillating frequency. Similarly, the loss factor is also increased by increasing oscillating frequency but shows some fluctuation in the loss factor at the starting of oscillation, initially recorded with more loss factor and then suddenly dropped and then again increased at all peak points. By considering all samples, it shows moderate results of damping in material.

Sample 4 (Isotropic 30%)

Figure shows the response of MRE3 having 30% of iron particles (isotropic) which includes behaviour of viscoelastic material in standings of G',G' plus tanδ in the frequency sort of 1 to 50 Hz at 5% strain amplitude.

Sample 4 is also showing (G' > G"). Storage modulus is increased by increasing oscillating frequency. Similarly, the loss factor is also increased by increasing oscillating frequency but shows some fluctuation in the loss factor at the starting of oscillation, initially recorded with more loss factor and then suddenly dropped and then again increased at all peak points.

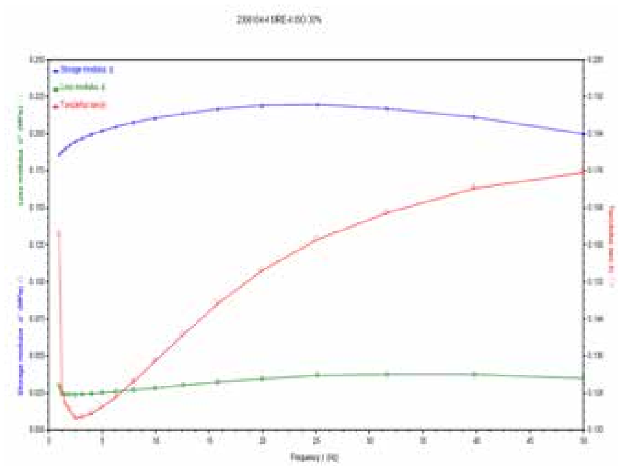

Fig. 6: Storage modulus(G'), Loss modulus(G") and Loss factor(tan δ) of MRE4 - Isotropic 30%

By considering all samples, it shows good results of damping in material behind sample 2.

CONCLUSION

Magneto-rheological (MR) elastomer is smart materials having good consistency which strongly influenced below magnetic field. The basic belongings of MR elastomer which change their rheological behavior in the existence of a magnetic flux are described. In this study, we explored the production, groups, components, and usage of smart MREs. The higher the Loss Factor, the more damping in the elastomer. Loss Factor is inversely proportional to Maximum Transmissibility (Tmax). By considering the loss factor and transmissibility conclusion has been made to specify sample with good damping properties. The sample (anisotropic 30%) is having more loss factor with increasing frequency range from 1-50 Hz. Behind this (isotropic 30%) is showing great loss factor with increasing frequency range. Then samples (anisotropic 15% and isotropic 15%) show moderate results of damping in material.

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Battlefield Awareness using IoT in Network Centric Warfare: Soldiers Health Integration for Enhanced Location Deployment (SHIELD) System

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ABSTRACT

Data transmission during modern combat situations needs to be fast and reliable. At the same time, it should be able to support the rapidly changing requirements of Network Centric Warfare (NCW) and battlefield awareness. Battlefield awareness refers to the capability of military forces to collect, analyse, and comprehend real-time information on the battlefield which enables commanders to make well- informed decisions. Soldiers being the most critical element on the battlefield, their fighting potential needs to be enhanced and their ability to provide valuable information about the battlefield should be explored. This paper presents a reliable and scalable implementation of an Internet of Things (IoT) architecture, specifically designed for monitoring soldiers' health and acquiring real-time battlefield data. The system, named Soldiers Health Integration for Enhanced Location Deployment (SHIELD), integrates a comprehensive range of biometric and environmental sensors. These sensors monitor not only the physiological parameters of the soldier but also critical aspects of the battlefield environment. Portable and designed for long-range functionality with low power consumption, the SHIELD system incorporates key IoT technologies and biometric sensors in a wearable device. This device facilitates seamless communication and data exchange between the soldier and a centralised command centre.

KEYWORDS : *Battlefield awareness, Internet of Things (IoT), SHIELD, Real-time monitoring.*

INTRODUCTION

Battlefield awareness is a crucial aspect of all tactical military operations, demanding continuous acquisition, processing, and comprehension of real-time information. The ability to make informed decisions, adapt swiftly to evolving circumstances, and optimize resource utilization is paramount for military commanders. Recognizing the soldier as the linchpin in this dynamic environment, this paper introduces an innovative solution in the form of the Internet of Military Things (IoMT) based Soldier Wearable System. Focused on augmenting real-time battlefield awareness, the system presented in this paper seamlessly integrates an extensive range of biometric and environmental sensors with the soldier making him a potent weapon in himself.

Beyond monitoring the physiological parameters of the soldier, the system extends its scope to encompass crucial aspects of the surrounding battlefield environment. This wearable device harnesses IoMT technologies, facilitating seamless communication and data exchange between the soldier's wearable and a centralized command centre. Emphasizing the achievement of low-latency and high- reliability data transmission, the system is designed for real- time monitoring and decision-making, thereby ushering in a new era of enhanced military operational effectiveness.

The focus of this paper is to implement a novel architecture for a long-range low power portable system which can be worn by a soldier in the tactical battlefield.

The system is expected to be robust and reliable and preferably have a very low latency for real time data accessibility. The system is designed using Military Internet of Things technologies which is a subset of IoT.

The Internet of Things (IoT) is a system of interlinked physical devices which can be any vehicle, appliance, and various other objects that are equipped with sensors, software, and network connectivity. This empowers them to gather and share data. The core idea of IoT is to establish a seamless and intelligent link between the information sensing and decision making, facilitating continuous and uniform data transmission among devices. This makes decision-making based on reliable data and knowledge.

Internet of Military Things (IoMT) takes IoT a notch further. The plethora of sensors and actuators that exist on the modern battlefield are integrated into a single system with IoT based technologies giving rise to IoMT. The integrated system now acts a force multiplier on the battlefield making battlefield awareness and soldier health monitoring easier than never before.

LITERATURE REVIEW

The inception of the Internet of Things (IoT) dates back to the early 1980s. First demonstration of an IoT based system was a modified beverage vending machine at a leading American University which emerged as one of the earliest instances of a network of smart devices. This vending machine, connected to a local network, transmitted data regarding its stock level and the condition of the stored products. However, the contemporary concept of IoT took shape in the early 1990s with leading researchers working on IoT based technologies. This idea gained traction in academic forums due to its potential for plethora of applications. Since then, IoT has undergone substantial development, giving rise to various subsets with their own applications in military, agriculture and medical fields.

T. Yokotani in his paper [1] has discussed the application and technical issues of IoT in 2012. His research introduces the concept and definition of IoT, as well as its architecture, key technologies, and challenges. The paper reviews some of the existing and potential uses of IoT in different areas, such as domestic, urban, smart grid, smart medicine, and smart industry. He also identifies some of the technical issues and research directions for IoT, such as standardization, interoperability, security, privacy, scalability, reliability, and energy efficiency.

Yushi et al. [2] in his paper explores the technical details and application modes pertaining to Military IoT (MIOT). The paper proposes a definition and an architecture of MIOT. The paper analyses three methods of MIOT, namely data detection, data communication, and data processing, and illustrates how they can be applied in various military domains, such as command and control, intelligence and reconnaissance, weapon control, logistics support, and training and simulation.

Jin, Gubbi et al. [3] have given an outline for forming an intelligent urban network using system of interconnected devices in 2014. They have given a comprehensive review of IoT technologies and proposed an architecture for an intelligent metropolitan using interconnected devices.

Aashoy Gondalic et al. [5] discuss a system that can detect the geographical position and sense the various parameters of the soldiers in real time with the help of positioning systems and various biometric sensors. Their paper also discusses the challenges and benefits of the system, such as enhancing the safety and performance of the soldiers, facilitating the medical decision making and intervention, and improving the command and control of the military operations. The paper presents a system architecture and a prototype implementation using Arduino, Node MCU, and various sensors.

In 2018, Afef Mdhaffar et al. [6] in their paper presented a system in which various sensors were used as an interconnected system for tracking the soldier's parameters using LoRaWAN and secure wireless communication technology. Their paper proposes a system that can collect and transmit biosensor data from patients to a cloud-based analysis module, where algorithms are used to detect abnormal situations and provide feedback. The paper also discusses the challenges and benefits of the system, such as reducing the cost and complexity of health monitoring, improving the quality of care and patient satisfaction, and enabling remote and preventive healthcare. The paper presents a system architecture and a prototype implementation using Arduino, Node MCU, LoRaWAN, and various sensors.

RELATED WORK

IoT and IoMT based technologies have seen rapid growth in the recent past owing to the plethora of applications they offer. There have been numerous implementations of IoT based systems in the field of defence and military applications. The aim of this research-based project is to propose and implement a novel framework architecture which may advance IoMT technology in a tangible way and contribute to further applications.

Maria Manoje et al. [7] have presented a model for combatant tracking system that detects the different physiological parameters. It is implemented using a programmable microcontroller and associated sensors. They have used Zigbee technology for transmission and reception of data.

Another implementation of such system is done by Shruthi Nikam et al. [8] in 2017. They have presented a system for the position tracking of a soldier and his navigation using GPS. The system has been implemented using an ARM based microcontroller.

SYSTEM ARCHITECTURE

The fundamental entity of battlefield is the soldier. In the SHIELD system, a wearable harness system is worn by the soldier. The system comprises of various sensors which capture soldier's physiological data and data from the surroundings. The graphical representation of the soldier with the SHIELD has been depicted in Figure 1.

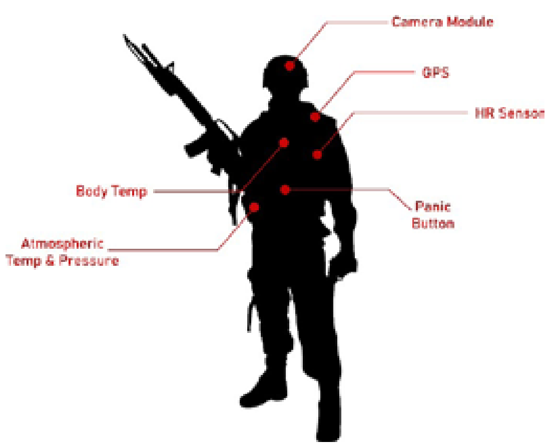

Fig. 1. System Architecture of the IoMT based System

The framework for the Soldier Wearable SHIELD device has been shown in Figure 2. It is based on three entities i.e. a Command-Relay Network, a Field Command Post and a Squad. [15]

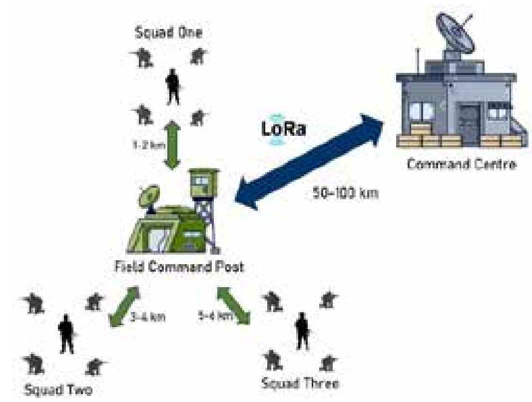

Fig. 2. System Architecture of the IoMT based SHIELD System

The system envisages the basic entity of a field unit as the Squad which consists of small team of 5 to 10 soldiers led by a team leader. The data from this squad flows to the Field Command Post. The collected data is collated and sorted here. It may be further sent to the Command Centre where higher computing resources are available for sorting and processing of data. Relevant decisions with respect to the battlefield are taken here and then are communicated down the chain.[18]

The consolidated architecture consists of the connection from each soldier to the Squad Leader and then further to the next command post or station. The Squad dynamics are illustrated in Fig. 3.

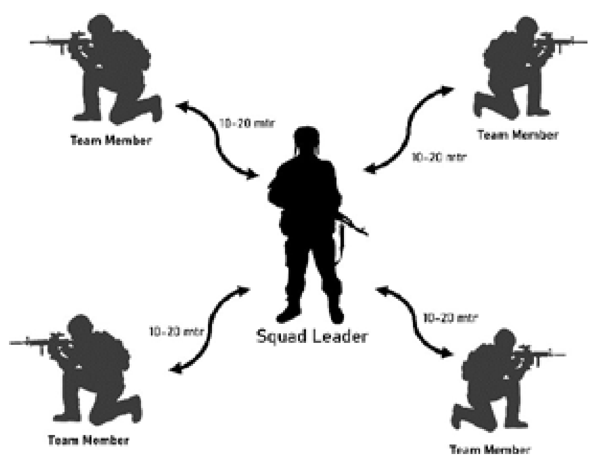

Fig. 3. Dynamics within a Squad

IMPLEMENTATION DETAILS

The main objective of SHIELD device is to improve the accuracy of actions of the soldiers on the tactical battlefield. It comprises of various components, like biometric and bio- mechanic sensors and other sensors which detect other environmental parameters. Temperature and humidity of the surroundings is detected with an AHT-10 sensor, providing the reading in degrees and humidity in percentage. The system also includes a hazardous gas sensor which detects the presence of harmful gases which can be used in chemical or radiological warfare. For soldier tracking, the system integrates the GPS sensor, offering accurate position data. The global positioning system sensor is employed to access the satellites signals, determining the soldier's position information, which are then sent to the microcontroller.[19]

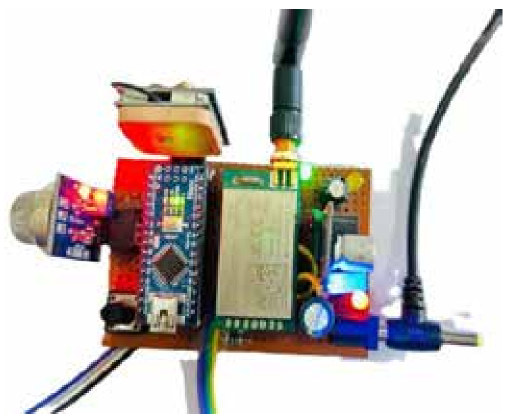

Fig. 4. SHIELD Transmitter Module

The programmable controller, equipped with integrated program for an IoT module on a programmable microcontroller, is designed to monitor and capture the physiological parameters of the soldiers. The in-built SHIELD device activates an alarm if the body parameters surpasses or declines as compared to a benchmark value, and it triggers various other mechanisms which can help the soldier to maintain their body parameters.Through a serial connection, the IoT module transmits and receives temperature, heart rate, and location data. The results are displayed in the base station. In emergency situations, an alert can be sent to the field command post or to the other unit by pressing an emergency switch. The receiver module continually monitors the status, presenting relevant information on an LCD display. The figures below show the actual system implementation.

Fig. 12 shows the transmitter module and Fig. 13 shows the receiver module. There can be many transmitter modules connected to a central receiver module.

Fig. 5. SHIELD Receiver Module at Base Station

RESULTS AND DISCUSSION

The system was rigorously tested in various environments and in varying weather conditions to simulate the battlefield environment.

Ranges Achieved

Typical range achieved was approximately 7 km. The range achieved remained unaffected by the presence of building and other structures.

Transmission and Reception of Data

The data from the sensors is constantly monitored, captured and transmitted to the base station by SHIELD transmitter. Parameter threshold can be set to alert the base station for various emergencies.

Upon successful transmission, an data frame containing GPS position information is dispatched to the command node or the nearest data processing node capable of taking decision. In case of the soldier's vital signs deviating from the set benchmarks, the command node promptly is alerted by the transmitter of the soldier and provides the accurate location. This allows for the collection and assessment of crucial physiological parameters and position of soldier.

There is provision of a ‘panic’ switch which can be manually activated by the soldier or automatically triggered in an event like the soldier taking a hit on the body. Upon activation, an emergency alert is sent to the command node including the position. This could be used to request for emergency backup or for evacuation.

Additionally, the combatant is in a surrounding which is having adverse weather and the parameters fall below or go above the benchmarks, there is a provision for inclusion of heating or cooling system which can be switched on. Any abnormal pulse rate triggers an alert to the command node or squad leader as the case may be, providing the precise position.

The device, affixed to the soldier's tactical harness or harness utilizes location sensor for tracking both health status and current position.

Interface for Data Reception

The system status interface is available in dual mode. It is implemented as part of the receiver module as LCD screen. This is aimed to facilitate handheld usage in field conditions by the squad leader or field command post. In a more sophisticated setting, the data can also be captured and represented on a computer display. In this system, the data is displayed remotely using Adafruit utility.

Fig. 6. LCD display of SHIELD Receiver Module

Fig. 7. System interface on Adafruit IO

Fig. 8. Data received and displayed on System Interface

CONCLUSION AND FUTURE SCOPE

The objective of this paper has been to disseminate data about successful employment of SHIELD system in the simulated combat scenario. SHIELD has been proven to be successful in capturing and transmitting various parameters of the solider and more importantly capture battlefield data using sensors like gas sensors, pressure and ambient temperature sensor. In future, we envision enhancing the system by incorporating a solar panel for continued power accumulation during the day.

SHIELD system employs an innovative data transmission method for transmitting accurate sensor data. The seamless and rapid flow of information is achieved over large range using LoRaWAN communication technology. This allows the command node or another squad to assist in critical situations by tracking the sensor values, the surrounding battlefield situation, and the soldier's location. The system proves highly advantageous in wartime and rescue operations, offering unrestricted use, ensuring the protection of combatants in battle, and exhibiting high effectiveness due to integrated systems and sensors.

SHIELD is capable of effortless attachment to a soldier's hand or harness and can be made more potent by implementing an improved communication protocols to boost robustness and scalability.

ACKNOWLEDGMENT

During the course of research for this project, various books, journal and papers have been referred to. Sincere gratefulness is conveyed towards all the authors whose

work we have referred to during the course of our research.

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Heart Rate Detection through Deep Learning Method PPG and IPPG- A Review

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ABSTRACT

Health monitoring is an important parameter to determine the health status of a person. Measuring the heart rate is an easy way to gauge patients' health. Normal heart rate may vary from person to person and a usually high or low resting heart rate can be a sign of concern. There are several methods for the measurement of heart rate monitoring such as ECG, oximeters etc. Such methods have some disadvantages that these are invasive and have a continuous contact with the human body. Remote health monitoring is the easiest and best alternative to avoid going out and getting infected. However, during the period of pandemic situations like Covid-19 where the viruses spread through physical contact and through air these traditional methods are risky and contagious. So, there is a great need for contactless heart rate measurement. This work targets to provide more accurate and effective approach of estimating contactless heart rate estimation from facial video sequences. Conventional steps include channel creation through Region of Interest (ROI) selection, followed by illumination rectification and filtering for heart signal detection. The novelty of this proposed work lies in two aspects. Instead of a single channel, multiple channel creation, like ECG, is targeted. This is expected to assure more reliable estimation of the HR. The multiple channel creation will be based on multiple ROI selection, as well, including the HR detection through micro movements of the head from the face video. Another novelty lies in the use of deep learning algorithms for the same. This is expected to assure better estimation accuracy. The work will be validated by performance comparison with the state-of-the-art solutions on the existing datasets.

KEYWORDS *: Deep learning, PPG, IPPG.*

INTRODUCTION

Health monitoring is important to determine the health status of a person. It helps to detect early signs of ill-health or disease. To maintain a good health is important. Heart rate monitoring plays an important role in determining the health status of a patient. It provides a real time snapshot of heart muscle function. Each person's heart rate determines their fitness level. Heart rate (HR) is also called as pulse rate, or the number of times your heart beats in one minute. Pulse rates vary from person to person. Heart rate is an important physiological parameter for many applications, such as medical diagnosis, lie detectors for criminal investigation [1] etc. So, developing effective heart-rate monitoring systems that allow a solution for multiple usage problems is needed [42].

PPG (Photoplethysmography)

PPG is technique to measure blood volume in the artery using specific frequency band of light. When light emitted by the photodiode enters the skin, most of it is absorbed by body tissues, but some is reflected. The amount of reflected light depends on several factors, one of which is the volume of arteries near the skin's surface. Blood in the arteries absorbs light better than the surrounding body tissues. So, as arteries contract and swell in response to the pulsating blood pressure, the intensity of the reflected light rises and falls. PPG devices detect this variation in the reflected light and use it to estimate the HR.

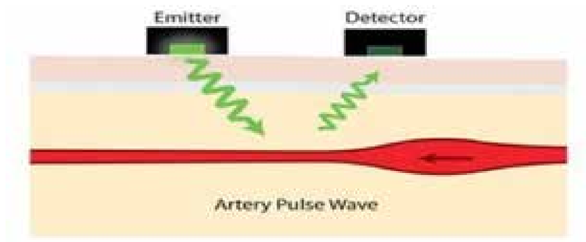

Figure 1. A lower pressure narrower arteries and less Absorption (higher reflectivity).

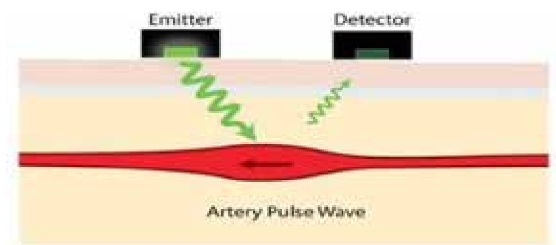

Figure 2. A higher blood pressure pulse causes wider arteries and more light absorption (lower reflectivity).

IPPG (Imaging photoplethysmography)

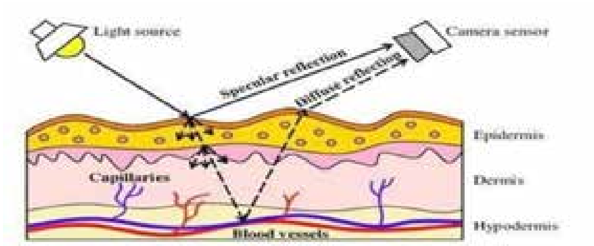

Figure 3. Remote IPPG

IPPG works on the same principle as that of IR sensor based but it is a contactless measurement. When we capture an image or a video of the skin, it contains variations in the color intensities based on volume of blood flow beneath the skin. Though such variations are not visible through naive eyes, they could be detected through image processing techniques. Specifically, it has been found that the green colored channel contains these HR variations more clearly [22]. There is one more principal existing to detect the HR variations through patient video. There are micro movements of the head in synchronization with the HR. This gives a possibility to detect the HR 6 even if the video is focusing on the head and not on the face. So, IPPG works on either of these two principles. It measures the variance of red, green, and blue light reflection changes from the skin, as the contrast between specular reflection and diffused reflection. Specular reflection is the pure light reflection from the skin. Diffused reflection is the reflection that remains from the absorption and scattering in skin tissue, which varies by blood volume changes.

LITERATURE REVIEW

Table 1:- Literature review on IIP and IPPG methods for object detection

Authors	Methodology/ Algorithm Used/ Processing Method	Remark
C. Markose	Non-contact Heart Rate Monitoring Using Machine Learning	Independent Component Analysis, Accuracy 91.3%, Webcam video of length 1 minute.
Lomaliza, J.P. Park	Improved Heart-Rate Measurement from Mobile Face Videos 2019	signal periodicity computation methods, camera live Video samples.
Yang, Zhao & Yang, Xuezhi & Wu, Xiu	Motion-tolerant heart rate estimation from face videos using derivative Filter	derivative filtering method, MAHNOBHCI dataset
Guochen Bai, Cypress & Huang, Jifeng & Liu, Huawei	Real-time Robust Noncontact Heart Rate Monitoring with a Camera	Savitzky-Golay filter, accuracy 99.38%
S. Sanyal and K. K. Nundy	Algorithms for Monitoring Heart Rate and Respiratory Rate From the Video of a User's Face	a novel iPPG method, Smartphone cameras video dataset
Lomaliza, J.P. Park	Bounded Kalman filter method for motion robust, non-contact heart rate Estimation	Bounded Kalman filter, Dataset 200 video, accuracy 95%

Hamed Monkaresi, Rafael A. Calvo	A Machine Learning Approach to Improve Contactless Heart Rate Monitoring Using a Webcam	Independent Component Analysis, Accuracy 87.1%, indoor cycling exercise live Dataset.
X. Li and J. Chen and G. Zhao and M. Pietikainen	Remote heart rate measurement from face videos under realistic situations	Temporal Filtering method, MAHNOBHCI is a public multi-modal database
Zheng, Y.-L.Ding, X.- R.Poon, C.C.Y. Lo, B.P.Zhang	Unobtrusive sensing and wearable devices for health informatics	Info about wearable systems
S. Sanyal and K. K. Nundy	Algorithms for Monitoring Heart Rate and Respiratory Rate From the Video of a User's Face	a novel iPPG method, Smartphone cameras video dataset
Lomaliza, J.P. Park	Bounded Kalman filter method for motion robust, non-contact heart rate Estimation	Bounded Kalman filter, Dataset 200 video, accuracy 95%
G. Balakrishnan and F. Durand and J. Guttag	Detecting pulse from head motions in video	principal component analysis,18 person video dataset captured from smartphones.

RESEARCH METHODOLOGY

Figure 1.4: Research flow diagram for Heartrate detection

Step1 :- Creating multiple channel pulse signals for heart rate detection involves leveraging various facial regions and extracting insights from the face video. Initial data collection is crucial for this process. Multiple regions of interest, including the chin, cheeks, and forehead, serve as key areas for detecting heart rate.

The detection process utilizes both blood flow volume and micro movements of the head captured in the video. Even when the video focuses on the head rather than the face, the micro movements of the head are synchronized with the heart rate, allowing for heart rate detection. This innovative approach expands the possibilities for monitoring heart rate in scenarios where facial visibility may be limited.

The methodology considers the micro movements of the head, which are intricately linked to the heart rate. This correlation enables the detection of heart rate even when the video primarily captures head movements. During the systolic and diastolic processes, the changes in blood volume within the arteries contribute to the collection of variable heart rate data from the patient.

Step 2: - In this segment, our attention is directed towards mitigating the impact of illumination interference. Assuming the face video is captured from an immobile subject, the mean green value of the Region of Interest (ROI) becomes a time-dependent function. Two primary factors influence the values of the green channel. The first factor is the fluctuations in blood volume induced by the cardiac pulse, while the second factor is the variations in environmental illumination throughout the video recording. The recording time, whether during daylight or moonlight, dictates alterations in the illumination effect on the video.

Green value= x + y Where x= green value variations caused by cardiac pulse y = green value variations caused by illumination changes

Step 3: - In deep learning, a convolutional neural network (CNN) is a class of deep neural networks, most commonly applied to analyze visual imagery. A CNN is a Deep Learning algorithm which can take in an input image, assign importance to various objects in the image and be able to differentiate one from the other. A CNN is a neural network that has one or more convolutional layers and is used for image processing, classification, segmentation and also for other auto correlated data.

CONCLUSION

photoplethysmography (PPG) stands out as a valuable and non-invasive approach for evaluating various physiological parameters by analyzing optical signals. Through the exploitation of light absorption and reflection principles, PPG technology has gained extensive use, particularly in gauging blood volume changes in peripheral tissues. The introduction of innovative imaging techniques, such as Innovative Imaging Photoplethysmography (IIP), has further enriched PPG's capabilities by offering real-time spatial information. This progress holds great potential across diverse fields, including healthcare, wearable technology, and biometric identification. As we continually refine and broaden our comprehension of PPG and its imaging variations, the potential for non-invasive and continuous monitoring of physiological parameters becomes increasingly apparent, opening doors to enhanced healthcare diagnostics and personalized well-being solutions.

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Optimizing Resource Allocation and Scheduling in Cloud-Based 3D Printing Environments

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ABSTRACT

This study addresses the challenges associated with resource allocation and scheduling in cloud-based 3D printing environments. With a growing need for effective resource utilization and timely task completion, research focuses on optimizing workflows in these dynamic settings. A detailed plan has been introduced to use cloud computing to enhance resource allocation and simplify scheduling in 3D printing operations. The framework integrates algorithms to dynamically allocate resources based on the specific requirements of each printing job. The approach considers factors like machine availability, material availability, and machine capabilities to make informed decisions about resource allocation. This ensures optimal use and minimizes idle time. Furthermore, a smart scheduling mechanism is introduced to adapt to real-time changes, prioritize tasks, and minimize delays. The research outcomes contribute to advancing cloud-based 3D printing by enhancing efficiency, reducing costs, and overall improving productivity. The proposed framework offers a practical solution for industries aiming to maximize their 3D printing capabilities within a cloud computing infrastructure.

KEYWORDS *: Cloud-based 3D printing, Resource allocation, Scheduling optimization, Dynamic environment, Machine capabilities, Smart scheduling, Real-time adaptation, Priority tasks, Efficiency enhancement, Cost reduction, Cloud infrastructure, 3D capabilities.*

INTRODUCTION

The research aims to improve the efficiency of cloud-based 3D printing by optimizing resource allocation and scheduling. In the rapidly growing landscape of 3D printing, effective resource management is paramount. The approach involves considering job types, required materials, and machine capabilities to ensure the efficient allocation of virtualized resources like computing power, storage, and printers. Drawing insights from Reede [18], Recognizing the critical importance of these factors in minimizing costs and maximizing utilization during resource allocation is imperative.

Moreover, scheduling tasks in a cloud-based 3D printing environment presents a complex challenge, given the variations in job sizes, priority levels, and resource availability. Building on lessons from Steed and Julier's research [20] in head-mounted display environments, our research aims to develop a smart scheduling system that adapts to real-time changes, prioritizes tasks, and reduces delays. [17] Adapting to Industry 4.0's digitalization push requires enhancing automation systems for increased flexibility, posing a notable challenge. The proposed smart scheduling system is a key component of our approach, contributing to improved efficiency in cloud-based 3D printing processes.

The ultimate goal is to reduce costs and boost overall productivity in cloud-based 3D printing, enabling industries to fully leverage their 3D printing capabilities within a cloud computing environment. Notably, the additive manufacturing industry is experiencing substantial growth, with over 10,000 desktop 3D printers sold annually. However, the existing operational protocol, involving manual file transfers to each printer via SD cards, poses challenges. To address this operational bottleneck, we introduce "Web Print" – an innovative solution designed to streamline the 3D printing process. "Web Print" establishes an advanced web-based platform that seamlessly integrates with the Raspberry Pi, enabling remote control of 3D printers through an intuitive interface. This groundbreaking advancement enhances user experience by simplifying and optimizing 3D printing projects from any location with an internet connection, the research not only addresses the challenges of resource allocation and scheduling in cloud-based 3D printing but also introduces a practical solution, "Web Print," to elevate the overall efficiency and user experience in the 3D printing process within a cloud computing environment.

LITERATURE SURVEY

The literature review begins by situating the research within the context of wireless control of 3D printers using Raspberry Pi 02W in smart manufacturing and industrial automation. The study incorporates insights from various sources, starting with "[3] Wireless Communication in Process Automation: A Survey of Opportunities, Requirements, Concerns and Challenges (2010)," which extensively reviews wireless technologies like Zigbee, Bluetooth, and Wi-Fi in industrial settings. This work provides a foundational understanding of the advantages of wireless communication, emphasizing reduced cabling complexities and increased flexibility, setting the stage for optimizing 3D printer control.

Moving on, "[12] IoT Industrial Automation Using Raspberry Pi (2020)" by Smith and Brown explores the versatility of Raspberry Pi in offering cost-effective and scalable solutions for automation processes. This crucial reference establishes the adaptability of Raspberry Pi in diverse industrial applications, laying the groundwork for its potential integration in the wireless control of 3D printers, a key aspect of our research focus.

In the realm of 3D printing and smart manufacturing, Chen et al.'s research "[9]Smart Manufacturing: Characteristics, Technologies, and Enablers" (2019) delves into the key features and technologies shaping smart manufacturing environments. This work underscores the necessity for intelligent control systems to enhance agility and efficiency in manufacturing processes, providing a rationale for incorporating wireless control into 3D printers, aligning with the broader goals of smart manufacturing.

Moreover, Kim et al. 's study [13] "An IoT-Based Solution for Control and Monitoring of Additive Manufacturing Processes" explores wireless 3D printing control systems, proposing an IoT-based control system for 3D printers. While differing in implementation, this research offers valuable insights into the challenges and advantages of wireless 3D printing control, complementing the objectives of our project.

[23] Cloud resource scheduling is a complex task, relying on meeting the quality of service (QoS) needs of cloud applications. Challenges arise from the heterogeneity, uncertainty, and dispersion of resources in the cloud environment, which current resource allocation policies struggle to address. Researchers encounter difficulties in choosing an efficient scheduling algorithm from existing literature for specific workloads. It categorizes resource scheduling in various aspects, presenting systematic analyses of algorithms, management, types, benefits, tools, aspects, and distribution policies. This research aids in understanding the characteristics of scheduling algorithms and selecting the most suitable one for specific workloads, suggesting future research directions.

METHODOLOGY

In this study, the methodology focuses on improving user interaction and optimizing system functionality within the printing infrastructure domain. The approach aims to provide a simplified and user-friendly experience for both new and returning users. For example, if a job needs 20 pieces and you choose 4 printers, the system finishes the task in 5 loops. If you choose 3 printers, it takes 6 loops, and 2 printers are left without a job once it's done. The system starts with the first printer available after the loops, and the remaining one gets a job later.

User Authentication

-New users undergo a simple sign-up process to access the user logic page, tailoring the experience to individual requirements.

-Returning users benefit from a seamless login process, minimizing access barriers and promoting user retention.

Fig. 1. Flowchart of Proposed Model

Dashboard Navigation

-Upon authentication, users are directed to the dashboard, serving as the central command center for printer management and job creation.

-Adding a printer involves furnishing requisite details, with the system establishing server connections and ensuring uninterrupted functionality amid connectivity challenges.

Automatic and Manual Job Creation:

-In the system's printing workflow, users are presented with a dynamic choice between two distinctive modes for job creation: Automatic and Manual.

-The Automatic mode introduces a sophisticated layer of intelligence to task distribution, allowing users to specify printer quantities. This facilitates the system in optimizing the allocation of tasks among available printers, taking into account factors such as printer speed, workload, and historical performance. The result is an efficient, resource-maximizing approach that significantly reduces manual intervention, leading to both time and cost efficiency. This mode not only streamlines the overall printing process but also leverages the capabilities of each printer for optimal performance.

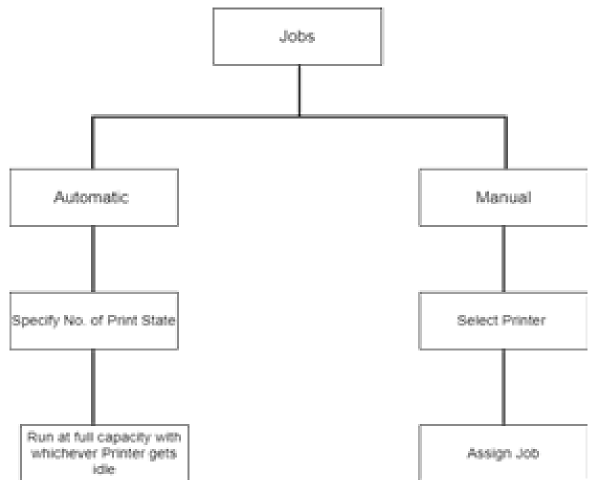

Fig. 2. Flow Chart of Job Creation

- On the other hand, the Manual Job Creation mode empowers users with a high degree of customization and control. Users can handpick printers for specific tasks, tailoring the allocation based on printer capabilities, quality requirements, and personal preferences. This enhanced control allows for a more personalized and adaptable printing workflow. Manual mode is particularly advantageous for scenarios where quality assurance is crucial, enabling users to allocate tasks to printers with specific quality settings or features. Additionally, the ability to prioritize jobs based on urgency or importance ensures that critical tasks are assigned to dedicated printers, contributing to a prioritized and streamlined workflow.

Task Management and Control

-Beyond job initiation, users have fine-grained control over ongoing tasks.

-The system facilitates pause and cancellation of printing jobs, enabling precision and error mitigation.

-This feature underscores the commitment to providing users with granular control, enhancing operational efficiency, and minimizing resource wastage.

Cloud Integration

- Our dashboard operates entirely on the cloud, orchestrating tasks such as instance creation, data retrieval for various printers, data management, and service provisioning. Leveraging AWS services as our cloud platform, we streamline instance management and remote connectivity within the project.

SIMULATION RESULT

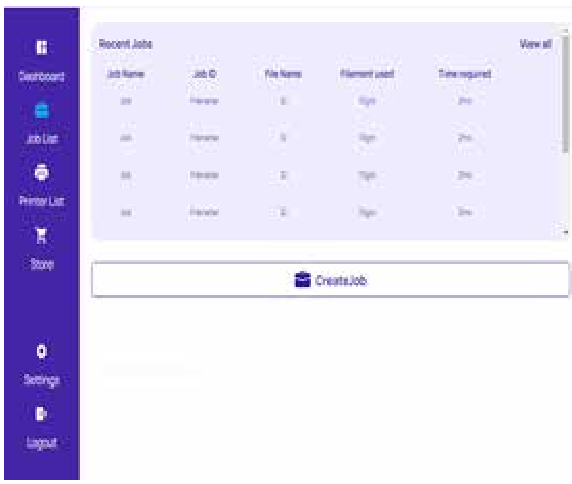

Fig. 3. Create Job Page

The Create Job Page provides a user-friendly interface for efficiently initiating and managing job entries, ensuring a seamless experience in defining parameters and preferences.

Fig. 4. Print Job Page

The Print Job Page offers an intuitive platform for users to manage and execute print jobs. With a focus on user-friendly controls and efficient workflow, this page ensures a streamlined process for printing tasks within the system.

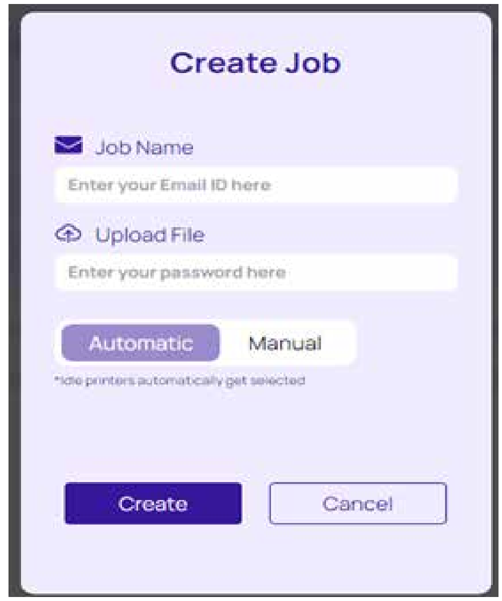

Fig. 5. Create Job Modal

The Create Job Modal features essential fields such as job name, file upload, and a toggle for selecting between automatic and manual execution.

Fig.4.4 Add Printer Modal

Includes fields for specifying printer details. This modal streamlines the process of adding new printers to the system, offering an interface for inputting essential information.

FEATURES

Efficient Resource Utilization

- The introduction of Automatic Job Creation mode has revolutionized resource allocation by intelligently distributing printing tasks across available printers.

- Users have reported a marked increase in printing efficiency, with resources allocated optimally to minimize idle time and maximize throughput.

Streamlined Task Scheduling

- Manual Job Creation mode empowers users

to customize task scheduling according to their specific requirements and priorities.

- By allowing users to handpick printers for individual tasks, the system facilitates dynamic task scheduling, ensuring the timely completion of critical printing jobs.

Reduced Downtime and Wastage

- The system's proactive approach to task management, including pausing and canceling printing jobs, has minimized downtime and resource wastage.

- Users appreciate the system's responsiveness in addressing printing errors and mitigating the impact of unforeseen disruptions on overall productivity.

Enhanced Operational Efficiency

- The optimized resource allocation and streamlined task scheduling have led to enhanced operational efficiency across the printing infrastructure.

- Users benefit from improved turnaround times, reduced wait times, and increased reliability in meeting printing deadlines.

Improved Cost-effectiveness

- By maximizing resource utilization and minimizing downtime, the system contributes to improved cost-effectiveness in printing operations.

- Users appreciate the cost savings achieved through reduced wastage and enhanced productivity, resulting in a more sustainable and financially viable printing environment.

CONCLUSION

This paper outlines a comprehensive approach to optimizing resource allocation and scheduling in cloud-based 3D printing environments. Drawing insights from diverse studies, the strategies address challenges in cost-effectiveness, time efficiency, and load balancing. The research significantly enhances cloud-based 3D printing functionality using smart technologies and advanced algorithms. These enhancements ensure optimal resource utilization, minimizing idle time for each 3D printer. The technological advancements lead to tangible benefits, notably reducing idle states and enhancing productivity.

Moreover, implementing these improvements results in substantial cost savings. Industries achieve heightened productivity through efficient resource utilization and smart scheduling with reduced expenses. This enhances the economic viability of cloud-based 3D printing, making it a cost-effective solution for various industries.

In conclusion, the research improves the technical and operational efficiency of cloud-based 3D printing, instilling confidence in its use. We aim to create a reliable, efficient, and cost-friendly environment for cloud-based 3D printing services, revolutionizing manufacturing processes and benefiting industries. These advancements not only enhance trust in cloud-based 3D printing but also drive positive impacts on industrial operations.

ACKNOWLEDGMENT

We extend our heartfelt appreciation to ShapeChimp Manufacturers Pvt Ltd for their generous sponsorship, which played a pivotal role in the successful realization of this innovative project. Their unwavering support has been instrumental in advancing technological initiatives and fostering meaningful progress. ShapeChimp Manufacturers Pvt Ltd's commitment to fostering innovation has significantly contributed to the success of our endeavor, and we are sincerely grateful for their valuable partnership.

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Contactless IOT Doorbell & Security System

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ABSTRACT

The Contactless IoT Doorbell & Security System redefines home security through innovative IoT technology. With features like automatic visitor recognition, a voice-assisted interface, and real-time online alerts, the system provides a dynamic and responsive user experience. It leverages sensors, including PIR, for seamless visitor detection. The system's remote alarm activation and continuous outdoor monitoring enhance security, while its IoT integration allows global monitoring via mobile phones. This fully automated solution reflects a paradigm shift in home security, offering versatility and robustness in today's interconnected world. It is set up using a Raspberry Pi, Pi Camera, PIR Sensor, LED, Bread Board, Resistor, Connecting wires and power supply

KEYWORDS : *IOT, Raspberry, PIR sensor, Pi Camera.*

INTRODUCTION

In a world dominated by technology, elevating home security to the next level need not break the bank. Introducing our innovative solution: an affordable, client intruder alert system based on Raspberry Pi. This device provides email alerts and captures a snapshot of the intruder, all well within your defined budget. Say goodbye to costly alternatives and embrace this home security project that leverages IoT technology.

Here's how it works: the system utilizes a PIR sensor and a Raspberry Pi camera to create a robust IoT-based home security setup. As soon as the PIR sensor detects an intruder, the system springs into action, sending a prompt email alert to the user. What sets this system apart is that the email includes a snapshot of the intruder, courtesy of the Pi camera. This versatile security solution can be installed at your main door or any area of your choosing to bolster safety. The beauty of it lies in its accessibility – you can monitor your home from anywhere in the world using your mobile phone's email functionality. This means you can travel to different countries or simply step out, and your house remains under your vigilant eye.

AIM

The objective of this project is to investigate and assess a set of appropriate components to create a Security system using Raspberry Pi that offers efficient security measures and swift accessibility to users.

That Contactless IoT Doorbell & Safety System comes with some fantastic advantages:

- Automatic Visitor Recognition
- Voice Assisted Interface
- Instant Online Alerts on Desktop/Mobile
- Ability to Sound Alarm at Remote Location
- Monitor Activity Outside the House at Any Time

LITERATURE REVIEW

In an era dominated by technological advancements, the integration of Internet of Things (IoT) into home security systems has become a focal point of research and innovation. A notable contribution to this realm is found in the work of Sushma N. Nichal and Prof. J.K. Singh, who presented an abstraction of a smart system utilizing IoT based on embedded Linux OS with ARM11 architecture. The emphasis of their research lies in the implementation of a real-time video monitoring system coupled with sensors such as PIR, temperature, and humidity. Notably, the system requires user authentication for activation, and upon detection of human presence, promptly transmits data to a server or the user's smartphone. This integration of sensor technology with IoT promises heightened security through automated and intelligent monitoring.

Building upon this foundation, the work of Sowmiya. U and Shafiq Mansoor introduces a doorbell and security system that connects any type of door to the internet. Similar to previous studies, they incorporate a PIR sensor for person detection and a camera for capturing images, creating a comprehensive security apparatus. The system sends captured photos to authorized individuals, suggesting applications not only for home security but also in various institutional settings such as banks and hospitals. This approach demonstrates the adaptability and scalability of IoT-based security systems.

Further insights are provided by Ms. Renuka Chuimurkar and Prof. Vijay Bagdi, who presented a smart monitoring system utilizing the Raspberry Pi and PIR sensor. Notably, their work expands the scope to include a smoke detector for fire detection. The system notifies users about incidents, be it a person's presence or a fire, by capturing images and forwarding them to the user's email through Wi-Fi. The incorporation of background subtraction algorithms for motion and smoke detection showcases a commitment to enhancing the system's accuracy and efficiency.

Shivprasad Tavagad's survey on various types of surveillance systems emphasizes the broader implications and benefits of security systems. The importance of video surveillance and PIR Sensor the architectural aspects of proposed systems are discussed, underscoring the holistic approach needed for effective security solutions. Tavagad's work also touches upon the significance of security systems, stressing the need for continuous monitoring, and proposes the use of background subtraction algorithms for face detection.

Collectively, these literature pieces illuminate the evolving landscape of contactless IoT doorbell and security systems. From real-time video monitoring to fire detection, the integration of sensors, IoT, and advanced algorithms showcases a multidimensional approach to enhancing home security. These studies collectively contribute to the growing body of knowledge, pushing the boundaries of innovation in creating intelligent and responsive security solutions for modern living.

HARDWARE SPECIFICATION

Raspberry PI

Figure 1 : Raspberry Pi

The Raspberry Pi is like a mini computer that packs a punch. The brain behind it is a quad-core processor, which means it can handle multiple tasks without breaking a sweat. It uses a microSD card, just like the one you'd find in your camera. So, you pop in the microSD card, and that's where your Raspberry Pi stores its files and operating system.

When it comes to connecting things, it has a couple of fast USB 3.0 ports, a couple of regular USB 2.0 ports, and even a spot for an Ethernet cable if we want a super-fast internet connection. Plus, it's got Wi-Fi and Bluetooth, so you can connect wirelessly to the internet or other devices.

The Raspberry Pi runs on various operating systems, but the most common one is called Raspberry Pi OS (used to be called Raspbian). It's based on Linux.

In a nutshell, it's a versatile and affordable little computer that you can use for all sorts of projects – from basic computing tasks to creating your own smart gadgets.

PIR Sensor

Figure : 2 PIR Sensor

A PIR sensor, short for Passive Infrared Sensor, is a heat- detecting electronic gadget commonly used in security alarms and motion-triggered lighting. It spots heat emitted from humans and animals. These sensors are like heat detectives, working both indoors (25 cm to 20 m range) and outdoors (10 m to 150 m range). They play a crucial role in making our security systems and automatic lights smarter by responding to our presence.

PI Camera

Figure 3 : PI Camera

The Pi Camera is your door's vigilant eye. It captures images and records videos of intruders, saving it all to an SD card. Compatible with both Model A and Model B Raspberry Pi, this portable camera is perfect for image processing, machine learning, and surveillance projects.

It interfaces seamlessly with your Pi through the MIPI camera serial interface protocol, making it a lightweight yet powerful companion. Ideal for applications like surveillance drones, where its weight fits perfectly for a secure and high-flying experience.

PCB Board

Figure 4 : PCB Board

A PCB (Printed Circuit Board) is a crucial element in electronics, serving as a flat board made of insulating material with conductive copper layers for creating electrical connections. It hosts electronic components like resistors and ICs, mounted either through holes or surface-mount technology. Traces form conductive pathways, while pads serve as attachment points. The board features a silkscreen for component information, a solder mask for protection, and via holes for layer connections. Copper pours may create grounding areas, and PCBs vary in size and shape based on device needs. Designs are saved as Gerber files, capturing layers like traces, solder mask, and silkscreen. PCBs are foundational for electronic systems, facilitating organized and reliable component integration.

Power Supply

Figure 5 : Power Supply

A power supply, typically operating at 12 volts DC, is an essential electrical device that furnishes electric power to an electrical load. Its primary function is to transform electric current from a source into the appropriate voltage, current, and frequency required to energize the load.

In essence, a power supply ensures that the electrical components receive the right specifications of power for seamless and efficient operation.

LCD/LED Display

Figure 6 : LCD Display

An LCD (Liquid Crystal Display) screen is like the unsung hero of electronic displays, finding its way into a ton of different gadgets. One of the classics is the 16x2 LCD display, a straightforward module that you'll spot in all sorts of devices and circuits.

SOFTWARE REQUIREMENTS

Python and OS Linux

Why Python Program ?

A Python program is a set of instructions written in the Python programming language. Known for its readable syntax, Python allows for concise code compared to languages like assembly, C, or Java. Initially designed as a Linux scripting language, Python programs resemble shell scripts, consisting of commands executed sequentially from top to bottom. In essence, a Python program is a file containing Python commands guiding a computer through specific tasks.

FEATURES

I. Signal Processing and Email Notifications:

- Fetches and processes signals from PIR sensor, Pi-camera, and Microphone.
- Sends email notifications to the owner or registered members.\

II. IoT-based Security:

- Utilizes IoT technology for advanced security.
- Early detection of emergencies like fires and water leakages.
- Integrates multiple sensors for a comprehensive security solution.

BLOCK DIAGRAM

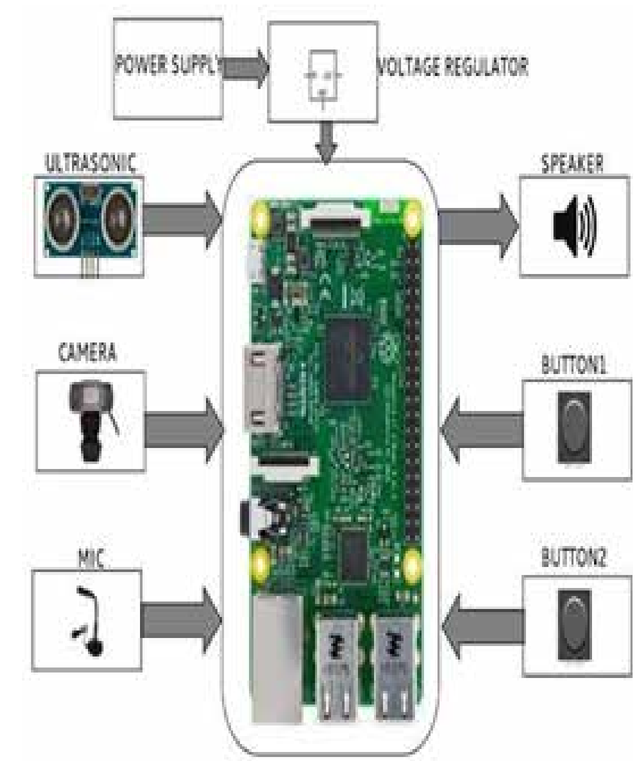

Figure 7: Block Diagram

WORKING OF OUR PROJECT

The project operates by using a PIR sensor to detect a person, triggering the Pi Camera via Raspberry Pi. Captured images are stored with filenames indicating the time and date.

Raspberry Pi then creates and sends an email with a predefined message and attached images to a designated email address. This streamlined process ensures efficient detection and notification of intruders.

ACKNOWLEDGEMENT

We express sincere thanks to our guide, HOD (Head of the Department), and principal for their guidance and support. Their encouragement and opportunities have been crucial in developing our skills through this project. We appreciate the collaborative effort of everyone involved, big or small, in making this project a reality.

CONCLUSION

In summary, our IoT-based security system enables the owner to view live door-front images with a button press on the IoT interface. It also allows for sounding alerts in case of potential issues or break-ins, providing a practical solution at a low cost. The Raspberry Pi system proves reliable, offering consistent security, energy efficiency through the PIR sensor, and ease of interaction for users. This project stands as a robust and cost-effective option for enhancing security in homes and offices.

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“JEEVAN” – Your Personal Health Assistant

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ABSTRACT

In the rapidly advancing realm of healthcare, the proliferation of Internet of Things (IoT) technology has given rise to transformative solutions. This project introduces an innovative approach by exploring the development and deployment of IoT-based Medical Health Assistants, designed to significantly enhance remote health monitoring and emergency response. These multifunctional devices continuously monitor vital parameters such as heart rate, pulses, Spo2, and body temperature in real-time. In the event of a medical emergency, such as a patient experiencing fatigue or weakness, these devices employ alert systems, including auditory signals like buzzers, to promptly notify relevant parties. This proactive strategy ensures the swift identification and response to potential health risks, minimizing the time gap between critical health indicator detection and the arrival of emergency medical services.

This paper emphasizes the concrete outcomes and developments in the field of Internet of Things-based medical health assistants, going beyond simple study and findings. It evaluates their proven talents, benefits, drawbacks, and likelihood of being widely used in healthcare environments. The study also explores the gadgets' subsequent effects on patients and medical personnel, illuminating the revolutionary conclusions drawn from the data.

KEYWORDS *: Jeevan device, MAX30102, Spo2, Heart rate, ADXL345, Fall detection, HW-827, Temperature sensor, DS18B20, OLED display, Precautionary messages, Emergency alerts, ESP32, Portability, Health monitoring.*

INTRODUCTION

The convergence of healthcare and the Internet of Things (IoT) has resulted in a paradigm shift in medical monitoring and emergency response in an era of exponential technological advancement. With the use of the Internet of Things, this project hopes to deliver a novel solution: the "JEEVAN" (जीवन) Medical Health Assistant. "JEEVAN" is derived from the Hindi word "life," which sums up the project's primary goal of safeguarding and preserving the priceless gift of life via advanced medical monitoring and emergency response.

The JEEVAN Medical Health Assistant overcomes classification and becomes a comprehensive healthcare partner that is carefully designed to record and analyze vital signs that are critical to a person's health. This includes the real-time monitoring of body temperature, heart rate, pulses, and Spo2 levels. To set it apart from other passive monitoring systems, the gadget has an intelligent alarm system with a buzzer that sounds in emergency situations, including when a patient passes away from exhaustion or weakness. By taking proactive measures, this modality aims to reduce the amount of time that passes between the beginning of health emergencies and the presence of medical professionals.

The device has a novel feature that enhances its functioning by dynamically presenting warnings and precautionary messages when sensor data exceeds predetermined levels. With the help of this real-time feedback system, people may take timely remedial action to address potential health hazards and ultimately enhance healthcare results. With a focus on the JEEVAN project.

LITERATURE SURVEY

The JEEVAN project, centering on the development of an IoT-based Medical Health Assistant, draws inspiration from a collection of influential research papers in the burgeoning field of healthcare IoT. [3] "A Review on Internet of Things (IoT) in Healthcare" (2016) by Mustafa Abdullah Azzawi et al. stands as a foundational pillar, offering a holistic view of IoT applications in healthcare. The paper underscored the urgency of real-time data acquisition and remote monitoring, laying the groundwork for JEEVAN's ambitious goal to redefine health monitoring and emergency response. The integration of continuous health monitoring and the emphasis on proactive strategies, hallmarks of the JEEVAN project, find their roots in the valuable insights provided by this seminal work.

[4] "Implementation of IoT Based Patient Health Monitoring System using ESP32 Web Server" (2023) by Jannatun Ferdous et al. has significantly influenced the technical dimensions of the JEEVAN device. This insightful review explores the latest advancements in wearable technology and advocates for the continuous tracking of vital health parameters. The decisions made regarding sensor integration within JEEVAN align closely with the recommendations outlined in this comprehensive review..

[5]" Fall detection system for elderly people using IoT and Big data " (2018) by Jara Suárez de Pugaa played a pivotal role in guiding the conceptualization of JEEVAN's intelligent alert system. This research paper delves into the critical importance of reducing the temporal gap between identifying potential health risks and initiating prompt medical assistance. The proactive modality, as advocated in this research, has been seamlessly integrated into JEEVAN. This ensures swift responses to critical health events, aligning with the principles promoted by this research and underscoring the practical application of proactive health monitoring.

METHODOLOGY

The Jeevan project incorporates various features to create a comprehensive health monitoring device with a focus on accessibility, portability, and cost-effectiveness. Here's a detailed explanation of each key feature:

Interfacing Various Sensors:

- MAX30102: This sensor is dedicated to measuring heart rate and oxygen saturation continuously. It plays a crucial role in monitoring vital signs and triggering alerts in case of critical levels.

- ADXL345: The accelerometer detects sudden falls or abrupt movements, signaling the ESP32 to activate the emergency alert system. This feature enhances the device's capability to address fatigue or weakness-related incidents.

- HW-827: A heart rate monitor (HRM) that allows users to measure and display their heart rate in real-time or record it for further analysis during physical activities.

- DS18B20: This temperature sensor improves temperature monitoring accuracy, providing redundancy in measurements for enhanced reliability during emergencies.

Precaution Displays

- The 1.3-inch I2C OLED Display Module delivers real-time feedback and instructions when monitored parameters such as heart rate, Spo2 levels, or body temperature deviate from safe bounds.

- Warning messages are informative, concise, and designed for easy comprehension, even by individuals with limited medical knowledge.

- Displays offer recommendations for actions, empowering users to make informed decisions about their health. In critical events, they serve as an immediate call to action, guiding users on necessary steps.

Fall Detection

- The ADXL345 accelerometer is strategically placed to continuously monitor movements and detect distinctive patterns associated with falls.

- When a fall is detected, the device triggers a multifaceted alert system, including visual indications on the OLED display, audio signals through a buzzer, and wireless alerts to emergency contacts via the ESP32's connectivity features.

- This feature is especially crucial for the elderly, providing a quick response mechanism and reducing the response time to emergencies, potentially preventing further injuries.

Portability

- Jeevan is designed to be compact and portable, catering to both elderly individuals and children.

- The small size ensures comfort and ease of wear for seniors, allowing them to maintain an active lifestyle while being monitored.

- For children, the device's portability enables easy incorporation into their daily routine, providing parents and caregivers with a non-invasive monitoring tool that ensures timely alerts.

Cost-Effectiveness

- Jeevan stands out for its cost-effectiveness compared to other health monitoring gadgets like Fitbits and microchips.

- The affordability makes it accessible to a broader range of individuals, promoting health equity and accessibility, especially in underserved communities.

- The simplicity and user-friendly interface make it suitable for individuals of all ages and technological proficiencies, ensuring widespread usability and impact.

BLOCK DIAGRAM

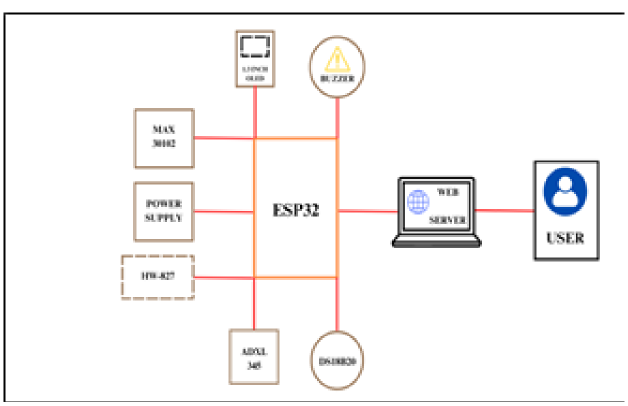

Fig. 1. Block Diagram

With the goal to enhance the user's safety and well-being—particularly for those who are elderly or young—the several components collaborate to continually monitor the user's health data, provide real-time feedback, and activate alerts when needed. Data from the user's side is displayed on the web server by means of several sensors attached to the ESP 32.

The above block diagram gives a comprehensive view of the project, providing a better understanding of the idea and the integration of various sensors to the main MCU board and then further interfaced with the Webserver to reach the user.

FLOW CHART

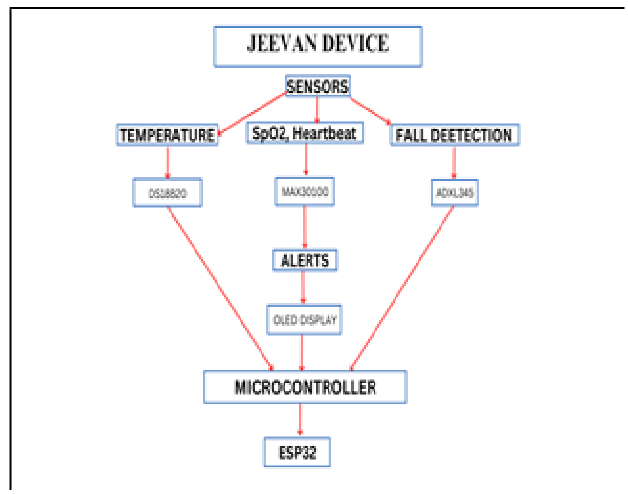

Fig.2. Flow Chart

The JEEVAN device is a sophisticated health monitoring system designed to capture, analyze, and respond to vital health parameters in real-time. At the core of the JEEVAN device lies a carefully chosen set of sensors, each catering to specific health metrics. The DS18B20 sensor is dedicated to temperature monitoring, ensuring precise and real-time tracking of the user's body temperature. The MAX30100 sensor is employed for SpO2 measurement, enabling accurate assessment of blood oxygen levels. Additionally, the device incorporates an ADXL345 sensor for fall detection, enhancing its capabilities for proactive health monitoring.

The microcontroller serving as the brain of the JEEVAN device is the ESP32. Its efficient processing capabilities make it well-suited for real-time health data analysis and decision-making. The ESP32 plays a pivotal role in executing the algorithms for fall detection and analyzing temperature, SpO2, and heartbeat data. It forms the central hub that enables seamless communication between the sensors and the output mechanisms.

The device employs an intelligent alert system to notify users or relevant parties in case of a medical emergency or fall detection. The alert system utilizes an OLED display, providing a visual interface for users. This compact and energy-efficient display communicates vital information, such as health parameter readings and alert messages, ensuring that users receive prompt feedback. Combined with the microcontroller, the alert system creates a responsive and effective mechanism for immediate notification and communication, thereby facilitating swift emergency response.

TOUBLESHOOTING & ERROR HANDLING

In order to ensure JEEVAN's reliability and performance, efficient troubleshooting and error management are essential. The implementation of graceful degradation and exception handling mechanisms to prevent system crashes, the careful identification and isolation of problems, the use of extensive recording and tracking features to track errors, and the routine updating of error handling protocols based on ongoing feedback and analysis are all important strategies.

RESULTS

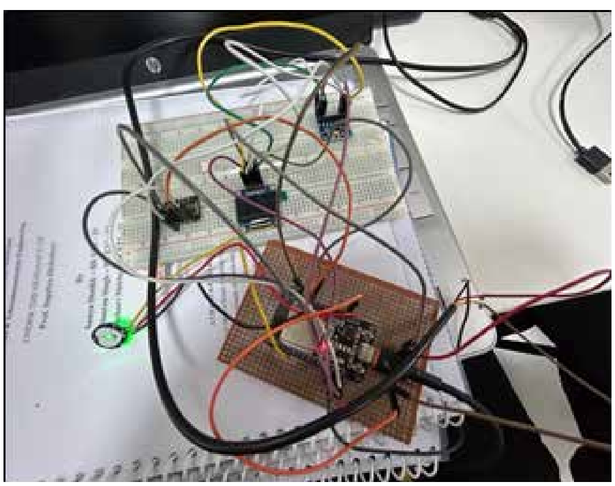

Fig.3. Hardware Prototype Testing 1

The hardware prototype for the Jeevan Healthcare Assistant is a small, multipurpose gadget that helps people efficiently monitor their health. It has sensors which monitor body temperature, heart rate, pulse, and other vital indications. It also has fall detection for senior citizens. By utilizing the power of IoT technology, the device's screen interface allows users to view and manage their health data from a distance. The Jeevan Healthcare Assistant prioritizes data security and privacy while offering consumers a user-friendly interface and real-time feedback to help them take proactive measures with their health. The device will be connected to a Velcro band which will make it portable and easy to access.

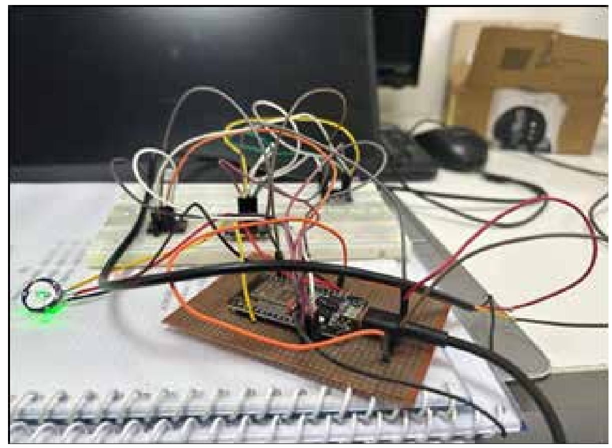

Fig.4. Hardware Prototype Testing 1

The IoT-based web server prompts users to enter the IP address associated with the Jeevan device for establishing connectivity. This step ensures that the web server can establish a direct link to the device, enabling seamless transmission of real-time health data. By entering the correct IP address, users facilitate the communication between the Jeevan device and the web server, allowing for continuous monitoring and analysis of health metrics.

Fig.5. Web Server confirming the IP address of the user.

Upon inputting a sample dataset into the IoT-based web server, the system utilizes MongoDB to process the data and generate insightful graphs displaying health readings. The server extracts vital signs like heart rate, SpO2 levels, and temperature from the dataset, then employs visualization tools to create interactive graphs. These graphs, ranging from line plots to scatter diagrams, showcase trends and correlations in the data, enabling users to track their health metrics over time.

As new data streams in from the Jeevan device, the graphs update in real-time, ensuring users have access to the latest information about their well-being. Through MongoDB's efficient storage and retrieval capabilities, the server seamlessly transforms raw data into actionable insights, empowering users to make informed decisions for better health management.

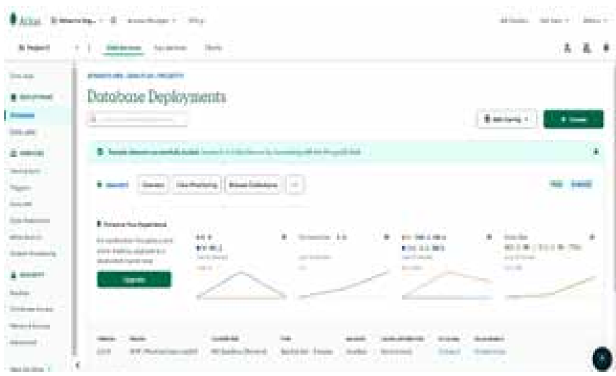

Fig.6. Sample datasets and readings.

CONCLUSION & FUTURE SCOPE

The Jeevan initiative offers an extensive and affordable solution for health monitoring, marking a significant breakthrough in healthcare technology. Jeevan is a unique health monitoring device that combines fall detection, proactive cautionary display, multipurpose sensors, and user-friendly design to bring advanced health monitoring and accessibility together.

Due to its affordability, people from diverse backgrounds can take advantage of ongoing health monitoring, which encourages diversity in the medical field. This cutting-edge tool gives caretakers peace of mind while enabling the elderly and kids to live healthier lives.

Jeevan can be a breakthrough in the field of health monitoring technology because of its dedication to enhancing well-being, ease of use, and affordability.

AI and machine learning will be included into Jeevan, the health monitoring system, in order to facilitate predictive analytics and early disease identification. By examining large-scale health data sets, Jeevan can spot trends that may point to potential health issues in the road. In addition, Jeevan's powers can be enhanced by merging it with wearable technology, and advances in telehealth provide remote consultations and diagnoses.

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Brushless DC Motor Control using PWM

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ABSTRACT

Brushless Direct Current (BLDC) motors have rapidly gained popularity in residential applications owing to their exceptional characteristics, including high efficiency, elevated power density, and minimal maintenance requirements. Their noiseless operation, compact design, and reliability have also led to widespread deployment across various sectors, including industries and household appliances. Despite their advantages, controlling the speed of BLDC motors poses challenges compared to other motor types in the industry. In this context, our objective is to devise an advanced, user-friendly, and cost-effective system. Initially, we plan to manually control the BLDC motor speed using a Variac or Regulator. Subsequently, our approach involves utilizing Arduino, ultrasonic sensors, and PWM techniques for digital control. This method treats the BLDC motor as a digital system, employing two predefined state variables to regulate speed. The simplicity of the controller's design and implementation is intended to reduce both cost and complexity in motor control hardware.

KEYWORDS *: Brushless direct current motor (BLDCM), Speed control of BLDCM, Pulse width modulation technique (PWM).*

INTRODUCTION

Electric motors are important in both industrial and residential areas and they are produced in excess of 5 billion units annually worldwide the popularity of brushless motors has increased due to the growing need for small dependable motors as well as improvements in permanent magnet materials and low-cost power semiconductor switches because they don't require mechanical commutators and have a high power density permanent magnet motors (PMMS) with trapezoidal and sinusoidal back electromotive forces EMFs have several advantages over other motor types these advantages include low maintenance requirements and suitability for applications requiring a higher torque-to-weight ratio additionally compared to other motor types (PMMS) are more adaptable since they have reduced rotor losses because of the usage of permanent magnets and have lower inertia which enables quick dynamic reactions compared to other motor types. This makes them versatile and applicable in diverse sectors, ranging from home appliances to the aerospace industry.

In residential and commercial applications, the prevalent choice for motors includes conventional options such as Induction Motors (IM) along with their respective drives. Typically, appliances in these settings are equipped with either single-phase induction motors or brushed DC machines, which are characterized by their relatively lower efficiency and increased maintenance needs. The proposition of replacing these less efficient motors with more cost-effective and efficient Brushless DC (BLDC) motors emerges as a viable solution for achieving substantial energy savings.

The Brushless DC Motor (BLDCM) operates based on the Lorentz law of force, a principle shared with brushed DC motors. Controlling the speed of a BLDCM to achieve the desired rate involves various techniques, including Pulse Width Modulation (PWM), control via an Android mobile application, coordination with SMS applications, and secure Bluetooth communication. The utilization of these varied control methods enables accurate and tailored speed regulation for the BLDCM.

Speed control in motors relies on two crucial factors: input DC voltage and current, with the speed being directly proportional to either parameter. To regulate motor voltage, power transistors operate as linear voltage regulators, while high-power motors necessitate the integration of microcontrollers for precise PWM control and starting mechanisms. The adoption of automatic speed control is proposed as a solution to the inefficiencies associated with traditional manual systems. Traditional approaches often result in substantial electrical energy wastage, emphasizing the need for a transition to automatic control systems, particularly for Brushless DC Motors (BLDCMs). The implementation of automatic speed control not only reduces power consumption but also minimizes human intervention, contributing to enhanced overall efficiency in motor operations. This evolution in control strategies aligns with the broader trend in industrial and automation systems towards increased automation and energy conservation.

Pulse Width Modulation (PWM) stands out as a widely embraced method for regulating the speed of Brushless DC (BLDC) motors featuring trapezoidal back EMF. Its popularity stems from its simplicity, making it adaptable for implementation on both analog and digital components. Microcontrollers, microprocessors, and digital signal processors (DSPs) are commonly employed to digitally implement PWM-based motor control techniques due to their computational capabilities. The design process involves carefully balancing factors such as cost and implementation complexity, as achieving an optimal trade-off is critical for overall system performance. The transition from analog to digital control methods poses challenges, with the digital implementation of continuous control techniques not necessarily resulting in a true digital controller. Ongoing development efforts in this field focus on improving performance and reducing construction costs to enhance the efficiency and cost-effectiveness of motor control systems.

This paper presents an economical and easily implementable control approach for Brushless DC (BLDC) motor drives. The utilization of a Pulse Width Modulation (PWM) controller in this context facilitates the conversion of the BLDC motor into a digital system. The primary focus is on delivering a cost-effective solution that is both straightforward to implement and promotes the integration of digital control within BLDC motor applications.

This paper is organized as follows. Section I introduces the research motive and also about BLDC motor. Section II gives a brief description of the scheme for the speed control of the BLDC motor drive which we proposed in our project. Section III describes the comparison between different techniques used for speed control of BLDCM.

BLDC MOTOR DRIVE SYSTEM (PWM TECHNIQUE)

A three-phase inverter bridge is utilized in a three-phase BLDC application. Fig. 1 depicts a standard BLDC motor inverter drive arrangement. The operation of the three-phase inverter is divided into six modes (1-6) according to the current conduction states and conduction sequence. The switches are configured to only carry current within a 120◦ period when the back electromotive force is constant. As seen in Fig. 2, every 60◦ electrical event causes a commutation between phases. Knowledge of rotor position is required for appropriate commutation. Position sensors are used to detect it directly, or it can be calculated without the use of sensors by tracking back EMF during the open phase. The three-phase currents are regulated to take on the shape of a quasi-square waveform to synchronize with the trapezoidal back EMF and provide continuous torque. The speed/torque control loop works with the rotor position sensor and the hysteresis current controller to accomplish this objective.

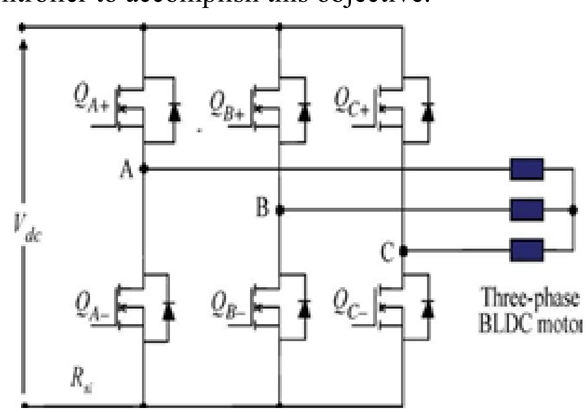

Fig.1. Inverter-fed BLDC motor drive system

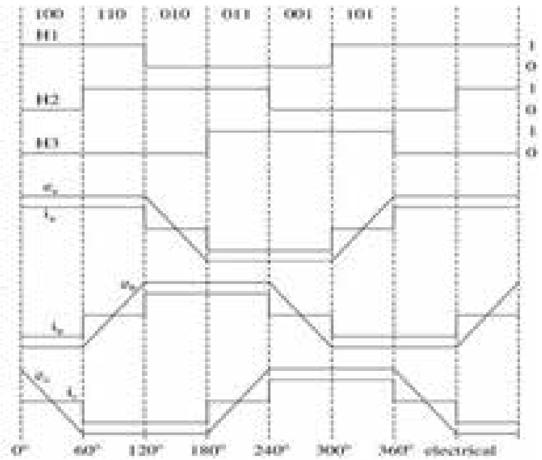

Fig 2. Hall sensor signals and Trapezoidal back EMF

In a BLDC, altering the voltage that's applied across the motor phases is one way to adjust speed. A sensored approach based on the ideas of PWM, hysteresis control, or pulse amplitude modulation can be used to accomplish this. PWM current control is a popular control method for permanent-magnet BLDC motors. It is predicated on the idea that the phase current and torque have a linear relationship, much like in a brushed DC motor. Thus, the electromagnetic torque may be regulated to satisfy the need by varying the phase current. Fig. 3 depicts the overall layout of a current controller for a brushless DC motor. The motor's instantaneous current is controlled by a hysteresis regulator in each phase, keeping the current within preset bounds. The rotor position information is detected to activate the commutation logic. Six outputs are then controlled by a PI regulator to maintain the rotor average speed and decrease phase leg power switches. There is no change in the current reference.

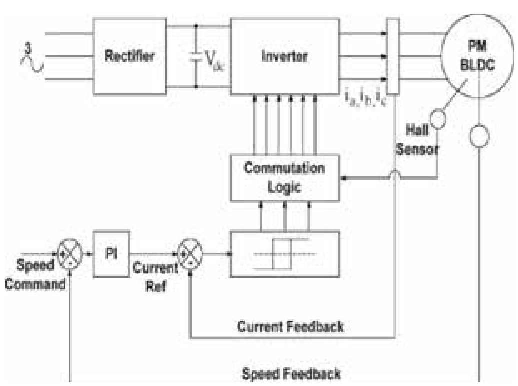

Fig 3. PWM Control Scheme

COMPARISON BETWEEN DIFFERENT TECHNIQUES

Speed & Direction Control of BLDC Motor using Android Mobile Application

Using an Android mobile application, the microcontroller is constructed to control both the speed and the direction of a direct current (DC) motor in either clockwise or counterclockwise directions. A high-frequency PWM signal is sent into the DC chopper and utilized to operate the DC motor. The duty cycle of this pulse width modulation signal may be adjusted to control the DC motor's terminal voltage, which in turn directly regulates the DC motor's speed. An Arduino UNO microcontroller is interfaced with a DC motor in this project. This system comprises an Arduino UNO microcontroller, a Bluetooth module, and a DC motor. The entire system is supplied with power by a 12v transformer. The Bluetooth module receives directives from an Android cellphone and transfers them to the microcontroller. The motor may run in the two directions at any time when it is switched on. The dc motor's speed and status are shown on an LCD. Via the Bluetooth module, a signal from an Android device will be transmitted to the microcontroller, which will then regulate the signal speed as well as the direction of the DC motor. The speed and direction of the motor are conveyed by a single direction in the signal that is transmitted to the microcontroller via the Bluetooth module. The three orientations of rotation—clockwise, counterclockwise, and halting the motor—will be represented by different letters. The following character will be the one used to change the motor's speed in the Arduino code. The DC motor's speed may be adjusted by varying the PWM signal's duty cycle. The direction of a DC motor can be controlled using the H-bridge

BLDC Motor Speed Control using SMS Application, Journal of Intelligent Control and Automation 5

Controlling the speed of a DC motor may be done easily by sending SMS messages from a mobile device.

The user will send an SMS to the GSM module indicating the intended motor speed in RPM. MCU will be used to proceed with the SMS received on the GSM module and for the PWM pulse to control the speed of the DC motor, MCU will convert the SMS into a suitable duty cycle. To continuously send an AT command to the GSM module MCU is programmed accordingly, which helps to check for messages in the SIM every 5 seconds at location 1. After receiving the message program will go to the next step after that, SMS will be received by MCU, which extracts the speed & changes it to a suitable duty cycle which is required for the PWM. Appropriate voltage is generated by employing PWM pulse control to manage the motor drive L2931. The motor receives this generated proper voltage to reach the necessary speed. The message was erased at position 1 of the GSM module by employing the AT command, looping again through the first step, and reading the SMS in SIM once more., after completion of this process. This will be a continual procedure. This method for operating a motor has many benefits, such as reducing worker effort because the motor's speed is controlled by directing the MCU, reducing wiring costs through the use of wireless technology, and enabling remote wireless control of a DC motor's speed.

Speed Control of BLDC Motor via Internet for Traction Applications

This system consists of the components as follows: Rectifier, filter capacitor, DC/DC converter. IGBT is an important component of DC/DC converter, It is powered by PWM pulses, microcontroller feds pulses to PWM. The Arduino onboard microcontroller is connected to the internet with the help of An Arduino Ethernet shield by plugging the Ethernet module into the RJ45 cable. The data is sent to the microcontroller through the internet by scrolling the slider in the Android app. There are 255 digital settings on the slider. The data is transferred to the Ethernet shield in accordance with the user-fixed value, and the associated duty-ratio pulse is obtained. By using the microcontroller signal to drive the IGBT, the speed of the motor may be adjusted.

Speed Control of BLDC Motor through Mobile Application via Bluetooth module

The speed control of BLDC motor through mobile application via secured Bluetooth. To control the speed and direction of a BLDC motor, a signal is delivered via an Android application, transferred to a Bluetooth module, and received by an Arduino Uno. This arrangement allows us to operate the motor in either a clockwise or counterclockwise manner. By reversing the direction of current flow either in the armature or in the field winding of the BLDC we can control the direction of the motor. This technique includes four main hardware which are as follows: Arduino Uno ATmega328 microcontroller, Android mobile, BLDC motor & Bluetooth module. This technique includes various steps which are mentioned further. Using an Android smartphone, the user instructs the Arduino Uno ATmega328 microcontroller. It uses the Bluetooth module to establish a wireless connection. The Bluetooth module receives the data given by the user and forwards it to the Arduino Uno microcontroller. This method powers the BLDC motor in this way. The PWM approach is used to regulate the BLDC motor's speed and direction. The most common and extensive application of the PWM method is in speed control. By varying the duty cycle of the PWM pulse, the speed of the DC motor is controlled. The motor's speed advances with increasing duty cycle and declines with decreasing duty cycle. Researchers conclude this work that a BLDC motor's speed and direction may be controlled over Bluetooth using an Arduino Uno. The duty cycle changes in direct proportion to changes in terminal voltage. The duty cycle can be adjusted using PWM control.

SIMULATION RESULTS

Using a modeled BLDCM whose specifications are listed in TABLE I, simulation research of a BLDCM drive are conducted using MATLAB/SIMULINK. Additionally represented is the three-phase inverter, which is switched between 10 and 60 kHz in frequency. The BLDCM drive schematic diagram and the simulated diagrams are displayed below, respectively. Hall sensor signals are used to determine the rotor position, and based on that information, the inverter's controls are switched on and off to enable a continuous rotation. The digital controller determines which switches need to be switched on using the appropriate PWM signals and the necessary duty ratio

Table I : Datasheet for Bldc Motor

Volts (Rated)	**24/48 V**
Speed (Rated)	1500/3000 rpm
Torque (Rated)	0.05 Nm
Current (Rated)	4A

Resistance	0.5 ohm
Inductance	0.2 mH
No .of poles	4/2

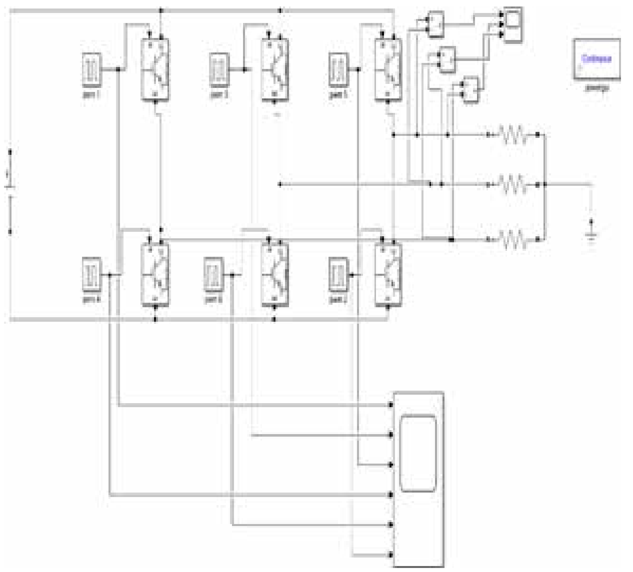

Fig.4. Simulation Diagram of BLDC Motor Drive

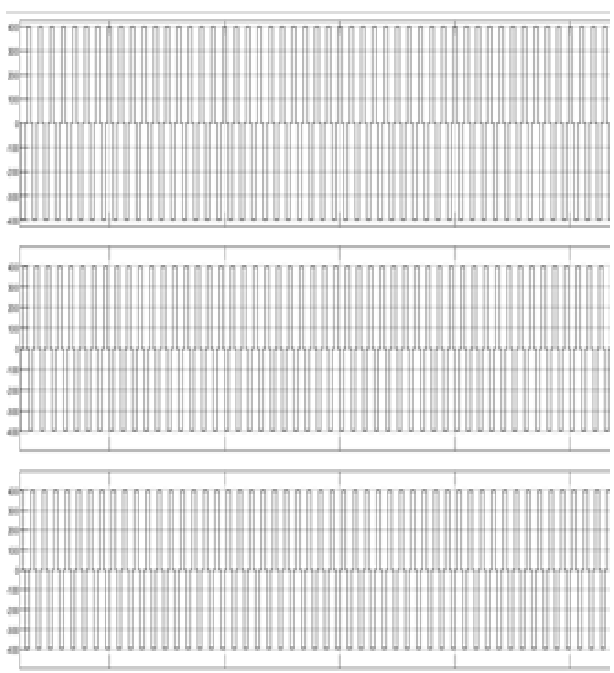

Fig.5. Per phase inverted output

In PWM control, drive simulation has been carried out to validate the control system. At t=0.4 seconds, the drive was running at its rated load torque. It was discovered that altering the duty ratio enables speed control. We may infer from the simulation outcomes that this control technique offers effective speed regulation with fewer speed ripples.

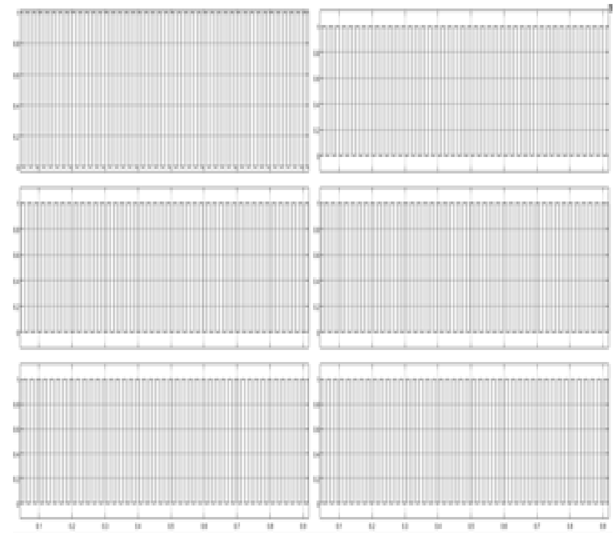

Fig.6. PWM output

Advantages

1. Speed control is achieved by using a Digital Controller (controlling duty ratio)
2. Economical and Simple
3. Only one current sensor is required for measuring dc-link current
4. Settling time is less
5. Ripples are negligible

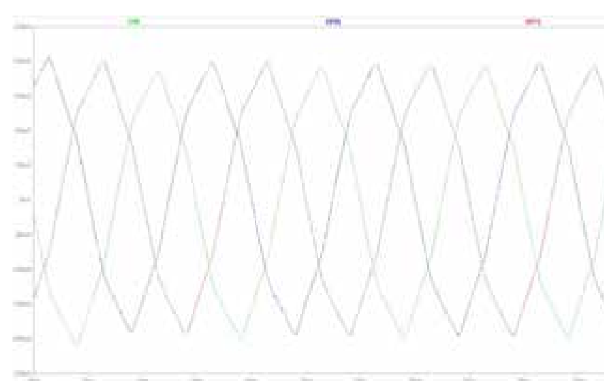

Fig.7. LT Spice Circuit Output

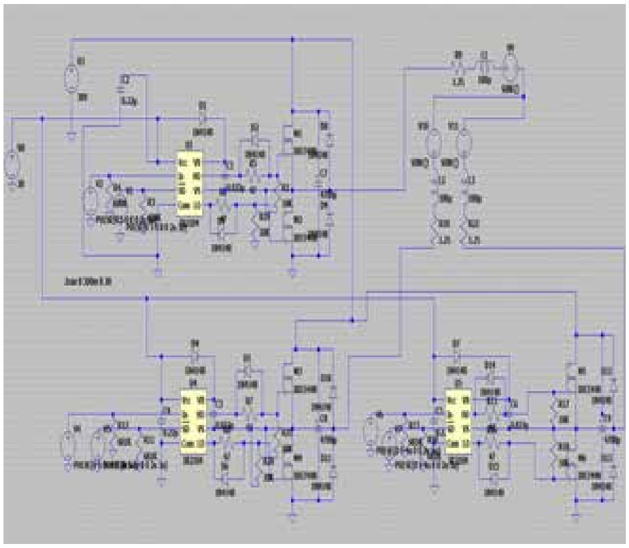

Fig.8. LT Spice Circuit

CONCLUSION

The paper introduces a straightforward yet highly effective digital control method for Brushless DC (BLDC) motor drives. Through simulation results, it is demonstrated that this approach can achieve precise speed regulation within designated speed limits by manipulating the system states. This implementation is notably simpler compared to conventional schemes. The study involves the simulation of a BLDC motor drive system, and the obtained results align with the theoretical analysis presented in the paper. Consequently, it is anticipated that the proposed digital control for BLDC motor drives will contribute to cost reduction and a decrease in the complexity of motor control hardware. This, in turn, has the potential to enhance the widespread adoption of BLDC motors for various commercial mass-production applications.

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New Advances in Smart Grid Technology: Prospects for the System that Supplies Electricity in the Future

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ABSTRACT

The rising demand for electrical energy driven by technological advancements has presented challenges in the distribution and production of electricity. This has created an increasing necessity for improved security, reliability, efficiency, and a focus on environmental sustainability in power grid operations. In response, the Smart Grid (SG) has emerged as a solution, integrating modern Information and Communications Technologies (ICT) with the electrical distribution network to deliver a dependable, efficient, sustainable, and environmentally friendly energy supply. The SG enables bidirectional transmission of both energy and information, opening the door to more intelligent approaches to electricity production, distribution, and consumption. This article delves into the dynamic landscape of Smart Grid technology, exploring its features and various applications in the electricity distribution sector.

KEYWORDS *: Smart grid, SCADA, NOx, Sox, Invogrid.*

INTRODUCTION

Recent studies have directed their attention toward inventive strategies for generating, distributing, and overseeing electric energy with the aim of achieving cleaner and sustainable consumption. Future electrical networks are anticipated to possess self-repair capabilities, ensuring dependable service through the incorporation of resilient technologies[1]. The growing demand for energy, fuelled by urbanization, elevated living standards, and technological progress, necessitates a transition toward more sustainable energy practices. Traditional power grids, characterized by their limited focus on production, delivery, and regulation, encounter challenges such as unreliability, high transmission losses, poor power quality, and susceptibility to disruptions. The emergence of the "smart grid" concept represents a transformative solution, tackling these issues and championing environmentally conscious energy distribution[2]. The inception of the Smart Grid concept can be linked to the changing requirements of electrical distribution systems, originating in the 1970s and 80s[3]. Although the deployment of smart meters is frequently connected with implementing the Smart Grid, the essential requirement for reliability and efficiency in energy transmission and distribution remains a critical consideration.

DEFINITION

A Smart Grid is defined as an intelligent electricity network that harmonizes the operations of generators, consumers, and entities performing both roles. Its primary characteristics comprise self-healing capabilities to automatically repair equipment, adaptability for swift and secure integration of distributed generation and energy storage, interactive functionalities offering clear system status information to operators and customers, and a concentration on security, encompassing both physical and cyber elements[4],[5].

The National Institute of Standards and Technology (NIST) has proposed a conceptual model that delineates the planning, developmental prerequisites, interconnected stakeholders, and essential equipment for a Smart Grid. The intricate and interdependent relationships among Smart Grid stakeholders are depicted in Figure 1.

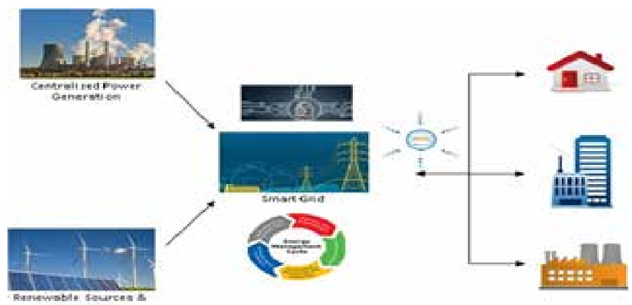

Fig.1 Smart grid's operational concept

ELECTRICAL ENERGY SYSTEM CONVENTIONAL

The traditional electric energy system in the context of a smart grid refers to the conventional infrastructure and practices that were in place before the implementation of smart grid technologies[6],[7],[8]. In this conventional system:

1. Metering Systems: Traditional metering systems were often manually read, with limited capabilities for real-time data collection. Smart grid implementation involves upgrading to advanced metering infrastructure (AMI) or smart meters for more accurate and timely monitoring of energy consumption.

2. Communication Networks: Conventional electric energy systems typically had limited communication capabilities, making it challenging to relay real-time information between different components of the grid. Smart grids introduce advanced communication networks to facilitate seamless data exchange.

3. Grid Management: In traditional systems, grid management relied heavily on manual processes and periodic maintenance. Smart grids incorporate automated grid management systems that use data analytics and real-time monitoring to optimize grid performance, detect faults, and enhance reliability.

4. Energy Distribution: Traditional grids faced challenges in efficiently distributing energy, especially when incorporating renewable energy sources and dealing with fluctuations in demand. Smart grids leverage advanced technologies for better integration of distributed energy resources and improved load balancing.

5. Resilience and Self-Healing: Conventional grids often lacked self-healing capabilities, meaning that disruptions could lead to prolonged downtimes. Smart grids are designed with self-healing features that enable the system to quickly identify and isolate faults, minimizing the impact of disruptions.

6. Demand Response: Traditional grids had limited mechanisms for incorporating demand response strategies. Smart grids enable more dynamic and responsive demand-side management, allowing consumers to adjust their electricity usage based on real-time pricing or grid conditions.

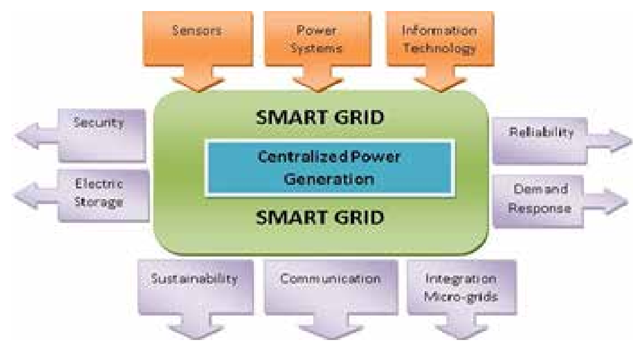

Fig.2 An outline regarding the architecture of the smart grid

7. Cybersecurity Measures: With the increasing digitization of energy systems, traditional grids may have been more vulnerable to cyber threats. Smart grids incorporate robust cybersecurity measures to protect against potential attacks on the interconnected digital components.

8. Integration of New Technologies: Conventional systems may not have easily accommodated newer technologies such as electric vehicle charging

infrastructure and advanced energy storage solutions. Smart grids are designed to integrate these technologies seamlessly for enhanced efficiency.

In essence, the transition from a conventional electric energy system to a smart grid involves upgrading and modernizing various components to create a more intelligent, responsive, and sustainable energy infrastructure.

SMART ELECTRICAL ENERGY SYSTEM OF THE FUTURE

The future smart electric energy system envisions a highly advanced and technologically sophisticated infrastructure that revolutionizes the generation, distribution, and consumption of electrical power. Key aspects of the future smart electric energy system include:

1. Advanced Metering Infrastructure (AMI): Smart meters will become more prevalent, offering enhanced capabilities such as real-time data analytics, bidirectional communication, and the ability to support dynamic pricing models. This enables more accurate monitoring and billing, as well as improved demand response mechanisms.
2. Decentralized Energy Generation: The future smart grid will see a significant increase in decentralized energy generation through the widespread adoption of renewable energy sources such as solar, wind, and geothermal. This shift towards distributed energy resources will contribute to a more sustainable and resilient energy system.
3. Energy Storage Integration: Advanced energy storage technologies, including improved batteries and innovative storage solutions, will play a crucial role [9]. These systems will facilitate efficient storage of excess energy during periods of low demand and enable its release during peak demand, enhancing grid stability.
4. Grid Intelligence and Automation: The smart grid of the future will feature sophisticated grid management systems employing artificial intelligence, machine learning, and automation[10],[11]. These technologies will optimize energy distribution, predict and respond to grid disturbances, and enhance overall system efficiency.
5. Cyber-Physical Security: As smart grids become more interconnected and reliant on digital technologies, robust cybersecurity measures will be paramount. Future systems will incorporate advanced cybersecurity protocols to safeguard against cyber threats and ensure the integrity of the grid.
6. Internet of Things (IoT) Integration: The integration of IoT devices will proliferate, enabling seamless communication and coordination among various components of the energy system. IoT sensors and devices will provide real-time data for better decision-making and grid optimization.
7. Electrification of Transportation: The electrification of transportation, including widespread adoption of electric vehicles (EVs), will be a key feature. Smart grids will need to support the increased demand for charging infrastructure and manage the integration of EVs into the overall energy system.
8. Dynamic Demand Response: Future smart grids will allow for more dynamic demand response strategies, empowering consumers to actively manage their energy consumption based on real-time pricing, grid conditions, and individual preferences.
9. Grid Resilience and Self-Healing: Enhanced grid resilience will be achieved through self-healing capabilities, rapid fault detection, and isolation mechanisms. These features will minimize downtime during disruptions and contribute to a more robust and reliable energy infrastructure.
10. Sustainability and Environmental Impact: The future smart electric energy system will prioritize sustainability, with a reduced carbon footprint and a focus on minimizing environmental impact. This includes a continued shift towards cleaner energy sources and increased energy efficiency.

In summary, the future smart electric energy system anticipates a highly intelligent, responsive, and sustainable grid that leverages advanced technologies to meet the evolving needs of society while addressing environmental challenges.

SECURITY

Cyber security stands out as a major apprehension for Smart Grids. The Electric Power Research Institute underscores the importance of implementing robust cyber security measures[12]. Strategies, including the integration of Smart Grid Systems Threat Analysis and Systems Security Threat Model, are recommended for the identification and mitigation of vulnerabilities. Structural attacks and decoding assaults targeting code-based cryptosystems are recognized, and modifications are proposed to bolster the resilience of the GPT cryptosystem.

INVESTMENT IN SMART GRID

Nations across the globe have acknowledged the importance of Smart Grids and have initiated efforts to incorporate them into their energy infrastructure[13]. As an example, the Government of Canada mandated the implementation of smart meters in Ontario and made substantial investments in a significant smart grid project, aiming to overcome challenges associated with the management of renewable energy[14],[15]. China has given priority to policies that concentrate on conservation, varied development, environmental protection, and a dependence on domestic resources.

CONCLUSION

The success of Smart Grid initiatives is apparent through projects like InovGrid and REIVE in Portugal. These endeavours highlight the importance of Smart Grid architectures, functionalities, and business cases, illustrating the potential for widespread implementation across the nation.

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A Short Overview of Diverse Analytical Methods for Material and Chemical Evaluation

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ABSTRACT

A significant and practical branch of science, analytical chemistry employs a range of tools and techniques to gather, separate, examine, and quantify distinct chemical, inorganic, and biological substances. This multidisciplinary field draws from chemistry as well as biology, physics, pharmaceuticals, and several technological fields. It covers the fundamentals of both qualitative and quantitative analysis, as well as thermal and electroanalytical techniques and spectrochemical procedures. Analytes are identified through qualitative analysis, and the concentration or quantity of the molecules under investigation is ascertained through quantitative analysis.

KEYWORDS *: Chemical analytical methods, NMR, IR, UV, Raman, Mass, Chromatography.*

INTRODUCTION

In material chemistry, instrumental investigation illustrates the chemicals present, qualitatively as well as quantitatively in a specimen. It is essential to comprehend these chemicals' physical and chemical properties to do this study. To put it another way, analytical chemistry is concerned with the elements within the sample being identified, separated, and determined. Furthermore it covers statistical data processing and the degree of chemical stability.

Methods

X-ray Diffraction: XRD ; A diffraction mechanism utilized for scanning the crystal's structure and the configuration of all the integrants. It is a convincing mechanism in the field of material science. The basis of XRD technique is to hit a crystal with X-ray incidence. The periodic and regular positioning of atoms within the lattice-grid results in the diffraction phenomenon in distinct directions.

Researchers can ascertain the array of atoms in the crystallographic presentation through scanning the ensuing diffracted spectrum and therefore it is captured with the help of a detecting device. But the above details are not sufficient to perceive the material's attributes and behavioural characteristics at the atomic as well as molecular extents. We are able to observe the crystallographic aspects, ascertain their structures, and estimate crystal-parameters. Moreover the research on several substances, comprising metals, minerals, ceramics, as well as biotic molecules, the technique is quite useful. It serves a purpose in an array of industrial areas, in the biological research field, geology, medicinal branches and most importantly in material sciences. A comprehensive understanding of the dimension, configuration, and the details attained through XRD spectrum XRD patterns, is much advantageous in deciding the substance's orientation as well as their dislocation crystal-defects per unit volume. The temperature expansion-coefficient, phase perception, identification and moderations, lattice extent features, the data residuary stress as well as strain, can also be noticed significantly.

X-ray Fluorescence Spectroscopy: This mechanism serves as a non-damaging strategy that on exposing a substance with X-ray radiations, this is able to provide the fluorescent X-ray-characters of its fundamental configuration. XRF mechanism-technique is extensively utilized for numerous explorations in the fields like, geology, ecological- sciences, study of archaeological artifacts, materialistic-sciences etc.

Infrared spectroscopy: (IR) technology is significantly used to investigate vibrational characteristics of molecules. It utilizes the infra-red segment only from the entire electromagnetic spectrum. This mechanism is quite a functional analysis and this is recurrently put in for various branches of sciences like chemical as well as allied fields, for the purpose of distinguishing functional-groups in many substances.

Molecular Vibrations: It is well known that the molecular bindings are the result of how they are chemically attached together. When such bonding gets vibrations, the preferred energy does belong to the precise frequency values of the IR spectrum.

- Infrared Light Absorption: Some fixed lambda values of the IR spectrum are carried off by the molecular structure of a given specimen, resulting in the vibrational state of bondings. Thus this captivated energy is a significant character to reveal about the bonding-type as well as the characterization of functional groups which are existing in the given specimen.
- Spectrum Generation: The graphical profile of the captivated intensity of infra-red waves with the lambda values or the wave's frequency relents the arising infra-red bandwidth. The top crests of the resultant bandwidth depicts the numerous modes of the chemical-bonding's vibrations.
- Interpretation: How a specimen is chemically configured, this can be The chemical structure of the sample can be concluded through the vivid analysis about the crest's locations and their intensities in the IR-bandwidth. For example, characteristic functional groups, say C-H, O-H, N-H, C=O, and others, can be distinguished.
- IR spectroscopy has various applications, including: Organic Chemistry, Polymer Chemistry, Pharmaceuticals, Science, Forensic Science.
- Two primary forms of infrared spectroscopy exist.: FT-IR (Fourier Transform Infrared Spectroscopy) and Dispersive Infrared Spectroscopy. FT-IR is more common nowadays due to its advantages in terms of speed, sensitivity, and data quality.

Ultraviolet spectroscopy

A method for studying the electronic transitions of molecules is called ultraviolet spectroscopy. It utilizes ultraviolet light throughout the electromagnetic spectrum.is a method for studying how molecules undergo electronic transitions by using ultraviolet light from the electromagnetic spectrum. It is a valuable analytical method, particularly in chemistry, biochemistry, and physics, for investigating the electronic structure of atoms and molecules.

The near-ultraviolet (NUV, 200-400 nm) and far-ultraviolet (FUV, 100-200 nm) are two common divisions of the UV spectrum. UV spectroscopy is complementary to infrared spectroscopy, which primarily deals with vibrational transitions, providing a comprehensive understanding of the electronic and structural aspects of molecules.

UV spectroscopy is commonly used to study biomolecules like proteins and nucleic acids. Proteins with nucleic acids (DNA and RNA) and aromatic amino acids (tryptophan, tyrosine, and phenylalanine) show distinctive UV absorption. This is often employed for determining concentrations, studying structural changes, and monitoring reactions involving these biomolecules.

The pharmaceutical sector uses UV spectroscopy to confirm the identity of medicinal ingredients. Pharmaceutical substances often have characteristic UV absorption spectra, allowing for the quantification of drug concentrations, purity assessment, and monitoring of chemical reactions during drug synthesis.

Conjugated systems, where alternating single and multiple bonds exist, exhibit unique electronic transitions that fall within the UV range. UV spectroscopy is used to study the presence and extent of conjugation in organic compounds. For example, it is employed to determine the degree of conjugation in unsaturated hydrocarbons. UV spectroscopy can be applied in environmental science for monitoring pollutants and contaminants. Certain organic and inorganic pollutants absorb UV light at specific wavelengths, enabling the detection and quantification of these substances in environmental samples. It can be used to gauge how much of specific substances—like vitamins, colorants, and additives—are present in food and drink items. It is applied to detect and quantify transition metal ions in solution. The presence of certain metal ions can be identified based on their characteristic UV absorption spectra.

These examples highlight the versatility of UV spectroscopy in various scientific and industrial applications, demonstrating its utility in characterizing and analysing a wide range of materials.

Nuclear Magnetic Resonance

This spectroscopy is a powerful way to analyze an atomic nuclei's magnetic characteristics. It offers comprehensive details regarding the interactions, dynamics, and structure of molecules in solution. The magnetic characteristics of some atomic nuclei, especially those with an odd number of protons and/or neutrons, are exploited by NMR. These nuclei experience nuclear magnetic resonance when they are placed in a high field of magnetism and subjected to radiofrequency radiation.

A typical NMR instrument consists of a strong magnet, a sample holder, a radiofrequency transmitter and receiver, and a computer for data analysis. The strong magnetic field aligns the nuclear spins of the sample. The magnetic environment of a molecule's nucleus is represented by the chemical shift in its NMR spectrum. It gives information on the electron density surrounding a certain nucleus and is expressed in parts per million (ppm). When spin-spin coupling arises nuclei in a molecule interact with each other. The NMR peaks split as a result of this interaction, revealing details about the number and locations of nearby nuclei. The number of nuclei contributing to each NMR peak is indicated by the area under that peak. The ratio of various nuclei in a sample can be ascertained with the aid of integration. NMR spectroscopy is widely used in structural elucidation of organic and inorganic compounds, determining stereochemistry, studying reaction kinetics, and investigating biomolecular structures, among other applications. High-resolution NMR instruments provide detailed spectra with narrow peaks, allowing for precise measurement of chemical shifts and accurate determination of molecular structures.

A vital tool in contemporary chemistry and biochemistry research, NMR spectroscopy is a flexible and non-destructive scientific approach The structures of complex molecules, such as proteins, nucleic acids, and tiny chemical compounds, can be studied with great benefit from it.

Raman Spectroscopy

When examining rotational, vibrational, Raman spectroscopy is used in conjunction with additional low-frequency forms in a system.. It is predicated on the Raman phenomenon and offers details on molecular vibrations.. The Raman effect occurs when light interacts with molecular vibrations in a sample. Most incident photons scatter unchanged (Rayleigh scattering), however, a tiny percentage experiences inelastic scattering, which modifies the energy. This energy change corresponds to the vibrational energy levels of the molecules. A typical Raman spectrometer consists of a laser light source, a sample holder, a dispersive element (such as a diffraction grating), and a detector. Following the application of the laser light to the sample, frequency alterations are detected in the dispersed light.The variation in frequency between received and dispersed light is known as the Raman shift. It is expressed in wavenumbers (cm^{-1}) or sometimes in frequency (cm^{-1}). The Stokes lines, which have lower frequency than the received light, and the anti-Stokes lines, which have greater frequencies than the received light, contribute to the Raman spectrum. Stokes lines result from the absorption of a photon, and anti-Stokes lines result from the emission of a photon. It requires minimal or no sample preparation. It is also non-invasive, making it suitable for studying biological samples and delicate materials.

Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) Both methods use electron beams instead of visible light to achieve higher resolution, allowing for the examination of fine details in samples. However, they differ in their imaging mechanisms and applications.

A concentrated electron beam is scanned over a sample's surface to produce SEM images. Several signals, including secondary electrons (SE) as well as backscattered electrons (BSE), emerge as the electron beam interacts with the material. These signals provide information regarding the topography and composition of the specimen surface. TEM works by transmitting electrons through an extremely thin sample. generally, provides higher resolution than SEM, enabling the visualization of details at the atomic level. In summary, SEM is primarily used for surface imaging and provides 3D information, while TEM is focused on internal structures and offers higher resolution, allowing for the study of nanoscale details within a sample. Both techniques are complementary and play critical roles in nanoscience and microscopy.

Mass Spectroscopy

Ions are produced from a sample in mass spectrometry, and these ions are subsequently divided according to their mass-to-charge ratio (m/z). The thereby created mass spectrum yields details on the ion distribution and constitution. Ionization is the initial stage of mass spectrometry, in which the material is transformed into ions.

Electrospray ionization, electron impact, and matrix-assisted laser desorption/ionization (MALDI) are examples of common ionization methods. After the generated ions are accelerated, they are separated and determined through their ratio of mass to charge in a mass analyzer. The time-of-flight (TOF), quadrupole,magnetic sector, ion trap mass analyzers are common types. A detector picks up the separated ions, and after processing the signal, a mass spectra is produced. The abundance of ions with particular mass-to-charge ratios is reflected in the spectrum's peak intensities.

Tandem Mass Spectrometry (MS/MS)

It involves performing two consecutive mass spectrometry experiments. In the first step, a specific ion is selected and fragmented, and in the second step, the fragments are analysed. This technique enhances specificity and is commonly used for structural elucidation.

High-Resolution Mass Spectrometry (HRMS)

High-resolution mass spectrometry provides greater accuracy and precision in determining the mass-to-charge ratio of ions. It is particularly useful for resolving closely spaced peaks in complex samples.

Isotope Ratio Mass Spectrometry (IRMS)

IRMS is applied to measure the abundance of isotopes in a sample, providing information about the isotopic composition of elements.

Because of its capacity to offer comprehensive details regarding the makeup of molecules, it is an essential tool in many different types of research..

Thermogravimetric Analysis

The weight of a sample can be studied as a function of temperature or time using a thermal analysis technique called thermogravimetric analysis (TGA), which involves subjecting the sample to a precise environment and controlled temperature regimen. A variety of materials' composition, thermal stability, and rate of breakdown can all be found out by TGA.

- The foundation of TGA is the concept that as a sample changes because of temperature or time, it goes through physical or chemical changes that affect its mass. The sample's temperature is regulated and its weight is constantly recorded.

A typical TGA instrument consists of a sample pan (where the sample is placed), a balance to measure the sample weight, a furnace for controlled heating, and a system for monitoring and recording the changes in weight. The analysis is often performed under a specific gas atmosphere (e.g., air, nitrogen, or inert gases) to control the oxidation or reduction of the sample. Samples for TGA are usually small and should be finely ground and homogenized. The sample pan is then loaded with a known amount of sample, and the pan is placed in the TGA instrument. TGA provides a thermogram, which is a plot of the sample weight or mass change according to the time or temperature. Key features include peaks or steps corresponding to different thermal events, such as decomposition, evaporation, oxidation, or reduction.

TGA can be performed isothermally (at a constant temperature) or non-isothermally (with a programmed temperature change). Non-isothermal TGA is often used to study complex reactions involving multiple steps.

DTG is a derivative technique that represents the rate of weight change with respect to temperature or time.

It provides additional information about the peaks observed in the thermogram.

Chromatography

In order to achieve separation, chromatographic procedures take advantage of the differing affinities of components for a stationary phase and a mobile phase.

The notion of differential component partitioning between a stationary phase and a mobile phase is the foundation of chromatography. Following the introduction of the specimen combination into the system, the chromatographic column or medium, different components are retained and eluted at different rates, leading to their separation.

- The kind of chromatography will determine whether a liquid or a solid is used as the stationary phase. An alumina base, different kinds of polymers, and silica gel are familiar stationary phases.
- A fluid known as the mobile phase is responsible for moving the object being examined through the stationary phase. In gas chromatography, it can be a gas, and in liquid chromatography, it can be a liquid. The elements in the sample separate as a result of the mobile phase's distinct interactions with them.
- Detection steps in chromatographic procedures frequently involve the detection and quantification of separated components. Refractive index, mass spectrometer, UV-Vis, and fluorescence detectors are a few examples of detectors that can be used, depending on the particular method.

CONCLUSION

Analytical instrumentation, which includes X-ray spectroscopy and nuclear absorption technologies, is unquestionably a broad topic. However, the goal of chemical or biological measurements is always to do so as quickly, precisely, and affordably as feasible. In addition to these divisions within the complex field of analytical methods, there have been advancements in technology. It was not at all comprehensive outside of this inquiry, since practically every analytical field of study developed and advanced. Instead of using the more common compounds, Researchers that take manufacturing into account may still be able to produce silver compounds with plasma resonance. Compared to high-speed atomic force microscopy, researchers utilize this method to visualize and measure simultaneous binding occurrences Furthermore, folks who are curious about surface features can now scan those surfaces more quickly than they could in the past. These days, analytical methods are recognized as a scientific instrument that helps the environment, the humanities sciences, and scientific society by employing ongoing knowledge from practically every subject to accomplish its goals. There can be no ultimate reward for analytical research, but there will be many amazing successes along the way, and the field is still constantly pushing for this. Even though there will be many noteworthy successes along the way, using analytical research methodologies is still a critical step in preventing a final victory.

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ABSTRACT

Every electrical system requires power as a supply. Each has a power rating, and the quantity of energy used to complete the work is specified. In industries, exceeding the contracted electricity use might result in significant penalties. A maximum demand meter's main objective is to track and restrict peak electrical consumption in order to reduce monthly electricity costs. The user has no need to worry about paying high bill amounts or about the electricity bill going up when they use the meter. All users, but especially industries, can benefit from maximum power demand meters. Society can gain from the expertise and information that went into making the meter. These capabilities enable consumers to proactively change their energy use habits, avoiding peak demand prices and complying with utility agreements.

KEYWORDS *: Maximum demand, Pic microcontroller, Demand meter, Penalty.*

INTRODUCTION

The demand controller is an electronic equipment whose main function is to maintain the active power demand of a consumer unit, within predetermined limit values, acting, if necessary, on some part of the Demand Controllers also controls the power factor and energy consumption. Controlling the demand is fundamental, not only for the consumer to reduce his costs with electric energy, but also for the concessionaire that needs to operate in a well-dimensioned way, avoiding interruptions or poor supply quality.

The maximum quantity of power used by a firm in a thirty minutes billing period is referred to as maximum demand. Maximum demand rates are computed using a predetermined capability cost rates for each kilowatt (kW) of contractual capacity and are in addition to commercial energy consumption fees. A maximum demand meter's main function is to track and regulate the maximum power consumption in order to lower monthly electricity bills. By utilizing the electricity meter, consumers may avoid worrying that their power cost will go up and they'll have to pay high rates. Every user, but especially industries, can benefit from a maximum power demand meter. The information and also knowledge that been used to produce the meter can benefit the society. [1]

As we have progressed, our goal in controlling maximum demand has been to stay within the contracted power limit. To achieve this purpose, we recommend installing a system capable of disconnecting non-critical loads at different time intervals and avoiding connecting loads concurrently to save instantaneous power. Noncritical loads are those that have no effect on the main manufacturing process or are unnecessary. When millions of power industrial clients turn on and off various electric appliances, the need for force changes. In an efficient Grid, energy use and invention must be balanced at all times; any significant imbalance could induce Grid volatility or severe voltage oscillations, resulting in system outages. Consequently, peak demand management is required. Because of this, the organization needs the right assets in order to gather the load at any given moment. Balancing among load demand and invention may be accomplished by either raising innovation or lowering demand. The idea behind energy production was primarily dependent on demand; Efficiency Group would simply raise its power generation capacity to meet the necessary demand if more electricity was needed. Maximum Demand is measured in kilowatts per hour, which represents the total quantity of electricity consumed over a given time period. [2]

The main goal of this essay is to lower monthly electricity expenses by keeping an eye on and controlling maximum power consumption. The consumer may avoid paying large amounts of funds on bills and worrying about their electricity bill going up by utilizing the meter.

METHODOLOGY

A peak meter measures the greatest quantity of electricity used by a certain user over a predetermined time frame, generally thirty minutes. Continuously recording the power consumption and storing the data for further study is what a half-hourly meter does. It is computed by detecting the electrical energy flowing through it and figuring out the average power use over a given time frame. The consumer's maximum demand is then calculated using this data. Peak demand meters are frequently utilized in residential and industrial environments where there is a high demand for power. The meter helps the electricity supplier manage the electricity distribution, allowing the consumer to understand their energy usage better and make adjustments. [2]

The largest quantity of electrical energy used at any one time is referred to as maximum demand. Assume that T1 is eight hours long and that it has been broken into one-hour segments. The gear is used to measure and record the maximum power consumption once every hour. [9]

FUNCTIONAL BLOCK DIAGRAM

Bipolar Junction Transistor (BJT)

A Bipolar Junction Transistor (BJT) is the BC547. It resembles an NPN transistor somewhat.

Voltage Stabilizer

In order to provide continuous 5V DC regardless of voltage fluctuations between 6V DC and 28V DC, voltage regulator is utilized.

Stepdown Transformer

230 volts AC will be converted to 12 volts AC supplied using a stepdown power transformer.

Electromechanical Relay

A relay is a basic electromechanical switch. A Relay is an electrical device that connects or separates two circuits, similar to how we manually open or close a circuit. Instead of a human action, a relay sends an electrical signal to an electromagnet, which connects or separates another circuit. When an electromagnet is powered by electricity, it creates an electromagnetic field around itself. A switches is used to deliver direct current (DC) to the load. The relay's electromagnet is composed of a copper coil and an iron core. When the magnetic coil is charged with direct current (DC), it begins to attract the contact, as illustrated. This is known as relay energizing. When you remove the supply, it returns to its previous place.

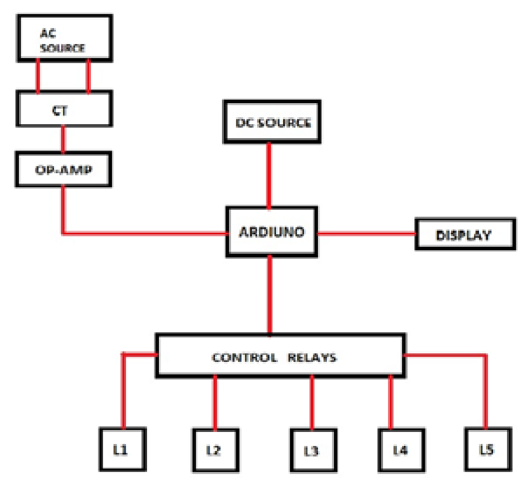

Fig.1. Functional block of energy management unit

Matrix Display Liquid Crystal Display

Liquid crystal displays (LCD) screens are electrical display components that have a wide range of uses.

Series Current Transformer

An example of an "instrument transformer" is the Series Transformer also known as current transformer, which is made to measure current in its primary winding and create an alternating current in its secondary circuit that is proportionate to that amount. By lowering high voltage currents to a considerably lower value, current transformers offer a practical means of utilizing a normal ammeter to safely measure the real electrical current travelling in an AC transmission line. A fundamental current transformer works on a somewhat different principle than an ordinary voltage transformer.

Gate Driver

External components, such as high-power relays, require >100mA and higher voltages. For operating such devices, a transistor-based driver circuit is employed to amplify current to the appropriate levels. When voltage and current ratings are in ideal range, the transistor functions as a high-current switch controlled by a lesser current electronic logic signal.

Operational Amplifier

An amplifier that is operational is an integrated device that's capable of amplifying weak electric impulses. An operational amplifier contains two input pins and a single output pin. Its primary function is used for amplifying and output the electrical voltage differential across the two inputs pins. An op-amp increases the voltage differential across the non-inverting (Non-IN(+)) and inverting (IN(-)) inputs.

Arduino (microcontroller)

An arduino (microcontroller) is used to conduct a number of tasks, and the pins perform a variety of activities such as the analog to digital converter comparator, timing, and so on.

AC Source

It is a device that can deliver variable power and frequency to a load. An alternating current (AC) power source generates an current is alternating that may be used to power or test another piece of device by imitating electrical grid disruptions, the presence of harmonics, transients, or other occurrences that might lead an equipment under test (DUT) to break down.

DC Source

It transforms alternating current (AC) electricity from a normal outlet into a steady DC power source. This dc regulated can be used to operate a device, module, or component. DC power supplies exist in a variety of input voltages, output voltage, current outputs, and power ratings.

CIRCUIT DIAGRAM

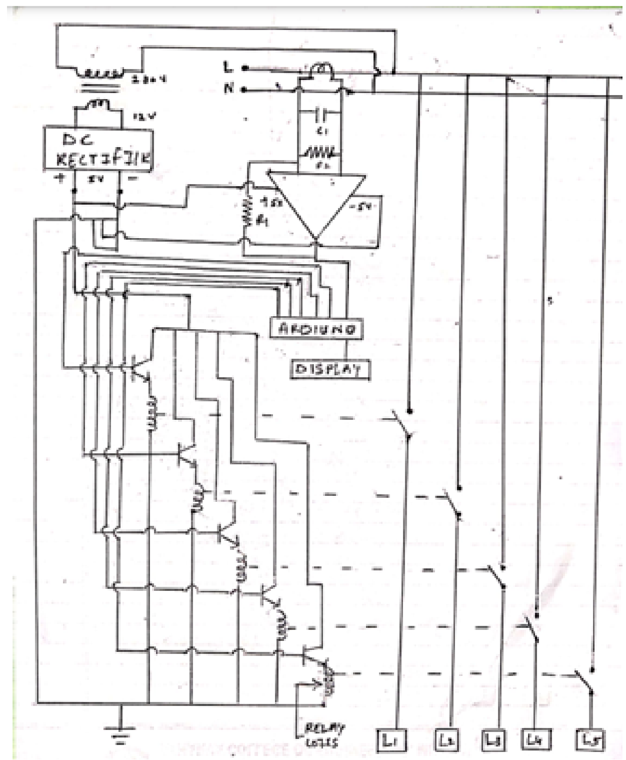

Fig. 2 Circuit diagram of a demand meter

The above mentioned circuit diagram explains the working of the model. 230 volts AC will be converted to 12 volts AC supplied using a step down power transformer. After that we will need DC power as for the control circuits. To do so, we will use a bridge rectifier circuit. It consists of 4 diodes connected in bridge format. It converts AC into 12v DC further this Dc supply is pulsating dc. [3]

First, a capacitor is totally depleted, resulting in a low resistive route that allows a 5V to flow through the capacitor, charging it and creating a high impedance condition between the 5V and reset pins. As a result, the voltage at the reset pin falls to zero. [3]

A filter consisting of capacitors and resistors makes the pulsating dc into pure dc. Now this pulsating dc is converted into pure dc by using filter circuits consisting of capacitors and resistors. As our microcontroller requires constant 5 volts dc supply, IC 7805 is used as the voltage regulator. Because the microcontroller operates at a constant 5 volt, it can deliver a maximum of 5 volts and 20 mA through its output. However the relay which we are using will require more current to operate. Therefore the coil of relays are connected in series with transistors BC547 which is connected to 12 volt dc supply. The gate pulse to the BC547 is given by the microcontroller. [4]

Fig.3 Energy management unit

EXPECTED OUTCOME

We will segregate our load on the basis of its criticality.

A) Critical

B) Medium

C) Non critical

When the overall load current hits a predefined level. For example, if our circuit detects 10 amps, an alert will sound. Then switch off the unnecessary burden. If the alert remains unattended, the circuit will automatically trip the specified noncritical load. As a result, the overall load current is reduced, and our power consumption remains below maximum demand. The current transformer will measure the load current and give the output to operational amplifier (op-Amp). Then the op amp will give voltage output in accordance with the current input to the microcontroller. As microcontroller is voltage sensing device. According to our program and segregation of load the microcontroller will decide what load will be turned off when the total load current will reach the predetermined value.

Getting high electricity demands for a restricted number of hours each day is one of the most serious issues at the national and international levels. The relationship between electricity users and providers in the electrical market has always been built on the expectation that whenever and whatever loads are required by users, they will be met by suppliers at the expected time and with the best quality. [8]

The increased consumption of electricity in the domestic and industrial sectors is a major contributor to the overloading of electrical demands. However, in order to fulfill the current nonstop expanding electrical demands, an ever-increasing electricity supply is required; this would allow the existing network to be supplemented with more electricity generators while also improving transmission and distribution organization. [5]

By utilizing the meter, the user has no reason to be concerned about their power bill going up or about spending more to pay bills. Since the whole system is automated, a manual edge is not required. This allows for the appropriate calculation of meter readings, which disables the requirement for conventional human meter reading. Energy is measured and computed using the energy meter. The evaluation's conclusions show that this instrument is a reliable method of measuring power. It is quite precise in order for the industrialist to utilize this meter to lower their monthly power costs. [6]

APPLICATION

Whenever the demand that is getting close to a pre-set value the alarm will trigger and the EMU will turn off non-critical loads if remedial action is not taken. It is used in operations where there are lot of load fluctuations between loads, such as industries and factories, etc.

FUTURE SCOPE

The EMU may be implemented wirelessly by utilizing the RFID technology, which can further simplify the installation process. Additionally, by utilizing GPRS to build the setup, it may be more movable. It is possible to increase power factor.

CONCLUSION

To summarize, an Energy Management Unit (EMU) equipped with a Maximum Demand Controller (MDC) is an invaluable tool for organizations and facilities seeking to successfully manage their energy use and expenses. By monitoring and managing peak electrical demand, these devices assist optimize energy usage, minimize electricity costs, and avoid utility penalties. Implementing an EMU alongside an MDC can result in increased energy efficiency and financial savings, making it a wise investment for enterprises looking to better manage their energy resources.

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Design, Simulation and Implementation of 32-bit ALU using Xilinx Vivado Suite and Artix 7 FPGA

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ABSTRACT

The proposed paper deals with the designing and implementation of an Arithmetic Logic Unit - ALU of a general CPU. The designed ALU performs base operations like taking binary inputs, executing the operation, and creating, storing, and distributing binary output. The ALU and its pre-requisite digital circuits are designed using Very High-Speed Integrated Circuit (VHSIC) Hardware Description Language (VHDL). ALU of digital computers aims at utilizing logic design algorithms to efficiently utilize the hardware. Various individual aspects of the ALU were designed and tested first and were later linked together to form a single powerful ALU with 32 discrete functions. In order to test the designed ALU, various test bench programs were developed to provide stimulus and verify responses. In this paper, we have simulated and synthesized a 32-bit ALU in Xilinx Vivado 2023. A scaled down version of the mentioned ALU is implemented on Arty A7 FPGA board housing the Artix 7 FPGA by Digilent.

KEYWORDS *: ALU, VHDL, Xilinx Vivado, FPGA, VLSI.*

INTRODUCTION

The design and implementation of the Arithmetic Logic Unit on a FPGA is of most relevance in the design of digital circuits since it is a basic part of the central processing unit. The results of a wide variety of simple arithmetical and logical computations can be computed by ALU. The operands—the data to be acted on—as well as a control unit code indicating the action to perform are inputs to the ALU. The computation's output is what is produced. Depending on the ALU's design specifications, the input can be 4, 8, 16 or 32 bits. We have used a 32-bit setup in the proposed paper. The planned ALU will carry out two key tasks:

- Arithmetic functions
- Logic functions

All the modules described in the design are coded using VHDL as it has high degree of parallelism.

According to Moore's Law, the semiconductor industry has shown a substantial exponential increase in device complexity and performance. The verification and implementation of enormous digital systems require the Very Large-Scale Integration as a key technology. In order to preserve the performance, reliability, and cost-saving advantages of large integrating systems, signal chips may now support designs with tens of thousands to millions of transistors. Computer-aided design tools have reduced the complexity of such designs into a set of clearly defined processes, thereby speeding up design completion and improving the quality of the final output. A functional description using a Hardware Description Language, such as VHDL, Verilog HDL, etc., always marks the beginning of the design process. A major area of interest in the study of algorithms and the development of tools for FPGA-specific design automation difficulties is the field programmable gate array (FPGA) technology. Due to the new challenges that FPGAs bring for logic synthesis and optimization, a number of cutting-edge approaches have been developed recently.

IMPLEMENTATION

An ALU is an important component of the central processing unit in a computer system as it performs both arithmetic and logic operations. An integrated circuit found inside a CPU or GPU, also known as an integer unit (IU), is the final component of the processor to carry out computations. It can perform all arithmetic and logical operations, such as addition, subtraction, multiplication, division and shifting operations, as well as Boolean comparisons (XOR, OR, AND, and NOT operations). Bitwise and mathematical operations can also be carried out on binary numbers. According to the input data, the ALU is instructed by its operands and code which operations to do. After the ALU has done processing the input, the data is sent to the computer's memory. Therefore, to design an entire ALU, its singular aspects such as adder, subtractor, multiplier, and multiplexer were firstly designed and implemented in Vivado and later all these circuitries was fused. Digital circuits such as Full Subtractor, Multiplier, Multiplexer which are fundamental aspects of an ALU were designed and verified with their intended operation.

Basic Full Subtractor

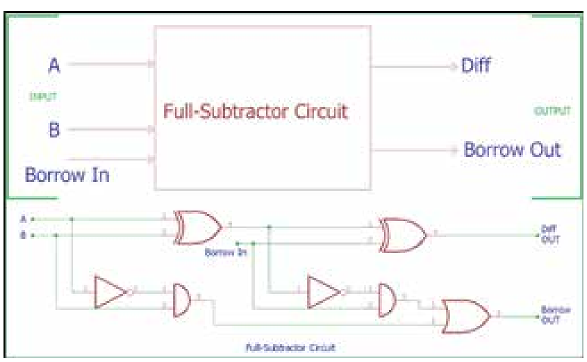

Fig 1. Full Subtractor Block Diagram and Logic Diagram

RTL Schematic of designed Full Subtractor

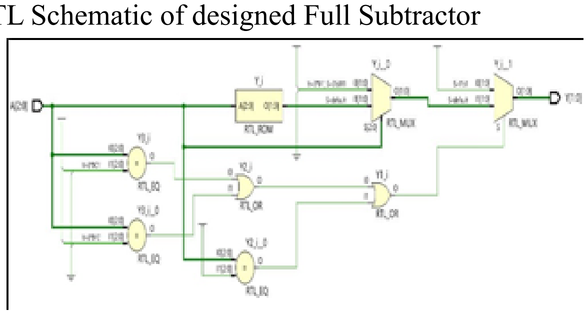

Fig 2. RTL Schematic of FS

Post Synthesis Schematic of Full Subtractor

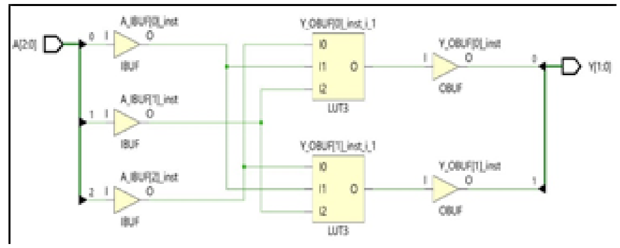

Fig 3. Post Synthesis Schematic of FS

Output Timing Diagram

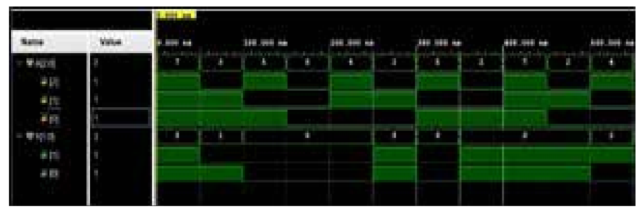

Fig 4. Output Timing Diagram of FS

Signed Multiplier

RTL Schematic of designed Signed Multiplier

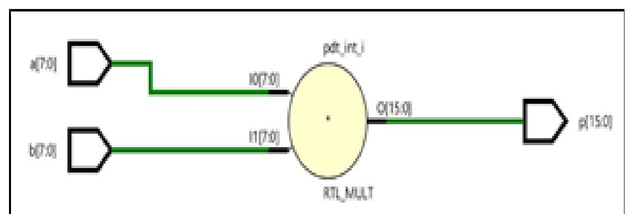

Fig 5. RTL Schematic of Signed Multiplier

Post Synthesis Schematic of Signed Multiplier

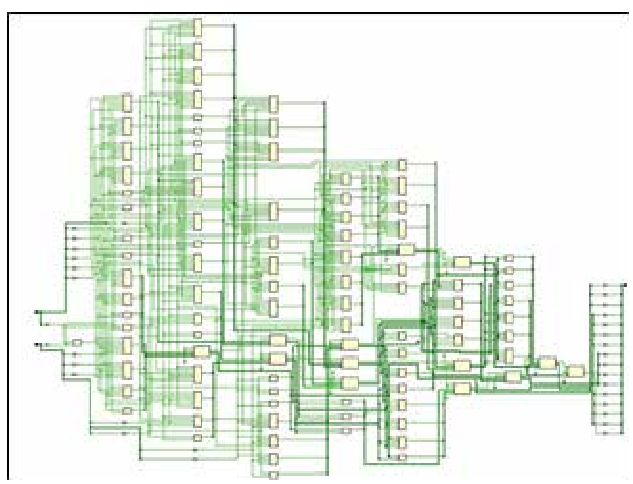

Fig 6. Post Synthesis Schematic of Signed Multiplier

Output Timing Diagram

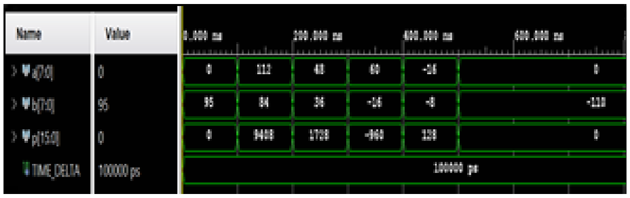

Fig 7. Output Timing Diagram of Signed Multiplier

16:1 Multiplexer

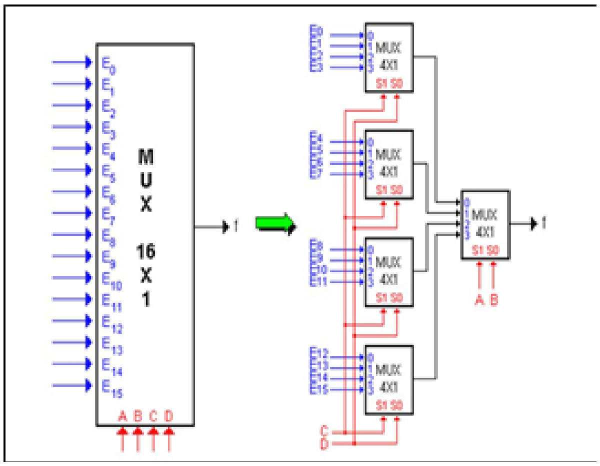

Fig 8. 16x1 Multiplexer Block Diagram and Logic Diagram

RTL Schematic of designed 16x1 Multiplexer

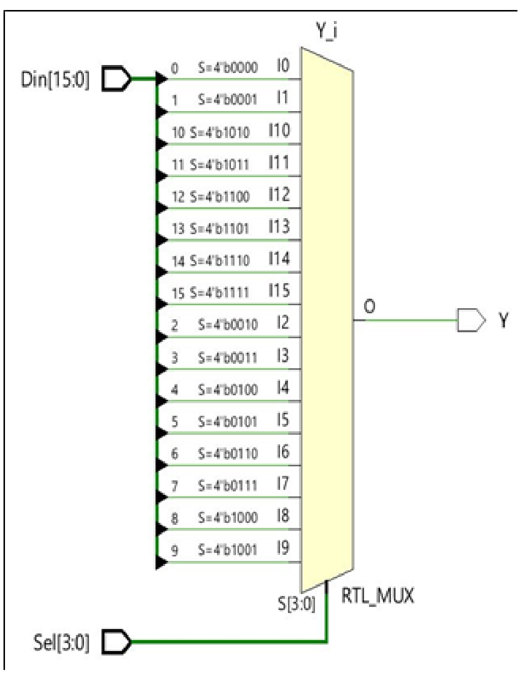

Fig 9. RTL Schematic of 16x1 Multiplexer

Post Synthesis Schematic of 16x1 Multiplexer

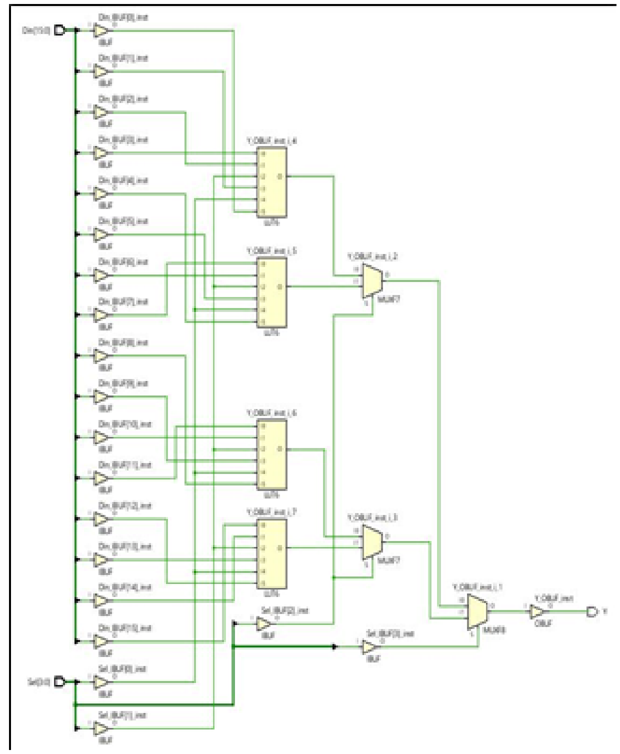

Fig 10. Post Synthesis Schematic of 16x1 Multiplexer

Output Timing Diagram

Fig 11. Output Timing Diagram of 16x1 Multiplexer

COMPILATION

The designed ALU has 3 inputs, namely, 2 operands and 1 opcode. The input operands are 32 bit each. The opcode is designed such that it performs 32 different operations. These operations include 4 arithmetic operations i.e., addition, subtraction, multiplication and division. The rest are logical operations with include AND, OR, etc. basic gates, shifting operations, and rotating bits operation. The output has 2 separate terminals, all arithmetic and logical operations except multiplication and division are received at one node, while the remaining are received at other.

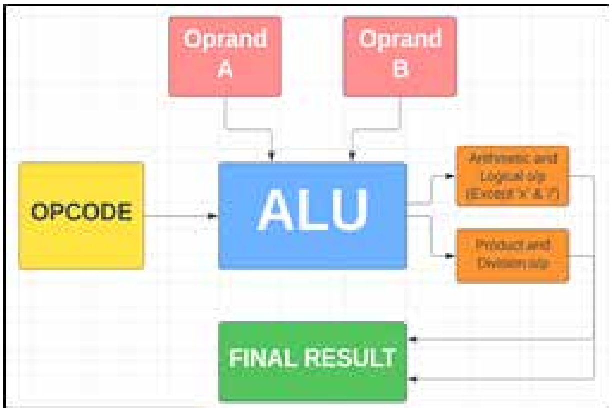

Fig 12. Block Diagram of Implemented ALU

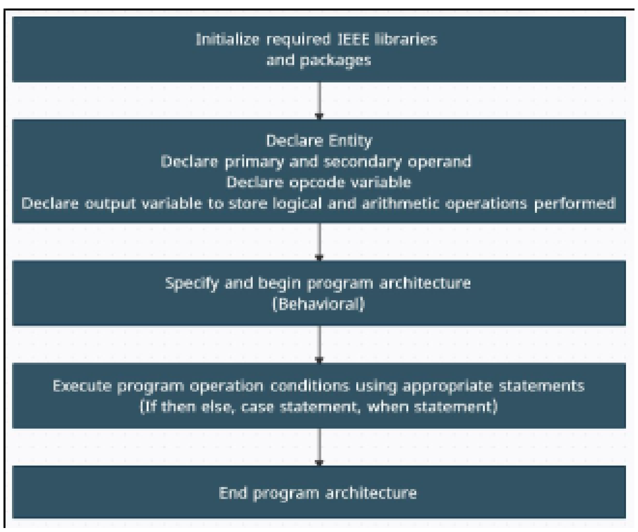

Fig 13. Program flow of ALU code

The basic program flow of ALU is as shown in Fig 20. Firstly, all required IEEE libraries such as 'std logic 1164', 'std logic unsigned' and 'numeric std' are initialized. After initialization, entity named ALU is declared, variables 'A' and 'B' are declared as primary and secondary operands. And 'ALU_Opcode' is declared as the opcode variable. Variables 'ALU_Out' and 'ALU_PQ' are declared as output variables. The program output for every input opcode is specified in the architecture using 'When" statement in VHDL. All the parenthesis are closed and the program architecture is ended. The opcode table of an ALU shows the user\ what operations the ALU is capable of performing. It also facilitates the programmer to reprogram, rearrange all the functionalities according to the user specific requirements.

Table 1. ALU Opcode Table

Sr. No	Opcode	Operation
1	00000	Add A with B
2	00001	Subtract B from A
3	00010	Multiply A with B
4	00011	Divide A with B
5	00100	Logical AND between A and B
6	00101	Logical OR between A and B
7	00110	Logical NAND between A and B
8	00111	Logical NOR between A and B
9	01000	Logical XOR between A and B
10	01001	Logical XNOR between A and B
11	01010	Logical complement of A
12	01011	Logical complement of B
13	01100	Shift left logical A by 1 bit position
14	01101	Shift left logical A by 4 bit position
15	01110	Shift right logical A by 2 bit position
16	01111	Shift right logical A by 3 bit position
17	10000	Shift left arithmetic A by 1 bit position
18	10001	Shift right arithmetic A by 4 bit position
19	10010	Rotate left A by 1 bit position
20	10011	Rotate right A by 2 bit position
21	10100	Shift left logical B by 1 bit position
22	10101	Shift left logical B by 4 bit position
23	10110	Shift right logical B by 1 bit position
24	10111	Shift right logical B by 4 bit position
25	11000	Shift left arithmetic B by 1 bit position
26	11001	Shift right arithmetic B by 4 bit position
27	11010	Rotate left B by 1 bit position
28	11011	Rotate right B by 2 bit position
29	11100	Rotate left A by 1 bit position
30	11101	Rotate right A by 2 bit position
31	11110	Rotate left B by 4 bit position
32	11111	Rotate right A by 4 bit position

The block diagram, program flowchart and opcode table of ALU being designed and verified the final VHDL code is made. To test the designed algorithm, a VHDL testbench is required. The testbench provides stimulus to the designed VHDL program and outputs timing diagrams. These timing diagrams are then verified with the original truth tables. The designed VHDL core source code and simulation test bench code were run in Vivado and the output timing diagrams were verified.

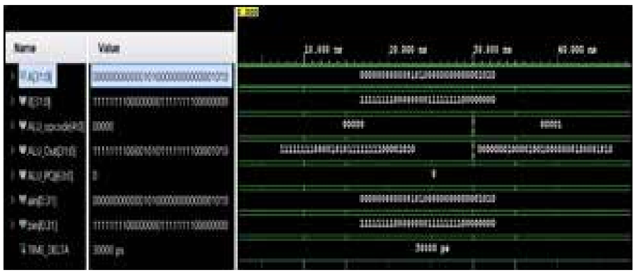

Fig 14. Timing Diagram 1: Addition Operation

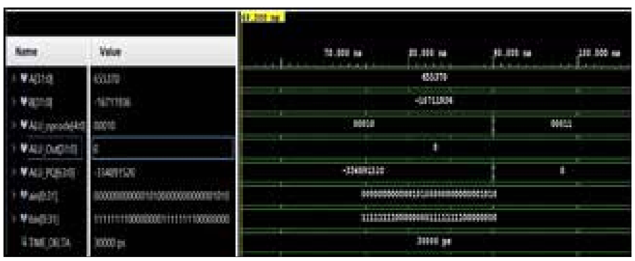

Fig 15. Timing Diagram 2: Multiply Operation

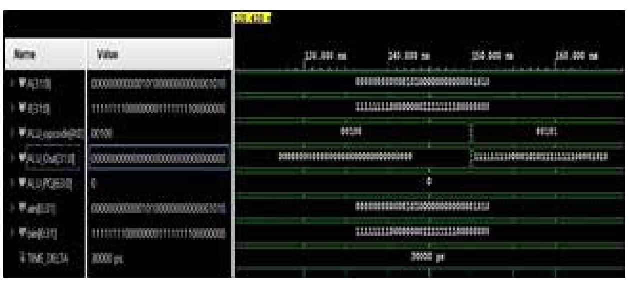

Fig 16. Timing Diagram 3: Logical AND

Fig 17. Timing Diagram 4: Logical NAND

Fig 18. Timing Diagram 5: Logical NOR

Timing Diagrams 1, 2, 3, 4 and 5 demonstrate efficient functioning of ADD-SUB, MUL-DIV, AND-OR, NAND-NOR, and shifting operations on 32-bit data stream effectively.

RTL Schematic of Arithmetic Logic Unit:

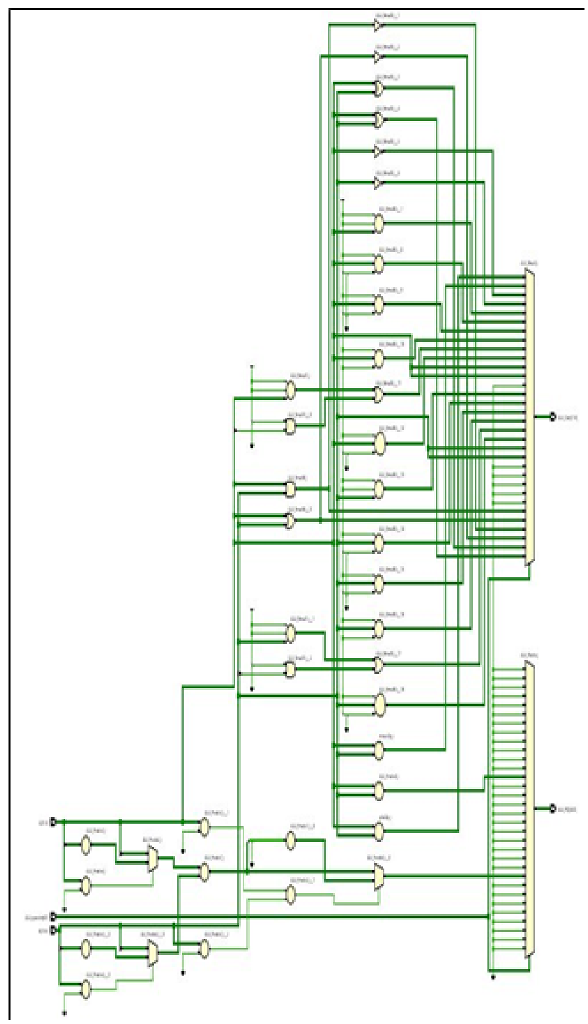

Fig 19. RTL Schematic of Arithmetic Logic Unit

Fig 20. Artix 7 FPGA implementation: Addition Operation

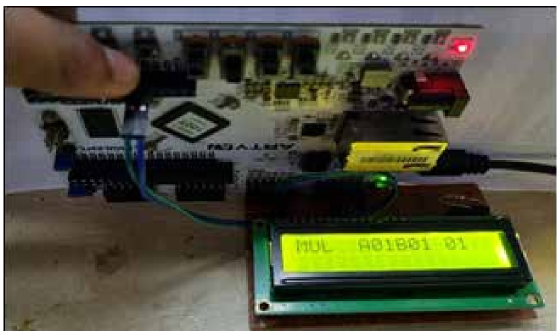

Fig 21. Artix 7 FPGA implementation: Multiplication Operation

Fig 22. Artix 7 FPGA implementation: XOR Operation

Fig 23. Artix 7 FPGA implementation: Shift Right Logical Operation

Fig 24. Artix 7 FPGA implementation: Shift Left Arithmetic Operation

CONCLUSION

In this project, we designed and implemented a 32-bit ALU using VHDL in Xilinx Vivado. The ALU performs arithmetic operations such as addition, subtraction, multiplication, division, and logical operations such as AND, OR, NOT, and XOR. We started by understanding the requirements and specifications of the ALU and then created the design using VHDL. We simulated the design using ModelSim simulator and verified its functionality. We then synthesized the design using Vivado, and implemented it on the Xilinx FPGA board. After testing, the ALU showed correct results for all the implemented operations. Overall, this project demonstrated the process of designing and implementing a complex logic circuit using VHDL and Vivado. It also provided an opportunity to explore the capabilities of FPGA boards and the power of hardware description languages in digital circuit design.

FUTURE IMPROVEMENTS

There are several improvements that can be made to the existing 32-bit Arithmetic Logic Unit (ALU) design using VHDL in Xilinx Vivado. Some of these improvements include:

1. Optimizing the design for speed: The current ALU design may have some areas where the combinatorial logic can be optimized to reduce delay and improve performance. This can be done by analysing the timing reports and using Xilinx Vivado's optimization tools to identify and eliminate timing violations.
2. Implementing pipelining: Pipelining the ALU can

improve its throughput by breaking the processing of an instruction into several stages. This can help to reduce the overall execution time of the ALU and improve its performance.

3. Adding more functions: The existing ALU design may have limited functionality in terms of the operations it can perform. Adding more functions such as bitwise logic, shift, rotate, and conditional operations can make it more versatile and useful for a wider range of applications.
4. Implementing parallelism: Another way to improve the performance of the ALU is to implement parallelism. This can be done by adding more processing units or replicating the existing units to work in parallel. Parallelism can increase the throughput of the ALU and enable it to handle more complex computations.
5. Adding support for Double Precision Arithmetic: Currently, the ALU design only supports single precision arithmetic operations. Adding support for double-precision arithmetic can make the ALU more powerful and suitable for applications that require high precision computations.
6. Adding Support for Floating-Point Arithmetic: If the application requires floating-point arithmetic operations, the ALU design can be modified to support them. This can be done by adding a floating-point unit (FPU) to the existing design or implementing floating-point arithmetic in the existing ALU design.
7. Increasing Bit Width: As the existing ALU design is 32-bit, Increasing Bit Width of operands and output can enable the ALU to work on more significant numbers.

Overall, these improvements can make the 32-bit ALU design more powerful, efficient, and versatile, making it suitable for a variety of applications.

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SensiGuide: The Smart Blind Stick

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ABSTRACT

Navigating urban environments poses significant challenges for visually impaired individuals, impeding their quest for self- sufficiency. The issues typically arise when one is trying to find a way through congested streets and marketplaces, walking on ramps, moving up stairs, and a variety of other scenarios. To get where they're going, one needs to ask for directions. They deal with greater challenges on a daily basis. The struggle lies in the inadequacy of the systems to cater to the unique safety and mobility concerns specific to the visually impaired within dynamic settings. The urgency to tackle the challenges faced by the visually impaired stems from a broader commitment to fostering a more inclusive and accessible urban environment. The study contributes to the development of innovative solutions that prioritize user safety and independence, recognizing the multifaceted problems that hinder self- sufficiency for visually impaired individuals in their daily lives. These difficulties are sparking interest in finding different approaches to solving them. This exploration delves into the application of advanced ultrasonic sensor technology, aiming to address the distinct problems faced by visually impaired individuals in navigating their surroundings. By providing real-time obstacle detection, the study seeks to alleviate the hurdles that hinder their independence. Unlike conventional solutions, this article endeavors to offer a more versatile and reliable tool for enhanced navigation. We provide an overview of all the research publications that discuss various approaches to developing a blind stick that is more portable, affordable, user-friendly by using 3D printing technology, along with sensors such as IR, and ultrasonic sensors as well as GPS. This overview paper presents a comparison and summary of all approaches.

KEYWORDS *: Visually impaired, Ultrasonic sensor, Obstacle detection, Safety, 3D printing.*

INTRODUCTION

Individuals who struggle with vision problems are individuals who can't even see clearly the slightest detail with normal eyes. When both eyes are open, the horizontal range of the visual field has less than or equal to 20 degrees for those with a visual acuteness of 6/60. People with visual impairments are those who have trouble seeing even the slightest detail with normal eyes. According to a 2011 World Health Organization survey, around 1% of the world's population has visual impairments (roughly 70 million individuals), of which 10% are entirely blind (roughly 7 million people) and 90% have limited vision (roughly 63 million people). The primary challenge faced by visually impaired individuals is finding their way around. People with good vision are needed to help these people. 10% of people who are visually impaired, according to the WHO, do not have any functional vision at all that would allow them to move around safely and independently.

The development of a sophisticated and intelligent walking stick that can inform the blind about their current location and assist visually impaired people by alerting them to potential hazards is necessary. The goal is to develop and build a device that would employ embedded electronic system or sensors to sense its surroundings and notify the user of the. The advantages of making the blind stick using 3D printing over alternative methods have been reviewed. This study analyzes various ways used to build the stick using sensors, wireless networks, and microcontrollers that were employed earlier. Furthermore, 3D printing offers a unique advantage in creating a stick with a tailored design, addressing specific user needs effectively. This is a big step toward making the stick more user-friendly, especially for those who are blind or visually impaired. For those who depend on the smart blind stick for navigation, this feature increases its practicality on a regular basis. A crucial factor to take into account, in addition to these benefits, is 3D printing's affordability. This makes it possible to produce these cutting-edge sticks in greater quantities without placing a heavy financial strain on them. In the end, this promotes more accessibility to the technology for those who are able to utilize it.

LITERATURE SURVEY

With the assistance, the user gains a better awareness of their surroundings and makes decisions much more quickly, enabling for them to travel around more confidently and effectively. You can use the cane in your immediate surroundings— at home, at work, in a park.

Proposed a functioning model that combines a microcontroller system with an integrated ultrasonic sensor into a cane. By employing ultrasonic waves, the ultrasound detection can identify barriers. The sensor transmits information to the microcontroller upon detecting obstructions. After processing the data, the microcontroller assesses the spacing between the obstacle which keeps the circuit inactive if the object is not in close proximity The blind person receives an alert signal from the microcontroller if an obstacle is approaching. Furthermore, it intend to incorporate the electronic Save Our Souls, or e-SOS, system. When a blind person has any pain while navigating, he or she can make a member's video call of their family by hitting the stick's e-SOS distress call button. [1]

Displayed The Assistor is a smart walking stick that helps people with visual impairments find obstacles and get where they're going by using image processing, echolocation, and a navigation system. The assistor facilitates autonomous navigation with object identification warnings by utilizing image sensors for real-time picture capture and ultrasonic sensors for object detection. With the use of a linked smartphone app, this technology provides a holistic solution with an effort to improve the quality of life for people with visual impairments. The Assistor distinguishes itself from other walking sticks and systems by offering warnings for object recognition and identification along with real-time autonomous navigation. [2]

Outstanding efforts are made to serve individuals who are unsighted or have visual hinderance move on their own particularly on roads or in distinct settings. Electronic Travel Aids (ETAs) have been created to recognize obstacles in the vicinity. They work Upon detecting an object in close proximity to the stick, then the system issues alerts through a vibratory circuit, which may involve speakers or headphones. The components of the system include an ultrasonic sensor, GPS module, GSM module, and the vibratory circuit. [3]

For navigation the gadget predominantly count on the global positioning system (GPS). These solutions based on gps are dependable due to their precision all these navigational devices give instruction to the blind on how to navigate therefore the user would not have to think and easily move around.

This inventive solution blends a raspberry pi Zero, high-definition camera, MPU sensor, buzzer with ultrasonic sensor and speaker to develop a holistic system aimed at overcoming the distinct obstacles that the community of people with vision impairments faces devices. Sophisticated functionalities like an object identification impediment identification and orientation monitoring enhances the ability to deliver instant feedback to users utilizing both auditory alerts and voice prompts, the AIot blind stick provides a versatile feedback mechanism tailored to accommodate various user preferences. [4]

Numerous new studies in the field of artificial intelligence are now underway. AI can be simply used to assist those with disabilities.

The goal of the technology aims to provide artificial eyesight to blind individuals and obstacle detection.

The system uses ultrasonic sensor to detect the object and the signal is transferred to the micro controller which notifies the user through a buzzer, it also utilizes a moisture sensor that is employed to detect the existence of water. [5]

A guide cane serves as a tool to aid people with visual impairments in both indoor and outdoor settings it possesses an obstacle recognition technology and a GPS navigation system the pre-programmed GPS system assists the user in navigating to their intended final location a raspberry pi is also employed to store the programs for impediment identification and GPS navigation whereby the system offers the user auditory feedback for the purpose of navigating and detecting obstacles. [6]

YOLO (You Only Look Once) symbolizes a widely utilized assemblage of models for object detection models applied for immediate acknowledgement and classifying of objects in real time for computer vision execution. This series of models denoted as yolo is renowned in the domain of Artificial Intelligence.(AI).

The text-to-speech device is then used to translate this data into text. The gadget lets users know what's ahead by warning them of potential hazards and providing thorough descriptions of the area. With an average item detection time of 0.426 seconds, the Smart Blind Stick is capable of real-time object identification across 80 classes. Furthermore, the user receives a distance measurement from an ultrasonic sensor along.with.this.information.

This portable gadget is intended to provide blind people "secondary.vision".[7]

This next innovation is likewise being strongly influenced by machine learning.

Different technologies have been used to develop the multipurpose blind stick. The stick uses a variety of microcontrollers, including the Arduino Uno, Arduino Mega, STM32, MSP 430, and PIC microcontroller, in addition to ultrasonic, water, and infrared sensors. Wherein these microcontrollers working as the brains behind the functions of the stick. Small computers with cameras, such as Raspberry Pi's, are used in the machine learning field for object detection. The identification of certain things, such as chairs, tables, cars, and people, is made possible by advanced object detection algorithms like R-CNN, Masked R-CNN, Fast R-CNN, YOLO, SSD, and MobileNet. In addition to RF transmitters to help find the stick in case it becomes lost, communication options in the stick include GPS and GSM for tracking user location. [8]

As power is one of the biggest constraint in the system as there are many sensors working altogether which consume a lot of energy.

Thus novel approach in which a piston system with piezoelectric plates and springs is integrated into the inner pipe this system generates voltage by compression and expansion which is used to charge the devices battery using a novel charging process the gadget generates voltage by continuously compressing and expanding the piezoelectric system this voltage is then transformed into dc current and sent to the battery energy delivery to sensors and the microcontroller unit is facilitated by USB communication when barriers potholes or staircases are present the microcontroller uses predefined patterns to activate the buzzer this allows users to decipher the type of obstacle by interpreting the distinct buzzing patterns because of its creative design the blind stick can be used by those who are hard of hearing as well. [9]

Barriers are first recognized by the ultrasonic sensor, then the camera module starts to detect the object and speaks its name. For the visually handicapped, voice instructions or a microphone make navigation easier. Furthermore, the camera module used, has the ability to identify the faces of friends and family and use voice commands to pronounce their names. The Raspberry Pi used as the central controller, makes it possible to identify any barrier that stands in the way of the user. In addition, maps which are integrated into the smart cane provide guidance in a direction from the user's current location to the desired destination. An accelerometer sensor is used to detect an accident, and a Telegram bot that makes use of the Internet of Things notifies family members of relevant information, such as the position. [10]

This configuration makes use of infrared sensors to identify elevated areas which include stairs and ultrasonic detectors to identify hurdles. Moreover, ISD1820 used to sound a vocal alert in an unfortunate circumstance that an obstruction is found. Users can share their GPS locations for assistance with chosen emergency connections by integrating an alert button and communicating with them. Supporting the optically criticized community is the goal of the smart blind stick. [11]

METHODOLOGY

Infrared detectors are used in the Intelligent visually impaired aid to detect barriers on the left and right sides, whereas ultrasonic sensors are utilized for recognizing blockages in the front and bottom area for pothole identification. These sensors keep an eye out for any obstacles in their constant environment. The corresponding vibrating motor on the handle of the stick activates when any of the sensors identify an obstruction, giving the user haptic input. Furthermore, a beeper is triggered to deliver audible cues, improving the user's awareness of potential hazards. With the help of the GPS mechanism built into the Advanced assistive device, users can notify their loved ones in the event of an emergency or discomfort. The user can share their whereabouts with family members by pushing a button on the stick, which guarantees their protection.

Li-ion rechargeable batteries power the system, giving the sensors, motors, buzzer, and GPS module enough power to function. The whole structure of the blind sticks will be made with 3D printing technology, resulting in a lightweight, ergonomic structure. The stick is easier for the user to carry and operate because to the 3D-printed pieces. All things considered, the smart blind stick helps people with vision impairments securely and autonomously navigate their surroundings by utilizing cutting edge sensor technology, haptic and auditory feedback systems, GPS functionality, and innovative 3D printing technology.

CONCLUSION

This project focuses on designing a system to enhance the quality of life for visually impaired individuals. The system integrates various components to create a versatile device catering to the needs of both blind individuals and those with visual impairments. Designed for portability, the device provides real-time obstacle detection through audio and tactile feedback mechanisms. Additionally, its rechargeable battery ensures convenient usage. Future enhancements include incorporating a panic button feature for communicating with emergency contacts, as well as utilizing accelerometer sensors to detect accidents and relay messages and location details to family members via an Internet of Things-enabled Telegram bot. Along with the advantages of 3D printing combined with the thoughtful arrangement of all parts on the handle produce a smart walking stick that is aesthetically pleasing, intuitive to use, and specifically designed to meet the needs of those who are blind or visually impaired.

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Plant Disease Identification through Image Feature Extraction Technique using MATLAB

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ABSTRACT

Identifying plant diseases involves investigating var- ious aspects of farming, like organic farming, ongoing plant observation, and illness detection. Plant diseases are difficult to manually track on farms that grow completely different crops. This calls for a significant investment of time, a great deal of labor, and knowledge of plant diseases. Accurate disease prediction may be achieved by image processing, complex neural network techniques, and k-means clustering. Image segmentation, data pre-processing, image fragmentation, feature detection, and recognition are some of the techniques used in the disease diagnosis process. This paper has involved the processing of images using feature extraction techniques

KEYWORDS : *K-mean clustering, Feature extraction, Plant disease.*

INTRODUCTION

Approximately 17 percent of the GDP is derived from farm- ing[1], which employs more than 60 percent of the workforce. In the context of agriculture, the identification of plant diseases is crucial. Indian farming includes crops like wheat, corn, and other crops. Each of these plants is cultivated with the energies of its roots and leaves. The plant disease experiments apply to studies using plants that exhibit clearly observable trends. An essential component of efficiently cultivating plants is managing plant health and illnesses. Plant disease tracking and examination were done manually in the past by someone with experience in this sector. This calls for a great deal of labor and processing time. Plant diseases can be identified using image processing techniques, and two distinct plant diseases can be predicted using algorithms. Research on plants that exhibit clearly discernible trends is covered by the plant disease trials. We have conducted a survey on the many plant diseases and the particular, specialized methods used to diagnose them in this article.

PLANT DISEASE

Plant Diseases

The plant disease severely damages the field and interferes with the physiological operation of the plants. Furthermore, there are numerous ways in which plant diseases might spread to other plants. The signs of each disease can be used to determine whether it is present in the plant may be found in the roots, fruits, leaves, flowers, and stems of the crops, among other parts. Plant diseases can cause unneeded changes to the size, shape, and appearance of fruits, leaves, flowers, and stems.

Plant diseases- Fundamentals

Plant diseases have an impact on both the quantity and quality of agricultural yield, which lowers crop production. Rice is the main food crop in Asian nations. Many methods are created to boost crop productivity in order to meet the demand for rice crops. Since rice is produced on expansive paddy fields, the spread of any disease would have an effect on production. These dangerous diseases infect the plant for a variety of biological reasons, some of which are stated below:

1) *Bacterial Blight*: Plant diseases are called bacterial blight if they are caused by bacteria. One of the plant diseases that is commonly brought on by bacterial infection is called bacterial leaf spot. Young leaves are primarily affected by this bacterial leaf spot, and the affected leaves looks like a water- soaked, twisted, oily, and black in color.

2) *Fungal diseases*: These diseases have an impact on the soil, yield, and seeds. It makes the plant appear as gray- green patches that are saturated in water. White fungal growths beneath the plant's leaf forms the development of graygreen patches. It causes the leaf surface to expand outward and turn yellow.

3) *Leaf Blast*: The leaf Blast is produced by the fungus Magnaporthe oryzae. The majority of the rice plant's damaged components are those that are above ground, including the col- lar, neck, and sections of the panicle, node, and, occasionally, the leaf and sheath.

4) *Leaf Smut*: Fungi are the source of leaf smut. The whole leaf surface is affected by this disease.

5) *Brown Spot*: A fungal disease called brown spot affects several plant elements, including spikelets, panicle branches, leaves, glumes, leaf sheaths, and coleoptiles.

Image Processing for plant disease

A methodology was proposed by Sethy et al. (2019) to recognize the RBPH (Rice brown plant hopper) on rice stems. An image of a rice stem was obtained using a smartphone. Then, the image processing approach was applied to the cap- tured photos in order to scale the population density of RBPH. Steps including k-means clustering, picture enhancement, and median filtering were carried out for the segmentation. To prevent rice pest infection, farmers can use this software on their Android cellphones.

With the assistance of image processing, Devi and Nee- lamegam (2019) had developed an approach to conduct disease determination in paddy leaves automatically. The DWT, SIFT, and gray scale co-occurrence matrices were utilized to extract features. Then, in order to distinguish between healthy and sick plants, the collected features were fed to a number of classifiers, including back propagation neural networks, multiclass SVM, KNN, and Naive Bayesian. Additionally, image processing was used to detect diseases and other issues lowering the quality of Malaysian rice.

LITERATURE SURVEY

An approach had been proposed by Sunny and Gandhi (2018) to detect the canker in citrus. The working of an efficient detection method of citrus canker using the Contrast Limited Adaptive Histogram Equalization Enhancement was described. Certain constraints such as weight adjustment, contrast limitation and brightness preservation were met in Histogram equalization. Contrast Limited Adaptive Histogram Equalization (CLAHE) approach is known as the combination of the adaptive histogram equalization and contrast limiting approach. The combined approaches were used at the starting of the pre-processing step for improving the contrast level of images of disease affected leaves. Statistical GLCM and K- mean Clustering were used to perform the segmentation and texture feature extraction respectively. In real-time, computer and medical applications, (CLAHE) was mostly implemented due to the fine statistical estimation results. In contrast with the traditional methods, digital image processing provides more accuracy in the detection of paddy leaf disease. An integrated method, based on image processing technique, was introduced by Bakar et al. (2018) for the recognition of Rice Leaf Blast (RLB). In this work, the HSV (Hue, Saturation, Value) image was employed and also the process such as image analysis, image pre-processing and image segmentation and classification were also performed. In the pre-processing, the activities such as image enhancement, noise restoration and resize of the image were carried out. The original image can be obtained by combining the segmented parts. Ahmad et al. (2017) had offered a segmentation method to identify the disease affected portions in leaf images. The major intention was to improve the previously implemented methods, based on both processing time and accuracy. The steps such as geome- try, artificial bee colony (ABC) and Otsu are involved in this process. The mathematical expressions for global searching and local searching were included via proposed geometry, Otsu and ABC. The performance of the proposed approach was analysed based on processing time and accuracy. The combination of both Otsu and ABC provided high accuracy in image recognition within short time duration. The calculation based on geometry could produce a lesion area with minor variance difference from the original area than pixel counting.

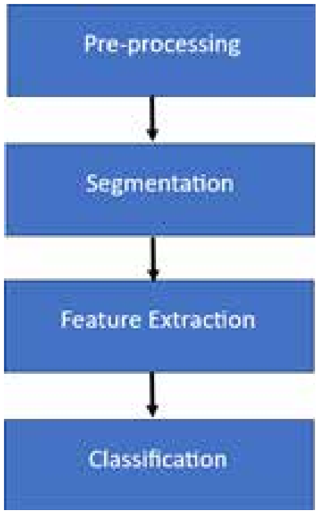

Fig. 1. Process involved in image processing

METHODOLOGY

The image pre-processing is required to boost the values of pixel by removing the various noise in the image, which results in quality enhancement in images. As a result of image enhancement, the required information is manipulated in the image, so that, the user can utilize the required information. The image pre-processing enhance the visual understanding regarding that image. The image processing techniques are categorized into the frequency and spatial domain techniques. In spatial domain techniques, the image pixels were directly manipulated, whilst, in the indirect method manipulation of pixels was performed at the frequency domain. In the fre quency domain enhancement technique, the kernels or convolution was used to make the transformation. Poor contrast or blur are generally considered to be the weakness in images. Image preprocessing overcomes the above issues and improves the quality of the image.

Machine Learning

In machine learning, Image processing is a method to convert an image into digital form and perform some operations on it. The four types of machine learning are Supervised Learning, Unsupervised Learning, Semi-Supervised Learning, and Reinforcement Learning. Image preprocessing techniques are applied to enhance the quality of the images. This includes noise reduction, contrast enhancement, and image normalization to ensure uniformity in the dataset.

Preprocessing

Contrast level, Intensity level, Histogram equalization are the four pre-processing techniques.

Segmentation

It is the process of partitioning the pixels of an image into groups. The segmentation is to simplify or change the representation of an image into something more useful.

Feature Extraction

In this image can be analyzed by using different parameters such as size, colours.

Classification

The image processing classification system consists of a database that contains predefined patterns which are used to detect and classify in proper category. It is used to develop a statistical characterization of the reflectance in each information class. Dataset is of 1000 images with 13 classes.

Support Vector Machine

SVM is a supervised machine learning models which is used for classification.

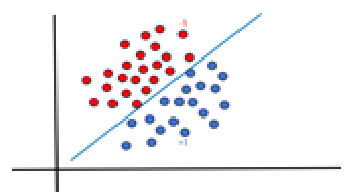

Fig. 2. Support Vector Machine

SIMULATION RESULT

Load Image

The input image is loaded as shown in Fig.3, and pre -processing technique is applied to the loaded image.

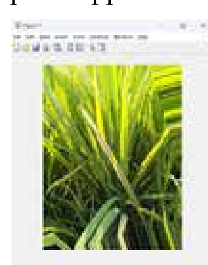

Fig. 3. Input Image

Conversion of input image to RGB

Following fig.4 specifies input image to RGB image.

Fig. 4. RGB Image conversion

Conversion of RGB image to HSV image

Here, Fig.5 specifies RGB to HSV image.

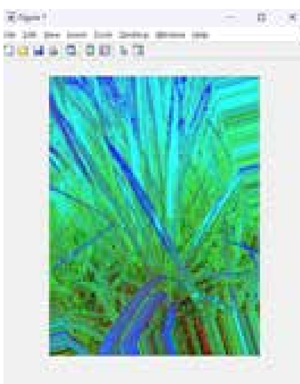

Fig. 5. RGB to HSV

Conversion of HSV image to RGB image

Here, fig.6 specifies HSV to RGB image.

Fig. 6. HSV to RGB

Conversion of image into clusters

After that, three types of cluster images have shown in fig. 7, which is helpful for classifying the disease.

Fig. 7. Cluster image

Performing segmentation

Then in fig.8, segmentation is performed.

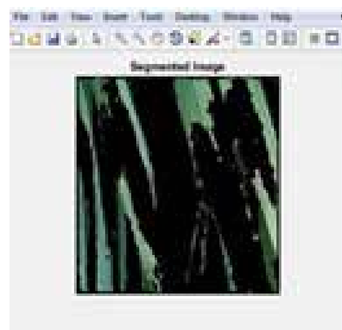

Fig. 8. Image Segmentation

Conversion of gray-scale image

Finally, gray scale image is generated as in fig.9.

Fig. 9. Gray Scale Image Conversion

Generated result

Finally, result is generated as in fig.10.

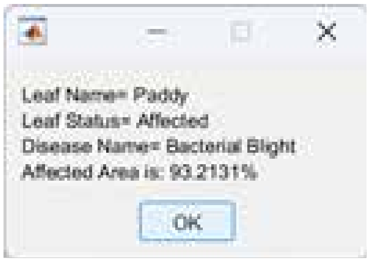

Fig. 10. Result

CONCLUSION AND FUTURE WORK

In the classification and selection procedures, the extracted features are used which tries to help in increasing the farm of production. The proposed method helps to find the plant disease and in monitoring the several environmental conditions. After processing the image in MATLAB, further neural network classification was used to determine the leaf's condition.

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Evaluating the Effectiveness of Machine Learning Models for Early Diagnosis of Chronic Kidney Disease

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ABSTRACT

Chronic Kidney Disease (CKD) is one of the most arising as concerning health issues among many others due to the gradual damaging of the kidney, causing it to slowly reduce its ability to perform essential and fundamental functions of the body. It tends to go undetected in the early stages. The early detection and prediction of Kidney diseases becomes extremely helpful in such cases for diagnosing the problem. A Glomerular Filtration Rate (GFR) is an evaluation test that is used to check functioning of kidney. Based on the different GFR ratios, the severity of kidney disease can be diagnosed.

The performance Assessment using ML Models for early prediction of kidney disease is a system designed by assessing and evaluating the attributes provided to the system. The system utilizes Logistic regression, Support Vector Machine, Random Forest, and Decision Tree Algorithms for the assessment. This study proposes using ML to diagnose the Kidney disease. The mentioned algorithms were trained using the data gathered with different attributes.

KEYWORDS *: Machine learning, Chronic kidney disease, Feature selection, Logistic regression, Support vector machine, Decision tree, Random forest, F1 score, Precision, Accuracy.*

INTRODUCTION

Kidney Disease is one of the most important health problems as it is an increasing disease worldwide and is a disease that eventually through a slow process damages the kidneys in the long term and reduces the ability of the kidneys to function in the body. Kidney Disease is interconnected with complications such as renal failure which causes it to lose its ability to filter blood properly, hypertension, anaemia which is a deficieny of blood, and neurological damage. A GFR ratio of 90+ is stage 1 and is considered as normal for healthy people. GFR ratio between 60 to 89 is stage 2 and a constant ratio for more than 3 months might be a sign of early CKD with very few symptoms observed. The range of 30 - 59 is stage 3 and is common in Kidney Disease. The stage 4 with GFR ranges in between 15-29 has fatal severity Kidney Disease and most likely needs dialysis.The stage 5 with GFR ratio of 15 and below is end stage renal disease and the kidney would have almost lost all of its ability to function properly and it needs to undergo dialysis or kidney transplant to survive.As the study done by National Medical Journal of India in 2023, the CKD prevalence is increased to nearby 30% in 2020 as compared to 1990. The same study also showed the 4% to 20% prevalence of CKD in India.

The goals of the research is to show how Kidney Disease can be diagnosed more accurately through prediction and classification by using ML algorithms. To achieve the aim we have used Linear regression, Support Vector Machine (SVM), Decision Tree, Random Forest for accurate prediction of the disease as proposed in this study.

The scope of Performance Assessment of Machine Learning Models for Early Prediction of Chronic Kidney Disease is to provide a more targeted and more effective methodology to identify the individuals at the risk of CKD by assessing various attributes. This utilises the Machine Learning models and algorithms like SVM,Logistic Regression, Decision Tree to analyse and assess the risk of Kidney Disease. It aims to address the evaluation of individuals having risk of CKD. This system can provide cost effective analysis as well as accurate results serving the medical field.

This system can be used by Healthcare Professionals in the medical field such as Nephrologists who specialise in treating kidney conditions. The general practitioners, nurses, healthcare staff working with CKD patients and healthcare administrators who regulate and manage such types of illness also benefit from this. The other beneficiary audience could be the Machine Learning researchers who are willing to apply Machine Learning knowledge in the medical field and healthcare problems. The patients and caregivers could also benefit from this to diagnose individuals at risk of CKD. Caregivers could monitor the individual from time to time to maintain records. The government bodies and agencies could use this system to keep track, monitor and regulate the statistics of CKD and to oversee the healthcare and medical care.

II. LITERATURE SURVEY

Related work

According to the research that has been already carried out shows that many medical features were used in utilisation with Machine Learning algorithms to implement the system for chronic kidney detection. The main challenges and problems that was observed in earlier work is that the datasets were not available or the datasets were not sufficiently large. Weilun et al [1] proposed the use of contracting network by successive layers and replaced the pooling by up-sampling and extensive use of data augmentation. Three machine learning models viz. a bagging tree model named Random Forest, a boosting tree model named XGBoost, and a neural network based model named ResNet were utilized in their work. Debal and Sitole [2] focused on cross validation based performance evaluation and comparing models by dividing data into partitions. The machine learning algorithms were applied to original datasets with all 19 features. The prediction models preferred are Random Forest (RF), Support Vector Machine (SVM) and Decision Tree (DT). Applying the models on the original dataset, the highest accuracy with RF, SVM, and XGBoost were observed. The feature selection is done using two methods i.e UFS and RFECV and two binary classifiers for 18 models. Training and testing on these models have been executed using tenfold cross-validation. In tenfold cross-validation, the dataset is partitioned randomly into ten equal size sets.

Akter et al. [3] used seven DL algorithms viz. ANN, LSTM, GRU, Bidirectional LSTM, Bidirectional GRU, MLP, and Simple RNN for CKD for discussion on the various clinical features of CKD. GRU, Bidirectional LSTM, Bidirectional GRU, MLP, and Simple RNN were implemented for early prediction of CKD. These algorithms were implemented on the pre-processed fitted CKD dataset. This study involves the measurement of accuracy, recall, precision and calculates loss and validation loss in the prediction. The accuracy that was observed during the training and testing was 99%, 96%, 97% for ANN, Simple RNN, and MLP respectively. In addition, the AdaBoost and Perceptron algorithms are applied to find the significant risk factors of CKD. However, the dataset that is used to train the model is small which could eventually cause the result to be unreliable. Finding the dataset with more attributes and higher instances is difficult as the dataset of patients are kept private due to privacy issues.

Ebiaredoh-Mienye et al. [4] have segregated the data for it to be used for Logistic Regression and SVM and Random Forest. Six other Machine Learning classifiers were implemented as the baseline for performance comparison. The classifiers include logistic regression, decision tree, random forest, SVM, XGBoost, and the traditional AdaBoost.

Machine Learning Model

1) Logistic regression: Logistic regression is one of

the highly accurate statistical analysis methods in Machine Learning algorithms that is mainly focused on the probability as a binary outcome. It is a type of supervised learning. It predicts whether the given instance belongs to the given class or not. It mainly focuses on solving problems based on the classification. The logistic regression fits the regression line to an "S" shaped logistic function which predicts the value based on the maximum values that typically range from 0 to 1. The logistic regression gives us the probabilistic value of the prediction between 0 and 1. This algorithm is simple and straightforward for the outcomes that lie between two classes.

2) Support Vector Machine: SVM stands for Support vector Machine. It is one type of machine learning algorithm that is proficient in analyzing data not only for classification but also for regression problems. The main goal of SVM is to form the best hyperplane for the separation of the data. The key purpose of SVM is to categorize or classify the data in two different categories by means of a hyperplane or decision plane. The hyperplane or decision plane is the best boundary or space that segregates the set of objects. For deciding the hyperplane, the extreme cases are considered as support vectors. The margin is the gap that is located in between the two lines on the closest point of difference.

3) Decision Tree: Decision trees belong to the supervised learning category of ML and are used for classification and regression problems. They are visualized as a tree-like structure, where the root node represents the starting point of the decision-making process using the dataset, while the split points resemble nodes where the root node is characterized into two sub-nodes based on feature selection and criteria. This step is important in constructing classification or regression tasks. Decision nodes are used to make decisions in the algorithm, while leaf nodes denote the final output that cannot be further divided. One of the main benefits of using the decision tree algorithm is that it imitates human thinking, making it easy to understand.

4) Random Forest: The Random Forest is a supervised Machine Learning algorithm used for classification and regression. It is based on ensemble learning, which combines the predictions of multiple neural networks to improve model performance and reduce variance.

Random Forest comprises of multiple decision trees, and the more trees it has, the higher the accuracy and the lower the over-fitting. This algorithm has several advantages, including a shorter training time compared to other algorithms, high accuracy in predicting outputs, and excellent performance on large datasets.

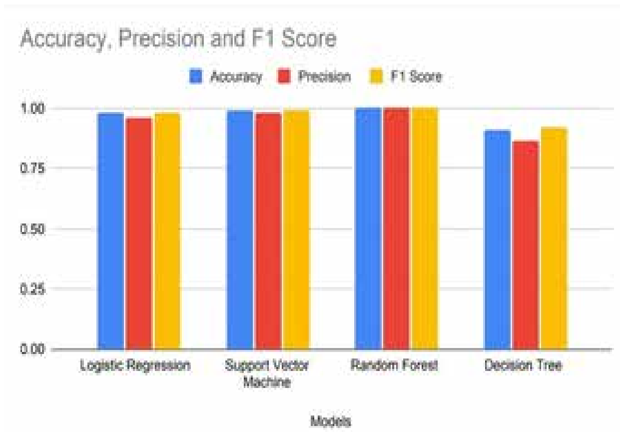
PROPOSED SYSTEM

The work intends to evaluate the performance of Machine Learning models to diagnose patients who are at risk of developing CKD well before clinical symptoms are recognized. The proposed system makes use of different Machine Learning algorithms to visualize graphs of various parameters required for diagnosis of CKD. The Performance Assessment using Machine Learning Models for Early Prediction of Chronic Kidney Disease is a system designed for early prediction of CKD by assessing the attributes provided to the system. The system utilises Logistic Regression, SVM, Random Forest and Decision Tree algorithms for the assessment. The above mentioned models were trained using the data gathered with different attributes and comparative analysis of the various models was carried out.

Collected CKD data is used by the University of California, Irvine (UCI) Repository. Prior to use, the original dataset—which included unique values and missing values—was pre-processed. The data set contains 400 patient records, some of which have missing values. It consists of 24 clinical characteristics that show up in the diagnosis of chronic kidney disease (CKD), with one class attribute acting as a predictor of the patient's propensity for chronic renal failure. The predicted feature diagnostic has two different sorts of values: ”ckd” and ”notckd.” There are 250 values (62.5%) of the ”ckd” class in the data set. 250 values from the ”ckd” class (62.5%) and 150 values from the ”notckd” class (37.5%) make up the data set.

RESULTS AND DISCUSSION

Models	Accuracy (%)	Precision	F1 Score
LogReg	98	0.9629	0.98113
SVM	99	0.9811	0.9904
RF	100	1.000	1.000
DT	91	0.8644	0.9189



The above table presents the performance assessment with metrics like Accuracy, Precision, and F1 Score. The accuracy is the measurement of the overall correctness of the model. Accuracy is given by:

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \quad (1)$$

TP stands for True Positive whereas TN is True Negative. The term False Positive is abbreviated to FP and FN is an abbreviation of False Negative.

Precision is the ratio between true positive values to all the positive values. It is calculated by:

$$Precision = \frac{TP}{TP + FP} \quad (2)$$

F1 score is the combination of recall and precision. It typically ranges from 0 to 1 where 1 is considered as better. It is given by:

$$F1 = \frac{2 * Precision * Recall}{Precision + Recall} \quad (3)$$

As seen above, Random Forest turns out to be the best-suited algorithm for diagnosis of CKD. The Random Forest has Accuracy, Precision, and F1 Score of 1 making it better in performance than other algorithms that are being used in our work.

In addition, after Random Forest, Support Vector Machine is most preferred with an accuracy of 0.99, precision of 0.9811, and F1 score of 0.9904

The Logistic Regression algorithm has an accuracy of 0.98, precision of 0.9629, and F1 score of 0.9811 The Decision Tree algorithm gave an accuracy of 0.91, precision of around 0.8644, and F1 score of 0.9189.

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Multi-objective Approach for Optimal Positioning of Sectionalizers in Distribution Network using Ant Colony Optimization

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ABSTRACT

This paper proposes a method to enhance client service reliability in medium voltage (MV) power distribution systems by strategically placing sectionalizers. Considering the impact of distributed generation, it emphasizes sectionalizers' role in improving reliability, configuration management, and network reconfiguration. Formulating the switch placement as a fuzzy multi-objective optimization task, the goal is to minimize sectionalizing switch costs while enhancing system dependability. Employing the Ant Colony Optimization algorithm, simulations on the Billiton system's bus 4 distribution network using MATLAB validate the method's effectiveness in handling the fuzzy multi-objective optimization challenge.

KEYWORDS : *Optimization, Sectionalizers, Distributed generations, Fuzzy logic, Ant colony optimization.*

INTRODUCTION

The distribution system, a crucial link in the electrical supply chain, connects utility transmission infrastructure with clients. 80% of client disruptions stem from distribution system failures, impacting downtime duration. Mitigating interruptions involves improving failure rates, while sectionalizer installation strategically reduces restoration times. Planning distributed generation (DG) in distribution networks is vital, considering technology constraints and regulatory limits on new substations and transmission lines. DG integration enhances supply continuity, reduces losses, lowers operating costs, and aligns with the evolving demands of electricity consumers.

LITERATURE REVIEW

This research introduces a value-based method for enhancing reliability in distributed systems, optimizing feeder sectionalizer placement to minimize client interruption costs[8]. Addressing the non-linear, non-differentiable, and combinatorial nature of the sectionalizer optimization problem, the study proposes using Simulation Annealing to determine the count and optimal locations of sectionalizers. The approach achieves a global optimal solution by balancing cost minimization and reliability investments.

Existing Methods

Optimization problems aim to minimize undesirable factors or maximize desirable ones, subject to constraints. Existing methods for solving the switch problem include

- Bellman's optimality principle,
- Direct enumeration, mixed enumeration search,
- Mathematical optimization methods, and
- Artificial intelligence methods.

Standard Reliability Metrics

Electric power system reliability assessment considers generating, transmitting, station, and distributing facilities. Client-centric reliability indices, such as SAIFI and SAIDI, evaluate interruptions. Primary indices include load points, predicted failure for each client, average outage period (r), and service availability/unavailability.

Averaging the number of clients at every load point and the individual client indices yields system dependability indices as well. The indices for the whole system are

$$SAIFI = \frac{\text{Total Number of Client Interruptions}}{\text{Total Number of Clients Served}}$$

$$SAIDI = \frac{\text{Total Duration of Client Interruptions}}{\text{Total Number of Clients Served}}$$

SECTIONALIZERS PLACEMENT PROBLEM

Overview

A multi-objective mathematical model for Sectionalizer Placement (SSP) aims to improve service dependability and reduce sectionalizer costs. The model includes reliability indices, primarily focusing on Annual Expected Energy Not Supplied (EENS). Employing a fuzzy optimization procedure, the objective function is transformed into the fuzzy domain for enhanced robustness.

Fuzzy Multi-Objective Problem Formulation

The two objectives are translated into the fuzzy domain, creating a single objective function that balances service reliability improvement and the cost of sectionalizers. Weighting factors are introduced to customize the multi-objective optimization procedure for different purposes.

MaxJ = ω1μR1+ω2μcs (3.1) where J is the overall objective function, μR1 indicates how the membership function enhances service dependability. The non-negative weighting variables ω1 and ω2 fulfill the criteria ω1+ ω2 = 1.

Membership Functions For Reliability Improvement

Membership functions quantify satisfaction in improving service dependency using an exponential function, which emphasizes higher membership for lower Annual Expected Energy Not Supplied (EENS) values. The chosen exponential function aims to increase reliability, expressing the degree of satisfaction with enhanced service dependability as below:

μRI = {1,EENS≤EENS$_{min}$, (1)

exp (EENS min-EENS/EENS$_{min}$), Otherwise EENS min is the lowest amount of energy not provided.

Membership Function to minimize Sectionalizer's Cost

The membership function for cost minimization considers the installation and relocation costs of switches. It assigns lower membership values for higher installation costs, accounting for changes in feeder configuration and load usage with distributed generation. The overall cost of switches includes the expense of relocating existing ones as well as installing new ones. Membership function for the cost of switches.

μCS = {1,CS<0 (2)

$\frac{CSmax-CS}{CSmax}$, 0≤CS≤CSmax

0, CSmax≤CS,

Total cost of switches

CS = NS select-NS exist) CIS+ $\sum_{i=1}^{NS\,exist} CRS\alpha i$ (3)

CS is the total expense for switches; NS selects and NS exists to denote the amount of chosen and active switches in the network, respectively: The cost of moving the i-th current switch is called CRSi, and the cost of investing in a newer switch is called CIS.αi symbolizes the current state of the i-th switch. (=0, if the i-th current switch's location is chosen for switch installation. If not, it equals one.) One can ascertain the maximum cost of switches by CS$_{max}$ = (NS $_{max-}$N$_{Sexist}$) CIS, where NS max, the number of potential switch installation locations, represents how many switches can be installed in a network at its maximum.

Evaluation of EENS

The formula for evaluating EENS incorporates failure rates, lengths of line sections, and various factors influenced according to the quantity and positioning of sectionalizers.

EENS = $\sum_{i=1}^{Nb} \lambda iLi\,, \sum_{j\varepsilon Si} Pj, TSi + \sum_{j\varepsilon Ri} Pj, TRi$ (4)

where

Nb: The number of network line sections, - failure rate (failure/km-year) of line section i T Ri- Line section's average repair time (hour), T Si- line segment i's average time to switch after failure (hour), Pj- average power of nodes (kilowatt), Ri- set of load points recovered during the in-line section i repair process, Si- set of load points recovered upon failure in line section i by transitioning actions; Li- line segment i's length (kilometers), Si as well as Ri depends on the amount and position of sectionalizers. While Si increases with the amount of sectionalizers, Consequently, Ri is decreased.

OPTIMIZATION OF ANT COLONY

Introduction

ACO i.e. Ant Colony Optimization is a recently developed method to solve combinatorial optimization problems[9]. Successfully applied in various domains, ACO is chosen here for its effectiveness in addressing complex problems such as maximum loadability, loss minimization, unit commitment, and multi-objective reactive power compensation.

Algorithm for Ant Colony Optimization for Sectionalizers Placement

Initialization

During Ant Colony Optimization (ACO) initialization, crucial variables like the number of ants, pheromone exploitation rate, maximum iterations, and initial pheromone level are carefully set. Configuration of each parameter is essential to restrict the search range, preventing lengthy processing times.

ζ0: first pheromone level, q0: algorithmic parameter (0< q0<1), α: Parameter for pheromone degradation (0< α<1), ρ: heuristically defined coefficient (0< ρ<1), β: parameter that controls the pheromone's proportional relevance to distance (β>0), d_{max}: the longest distance an ant can cover t_{max}: maximum iteration, n: ant count, M: The number of modes.

The following equation can be used to determine the maximum distance (dmax) that an ant can travel on its tour:

$$d_{max} = \sum_{i=1}^{n-1} di \quad (5)$$

$$d_1 = |r - (u)\ | \quad (6)$$

where:

di: distance between two nodes, u: unvisited node, r: present node

The initial node in the list must be set for each node to calculate dmax. For each Ant tour, a single selection can be made from the list of nodes. Every ant will choose the subsequent node that is farther away from itself than it is now. This method will be continued till the list reaches its end code.

Generate First Node

The uniform distribution will be used to randomly select the first node, having variables range 1 to n.

State Transition Rule

A state transition rule guides ants in choosing the next node, balancing exploitation and exploration. The rule incorporates probability equations based on pheromone levels and distances.

The state transition rule is:

$$s = \{arg\ arg\ max\varepsilon Jk\,(r)\,\{[\mathrm{T}(r,u)][\eta(r,u)\beta]\}$$

if q≤q0 (exploitation) (7)

where S: random variable chosen based on the provided probability distribution q0: algorithmic parameter (0<q0<1) q: evenly distributed random number in the range of 0 to 1.

The probability equation mentioned below is used to determine the likelihood that an ant k at the current node (r) will select the node(s) after it.

$$Pk(r,s) = \{\frac{[\mathrm{T}(r,s)][\eta(r,u)\beta]}{\sum_{u\varepsilon}\ [\mathrm{T}(r,s)][\eta(r,u)\beta]} \quad (8)$$

where

η:1/d, is the inverse of the distance d(r,s)

β: parameter, it establishes the pheromone's proportional relevance to distance (β>0).

To make the solution possible, the set Jk(r) of nodes that ant k positioned on node still needs to visit, ζ : pheromone.

Ants select paths by multiplying the heuristic value η(r, s) with pheromone ζ(r, s) in equations (4.3) and (4.4) for shorter and more pheromone-rich routes. The choice of the next node, s, is determined by a specific ant at the present node, r, based on the q parameter, where exploitation (equation 4.3) is favored if q ≤ q0; otherwise, exploration (equation 4.4) is pursued. The subsequent node is then identified by computing the probability using equation 4.4, generating a random value for q. If q ≤ q0, the node with the highest probability is chosen in exploitation mode; otherwise, a random selection is made from unexplored nodes in exploration mode.

Local Updating Rule

The following formula can be used to update the pheromone quantity: -

$$T(r,s) \leftarrow (1-\rho)T(r,s)+\rho\Delta T(r,s) \quad (9)$$

where,

P: heuristically defined coefficient (0<p<1),

$\Delta \zeta(r,s) = \zeta o$, Zo: initial pheromone level

Fitness Evaluation

Fitness assessment occurs after each ant's tour by evaluating the control variable 'x,' determined once all ants complete their journeys. In this phase, the following equation is used to compute the control variable (x): -

$$X = \frac{d}{dmax} \times Xmax \quad (10)$$

where,

d_{max} : maximal tour distance of each ant, x_{max}: maximal x, d: each ant's tour's distance.

The ACO algorithm will assign values to variable x based on fitness.

Global Updating Rule

The ant with the highest fitness level reinforces the path by updating the pheromone levels globally, ensuring optimal fitness determination. Equation (4.7) is used to update the pheromone level whenever every ant has finished its tour.

$$T(r,s) \leftarrow (1-\rho)\, T(r,s)+\alpha\, \Delta\, T(r,s) \quad (11)$$

where,

$$\Delta T(r,s) = \{\left(\frac{Q}{Lgb}\right), if\ (r,s)\varepsilon global - best - tour$$

0, otherwise

α: pheromone decay parameter (0<α<1), Lgb: The tour's duration measured from the start of the world's best tour. The route that is part of the current iteration's internationally best tour (best fitness) will gain support. Each ant will choose the first node for the subsequent iteration based on which tour was the best globally in the previous iteration.

End Condition

The algorithm iterates till the maximal number of iterations are reached, considering the best path discovered in each iteration.

SIMULATION RESULTS

An investigation is carried out on a rural distribution network that has 23 load points and is linked to Roy Billinton Network's Bus. 4. Placing sectionalizers optimally involves using the fuzzy multi-objective strategy based on ACO. Results, including optimal switch positions, membership values, and EENS, prove that the suggested strategy is effective and the reliability of the system.

Table 1: Final results of SSP

DG capacity (MVA)	W1	W2	EENS (kWh/year)	µRI	µCS	NS select	Objective function	Proposed sections for sectionalizers installation
N/A	0.5	0.5	59681/ 62328 (BP)	0.0225/ .8483 (BP)	0.800/ 8.866	4/4	0.4112	45U,50U,53U,59U
1	0.5	0.5	53312/ 54559	0.5425/ 0.8701	0.700/ 0.800	6/6	0.6212	39U,45U,48D,50U,53 U,60U
2	0.5	0.5	45352/ 48754	0.9471/ 0.8565	0.700/ 0.800	6/6	0.8235	39U,45U,49D,50U,53 U,60U
3	0.5	0.5	38984/ 44293	0.7918/ 0.8602	0.650/ 0.766	7/7	0.7209	39U,44U,45U,49D,50 U,56U,59U
4	0.5	0.5	31023/ 42509	0.9215/ 0.8230	0.700/ 0.800	6/6	0.8107	42U,44D,45U,49D,50 U,60U

***There are two candidates for installing sectionalizers in every section. The two sites are marked by the letters D, stands for the section's load side while U, stands for the section's source side.**

Table 2: ACO parameters in test case

Parameter	Value
Number of ants	50
Pheromone exploitation rate	0.9
Maximum number of iterations	100
Initial value of lower bound of pheromone	0.1

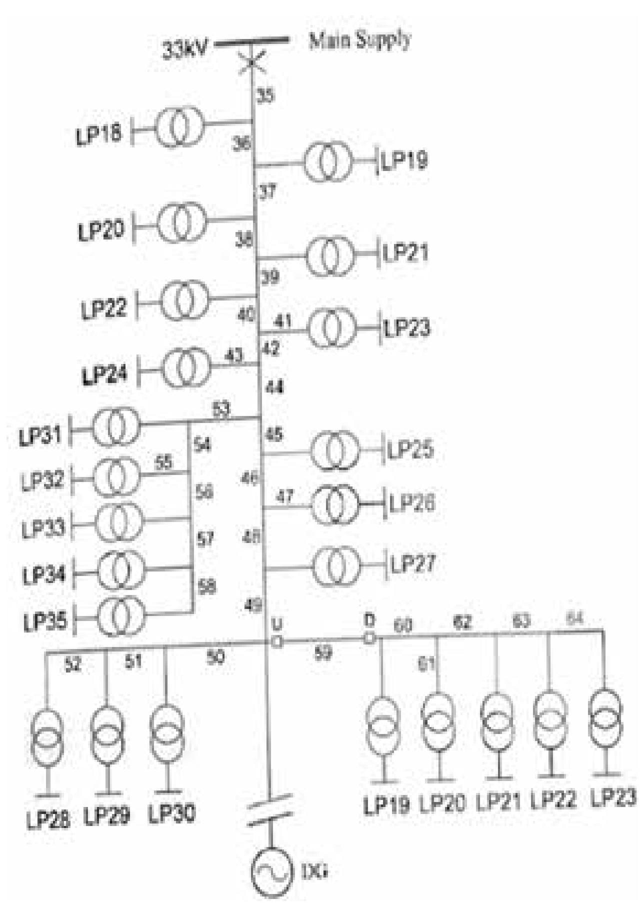

Fig .1 Novel Distribution Feeder linked with RBTS (Roy Billinton Test System) Bus 4 Including DG

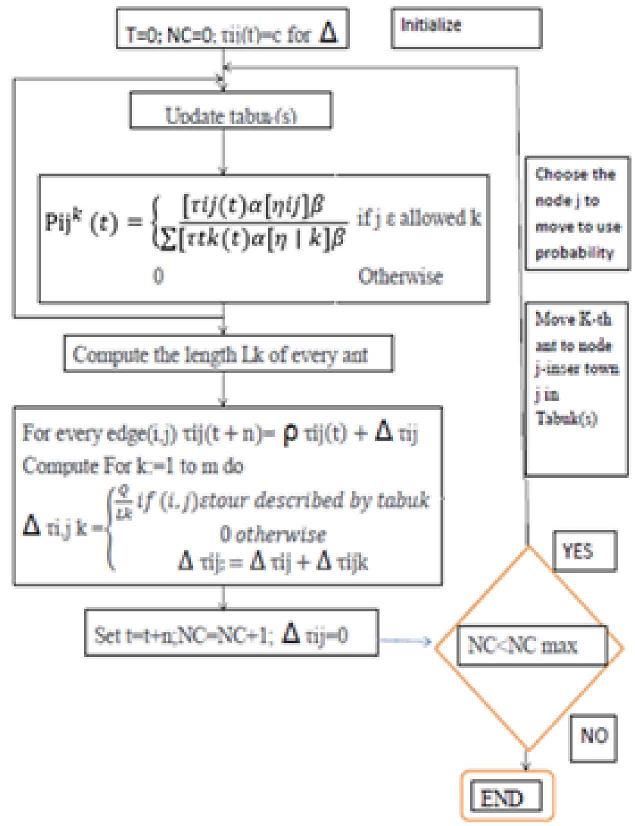

Fig. 2. Flowchart for ANT cycle Algorithm

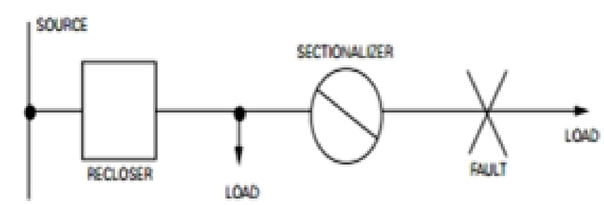

Fig. 3. Sectionalizer Connection

CONCLUSION

This paper introduces an Ant Colony Optimization (ACO)-based method coupled with a fuzzy multi-objective model to offer decision support for the switch placement problem within distribution networks. The implementation of the Ant colony Optimization technique aims to optimize the placement of sectionalizing switches. The formulation of the placement problem integrates two primary objectives: minimizing the cost of sectionalizing switches and maximizing system reliability. The proposed approach test on the Roy Billinton test system and the results were compared and discussed in relation to the base paper's findings as well as the simulation results. The technique presents an efficient tool that distribution system planners can utilize to determine the optimal number of switches and their respective locations, thereby enhancing the overall reliability of the distribution network.

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Application of Galois Extensions

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ABSTRACT

This paper explores the fundamental concepts of Galois theory and their implications on understanding the structure and properties of splitting fields. Galois theory provides criteria for identifying when a polynomial equation can be solved using radicals. It explores the deep relationship between Reed-Solomon codes and Galois extensions, exploring the fundamental symmetries displayed by field extensions and their role in polynomial factorization. It serves as a link between coding theory and field theory.

INTRODUCTION

Galois theory explores the connections between field extensions and Galois theory, particularly focusing on the relationships between splitting fields of polynomials & Galois extensions. Strong ties exist between the study of splitting fields and Galois extensions & the solvability of polynomial equations by radicals. For instance, the Abel–Ruffini theorem characterizes which polynomial equations can be solved using radicals. Based on characteristics of the polynomial problem's Galois group, Galois theory offers standards for identifying when polynomial equation can be solved by radicals.

1. Field theory has applications in various branches of mathematics, including algebraic geometry, where it is used to study solutions of polynomial equations.
2. In algebraic number theory, field theory helps understand properties of number fields and their extensions.
3. In physics, field theory is a central concept in areas like quantum field theory, which describes the fundamental forces and particles in the universe.

Symmetries and structures of polynomial roots are studied by Galois theory, which was created in the 19th century by Évariste Galois. It offers a profound link between group theory and field theory.

Error-correcting codes, or methods for adding redundancy to information to detect and rectify faults that may arise during data transmission or storage, are the subject of coding theory, a subfield of information theory. Reed-Solomon codes are a significant and often utilized class of error-correcting codes.

In 1960, Irving S. Reed and Gustave Solomon created the Reed-Solomon code, a revolutionary kind of block error-correcting code. These codes have found extensive applications in various communication and storage systems due to their ability to correct multiple errors and handle burst errors efficiently.

FUNDAMENTALS OF FIELD THEORY

Terminology

Extension field

Field M is called the extension field of field L if field L contains field M. This is shown by L/M (L over M). [1]

Each field represents an extension of its prime subfield, and the field denoted by ‘M’ serves as the base field for this extension.

Algebraic Field

Let L over M be a field extension. An element α in L is considered algebraic over M if it serves as a root for a nonzero polynomial (x) in [x]. Conversely, if α is not algebraic over M, it is classified as transcendental with respect to M. [1]

The extension L/M is considered algebraic when all elements of L are algebraic over M.[1]

Splitting Field

Consider g(x) ϵ G[x] be a non-constant monic polynomial. A splitting field for g(x) over G is an extension field L of G such that

I. g(x) factors into linear factors in L :

$g(x) = (x-\alpha_1) \ldots (x-\alpha_n)$, with α_i belongs to L.

II. L is generated by the roots of g(x):

$L = G(\alpha_1, \ldots \alpha_n)$

Important Result

Any of the 2 splitting fields of g(x) over a field G are isomorphic. [2]

Consider L/G be a field extension. Consider α ϵ L be algebraic over G. Afterwards m(x), which belongs to G[x], is a unique monic irreducible polynomial in which has α as a solution. Furthermore, a polynomial g(z) ϵ G|x] has α as a solution iff m(x) divides g(x) in G[x].

Let α ϵ F be a algebraic over a subfield K of F and let g(x) the minimal polynomial of α over K. Then

g(x) is irreducible in K[x]

For f(x) ϵ K[x] ; we have $f(\alpha)=0$ Iff g(x) divides f(x)

Having α as solution of, g(x) is the least degree polynomial.

Every finite extension is an algebraic extension.

Minimal polynomial of any element is irreducible over F. [2]

Example 1.1

Consider $p(m) = m^3 - 2$ ϵ Q [m]. Now consider p(m) has none of the solution in Q & is of degree 3 after by our divisibility criteria p(m) need to be irreducible over Q . As a result, there exist an extension of Q in which p(m) has a solution. Furthermore, this extension might be expressed as the quotient Q $[m]/(m^3-2)$.

Hence Q $[m]/(m^3-2) \cong (\alpha)$

α is a root of $p(m) = m^3 - 2$.

We may let this root α of p(m) be $\alpha = \sqrt[3]{2}$.

Thus we obtain Q $[m]/(m^3-2) \cong$ Q $(\sqrt[3]{2})$ which is spanned by the basis $\{1. \sqrt[3]{2}, \sqrt[3]{4}\}$ over which implies Q $(\sqrt[3]{2})$ is an extension of degree 3 over Q.

Example 1.2

Lets discuss the degree of the extension Q $(\sqrt{2} + \sqrt[3]{2})$

Over field $(\sqrt{2})$

$$d-(\sqrt{2} + \sqrt[3]{2})=0$$

$$d-\sqrt{2} = \sqrt[3]{2}$$

$$(x-\sqrt{2})^3 = 2$$

$d^3 + 2\sqrt{2} + 6d-3\sqrt{(2d^2)} = 2$

$d^3 + 6d-2 = 3\sqrt{(2d^2)} + 2\sqrt{2} = \sqrt{2}\,(3d^2 + 2)$

$(d^3 + 6x-2)^2 = 2(3d^2 + 2)^2$

We got the monic polynomial of degree 6

Degree of Extension (Q $(\sqrt{2}+\sqrt[3]{2})$(Q)) = 6

And degree of extension (Q$(\sqrt{2})$(Q))=2

Degree of extension (Q $(\sqrt{2}+\sqrt[3]{2})$ Q$(\sqrt{2})$) = 3

Fundamentals of Galois Theory

1) Let E over G be a finite extension. Then E is expressed to be Galois over F and E/F is a Galois Extension if |Aut(E/G) | = [E:G]
2) If E/G is a Galois extension, its group of automorphisms, denoted as Gal(E/G), represents the Galois Group of E/G.
3) If the polynomial (z) is separable over the field G, then the Galois group of (z) with respect to G corresponds to the Galois group of the splitting field of g(z) over G.
4) Field is said to be Galois field if it is finite.

Important Result

- Let E represent the polynomial's splitting field. g(x) ϵ G[x] over G. [1]

  Then |Aut (E/K) | ≤ [E:F].

  If g(x) is separable over G, then equality holds.

- For each prime number d and integer greater than or equal to 1, there exists a field with d power m entries..
- Isomorphism of finite fields occurs when their element count is the same..
- If F is a non-zero characteristic field, then the cyclotomic extension is normal and separable..
- If a polynomial f(z) belongs to Z[z] can be expressed as product of two polynomials over Q, the rational field, then it can be expressed as a product of two polynomials over Z.

Remember that a field is an identity-preserving commutative ring whose nonzero members form a group when multiplied. H is referred to be a field extension of G if $G \subseteq H$ are fields. The pair $G \subseteq H$ will be referred to as the basic field, and G as the field extension H / G. By defining scalar multiplication for an E G and $\alpha \in H$ as $\alpha.j = \alpha j$, the multiplication of a & an in H, we turn H into an G-vector space. For dimension of H, we represent an G-vector space as [H: G]. We refer to this dimension as the degree of H/G. H is referred to as a finite extension of G if $[H| G] < \infty$. If not, H is an endless extension of G. [2]

Example 2.1

Consider $p(z) = z^3 — 2 \in Q[z]$. Then p(z) is irreducible over Q by the rational root test.

Then the ideal (p(z)) generated by p(z) in Q[z] is maximal; hence, K=Q[z]/ (p(z)) is a field. The set of cosets $\{e+(p(z)): e \in Q\}$ can be seen to be a field isomorphic to Q under the map $e \rightarrow (P(z))$.

We view the field Q[l]/(p(l)) as an extension field of Q by thinking of Q as this isomorphic subfield. If $f(z) \in Q[z]$, then by the division algorithm,

f (z) = j(z)k(z) + m(z) with m (z) = 0 or

deg(m)< deg(k) = 3.

Moreover, f (z) & m(z) produce the same coset in Q[z]/ (p(z)). It indicates that for every element in K, there exists a distinct representation in the format

$e + dz + cz^2 + (p(z))$ for some e, d ,c $\in$ Q. Therefore, the cosets 1+ (p(z)), z + (p(z)), and z^2 (p(z)) form a basis for K over Q, so [K: Q]= 3.

Let e = z + (p(z)).Then $e^3 — 2 = z^3$ (p(z)) —(2+(p(z))= $z^3 — 2$ + (p(z)) = 0.The element a is then a root of $z^3 — 2$ in K. Note that we used the identification of Q as a subfield in this calculation.

Example 2.2

GF(2) represents the two-element field known as Galois Field.[3] Addition & multiplication rules for the two elements in this field, 0 and 1, are as follows:

Addition: An XOR operation is the same as the addition operation in GF(2). 0 + 0 = 0, 0 + 1 = 1, and 1 + 1 = 0, for instance.

Multiplication: In GF(2), the AND operator is equal to the multiplication operation. 0 * 0 = 0, 0 * 1 = 0, and 1 * 1 = 1, for instance.

Example 2.3

GF(3), the Galois Field, consists of three elements: 0; 1, and 2. This field performs addition and multiplication modulo 3, which means that any operation's output will always be less than 3. For instance, since 3 is equivalent to 0 modulo 3, 2 + 1 = 3 would become 0 in GF(3).

Properties of Galois Field

3. Finite Size: The finite nature of a Galois Field is its most significant characteristic. It already contains a certain amount of elements, and more cannot be added. A prime number, "p," is used to represent the field's size.
4. Closure: The outcome of any operation carried out within the set will always be an element of the set as the Galois Field stays closed under addition & multiplication operations.
5. Commutative: The two addition and multiplication operations on the Galois Field commute. This indicates that while carrying out operations, the elements' sequence is irrelevant. As an illustration, a+b equals b+a and ab = ba.
6. Associative: Both addition and multiplication operations result in the associative nature of the Galois Field. This implies that it makes no difference how the components of an operation are arranged. Likewise, (pq) * r = p * (qr) and (p+q) + r = p + (q+r) are examples.

7. Distributive: The distributive property is adhered to by the Galois Field. h * (j +k) = h *j + h * k indicates that multiplication distributes over addition.
8. Identity Elements: There are two identity elements in the Galois Field: 0 for addition and 1 for multiplication. Any element multiplied by one is identical to the original element, as is any element added with a value of 0.
9. Inverse Elements: There is an inverse element for each element in the Galois Field under addition and multiplication. The reciprocal of the original element is the inverse element for multiplication, while the negative of the original element is the inverse element for addition.[3]

Galois Fields are beneficial in many domains, including error correction, coding theory, and cryptography, because of their characteristics.

Application based on reed solomon code

The study of error-detecting and error-correcting codes used in reliable information transmission and storage is known as coding theory. It deals with data integrity concerns, particularly when mistakes may arise during data transport or storage.[5]

Reed-Solomon Codes

- o These codes belong to a family of error-correcting codes that are widely used in data storage (such CDs and DVDs) and communication systems.
- o These codes are based on algebraic structures over finite fields, making them effective in correcting errors that may occur in transmitted data.

Construction of Reed-Solomon Codes

- Reed-Solomon codes are generated based on polynomial division. The codewords are essentially the remainders obtained when a message polynomial is divided by a generator polynomial.
- Generator polynomial is carefully chosen to have roots in the splitting field. These roots are related to the error locations that the code can correct.
- The features of the generating polynomial and the choice of splitting field dictate the code's parameters, including the codeword length and the number of correctable mistakes.[5]

Error Correction and Decoding

- During transmission or storage, errors may occur, leading to received codewords differing from the transmitted ones.
- Finding the error spots, which correspond to the splitting field's generating polynomial's roots, is a step in the decoding process.
- The correction process then uses these error locations to adjust the received codeword and recover the original message.

Galois Finite Fields and the Advanced Encryption Standard (AES)

Every field with 256 members has the same universal features since all finite fields of a given size are comparable. Galois, who passed away at the age of 20 during the turmoil of France after Napoleon, laid the groundwork for most of this subject of mathematics, which is why the field with 256 elements is known as "Galois Field with 7 ^ 8 elements" or GF(2 ^ 8).

Interestingly, polynomials up to degree 7 with coefficients selected from integers modulo p (a "field with characteristic p") are equal to members of a field of size p". For instance, we could perform the obvious and use the polynomial 0 or 1 to represent integers like 0 or 1 1. Everything is going well so far, but coefficient 2 is troublesome as we can only have coefficients modulo p. To solve this, we raise the polynomial's power to x and choose "2-10=1x-0". As a result, the terms of the related field polynomial and the bits in a binary representation of a number have a straightforward connection.

Number	*Binary*	*$GF(2^8)$ Polynomial*	*Simplified*
0	0	0	0
1	1	1	1
2	10	$1x+0$	x
3	11	$1x+1$	$x+1$
4	100	$1x^2+0x+0$	x^2
5	101	$1x^2+0x+1$	x^2+1
8	1000	$1x^3+0x^2+0x+0$	x^3
16	10000	$1x^4+0x^3+0x^2+0x+0$	x^4
21	10101	$1x^4+0x^3+1x^2+0x+1$	x^4+x^2+1

CONCLUSION

Reed-Solomon codes have become an integral part of many digital communication and storage systems, providing a reliable and efficient means of error detection and correction. Their widespread use is a testament to their robustness and versatility in handling various types of errors.

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Electrochemical Properties of Magnetic Supercapacitor $Co_{0.9}Ni_{0.1}Fe_2O_4$ Electrode Prepared by Hydrothermal Method

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ABSTRACT

In the present work, $Co_{0.9}Ni_{0.1}Fe_2O_4$ (CNFO) is synthesized by hydrothermal method. After annealing the resulting $Co_{0.9}Ni_{0.1}Fe_2O_4$ electrode at 300°C, it is evaluated using a variety of methods, including scanning electron microscopy (SEM) for morphological investigations and X-ray diffraction (XRD) for structural studies. Single-phase cubic with Fd-3m space group of spinel structure was confirmed by structural analysis. The produced CNFO electrode's electrochemical characteristics, such as Cyclic Voltammetry (CV) and Galvanostatic Charge-Discharge (GCD), are investigated using an electrolyte solution of 1 M KOH. Cyclic voltammetry (CV) revealed the highest specific capacitance of 87.49 F/g at a 5 mV/s scan rate. Electrochemical stability of CNFO electrode is studied using cyclic voltammetry for 500 cycles.

KEYWORDS *: Electrochemical, Cyclic voltammetry, Hydrothermal, Supercapacitor.*

INTRODUCTION

Now days, people are becoming more and more aware of how crucial it is to investigate and make use of green and renewable energy resources as well as related gadgets as a result of the slow depletion of non-renewable energy supplies and the quickly rising request for a sustainable environment. In relation to this, research into novel energy storage technologies and systems has been conducted during the previous several decades [1]. Among these gadgets a promising option for the transport and storage of electrochemical energy is the supercapacitor. Supercapacitors offer significant power density, extended cycle life, high energy density, and improved stability [2]. They can be further separated into asymmetric or hybrid capacitors, pseudocapacitors, and electrochemical double layer capacitors based on the charge storage technique used, which includes both faradic and non-faradic ion conduction [3].

Numerous variables, including the potential window of the electrodes, the electrochemical characteristics of the electrode materials, and the choice of electrolyte, have a substantial impact on the performance of SCs [4]. Many studies have demonstrated the importance of transition metal oxides as effective supercapacitor electrode materials because of their low cost, favourable environmental effects, and superior structural, electrical, and mechanical qualities [5]. These factors have led to a great deal of research being done on metal oxides such as NiO, ZnO, Co_3O_4, and Fe_2O_3 [6]. During charge storage, the quick and reversible faradaic reaction involves the ions and electrons found in electrode materials. Despite the lower cost, these transition metal oxides still need to be improved due to their limited electrical conductivity and specific capacitance.

Research on mixed metal oxides, such as Mn/Fe, Ni/Co, Ni/Mn, and Ni/Mn/Co oxide, has demonstrated notable improvements in electrochemical performance. Mn, Co, or Ni spinel ferrites, MFe_2O_4, are intriguing due to their distinct redox states and electrochemical stability [7]. Moreover, they have remarkable optical, magnetic, and electrical qualities. Not much research has been done on $M_1M_2Fe_2O_4$, a mixed ternary transition metal ferrite, where M_1 and M_2 are either Cu, Co, or Ni, for use in supercapacitors [8]. Nanostructured materials have better kinetics and activity as an electrode in a supercapacitor than bulk materials because of their larger specific surface area and narrower ion and electron transport channels. To create a supercapacitor, electrode materials with a wide range of operating potential and high specific capacitance are particularly preferred. Ferrites in a range of oxidation states have shown promise as supercapacitor electrode materials. The diverse oxidation states, affordability, eco-friendliness, and plentiful availability of ferrite materials render them appealing options for supercapacitor electrodes. Additionally, their synthesis method is straightforward and appropriate for large-scale industrial manufacturing.

Here, we demonstrate the easy, regulated, and binder-free hydrothermal production of CNFO electrode material on stainless steel substrate. Compared to nickel foam and carbon cloth, stainless steel is a more affordable and readily accessible conducting substrate that offers a robust conducting foundation for CNFO. During the film's deposition, the hydrothermal approach offers exact control over temperature, duration, and pressure. High aspect ratio and high purity are maintained during hydrothermal synthesis, which forms stable nanostructures and prevents the collapse of active material. Additionally, the hydrothermal approach is straightforward and yields acceptable nanostructure arrays [9].

EXPERIMENTAL

Materials

For the synthesis of CNFO, all of the reagents employed are AR graded: $Co(NO_3)_2.6H_2O$ (cobaltous nitrate), $Ni(NO_3)_2.6H_2O$ (nickel nitrate), and $Fe(NO_3)_3.9H_2O$ (ferric nitrate). The 304 grade stainless steel substrates that are utilized for deposition have dimensions of 1 × 4 cm and a thickness of 0.005 mm. Prior to the deposition process, the stainless steel substrates underwent cleaning and ultrasonication in distilled water and acetone for a duration of 15 minutes in each solution. They were then dried at room temperature. All of the water used in the procedure was distilled.

Synthesis of CNFO

In order to create the CNFO film hydrothermally, distilled water was mixed with 50 mM of $Ni(NO_3)_2.6H_2O$, 50 mM of $Co(NO_3)_2.6H_2O$ and 100 mM of $Fe(NO_3)_3$. $9H_2O$ using magnetic stirring for 30 minutes. A 50 ml Teflon-lined autoclave was filled with the obtained solution and the stainless-steel substrate. After being sealed, the autoclave was kept at 180 °C for 12 hours. After the procedure was finished, the CNFO film-coated stainless steel was rinsed with distilled water, dried, and calcined for four hours at 350 °C. The material's mass loading was approximately 1.4 mg cm−2. The deposition film's thickness is measured in nanometers.

Material Characterization

A Proto-AXRD Benchtop Diffractometer (CuKα radiation) was used to examine the structural properties of zinc cobaltite electrode materials throughout a 2θ range of 20° to 80°. Using a 20 kV accelerating voltage, the JEOL JSM IT-300 scanning electron microscope (SEM) was used to analyze the morphological characteristics. A CHI (660C) electrochemical workstation was used to study the supercapacitive properties of the electrode materials using galvanostatic charge-discharge (GCD) and cyclic voltammetry (CV) in a three-electrode setup with 1 M KOH electrolyte.

RESULTS AND DISCUSSIONS

Structural and Morphological Studies

The X-ray diffraction (XRD) pattern of CNFO is displayed in Figure 1. With the Fd3m space group, CNFO ferrite exhibits a cubic spinel structure. The peaks of CNFO are confirmed by JCPDS cards 791744 [10] and 742081 [11] for $CoFe_2O_4$ and $NiFe_2O_4$, respectively. The materials' crystallite size is determined using the Debye-Scherrer equation [12]. The size of the CNFO crystallite is 63.23 nm. The CNFO micrograph (SEM analysis) is displayed in Figure 2. Larger CNFO granules with a dense, porous structure is visible in the micrograph.

Electrochemical Characterizations

The shape, porosity, and surface area of a material all directly affect its electrochemical performance. In 1 M KOH electrolyte, the electrochemical characteristics of the CNFO electrode were investigated. Charge-discharge and cyclic voltammetry experiments are used to calculate specific capacitance values. It is discussed how scan rate affects a specific capacitance.

- Cyclic voltammetry:

  The CV profile of the produced CNFO electrode material in 1 M KOH is shown in Figure 3 for scan rates ranging from 5 mV sec−1 to 100 mV sec−1, with the potential range being 0–0.3 V/SCE. At 5 mV sec−1 of scan rate, the highest specific capacitance of 87.49 F g−1 is achieved. Due to the faradic charge storage mechanism, the CV curves demonstrate the pseudocapacitive nature of the CNFO electrode. Furthermore, the form of the acquired CV curves attests to the pseudocapacitive nature of the CNFO electrode.

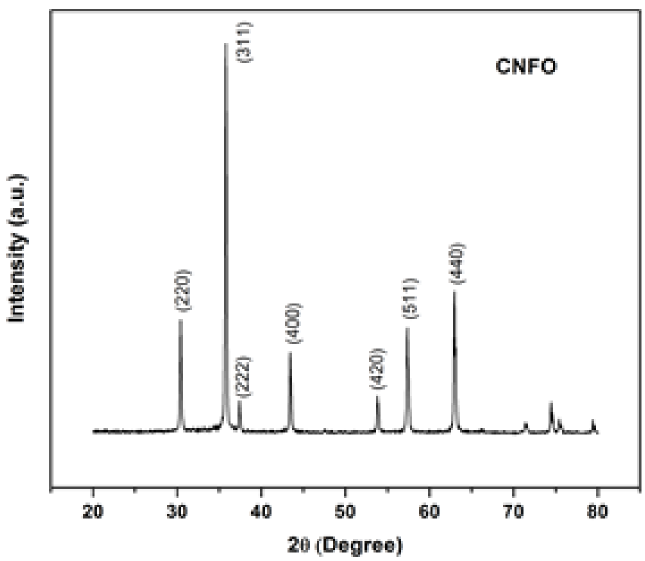


Figure 1. XRD Pattern of CNFO

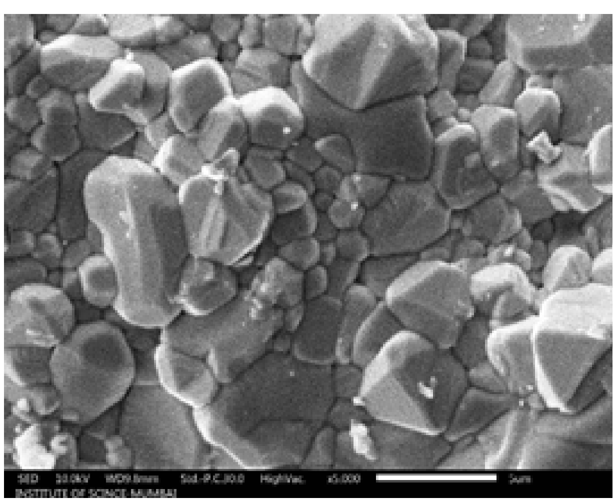
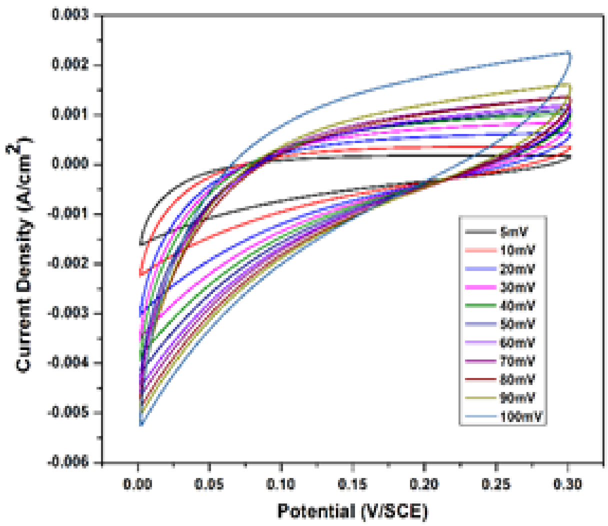


Figure 2. SEM Image of CNFO



- Galvanostatic charge-discharge: Figure 4 displays the galvanostatic charge-discharge profile in a constant potential range of 0-0.3 V at 1 mA cm^{-2} current density. Improved columbic efficiency is indicated by the almost symmetric charge-discharge curves for CNFO, which also exhibit a time-dependent variation in slope caused by surface reactivity at the electrode-electrolyte interface [13]. Charge-discharge profiles have also been used to determine specific capacitance values, which further support the electrochemical character of the CNFO electrode. At 1 mA cm^{-2} current density , the specific capacitance measured for CNFO is 175.44 F g^{-1}.

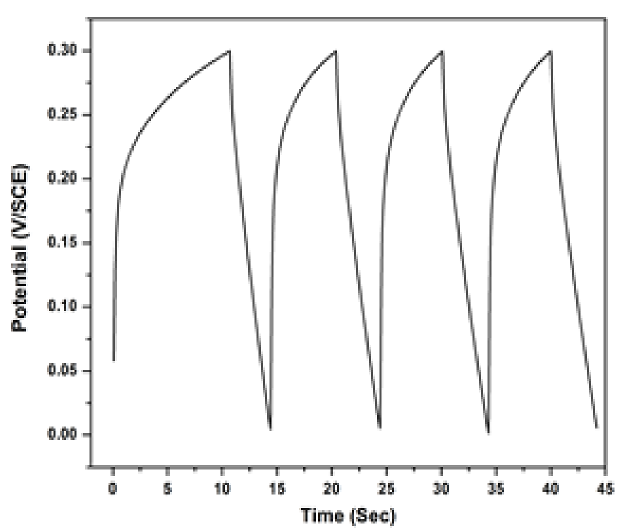


Figure 4. GCD Of CNFO Electrode

- Effect of scan rate: A graphical trend of the specific capacitance variations in relation to varying scan rates is shown in Figure 5. The features of the curves clearly show a decrease in specific capacitance with an increase in scan rate. This is because electrolyte can thoroughly penetrate the electrode material's matrix at lower scan rates, enhancing ionic conductivity and revealing the existence of significant Redox peaks. However, the electrolyte can only interact with surface ions at a greater scan rate, which causes the capacitance values to fall. At 5 mV sec^{-1} scan rate, the highest capacitance value of CNFO is 87.49 F g^{-1}, while at 100 mV sec^{-1}scan rate, it decreases to 16.19 F g^{-1}.

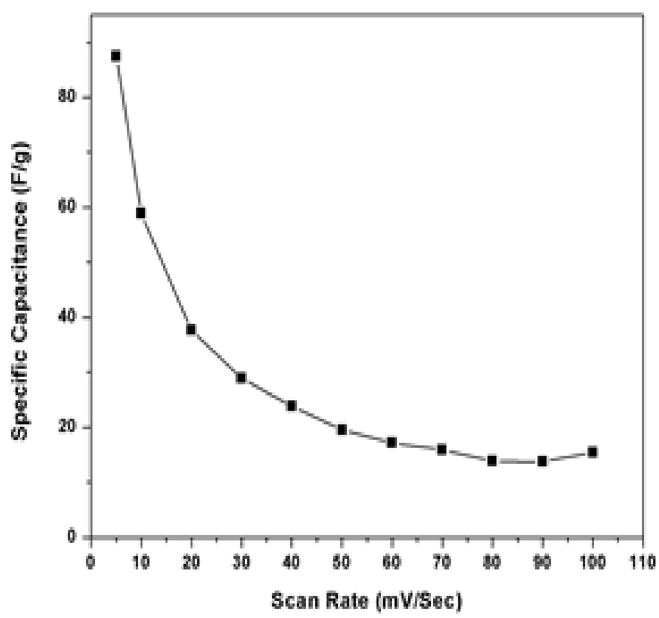


Figure 5 Effect of Scan Rate on Specific Capacitance

- Cyclic Stability: A stability curve of the CNFO in 1 M KOH is displayed in Figure 6 following 100 and 500 cycles at 100 mV sec−1 scan rate. The CNFO electrode exhibits capacitance retention of 90% and 85% after 100 and 500 cycles, respectively, according to these long-term cyclic stability plots. This drop in capacitance value could be the consequence of tiny levels of active material degradation or loss during continuous electrode use. The CNFO electrode has a good potential for supercapacitive use, according to cyclic stability studies.

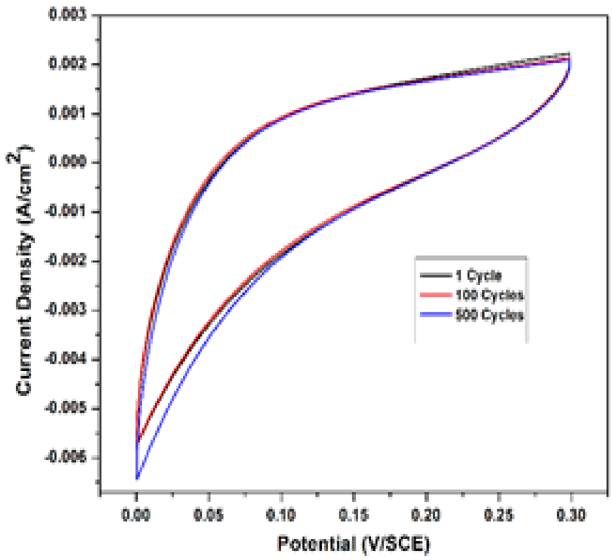


Figure 6. Stability Study for 500 Cycles

CONCLUSION

Single-phase cubic spinel structure is confirmed by X-ray diffraction experiments. The FE-SEM micrographs show well dispersed nanoparticles with clearly defined spherical shape. The maximal specific capacitance obtained from cyclic voltammetry measurements is 87.49 F/g at a scan rate of 5 mV/sec. Stability study shows above 85% retentivity of CNFO electrode after 500 cycles at 100mV/Sec scan rate. This electrode can be further studied for the better results in energy storage.

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Questioning ‘Family’: A Study of Dina Mehta’s Getting Away with Murder and Marsha Norman’s Getting Out

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ABSTRACT

Family means the bond, commitment, love, sacrifice, affinity and dwelling together. People in a family are connected and concerned with each other. Happiness of a family depends on the happiness of each and every member of the family. Without care, love, equality and commitment no family becomes heaven on earth. The existence of man and woman is important in a happy family; both are integral parts of the family. But throughout history women are treated as subordinates in any part of the world. Women go through multilayers of oppressions and most of the time these oppressions start from the family. The aim of present study is to find the role of family in exploitation of women characters in Dina Mehta’s Getting Away with Murder and Marsha Norman’s Getting Out. Patriarchal agents in the society use various institutions to exploit women and continue their dominance. This paper reveals different types of violence used by family members to subjugate the women characters.

KEYWORDS *: Family, Exploitation, Violence, Traditional value, Patriarchy.*

INTRODUCTION

Gender is a very important concept in society. Sex is biological while gender is socially constructed. Patriarchal agents use this concept very shrewdly to subjugate women. From childhood the concept of gender and gender roles are systematically imbibed through the nurturing process of girl child. The institutions like family, church and marriage play a very dominant role to make women submissive. The position, status and identity of women in society are the central topics of feminine literature. Basically family is the safest place to live in but in many cases women are victims of childhood sexual abuse and domestic violence which are initiated by family. In traditional families men hold all the powers and they are always in the driving seat. They take all major decisions and control the whole family. Men’s dominance in every relationship like father-daughter, brother-sister, husband -wife makes women timid and vulnerable. The study of Dina Mehta’s Getting Away with Murder and Marsha Norman’s Getting Out reveals the fact that it is the family which ruins the lives of women.

The Role of Family in Dina Mehta’s Getting Away with Murder

Dina Mehta is one of the influential playwrights who present women’s issues through her plays and strongly protests against the traditional patriarchal structure. Men use different kinds of violence to subjugate women. Patriarchal dominance in society and in family is mainly responsible for the vulnerability of women. The playwright shows the dark and bleak condition of Indian society where women experience discrimination and bias from family members. They get unequal treatment in almost all things like education, health, clothes, different facilities, decision making and career because of their gender which is constructed by patriarchal society.

Dina Mehta’s play Getting Away with Murder shows the role of family in the devastating condition of women. The play revolves around three friends Sonali, Mallika and Raziya. Sonali was the victim of childhood sexual abuse and Raziya was humiliated by her husband and mother-in-law. The childhood experiences of Sonali completely change her life. The cruel impact of childhood memories is clearly visible through her behaviour. She used to talk in a little girl's voice whenever she was alone. She talks in front of the mirror and screams. Her abnormal behaviour is the result of her childhood sexual exploitation. When she was a child her mother shifted to her uncle's house. As a single parent without any source of income it was difficult for her to take care of her children. Her uncle Narrotam was the representative of androcentric society. He takes advantage of the situation and everyday he sexually abuses Sonali. He stands outside her bathroom to see her naked. Her mother knew the fact but unfortunately she didn't save Sonali from the evil tortures.

After marriage when Sonali becomes pregnant the cruel memories of her past force her to terminate her pregnancy. Sonali feels that if she delivers a girl child she will also be the victim of patriarchal society. Her mother-in-law is also expecting that she should deliver a baby boy. Not only men but also women are responsible for the vulnerable condition of women. The continuous tortures and exploitation harm women's psyche and their self-image. Dina Mehta wisely demonstrates these aspects of family which are responsible for women's degradation in society.

Raziya is a doctor by profession. Though she is an educated girl yet cannot avoid her subjugation in the hands of patriarchal agents. Her Mother-in-law never liked her and treated her badly. She feels that educated girls are disobedient. Her bias towards Raziya is reflected through her behaviour. After a few years of Habib's marriage when Raziya failed to become a mother, mother -in-laws suggested her son to remarry. Though it was a love marriage but due to patriarchal mindset Habib also supported his mother's decision. He starts meeting a girl quite younger than him. Raziya accepted this decision of her husband and started blaming her destiny. Thus, the family becomes a place of subjugation and oppression of women. The playwright shows how the most private domain of society plays an important role to discriminate and exploit women. In most of the cases, tortures and violence by family members are never reported due to the social restrictions. Women always think about their family honour and become ready to sacrifice their lives. The traditional system of family controls women's behaviour and encourages women to live their lives for men.

The Role of Family in Marsha Norman's Getting Out

Marsha Norman presents harsh realities of society through her play 'Getting Out.' The playwright presents Arlie as a rebellious character who breaks all sorts of rules of behaviour which are created by patriarchal agents to continue their dominance. She challenges existing structure and becomes bold and subversive. She was arrested and spent eight years behind bars for robbery, kidnapping and homicide. The play opens with the announcement of a release of Arlene Holsclaw. Arlene is a modified version of Arlie. Arlie changes her name as she wants to start a new journey of her life.

Arlie becomes subversive and rebellious because she wants to take revenge from all who have exploited her life. Her exploitation started from her family. She was the victim of childhood sexual abuse. Her father sexually exploited her and beat her. Her mother knows this fact but she ignores the beating and exploitation of Arlie. Marsha Norman criticizes the role of a mother in such circumstances. Most of the time mothers are also responsible for the vulnerable condition of daughters because in spite of knowing the facts they simply ignore it to avoid their own subjugation. They accept all ill-treatments because they do not have courage to challenge their husbands. Men apply all discriminative norms against them to make them weak. They practice all kinds of violence to exploit them.

The scars of humiliation and exploitation motivate Arlie to become violent and subversive. She becomes a prostitute and her aggression reflects through her behaviour. She kills a taxi driver who tries to rape her. Her family is completely responsible for her degrading condition. After spending eight years in prison Arlie decides to change her way of living but the people around her hardly allow her. When she reached her sister's house no one was there to welcome her. Arlene's mother comes there to visit Arlene but her mind is completely biased. She was not ready to accept Arlene as a changed version of Arlie. When Arlene asks her about her visit to their house on coming sunday her mother rejects all possibilities. Mother is a person who always stands with her kids but Arlene's mother doesn't trust her. When she sees a hat of a man in the house she starts criticizing Arlene and says that she knows Arlie. The playwright presents the role of family members in the subjugation of a girl child in the family.

CONCLUSION

Thus, it is found that in both the plays the basic location of exploitation and subjugation is 'Family.' It is a place where everyone feels secure but unfortunately there are countless women victims who suffer a lot at this private domain. The social conditions and family reputation restrict women to raise their voice against any vicious act. It is a family which supports patriarchy and creates discriminative norms. It is a place where patriarchal values are imbibed in girls and men get a superior place to women. In each family head of the family is a man who controls the whole family. The characters like Sonali and Raziya from Getting Away with Murder and Arlene from Getting out are the victims of the family. Sonali is exploited by her own father whereas Raziya was ill-treated by her husband and mother-in-law. Arlene was also a victim of sexual abuse.

Both the playwrights attempt to present a dark aspect of family which is normally neglected by women. The playwrights present this aspect because they are really concerned about women's situation and condition. They empathetically understand women around them and their family's role in their oppression. They consciously present the dark side of family to show the brutalities that women face in the family. The playwrights also depict the efforts of these victimized women to liberate themselves. Their struggle to liberate themselves from the patriarchal clutches of family generate some positivity among the audience.

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Sustainability – Opportunities for Electricity Utilites in India

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ABSTRACT

Known Mankind's history is hardly 7000 years old as compared to earth which is more than 4.5 billion years old. During the last 260 years post industrial revolution, earth's environment has deteriorated to a limit wherein reversal from unprecedented adverse effects of Global warming is getting nearly impossible. During the Paris Agreement in 2015, World leaders advocated limiting global warming to less than 1.5 Deg C by the end of the 21st century. The United Nations has made many efforts to curb global warming including defining the 17 sustainability development goals (SDG). These goals are defined with a perspective to survive the present without compromising the future. This technical paper discusses various opportunities available with Electricity Utilities vis a vis SDG goals and various avenues available in Industry 5.0 to complement the diverse efforts to be taken.

KEYWORDS *: Industrial revolution, Global warming, Sustainability, SDG goals, Industry 5.0.*

INTRODUCTION

Since its evolution, earth has seen witness to many catastrophic natural events which nearly resulted in various species going extinct. Human activity since the start of Industrial revolution has jeopardized mankind's future in wake of global warming which is poised to disturb the earth's ecology and habitability. Since the Years 1880, global temperature has risen by 1 degree C [1]. The global temperature is projected to rise by more than 5 degree C by the end of 21st century at current emission rate of greenhouse gases (GHG). The main reasons for GHG production are fossil fuel burning, de-forestation and population growth. India is worst affected by global warming in view of its heavy dependence on Monsoon for food security. Major rivers emanating from the Himalayan range are at risk of losing their glaciers which are shrinking at an alarming rate. Unprecedented growth in population and industrial activities has resulted in high contribution of India to global warming and emission of greenhouse gases. India in 2021 emitted 3.9 billion metric tons of Carbon di-oxide equivalents (GtCO2e) which was close to 7% of global emissions and stood three behind USA and China [2].

Global warming has manifested its effect on Indian sub-continent which is evident from the fact that 2010-2020 decade has been declared as the warmest decade on record wherein the temperatures in country were 0.36 degree C [3] higher than average [6]. Fig 1.

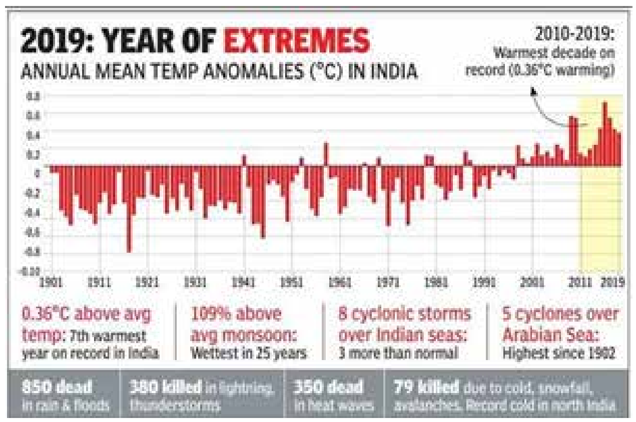

Fig1: Annual mean Temperature Anomalies in India

The biggest contributor to GHG gases is the energy sector wherein dependability on coal has not subsided even after taking various measures in renewable energy. As per projections for Year 2022, though renewable energy is nearly 27% of installed capacity, its contribution in actual utilization of energy is less than 10% due to non-firm nature. Coal contributes to more than 71% of energy requirements in India [4]. Fig 2.

The second largest contributor of greenhouse gases in India is agriculture sector which produces huge amounts of Methane gas, a potent GHG having global warming potential (GWP) of more than 30 times of Carbon di-oxide gas. Methane gas is by- product of rice paddies and cattle farming. Unorganized and inadequate management of farm residues has posed a huge challenge for policy makers to control the impact in longer terms.

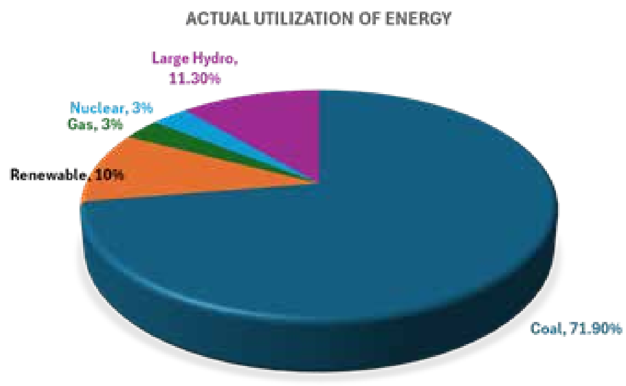

Fig 2: Actual Utilization of Energy in India, year 2022

For last few years, North Indian States of Delhi, Punjab and Haryana have been experiencing the huge disruption in normalcy during winter season due to burning of paddy husks. Rampant paddy burning and absence of concrete policy in place has jeopardized the life of close to 15 crore people. Health risks and loss of productivity are just the tip of iceberg while challenge to nation's sustainability is a major factor.

India is plagued by high inefficiency in energy sector. As per the report published in T&D India, India's aggregate technical and commercial (AT&C) loss is approx. 17% for FY 2022 [5]. AT&C loss of few state utilities are even more than 40%. High inefficiency is wastage of expensive fossil fuel and at the same time putting additional stress of environment in terms of GHG generation. Through this technical paper, authors have proposed measures to reduce the technical losses of distribution network.

UNITED NATIONS SUSTAINABILITY DEVELOPMENT GOALS AND ENERGY SECTOR

The United Nations with inclusion of all member countries defined 17 sustainability development goals [1] which target to transform the world against current challenges and create a better future. The SDGs address various aspects of human society and aim to bring equality, eradicate disease and poverty and protect the planet. Out of said 17 goals, goal 7 "Affordable and clean energy", goal 9 "Industry, innovation and infrastructure" and goal 12 "Responsible consumption and production" are most relevant to energy sector [2].

SDG 7: Affordable, reliable, sustainable and modern energy

SDG goal 7 aims to create an eco-system through government policies, utility interventions, customer partnership wherein energy as commodity is cost effective, produced through minimal fossil footprint and consumed in most efficient manner. Leading Indian utilities like NTPC, Adani, TATA are putting best efforts in changing the energy landscape and facilitating customers in getting green power at affordable cost. NTPC historically has been the largest central electricity generator with installed capacity of more than 73,874 MW comprising of thermal, hydro, gas and renewable portfolio. NTPC has been a front runner in commissioning the floating solar plant across India and plans to generate 50% of power through renewable sources.

Floating solar Photovotaic plants

Floating Solar Photovoltaic (FSPV) Plants are PV arrays that float on reservoirs provided for storing potable water or for irrigation. Fig 3. These can be lakes, local ponds, and dams or even closed mines and queries converted into water bodies. FSPV carry many advantages as compared to their land counterparts:

Saving the exorbitant cost of land

Commissioning of FSPV on land surface requires huge investment in purchase or leasing. Apart from it, it deprives the land potential for cultivation and farming. For metropolitan areas, cost of land makes the installation of Solar PV unviable even in case of high solar irradiation index. As peer the estimate for India to achieve its target of 292 GW of installed solar capacity would require six lakh hectares of land which is not plausible [7]. Considering this fact, many government and private utilities are planning to install floating solar plants. Though initial cost of FPSVs is 15-30% higher, 10% more generation capacity due to less operating temperature offset the cost differential [10]. As per the TERI report, India has achieved a lowest cost of FPSV as low as Rs.35/Watt which is significantly 45% lower than the 2018 average cost. Technology advancements in mooring and O&M of FPSV have further reduced the life cycle costs.

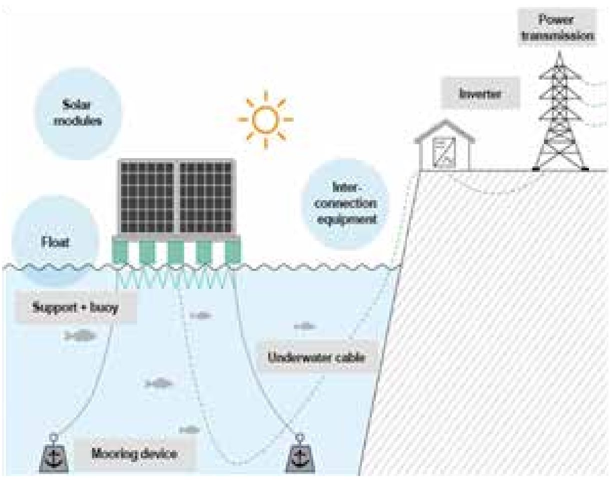

Fig 3: Floating Solar PV

Reduction in water loss due to evaporation

Ensuring the water security in Monsoon dependent country like India during summer peaks is necessary for food and irrigation requirements. This puts abundant pressure on governments to take measures for water conservation which are at times unpleasant for human comfort. FPSVs are gaining ground for freshwater conservation in addition to yielding energy [8]. As per research, 42% saving [8] in water evaporation can be achieved on reservoir with FPSV as compared to uncovered reservoir [10]. An additional benefit is reduction in carbon footprint to an extent of 730 tons of CO_2/ MW of solar generation which is equivalent to planting 33,183 trees.

Potential of FPSV in Mumbai metropolitan area

Mumbai region has seven huge reservoirs in metropolitan area and in vicinity which house the potable water for close to 3 million people. Within Mumbai, Vihar and Powai Lake cover area of 9.1 Sq kM. considering utilization potential of 15% at 1.365 Sq. kM, FPSV, Fig 4 of 113.75 MWp can be installed on said two water bodies. With a potential to generate 5.56 kWH average/kWp/day, FPSV installation has the potential of generating 231 GWH per year. These FPSVs can be built through public-private partnership with TOTEX model. Installation of 113.75 MWp FPSV requires Capex of 73.94 Crores. The estimated TOTEX works out to be 1655 crores (Net present value) considering the life span of 20 years. Average cost of generation shall be 3.58/kWH. Considering power purchase cost of Rs.4.7/kWH, payback period is realized in 6.4 years. FPSV in Mumbai region is a viable option for utilities in addition to providing an avenue for reduction in distribution losses by way of localized generation in saving on wheeling of power from interstate and intra-state generators. It also equips electricity utilities to unburden their RE obligation as mandated by the State Regulatory Commission.

Fig 4:Floating Solar PV, Image for representation

SDG 9 : Industry innovation and infrastructure

SDG 9 aims towards building highly endurable and long-lasting infrastructure with considerate industrialization and penetrative innovations. Creation of future infrastructure with long term planning reducing waste and losses is a priority for electricity utilities as well. Measures which those utilities can prioritize are explained in this section.

Energy efficient smart Equipments and monitoring interfaces

Since the start of millennium, Indian Electricity utilities have come a long way in adopting emerging trends in material, manufacturing and maintenance of assets. The biggest step towards sustainability was adopting XLPE

(Cross linked polyethylene) in place of PILC (Paper insulated lead sheathed) cables. XLPE cables are rated at 90 Deg C which also ensures higher ampacity for cables with similar cross section area as compared to PILC cables. Aging characteristics are also superior for XLPE cables in addition to short circuit rating. With advent of technology in extrusion and materials, now Indian utilities have migrated to triple extruded Tr-XLPE (Tree retardant) cables with superior water tree resistance and longer service life. Many manufactures in India have now started manufacturing E-beam (Electron beam) irradiated insulation which facilitated less thickness for insulation of cables and wire but superior performance.

BIS (Bureau of Indian Standards) has revised IS standards for distribution transformers in 2017 and introduced loss levels in line with star rating of Equipment's. Superior manufacturing technologies with indigenous vendors have ensured that these loss levels are met during design and manufacturing under BIS license. Deviation in loss level during manufacturing is considered as non-compliance and provisioned with penal action. Allowing bio-degradable Ester oil in place of mineral oils has also given a green push to utility efforts towards sustainability.

Smart sensorization and monitoring systems have reduced the resource requirements for maintenance and optimized the maintenance frequencies. Due to it, consumption of resources like spares, mineral oil, lubricants and most important fossil fuel has reduced. Many advanced utilities are evaluating solutions like Asset Performance Management (APM) to implement Reliability centered maintenance (RCM) regime. RCM regimes drive the maintenance of Equipment's based on criticality indices and is in coherence with optimum Capex infusion to support sustainability. Industry innovation like the possibility of use of new material Perovskite, Fig 5 has given a new boost to solar plants. Perovskites have unique crystalline structure and as Halide composites are used for solar cell. These cells have efficiencies up to 29% in research environments. IIT-Bombay has developed one such perovskites indigenously which has efficiency of 26% [11]. With enhancement in industrial manufacturing capabilities, it is expected that by end of this decade, efficiency of close to 30% for solar cells shall be a close reality.

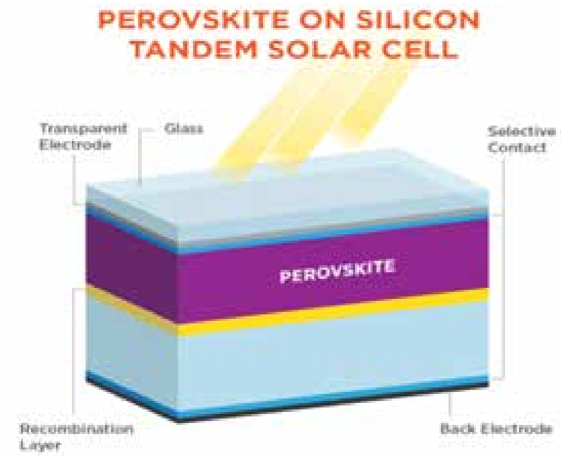

Fig:5 Perovskite Solar cell, image for representation

SDG 12 : Responsible consumption and production

Distribution utilities across the world are putting humongous efforts to reduce their Aggregate Technical and Commercial (AT&C) losses. Reduction in distribution losses increases efficiency and at the same time creates a margin for utility to increase their sales in similar proportion and reduce bills on costly power purchases. Technical losses though an inherent feature of electrical network does have margin for optimization by way of reducing the hot spot abnormalities, loading optimization, reducing unbalance and contact resistance in various components & junctions. Utilities have adopted merging trends in Infrared Thermography (IR), Fig 6 to monitor the condition of assets.

Fig: 6 IR Thermography, Image for representation

Fig 7:Conductivity Paste & T-Tap Connector

As an estimate, fuses in LV distribution system consume close to 15 Watts. Considering the contact resistance the loss may go up to 60 Watts. As an estimate, in low voltage (LV) distribution fuse losses may contribute to 10% of LV distribution losses. Reduction in fuse base contact resistance and eradication of fuses at multiple intermediate nodes can substantially reduce the LV losses. Products like “high conductivity pastes,” Fig 7 are also viable solutions for fixed contacts like bus Bars. As per application feedback, contact resistance reduces up to 40% post application of Ni-Al based conductivity paste.

CONCLUSION

Distribution utilities have huge potential to improve upon efficiencies, reduce energy waste and tap potential of merging trends in manufacturing and renewable energy. India has challenge to reform its energy sector through the Capex requirements is huge. Regulatory commissions and policy makers like Central electrical Authority can consider setting the benchmark for utilities in network planning, equipment procurement and maintenance vis a vis leading utility in world. Distribution loss has been a silent killer for state utilities. These utilities may consider implementing the best practices in theft mitigation, procurement of energy efficient products and reliability centered maintenance from private counterparts. Floating Solar PV (FPSV) has been a shot in the arm of utilities to reduce their high purchase cost and distribution loss through distributed generation. Utilities may consider working out Escrow model on TOTEX basis with their investor and partners to reduce the capex and tariff burden on consumers.

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Advances in Skin Cancer Detection and Classification: An Overview

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ABSTRACT

This paper explores recent breakthroughs in skin cancer detection and classification methodologies, showcasing diverse approaches for early diagnosis. Various studies leverage advanced technologies, such as Global-Part Convolutional Neural Networks (GP-CNNs) and ensemble learning strategies, achieving state-of-the-art performance without external data. Additionally, research introduces an optimized Convolutional Neural Network (CNN) model, enhanced through a genetic algorithm for hyperparameter tuning, excelling in skin lesion classification across multiple evaluation metrics. The use of machine learning (ML) and deep learning (DL) techniques, coupled with the employment of k-nearest neighbor (KNN) and AlexNet with Grey Wolf Optimizer, further exemplifies remarkable accuracy exceeding 99%. These innovations hold promise for effective and efficient clinical tools, emphasizing the ongoing progress in automated skin cancer diagnosis.

KEYWORDS *: Skin cancer, Melanoma, Convolutional neural networks, Segmentation, Classification, Machine learning.*

INTRODUCTION

Skin cancer, one of the most prevalent forms of cancer, continues to pose a significant global health challenge. According to this epidemiological analysis of worldwide cancer statistics, there were significant regional differences in the incidence of melanoma in 2020, with an anticipated 325,000 new cases and 57,000 deaths from the disease [1]. Early detection is crucial in managing this disease effectively, as it significantly increases the chances of successful treatment and survival. Dermoscopy, a non-invasive skin imaging technique, plays a pivotal role in the early detection of skin cancer. The deadliest type of skin cancer, melanoma, has the greatest death rate. Due to the wide variability in the morphological features of skin lesions, doctors have a difficult time screening for and early detecting melanoma. An effective and dependable automated diagnosis system is desperately needed to help dermatologists make accurate diagnoses and decisions [2]. This paper provides an overview of recent advances in skin cancer detection and classification methodologies, focusing on both traditional and emerging technologies.

ADVANCEMENTS IN SKIN CANCER DETECTION AND CLASSIFICATION

Melanoma Detection: Adaptive Curvature, Color Normalization, ABCD Rule

This work [3] proposes a method for detecting melanoma skin cancer through three stages: adaptive principal curvature for hair detection and removal, color normalization for skin lesion segmentation, and melanoma detection via the ABCD rule. Experimental results on the ISIC dataset show high accuracy and overall good performance, with segmentation accuracy, Dice, and Jaccard scores reaching 96.6%, 93.9%, and

88.7%, respectively. Melanoma detection achieves up to 100% accuracy for a selected subset. The method effectively addresses challenges like hair detection, low-intensity skin lesions, and shadow effects. However, limitations include testing on a subset due to varying image resolutions, suggesting potential improvements with uniform image resolution. Future plans involve exploring deep-learning models and training on a larger image collection for enhanced accuracy.

Enhancing Skin Lesion Classification with GP-CNN-DTEL

This paper [4] proposes a Global-Part Convolutional Neural Network (GP-CNN) combined with a data-transformed ensemble learning strategy for skin lesion classification. GP-CNN utilizes both global and local information extraction, enhancing classification with a CAM-guided probabilistic multi-scale cropping method. Results on ISIC 2016 and ISIC 2017 datasets demonstrate SOTA performance without external data. GP-CNN-DTEL outperforms other methods, achieving optimal classification without segmentation training. While the CAM-guided approach slightly improves accuracy, the paper acknowledges the challenge of melanoma classification using single-modal dermoscopy images. Future work will focus on multi-modal learning, incorporating dermoscopy images, clinical images, and patient metadata to advance melanoma detection.

Automated Identification of Melanoma

The research [5] introduces a computerized system for early malignant melanoma detection using Epiluminescence Microscopy (ELM) images. Employing basic segmentation algorithms and a fusion strategy, the system achieves over 96% accuracy in skin lesion segmentation. Features, resembling clinical criteria, are calculated and reduced from 122 to 21 through statistical feature subset selection. A 24-NN classifier yields 61% overall classification performance and 73% for melanomas. The system, currently under comprehensive testing, supports clinical diagnosis, particularly in large-scale screening applications. Future improvements may involve incorporating new parameters and texture descriptors for enhanced discriminative information.

ML Approaches for Binary and Multiclass Melanoma Thickness Classification

1) The paper [6] presents a non-invasive system for estimating melanoma thickness from dermoscopic images. Using a supervised approach, it employs a binary and a three-class classification scheme. The Logistic regression using the Initial variables and Product Units (LIPU) model outperforms others with 77.6% accuracy in the binary case. In the three-class scheme, LIPU achieves the highest overall accuracy, but ordinal methods provide a better balance between class performances. The LIPU model's interpretability and feature contribution are highlighted. Compared to a previous study, the proposed system achieves 84% accuracy in a more extensive three-class problem. Notable features include color, pigment network, homogeneity, and texture. The three-class scheme, utilizing ordinal methods, shows improved performance and reduced errors, particularly in distinguishing between stage II and III melanomas.

Dual system for Melanoma Detection

This paper [7] addresses melanoma detection in dermoscopy images through two distinct systems. The first system employs global methods for skin lesion classification, while the second utilizes local features and a bag-of-features classifier. The primary goal is to determine the most effective system for skin lesion classification and to compare the discriminative roles of color and texture features. The findings indicate that, when used individually, color features outperform texture features. Both systems achieve excellent results, with global methods reaching Sensitivity of 96% and Specificity of 80%, and local methods achieving Sensitivity of 100% and Specificity of 75%. The classification evaluation is based on a dataset of 176 dermoscopy images.

Enhancing Skin Cancer Classification

This paper [8] addresses the critical role of computer vision in skin cancer detection, proposing two methods for classifying dermoscopic images into benign and malignant tumors. The first method employs k-nearest neighbor (KNN) with pre-trained deep neural networks as feature extractors, while the second uses AlexNet with grey wolf optimizer. The study compares machine learning (ML) and deep learning (DL) approaches, testing various models on 4000 images from the ISIC archive dataset. Both proposed methods outperform other approaches, achieving accuracies exceeding 99%. The research emphasizes the potential of DL techniques in enhancing skin cancer classification accuracy compared to traditional ML algorithms.

Optimizing CNN for Skin Lesion Diagnosis via Genetic Algorithm

This paper [9] introduces an optimized Convolutional Neural Network (CNN) model for early skin lesion diagnosis, leveraging a genetic algorithm to fine-tune hyperparameters. The model, trained on three public datasets, demonstrates superior performance in skin lesion classification, outperforming existing methods in evaluation metrics such as dice coefficient, precision, recall, F-score, accuracy, and specificity. The proposed model exhibits the ability to identify various types of skin lesions, making it a valuable tool for early diagnosis in clinical settings. The study contributes to the advancement of automated skin lesion classification, indicating the potential for a cost-effective and efficient diagnostic tool for dermatologists. Summary of the performance of classification methods is given in Table 1.

Table 1. shows Summary of performance of various classification methods for skin cancer

Author and Year	Methodology	Dataset	Performance
Thanh et al., 2020 [3]	Adaptive Principal Curvature, Colour Normalisation, and Feature Extraction with the ABCD Rule	ISIC 2017	Segmentation Accuracy: 96.6%, Dice Score: 93.9%, Detection Accuracy: 100%
P. Tang et al. 2020 [4]	GP-CNN	ISIC 2016 ISIC 2017	Accuracy: 0.718 (ISIC 2016), 0.842 (ISIC 2017)
H. Ganster et al. 2001 [5]	Segmentation and Fusion	Vienna General Hospital	Sensitivity: 0.87, Specficty:0.92, Segmentation Accuracy >96%
Sáez et al. 2016 [6]	Supervised LIPU Model	Private dataset	Accuracy:77.60% Sensitivity: 60.2%
C. Barata et al. 2014 [7]	Global Methods vs. Local Features and Bag-of-Features Classifier.	Pedro Hispano Hospital	Sensitivity: 96%, Specificity: 80% (global), Sensitivity:100%, Specificity :75% (local)
A. Magdy et al. 2023 [8]	**KNN with pre-trained DNN classifier AlexNet with Grey Wolf Optimizer**	ISIC Archive dataset	Accuracy: 99%
Salih, O., Duffy, K.J. 2023 [8]	Optimized CNN model	AM10000, ISIC 2018, and ISIC 2019	Accuracy: 98.66%, Specificity: 99.23%, Sensitivity: 98.57% (HAM10000)

CONCLUSION

The suggested overview presents a wide range of approaches and thoroughly examines developments in the identification and categorization of skin cancer. Techniques include improved Convolutional Neural Network (CNN) models that use genetic algorithms for hyperparameter tuning and Global-Part Convolutional Neural Networks (GP-CNNs). Accuracy above 99% is attained by the use of ensemble learning techniques, k-nearest neighbor (KNN), and AlexNet with Grey Wolf Optimizer. According to the report, computer-aided diagnosis (CAD) has great promise in dermatology and can provide doctors with useful second opinions. While some studies concentrate on particular methods, including adaptive principal curvature and ABCD rule-based features, others explore the incorporation of deep-learning models. Overall, the paper highlights encouraging advancements in automated skin cancer diagnosis, highlighting the need for ongoing research to develop practical and efficient clinical tools. Future directions include exploring multi-modal learning and training on larger datasets for improved accuracy and generalizability.

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Smart Washing Machine Controller Using Fuzzy Logic

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ABSTRACT

The paper compares a study of a fuzzy logic controller-equipped washing machine to a traditional washing machine. Fuzzy logic washing machines are becoming more and more common these days. The majority of the functions of a washing machine are fulfilled by machines without fuzzy controllers, but the handling of wash time is a little off. On the other hand, fuzzy controller-equipped machines can compute the impact of several factors and select the ideal wash settings. The benefits of these machines include reduced costs, simplicity, performance, and productivity.

KEYWORDS *: Fuzzy logic controller, MATLAB, Linguistic input linguistic Output, Membership.*

INTRODUCTION

Fuzzy logic outperforms traditional methods in controlling complex systems because PID is less powerful. This machine's main purpose is to lighten the workload and efficiently supply cleaner clothing. Manufacturers of washing machines are working to create fully automated machines with sensors that can fully detect the amount of laundry loaded, the amount of dirt on the clothes, and the type of material in the current wash cycle in order to display the cleanliness of the clothes. It is possible to translate the direct prediction of the necessary washing time into electrical signals that indicate the quantity of dirt.

Function more than one state concurrently, enabling engineers to provide a description of the system beyond natural language. The uses of fuzzy logic controllers: In contrast to classical controllers, the fuzzy controller can make use of information derived from operator or decision-making by humans. Fuzzy logic is used in rice cookers to calculate cooking times based on the quantity of rice and water.

Fuzzy logic is used in the case of air conditioning to determine the operating mode, fan direction, compressor speed, and fan speed based on the room's humidity and temperature. In the medical field, fuzzy logic is used to modify body tilt in order to modify heart rate (HR), systolic or diastolic blood pressure (SBP, dBP), or cardiovascular variables for patients undergoing extended bed rest. In 2007, time was calculated using fuzzy inference. provides the benefits of affordability, ease of use, and performance. This paper examines the most recent advancements in washing machine technology, which are based on an enigmatic technology that allows the machine to learn from its past experiences and save and modify programs to lower operating costs.

LITERATURE REVIEW

Fuzzy logic is used in the case of air conditioning to determine the operating mode, fan direction, compressor speed, and fan speed based on the room's humidity and temperature[3]. In the medical field, fuzzy logic is used to modify body tilt in order to modify heart rate (HR), systolic or diastolic blood pressure (SBP, dBP), or cardiovascular variables for patients undergoing extended bed rest[4]. In 2007, time was calculated using fuzzy inference. provides the benefits of affordability, ease of use, and performance.

This paper examines the most recent advancements in washing machine technology, which are based on an enigmatic technology that allows the machine to learn from its past experiences and save and modify programs to lower operating costs.

FUZZY CONTROL OF WASHING MACHINE

The type of laundry had to be manually selected in the past, and the user had to input the water level and cycle length before the machine could begin washing. The common logic of automating this process is explained by modern automatic washing machines. A mathematical system known as diffuse logic is able to interpret analogue input values and translate them into logical variables. In washing machines, diffuse logic is a crucial preset because it conserves water. Control-based devices can determine the ideal wash configuration by calculating the effects of various variables. The thickness of the garment, the type of sauce, the amount of water, and the amount of electricity required for a perfect wash all affect the washer's diffusion control.

Fuzzy Logic Structure

Figure 1 illustrates the fundamental components of fuzzy logic: fuzzy inputs, fuzzy outputs, rules, and defuzzification.

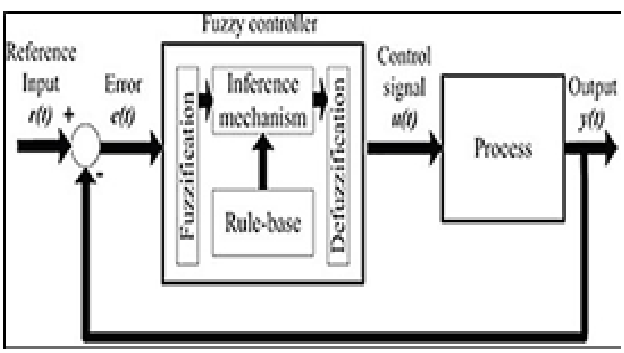

Fig. 1 Block Diagram of Fuzzy Controller

Fuzzy takes data from a system that is in a standard language and transforms it into values. The input quantity values, linked to membership functions, are expressed as words like "smallest" or "smallest" [7].

The fuzzy system's input and output variables are identified, and their values such as less, much, hot, and cold, among others—are subsequently chosen. Rules are then created, and the input and output relationship is created using those rules.

Development of Fuzzy controller for Washing Machine

The selection of an input variable known as a linguistic variable is the first step in the distributed controller's design. The type of fabric, the kind of dirt, the size of the clothes, and the dirt are the input variables used in this automatic washing machine. This variable was derived from a literature review and a conversation with a Yogyakarta laundromat customer who used a washing machine. The value, sometimes referred to as the "fuzzification process," maps the sensor data to the proper membership function and the ground truth values of the variable during the input phase.

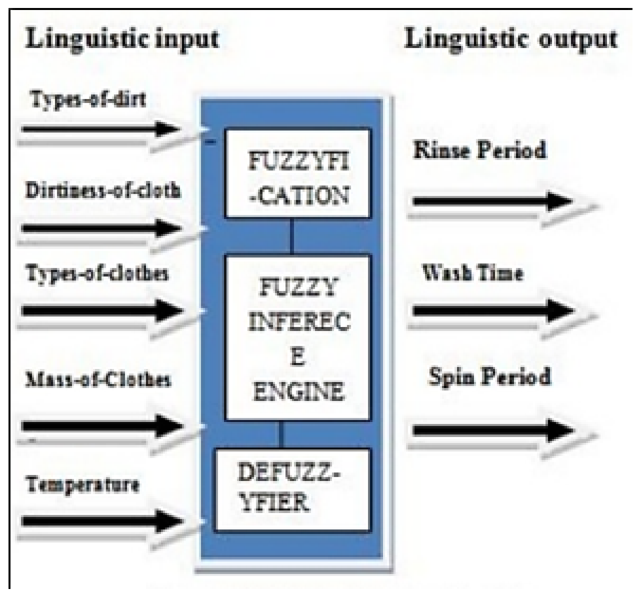

Fig. 2 Design of the Controller for Washing Machine

Following the processing of that variable with the relevant rule in the form of an IF-THEN statement, each rule's results are generated. Defuzzification, or translating the outcome of the rules back to output value, yields the output. The mapping of this controller's inputs and outputs is depicted in the figure below. The Mamdani method with triple membership function is the washer inference technique that was employed in the control system design. There are four steps involved in applying the Mamdani approach to fuzzy inference: fuzzing the input variable, evaluating the rules (inference engine), and assembling the rule outputs (synthesis).

Three linguistic inputs make up the proposed fuzzy logic controller for the washing machine:

1. Types of clothes
2. The kind of dirt
3. The state of the clothing

The one LO, or wash time, is managed by all of the aforementioned LIs. A total of 27 rules are used in the design of the proposed Fuzzy Logic Controller inference engine for Wash Time. Each input and output in linguistics has a set of membership functions. Triangle MF is the MF that is utilised for all LIs and LOs. All of the MF graphs' X-axes show the LI values that come from the sensors and go from 0 to 1 up to first, while all of the MF graphs' Y-axes show the degree of membership function.

Here, the sensors detect the input values. Using the model mentioned above, the inputs are fuzzyfied. The output fuzzy function is then obtained by applying basic if-else rules and other basic fuzzy set operations.

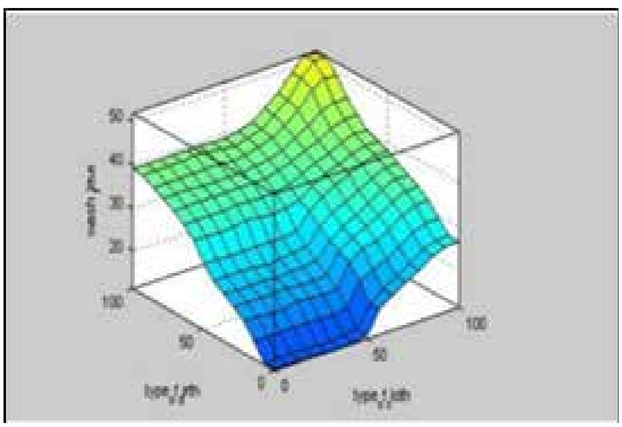

Fig. 3 Response surface of Input Output Relation

Figure 3. shows the response surface of the input output relations as determined by fuzzy interface unit. To obtain the accurate wash, rinse, and spin times, Suchitra and Naveen Kumar Malik (2008) introduced a fuzzy logic controller with three outputs and five input variables. FLC simulation is done using MATLAB's fuzzy logic toolbox.

Five linguistic inputs make up the proposed fuzzy logic controller for the washing machine:

1. Type of dirt
2. The state of the clothing
3. Clothing types
4. A large quantity of clothing
5. A temperature

All three of the LOs—

1. Wash time,
2. Rinse time—are controlled by the aforementioned LIs.
3. The spin time

There are 216 rules for the wash time, 216 rules for the rinse period, and 25 rules for the spin period in the proposed fuzzy logic controller inference engine.

A basic approach to the proposed FLC is shown in Figure 2. The three primary blocks of the fuzzy logic controller for washing machines are the defuzzifier, fuzzy rule select, and fuzzyifier.

Fuzzifier: The input and output variable values are predetermined in order to handle the specifics of the fuzzy logic controller. After the crisp input values are mapped to the fuzzy values using a membership function, the appropriate operation is applied to them. Fuzzification is the process of converting crisp values into fuzzy values; fuzzifier is the tool used to carry out this process.

Fuzzy Rule Select: The fuzzy logic controller bases its decisions on a set of rules called fuzzy rules.

Defuzzification: The outcome of the fuzzy inference technique is subsequently processed to yield a quantitative result, such as the total amount of time needed for washing (Wash Time), rinsing (Rinse Period), and spinning (Spin Period) the clothes. The defuzzification process is used to interpret the fuzzy sets' membership degrees in a particular real value (i.e., in a crisp value that is the opposite of what the fuzzification does). The defuzzification process uses the centroid method.

We have been able to obtain different Wash Time, Rinse Period, and Spin Period (output Variable) for different Types of Dirt and Dirtiness by using the proposed fuzzy logic controller.

RESULT ANALYSIS

When considering a control system, fuzzy logic presents a completely distinct approach from the traditional one.

Instead of attempting to comprehend how the control system operates, these techniques concentrate on what it should be able to do. Fuzzy logic imitates the actions that knowledgeable or experienced staff members should take.

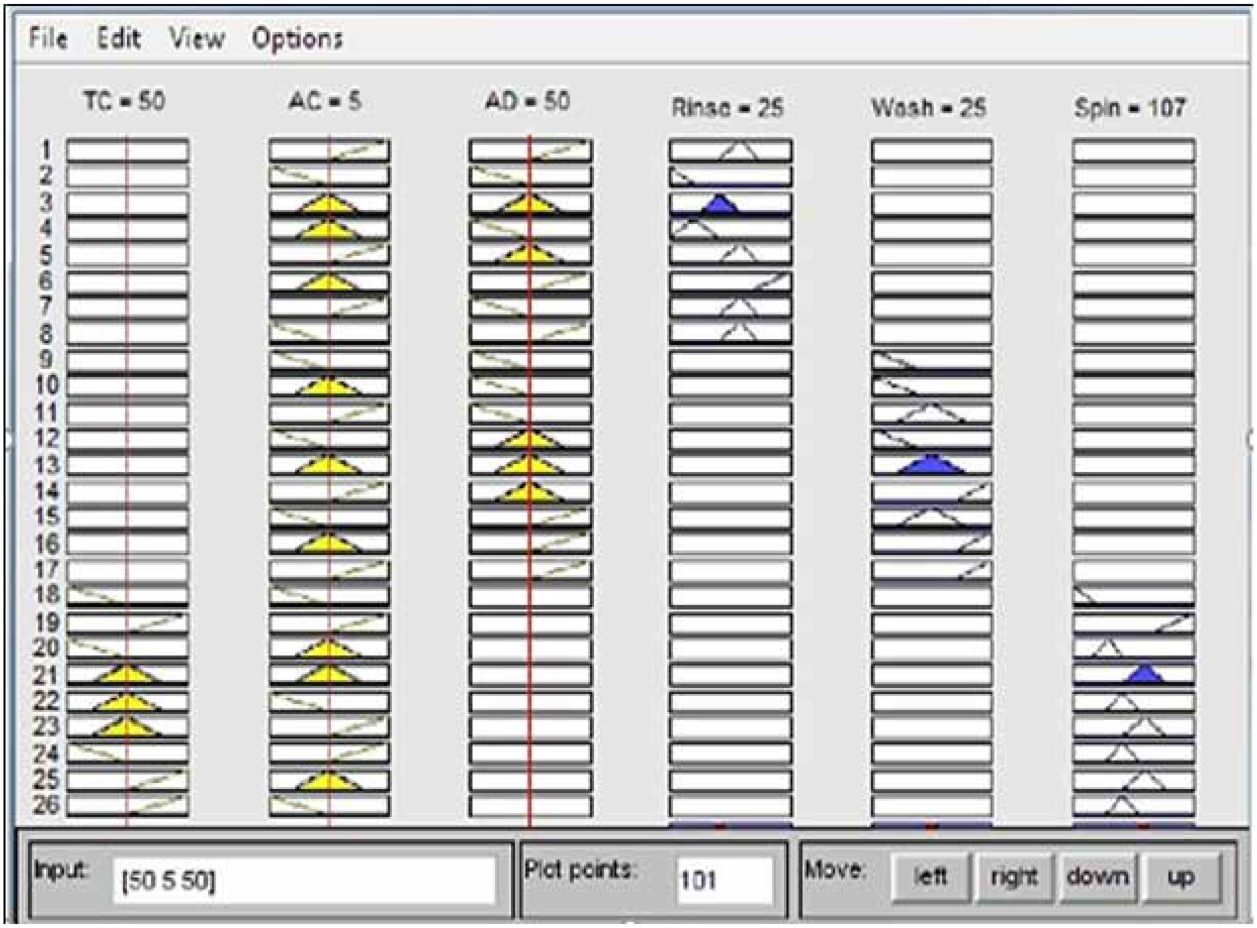

Fig. 4 The Rule Viewer on the Fuzzy Logic Tool Box

When compared to a traditional washing machine, the designed washing machine offers the user high performance, simplicity, productivity, and reduced costs. The best course of action is to use a sensor to automatically determine the output washing time based on input, as shown in Figures 3 which depict the surface graph relationship between the input variables of type of dirty and dirtiness of clothes and the output variable washing time. The graph indicates that the time of washing depends on those input variables.

As is well knowledge, the Min-Max operator is used to establish control rules. The following figures show these guidelines as 3D graphs. The relationship between input and output parameters is depicted in figure 3.

CONCLUSION

In addition to offering excellent water and electricity management, the fuzzy logic controller also improves washing machine control. As a result, the washing machine will last longer because it can now weigh the necessary amount of laundry to prevent overloading and adjust the water level. Modern technology has rendered the traditional washing machine obsolete, requiring human intervention to modify the washing speed and calculate the water amount based on experience. The best washing machine design in the future will be one that automatically adjusts to the particular task at hand by leveraging past experiences. This will save operating costs. The article's main focus is on using MATLAB to simulate and design a washing machine. There is a space designated for the design of electronic circuit boards that will show how these sensors will function in the future to automate the washing machine.

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Streaming IOT data with MQTT and Apache Kafka

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ABSTRACT

New generation applications of IOT range from healthcare, architecture, smart cities, home and industry automation etc. These applications demand flawless methods to collect data from power and size constrained devices and also seamless methods for streaming this collected data for processing. Modern technology supports these applications using various cutting edge technologies. MQTT protocol and Kafka streaming are two such technologies that complement each other and provide efficient results. This paper discusses the possibilities of increasing efficiency of MQTT with the Kafka framework to analyze the data.

KEYWORDS *: MQTT, Kafka, Connectors, Streaming data, V2X.*

INTRODUCTION

IOT data collected from sensors requires computational resources and storage space for processing the data. Edge computing, a distributed computing framework places computational resources and storage facilities in close proximity to end users. Edge computing is widely used in connected cars applications, where data is collected from various sensors connected to the vehicle to measure certain parameters like speed, direction, location etc. This data needs to be further processed and sent for analysis to cloud servers. Due to constrained devices used at the source of the sensor data, data can be transferred using special protocols that are designed for constrained devices applications. Message Queuing Telemetry Transport (MQTT) is an efficient protocol that is the current buzzword for connected vehicles. MQTT in combination with the Kafka framework at the cloud side for data aggregation and analysis provides an end to end solution for integration from edge to data center. In this paper we will discuss the framework to connect MQTT with Kafka for seamless data transfer from source to analysis platform.

MQTT

MQTT is a publish-subscribe messaging protocol designed for constrained devices or devices that have limited power, size, processing capability. Sensors applications, where MQTT can be used, work with low-bandwidth, high-latency, or unreliable networks.

It's commonly used in IoT (Internet of Things) scenarios, including connected vehicles communication, due to its efficiency in handling small, frequent messages and its ability to work well with resource-constrained devices.

In connected vehicles, MQTT can be used for transmitting real-time, small-sized data packets, such as vehicle status updates, sensor readings, or traffic information.

The MQTT protocol exchanges messages using a model that has a publisher and a subscriber. Whereas, in traditional network communication, clients and servers communicate with each other by using a protocol. The clients request resources or data from the server, then the server processes the request and sends back a response. However, in MQTT a third component, called a message broker, handles the communication between publishers and subscribers [1]. The message sender (publisher) sends data to a broker, the message receiver (subscriber) in turn collects data from the broker. The broker's role is to distribute all incoming messages from publishers appropriately to respective subscribers. The broker handles the process of message exchange using following steps:

1. An MQTT client sends a CONNECT request to the broker to establish a connection.
2. A client one connected can either publish messages or subscribe to specific messages, or do both.
3. A subscriber can register with the broker to receive specific types of messages. When the MQTT broker receives a message, it will check for interested subscribers and forward the messages to subscribers who have registered to a particular topic.

MQTT Topic

The MQTT broker stores the received messages under a specific title called "topic". Topics are hierarchical structures used to categorize messages within MQTT. Subscribers can subscribe to specific topics, and publishers can publish messages to specific topics. Subscribers receive messages that are published to topics they are subscribed to.

For example, consider a connected car system that has different smart devices and sensors connected to every vehicle. Data is stored in a hierarchical manner in the MQTT broker in organized topics as shown below:

ourcar/gps/location/direction

ourcar/sensorrare/distance/speed

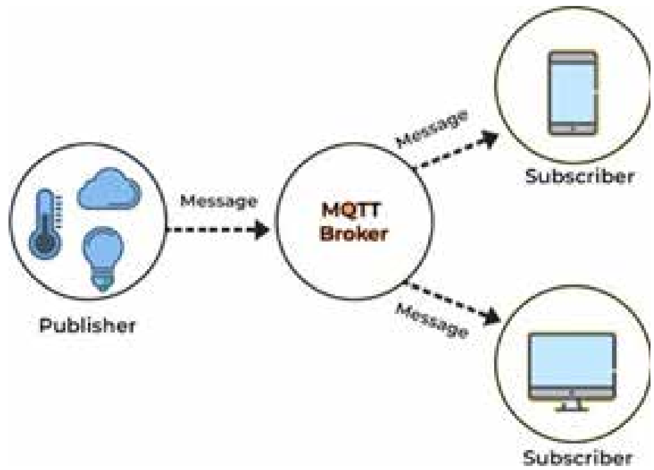
MQTT Publish

MQTT clients publish messages that contain the topic and data in a prescribed format such as text data, binary data, XML, or JSON files. The topic is created in a hierarchical directory structure. For example, a sensor at the rear of a connected vehicle measures the distance and finds out the speed. The message is then published on the broker under a specific topic.

ourcar/sensorrare/distance/speed

MQTT Subscribe

An MQTT subscriber is a client application or device that connects to an MQTT broker to receive messages published to specific topics. Subscribers are part of the MQTT publish/subscribe messaging pattern, where they express interest in certain topics and receive messages published to those topics in real-time. This message contains a unique identifier and a list of other subscriptions. For example, an application on mobile phones can display the speed of a vehicle by requesting the information from the appropriate topic on broker. It will subscribe to the topic distance. [1]



RELATED TECHNOLOGIES

Cloud Computing

Cloud Computing, due to its services like storage, databases, networking etc, has gained importance in vehicular data aggregation and computation. One such state of art example is Toyota's connected car architecture that is powered by Microsoft Azure HDInsight to process a large amount of data on a daily basis. Toyota vehicles have an inbuilt data communication module to transmit the vehicular data to a Toyota data center. The data center then provides various services using machine learning and analytics so as to offer customer specific services.

Edge Computing

Edge computing uses a range of network and processing devices near the end user. For example, data collected from sensors in a vehicle is processed at the edge devices placed in a Road Side Unit (RSU) instead of typical centralized cloud servers [7]. This results in significantly low latency Thus service requests need to travel a much shorter physical distance across fewer network nodes. Also the data storage capacity constraint is taken care of [3].

Fog Computing

Fog Computing in the connected vehicular scenario refers to any intermediate computation, storage, and network services between vehicles and the cloud that is located centrally. There are various scenarios of connectivity in vehicular networks: vehicle to vehicle and roadside units or infrastructure (using Wi-Fi, DSRC), vehicle to network (using LTE, 5G), and other Vehicle to Everything (V2X) scenarios. Fog computing uses decentralized model in which data is processed close to edge devices [7].

APACHE KAFKA

Apache Kafka is a distributed streaming platform used for building real-time data pipelines and streaming applications. It's highly scalable, fault-tolerant, and designed to handle large volumes of data streams across multiple producers and consumers.

In connected vehicles applications, Kafka can be employed as a centralized data backbone to handle massive amounts of data generated from vehicles, traffic infrastructure, or other sources. It can help in processing, aggregating, and distributing this data across various applications and services.

Both MQTT and Kafka can play complementary roles in a connected vehicle ecosystem. MQTT might be used for lightweight, real-time communication between individual vehicles or between vehicles and infrastructure components. [1]

Kafka could be employed for aggregating data from multiple sources (including MQTT streams), performing analytics, and distributing processed data to different applications or services within the ecosystem [2].

Ultimately, the choice between using MQTT, Kafka, or both would depend on the specific requirements, scalability needs, and data processing capabilities required within a V2X environment.

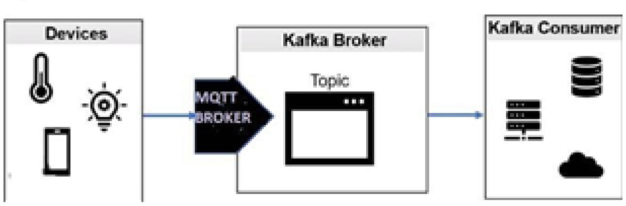


Fig.2. MQTT Apache Kafka Framework

KAFKA MODEL

When analyzing data within Apache Kafka, the model generally involves setting up Kafka as a streaming platform and utilizing various components/tools to process and analyze the data. Here's a typical model for data analysis on Kafka:

Data Ingestion

- Producers: Data is ingested into Kafka topics from various sources, such as sensors in vehicles, traffic signals, weather stations, etc. Producers publish data to specific Kafka topics [5].

Kafka Cluster

- Topics: Data is organized into topics, acting as feeds or categories where records are published. Topics can represent different data types or sources (e.g., vehicle telemetry, traffic conditions).
- Partitions: Topics are divided into partitions, enabling parallel processing and scalability. Partitions store ordered, immutable sequences of records.

Kafka Broker and Zookeeper

Kafka broker that helps to transfer the message from the producer to the consumer. The zookeeper works as the centralized controller which manages the entire metadata information for the Kafka producers, brokers, and consumers [8].

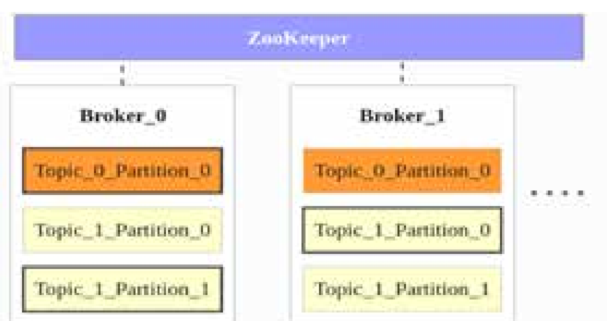


Fig.3. Zookeeper

Data Processing

- Stream Processing: Kafka Streams or other stream processing frameworks can be used to perform real-time analytics, transformations, and computations on the data within Kafka.

- Consumer Groups: Consumers subscribe to topics and process data from Kafka. Consumer groups enable parallel consumption and scaling of data processing tasks.

Integration with Data Analytics Tools

- Connectors: Kafka Connect facilitates integration with external systems and databases. Connectors can be used to push data from Kafka into data lakes (like Hadoop or cloud- based storage) or to pull data from external systems into Kafka for analysis [7].
- Data Analysis Tools: External analytics tools like Apache Spark, Flink, or custom applications can be employed to read data from Kafka topics for complex analytics, machine learning, or data aggregation.

Monitoring and Management

- Monitoring Tools: Implement monitoring tools such as Kafka Manager, Confluent Control Center, or custom monitoring solutions to track the health, performance, and throughput of Kafka clusters and data pipelines.
- Scaling and Optimization: Kafka allows for scaling horizontally by adding more brokers, partitions, or consumers to meet increased throughput or processing demands.

Output and Visualization

- Analyzed and processed data can be further pushed to downstream systems, databases, or visualization tools for insights and decision-making purposes. This might involve storing aggregated data, generating reports, or real-time visualization dashboards [6].

Subscribe to the messages posted to connect-speed topic: We shall start a Consumer and consume the messages in the speed.txt file.

The model is adaptable and can vary based on specific use cases, system architectures, and requirements. It involves configuring Kafka to act as a central data hub, enabling real- time data processing, and integrating with various tools and systems for analysis, storage, and visualization of the data streams.

RESULTS AND DISCUSSION

KAFKA Connect

1. Create a text file (speed.txt) as a source for the Kafka source connector.
2. Start Zookeeper and Kafka cluster

bin/zookeeper-server-start.sh config/zookeeper.properties bin/kafka-server-start.sh config/server.properties

3. To start the standalone Kafka connectors three configuration files are used namely:

connect-standalone.properties connect-file-source.properties connect-file-sink.properties

4. Run the following command from the kafka directory to start a Kafka Standalone Connector[8].

bin/connect-standalone.sh config/connect-standalone.properties config/connect-file-source.properties config/connect-file-sink.properties

5. You will notice a speed.sync.text created next to speed.txt:

Immediately after the Connector is started, the data in speed.txt would be synced to speed.sync.txt and the data is published to the Kafka Topic named, connect-speed. Then any changes made to the speed.txt file would be synced to speed.sync.text and published to connect-speed topic [8].

CONCLUSION

Using the MQTT protocol is found to be an effective solution for acquiring IOT sensor data in a constrained environment. This data has to be collected and analyzed so as to be suitable for varied types of consumers. Apache Kafka allows you to stream data between MQTT topics and external systems with minimal configuration and development effort. Real-time message processing, analytics, and integration with other downstream systems is supported by this framework. Additionally, this architecture provides scalability, fault tolerance, and flexibility in handling large volumes of data streams.

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Navigating Advancements: From Micro Drones with LIDAR to Robotic Innovations in the IoT Era

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ABSTRACT

In the realm of drone technology, a compact micro drone incorporating LIDAR-based proximity sensing has been introduced to tackle industry challenges like high costs and limited obstacle-avoidance capabilities. The integration of an Arduino Pro Mini, F3 EVO controller, LIDAR module, buzzer, LED indicators, and drone motors results in a cost-effective, adaptable, and noise-efficient platform. The LIDAR sensor, employing infrared technology, is instrumental in detecting obstacles and delivering real-time proximity alerts through LED indicators and a buzzer, facilitating rapid collision avoidance. The micro drone's lightweight design allows takeoff from unconventional locations, making it suitable for indoor operations, wildlife protection, and recreational use. However, limitations include restricted battery life, operating range, and reliance on manual obstacle avoidance. This research lays the groundwork for the democratization of drone technology, providing valuable insights for future advancements in autonomy and operational capabilities.

KEYWORDS *: Micro drone, LIDAR-based sensing, Obstacle avoidance, Autonomy, Cost-effective platform.*

INTRODUCTION

Drones have revolutionized various industries, including aerial photography, videography, infrastructure inspections, and environmental monitoring. However, their widespread use faces challenges such as financial barriers, limited adaptability to complex environments, and the inherent risk of mid-flight collisions. This study aims to tackle these issues by introducing an innovative and cost-effective microdrone system enhanced with advanced LIDAR-based proximity sensing. The envisioned micro drone is carefully crafted to address diverse applications, making it suitable for scenarios where traditional drones may be less effective. The integration of essential components like the Arduino Pro Mini, F3 EVO controller, LIDAR module, buzzer, LED indicators, and drone motors form the foundation of this compact and adaptable platform, designed for affordability and precision.

By leveraging LIDAR's ability to use infrared (IR) technology for obstacle detection, the micro drone aims to provide immediate feedback to the operator, enabling real-time collision avoidance. The system utilizes LED indicators and a buzzer to communicate proximity alerts, with frequency modulation serving as an intuitive indicator of obstacle distance. The micro drone's lightweight design and adaptability to non-traditional take-off locations, such as the palm of one's hand, trees, or tight spaces, expand its potential applications.

However, it is crucial to acknowledge certain limitations, including restricted battery life, limited operational range, and dependence on manual obstacle avoidance. This research not only introduces an innovative micro drone solution but also lays the groundwork for future advancements to enhance autonomy and extend the operational capabilities of this emerging technology. The goal is to contribute to the democratization of drone technology, unlocking its potential for a more inclusive range of applications and industries.

Internet of Things

The Internet of Things (IoT) encompasses a broad spectrum of applications, ranging from smart residences and urban setups to industrial automation and healthcare. The driving factor behind the widespread adoption of IoT is the necessity for increased connectivity and data-centric decision-making. IoT facilitates seamless communication, data gathering, and exchange among various objects and devices, enabling automation, remote monitoring, and improved operational efficiency. This technology is instrumental in addressing practical challenges like resource management, environmental monitoring, and advancements in healthcare delivery systems. Crucially, the impact of IoT extends beyond the consumer market, making significant contributions to vital sectors such as agriculture, transportation, and manufacturing.

LITERATURE SURVEY

Roberto Opromolla's paper (2016)[1] focuses on addressing challenges faced by Unmanned Aerial Vehicles (UAVs) in environments with unreliable GPS signals. The study advocates for integrating Light Detection and Ranging (LIDAR) technology and inertial sensors to enhance UAV performance, particularly in real-time environmental mapping and precise positioning for scenarios like infrastructure inspection and search and rescue missions.

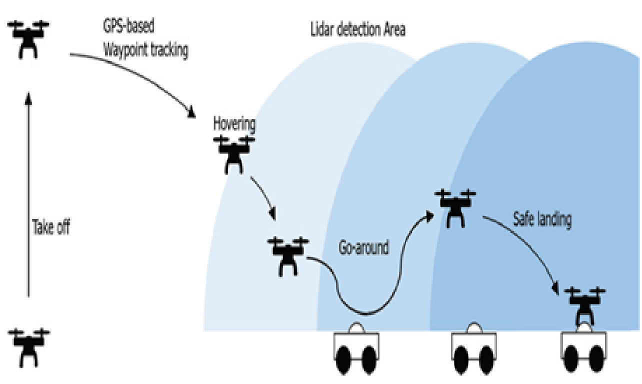

Fig 1.Proposed scenario of UAV landing autonomously on a UGV (Jonghwi Kim, 2017)[1]

Jonghwi Kim's work (2017)[2] introduces an innovative approach to autonomous UAV landing using LIDAR-based 3D point cloud data and clustering algorithms. Emphasizing the limitations of conventional landing methods, Kim's methodology demonstrates tangible improvements in overall autonomous landing performance.

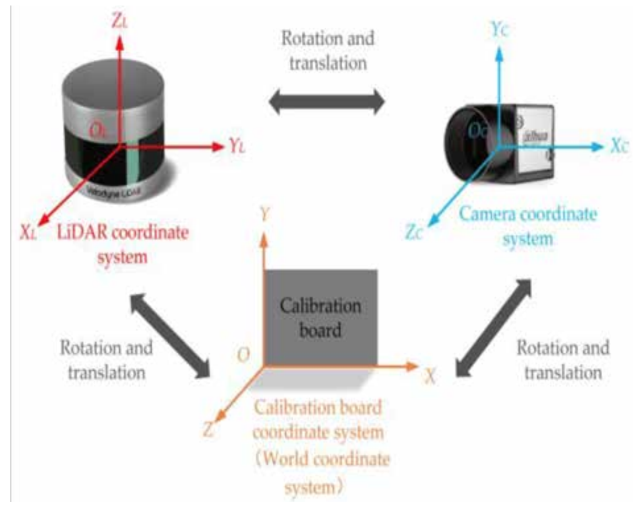

Fig 2. (a) A schematic diagram of the conversion relationship between three typical coordinate systems

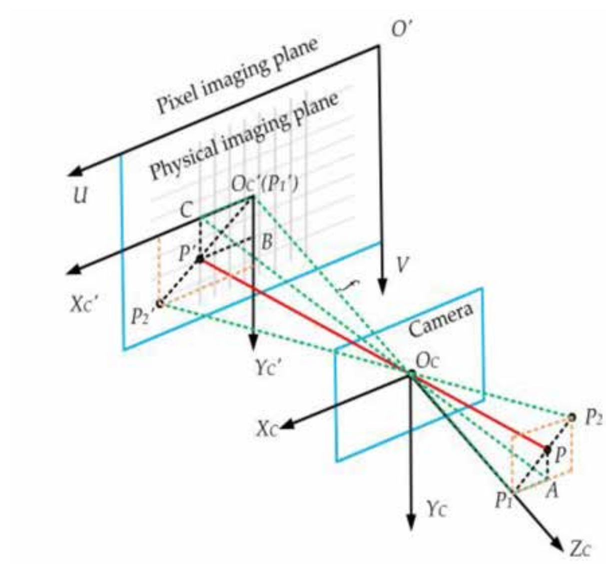

Fig 2. (b) An ideal pinhole camera imaging transformation model. Abbreviations: LiDAR, light detection and ranging

Kai-Wei Chiang's research (2017)[3] centres on the calibration of UAV LIDAR sensors. The study provides a dataset and calibration estimates, highlighting the critical importance of UAV LIDAR sensor calibration for achieving enhanced accuracy. Comprehensive flight line specifications and target features contribute to methodological rigor.

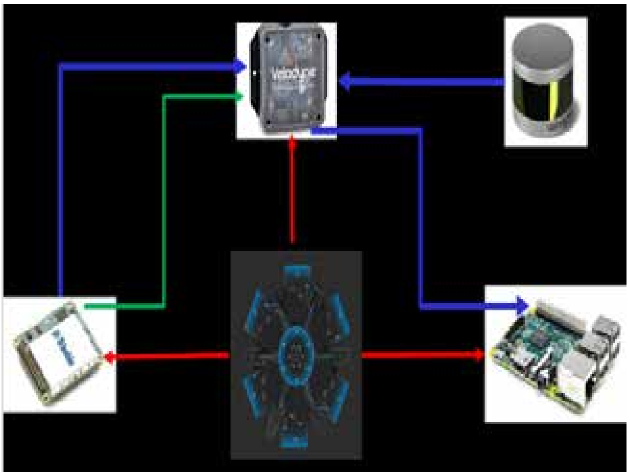

Fig 3. Integration scheme for the M600 UAV-based system

Radhika Ravi ID (2018)[4] explores advancements in Frequency-Modulated Continuous-Wave (FMCW) Lidar for accurate environmental detection. The paper elucidates FMCW Lidars' fine resolution and coherent detection capabilities, emphasizing their pivotal role in achieving precise environmental detection. The work concludes by underscoring the evolving significance of FMCW Lidars in advancing accurate environmental detection for autonomous machines. Overall, these papers collectively contribute significantly to the advancement of UAV technology and sensor integration, addressing challenges and highlighting the potential of cutting-edge technologies.

The paper "LIDAR Based Micro-Drone for Birds and Rodents Repellent System" presents a novel approach to agricultural pest management by introducing a micro drone equipped with LIDAR technology. Acknowledging the significant damage rodents inflict on crops, the authors propose a lightweight drone solution capable of obstacle detection using LIDAR sensors. The drone's design incorporates an Arduino Pro Mini F3 EVO controller, motors, propellers, and a buzzer, with the LIDAR sensor detecting obstacles and the controller activating alerts. The study outlines the system architecture, necessary components, methodology, and testing results, underscoring the potential of drones in agriculture. Additionally, it discusses future research directions, including the integration of a micro camera for pest identification, thereby contributing to advancements in drone-based agricultural pest control strategies.

The paper authored by Tudor et al. explores the integration of LiDAR sensors to enhance safety in electronic-controlled vehicles, particularly focusing on long-range distance measurements. Through detailed analyses of LiDAR operational principles and experimental assessments, the study demonstrates the sensor's efficacy in accurately measuring distances from 0.4m to 12m, regardless of target color. The authors also discuss potential applications of LiDAR technology in developing long-range mobile detection systems for vehicular safety, emphasizing the need for further research and development in this field.

Zhang et al. from Shandong University of Science and Technology propose an innovative real-time obstacle detection method using lidar and wireless sensors to enhance laser radar precision for dynamic obstacle detection, crucial for autonomous vehicle safety. Their approach integrates vehicle identification, multi-feature detection, and tracking to address dynamic obstacles, establishing a preliminary model of mobile obstacles with lidar data. Energy consumption is optimized through tracking area design for wireless sensor data utilization. Grid mapping techniques and data fusion ensure consistency between lidar and sensor outputs, effectively mitigating occlusion effects and improving obstacle detection accuracy, promising enhanced safety and efficiency for autonomous vehicles in urban environments.

COMPARISON

PAPER	OPROMOLLA (2016)[1]	KIM (2017)[2]	CHIANG (2017)[3]	RAVI ID (2018)[4]
Objective/ Purpose	Enhance Uav Performance In Gps-Unreliable Environments	Achieve Autonomous Uav Landing Using Lidar And Clustering	Improve UAV Lidar Sensor Calibration Using Reflective Targets	Explore FMCW LIDAR Advantages For Accurate Environmental Detection

Applications	Real-Time Environmental Mapping, Precise Uav Positioning	Autonomous Uav Landing	UAV LIDAR Sensor Calibration, Enhanced Accuracy	Accurate Environmental Detection for Autonomous Machines
Experimental Validation	Demonstrated Accuracy In Challenging Environments	Improved Overall Autonomous Landing Performance	Significant Enhancement in Calibration Quality	Not Explicitly Mentioned
Key Findings/ Results	Increased Autonomy For Infrastructure Inspection, Etc.	Improved Autonomous Landing Performance With LIDAR	Enhanced Calibration Quality Surpassing Expected Accuracy	FMCW LIDARs Offer Fine Resolution and Coherent Detection
Methodology	Lidar And Inertial Integration Process	LIDAR-Based 3D Point Cloud And Clustering	Reflective Targets For Calibration Estimates	Exploration Of Fmcw Lidar Characteristics And Applications
Significance/ Contributions	Proposes A Solution To Gps Limitations In Complex Environments	Innovates Autonomous Uav Landing With LIDAR And Clustering	Provides Calibration Estimates and Dataset For UAV LIDAR	Explores The Evolving Role of FMCW LIDARs In Accurate Environmental Detection
Challenges/ Limitations	Reliability And Accuracy Of The Integrated System	Not Explicitly Mentioned	Not Explicitly Mentioned	Not Explicitly Mentioned
Advantages	Real-Time Environmental Mapping, Precise Positioning.	Improved Autonomous Landing With Lidar, Enhanced Accuracy.	Enhanced Calibration Quality	Fine Resolution and Coherent Detection For Accurate Environmental Detection
Future Scope	Enhanced Autonomy In Challenging Environments, Scalability.	Advanced Autonomous Landing Approaches, Integration With Ai.	Further Enhancement of Calibration Methods, Broader Dataset.	Integration Into Diverse Autonomous Machine Applications.
Limitations	Reliance On Sensor Accuracy, Potential Complexity.	Dependency On Lidar Data, Potential Clustering Challenges.	Sensitivity To Reflective Target Quality, Specific Altitude Range.	Limitation On Specific Environmental Conditions For Optimal Performance.

CONCLUSION

The papers collectively advance UAVs and sensor integration. Opromolla (2016) improves UAV autonomy in challenging environments through LIDAR and inertial sensors. Kim (2017) pioneers autonomous UAV landing using LIDAR-based 3D point cloud and clustering. Chiang (2017) enhances UAV LIDAR accuracy through reflective target calibration. Ravi ID (2018) explores FMCW Lidar for precise environmental detection. Limitations include reliability concerns (Opromolla), potential clustering issues (Kim), reflective target sensitivity (Chiang), and unspecified FMCW Lidar limitations (Ravi ID). Future research includes scalability, advanced autonomous landings, and broader datasets, promising avenues for interdisciplinary exploration. The papers set the stage for continued UAV and sensor integration research.

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B92 Quantum Key Distribution Protocol for Secure Communication

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ABSTRACT

Key distribution enables two parties to generate and share a random secret key, crucial for encrypting and decrypting messages using symmetric cryptosystems. In contrast to traditional methods relying on the complexity of mathematical problems, Quantum Key Distribution (QKD) introduces quantum mechanical elements, providing a foundation for significantly secure communication. This paper outlines the practical application of the B92 Quantum Key Distribution protocol using Matlab to enhance communication security. Among the various possibilities, any two non-orthogonal states of the B92 protocol can be selected to model optical and electrical components. The B92 quantum coding scheme resembles BB84, encoding classical bits in two non-orthogonal BB84 states. Distinguishing itself from BB84, the B92 protocol employs only two states – one from the rectilinear basis (typically the H-polarization state) and another from the diagonal basis (typically the +45° - polarization state). This modification simplifies the protocol, making it more efficient while maintaining a high level of security. By employing these non-orthogonal states, the B92 protocol enhances the resilience of quantum key distribution for secure communication.

KEYWORDS *: Quantum computing, Cryptography, Quantum key distribution (QKD), B92 protocol.*

INTRODUCTION

Quantum cryptography is an encryption method that utilizes quantum properties to do cryptographic activities. A lot of public-key cryptography is started on the assumption that assessing the variables of an enormous number is hard for an old style PC or a DESKTOP. For even the most remarkable old style PCs, considering enormous whole numbers can require hundreds of years utilizing customary factorization calculations. Quantum registering represents a test to this encryption approach. Shor's quantum calculation speculatively works out the great variables of a huge whole number in polynomial time — substantially more effectively than an old style PC — which could break this technique for encryption. Because of present quantum equipment impediments, Shor's calculation can't right now genuinely undermine contemporary encryption rehearses, yet with additional improvement of quantum gadgets, quantum calculations like Shor's calculation might possibly represent a significant risk to computerized security later on. Subsequently, encryption procedures in light of quantum mechanical properties have been proposed and contrived as opposed to depending on the trouble of huge whole number factorization. The objective of quantum cryptography is to deliver and convey a mystery key between two clients, routinely known as Alice and Bounce, utilizing a strategy known as Quantum Key Dispersion (QKD) (Fig1). Since the condition of a qubit can't be estimated without falling the qubit, a snoop, Eve, will most likely be unable to correct the data from a specific qubit. To try not to be found, Eve would need to identify the qubit and afterward re-send it. Nonetheless, she will probably at last send a qubit in the mistaken state, bringing about blunders that will uncover the presence of the busybody. The BB84 conspire, the E91 plot, and the B92 plot are three of the most widely recognized QKD plans. The fairly fresher and less well-informed B92 plot is the subject of this review.

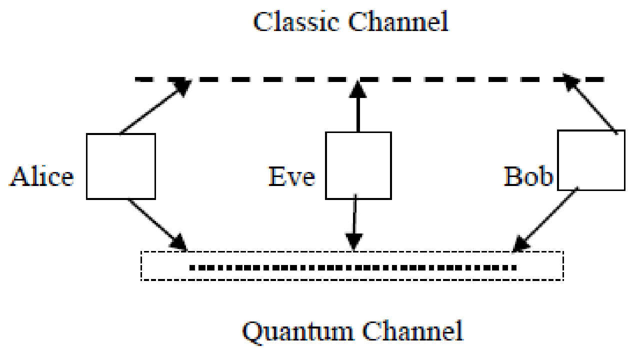

Fig.1. Quantum Key Distribution presentation

The basic model of QKD protocols involves two parties (Fig.1), Alice and Bob aim to establish a shared key for accessing both a classical public communication channel and a quantum communication channel. The illustration provided depicts this scenario, with an eavesdropper named Eve presumed to have access to both communication channels. The model does not make any assumptions about the specific resources at Eve's disposal. With this foundational framework in place, let's explore the fundamental principles underlying Quantum Key Distribution (QKD) protocols without duplicating existing content.

Assumed are Alice and Bob, two users who need to generate a secret key in order to communicate. There are two stages to a quantum key distribution protocol. During the post-processing phase, the generated bit strings from the quantum phase undergo a transformation to establish a pair of secure keys. The quantum transmission phase involves the sender and receiver either sending and measuring quantum states or simply performing measurements on these states. Two channels are required for the quantum key distribution process: a quantum channel and a classical channel where the message exchange process takes place. A photon ray is communicated across the quantum channel, with each photon being encoded using the polarization approach.

A fundamental aspect of information encryption and quantum key distribution is photon polarization. To put it simply, the polarization of light allows us to orient the electromagnetic field associated with its wave in a geometric manner. We concentrate on two varieties of polarization bases: the diagonal basis (orientation rotated by +45° and −45°) and the rectilinear basis (horizontal and vertical orientation). Thus, filters or crystals are used to encode a classical bit (0 or 1) into a photon's polarization.

B92: The B92 QKD Protocol utilizes energized photons to permit two gatherings, Alice and Bob, to make a mystery shared key, as well as recognize any snoop, Eve, who might have caught the quantum channel.

The QKD uses two non- orthogonal states of B92 (Fig. 2). The B92 protocol allows for the usage of any two non-orthogonal states. Having states that are orthogonal to them, or at least roughly so, is crucial. A pair of coherent states is one example. Any two coherent states can never be orthogonal. the scalar product of two states that are coherent is $\langle\alpha|\beta\rangle$ = e raise to $-|\alpha-\beta|^2$. This scalar product is substantially nonzero for two weak coherent states, which implies that two weak coherent states are never orthogonal. Where the two states differ by a phase angle, while the zero is encoded by $|\alpha\rangle$ and the unity as well and by the state $|-\alpha\rangle$. The type of encoding is very simple as it uses phase modulators.

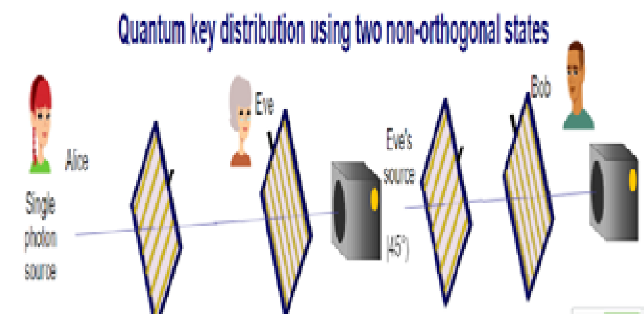

Fig.2. QKD Using 2 non- orthogonal states of B92 protocol (https://www.st-andrews.ac.uk/physics/quvis/simulations_html5/sims/cryptography-b92/B92_photons.html)

ANALYSIS OF B92 PROTOCOL

In 1992, Charles Bennett introduced the B92 protocol in his paper titled "Quantum cryptography utilizing any two non-symmetrical states." The B92 Protocol is a modified version of the BB84 Protocol, distinguished by a key difference. While the BB84 protocol utilizes four distinct polarization states of photons, the B92 Protocol employs only two. These include one from the rectilinear basis, typically the H-polarization state, and another from the diagonal basis, conventionally the +45°-polarization state.

The B92 Protocol can be summarized in the following steps:

1. Alice transmits a sequence of photons, randomly choosing between the H-polarization state and the +45°-polarization state. The H-state corresponds to the bit '0,' while the +45°-state corresponds to the bit '1.'

2. Bob randomly selects between rectilinear and diagonal bases to measure the polarization of the received photon.

3. If Bounce is measure on the rectilinear basis, there are two possible scenarios: on the off chance that the occurrence photon is H-enraptured, the estimation result will be H-state with likelihood 1 though on the off chance that the episode photon is +45°-captivated, the estimation result will be either H-state or V-state with likelihood 0.5If, by chance, the outcome is the V-state, Eve can conclusively deduce that the polarization state of the photon is '+45°'.

4. Similarly, if Bounce is measuring in the diagonal basis and obtains the result of the -45°-state, it unequivocally signifies that the incident polarization state of the photon is 'H'.

5. Following the transmission of a series of photons, Sway identifies instances where the measurement result was either 'V' or '-45°,' discarding the rest collaboratively. These outcomes serve as the foundation for generating a random bit string between Alice and Bounce.

6. For the confirmation of listening in, Sway and Alice openly share a piece of the produced irregular piece string and in the event that the piece blunder rate crosses a mediocre breaking point, the convention is cut off. If not, they presently have had the option to create a solid and symmetric key between them.

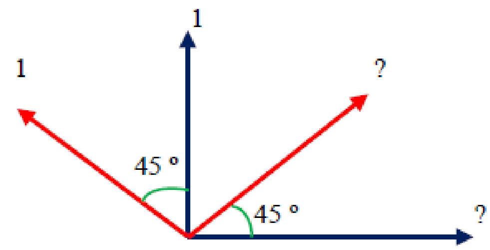

Fig.3. Photon Polarization Representation of B92 protocol

In accordance with Malu's law, the intensity of plane-polarized light as it traverses a polarizer is directly proportional to the square of the cosine of the angle formed between the plane of the polarized light and the transmission axis of the polarizer. The following formula describes the law of Malu's : $I = I_o \cos^2\theta$. In the provided equation, 'I' denotes the intensity of light that successfully passes through the polarizer, 'I_o' signifies the initial intensity of light entering the polarizer, and 'θ' represents the angle formed between the axes of the polarizer and the direction of the incident light.

According to quantum mechanics, light consists of individual packets called photons. Therefore, each polarizer has a certain probability of blocking or allowing a single photon to pass. This probability corresponds directly to θ.

Malus, the law states that light will not pass through a polarizer if the transmission axis of the polarizer and the polarization of the photon are perpendicular to each other, if there is an angle of 45° between them. With a probability of 0.5 that a photon passes and a probability of 0.5 that a photon does not pass. The coding scheme is shown in Table 2.

Table 1. Coding Scheme of B92 Photon Polarization

Base	Polarization angle	Bit Value
+	0°	0
×	45°	1

THE ALGORITHM

B92 Quantum Key is explained using the following steps:

1. Alice selects a bit string a = (a1, ..., an) and proceeds to encode each bit value, ai, where i ∊ {1, ..., n}, with the encoding rule: 0 is represented as |0>, and 1 is represented as |+> = |0> + |1>/√2.

2. Subsequently, Alice transmits her qubits to Bob, who, in turn, generates a bit string b = (b1, ..., bn). For each bi where bi = 0, Bob selects the ⊕ basis, and for bi = 1, he opts for the ⊕ basis.
3. Following this, Bob performs measurements, yielding another bit string s. In the event that Bob obtains a result of −1, the i-th bit of s is denoted as si = 0; conversely, if Bob obtains a result of +1, si = 1.
4. Subsequently, via the public channel, Bob publicly discloses the bit string s while maintaining the secrecy of the bit string b.
5. Following the public announcement, Alice and Bob selectively retain only those pairs of bits [ai, bi] for which si = 1.

Table 2. Implementation Example of B92 Photon Polarization

Bits that are sent by Alice (*ai*)	0	0	0	0	1	1	1	1
Alice's basis polarization	$\|0\rangle$	$\|0\rangle$	$\|0\rangle$	$\|0\rangle$	$\|1\rangle$	$\|1\rangle$	$\|1\rangle$	$\|1\rangle$
Bits that are chosen by Bob (*bi*)	0	0	1	1	0	0	1	1
Bob's basis	⊕	⊕	⊗	⊗	⊕	⊕	⊗	⊗
Measurement's result by Bob	$\|0\rangle$	$\|1\rangle$	$+\rangle$	$\|-\rangle$	$\|0\rangle$	$\|1\rangle$	$+\rangle$	$\|-\rangle$
Value of s	0	-	0	1	0	1	-	0

The security of the B92 Quantum Key Distribution protocol is fundamentally rooted in the principles of quantum key distribution, ensuring its robustness and reliability. The two gatherings can convey and trade a mystery key securely, as it is beyond the realm of possibilities for a deceitful client to get familiar with data's about the states and hence the key, without upsetting the quantum framework.

SECURITY MEASURES OF QKD

Quantum Key Distribution (QKD) stands out as a secure method for generating and exchanging cryptographic keys, leveraging the principles of quantum physics. The pioneering BB84 QKD protocol demonstrated its security against specific attacks, and subsequent protocols have introduced additional security certificates. Despite the theoretical foundation of being inherently unbreakable, the transition from theory to practical implementation reveals some challenges that warrant careful consideration. The security of quantum key distribution is a vital area of ongoing study, aiming to bridge the gap between theoretical assurances and real-world applications.

The vulnerability of Quantum Key Distribution (QKD) protocols stems from the intricate processes involved in the creation and measurement of photons, coupled with the inherent limitations and weaknesses in the optoelectronic interfaces of single photon detectors [18]. In light of these factors, malicious entities can exploit various avenues, strategically developing methods to illicitly extract information from the communication channel.

Attacks on Quantum Key Distribution (QKD) protocols vary in their impact, contingent upon the level of power bestowed upon the potential eavesdropper and the manner in which the rogue user engages with the transmitter's quantum states. In scenarios where the eavesdropper possesses limited power, the discussion revolves around individual and collective attacks, serving as a simplification in the security analysis of the QKD protocol. Conversely, when the eavesdropper wields unlimited computing power, coherent attacks come into play. These coherent attacks are regarded as a benchmark for assessing the robustness and security of the QKD protocol.

CONCLUSION

The B92 protocol, while presenting fundamental concepts applicable in various scenarios, is considered less secure compared to more advanced quantum key distribution protocols. Although there exist numerous contemporary and sophisticated protocols in the field, these foundational protocols like B92 and BB84 serve as the basis for Quantum Key Distribution.

Quantum Cryptography signifies a revolutionary advancement in secure communication. However, the B92 protocol, even in its theoretical foundation, doesn't exhibit the same level of security as some of the more modern encryption techniques. Further research and optimization are imperative before considering its widespread adoption to replace current encryption systems.

In practice, the B92 protocol is not as secure as desired, necessitating further development and enhancement. As of now, it may not be a viable replacement for existing encryption methods, particularly when these methods are still considered robust and effective. In comparison to the BB84 protocol, the B92 protocol eliminates the need to disclose measurement information, providing a potential advantage. However, its efficiency is limited to 25% in an ideal environment, with a significant portion of log particles being discarded. Consequently, only 25% can be retained as the original key, making the B92 protocol less efficient than the BB84 protocol.

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Comprehensive Survey of Visibility Prediction System

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ABSTRACT

Human perception of the environment depends on atmospheric visibility, which is influenced by factors such as climate, contaminated species, and air quality. It has an impact on life quality, traffic safety, and human health. Via numerical indices, digital image processing techniques offer visibility data. Although predicting visibility is crucial for life and production, there are more intricate aspects that influence meteorological visibility. Like weather prediction, current methods are based on numerical prediction. This research presents a comprehensive study of various prediction techniques

KEYWORDS *: Weather prediction, Numerical prediction; Atmospheric visibility.*

INTRODUCTION

Fog is a thick collection of tiny water droplets floating in the atmosphere near the ground. Fog's vertical depth can range from a few to hundreds of metres. Its density lowers vision from many km to near-zero. The World Meteorological Organisation (WMO) defines fog as horizontal visibility of less than 1000 metres on the ground (WMO 1966). Fog is described as extremely minute water droplets that decrease sight to the point that aviation operations are impeded or prevented (ICAO 2007).

Making judgements regarding weather predictions involves uncertainties caused by insufficient knowledge, missing or low quality data, uncertainty in observation, or ambiguity in helpful guidance tools. Many weather forecasts rely on numerical weather prediction (NWP); nevertheless, the geographical resolution of NWP models restricts the magnitude of atmospheric processes that these models can depict. Furthermore, fog generation is a complicated local process that is dependent on a delicate balance of local elements, which complicates fog forecasting. A high geographic level of visibility data in some locations (e.g., the UK) may make high-resolution NWP more appropriate for short-term fog forecasts.

For the purpose of reporting air quality and protecting the environment, visibility is an essential metric. Applications for it include smart cities, industry, agriculture, and traffic safety. Visibility estimation has historically been accomplished with specialized equipment, but this is costly and time-consuming. Visibility estimation based on climate indicators creates a mapping between visibility values and climate indicators. The goal of machine learning visibility estimation projects is to build predictive models based on atmospheric characteristics in order to overcome the shortcomings of existing methods. Real-time visibility estimation is achieved through the collection, training, and application of data on temperature, humidity, air pressure, and visibility values through supervised learning approaches. Metrics like mean absolute error, root mean squared error, or correlation coefficient are used to assess the model's performance. The ultimate objective is to create a scalable and trustworthy visibility estimation system for use in a variety of sectors, such as environmental monitoring, aviation, and transportation.

In order to solve safety issues and environmental monitoring challenges in sectors such as transportation and aviation, this study intends to design a machine learning-based system for accurate visibility estimation in a variety of weather circumstances. This will ultimately improve safety.

The main aim of this study is:

- Gather and preprocess data on visibility and atmospheric parameters.
- Create a machine learning model for visibility estimates by applying supervised learning techniques.
- Use measures such as correlation coefficient, mean absolute error, and root mean squared error to assess the efficacy of the model.
- Optimize the architecture or feature selection of the model to increase accuracy and dependability.
- Provide a scalable, trustworthy framework for estimating visibility across several industries.

Motivation

The following factors make machine learning visibility estimation necessary:

Accuracy: In sectors like transportation and aviation, machine learning can increase the accuracy of visibility estimations, lowering safety concerns.

Scalability: Systems based on machine learning are suited for a variety of industries since they can manage massive volumes of data.

Real-time Monitoring: In urgent situations, fast decision-making is made possible by real-time visibility estimates based on actual atmospheric conditions.

Automation: By reducing manual observation and intervention, visibility estimation that is automated can save costs and improve operational efficiency.

LITERATURE SURVEY

Elsevier B.V.[1]. The amount of research being done on weather predicting occupations has skyrocketed since weather-big data became widely accessible. The grid approach is used in this article's Auto-regressive Integrated Moving Average (ARIMA) model to anticipate increased visibility for the Machine-Based Visibility Predictions. This article [2] compared the accuracy of the approach with and without principle components analysis (PCA), using examples from the European Centre for Medium-Range Weather Forecast (ECMWF) and National Centres for Environmental Prediction (NECP) data. The results imply that PCA can improve visibility forecasting. Neural networks are incredibly accurate when it comes to machine learning methods. Prompt visibility information improves forecast precision.

The paper[3] analyzed the 500 most important scientific articles published since 2018 on machine learning algorithms for climate and numerical weather prediction using Google Scholar. The abstracts emphasised topics that are common to numerical weather prediction research, such as severe events, parametrizations, solar and wind energy, atmospheric physics, and processes. Common meteorological fields (wind, precipitation, temperature, pressure, and radiation) were extracted from the database using a variety of techniques, including XGBoost, Deep Learning, Random Forest, ANN, and SVM

This study[4] used an intelligent system to estimate long-term rainfall patterns, and the findings were compared to mathematical models such as ARIMA. Long-term forecasting is done using the present forecasting model. The rainfall in the Karoon basin the previous month, together with global meteorological signals like the north athletics oscillation (NAO) and southern oscillation index (SOI), are used to create a long-term forecasting method. The best outcomes come from SST and NAO signals, followed by long-term projections for six months, one year, and two years. The integrated model outperformed the two-year forecasts in predicting the six-month and annual periods

Cheol-Han Bang et.al [5] evaluated and improve the capabilities of the Weather Research and Forecasting (WRF) model in simulating fog and visibility in small airports over Korea. When the four visibility algorithms are compared in the WRF model reveals uncertainties that affect the accuracy of numerical fog forecasts over Korea. The Advanced Research WRF (ARW; Skamarock et al., 2005) is a community-based model useful for research and forecasting. his model has excellent potential for replicating mesoscale events.

Predicting visibility [6] is important for managing life and productivity. The variables that affect meteorological visibility are more complex than those that affect weather forecast, which is based only on atmospheric parameters. One example of such a factor is air pollution from factory exhaust emissions. To train the fusion model for numerical prediction, we employed LightGBM and XGBoost, the most sophisticated regression approach. The numerical prediction model proves to be more accurate than other currently used techniques, and our visibility prediction system's accuracy has been further enhanced by combining it with the emission detection method.

The creation of nonlinear postprocessors for visibility and ceiling prediction is covered in this article [7]. Neural networks are used as the statistical model to map these data to visibility and ceiling. When numerical model output is paired with surface data, statistical postprocessing of the model's output can enhance the forecast's quality. One way to approach the ceiling and visibility prediction is as a classification problem. The predictors, which are the model output variables and surface data, quantify the atmospheric conditions at the moment the NN is supposed to generate, which is the chance of falling into one of the groups or categories.

The current analysis, which spans two years of research, is provided by Sara and David [8]. It considers visibility time series as well as exogenous factors collected in the zone most affected by extreme low-visibility occurrences. This work aims to accomplish two goals: first, we do a statistical analysis to forecast the fittest probability distributions to the fog event length using the Maximum Likelihood method and an alternate technique known as the L-moments method. Second, we apply the Extreme Learning Machine (ELM) algorithm-trained neural network approach to anticipate the event of fog-induced low-visibility events using atmospheric predictive data.

Dustinet al. [9] evaluates artificial neural networks' (ANNs') capacity to produce precise predictions of these kinds of occurrences at Canberra International Airport (YSCB). ANNs show potential for use in fog prediction because, in contrast to traditional statistical techniques, they are ideally adapted to issues containing complex nonlinear interactions.

Because of the intricacy of the physical processes involved as well as the influence of the local topography and meteorological factors, fog episodes are challenging to predict [10]. In many different application sectors, A well-liked probabilistic reasoning instrument for risk assessment, diagnosis, and prediction is the Bayesian network (BN). Comparatively speaking to other networks and learning techniques, BNs are more extensible. It doesn't work well with high dimensional data. The goal of this research was to create a BDN for fog forecasting at Melbourne Airport that forecasters would accept and that performed equally well or better than historical operational skill. Forecasters have adopted the network and have been using it constantly since 2006.

Table 1: Summary of Visibility Prediction Methods

Sr. No	Author	Advantages	Disadvantages
1	Salman & Kanigoro [1]	Suitable for non-stationary time series, the forecast is stable and very accurate.	Reaction time is delayed.
2	Zhang Y et.al [2]	PCA can enhance algorithm performance and visibility prediction.	Less interpretation may be made of independent variables
3	Bochenek & Ustrnul [3]	You may narrow down your search results by dates, document kinds, language, domain, and other criteria.	Allow users to filter their search results to peer-reviewed or full-text items, as well as by discipline.
4	Sarah A. et. Al [4]	The system is simple to use and dynamic, requiring just endogenous variables. It is also self-learning and adaptable.	Unable to handle fluctuations, Unable to react to non-linear interactions. Unpredictable predicting abilities.
5	Cheol-Han et.al [5]	able to swiftly create basic layouts	Compute arrays slowly if you don't use Fortran.
6	CHUANG Z. [6]	Utilising an efficient fusion technique to combine the information from many modalities can greatly increase overall accuracy.	Compared to unimodal biometric systems, they are more costly and need greater computing and storage power.

7	Caren M. et. al[7]	Fast computation speed, great resilience, fault tolerance, and high accuracy	One of the known drawbacks of neural networks is their complex algorithms.
8	Sara C et.al [8]	dependable forecasts.	Processing of huge neural networks takes a while.
9	Dustin F et. Al [9]	a strong ability to forecast models.	Predictions of high quality require a lot of data.
10	Tal & T. Weymouth [10]	more expandable compared to alternative learning approaches and networks.	When dealing with large dimensional data, it performs badly.

CONCLUSION AND FUTURE SCOPE

Since weather-big data became available, there has been a considerable increase in research on weather forecasting. An ARIMA model for enhanced perceptibility forecasting using grid approaches is presented in this paper. Examples from the NECP (National Centres for Environmental Prediction) and the ECMWF data were used to evaluate machine-based visibility predictions. The results imply that PCA can improve visibility forecasting. When it comes to machine learning approaches, neural networks are quite accurate. Additionally, prediction accuracy is improved by early visibility data.

An intelligent system was employed in a study to forecast long-term rainfall patterns, and the results were compared with mathematical models such as ARIMA. When it came to six-month and yearly period predictions, the integrated model fared better than the two-year projections. In order to simulate weather, the WRF model was assessed as well as enhanced.

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WordNet Mapping of Terms from Twitter

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ABSTRACT

The analysis of data from social media platforms, such as Twitter, can play a significant role in our analysis in the age of digital communication, as individuals use these platforms for quick and frequent communications. The goal of this project is to map the tweets that are retrieved from Twitter and used in regular conversations to the WordNet, extracting phrases or acronyms that are not included in the WordNet. WordNet is an online lexical database that users may access through a web browser. It organizes English words into synsets, or sets of synonyms, gives brief definitions and use examples, and keeps track of several relationships between the members of these synsets [8]. The project's goal is to give beginners access to a dictionary of meanings for commonly used "Internet specific words."

KEYWORDS : *WordNet, Synsets, Twitter.*

INTRODUCTION

Our primary focus is on text analysis of the conversational data from Twitter (tweets). Our study involves decipher- ing abbreviations, phrases, or well-known "internet slangs," classifying the extracted words based on WordNet's synset grouping, and establishing a mapping with the current synset or, if necessary, generating additional synsets [8]. There is a set of research papers called "Five Papers" [1] which present the development and the implementation of WordNet. We have referred the following research papers for our analysis which helped us in understanding the evolution and the implementation of the WordNet. The categorization of words into different categories like Noun, Verbs, Adjectives and Adverbs and semantic relationship between these words [9]. [2] for referring to (online)wordnet database. [3] for referring to the Microsoft Research Conversational DataSet

PROBLEM ADDRESSED

The vast quantities of conversational exchanges now avail- able on social media websites such as Twitter and Reddit raise the prospect of building data-driven models that can begin to communicate conversationally [4]. People utilize a variety of acronyms and phrases in today's age of digital communication, where they use social networking sites like Twitter for quick and frequent chats. These terms are not included in any dictio- nary, therefore it is quite difficult for beginners to look them up and learn their definitions. Furthermore, there isn't a specific website or dictionary that lists all of these acronyms and phrases together with their definitions and context. Therefore, the goal of this project is to extract these terms and map them to WordNet, an existing lexical database, making it possible for users to get the meanings of these words via a web-based portal along with context, categorized usage (speech parts), and examples.

EXISTING SYSTEM

There isn't currently a platform that allows users to look up the definitions, usages, and context of these terms. Numerous groups have worked on it, gathering words and storing their definitions so they could manually pull it up if they came across new terms, acronyms, or expressions.

Online resources such as webpages or blogs

A number of websites, such as smart-words.org, have com- piled a list of terms by hand. Additionally, there are blogging systems, such as Computer Savy Weblog (CSW), that are updated frequently. Some of the site members who consistently update this collection have been granted blog membership and access credentials.

WHY WORDNET: AN ANALYSIS IN COMPARISON TO OTHER ONLINE DICTIONARIES

WordNet is a large electronic lexical database for English (Miller 1995, Fellbaum 1998a). It originated in 1986 at Princeton University where it continues to be developed and maintained. [5]WordNet is an electronic database that searches words conceptually as opposed to alphabetically, as most con- ventional dictionaries, such as Oxford, do. While the wordnet stores words based on their semantic relationship, such as synonyms, antonyms, homonyms, meronyms, troponyms, and entailment, all other online dictionaries store words lexico- graphically, and words with similar meanings are dispersed throughout different places. A single search can yield all the related words along with their usage. We have searched all terms with comparable meanings that map to acronyms or terms unique to Twitter to terms from English literature using wordNet as our source of meanings. WordNet offers a productive way to accomplish this operation. Any internet dictionary can provide us as many synonyms as possible, but WordNet gives us access to the complete ontology.

Design of WordNet

WordNet's structure can be thought of as a network struc- ture, where the nodes stand in for the synsets. The success of WordNet, as mentioned, is largely due to its accessibility, quality and potential in terms of NLP [6].Cross-synset pointers allow us to traverse the graph from one node to the next and obtain the complete ontology [10]. The lexicon is separated into five categories by WordNet: function words, verbs, ad- jectives, adverbs, and nouns.Semantic relations are used to organize WordNet. All synsets are related to one another by the existence of semantic links between them. The following types of relationships make up wordnet:

- Synonymy: The commonality of meaning is the most significant relationship. If substituting one expression for another never modifies the truth value of the sentence containing the substitution, then the two expressions are synonymous. y is similarly comparable to x if x and y are similar [7].
- Polysemy: This relation represents words that have more than one meaning. Or, to put it another way, they are words with several meanings. Crane, for instance, might mean two things: First, a long-necked bird and second is a kind of building tool that resembles a long neck.
- Antonymy: A word's antonym is occasionally not x, but not always. For instance, although joyful and sad are antonyms, it doesn't follow that someone who is unhappy is also depressed.
- Hyponymy: This semantic relation illustrates a ”kind/subordinate” type of relation. A type of y is an x. For instance, a family is a form of group, while a tree is a type of plant [7].
- Meronymy: This semantic relation illustrates a ”part/whole” sort of relation. An x is either a part of y or a section of y possesses an x. Sheep, for instance, belong in the fleet, and brims belong in the hat.
- Entailment: The process of inferring necessary implica- tions from the use of a word is known as implication. If A then B, that is, if A is true, then B must also be true. For instance, marriage and divorce are related. If a marriage is formed, a divorce may follow.

PROPOSED WORK

- Extraction of conversational tweets to obtain and examine these acronyms and words
- After extracting the words from tweets, search WordNet for them. If they are not there, check a standard dictionary like Oxford to see if they are there.
- Map the words which exist in standard dictionary but not in WordNet to the WordNet synsets
- If the term is found in the standard dictionary, obtain its definition from it. Store the word and its conceptual meaning if the WordNet synset for it does not exist, or transfer it straight to the WordNet synset it is a part of.

- Keep the terms in a file that are not included in the standard dictionary.
- The developers will manually insert the word-related data during the parsing of the words in the aforementioned file.
- Following the database's storage of the words and their associated concepts, the concepts are mapped to the Wordnet's synsets.
- The third group of terms, those that are not included in WordNet or any other standard dictionary, will be labeled as "unknown" since they either relate to words whose usage is unclear or to words that are grammatically improper.

IMPLEMENTATION

Implementation

- We began by extracting the conversational tweets from conversation data tweet and replies to it—provided by Microsoft Research. From there, we isolated the chat tweets and combined the tweets by eliminating links, stopwords, and retweets.
- We collected all the words in the tweets fetched in a CSV file
- We iterated through every word in the CSV file one at a time and checked to see if it was present in WordNet; if not, we saved it in a different CSV file. This was the initial filter we used to identify words missing from WordNet.
- The next stage involved determining the definitions of terms that were not present in WordNet but could be located in dictionaries such as Oxford, Pydictionary, and others.
- Following their screening, the terms that weren't found in any dictionary remained. These words were either grammatically incorrect, abbreviated versions of words, phrases, or abbreviations.
- Consequently, we were left with three categories of words after running two level filters over the collection of words we obtained from retrieved conversational tweets:
  - Words that were present in conventional dictionaries but absent from WordNet.
  - The terms that were absent from WordNet and all dictionaries.
  - Words that fall under the category of "unknown" if their usage cannot be matched to a standard dictionary or WordNet.
- Following the two-step word filtering process, we eliminated the third group of terms labeled as "unknown" from the list above. These are words whose usage is unclear or whose grammar is incorrect.
- The remaining categories that needed to be mapped to the WordNet were as follows:
  - Words that were directly present in WordNet
  - The Oxford terms that were absent from WordNet.
  - The terms that were absent from both Oxford and WordNet.

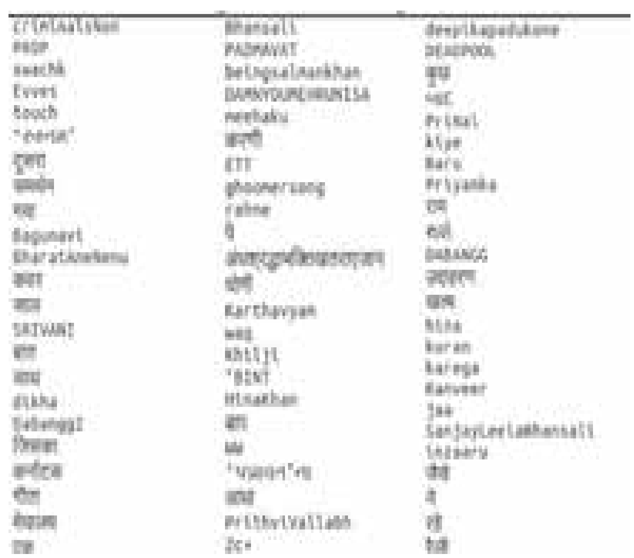

Fig. 1. Dataset when hashtag used

- Using the NLTK and function calls via the WordNet Interface, it is simple to extract the words that are directly present in WordNet, along with their data and synsets.
- By using the Oxford API, one could search for words in the Oxford Dictionary online.
- We personally searched for the meaning and usage of the remaining words that were not present in

WordNet or Oxford, recording the concept and its commonly used meaning in our database. MongoDb is a NoSql database that we have utilized.

- To enable concept mapping to WordNet, the idea for sentences like ”Talk To You Later” (ttyl) was reduced to a single word, ”wait.”

Datasets

As a Result from this work we found a of words which doesn't exist in WordNet, Oxford or any other dictionary, Some of these words include :

- LOL- Laughing out Louder
- SMH -Shaking my head
- IDK - I don't know
- IMAO - In my arrogant opinion

1) Initial Dataset: This is the dataset containing multi-lingual terms like Hindi, English, Sanskrit, and so on, with hashtag queries like ”Padmavat” or ”Modi.”

2) Language Restricted dataset: We changed the search query to a nation-based search and added the country ”US” in order to limit the language to simply English and obtain the words we wanted.

3) Targeted DataSet: Ultimately, we were able to acquire our desired dataset from the conversational tweet ids provided by Microsoft Research. Upon obtaining the tweets from these account IDs and using several levels of filtering, we managed to extract the collection of words we were looking for, which included phrases, acronyms, and ”internet slang.”

4) Categorizing the DataSet: The acquired dataset was divided into a number of groups and categories, such as ”abbreviations” (ttyl for ”talk to you later”), ”short forms” (lyk for ”like”), and ”expressions” (haha).

5) Mapping Words and their Meanings: Once the words were divided into different groups, we manually looked up every thought that might be connected to that word and kept in our database for each category.

Danielle	tigerwoods
OHLORT	Who's
21	SXSW
valsparchampionship	CareerArc
34	mill
su	Blockedddddredd
liberalcommentators	Tiger's
Idol'	Gobert
Golazo	militaryVOLUNTARYtotally
Valspar	paulcasey
can'tmiss	OklahomaCity
WEBDeBois	Christina
WOWOWOWOOWOWOW	Cullman
ATLUTD	Harrisonville
SorryToBotherYou	"political"
'American	Ulta
shower	Neil
Gaiman	ValsparChampionship
AMAM2018	50"
288	"I'd
"the	litty
Hahahaha	tha
beach"	leling
valspar	retrogame
Ove	

Fig. 2. Dataset when country restricted to US

ok	iky	tlk
annnnnnnnnnnnd	LOL	gtwt
chillin	TALM	catl
tommarrow	HMU	omfg
hahahha	CTFU	fml
SOO	SMH	idfk
Lol	IDK	HMPH
ik	IMAO	bby
lyk	huh	otr
ahaha	gonna	lowkey
Yupp	erm	lght
meann	wtw	stfu
ohhh	lmfao	lght
goooood	AMP	wbu
ahahah	IKR	okc
yoursif	TTLY	hbu
ey	dunno	ps3
hmmmmm	ASAP	wyd
verrrry	NTY	whn
Okayso	btw	slao
lmfaoooo	omg	bofl
lovvvveeee	lyk	

Fig. 3. Dataset from conversational tweets provided by Microsoft

6) Creating Web Based Portal For Searching Word: Using Python Flask, we have developed an online portal that facil- itates word searches within our word collection as well as WordNet and Oxford.

a) Words present in WordNet: We have acquired the user-specified word's part of speech, concept, examples, and lemmas.By clicking on the link, the user can further explore the meanings through the lemmas. To retrieve the word's meaning from Wordnet, we have so created function calls via the Wordnet interface offered by the nltk corpus.

By using Oxford API calls, we can also retrieve the definition of the term entered by the user from the Oxford Dictionary.

b) Words not in WordNet but present in Oxford: We have used Oxford API calls for words that are present in Oxford but not in WordNet. The data is returned in JSON format by the Oxford API.

c) Words neither in WordNet nor in Oxford:

- Words taken from Twitter and added to our word database: The user can access all concepts linked to a term if it is not found in Wordnet or Oxford, but rather in our repository or database. The user can then conduct other searches on the WordNet to learn more about these ideas or terms that define how the sought word is used. As a result, we have searched the database for all concepts related to these terms, and then we have used the WordNet Interface to call functions to get definitions, examples, and other information.
- Words taken from Twitter that are not in our word database: The user has the option to provide a recommendation for the meaning of terms that are not found in either Wordnet or Oxford. The mail module in Flask is used to send an email to the administrator. After manually confirming the word's meaning, the administrator adds it to the database.

RESULTS

Oxford and WordNet are the two dictionaries we have utilized. We have categorized the words into the following three groups based on the terms that are present in them. If a word is found in either of the two dictionaries, the user can search for it and view its definition. Refer to figure 4.

Words present in WordNet and Oxford

The user can view the Oxford and WordNet definitions for these kinds of words.Refer to Figures 5 and 6, in that order. The word's lemma can also be searched by the user. A word's lemma is supplied by WordNet. As an illustration, Place is a lemma that WordNet provides for Home. By clicking on Place, WordNet will immediately search Place and display its definition. Refer to figure 7.

Words not present in WordNet but are present in Oxford

For these kinds of words, Search In Oxford will give the definition straight from Oxford (see figure 8), but Search In WordNet will ask the user to recommend words to the administrator so that the administrator can send a message with the word and the recommendation, and the administrator can confirm and add them to the database.(For email, see figures 9 and 10)

Words neither in WordNet nor in Oxford

This class of words, which is not found in the Oxford or WordNet dictionaries, makes up a bigger portion of our dataset. It is made up of words that are often used in chats and conversations on the internet (in our instance, Twitter). Similar to the last instance, the user will be asked for suggestions for these kinds of terms, and an email will be sent to the admin.

The Web based Portal

Using Python Flask and MongoDB, we have developed an online gateway that enables word meaning searches within our own repository as well as WordNet and Oxford. The screenshots of various screens are mentioned below.

CONCLUSION

We are aware that there are numerous terms like short forms, phrases, and abbreviations that people use on a daily basis to save time typing in conversations, but there are also a lot of individuals who are still ignorant of these terms and find it difficult to understand them. Thus, we tracked down every instance of these terms in the conversational data we obtained from Microsoft and compiled them into a CSV file. These words were divided into three groups: those that are present in WordNet, those that are not in WordNet but are present in the Oxford Dictionary, and those that are not present in any of these. We developed a gateway where users can look up a word's definition from Wordnet or Oxford, depending on which of them is used. If they are still unable to determine the meaning, they can propose the word's definition to the administrator. This will contribute to the database's enrichment. As a result, we may anticipate that the database will eventually contain the majority of commonly used online terms, making searching easier and fulfilling the paper's goal.

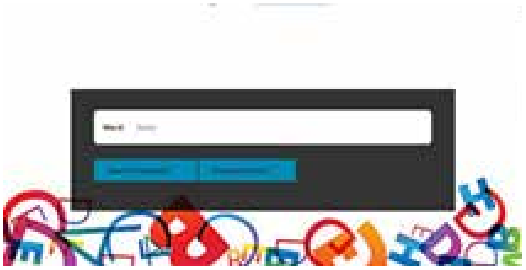

Fig. 4. Search Screen

Fig. 5. Output when Search In WordNet

Fig. 6. Output when Searched In Oxford

Fig. 7. Output when Place lemma clicked in Figure 5

Fig. 8. Output when TTYL is searched in Oxfordt

Fig. 9. Word not in WordNet and System Database so asking suggestion

Fig. 10. Email sent to Admin for suggestion

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Securing the Sustainable Energy with AI -An Overview

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ABSTRACT

In recent years, India has faced numerous challenges in its power sector, including issues with distribution, transmission, and generation. The country's current electrical infrastructure requires significant improvements to meet the growing demand for electricity. Fortunately, artificial intelligence (AI) has emerged as a promising solution to address these flaws and enhance power sector efficiency. AI, a branch of computer science, involves the development of intelligent machines that can perform tasks without human intervention. By analysing large sets of data and making informed decisions, AI systems have the potential to transform the power sector in India. Currently, India's power distribution system is plagued with issues such as high transmission losses, power theft, and billing inaccuracies. These problems result in significant revenue losses for power companies and unreliable electricity supply for consumers. However, by integrating AI into the distribution network, these issues can be mitigated. In this paper we will discuss the concepts of artificial intelligence, the overview of current power system of India, the role of artificial intelligence in eradicating the current flaws in the system and also in getting the power sector infrastructure future ready.

KEYWORDS *: Artificial intelligence(AI), Energy management, Power sector, Smart grid, Optimization.*

INTRODUCTION

The energy sector has undergone rapid development in response to the demand for sustainable and efficient energy generation, delivery, and consumption. Artificial intelligence (AI) has revolutionized the energy management industry with its capacity to offer smart grid optimization, predictive maintenance, and advanced data analytics. The application of AI to energy management improves decision-making, efficiency, and outcomes. The energy industry is undergoing a dramatic change as a result of the development of artificial intelligence (AI) and machine learning. Artificial intelligence (AI) provides a more scalable, sustainable, and effective means of producing, distributing, and transferring power, which has the potential to revolutionize energy management. AI is transforming the energy industry in a number of ways, including smart grid technology and predictive maintenance. The term artificial intelligence (AI) describes how computers, especially computer systems, may mimic intelligent human behaviour. AI in energy management refers to the automation and optimization of energy production, use, and management through the use of machines and algorithms. Artificial intelligence (AI) systems are capable of carrying out tasks like pattern recognition, natural language processing, and decision-making that normally need human intelligence. The need to promote sustainability and decrease carbon footprint is causing a major revolution in the energy sector. AI is essential to this shift because it helps energy businesses streamline their processes, cut expenses, and lessen their environmental impact. Since the 50s, artificial intelligence has advanced significantly, and Alan Turing, a well-known computer scientist and mathematician, is considered one of the among its forerunners saw the official introduction of the phrase artificial intelligence, and .64 saw the proposal of the List Processing program. Artificial intelligence (AI) technology faced a lack of attention, financing opportunities, and computer resources between 75 and 80. In 82, the artificial neural network theory became well-known. Artificial intelligence (AI) has changed dramatically between the .90s and 2015, moving from cloud-based devices to sophisticated software libraries like Tensor Flow, Caffe-2, and Lite Libraries. These libraries have been crucial in helping to solve the challenging analytical problems that AI has brought forth. Artificial intelligence has witnessed advancements and innovations over the course of several historical eras. [1].

REVIEW OF LITERATURE

One innovative technology that has drawn interest in energy management is artificial intelligence (AI). Artificial Intelligence consists of a collection of sophisticated algorithms that can be applied to energy trading, demand response, scheduling, and prediction. Federal learning (FL) and Q-learning are the best options for energy scheduling, demand response, and energy trading, while machine learning (ML) methods like neural networks and support vector machines are frequently employed for energy forecasting. Research is being done on hybrid and multi-stage models to improve AI performance in energy management. With the use of these models, several techniques can be integrated to increase model accuracy [2]. By selecting features and optimizing data for power management, data mining is a crucial tool for improving AI performance. It is in favor of building energy scheduling the charging and draining of storage devices using data mining methods. To measure the influence of a particular component on the variance of other variables, analysis of variance (ANOVA) methods are applied. An unsupervised neural network model known as a self-organizing map (SOM) maps high-dimensional input in a nonlinear way to low-dimensional map space. Using SOM, we generated maps for every load and 25 meteorological parameters, then analysed the associations between them. Energy management employed these clever algorithms for energy storage optimization and demand predictions [2]. Furthermore, AI is employed in the automation of smart energy management, which entails anticipating energy demand and modifying consumption correspondingly [2, 3]. AI has the ability to learn from human behavior and modify energy use accordingly. AI additionally makes communication between various energy sources, which facilitates the optimization of energy use [3]. AI is also utilized in residential energy management systems. For example, realistic models for renewable energy systems are developed using forecasting driven by AI. By adding the effects of elevation and other morphological parameters into artificial neural network models designed to predict the spatial distribution of heat islands in urban areas, artificial intelligence (AI) is also used to improve the accuracy of predictions of urban heat islands on Earth's surface [2–5].AI plays a bigger role in energy cost reduction and consumption optimization. Energy suppliers can improve energy use thanks to AI's capacity to simulate and forecast patterns of energy usage [7]. This is one of the technology's main benefits. By evaluating data from energy use to discover inefficiencies and areas for development, AI can also help identify the most economical sources of energy and reduce energy waste [6]. AI can also regulate and modify energy consumption in response to availability and demand, guaranteeing effective energy use [7]. AI can also assist in predicting spikes in the need for electricity by analyzing vast amounts of weather prediction and internet search data, allowing energy companies to react proactively to variations in demand. AI-designed intelligent grids are capable of efficiently managing several energy.

THE NEED FOR AI IN ENERGY MANAGEMENT

The demand for energy is increasing rapidly, and traditional methods of energy management are no longer sufficient to meet this demand. As a result, there is a growing need for more efficient and effective energy management solutions. This is where AI comes in. By leveraging the power of machine learning and data analytics, AI can help energy companies and businesses optimize their energy usage, reduce costs, and improve sustainability. AI techniques can be used to model load and demand forecasting as demand and supply forecasting are helpful in many other smart grid decisions [8]. The types of energy management systems in the smart grid with supporting technologies are shown in Figure 1, where RES refers to renewable energy sources.

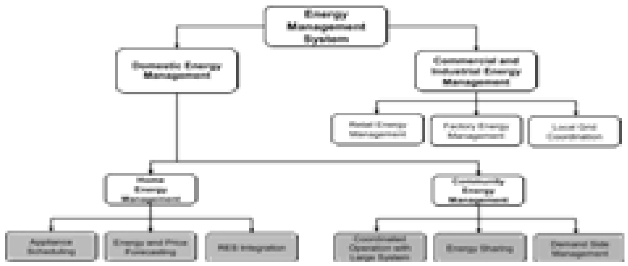

Figure 1. Energy management system in the smart grid system [8]

Optimization of Energy and Smart Grids :- Smart grids are intelligent energy networks that track and control energy use in real time using sensors, smart meters, and other cutting edge technologies. AI algorithms are able to forecast future usage trends by analysing the data collected from these devices. This lowers costs and boosts efficiency by enabling energy businesses to improve their energy production, storage, and distribution.

Predictive maintenance and data analytical systems are able to monitor machinery and anticipate when repair is needed by using data analytics. By doing this, energy businesses may increase equipment longevity, decrease downtime, and improve reliability. For instance, AI-powered algorithms are able to spot possible problems in wind turbines, enabling maintenance personnel to fix the problem before it becomes a issue.

Requirement response and intelligent energy storage An essential part of the renewable energy scenario is energy storage. Energy storage systems can be optimized by AI systems through the prediction of energy demand and subsequent adjustment of energy storage levels. Another area of energy management where AI can be useful is demand response. Energy waste can be decreased and efficiency can be increased by using AI algorithms to monitor patterns in energy consumption and modify energy production accordingly.

Using AI to Increase Energy Efficiency Enhancing energy efficiency is one of AI's most important advantages for energy management. Here are two ways that artificial intelligence is advancing energy efficiency:

Automation and Smart Building Management- driven smart building management systems can automate heating, lighting, and other functions to maximize energy efficiency. Smart building management systems have the ability to save energy expenditures and consumption by tracking occupancy patterns and making necessary adjustments to these systems.

Energy Analysis and Optimization Driven by AI: AI can be used to find locations where energy is wasted and to evaluate patterns in energy usage. Artificial Intelligence (AI) can recognize patterns that point to inefficient energy use by utilizing machine learning algorithms to analyse data from sensors and other sources. Then, by using this data, waste may be decreased and energy consumption can be optimized. As a result, a great deal of research has been done on system topologies, architectures, and operating modes. For example, a consistent power supply to consumers can regulate and optimize the stochastic character of installed renewable energy sources while preserving ideal operating conditions for the storage system, electricity bill, and occupancy. Figure 2 displays recommended

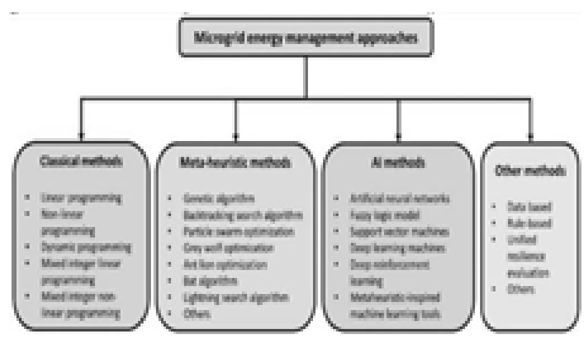

Figure 2. Optimization procedures in the energy management system [9]

Asset management and predictive maintenance:- Predictive maintenance and asset management are two more ways artificial intelligence is revolutionizing energy management. Here are two examples of how AI is advancing various fields.

Predictive Maintenance and AI's Role:-Artificial Intelligence has the potential to forecast equipment failure dates, enabling maintenance personnel to make necessary repairs in advance of a malfunction. Artificial Intelligence (AI) can recognize trends in sensor and other data that point to imminent equipment breakdown, enabling maintenance teams to plan repairs ahead of time.

Using AI to Optimize Asset Management:-By forecasting the best time to replace equipment, AI can also be utilized to optimize asset management. Data on equipment usage trends and maintenance records are analysed.

AI for Forecasting Energy Demand and Load Balancing:-AI can improve load balancing and predictions of energy consumption. According to the following elements, AI is advancing advancements in this field in two ways.

Effective AI-Powered Energy consumption Forecasting AI may be used to forecast patterns in energy consumption, which enables businesses and energy companies to manage their energy use and cut expenses. AI is capable of producing precise and trustworthy forecasts of future energy demand by evaluating data on historical patterns of energy consumption as well as other variables that affect energy demand.

AI-Powered Load Balancing for Improved Energy Administration

AI can also be utilized to better balance energy loads, distributing energy in a way that reduces waste. Additionally, AI can be used to more efficiently balance energy loads, ensuring that energy is distributed in a way that minimizes waste and lowers costs. Artificial Intelligence (AI) has the potential to enhance energy distribution and minimize power outages by evaluating data on energy usage trends and other factors that impact energy distribution. In conclusion, artificial intelligence has a substantial and wide-ranging influence on energy management. Artificial Intelligence (AI) is bringing about a dramatic change in the power business by utilizing machine learning and data analytics to create more sustainable, effective, and efficient energy management solutions that better fit the needs of the modern world.

THE POWER INDUSTRY'S AI ADOPTION DIFFICULTIES

Data Security and Privacy Issues:- AI in energy management presents privacy and security issues, as it does with any technology that gathers and processes massive volumes of data. Energy firms are required to guarantee the security of their data and to comply with privacy legislation.

Insufficient Trained Personnel and Skill: -AI adoption in the electricity sector necessitates a staff with the necessary skills and training to operate and maintain these systems. In order to guarantee that their staff members are prepared to work with AI systems, energy companies need to make investments in training and development.

Integrating with Infrastructure and Legacy Systems:-The fact that many energy businesses continue to operate on outdate infrastructure and systems might be difficult. To fully utilize AI in energy management, energy businesses need to make investments in modernizing their current systems and infrastructure.

AI's Possibilities and Potential Impact in Energy Management

In spite of these obstacles, artificial intelligence has a lot of potential in the energy sector. AI systems can improve energy efficiency, lower prices, and stabilize the grid. In order to achieve a sustainable energy future, AI is also necessary for the grid's integration of renewable energy sources. AI has a huge potential to change the energy sector, and it will probably be a major factor in how energy management develops in the future. To sum up, artificial intelligence is causing a radical change in the energy sector. To fully utilize AI in energy management, energy businesses need to make investments in modernizing their current systems and infrastructure. Through boosting grid stability, facilitating better energy trading, increasing energy efficiency, and streamlining asset management. Although there are still obstacles to be solved, artificial intelligence has a plethora of prospects for energy management. Artificial intelligence will surely be a major factor in determining how energy management develops in the future as the sector continues to innovate and change.

AI's Possibilities and Potential Impact in Energy Management:-Artificial Intelligence (AI) is a fast evolving field with multiple potential paths and prospects in power systems and energy markets. The following potential fields could influence how AI applications in this field develop in the future:1. Advanced Predictive Analytics: By advancing AI, power system components like transformers, generators, and transmission lines can benefit from more precise and complex predictive analytics. By extending asset lifespans, minimizing downtime, and optimizing maintenance schedules, utilities may be able to lower costs and increase system reliability.2. Distributed Energy Resources (DERs) Management: AI can be extremely helpful in handling the intricate relationships between distributed energy resources (DERs), which include solar panels and battery storage, as their use in the energy sector increases. AI has the potential to be extremely helpful in controlling the intricate relationships that these dispersed resources have with the grid. In order to maximize DERs' value and promote grid stability, advanced AI algorithms can optimize their operation and scheduling while accounting for variables like demand patterns, weather, and grid limits.3. Integration of Block chain and AI: By permitting peer-to-peer energy trading and grid transactions, Block chain, a decentralized and transparent ledger technology, has the potential to revolutionize the energy markets. By offering sophisticated analytics and decision-making skills for managing energy contracts, maximizing energy transfers, and validating transactions, artificial intelligence (AI) can supplement block chain technology and create more secure, transparent, and efficient energy markets.4. Real-time Grid Monitoring and Control: Artificial Intelligence can still be extremely important for real-time grid monitoring and control.

Enhancing situational awareness, making accurate decisions, and increasing operational efficiency can all contribute to more sustainable and successful energy management in the long run.6. Ethical and Responsible AI: Ethical and responsible AI practices will be essential as AI continues to play a larger role in the energy markets and power infrastructures. In order to ensure that the deployment of AI in energy markets and power systems is in line with societal values and tackles any ethical concerns, this involves taking into account factors like fairness, transparency, and accountability in AI algorithms, data privacy and security, and responsible usage of AI.7. Interdisciplinary Research and Collaboration: Because the subject of artificial intelligence (AI) in energy markets and power systems is so interdisciplinary, it calls for cooperation amongst specialists in energy economics, policy, power systems, AI, and other pertinent domains. upcoming studies and Opportunities might entail interdisciplinary teamwork to create novel artificial intelligence models, approaches, and applications that can successfully handle the intricate needs and problems of the energy industry.

CONCLUSION

In conclusion, as the globe works to switch to cleaner, more sustainable energy sources, the application of AI in energy markets and power systems is becoming more and more significant. AI is being utilized to lower carbon emissions, increase energy efficiency, and optimize power system performance. The incorporation of artificial intelligence (AI) in India's electrical infrastructure has the potential to significantly improve reliability, efficiency, and accessibility. By leveraging AI technologies, such as predictive maintenance and fault detection, India can combat flaws in power distribution, transmission, and generation effectively. This will enhance the performance of the power sector, benefiting both power companies and consumers. AI also plays a crucial role in energy optimization, demand response, and intelligent load management, enabling efficient and reliable operation of the electrical infrastructure. Additionally, AI contributes to the integration of renewable energy sources, optimization of energy storage systems, and the development of resilient and self-healing electrical grids. Overall, the use of AI in India's power sector holds immense potential for shaping a greener, more sustainable, and efficient energy future. In deregulated power markets, artificial intelligence (AI) algorithms are also being developed to provide energy forecasting, fault detection and repair, and energy trade optimization. The production, distribution, and consumption of energy might all be completely transformed by the application of AI-based tools and technology in the power industry, creating more dependable, sustainable, and efficient energy systems. The goal of ongoing research in this field is to enhance the application of AI to handle the intricate problems that the power industry faces, such managing the growing need for energy and the integration of renewable energy sources into the electrical grid. In the end, realizing a cleaner and more sustainable energy future depends on the integration of AI into power infrastructure and energy markets.

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Analyzing Video Game Pricing and Recommendation Algorithms on PlaySense

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ABSTRACT

Video games are widely embraced as a form of entertainment, offering diverse genres and modes to suit various preferences. Beyond mere amusement, they offer cognitive benefits, foster creativity, and alleviate stress. Additionally, certain games facilitate global social connections among players. Despite their manifold advantages, selecting the right game amidst the plethora of options can be daunting. To address this challenge, we propose a website designed to provide tailored recommendations based on user input.

This website, constructed using Streamlit, leverages a content-based recommender system driven by cosine similarity, a metric measuring the resemblance between two items. Drawing from a dataset encompassing over 5,000 games from platforms like Steam, epic-games, and PlayStation, we extract features such as genres, themes, keywords, developers, publishers, and platforms. By calculating the cosine similarity between each game pair, we rank the recommendations according to their relevance to the user's input. Users simply input a game they enjoy, and the website generates a list of similar games along with pertinent information and links to purchase from various storefronts.

KEYWORDS *: Machine learning, Web scraping, Data pre-processing, Video games, Digital distribution sites, Recommendations, Cosine similarity, Count vectorization.*

INTRODUCTION

PlaySense is an innovative platform designed to assist users in discovering games that align perfectly with their individual preferences and interests. Whether you're in search of a specific genre or theme, PlaySense is your go-to resource. Powered by Streamlit, a user-friendly framework for crafting dynamic web applications, PlaySense ensures an intuitive and visually appealing interface with minimal coding requirements.

Utilizing cosine similarity, a mathematical method for assessing the likeness between two vectors based on their orientation, PlaySense compares games across various attributes including tags, reviews, ratings, and popularity. As the cosine similarity approaches 1, it indicates a higher degree of similarity between the games. Subsequently, PlaySense presents users with a curated list of games closely resembling their preferences, complete with detailed information and convenient links for purchasing or playing.

With PlaySense, users can embark on a seamless journey to explore new games and unearth their next beloved favorite.

DIGITAL GAME DISTRIBUTION SITES

Online platforms for digital distribution enable users to acquire and download video games and software products conveniently. Prominent examples of these platforms include Steam, Epic Games, and the PlayStation Store, each offering a range of benefits for developers and consumers alike.

A primary advantage of digital distribution platforms is the unparalleled convenience and accessibility they afford users. By accessing these platforms, individuals can seamlessly browse, purchase, and download games from any location with an internet connection, eliminating the need to visit physical stores or await shipping. Furthermore, users can enjoy the flexibility of accessing their purchased games across various devices and platforms. Additionally, these platforms offer supplementary features such as cloud saving, automatic updates, social networking integration, and online multiplayer capabilities.

Another benefit of digital distribution platforms is their ability to empower developers to reach a global audience and directly sell their games to consumers, bypassing traditional intermediaries such as publishers or retailers. This grants developers autonomy in setting prices and offering discounts, while also enabling them to receive valuable feedback and reviews from users. Moreover, these platforms serve as a supportive environment for indie and niche games that may struggle to gain traction in the mainstream market.

In our project, we focused on extracting data from these distribution platforms to enhance the comparison of purchase options provided by developers to consumers. In summary, digital distribution platforms represent a significant force within the video game industry, offering both convenience and diversity to users and developers alike.

WEB SCRAPING

Web scraping is a valuable technique utilized for extracting data from websites, a process that can be performed manually by a user or automatically using bots or web crawlers. Its applications span a wide array of purposes including price comparison, data analysis, market research, content aggregation, and more. By swiftly and efficiently accessing large volumes of data from diverse sources, web scraping facilitates businesses in gaining insights into competitors, customers, and markets. It enables the collection and analysis of data from various online platforms such as e-commerce websites, social media platforms, news outlets, and beyond.

Additionally, web scraping serves as a valuable tool for researchers and journalists, granting access to data that might otherwise be inaccessible or difficult to obtain, such as historical records, government documents, or scientific publications. Moreover, individuals can leverage web scraping to find information tailored to their needs and preferences, such as product reviews, travel deals, or job opportunities.

In our project, we utilized web scraping techniques to extract data from several digital game distribution platforms, including Steam, Epic Games, and PlayStation. Combining web scraping with API-endpoint scraping enabled us to compile a comprehensive database for PlaySense. This database serves as the foundation for PlaySense's recommendation model, which provides users with tailored game recommendations based on specific titles present in our database. Furthermore, the data within the database allows us to furnish descriptions of recommended games and provide convenient links to the respective digital distribution platforms.

RECOMMENDATION SYSTEM

Recommendation systems are sophisticated software tools designed to offer users personalized suggestions tailored to their preferences or requirements. In the realm of video games, these systems play a pivotal role in aiding gamers in discovering new titles that align with their tastes or enhancing their gaming journey by suggesting relevant in-game content like levels, characters, or items. Leveraging diverse sources of information such as user ratings, game descriptions, genre tags, and release dates, recommendation systems analyze the preferences and profiles of individual gamers to generate meaningful recommendations.

The benefits of recommendation systems extend to both gamers and game developers. They enhance user satisfaction, engagement, and retention by providing tailored recommendations, ultimately contributing to increased sales and revenue for developers. Recommendation systems employ a variety of algorithms to deliver recommendations based on the dataset they have been trained on. In our project, we employ count vectorization and cosine similarity algorithms to train our model to recommend games, which will be elaborated upon further.

Count Vectorization

Count vectorization serves as a pivotal technique in the realm of transforming textual data into numerical representations, commonly employed in natural language processing and machine learning tasks. This method facilitates the conversion of documents into vectors based on word counts, enabling efficient analysis of textual data. For instance, in the domain of video game descriptions, count vectorization allows us to construct a matrix wherein each row corresponds to a specific description, and each column represents a distinct word in the vocabulary. The values within the matrix cells denote the frequency of each word's occurrence within the corresponding description. This conversion process enables the transformation of video game data into a structured format suitable for various analytical tasks such as sentiment classification, topic modeling, and recommendation systems.

Within our project, we harness game data attributes like game descriptions, genre tags, and release dates, among others. These attributes undergo transformation into count vectors, wherein each attribute contributes to the vector's components. Subsequently, these count vectors are employed by the cosine similarity algorithm to compute the similarities between individual video games concerning a reference video game, thereby facilitating the generation of recommendations.

Cosine Similarity

Cosine similarity serves as a valuable metric for assessing the likeness between two texts based on the angle between their respective count vectors. Count vectors represent numerical representations of texts, quantifying the frequency of each word's occurrence within a given text. The degree of similarity between two texts is inversely proportional to the angle between their count vectors; a smaller angle indicates greater similarity. Calculation of cosine similarity involves dividing the dot product of two count vectors by the product of their magnitudes. This metric finds application across various domains including text classification, document retrieval, plagiarism detection, and recommendation systems.

Within our project, cosine similarity is employed to evaluate the resemblance between two count vectors, specifically the reference game and other games within the dataset. This similarity assessment enables the generation of game recommendations in relation to the reference game, facilitating the exploration of similar gaming experiences for users.

OBJECTIVES

In the vast landscape of available video games, making a choice can prove daunting, particularly when users are unfamiliar with specific genres, platforms, or styles. To alleviate this challenge, a website equipped with a content-based recommendation system is invaluable. This system analyzes various game attributes such as name, genre, and description, juxtaposing them with user input such as preferred games or genres.

The primary goal of this website is to aid gamers in discovering new and enticing games that resonate with their preferences. Leveraging cosine similarity—a metric gauging the similarity between two vectors—the system ranks games based on their alignment with the user's input. Moreover, the website seamlessly directs users to the respective game's website or store page, facilitating further exploration and potential acquisition.

Additionally, the website offers comprehensive summaries of recommended games, encompassing details like title, description, rating, and genre. Developed using the Streamlit framework—a Python library renowned for simplifying the creation of interactive web applications with minimal coding—the site ensures a user-friendly experience. Streamlit simplifies the display of data, charts, images, and widgets on the website, while also streamlining the deployment and sharing of the application online.

PROPOSED SOLUTION

The current system stores data and price histories of digital game distribution sites, yet it caters exclusively to regions beyond the Indian subcontinent. In our project, we aim to rectify this gap by developing a system tailored specifically for the Indian subcontinent. Given that digital game distribution sites often have distinct pricing structures for different regions, a simple conversion of foreign prices is insufficient. Therefore, our solution is designed to address this challenge comprehensively.

The proposed system encompasses the following functionalities:

- Users can search for and select games available in the scraped dataset.
- It processes user input and employs the cosine similarity algorithm to compare it with features of other games in the database.
- The system presents a curated list of recommended games that align with the user's input, accompanied by relevant data.
- Links to each recommended game's official website or online store are provided, enabling users to purchase or download the game.
- Statistical graph data depicting game prices across various distribution sites is displayed.
- By offering tailored recommendations and comprehensive price data specific to the Indian subcontinent, our system aims to enhance the gaming experience for users in this region.

The proposed system has the following architecture:

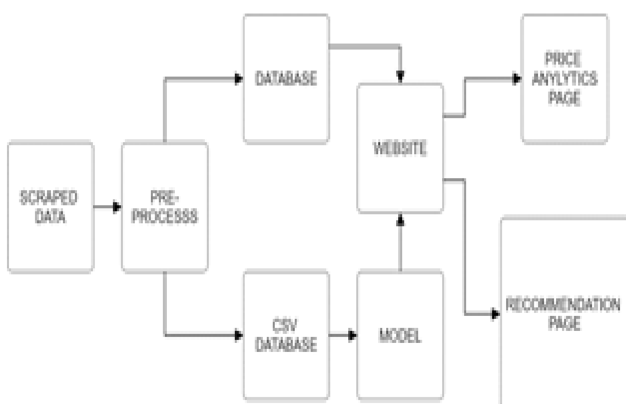


Fig -1: System Architecture

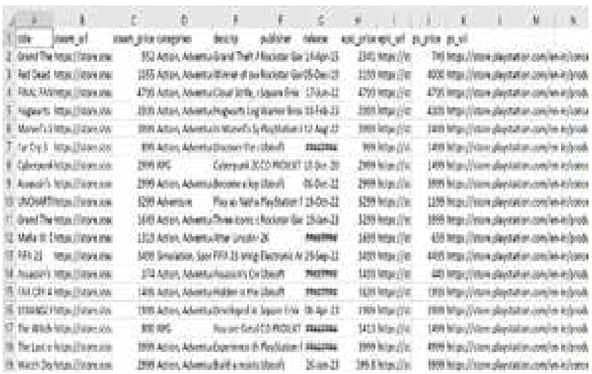
1. Initially, the data is scraped by sending requests to various game distribution sites.
2. Subsequently, the acquired scraped data undergoes preprocessing and cleaning.
3. The cleaned data is then stored in two formats: a database and a CSV file.
4. The CSV database is utilized to train the recommendation model.
5. Data from the primary database is utilized to populate the website with content, which users can interact with. The user's input is fed into the trained recommendation model from the website.
6. Upon receiving input, a recommendation page is dynamically generated. This page includes recommended games, their descriptions, and links directing users to various digital distribution sites where the game is available.
7. Additionally, the recommendation page incorporates graphical data illustrating game prices across distribution sites.
8. The website features a separate price analytics page, presenting users with further graphical representations of price data from different distribution sites.

TOOLS AND TECHNOLOGIES USED

1. Python: This programming language serves as the primary coding tool for the project.
2. MongoDB: Utilized as a document database, MongoDB stores JSON documents efficiently.
3. Streamlit: An open-source framework, Streamlit facilitates the development of data science and machine learning web applications.
4. Pandas: A Python library renowned for its data preprocessing capabilities, Pandas plays a crucial role in the recommendation system.
5. Bokeh: Bokeh, a Python library, is employed to create visualizations and interactive graphs, enhancing data presentation.
6. Scikit-learn: An open-source data analysis library, Scikit-learn offers a plethora of tools and algorithms for machine learning tasks.
7. Altair: Altair, a statistical visualization library for Python, enables the creation of informative and visually appealing graphs.

RESULT AND ANALYSIS

CSV file data



Mongodb collection data

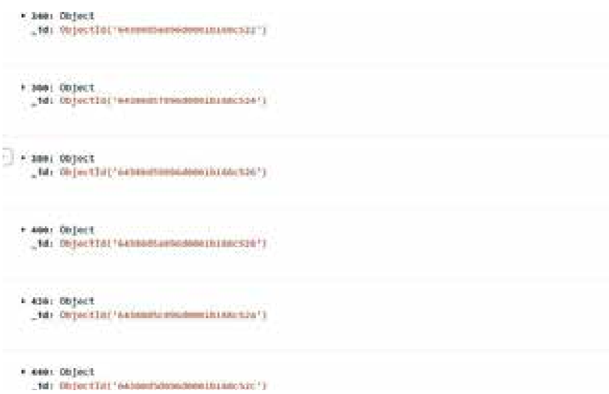


Fig 2.

Fig 3.

APPLICATIONS

This project aims to assist consumers in the Indian subcontinent by facilitating effortless comparison of video game prices across various distribution platforms like Steam, Epic Games Store, and PlayStation, among others. By providing this functionality, users can make more informed purchasing decisions.

Additionally, the project will offer users recommendations based on their preferences for specific video games. Furthermore, it will present users with various graphs and visualizations related to the game price data of the recommendations. These visual aids aim to enhance the user's understanding of the price data, making it easier for them to assess and interpret the information provided.

FUTURE SCOPE

This project holds potential for several enhancements:

Expanding Distribution Stores: Currently, the project supports price data from three digital game distribution sites—Steam, Epic Games Store, and PlayStation Store. In the future, integration with additional platforms like GOG.com, Humble Bundle Store, G2A.com, and the Microsoft Store can broaden the scope of available price data.

Database Expansion: The current database encompasses 5000 games. In the future, expanding the database to accommodate over 40,000 video games, along with their supplementary content such as DLCs and micro-transactions, can enrich the platform's offerings and user experience.

Improved Recommendation Model: With an expanded database, the recommendation model can be further refined to provide more precise and accurate recommendations. Enhancements to the model will enhance user satisfaction and engagement.

CONCLUSION

In summary, this project is designed with the user's benefit in mind. By allowing users to compare prices across various digital game distribution sites, it empowers them to make more informed purchasing decisions.

Moreover, the project aims to serve as a centralized hub for video game-related information. It can serve as a valuable resource for users seeking information when considering their next video game purchase.

Additionally, the project aspires to function as a recommendation system for video games based on user input. This feature adds another layer of utility and convenience for users.

Given that it is currently the sole project of its kind available for the Indian subcontinent, this project holds significant potential. Future enhancements, such as expanding the supported library of games, increasing support for additional digital distribution sites, and refining the recommendation system, have the potential to further enhance its usefulness and utility for users.

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Advanced Deep Learning for Network Intrusion Detection Systems

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ABSTRACT

This research underscores a technical synergy in advancing Network Intrusion Detection Systems (NIDS) through cutting-edge deep learning techniques. Integration of CNNs, RNNs, attention mechanisms, and autoencoders is explored for effective anomaly detection, with emphasis on LSTM networks and attention mechanisms for real-time adaptability. Transfer learning with pre-trained models expedites training and enhances generalization across diverse network environments. Specific technologies within the framework, such as LSTM, Autoencoders, RNNs, and Big Data integration (Apache Kafka and Apache Flink), contribute to real-time processing, advanced data analysis, and model training. The system architecture and intrusion detection module exemplify a sophisticated and resilient NIDS design, showcasing a strategic evolution beyond traditional methods.

KEYWORDS *: Network intrusion systems(NIDS), Deep learning, Long short-term memory, Autoencoders.*

INTRODUCTION

In the dynamic landscape of network security, the integration of advanced deep learning techniques is imperative to fortify Intrusion Detection Systems (IDS) against sophisticated cyber threats[1]. This research focuses on leveraging cutting-edge technologies, including convolutional neural networks (CNNs), recurrent neural networks (RNNs), attention mechanisms, and autoencoders for anomaly detection.

The proposed intrusion detection framework ensures real-time adaptability through the integration of LSTM networks and attention mechanisms, allowing for timely responses to emerging threats. Transfer learning strategies, utilizing pre-trained models on extensive datasets, expedite training convergence and enhance the model's generalization across diverse network environments.

This exploration into the technical intricacies aims to propel the evolution of Network Intrusion Detection Systems, advancing their efficacy beyond traditional methods in addressing the nuances of contemporary cyber threats.

APPLYING DEEP LEARNING FOR NETWORK INTRUSION DETECTION SYSTEM

Long Short-Term Memory (LSTM)

Within Real-Time Network Intrusion Detection Systems, Long Short-Term Memory (LSTM) neural networks are instrumental for modeling dependencies in sequential network data[2]. Their recurrent architecture, incorporating memory cells, enables nuanced temporal representation, facilitating the discernment of normal network behavior from potential intrusions. LSTMs exhibit real-time adaptability, detecting anomalies promptly and dynamically responding to evolving network conditions. When seamlessly integrated into broader deep learning frameworks, LSTMs augment the system's capability to decipher intricate sequential patterns, contributing to the timely identification of potential security threats. In essence, LSTMs serve as a foundational component, elevating sensitivity and adaptability within the intricate landscape of intrusion detection.

Autoencoders

The fusion of Autoencoders and AlexNet contributes to real-time anomaly detection by efficiently compressing and processing high-dimensional network data. Autoencoders play a pivotal role in unsupervised learning, ensuring the preservation of crucial features during dimensionality reduction. The adapted AlexNet's deep convolutional layers further enhance the system's capability to discern intricate spatial and temporal dependencies within network traffic. This technical amalgamation not only fortifies analytical prowess but also bolsters the system's accuracy and efficiency in identifying potential security threats.

Recurrent Neural Networks (RNN)

In Real-Time Network Intrusion Detection Systems (NIDS) utilizing Deep Learning, Recurrent Neural Networks (RNNs) play a crucial role in capturing sequential dependencies within network data. RNNs, equipped with feedback loops, excel at processing sequential information, making them adept at discerning temporal patterns in network traffic. This technical proficiency enables RNNs to effectively identify and analyze dynamic sequences of events, contributing to enhanced anomaly detection and cybersecurity efficacy within the NIDS framework.

Big Data

In Real-Time Network Intrusion Detection Systems (NIDS) employing Deep Learning, the integration of Apache Kafka and Apache Flink establishes a distributed, scalable infrastructure, facilitating seamless real-time ingestion and processing of dynamic network data. Apache Kafka's data streaming and Flink's stream processing capabilities enhance NIDS responsiveness to anomalies in logs, events, and network packets. These technologies adeptly handle data velocity, volume, and variety, enabling swift threat detection and mitigation. Beyond real-time processing, they contribute to model training through transfer learning, utilizing pre-trained models for heightened adaptability in diverse network environments. The strategic integration of Big Data technologies fortifies NIDS with real-time processing prowess, advanced data analysis, and model training for enhanced cybersecurity efficacy.

System Architecture of Network IDS

The architecture of the real-time network intrusion detection system, rooted in deep learning, is delineated with meticulous layers to optimize functionality. At the foundational data acquisition layer, the system exhibits prowess in collecting extensive enterprise data. The subsequent data storage layer, governed by Extract-Transform-Load (ETL) mechanisms, ensures distributed and efficient storage of massive datasets. Meanwhile, the data analysis and calculation layers are equipped with robust flow computing capabilities, facilitating intricate tasks such as data analysis, feature extraction, and calculations. Notably, the depth of the neural network model, specifically employing the AlexNet architecture, enhances the system's analytical capabilities. The upper echelon, known as the data presentation layer, serves as the interface for intrusion detection, issuing warnings, and offering security analysis features through the Java Web self-analysis tool, culminating in a comprehensive and sophisticated Real-Time Network Intrusion Detection System.

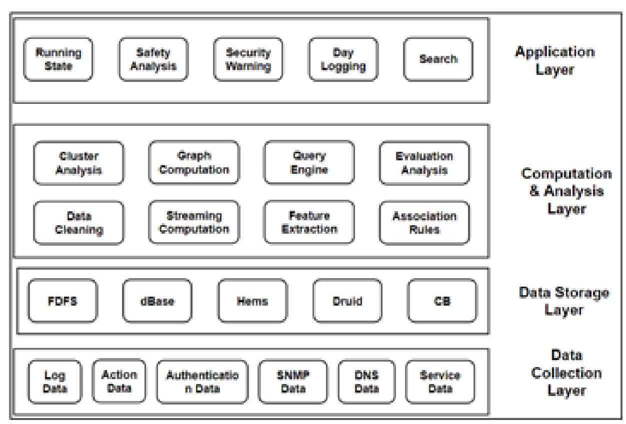

Fig.1: System Architecture

The intrusion detection module unfolds in three integral components: data preprocessing, Auto-Encoder (AE) feature dimension reduction, and data classification post-AE dimension reduction.

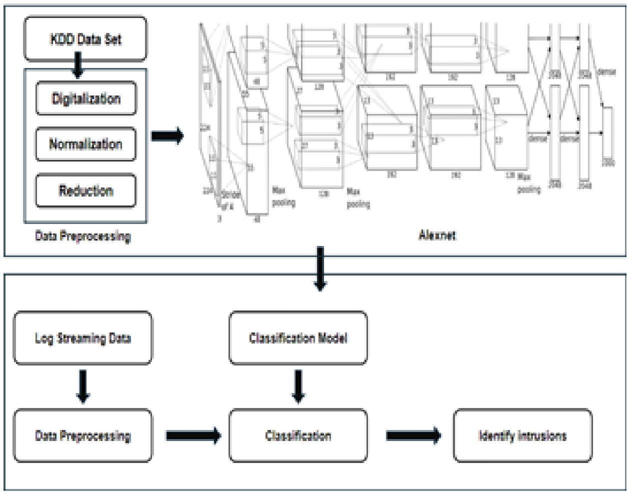

Fig.2:Design of NIDS

Data preprocessing serves a tripartite function, transforming raw data into a model-conforming input format, enhancing model accuracy through normalization and thermal coding. Leveraging the KDD 99 dataset, a benchmark in intrusion detection, normalization ensures comparable dimensions across all training and test data records[1]. The subsequent Auto-Encoder Network (AE Network), a nonlinear dimensionality reduction tool, employs hidden neural network layers to transform high-dimensional data into low-dimensional features, maximizing information retention.

AE- AlexNet classifier, the culmination of this design, leverages the layered abstraction of AlexNet for classification. Utilizing the KDD 99 network intrusion dataset for training, the AE- AlexNet classifier processes original data from the data acquisition module. The AE- AlexNet classifier, adept at classifying and judging, achieves the overarching objective of intrusion detection in the system, showcasing a technical synergy in realizing an efficient and sophisticated network intrusion detection mechanism.

FUTURE PROSPECTS

The future of Advanced Deep Learning for Network Intrusion Detection Systems involves refining model interpretability with advanced explainability techniques, bolstering robustness against adversarial attacks through sophisticated adversarial training methods, and delving into federated learning for collaborative model training across distributed networks. Additionally, optimizing scalable architectures is crucial to accommodate the growing scale and complexity of network data. Research will likely focus on efficient deployment on resource-constrained devices and exploring edge computing for real-time intrusion detection, addressing the evolving challenges in the cybersecurity landscape.

CONCLUSION

In the forefront of cutting-edge deep learning for Network Intrusion Detection Systems, the amalgamation of CNNs, RNNs, attention mechanisms, and autoencoders fortifies the security apparatus against intricate cyber threats. The proposed framework, enriched with LSTM networks and attention mechanisms, establishes a real-time security stronghold, ensuring prompt responses to evolving threats[2]. The integration of Autoencoders and AlexNet elevates real-time anomaly detection, enhancing the security system's capability to efficiently process high-dimensional network data. RNNs contribute significantly to bolstering security by capturing nuanced sequential dependencies within network data, fortifying the system against potential intrusions.

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Comparative Analysis of Emotion Recognition Methods: A Evaluation Measure-based Approach

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ABSTRACT

Emotion recognition has gained significant attention in recent years due to its applications in human-computer interaction, affective computing, and mental health assessment. Various methods and algorithms have been proposed to recognize human emotions from different modalities such as facial expressions, speech, and physiological signals. However, comparing these methods is challenging due to the lack of standardized evaluation measures and benchmarks.

This paper presents a comprehensive comparative analysis of emotion recognition methods based on evaluation measures. We apply the evaluation measures like accuracy, sensitivity, and specificity to assess the performance of different emotion recognition methods across different modalities and datasets. Our analysis provides insights into the strengths and limitations of each method. Overall, this comparative analysis serves as a valuable resource for researchers and practitioners in the field of emotion recognition, aiding in the selection and optimization of suitable methods for specific applications.

KEYWORDS *: Emotion Recognition, ANFIS.*

INTRODUCTION

Emotion recognition, a pivotal component of human communication and interaction, has garnered considerable attention across various domains, including human-computer interaction, affective computing, and mental health assessment. The ability to accurately detect and interpret human emotions from different modalities, such as facial expressions, speech, and physiological signals, holds immense potential for enhancing user experiences and facilitating more personalized interactions.

Numerous methods and algorithms have been proposed by researchers to tackle the challenge of emotion recognition, each leveraging diverse techniques ranging from traditional machine learning to sophisticated deep learning architectures. However, evaluating and comparing the performance of these methods pose significant challenges due to the absence of standardized evaluation protocols and benchmarks. As a result, researchers and practitioners face difficulties in discerning the strengths and weaknesses of different approaches, hindering the advancement and adoption of effective emotion recognition systems.

In response to these challenges, this paper undertakes a comprehensive comparative analysis of emotion recognition methods, focusing on evaluation measures as the basis for comparison. By systematically reviewing and categorizing commonly used evaluation measures, including accuracy, sensitivity, specificity, confusion matrix. By examining the trade-offs between accuracy, computational complexity, we endeavor to guide researchers and practitioners in selecting and optimizing suitable emotion recognition approaches for specific applications.

PERFORMANCE AND COMPARATIVE ANALYSIS

Two techniques are used for comparison in the current study for emotion recognition using speech. First methodology is using Modified Artificial Bee Colony algorithm (MABC) and "Adaptive Neuro-Fuzzy Inference System" (ANFIS). The hybrid system with MABC and ANFIS classifier based recognition has superior accuracy value, superior sensitivity value and superior specificity value as compared with the current techniques. Performance of algorithm for different training set and testing set percentage is analyzed.

The proposed approach is compared to conventional techniques for similarity examination. "Mel Frequency Cepstral Coefficient" (MFCC) characteristics are retrieved using the projected technique. The features are chosen using the MABC method. The emotion recognition system is given the desired feature. An "adaptive neuro-fuzzy inference system" (ANFIS) is utilized to recognize different datasets. Assessment inquiry in terms of "accuracy, sensitivity, and specificity" is used to show the effectiveness of the proposed approach [1].

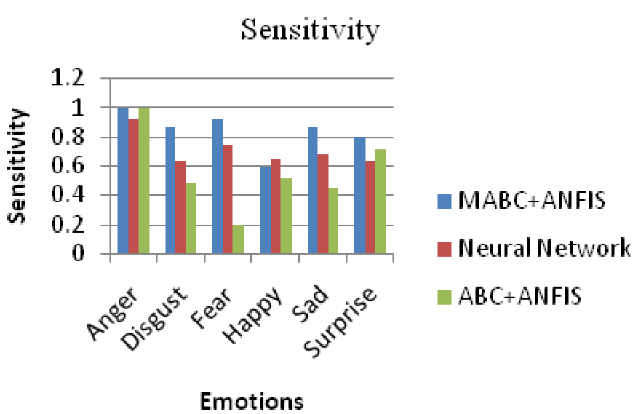

Figure 1. Sensitivity Comparisons

Figure 1 shows the graphical representation of sensitivity comparison for different emotions. It shows that the technique's sensitivity factor for the anger dataset is 1, whereas, the sensitivity factors for neural networks and ANFIS are 0.92 and 1, respectively. The MABC has a sensitivity value of 0.87, the neural network has a sensitivity factor of 0.64, and the ANFIS has a sensitivity factor of 0.48 for the disgust dataset. The sensitivity factor for MABC is 0.93, the neural network is 0.75, and the ANFIS is 0.2 for the fear dataset. For a happy dataset, the sensitivity factors for MABC, Neural Network, and ANFIS are 0.6, 0.65, & 0.52, respectively. The MABC factor has a sensitivity factor of 0.8, the neural network has a sensitivity value of 0.64, and the ANFIS factor has a sensitivity factor of 0.72 for the surprise data set.

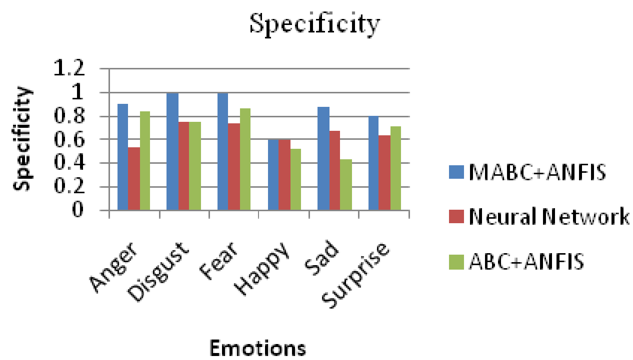

Figure 2. Specificity comparisons

Figure 2 shows the graphical representation of specificity comparison for different emotions. The specificity value for the anger dataset utilizing the projected approach, MABC, Neural Network, and ANFIS are 0.91, 0.54, and 0.84, respectively. For the disgust dataset, the MABC specificity value is 1, the neural network specificity value is 0.75, and the ANFIS specificity value is 0.75. The specificity is 1 for fear dataset using MABC, the neural network specificity value is 0.74, and the ANFIS specificity value is 0.87. The happy dataset yielded 0.6, 0.6, and 0.52 in MABC, neural network, and ANFIS, respectively. The specificity value using MABC is 0.88, neural network is 0.68, and ANFIS specificity value is 0.44 again for sad dataset. MABC has a specificity value of 0.8, whereas neural network and ANFIS have specificity values of 0.64 & 0.72, respectively.

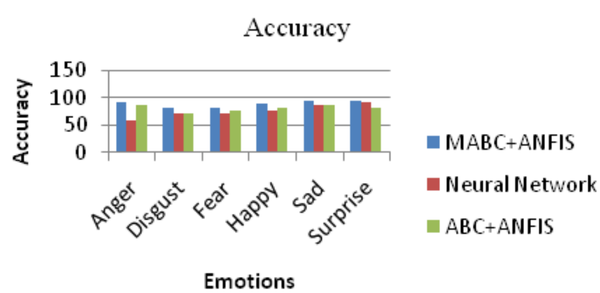

Figure 3. Accuracy comparison

Figure 3 shows the graphical representation of accuracy comparison for different emotions. It is apparent from the figure that employing MABC, Neural network, and ANFIS, the accuracy factor for the Anger data set is 92.56 percent, 60.40 percent, and 87.2 percent, respectively. For the disgust dataset, the accuracy factor acquired using the projected approach is 83.22 percent and 72.48 percent, respectively. For the disgust dataset, the accuracy factor obtained using classic MABC, Neural network, and ANFIS technique is 71.14 percent. The accuracy factor for the fear dataset utilizing ANFIS is 76.55 percent, while the accuracy factor for current approaches is 83.89 percent and 71.14 percent using MABC as well as neural network, respectively. For the happy dataset, the accuracy factor achieved using the projected approach is 89.89 percent, whereas the accuracy factor obtained using neural network and ANFIS is 77.85 percent and 83.89 percent, respectively. The sad dataset's accuracy factor is 95.30 percent when using MABC+ANFIS, 87.91 percent when using neural network, and 87.91 percent when using ABC+ANFIS when using the projected approach. ABC+ANFIS, neural network, and MABC+ANFIS, respectively, provide 83.89 percent, 93.28 percent, and 96.64 percent factors.

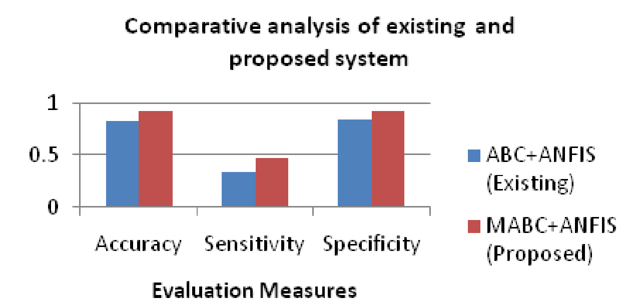

Figure 4.Comparative analysis of existing and proposed system

Figure 4 shows the graphical representation of the comparative analysis of existing and proposed system. It shows the comparative analysis of existing and proposed system. Three parameters namely accuracy, sensitivity and specificity have been used for the comparative analysis of the existing system using Artificial Bee Colony (ABC) algorithm and the proposed system using Modified Artificial Bee Colony (MABC) algorithm for feature selection and ANFIS for feature classification. It is observed that the values of evaluation measures have been greatly improved with the proposed algorithm. It is observed from the table that the accuracy is improved from 82 % to 92 %. The sensitivity is improved from 33 % to 46 % and the specificity is improved from 83 % to 92 %.

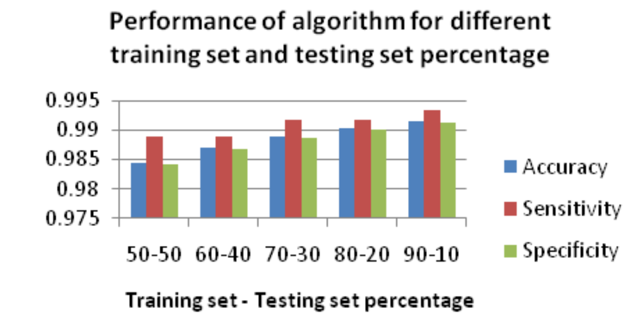

Figure 5. Performance of algorithm for different training set and testing set percentage

Figure 5 shows the graphical representation of the performance of algorithm for different training and testing ratio of dataset. The figure shows the performance analysis of the proposed algorithm (MABC+ANFIS). Three parameters namely accuracy, sensitivity and specificity have been used for performance analysis. Datasets have been divided into different combinations for training and testing phases. Here, the variations are from training 50 percent and testing 50 percent to training 90 percent and testing 10 percent. As a balance between all the parameters used for evaluation, training 80 percent and testing 20 percent ratio is found most suitable with accuracy, sensitivity and specificity values as 0.9903, 0.9917 and 0.9900 respectively.

In another methodology, improved illustration of voice signal was acquired through linear predictive coefficient derived from DWT-decomposed sub-bands in dyadic fashion. For training, classification, and prediction, a "convolutional neural network" is used. Comparatively better recognition accuracy is obtained through DWT - LPC & CNN as compared to other approaches. The comparative analysis of evaluation measures for different algorithms is carried out. The different methods used for comparison with the DWTLPCC+CNN method are Support vector machines (SVM), Artificial Neural Networks (ANN) and K-Nearest Neighbor (KNN). It is observed that the values of the evaluation measures of the proposed method are greatly improved as compared with all other methods.

Figure 6 demonstrations the performance of DWLPC and CNN in terms of percentage recognition rate. There are eight different emotions that are employed. Each emotion has 180 signals inside the database. The angry emotion has the greatest recognition rate at 82, while the neutral signal has the lowest rate of 63, according to the projected algorithm. The percentage recognition rate for the calm, happy, sad, fearful, disgusted, and surprise emotions is 74, 81, 79, 77, 70, and 80 respectively [2].

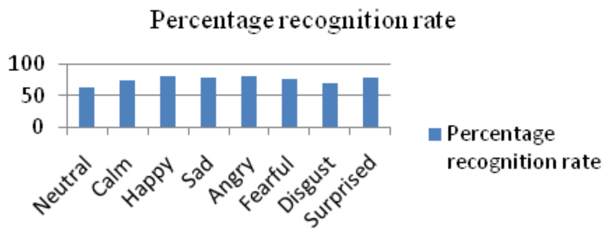

Figure 6. The graphical representation of recognition rates for different emotions

Table 1. Comparative chart for the accuracy of the proposed algorithm with other models for emotion recognition [7]

Comparative chart for the accuracy with different methods								
“Emotions	Neutral	Calm	Happy	Sad	Angry	Fearful	Disgust	Surprise”
Proposed model (DWT+ LPC + CNN) using RAVDESS	63	74	81	79	82	77	70	80
Human Performance using EMOVO database	93	--	65	92	92	74	67	81
CNN model using EMOVO database	76.2	--	79.7	76.1	90.4	78.5	75	78.5
DSCNN model using RAVDESS database	95	85	87	94	82	43	52	98
Time distributed CNN model using Berlin database	90	--	73.2	94.5	88.6	81.5	88.9	--
MABC+ANFIS model on Berlin database	--	--	83.6	90.8	80	77.1	75.2	91.6
SMO algorithm using Berlin database	55	--	58	66	100	30	33	52
MFP features + Random Forest classifier	92	--	87	94	97	--	77	--

It is observed from the table 1 that MFP (Mean Fourier Parameters) features make better than MFCC features for all emotions. Also, it is ensured that the combination of MFP and the Random Forest classifier work better than other features and classifiers in “emotional recognition”. Sequential Minimal Optimization (SMO) provided the same results on different databases such as SAVEEE, Berlin, and TESS. The CNN model provides 90.48% "accuracy" compared to other emotions. The DSCNN model [7] realizes enhanced predictions for all classes in RAVDESS dataset. The proposed model performs better than the human performance for happy, fearful, and disgusted emotions. Also, this model outperforms for fear and disgust emotions as compared with the DSCNN model. The model gives enhanced outcomes for happy, sad, and surprise emotions as compared to the "CNN model" using EMOVO database. Time distributed CNN model gives enhanced outcomes for all emotions but the DWT-LPC-CNN model has obtained better accuracy of 81% as compared to 73.28% to TDCNN model. This contrast of consequences delivers a starting point aimed at approaching investigation besides it is expected to obtain enhanced outcomes using more concatenated CNNs and audio/video-based "multimodal emotion recognition" tasks. Figure 7 shows the comparative chart of the accuracy for different methods.

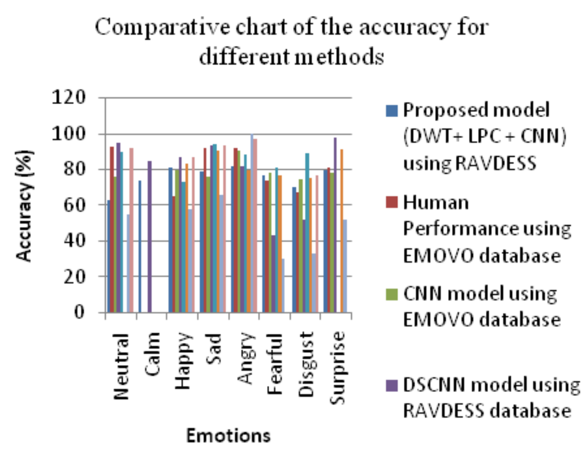

Figure 7. Comparative chart of the accuracy for different methods

The figure 8 shows the comparative analysis of evaluation measures for different algorithms. The evaluation measures used for comparison are sensitivity, specificity, accuracy, precision, recall and f-measure. The different methods used for comparison with the proposed method (DWTLPCC+CNN) are Support vector machines (SVM), Artificial Neural Networks (ANN) and K-Nearest Neighbor (KNN). It is observed from the graph that the values of the evaluation measures of the proposed method are greatly improved as compared with all other methods. The method using SVM have obtained better results as compared to ANN and KNN methods. KNN method has obtained lower performance as compared to all other methods.

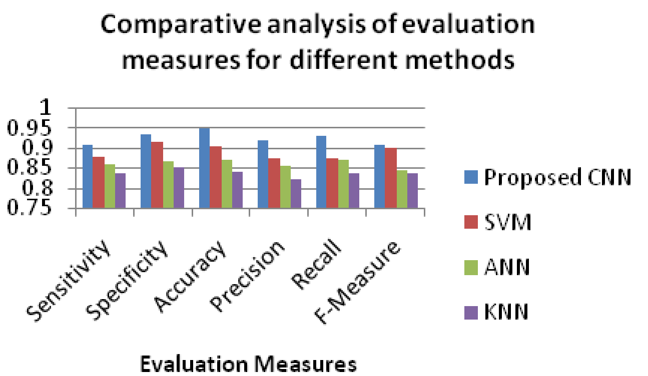

Figure 8. The comparative analysis of evaluation measures for different algorithms

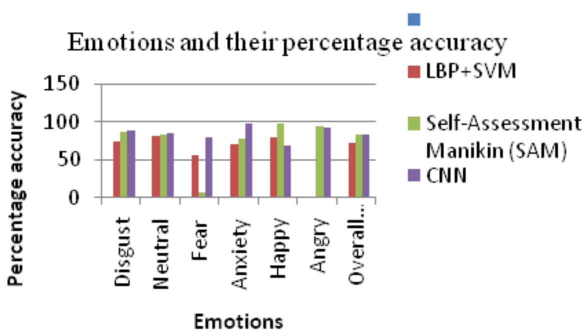

Figure 9 Comparative analyses of emotions and their percentage accuracy

Figure 9 shows the comparative analysis of accuracy of different emotions for different methods. The different emotions used are angry, disgust, neutral, fear, anxiety and happiness. The results of the implemented method using LBP for feature extraction and SVM for feature classification are compared with Facial Emotion Recognition (FER) using CNN and Self-Assessment Manikin (SAM) methods. It is observed that FER using CNN has obtained better accuracy as compared to LBP+SVM and SAM methods for disgust, neutral, fear, anxiety emotions. Self-Assessment Manikin (SAM) [4] method have obtained better accuracy than LBP+SVM and CNN for happiness and angry emotions. Based on these results one can prefer for deep neural network techniques like CNN for better accuracy.

The graphical representation of the comparative analysis of the recognition rates of Facial Emotion Recognition (FER) for the different feature extraction methods is shown in the figure 4.10. The different feature extraction methods considered here for comparison are LBP, HOG, LDP and LGC [6]. The percentage recognition rate using these methods is 89.42, 85.71, 85.20 and 90.38 respectively. It is observed from the results that LBP and LGC feature extraction methods give better recognition as compared to HOG and LDP and hence are popularly used.

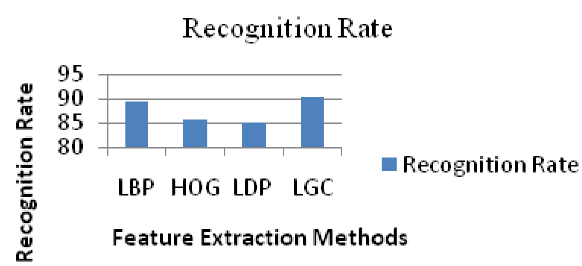

Figure 10. The graphical representation of the recognition rates

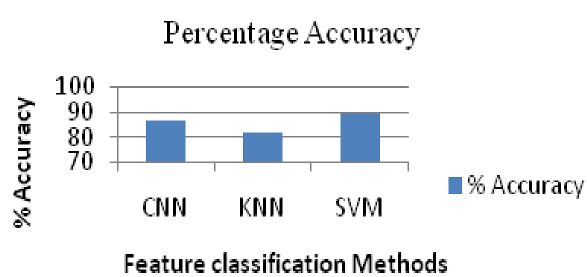

Figure 11. The graphical representation of the accuracy for different feature classification methods

Figure 11 shows the graphical representation of the accuracy for different feature classification methods [3]. The feature classification methods used for comparison are CNN, KNN and SVM. The percentage accuracy of FER using these classification methods are 87.35, 82.2 and 89.78 respectively. It is observed that SVM has obtained highest accuracy of 89.78 percent, whereas KNN method is having the least accuracy of 82.2 percent as compared to CNN.

CONCLUSION

This paper has provided a comprehensive comparative analysis of emotion recognition methods based on evaluation measures.

From the result, we understand that approach of MABC+ANFIS classifier based prediction has higher accuracy value, higher sensitivity value and higher specificity value than the existing methods. Hence this method serves the best data classification technique. Relatively higher recognition accuracy was obtained through DWT - LPC & Convolution Neural Network as compared with different methods like SVM, Random Forest, and HMM. It is observed from the graph that the values of the evaluation measures of the proposed method are greatly improved as compared with all other methods.

Furthermore, our analysis has underscored the need for standardized evaluation protocols, benchmark datasets, and robust performance metrics to facilitate fair and meaningful comparisons between methods. Looking ahead, the findings presented in this paper offer valuable guidance for researchers and practitioners in the development and deployment of emotion recognition technologies.

In conclusion, this comparative analysis serves as a valuable resource for advancing the state-of-the-art in emotion recognition, ultimately contributing to the development of more accurate, reliable, and scalable systems that can enhance human-machine interaction and user experiences across a wide range of domains.

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Gosolo-A Freelancer Portal

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ABSTRACT

Amid the pandemic, numerous individuals found themselves without employment opportunities, while many remained idle at home. To address this issue, we introduced the GoSolo Freelancer's Portal, tailored specifically for independent contractors. Unlike traditional employment, freelancers operate on a project basis, offering the flexibility to work part-time yet earn a full-time income based on their skills. Upon registration, users can select their role as either a Freelancer or a Service Provider.

Our platform incorporates a blogging feature, enabling users, including service providers and students, to contribute articles on various aspects of freelancing. One of the primary benefits of freelancing is the autonomy it affords individuals over their workload, client selection, and income. Freelancers are essentially self-employed, granting them the freedom to choose their projects and duration of engagement. This level of control surpasses that of conventional employment, offering unparalleled freedom and flexibility in terms of work type, hours, location, and workload.

***KEYWORDS** : Freelancing website, Self-employment.*

INTRODUCTION

The platform facilitates communication between freelancers and service providers, enabling freelancers to apply for jobs and providers to post tasks and select freelancers. Once the freelancer completes the task, it undergoes review by the provider before payment initiation. Freelancers typically work on a temporary or part-time basis for various businesses, offering their services remotely, often from home. They cater to clients across diverse sectors such as marketing, media, food, and finance.

The website serves as a marketplace for freelancers to showcase their skills and connect with potential clients, streamlining the hiring process. It offers a simplified hiring process, allowing clients to quickly find and hire qualified freelancers. Additionally, it fosters a community where freelancers from different backgrounds can offer their expertise, providing clients with access to a diverse pool of talent.

Ensuring secure transactions, the platform features a reliable payment system safeguarding both freelancers and clients. With a built-in chat option, easy communication is facilitated between service providers and freelancers, fostering interaction and collaboration within the community.

The website is structured into several sections: Related Work, Proposed System – Methodology and Proposed Work, Results and Discussions, Conclusion, and References.

RELATED WORK

Based on the insights from the survey paper titled "Online Freelancing-Need of the Hour," it becomes evident that the prominence of freelancing has surged notably post-lockdown, not only in prominent nations like the USA and India but also in smaller countries like the Philippines and Bangladesh. Freelancing empowers individuals to explore opportunities globally and fulfill tasks from the comfort of their homes.

India boasts a substantial number of young individuals gravitating towards freelance or contractual roles, establishing it as the largest freelance economy globally. To address the escalating demand for skilled professionals, multinational corporations are increasingly engaging freelance talent to fulfill their requirements.

The most lucrative freelancing roles encompass content writing, web development, social media marketing, and graphic design. These roles are sought after across numerous countries, prompting individuals from various age groups to pursue freelancing as a supplementary source of income.

A freelancing platform facilitates communication between freelancers and job providers, offering a medium to search for jobs specific to their expertise and apply accordingly. Upon completion of tasks, individuals receive compensation commensurate with their work. Given the substantial surge in the global freelancer population, there is a growing need for platforms that simplify the connection between freelancers and service providers.

PROPOSED SYSTEM METHODOLOGY-USE CASE DIAGRAM

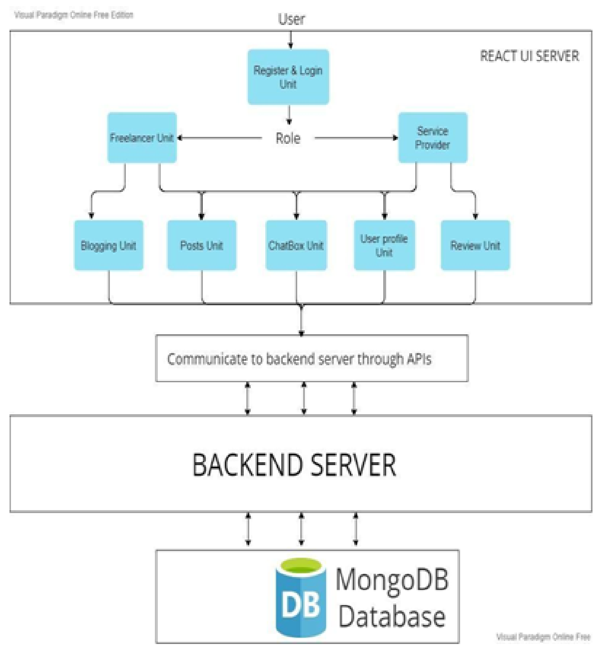
Entities (Freelancer and Service provider): These entities interact with the system and are depicted as stick figures in the diagram.

Use cases depict the system's functionality or behavior. Each use case signifies a particular objective or task performed by the system for the entities and is illustrated as ovals in the use case diagram. An association relationship in the diagram establishes a communication link between an entity and a use case, indicating that the entity can initiate the use case or be part of its execution.

PROPOSED WORK

The operation of our website is outlined in the following steps:

1. **User Registration:** Users register on the website by providing personal details such as name, email address, and password. They also choose their role, either as a freelancer or service provider.



2. **User Login:** Following successful registration, users log into the system and gain access to various website services based on their designated role.
3. **Profile Creation:** Upon login, users can create a comprehensive profile featuring qualifications, experience, work samples, a biography, and a profile picture. Additionally, users can view posts and blog components within the profile view section.
4. **Job Posting:** Service providers can post job listings by furnishing project descriptions, required skills, location, and currency details. We have incorporated a markdown editor to facilitate the

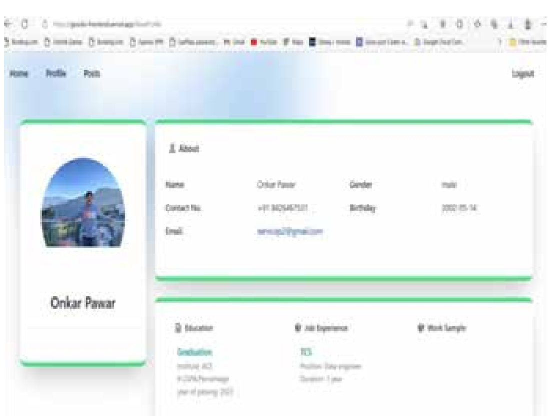
creation of responsive descriptions tailored to user preferences.

5. **Bidding on Jobs:** Freelancers have the opportunity to bid on jobs posted by service providers. Providers can then select their preferred bidder based on various criteria.
6. **Selected Freelancer:** Once a provider selects a freelancer, the freelancer's profile is updated. Within the profile section, the freelancer can view the post where they were chosen.
7. **Chatroom:** Selected freelancers and providers can utilize the chatroom feature to discuss project details and various aspects.
8. **Project Completion:** Freelancers are responsible for completing projects within agreed-upon timelines and submitting the work for client review. Providers can review the project and either approve or disapprove of the submitted work. In the event of disapproval, the freelancer must resubmit the work.
9. **Payment Processing:** Upon approval of the work by the provider, the website initiates payment processing. A commission fee is deducted before the payment is released to the freelancer.
10. **Blogging:** Both users have the ability to create and view blogs, as well as add comments, which can contribute to enhancing their profiles.

RESULTS AND DISCUSSIONS

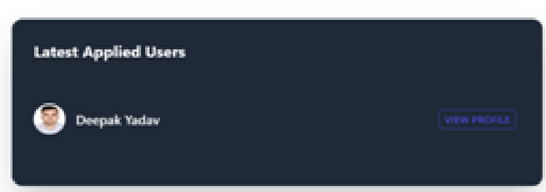
Basic functions of the website

1. Gives choice to the user to create a profile as a freelancer or a service provider.



2. Let the service provider post various jobs to be done.

3. Let the user apply for jobs.



4. A chat box provision for the user and the service provider to communicate. Project Architecture:

Front-end: For website development, we primarily utilized React JS and Tailwind CSS as front-end frameworks. These technologies govern the website's user interface design, responsiveness, and interactivity, ensuring a dynamic and user-friendly graphical user interface (GUI).

Back-end: The back end manages user queries, data processing, storage of user data and profile information, and database connectivity. Node.js serves as one of the backend technology stack options.

Database: All user and service provider data is stored in the database, encompassing information such as emails, passwords, qualifications, work experiences, and templates. MongoDB serves as the database for the website.

Authentication and Authorization: Authentication and authorization mechanisms are implemented to restrict access to certain website areas to authorized users only. Upon user login and subsequent actions, such as post checks, a JWT token is generated for verification, ensuring secure access.

The website is accessible for free on any system with an internet connection, requiring no additional software installations. It facilitates seamless communication between service providers and freelancers. Upon hiring a freelancer, both parties agree on terms and conditions, including task details and payment arrangements.

The website prioritizes security and reliability, offering freelancers job opportunities tailored to their skills. While no legal documentation is currently provided, future updates may include official documentation. Additionally, the website is operationally feasible, requiring minimal maintenance costs.

CONCLUSION

With the shift in business preferences towards freelancers over full-time employees, freelancing has witnessed a surge in popularity in recent years. India stands as the world's largest freelancing economy, where a significant number of young individuals opt for contract or freelance work. As global organizations face an increasing demand for experienced professionals, they are turning to freelancing talent to fulfill their requirements. India's annual production of a large number of scientific and technology graduates, coupled with the creative inclination of Gen-Z and millennial talent, has further fueled this trend away from traditional 9-5 occupations.

The GoSolo initiative aims to streamline the process for independent contractors to find suitable work opportunities that align with their skills and expertise, while also assisting service providers in locating qualified personnel for their projects.

In our project, we focus on full-stack development, employing the MERN stack. This encompasses React for the frontend server, Node.js and Express for the backend server, and MongoDB for the database. Our website prioritizes facilitating seamless communication between freelancers and providers. Additionally, it features blog posts authored by freelancers, enhancing their visibility and profile, while also allowing service providers to post reviews based on freelancers' performance in their respective roles.

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Predicting Bitcoin Prices using High-Performance Machine Learning Models

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ABSTRACT

This paper explores the application of high-performance machine learning models for predicting Bitcoin prices in short and medium terms. Bitcoin, a decentralized cryptocurrency, operates on peer-to-peer technology without central authority or banking institutions. The open-source nature of Bitcoin allows anyone to participate in its network. However, the significant issue of price volatility necessitates the study of underlying price models. This research extends beyond previous works by employing based on machine learning classification and regression models to calculate Bitcoin prices for various time intervals, ranging from end-of-day to ninety days. The developed model demonstrates superior performance compared to existing models, achieving an accuracy of 65% and an error percentage of 1.44% for next-day forecasts, and 62% to 64% accuracy with 2.88% to 4.10% error for seventh to ninetieth day forecasts.

KEYWORDS *: Bitcoin, Classification models, Regression models, Superior performance, Error percentage, Cryptocurrency market.*

INTRODUCTION

The ongoing digital transformation of economies and financial systems is a disruptive force worldwide. A recent report predicts that the digital economy's size will reach 25% (23 trillion USD) by 2025, encompassing digital assets that are concrete and intangible. The distributed ledger technology (DLT) plays a pivotal role in this transformation, with Bitcoin as a prominent application. At the nexus of Fintech and next-generation networks, blockchain technology is becoming more and more important.

The introduction of the most valuable cryptocurrency in the world happened after a whitepaper written under the pseudonym Satoshi Nakamoto was published in 2008. Peer-to-peer, decentralized networks provide the foundation of the money. This has the effect of removing all central authority over Bitcoin. Its market value is currently $9 billion, and it is traded on more than 40 exchanges globally that accept more than 30 different currencies. It has no taxes, is unchangeable, borderless, and distance-unbound, is decentralized, verifiable, safe, and has very little transaction fees.

Bitcoin, introduced in 2008 through a whitepaper authored by Satoshi Nakamoto, is the world's most valuable cryptocurrency. Operating on a decentralized, peer-to-peer network, Bitcoin is not controlled by any central authority. Carrying over thirty different currencies, it is traded on more than forty exchanges globally and has a market capitalization of nine billion dollars..Bitcoin's unique features include tax-free transactions, unforgeable nature, borderless and distance-independent transactions, decentralization, verifiability, and security.

BACKGROUND

The speed at which our modern world is becoming more digitalized makes it fascinating to learn about how this has affected currencies around the globe. In particular, we are interested in learning about how the disparities between these various currencies led to the development of new, decentralized cryptocurrencies, such as Bitcoin. As is well known, the COVID-19 pandemic severely disrupted the world's economies. An increasing number of people are investing in cryptocurrency as everything moves online. We think it is important for individuals to know about the market they are investing in during this pandemic, regardless of whether it will be advantageous for them in the long run. In addition, bitcoin and other cryptocurrencies are well known to be non-stationary and volatile.

The unprecedented growth of the digital economy, driven by technologies like DLT and cryptocurrencies, poses challenges, notably the issue of price volatility in decentralized cryptocurrencies. Previous research has primarily focused on machine learning-based classification models for short-term price predictions, typically limited to one day. This study aims to address these limitations by extending the forecasting horizon and evaluating the performance of machine learning models.

METHODOLOGY

The proposed methodology involves the use of high-performance machine learning models for classification and regression. The models are trained on historical Bitcoin price data, incorporating features relevant to the cryptocurrency market. The prediction intervals include end-of-day, seven days, thirty days, and ninety days. Following steps were involved for methodology:

Data Gathering

Bitcoin characteristics and pricing information are publicly available on the internet. A Python 3.6 web scraper was used to gather the data for this study from https://bitinfocharts.com. A collection of over 700 technical indicator-based features was gathered. The feature selection method was used to choose a smaller subset of features from this vast feature set. Different timeframes, including end-of-day, 7, 30, and 90-day intervals, are used to calculate these technical indicators. Raw values are defined as the closing prices at the end of the day.

Data Pre-Processing

Wherever feasible, the linear interpolation method was used for the pre-processing step to impute missing cases. If not, imputation is done using the feature's value that occurs the most frequently. The dataset was divided into training and validation sets after being scrambled for each regression model. 80% of the data were used for training, and 20% were kept for validation. The training set for the stacked artificial neural network was subjected to fivefold cross-validation. The dataset was split linearly into training and validation sets for each classification model. The training set contained the first 80% of the data, while the remaining 20% were retained for validation.

Feature Selection

To increase model performance, feature selection—a critical component of data pre-processing—is required. Various methods were employed to extract and trim the characteristics repeatedly. First, a random decision forest-based ensemble technique was used to determine the feature importance. Second, multi-collinearity and cross-correlations were examined in the smaller feature set. These procedures involved the usage of Pearson correlation and the variance inflation factor (VIF). With low cross-correlation values and no multi-collinearity, the resultant subset of features was deemed to be of relatively high relevance.

RESULTS

The developed machine learning model exhibits notable accuracy and performance metrics. For next-day forecasts, the model achieves 65% accuracy with a 1.44% error percentage. The accuracy ranges from 62% to 64% for seven to ninety days, accompanied by error percentages between 2.88% and 4.10%.

FUTURE ENHANCEMENT

1) Examining the possibility of modeling cryptocurrency prices with artificial intelligence in order to calculate the risk associated with using block-chain technology for financial purposes.
2) This model could also be useful in detecting fraudulent activities and anomalous behavior.
3) The stability of cryptocurrencies may be evaluated

and predicted by combining machine learning-based price models and anomaly detection techniques with external data inputs pertaining to international events and financial risk.

CONCLUSION

This research provides study for the field of crypto currency, price prediction by extending the forecasting horizon and demonstrating the effectiveness of high-performance machine learning models. The achieved accuracy and low error percentages highlight the potential of these models in addressing the challenges associated with Bitcoin price volatility.

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HD-CNN: Early-stage Alzheimer Detection system using Hybrid Deep Convolutional Neural Network

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ABSTRACT

According to recent predictions, Alzheimer disease (AD), which is presently the sixth greatest cause of impermanence in the USA, may come in third place among all causes of death for seniors, just after cancer and heart disease. It is obvious that it is crucial to identify this illness early and stop it from spreading. Numerous medical tests are necessary for the diagnosis of Alzheimer disease (AD), which generates enormous amounts of multivariate heterogeneous data. The varied nature of medical testing makes it difficult and taxing to manually compare, evaluate, and analyze this data. In this research we proposed an early-stage detection AD using hybrid deep learning algorithms. The various feature extraction and selection methods are used for extraction of potential features. The RESNET-101 and VGGNET are the deep learning frameworks that we use for classification. The YOLOv8 is used for data preprocessing as well as object detection. The RESNET-101 obtains higher 99.35% accuracy with 100 epoch size and 15 hidden layers which is higher than all experiments. In comparative analysis our model evaluation has done with VGGNET and ShallowNet, As a result our system outperforms higher result than both.

KEYWORDS *: Alzheimer's disease, Deep learning, Biomarkers, Positron emission tomography, Magnetic resonance imaging, Mild cognitive impairment..*

INTRODUCTION

The word "dementia" refers to a range of diseases that may damage brain cells and cause gradual, permanent memory loss in humans. Alzheimer's disease, the most common form of dementia, is classified into these three levels based on its severity: mild, moderate, and severe [1]. Patients with Alzheimer's disease are reported to undergo a gradual loss of cognitive function throughout the course of the illness, culminating in a complete loss of memory and an inability to do even the most basic of tasks [13, 14, 16, 17, 25, 26]. The most common type of dementia, Alzheimer's disease is the sixth leading cause of mortality worldwide. As much as 80% of dementia cases may be attributed to it. The number of people living with Alzheimer's disease is expected to almost triple, from 5 million in 2014 to 14 million in 2060, as predicted by the Centers for Disease Control and Prevention (CDC). Despite its prevalence, this degenerative illness is still untreatable [18, 19, 20]. Magnetic resonance imaging (MRI) techniques like diffusion tensor imaging [18] have been shown to be beneficial for studying the brain's white matter structure. DTI is one of many imaging approaches that have been used to identify and study Alzheimer's disease [21, 22]. DTI is a noninvasive imaging technique that uses the Brownian motion of water molecules as its foundation. It may be used to learn more about

the distribution of water molecules in tissues, including their size, anisotropy, and spatial orientation.

MRI scans of the brain are used to diagnose Alzheimer's disease based mostly on the presence of cerebral atrophy, the shrinking of brain tissue caused by the loss of gray and white matter in the proximal temporal and temporoparietal cortical lobes. In addition, Alzheimer's disease brain structural abnormalities may be quantified using the classification of brain MRIs obtained at different stages. However, clinicians may struggle with manual data collection and processing from large, complex DTI datasets. Furthermore, inter- or intra-operator variation concerns might make mechanical examination of brain DTIs extremely time-consuming and inaccurate. One approach to completely automating the DTI assessment process is to use existing automated techniques for MRI classification, representation, and registration. Because of this, accurate data may be generated with more assurance [13].

Brain MRI segmentation is considered crucial in a wide range of medical applications because of the effect it has on the entire investigation's findings. Measurement and visualization of brain structures, lesion identification, and image-guided therapies and surgeries are some of the most common uses of MRI segmentation. The fundamental purpose of brain MRI delineation is to divide an image into distinct regions, each of which is made up of pixels with the same tonal range and texture as the rest of the image.

There have been many presentations of deep learning techniques to aid in DTI evaluation's segmentation and detection [18, 19]. In this study, we show how to implement a specific kind of CNN called a Convolutional Neural Network (CNN). Convolutional neural networks (CNNs) are widely used in machine vision applications. This is meant to mimic the way neurons in the brain communicate with one another. One input layer, several hidden layers, and one output layer make up the convolutional neural network. The network's robustness and resistance to overfitting are supported by the hidden layers, which consist of a convolutional layer, a pooling layer, an activation layer, and a fully connected layer. Fully linked layers are another kind of hidden layer. In the convolutional layer, a filter "convolutes," or iteratively traverses and analyzes the input image's pixel values. Colors, arcs, and boundaries may all be determined with the help of this array. After the first layer of processing is complete, a numerical activation map is produced. The output of the map is a set of numbers that stand for the presence or absence of certain visible features. The SoftMax layer is the last stage of a convolutional neural network (CNN) and is used to evaluate the relevance of the map of activation's high-valued attributes to a given picture classification. Until the training data yields consistent results, the thresholds and weights of the different layers are adjusted during the "training" process.

LITERATURE SURVEY

According to A. Kahn et.al. [1] describes an challenging to detect and predict the progression of Alzheimer's disease from the early stage of Mild Cognitive Impairment (MCI). Citing: Khan et al. Regression analysis is a statistical method for determining which characteristics and indicators are most strongly correlated with a desired result. The major goal of this study is to use a total of 20 different biomarkers in combination with medical information to conduct a tailored regression analysis of cognitively typical persons and MCI converters. From a total of 1713 male and female participants, 768 female respondents were chosen to examine the prevalence of AD and MCI, the characteristics of individuals diagnosed with AD and MCI, and the variables that contribute to their development. The data utilized in this study came from the Alzheimer's Disease Neuroimaging Initiative (ADNI). Twenty different potential medical characteristics were included in the analysis. Factors from a wide variety of diagnostic procedures, including MRI, PET, DTI, and EEG, were included in this analysis. The results indicated that cognitive assessment measures were much more important than other testing biomarkers. The results of this research may have implications in the clinical setting, either by helping to refine a machine learning approach to predicting the progression from MCI to AD or by helping to identify key people for therapy trials.

J.'s study aimed to determine. K. Medina et al. [2] aims to create a system that can consistently diagnose fish infections far earlier than the conventional method. The device uses a camera component to capture still images or stream video of goldfish, which are then pre- processed to bring out their most salient features. The YOLO method extracts characteristics after they have been segmented. Following that, the technique categorizes each identified disorder. The collected data successfully identified and classified the goldfish specimens with a 91% overall detection rate. Using CNN and YOLO, this inquiry helped solve the problem by identifying the most common sickness among goldfish. This instrument is useful for the early diagnosis of illness and may be used by both novice fish producers and veterinary technicians or aquarium owners.

W. The YOLO v5 technique is used by Fan et al. [3] to diagnose 14 lung illnesses through abnormal target detection in chest X-rays. The primary goal of developing this method was to aid in the diagnosis of lung ailments. The Vindr-CXR dataset made public by the Kaggle Competition was used to verify the accuracy of the YOLO version5 anomaly detection system. Experiment results show that the YOLO v5 strategy, used in this study, is more accurate than competing approaches when it comes to spotting outliers. When compared to the Faster RCNN and EfficientDet methods, the metric score is 7.2% higher. This offers as evidence that the method is effective in picking out abnormalities in chest X-rays.

M. Hashim et al. [4] present a state-of-the-art, extremely effective method for diagnosing agricultural diseases. The proposed method will employ the YOLO approach to identify plant diseases. Compared to other object recognition methods, the YOLO algorithm can analyze 45 frames per second in rapid succession, making it ideal for analyzing photographs of leaves. Segmenting the picture into a grid of cells is the initial step in image analysis. One neural network can predict both the box sizes and the class probabilities in a single assessment. The offered technology will assist farmers in early disease detection, leaf disease identification, and crop management to guarantee the safety and health of plants.

A. According to Morbekar et al. [5], India is home to billions of smallholder farmers who rely on farming as their main source of income. The possibilities accessible to farmers for selecting profitable crops are vast. Farmers, however, remain in the dark about numerous diseases that might affect their crops because of a dearth of relevant information. When harvesting sick crops, many farmers have trouble and waste a lot of time. Timely analysis of the situation is crucial for avoiding costly consequences and maximizing output. The proposed system employs the YOLO technique as a novel application of the object detection approach for disease diagnosis in plants. In comparison to other technologies, YOLO's real-time processing of 45 frames per second is much faster when applied to images of leaves. The picture must be divided into several grid cells before further processing can begin. The prediction intervals and class probabilities are all calculated using a single neural network. This improves the speed and accuracy with which leaf diseases may be diagnosed.

"Y" claims. Chest pain is one of the most common medical complaints, according to research by Yuan et al. [6]. Chest X-rays play a crucial role in the evaluation and diagnosis of chest illnesses. Artificial intelligence applied to X-ray images may provide a workable answer to the shortage of healthcare resources and the heavy burden imposed on clinicians. This research looks at the feasibility of using the real- time detection technique YOLOv4 to diagnose respiratory problems. Chest X-rays are generally 256-level grayscale pictures, which does not provide enough information for precise diagnosis. Therefore, a method is created to transform black-and-white X-ray images into those that seem to have color. Grayscale X-ray pictures, which only provide a minimal amount of information, are converted to color X- ray images, which reveal much more detail. The YOLOv4 is then put through its paces by being taught to identify the chest X-ray's colorful pictures. Publicly accessible datasets are used to evaluate the method, and the results of the trials show that the method can accurately detect and locate chest X-ray problems.

A. Mohandas et al. [7] provide an algorithm that can identify and recognize the plant illnesses that damage the leaves by using techniques often connected with the identification of objects in Image Processing. The Yolo v4 architecture, which is based on convolutional neural networks (CNNs), is used to do real-time object identification. Tomatoes, mangoes, strawberries, beans, and potatoes are just few of the plants whose leaves are the subject of this study. Bacterial and fungal diseases, as well as blight, are major causes of leaf damage in plants. One probable cause of these conditions is exposure to biological agents, sometimes called pathogens. The focus of this study is on recognizing and identifying illnesses of plant leaves using a specific model called YOLOv4-tiny in order to provide a preventative approach against the related ailment. The approach culminated in the system's incorporation into an android-based application. Users of this app would have a direct line to a diagnostic service for leaf diseases in real time.

S. made use of the revelation of the image-immortalizing YOLO c4 object. A reaction that helps generate more public interest in and support for covering up in public is highlighted by Degadwala et al. [8]. Good coding constraints are already included into the given Yolo v4 learning model. Even when they can't fix accuracy problems or meet complex arrangement demands, the company nonetheless promises fast access that may provide satisfying results. The suggested strategy might be divided into three parts: exposed skin, no cover, and no disguise. Because of how well it performed throughout development and testing, the model achieved a degree of accuracy of 99%, which was more than that of any of the alternatives considered.

K. In order to automatically recognize cysts in ultrasound images, Mahajan et al. [9] suggested a novel and extremely effective method. The YOLO approach was developed in this work to automatically identify PCOS and non-PCOS images in real time. The proposed method uses a single Convolutional Neural Network to automatically identify ultrasound images with PCOS and those without.

The Y might vary from the YOLOv5 perspective. In order to identify and categorize COVID-19, Li et al. [10] provide a method. The results of the studies show that the algorithm's efficacy is higher than that of other deep learning algorithms. More specifically, compared to the Fast RCNN technique and the Efficient Net design, the forecasting output has a map index (0.5) of 0.605, an increase of 32% and 18% respectively.

A. Koirala et al. [11] propose a novel approach to improving the performance of deep learning algorithms for the purpose of recognizing infections on microscope photos of thick blood smears via the consistent labeling of ground truth bounding boxes. The ground truth labels may be applied consistently to the bounding box to achieve this. Recommendations are made based on the outcomes of reliability and reproducibility tests conducted on the trained models. To maximize efficiency in terms of accuracy and speed of detection with minimal resources, a custom deep learning framework called YOLO- mp was developed. Specially developed 3-layered and 4- layered,YOLO-mp-3l and YOLO-mp-4l models achieved best mAP ratings of 93 (@IoU=0.5) and 94 (@IoU=0.5), respectively, for identification of the parasitic infections pathogen on a publicly available set of thick blood smear microscope pictures obtained with a phone camera. It has been shown that YOLO-mp-3l (with BFLOPs and model size equal to 21 and 24Mb) and YOLO-mp-4l (with BFLOPs and model size equal to 24 and 25 Mb) are superior to regular YOLOv4 (with BFLOPs and model size equal to 127 and 244Mb) when it comes to the amount of memory and processing power they require.

Because to A's efforts, ophthalmologists can now detect diabetic retinopathy at any stage. Padyana et al. [12], which aims to classify diabetic retinopathy into its various stages. The proposed method employs YOLO-RF to classify the picture data into several groups. Support vector machine, Decision Tree, Random Forest, and YOLO were among the traditional machine learning classification techniques compared with the proposed approach. Retinal fundus pictures from KAGGLE and IDRID were used for this analysis. With an accuracy of 99.3%, precision of 97.2%, and recall of 99.1%, the results show that the YOLO-RF model proposed for the system performed brilliantly. According to M., Alzheimer's disease is a degenerative brain ailment that irreversibly erodes mental faculties over time. Authors: Velazquez et al. Recent years have seen extensive research on the link between the prodromal stage of MCI and the development of Alzheimer's disease, with the hope of finding a method to make an early diagnosis of the illness. Early detection at the MCI stage may select appropriate therapy measures and help to research study enrollment since 32% of persons with MCI will be diagnosed with Alzheimer's disease over the following five years. Researchers have shown encouraging results when classifying Alzheimer's disease stages using machine vision in combination with MRI, DTI, and PET. DTI-centric research has shown that there are substantial differences in white matter organization throughout different developmental phases. In order to identify the 32% of people with Early MCI who would eventually develop Alzheimer's disease, an alternative to phase classification is proposed: a recurrent neural network model (RNN) dependent on the DTI modality. The study's results are state-of-the-art because they show how accurately certain individuals' likelihood of receiving an Alzheimer's diagnosis over the next 5-7 years may be predicted.

In A.'s opinion. According to Thushara et al. [14], Alzheimer's disease is a global epidemic that affects millions of people's brains. Individuals and their loved ones face a dramatic drop in quality of life as a consequence of the disease. Since Alzheimer's is only diagnosed in its advanced stages, the only treatments available are palliative. There are currently no drugs available that may slow or halt the disease's progression. Therefore, the most efficient method for developing a treatment strategy is an early diagnosis of Alzheimer's disease. Neuroimaging techniques such as magnetic resonance imaging (MRI), diffusion tensor imaging (DTI), positron emission tomography (PET), and resting-state functional magnetic resonance imaging (rs-fMRI) may detect the structural and functional changes brought on by Alzheimer's disease. In recent years, machine learning methods have gained traction for use in analyzing neuroimaging data acquired by MRI imaging techniques for the goal of identifying and prognosing neurological diseases. In order to classify and make predictions about Alzheimer's disease, a random forests-based classification method is used in this research. The TADPOLE data collection, used in this study, was made available to the researchers by the Alzheimer's neuroimaging Initiative (ADNI). This study's multiclass strategy for determining AD stages has achieved accuracy on par with that of current studies in the area of Alzheimer's prognosis.

Findings by K. Diffusion tensor imaging, as described by Aderghal et al. [15], is an emerging imaging method that supplements structural MRI data in studies of Alzheimer's disease. Recent studies looking into the pathologic stages of Alzheimer's disease have relied heavily on Mean Diffusivity maps, which are obtained using the Diffusion Tensor Imaging modality. Deep Neural Networks are appealing tools for the classification of imaging data from people with AD, which is a key component of computer-assisted diagnosis. The main problem is that there isn't a publicly accessible database that has sufficient amounts of training data for both paradigms to solve the problem. Over-fitting occurs when there aren't enough data to properly train a model. We offer a learning strategy that is portable across modalities, in this case from structural MRI to DTI. In order to train on Mean Diffusivity data, models developed from a structural MRI dataset with domain-dependent data augmentation are used to activate network variables. With this method, overfitting is mitigated, learning efficiency is increased, and prediction accuracy is improved. A portion of the ADNI dataset is classified better between healthy controls, Alzheimer's patients, and persons with mild cognitive impairment once the classification algorithms are merged using a majority vote.

Normal cognition, mild cognitive impairment (MCI), moderate to severe MCI, and Alzheimer's disease are the four classifications used when A. For AD spectrum individuals, Song et al. [16] implement and assess a multi-class GCNN classifier for network-based classification. These people are divided up into four categories. Using structural connection graphs produced from DTI findings, the network architecture is designed and validated. Using receiver efficiency curves, we show that the GCNN classifier outperforms a support vector machine classification model by margins that vary depending on the kind of illness being analyzed. The findings show that the performance gap between the two methods widens as the disease develops from CN to AD. This shows that GCNN may be used to effectively stage and categorize patients throughout the AD spectrum.

An entirely novel strategy for assessing AD is proposed by Guo et al. [17]. In order to examine the characteristics of the whole brain, a network of the brain was built from scratch using an original segmentation atlas, and global graph conceptual variables were calculated. Using this comprehensive map of the brain, we may then get the graph theoretical characteristics of specific brain regions. Finally, neuropsychology measures are employed to conduct a correlation study between the conceptual properties of the graph and scale scores in various subdomains. The results not only emphasize the correlation between neuroimaging data and neuropsychological assessments, but also offer strong evidence for the relationship between medical outcomes and physiologic brain lesions of people with AD [20].

Table 1: Review of literature

Author	Methodology	Gap Analysis
Menagadevi et al. [21]	ELM based autoencoder has used	Complex model Classifier-dependent method Demand more time for the training.
Murugan et al. [22]	Deep CNN and various pre- process ing techniques	Complexity in terms of the computations required Overfitting issue A issue in model convergence poor performance on large amounts of data.
Loddo et al. [23]	Ensemble learning algorithm has used with pretrained model	Less interpretable Complications regarding both time and money Inappropriate for use in actual applications Poor accuracy across both large and small data sets.
Sharma et al. [24]	SVM based ML algorithm with pretrained model	Low accuracy despite the large amount of data Poor performance in datasets with uneven distributions of elements Overfitting problem Classifier dependent technique.
Mohammed et al. [25]	SVM based ML algorithm with pretrained model	Low accuracy despite the large amount of data. Overfitting issue requires a significant amount of available resources.
Balasundaram et al. [26]	Image segmentation techniques and pretrained model	The gradient is exploding, there is a problem with the datasets being unbalanced, and the model is complicated.
Bangyal et al. [27]	Deep CNN	obtained a poor degree of accuracy Complex model Inappropriate for use in actual applications.
Ahmed et al. [28]	CNN with pre-processing and optimization methods	Overfitting issue Complexity in terms of the computations required inaccuracy over large amounts of data.
Tuvshinjargal and Hwang [29]	Pretrained model with deep learning methods	Low accuracy despite the large amount of data Not sturdy enough.
Hazarika et al. [30]	2D and 3D CNN combined for classification	It is difficult to comprehend how the model arrives at its conclusions, and the computation involved is rather extensive.
Balaji et al. [31]	3D CNN has used with LSTM model	due to the lack of adoption of a reliable feature fusion approach for axial Not sturdy enough.
Hu et al. [32]	CNN with pre-processing and optimization methods	Overfitting problem for large dataset
Lee [33]	MRI image dataset with Deep CNN classification	Perform poorly in imbalanced datasets
Feng [34]	Deep feature extraction and selection deep CNN	Not suitable for real applications
Mefraz [35]	Various learning model with RESNET-101 and VGGNET	Low performance on big data
Ruoxuan [36]	CNN with pre-processing and optimization methods	Perform poorly in imbalanced datasets

Ahmed [37]	Ensemble method has used for detection of AD in complex data	In order to correctly learn complicated characteristics, a substantial quantity of data is required.
Fung [38]	Deep CNN method has used for detection of AD in complex data	a very poor accuracy was obtained for the job of binary classification.
Kam [39]	Embedded feature extraction using deep CNN	Overfitting problem
Shi [40]	Heterogeneous dataset used for classification using CNN	Obtained low accuracy for binary classification task
De, A. [41]	RF based machine learning techniques has used for classification	Only review based deep learning methodologies
Nawaz, H. [42]	Efficient framework for transfer learning	Overfitting and class imbalance
Ucuzal, H. [43]	Hybrid DL methods used for AD classification	Only one location was inspected during the course of this investigation. Despite the limited size of the sample, it was determined that the accuracy was sufficient.
Herzog, N.J. [44]	3D image dataset using 3D CNN	Hard to achieve higher accuracy on large dataset
Kaka, J.R. [45]	H hybrid methods has proposed for detection of AD using SVM based machine learning	Individual Modalities
Basher, A. [46]	Volumetric Features Extraction and DNN	Overfitting problem
Chen, S. [47]	Deep learning methods with deep CNN	High computation and low accuracy
Suhuai Luo al [48]	Convolutional neural network	Low accuracy on complex medical images
Shweta Madiwalar al [49]	Numerous machine learning algorithm with image segmentation techniques	Time consuming operation that could compromise the algorithm's accuracy
Sergio Gruesoal [50]	SVM and CNN used for classification	Methodological details are not included
C. Kavitha al [51]	Various machine learning algorithms	Failed to identity relevant features and attributes to identify the issue at hand
Habil Kalkanal [52]	Numerous deep learning techniques	Higher misclassification was observed while performing three-class classification
Spiegelhal-ter, D.J. [53]	An study of data from the micro level that is employed in the field of healthcare research is called a clinical trial.	Obtained low accuracy for binary classification task
Guintivano, J. [54]	The health and well-being of a person may be deduced from the sensitive information included in genetic tests.	No implementation, only review based system
Archer, P.E.H.A. [55]	The use of PET is essential for determining the relative amounts of cholesterol and amyloid in the brain.	Overfitting and class imbalance
Kam, A.E.M.K. [56]	The information included in the biospecimen data pertains to the physical sample extracted from an Alzheimer's disease patient and prepared for sequencing analysis.	This work was limited to a single location throughout its entirety. In spite of the limited number of respondents, the reliability was judged to be satisfactory.

Gomez-Isla [57]	Imaging methods are used to undertake a number of different types of analyses, including structure analysis and anatomical morphology.	A large dataset is a significant challenge.
Blennow [58]	The ratios of different proteins found in CSF biomarkers are what decide whether or not a specific biomarker may be used to identify Alzheimer's disease.	Individual Modalities
Noguchi, S. [59]	Genetic effects have an effect on the parts of the human body that are located in the brain area, the lung region, and the heart region.	Overfitting problem
Schwartz, L.H. [60]	AD may be identified by the use of a diagnostic technique known as a flare picture, which is also known as a fluid-attenuated inversion recovery image.	Low accuracy

PROPOSED SYSTEM DESIGN

The input to the system will consist of MRI or PET images that have undergone pre-processing. This imaging method utilizes radio waves and magnetic fields to generate high-fidelity, high- resolution two-dimensional (2D) and three-dimensional (3D) pictures of specific areas inside the brain. X-rays and radioactive tracers are not associated with the production of any harmful radiation. The structural magnetic resonance imaging (MRI) modality is often used to evaluate brain volumes in vivo with the aim of detecting brain degeneration, making it the most frequently utilized MRI technique in instances of Alzheimer's disease (AD). The Positron Emission Tomography (PET) imaging procedure involves the use of radiotracers to see the brain's activity as radioactive spheres. Data augmentation is a technique used to generate more training data by intentionally manipulating current data. Transformations include various operations such as shifts, flips, zooms, and other manipulations often used in the realm of image editing. In general, picture data augmentation is often applied just to the training dataset, while the validation and test datasets remain unaltered. The primary aim of image segmentation is to effectively cluster regions within an image that have common characteristics and can be classified as belonging to the same object class. This method is sometimes referred to as pixel-level categorization. In other words, this process involves the partitioning of images (or frames of video) into many segments or distinct entities. Ultimately, the act of reducing the amount of data facilitates the machine's ability to construct a model with less exertion, hence expediting the processes of machine learning and generalization.

A pre-existing model refers to a model that has undergone prior training to effectively tackle a comparable challenge. One approach involves using a pre-trained model that has been previously trained on a different issue, as opposed to commencing the problem-solving process from the beginning when faced with a comparable challenge. A convolutional neural network (CNN) is a class of deep neural networks that is specifically designed for the purpose of analyzing visual images within the context of deep learning. Subsequently, the obtained data will be subjected to analysis, enabling the formulation of suitable preventive dietary plans, exercise regimens, and other pertinent advice aimed at mitigating further complications.

CNNs are multiple encoders that have been specifically developed to recognize two-dimensional (2D) forms and may be used to transfer the input vector to the required output. Each neuron in a CNN is linked to a neuronal in a small region of the network's preceding layer, decreasing the number of weights in the network. CNNs utilize a hierarchical connection topology similar to conventional neural network models. A CNN, in other words, is made up of components that are layered layer by layer. Figure 1 shows convolutional, pooling, and fully linked layers, as well as an output layer.

Convolutional and pooling layers alternating in these first few layers of a conventional CNN, succeeded by the fully - connected layers. The categorization results are generated by the final output layer. Finally, system demonstrates a Alzheimer detection class for entire test dataset.

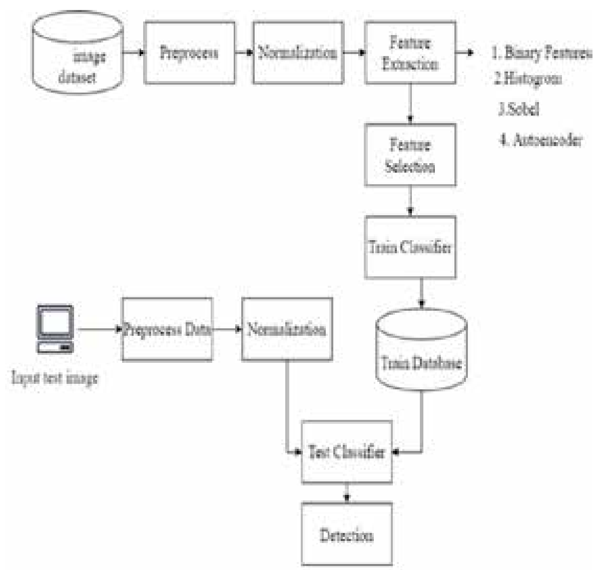

Figure 1 : proposed system architecture for Alzheimer disease detection and classification

RESULTS AND DISCUSSIONS

The accuracy of the Alzheimer detection algorithms can be measured through train and testing model. The i7 Intel processor has used with 16 GB RAM. The model has run with different methods such as RESNET-50, RESNET-100 and RESNET-101 with deep CNN. In below Table 1 and Figure 2 to 6 demonstrates proposed model evaluation and Figure 7 describes comparative analysis of proposed system.

Table 1: performance analysis of proposed model

Epoch size	Method	No. of hidden layers	Detection Accuracy
20	RESNET-50	5	96.15
	RESNET-100	10	96.95
	RESNET-101	15	97.00
40	RESNET-50	5	96.45
	RESNET-100	10	97.60
	RESNET-101	15	98.50
60	RESNET-50	5	97.10
	RESNET-100	10	97.80
	RESNET-101	15	98.55
80	RESNET-50	5	97.4
	RESNET-100	10	98.30
	RESNET-101	15	98.95
100	RESNET-50	5	97.95
	RESNET-100	10	98.40
	RESNET-101	15	99.35

Table 1 provides a description of three distinct deep learning modules of RESNET, each with frameworks consisting of 50, 100, and 100 layers respectively. The study demonstrates that increasing the number of hidden layers results in an increase in time required and also improves the accuracy of the module.

The ResNet, is Residual Networks, is a specific form of deep neural network structure that was developed to tackle the issue of the vanishing gradient problem in networks with a large number of layers. The primary advancement of ResNet lies in the incorporation of residual blocks, which consist of skip connections or shortcuts that allow for bypassing certain levels. This facilitates the training of more complex networks by enabling a smoother flow of gradients across the network.

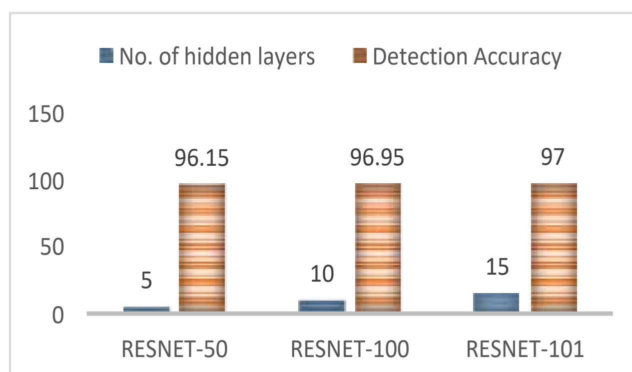

Figure 2 : detection accuracy of proposed model using different RESNET architecture and hidden layers with 20 epoch size

The above Figure 2 demonstrates an 5,10 and 15 hidden layers performance analysis with 20 epoch size using RESNET-50, 100 and 101 layers.

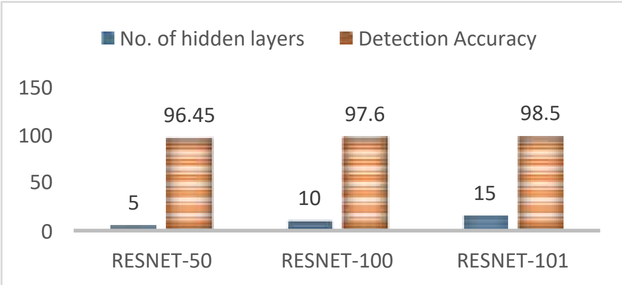

Figure 3 : detection accuracy of proposed model using different RESNET architecture and hidden layers with 40 epoch size

The performance study of 5, 10, and 15 hidden layers with 40 epoch size using RESNET-50, 100, and 101 layers is shown in Figure 3 above.

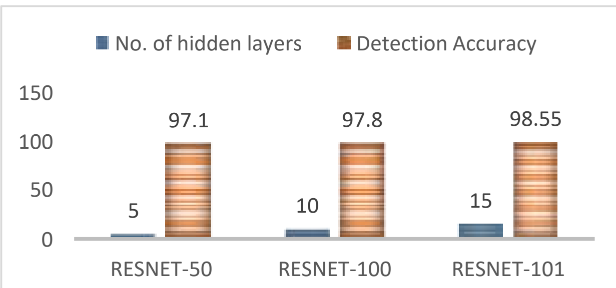

Figure 4 : detection accuracy of proposed model using different RESNET architecture and hidden layers with 60 epoch size

The above figure 4 describes classification accuracy with different hidden layers such as 5, 10 and 15. The epoch size has given as a 60 for entire execution. As a result we conclude RESNET-101 with 60 epochs provides higher accuracy than RESNET-50 and RESNET-100 framework.

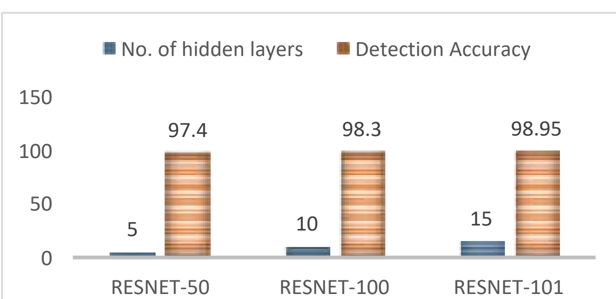

Figure 5 : detection accuracy of proposed model using different RESNET architecture and hidden layers with 80 epoch size

Figure 5, provides a description of the accuracy of classification using several hidden layers, including 5, 10, and 15. A value of 80 has been assigned to the epoch size throughout the whole operation. We have come to the conclusion that the RESNET-101 framework, which has sixty epochs, offers a better level of accuracy than the RESNET-50 and RESNET-100 frameworks.

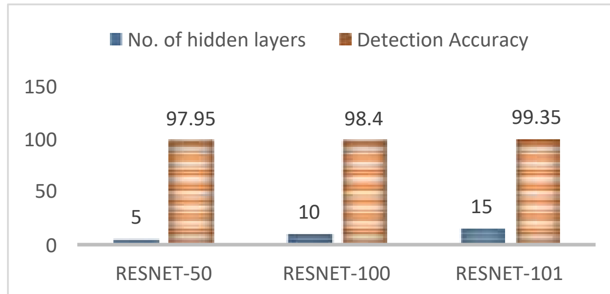

Figure 6 : Detection accuracy of proposed model using different RESNET architecture and hidden layers with 100 epoch size

Figure 6 above shows the classification accuracy with 5, 10, and 15 hidden layers. The whole execution has an epoch size of 100. We find that RESNET-101, with its 60 epochs, outperforms the RESNET-50 and RESNET-100 frameworks in terms of accuracy.

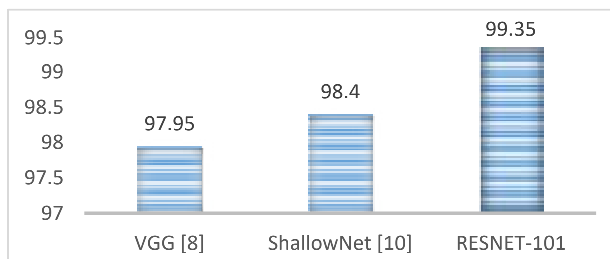

Figure 7: comparative analysis of proposed model with existing systems

The above Figure 7 describes an comparative analysis for proposed model, the evaluation has done with VGGNET [8] and ShallowNet [10]. The proposed model shows around 1% higher accuracy with both existing models.

CONCLUSION

The purpose of this study was to apply the popular YOLOv4 and YOLOv8 algorithms to the task of multiclass classification, specifically in the context of brain DTI scans taken from persons with Alzheimer's disease. These models could be implemented effectively, and the research that led to that conclusion added considerable new information to the area of medical imaging. The study has provided valuable insight into the use of machine learning in medical imaging diagnosis, expanding the scope of possible future studies. Radiologists may employ technique predictions, like as those produced by YOLOv8, to supplement their in-depth knowledge of Alzheimer's disease patients' medical conditions. The described models may be improved upon by adjusting the parameters of the YOLOv4 and YOLOv8 algorithms and doing performance optimization. This requires more time spent training the models, better image enhancement for better image recognition, and the creation of more images to help smooth out inequalities in the training dataset. The next phase of the study will include the categorization of ensembles via the use of a "voting ensemble," in which the most popular prediction will be implemented. The main advantage of utilizing an ensemble classification model is that a classifier using ensembles may correct mistakes produced by individual classification models and combine the results of several classification models to obtain the best achievable accuracy.

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Streamlining 3D Printing: A Web-Based Approach for Enhanced User Experience and Quotation Generation

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ABSTRACT

With the changing technologies and upcoming trends in the technical and industrial market the expectation of the world towards the interfaces that provide them with the access to various operations and services over the internet has changes magnificently. Implementing a capable system to withstand the user expectation is a challenging task, wherein, companies indulge themselves into recursive research for user experience enhancement and improvisation of the product/service based on the feedback of the user base. This review has been constructed to get insightful information on how these different challenges are overcome and addressed within a company's ecosystem. A thorough research in improvements to user experience composes of various steps such as system understanding, market research, competitor research, user expectation and various official and unofficial surveys. The broad idea behind these research iterations is to improve an existing system or create a well-defined and globally accessible system. The market for 3D printing is highly competitive and thriving for sustainability. This review will indulge you in understanding the automation and delivery undergoing in the digitalized 3D printing systems.

KEYWORDS *: User experience, Market research, Competitor research, Customer research, Product structure & strategy.*

INTRODUCTION

The advent of E-commerce and M-commerce has significantly transformed the 3D printing industry, enabling global market accessibility through online platforms. The evolution of online-based systems has been driven by rapid technological advancements, leading to enhanced features and controls. Companies prioritize customer satisfaction as a core motive, necessitating a responsive approach to complaints and feedback. Initially, digitalized systems were basic due to technological constraints, but as new 3D printing technologies emerged, there was a demand for more sophisticated online systems. Today's online platforms are not just programmatic bundles; they result from thorough research and progressive development, involving specialized teams for UI/UX equipped with modern tools. The industry standardizes research and prototyping to understand system architecture effectively, with product/service development encompassing project planning, design, implementation, deployment, and maintenance.

LITERATURE REVIEW

[1] Price Quotation Methodology for Stereolithography Parts Based on STL Model by Hongobo Lan, Yucheng Ding provide pricing methodologies for Stereolithography (SL) parts based on STL models, presenting two approaches: rough quotation (weight-based) and precise quotation (build-time-based). Rough quotation estimates costs using weight, adjusting for market dynamics. Precise quotation relies on a novel algorithm predicting build-time, incorporating

geometric data from STL models and statistical support structure values. Tests show a 10% build-time prediction error, suitable for early-stage pricing. Primarily focused on SLA printers, neglecting cost models for other printer types. While suitable for early-stage pricing, a 10% build-time prediction error may limit precision in certain applications. The precise quotation method, based on build-time, may be more complex to implement than weight-based estimation.

[2] Implementation of Additive Manufacturing Cost Estimation Tool (AMCET) Using Break-down Approach by Aditya Mahadik, Dr. Dale Masel presents method for cost estimation. In this casethe cost is determined based on input parameters. The cost estimation method relies on manual approach. The model also tries to increase the accuracy with the help of previous parameters. It will require specialized personnel in the since he still needs to use slicer tool to decide orientation and enerate support and find the proper cost.

[3] Additive Manufacturing Cost Estimation Models a classification by Aini Zuhra Abdul Kadir, Yusri Yusof and Md Saidin Wahab presents are view of all the cost models developed over the last 3 decades and they categorize the study of cost model development into method based,task-based,system- based, hybrid based. Despite all the research they conclude that there is no satisfactory model through which can be used to estimate the cost of the models.

[4] Build Time and Cost Models for Additive Manufacturing Process Selection by Sungshik Yim and David Rosen presents a cost model primarily based on build time estimation. While this approach offers nearly accurate estimations, it comes with certain drawbacks. While it can be adapted for use with different types of printers to estimate costs, it remains a manual and time-consuming process. Each printer type would require different parameter inputs, making it complex to implement and maintain. The manual and time-intensive nature of the process still demands specialized personnel, posing potential limitations in terms of efficiency and scalability.

[5] Building a Quality Cost Model for Additive Manufacturing by Musab Hajalfadul and Martin Baumers present a cost model which is based on parameters and build time. It considers all the typesof cost that might incur and based on that it generates the final cost. This method of cost generation is manual as well. It can work with other types of printers and provide the estimations. The model relies on specialized personnel.

SOFTWARE IMPLEMENTATION

The software implementation of the cost model revolves around a web-based platform developed using TypeScript, React, Express, MongoDB, and AWS for STL file storage.

Cost Estimation Process

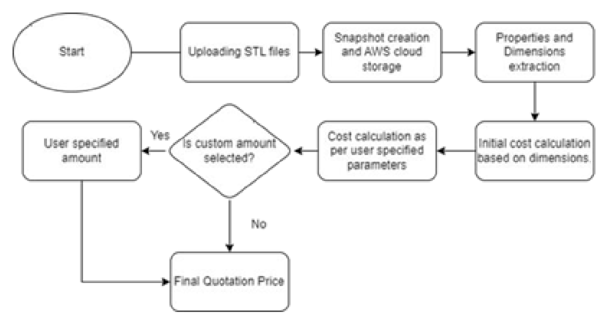

Fig. 1. Cost estimation process flow

The initiation of the cost estimation process begins with users uploading STL files, subsequently stored in AWS cloud storage. Leveraging the node-stl package, critical information about the STL files, including dimensions and volume,isextracted. This volume data holds paramount importance in our model for precise quotation generation. Simultaneously, a snapshot of the model is generated for integration into the quotation PDF, to be later transmitted via email. The initial cost estimate is then computed based on the volume:

Initial Cost Estimate = Volume of Model × Density of Material × Material Selling Price per gram

Users have the flexibility to select the desired infill amount, influencing the price calculation of a part:

Cost of a Part = Initial Cost Estimate × Infill Multiplication Factor

Subsequently, the cost based on the infill is derived. For users requiring 3D printing along with finishing services, additional options can be included:

Final Cost of Part = Cost of Part × Quantity + Finishing Amount

In instances where users find the generated price inappropriate or wish to charge differently, the platform offers the provision to input a custom price, which will be reflected in the quotation

UI/UX

User interface plays a very important role in any digital platform's success, and we have also put a lot of thought into the user interface and experience while working on our project. We are highlighting the importance of making a perceptive and user- friendly interface. A well-designed user interface provides seamless navigation and also majorly reduces the learning curve of users. We continuously took user feedback while designing user interface and made sure that we made a continuous growth of improvement.

User Flow

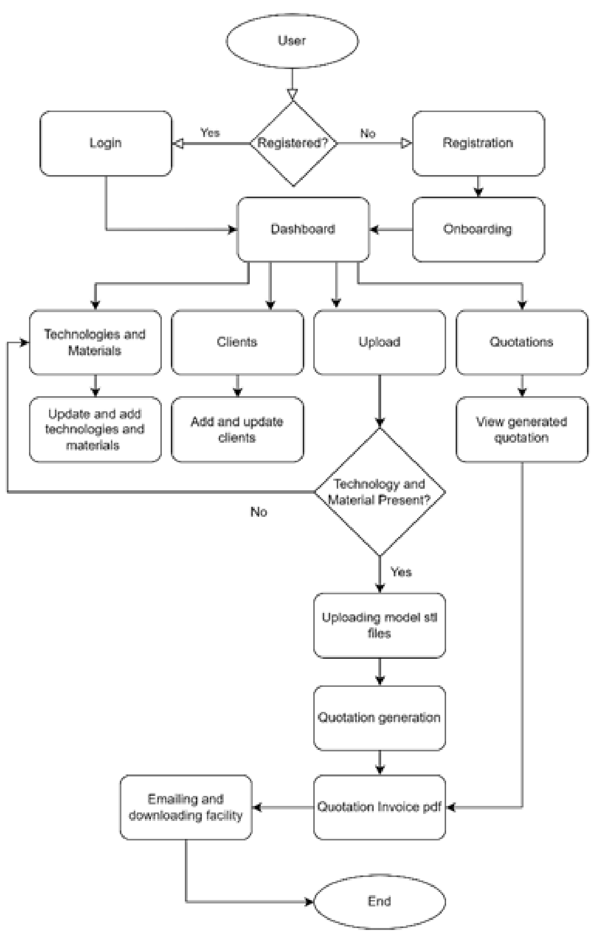

Fig. 2. User Flow Chart

RESULTS

The implemented web application offers quotations based on the provided STL file, providing an estimate forthe3Dprint.Thecalculationisvolume- based, allowing customization based on infill amounts. Additionally, the platform facilitates the management of printers, materials, and clients. Users can send quotation emails directly to clients, enhancing profit opportunities and staying competitive. Despite providing estimates, the system's accuracy may not be entirely precise. During setup, users need to consider additional parameters to determine a selling price that justifies the estimated cost. While expertise is required during the initial setup, the application becomes user-friendly, enabling even novices to generate quotations effectively.

Fig. 3. Quotation generation interface

CONCLUSION

In conclusion, the Automated Quotation Service project for the 3D printing industry aims to revolutionize the industry by automating the quoting process, enhancing operational efficiency, and improving client satisfaction. By streamlining the traditionally manual task, the project reduces response times, making businesses more competitive. Its user-friendly interface and automation reduce reliance on specialized personnel, ensuring operational consistency. Accurate cost estimations driven by advanced algorithms and 3D model analysis, bolster trust and eliminate the need for manual calculations. Cross-platform accessibility aligns with modern expectations. With strong technical and financial feasibility and market acceptance, this project has the potential to reshape the 3D printing landscape, offering efficiency, satisfied clients, and a competitive edge. Careful execution promises transformative outcomes.

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4. Sungshik Yim and David Rosen. “Build Time and Cost Models for Additive Manufacturing Process Selection”
5. Musab Hajalfadul and Martin Baumers “Building a Quality Cost Model for Additive Manufacturing”

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