

EMERGING TRENDS IN MACHINE LEARNING, DATA SCIENCE, AND INTERNET OF THINGS

PART 2

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Bentham Books

Emerging Trends in Machine Learning 'Data Science, and Internet of Things

(Part 2)

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**Emerging Trends in Machine Learning, Data Science, and Internet of Things
(Part 2)**

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ISBN (Online): 979-8-89881-516-5

ISBN (Print): 979-8-89881-517-2

ISBN (Paperback): 979-8-89881-518-9

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First published in 2026.

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FOREWORD

The rapid advancement of artificial intelligence and data-driven technologies continues to redefine the boundaries of innovation across multiple sectors. This volume reflects the dynamic and interdisciplinary nature of modern research in Machine Learning, Data Science, Blockchain, and the Internet of Things. The collection of chapters presented here demonstrates not only technical sophistication but also a clear commitment to addressing real-world societal challenges.

Several contributions in this book illustrate how machine learning techniques are being translated into impactful applications. From augmented reality-based educational tools and intelligent traffic classification to smart braking systems for vehicle safety and predictive models for heart disease detection, the research emphasizes practical implementations that enhance safety, well-being, and user engagement. The integration of wellness analytics and labor welfare authentication systems further highlights the role of AI in promoting inclusive and human-centered technological solutions.

Equally significant are the chapters devoted to secure and decentralized digital ecosystems. The exploration of blockchain-based healthcare data security, decentralized marketplaces for educators, and digital content verification systems reflects the growing importance of transparency, trust, and data integrity in the digital age. The inclusion of automated web and video summarization tools and smartphone usage analytics demonstrates how data science can provide meaningful insights into human behavior and information consumption.

The work on IoT-enabled healthcare monitoring and smart agricultural management underscores the transformative power of interconnected systems in improving quality of life and enabling informed decision-making. These contributions collectively reinforce the need for responsible, secure, and scalable AI systems.

I commend the editors and authors for compiling a volume that captures the spirit of innovation and interdisciplinary collaboration. This book will serve as an important resource for researchers, practitioners, and students seeking to advance intelligent technologies for the benefit of society

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Preface

The continuous evolution of intelligent computing and digital technologies has created unprecedented opportunities for innovation across multiple domains. The integration of Machine Learning, Data Science, Blockchain Technology, Natural Language Processing, and Internet of Things is transforming traditional systems into intelligent, automated, and secure platforms. This volume is compiled to present contemporary research contributions that address real-world challenges and promote technological advancement.

This book brings together research work from academicians, researchers, and industry professionals who have explored innovative solutions across diverse interdisciplinary areas. The contributions included in this volume demonstrate how emerging technologies are being effectively utilized to improve safety, healthcare, education, agriculture, digital security, and human well-being.

The Machine Learning section presents research on intelligent, user-centric applications. The chapters cover augmented reality-based learning tools, network traffic classification using advanced boosting techniques, smart vehicle braking systems for road safety, wellness applications integrating fitness and nutrition monitoring, authentication frameworks for labor welfare, and predictive healthcare models for heart disease detection. These studies illustrate the growing role of machine learning in enhancing system intelligence and improving quality of life.

The Data Science section highlights the importance of data-driven technologies in ensuring security, accessibility, and efficient information processing. The research contributions include blockchain-based secure healthcare data management, decentralized digital content marketplaces for educators, automated summarization tools using natural language processing, and analytical studies examining smartphone usage patterns and their impact on student performance. These works emphasize the relevance of data analytics in modern digital transformation.

The Internet of Things section focuses on innovative applications of connected devices in healthcare, agriculture, and digital content authentication. The chapters present IoT-enabled cloud healthcare monitoring systems, smart agricultural management using real-time data analytics, and blockchain-based digital content verification frameworks. These contributions highlight the importance of reliable, secure, and efficient interconnected technological infrastructures.

The editors express their sincere gratitude to all authors for their valuable research contributions and dedication. We also extend our appreciation to the reviewers for their constructive feedback and suggestions that have helped maintain the quality and relevance of this publication. Special thanks are due to all supporting institutions and organizing members whose continuous encouragement and support made this volume possible.

It is our sincere belief that this book will serve as a useful reference for researchers, academicians, students, and industry professionals. The research presented in this volume is expected to inspire future innovations, promote interdisciplinary collaboration, and contribute to the advancement of intelligent computing technologies.

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Summary of the Chapters

Section 1: Machine Learning

Chapter 1: AR Based Interactive 3D Alphabets for Dynamic Object

This chapter presents an augmented reality (AR) application that enables interactive 3D alphabet visualization to enhance early childhood learning. The system integrates computer vision and dynamic object rendering to create immersive educational experiences.

Chapter 2: Network Traffic Application Detection and Classification Using Extreme Gradient Boosting

The chapter explores the use of XGBoost for accurate detection and classification of network traffic. It focuses on improving traffic analysis efficiency and strengthening cybersecurity through advanced machine learning models.

Chapter 3: Drive-Safe: Smart Braking Against Neutral Danger Using Machine Learning Approach

This study proposes an intelligent braking system that uses machine learning to detect potential hazards and reduce road accidents. The system emphasizes real-time decision-making and improved vehicular safety.

Chapter 4: Integrated Wellness: Combined Workout and Nutrition Features in Fitness Applications

The chapter analyzes the synergistic impact of workout tracking and nutrition monitoring features in fitness applications. It highlights data-driven wellness analytics for promoting healthier lifestyles.

Chapter 5: Wages Authentication System for the Labour's Welfare

This chapter introduces a secure digital authentication system designed to ensure transparency and fairness in wage distribution, supporting labor welfare initiatives.

Chapter 6: Ensemble Learning for Heart Disease Prediction Using Lifestyle Parameters

A comparative analysis of ensemble learning models for predicting heart disease based on lifestyle factors. The study emphasizes improved diagnostic accuracy and preventive healthcare support.

Section 2: Data Science

Chapter 7: Blockchain-Based Methods for Secure Healthcare Data in Cloud Applications

This systematic review evaluates innovative blockchain frameworks for securing healthcare

data in cloud environments, addressing privacy, transparency, and data integrity challenges.

Chapter 8: Decentralized Marketplace for Educators Using Blockchain

The chapter proposes a blockchain-enabled decentralized platform for secure and transparent educational content monetization.

Chapter 9: Automated Web & Video Summarization Tool Using NLP Techniques

This study presents a natural language processing-based system for automated summarization of web content and videos, enhancing information accessibility and time efficiency.

Chapter 10: Smartphone Usage Analysis and Its Effect on Student Performance

The chapter investigates patterns of daily smartphone usage and analyzes their impact on academic performance and productivity.

Section 3: Internet of Things

Chapter 11: IoT Enabled Cloud-Based Healthcare System

This chapter discusses the design and implementation of an IoT-integrated cloud healthcare system for remote monitoring and efficient medical data management.

Chapter 12: Smart Agriculture with Real-Time Scale Management System (Agriscale-Pro)

The study presents a real-time IoT-based smart agricultural management system that enables informed decision-making and improved resource optimization.

Chapter 13: Digital Content Authenticity and Verification Using Blockchain

This chapter introduces a blockchain-based framework for verifying digital content authenticity, ensuring transparency and protection against data tampering.

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Section 1: Machine Learning

CHAPTER 1

AR-Based Interactive 3D Alphabets for Dynamic Object

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Abstract: Anilearn, an Augmented Reality (AR)-based mobile application, has the potential to revolutionize the Indian educational system in rural areas. Given that 65.5 percent of the Indian population resides in rural areas and the literacy rate in these areas is only 61.14 percent, there is a critical need to enhance the educational experience for rural communities. Anilearn utilizes cutting-edge AR technology to create a dynamic and interactive learning environment for pre-primary students. By using the app to scan objects and offering interactive features and audiovisual assistance, Anilearn captures the attention and interest of young learners and provides a distinctive learning experience. This program can give all children, regardless of their location, equal learning experiences through the power of technology. However, it is essential that Anilearn is user-friendly, accessible, and aligned with the curriculum. Involving teachers, parents, and local people in the development and implementation of Anilearn can help adapt it to the unique needs and cultural setting of India's rural areas. Anilearn has the potential to empower young learners and open the door for a better future for rural communities by making learning dynamic, engaging, and accessible.

Keywords: Android application, Augmented reality, Education, Machine learning, TextMeshPro, Unity software, Yolo.

INTRODUCTION

Improving the educational system in rural India is crucial for the nation's progress and development. Traditional teaching methods fall short in engaging and motivating students, leading to a need for innovative solutions. Augmented Reality (AR) shows promise in transforming education by creating dynamic and interactive learning environments. By integrating AR into the classroom, students can explore difficult concepts through visualizations and interactive simulations, enhancing their comprehension and critical thinking skills [1]. AR-based edu-

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cational apps can bridge the gap between rural and urban education, reaching a wider audience. Collaboration between educational organizations, technology developers, and policymakers is necessary for successful implementation. Overall, prioritizing the upgrade of the education system in rural areas can empower children and prepare them for the future.

The Anilearn app combines Augmented Reality (AR) and Machine Learning (ML) to enhance children's learning experience. By transforming objects into 3D alphabets, the app engages children and promotes active learning. It not only visualizes the alphabet but also provides detailed information and pronunciation guidance in the local language. The user-friendly app is designed to bridge the educational gap between urban and rural communities, ensuring equal access to quality education. By leveraging the widespread use of smartphones, the Anilearn app offers an immersive and interactive learning environment for children, contributing to the improvement of the Indian educational system, especially in rural areas.

The increasing availability of smartphones in rural India has contributed to a significant rise in literacy rates and the closing of the digital gap between rural and urban areas. The annual ASER study shows that in rural regions, smartphone usage increased from 40 percent (approx.) in 2018 to 70 percent (approx.) in 2021. This surge in smartphone usage has provided rural residents with access to online learning platforms and educational apps, offering new opportunities for educational engagement and learning. By leveraging the widespread availability of smartphones, innovative initiatives like the Anilearn app, which utilizes augmented reality and machine learning, can provide interactive and engaging learning experiences for children in remote areas. It is crucial to continue utilizing the expanding smartphone market to enhance educational programs, promote digital literacy, and empower rural students for success in the digital age.

This paper presents Anilearn, an augmented reality (AR)-based mobile application designed to enhance early childhood education, particularly in rural India. The application integrates machine learning (YOLO) and Unity to create an immersive learning experience by recognizing real-world objects and displaying corresponding animated 3D alphabets along with auditory cues in local languages. The project's major contribution lies in offering a scalable, low-cost, and engaging educational tool that overcomes the limitations of traditional teaching methods. By leveraging the growing accessibility of smartphones in rural areas, Anilearn bridges the urban-rural educational divide. The system's architecture combines Unity, OpenCV, and YOLO to ensure real-time object detection and accurate 3D rendering. A performance analysis comparing YOLO with Faster R-CNN and SSD demonstrates that YOLO consistently outperforms others in terms

of accuracy, recall, and F1-score, making it the optimal choice for real-time deployment. The application also supports multilingual and offline usage, making it an inclusive and practical solution for diverse educational settings.

LITERATURE REVIEW

“An overview and Five Directions for AR in Education” paper discusses the concept of Augmented Reality (AR) and its applications across a range of disciplines, with an emphasis on education [1]. AR enhances the real world by integrating virtual objects, providing immersive and interactive learning experiences. The benefits of AR in education include enhanced visualization, interactive learning, immersive experiences, personalized learning, and collaborative learning. “AiR” is an AR-based app that detects air quality and visualizes air pollutants through GPS location data. It provides information about various pollutants, their sources, and their impact on human health, aiming to raise awareness about air pollution. The “AR in Education” paper discusses an AR application for learning, where a smartphone is used to connect with a book. Users download the AR software and can view 3D models or videos when focusing on text or images, enhancing understanding and motivation in education and various industries like business, tourism, gaming, and medicine.

The paper, “AR in Maintenance Training for Military Equipment,” discusses the application of augmented reality to military equipment maintenance instruction [2]. It covers the structure of a typical augmented reality maintenance system, key technologies involved, and the specific challenges in military equipment maintenance. It aims to improve maintenance training in the military through augmented reality technology. “A Review of Research on Augmented Reality in Education” research paper discusses the benefits of augmented reality (AR) in the classroom [3]. It highlights how AR enhances learning by visualizing concepts and creating engaging experiences. AR allows students to interact with virtual objects and simulations, making abstract ideas easier to understand. It also promotes personalized learning, collaboration, and motivation. The paper likely explores different applications of AR in subjects like science, mathematics, and history. Similarly, another paper shows that integrating AR into online shopping websites increases sales by enhancing the effectiveness and satisfaction of the shopping experience.

The paper “Integrating Machine Learning with Augmented Reality for Accessible Assistive Technologies” explores the integration of machine learning (ML) and AR (augmented reality) with relation to usable assistive technology [4]. It discusses the potential benefits of combining ML algorithms with AR to provide intelligent and personalized assistance to users with disabilities. Specific

Network Traffic Application Detection and Classification Using Extreme Gradient Boosting

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Abstract: In today's technology-centric era, identifying and classifying traffic flowing through both private and public networks is crucial, given the emphasis on network performance, security, and lawful interceptions. With the increasing demand for network bandwidth fueled by modern applications, prioritizing business-critical applications and throttling non-productive ones is essential to optimize bandwidth usage. Accurate traffic classification is pivotal in achieving these objectives. Various methods, including traditional port-based detection, DPI (Deep Packet Inspection), and contemporary Machine Learning and Deep Learning approaches, have been employed for traffic classification. This study aims to develop and evaluate different ML models to classify IP network traffic and identify application layer protocols without relying on Deep Packet Inspection. The study utilizes a dataset from Juan Sebastian Rojas at the University of Cauca in April and May 2017. Different ML classification algorithms were implemented and validated, such as Random Forest, Decision Tree, Support Vector Machine, and Extra Gradient Boost (XGBoost Classifier). The results indicate that tree-based classifiers, particularly the XGBoost Classifier, outperformed others, both with and without the use of up-sampling methods like SMOTE. While SMOTE did not significantly affect the accuracy score, it did improve the recall values. These findings suggest opportunities for further research in popularizing Machine Learning-based application detection compared to traditional DPI and Signature-based detection methods.

Keywords: ADASYN, Network Traffic Classification, PyCaret, SMOTE, XGBoost Classifier.

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INTRODUCTION

The footprint of information technology has extended across all industries and domains, influencing various facets of life. Today, there is a continuous revolution in information and communication technology, marked by innovations in both wired and wireless network mediums, including Optical Fiber technology, 5G LTE, Wi-Fi 6, and Wi-Fi 7. Consequently, the availability of bandwidth in internal networks and on the internet has experienced a significant surge in recent years. However, with the increasing prevalence of dynamic scaling applications, Over-The-Top (OTT) platforms, streaming services, high-quality online content, and the growing demand for video conferences, there has been a proportional increase in bandwidth requirements.

Despite advancements, bandwidth remains a valuable and sometimes expensive resource. Like any precious resource, efficient utilization of bandwidth is imperative. Moreover, the crucial need for security and lawful interception further underscores the importance of efficient network management. The initial and most vital step involves classifying network flows and identifying causal applications. Traditional methods, such as DPI or signature and port-based application identification, have been continually improving over time and remain popular methods for application identification.

However, some challenges still need to be addressed. Traditional methods struggle to keep pace with new applications, encrypted traffic, and the increasingly sophisticated obfuscation techniques employed by attackers. They may rely on outdated signatures or heuristics that may not function effectively with newer technologies. Additionally, deep packet inspection used to analyse encrypted traffic raises privacy concerns and may not be feasible for all. Machine learning can offer promising solutions. It can continuously adapt to new threats, identify suspicious patterns in encrypted traffic without requiring decryption, and recognize application-layer protocols. Even with privacy considerations, machine learning models can be designed to analyze traffic while protecting sensitive data.

The aim of this study is to develop an efficient model for identifying network traffic flow using features available in packet headers and further engineering these features using purpose-built tools, without relying on DPI-generated features. Researchers at Universidad de Cauca captured the dataset used for this study and made it publicly available. This dataset has over 3 million rows and 87 features, labelled with 78 classes.

The Method applied is to detect “Protocol Name” as the classification target, using multiple classification algorithms. The XGBoost classifier outperformed other models, which were further hyperparameter-tuned and later retrained under

different circumstances. The dataset being a heavily imbalanced one, sampling methods, such as SMOTE and ADASYN, are applied. While SMOTE achieved high accuracy (approximately 92%), it exhibited signs of overfitting in certain oversampled classes. Conversely, ADASYN demonstrated stable performance with an accuracy of around 84%.

This Paper is organized as follows: Section 2 discusses related work, research, and limitations. Section 3 covers the proposed architecture, dataset, model building, and methodology. Section 4 focuses on the experimental setup, result discussion, and system limitations. Section 5 presents the conclusions, and Section 6 provides the references.

This research contributes to the field of network traffic classification by developing a high-performing machine learning model based on Extreme Gradient Boosting (XGBoost). Unlike traditional Deep Packet Inspection (DPI) techniques, the proposed Method relies solely on flow-level features extracted from packet headers, ensuring privacy preservation and computational efficiency. The study compares several classification models and demonstrates that XGBoost consistently outperforms others in terms of accuracy, precision, recall, and F1-score. It further addresses the challenge of class imbalance through the application of advanced oversampling techniques, notably SMOTE and ADASYN, with ADASYN providing superior generalization. The Paper also includes rigorous model training, validation, and hyperparameter tuning using 10-fold cross-validation. A significant contribution lies in the preprocessing of a large-scale real-world dataset, including intelligent feature selection and handling of class distribution, making the methodology reproducible for future research. Overall, this work highlights the potential of XGBoost in delivering efficient, accurate, and scalable solutions for application-level network traffic classification in modern, encrypted, and diverse networking environments.

RELATED WORK

The identification and classification of network traffic have significantly enhanced several networking applications, including resource management, security, anomaly detection, lawful interception, and quality of service (QoS) provisioning. As network traffic grows more complex and varied, the need for precise and effective classification techniques is becoming more pronounced.

A research [1] presents a network traffic classification approach using adversarial training and deep clustering. Feature dimension reduction in IoT traffic uses an autoencoder, aiding classification efficiency when the data is unlabeled. The model achieves a 92.2% multi-classification accuracy despite using no labeled data. Being both resistant and computationally simple, it allows for efficient

CHAPTER 3

Drive-Safe: Smart Braking Against Neutral Danger Using A Machine Learning Approach

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Abstract: Road safety is essential. Some reasons for road safety breaches include keeping the vehicle in neutral mode, using a manual braking system, driver drowsiness, and uncontrollable vehicle speed. Any technological development that enhances road safety is utterly essential. This project synergizes road safety and vehicle security through a unified solution. By combining a Drowsiness Detection System with an Arduino Uno, a blink sensor, a CNN, and OpenCV, the system monitors driver alertness by analyzing eye blink patterns. Simultaneously, a Neutral Gear Safety Shutdown, utilizing OpenCV and a CNN, prevents unintended vehicle movements in neutral gear, thereby enhancing overall safety. This paper demonstrates a holistic approach, leveraging cost-effective components and advanced technology, to ensure adaptability and effectiveness across diverse vehicles, addressing immediate safety concerns and preventing potential accidents.

Keywords: Convolutional neural network, Gear recognition, Matchmaking algorithm, OpenCV.

INTRODUCTION

In recent years, advancements in technology have driven innovative solutions that aim to enhance road safety and optimize vehicular systems. This research paper introduces an integrated approach to driver monitoring and vehicle safety by combining two distinct projects: the Drowsiness Detection System using Arduino [1] and a Blink Sensor, and the Neutral Gear Detection and Safety Shutdown employing OpenCV [2] and a CNN.

The primary goal of this integrated system is to create a comprehensive driver safety mechanism that addresses both the physiological state of the driver and the operational status of the vehicle. By merging these projects, we aim to develop a

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unified platform that not only monitors the driver's alertness but also introduces an intelligent safety feature related to the vehicle's gear status.

The Drowsiness Detection System utilizes an Arduino Uno microcontroller and a blink sensor to assess the driver's eye blink patterns continuously. Recognizing the critical role of a vigilant driver in accident prevention, this subsystem provides real-time feedback to the driver, alerting them to moments of potential drowsiness and encouraging immediate corrective actions.

Simultaneously, the Neutral Gear Detection and Safety Shutdown system utilizes OpenCV and a CNN for image processing to determine the vehicle's gear status. The integration of this subsystem addresses the potential safety hazards associated with unintentionally leaving the vehicle in neutral gear. In such scenarios, the system not only generates a visual indicator but also implements a safety shutdown mechanism, mitigating the risk of unintended vehicle movements.

By combining these two projects, our research endeavors to create a holistic approach to driver and vehicle safety. The symbiotic relationship between these subsystems ensures a more comprehensive safety net, promoting a secure driving environment for both the driver and surrounding road users. This paper examines the design, implementation, and experimental results of the integrated system, highlighting its potential to make a significant contribution to ongoing efforts in the realm of innovative and safe transportation systems.

LITERATURE REVIEW

In this research paper [3], the authors address the issue of road accidents in speed-restricted areas, such as schools and hospitals. The system utilizes an Arduino UNO microcontroller, Zigbee wireless communication, and speed sensors.

Suchi Rawat *et al.* studied and analyzed multiple methods to track electroencephalogram (EEG) signals, including waveform analysis and frequency analysis [4]. Jadhav *et al.* [5] presented a system that raises the alarm whenever a driver can fall asleep. Molina *et al.* [6] proposed a stem that detects Face pose, for which an automatic 3D model is created to monitor the driver's attention.

Das *et al.* [7], In their paper, they presented a microcontroller-based car safety system, which they implemented for drowsiness detection and distance detection between two vehicles.

Joshi *et al.* [8] discuss the development of an anti-drowsiness device to prevent road accidents. They utilize OpenCV and Python for eye tracking, and the Dlib library for facial landmark detection. Praveenkumar *et al.* [9] proposed a system

that captures drivers' eye blinks and subsequently prevents accidents. Sumit Kathe *et al.* [10] utilized multiple sensors to avoid accidents.

Vandana Saini and Rekha Saini highlight the risks of driver fatigue and the need for effective detection systems [11]. The review categorizes drowsiness detection into three main approaches: vehicle-based, behavioral-based, and physiological-based measures.

In this research paper [12], the authors presented an embedded system along with RF transmitter and receiver modules to prevent vehicle collisions. They provided a system to control the vehicle's speed.

Several studies have demonstrated the application of machine learning models in driver assistance and safety systems, with Convolutional Neural Networks (CNNs) being a preferred choice for analyzing visual data. These models typically follow a structured process including data acquisition, preprocessing, model training, validation, and evaluation. Training involves feeding annotated image datasets to CNNs, where multiple convolutional and pooling layers are used to automatically extract features like edges, textures, or object positions. The output is then passed through dense layers for classification. Loss functions, such as categorical cross-entropy, and optimizers, like Stochastic Gradient Descent, are used during training to fine-tune model performance. Post-training, the models are evaluated using standard metrics such as accuracy, precision, recall, and F1-score to ensure reliability. Some implementations integrate CNNs with real-time control systems (*e.g.*, Arduino or Raspberry Pi) to trigger alerts or physical actions, such as braking. These detailed processes provide a clear path for deploying intelligent, real-time vehicle safety mechanisms, such as those proposed in this study.

TECHNOLOGY USED

CNN

CNN, or Convolutional Neural Network, is a deep learning algorithm that primarily yields excellent results for analyzing visual imagery. CNN learns hierarchical patterns in data and classifies images, which is also very useful for object detection [13, 14].

Open CV

OpenCV is an open-source ML and computer vision library. Using this library, image and video processing become easier. It is beneficial for object detection, facial recognition, and gesture recognition [2].

CHAPTER 4

Integrated Wellness: A Comprehensive Analysis of the Synergistic Impact of Combined Workout and Nutrition Features in Fitness Applications

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Abstract: Nowadays, using digital technology can help us lead healthier lives. This research introduces a new app that makes it easy for people to manage their daily health care. In the current market, with numerous fitness applications, there is a significant drawback: these applications prioritize either workout or nutrition, but not both. The goal of this research is to create a specialized app for your phone that will provide both workout and nutrition information, making it easier for users to access all the necessary fitness information. This application will give personalized workout plans along with nutritional diet information. It even includes short videos with exercises for people who need rehabilitation. Research shows that apps like this one can motivate people to be more active, as they save time by browsing fewer applications and websites. This study contributes to the conversation about how technology can support our health by introducing a modern workout program that extends beyond traditional methods. The app is a handy and effective tool for individuals seeking to manage their health in the digital age. It focuses on being easy to use for all users, regardless of their respective activity levels, while also providing diet information.

Keywords: Fitness application, Guided workout, Health management, Nutrition, Personalized workouts, Rehabilitation, User-friendly interface.

INTRODUCTION

Using wireless technology, or even technology associated with IoT programming frameworks [1], to help people lead healthier lives is a significant step towards our primary goal of ensuring everyone lives a healthy life and avoids problems such as obesity and related diseases. This means encouraging people to eat smart

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and control their weight effectively. One important thing to note is that maintaining a balanced diet, which involves consuming a variety of foods, is crucial for your overall health. This type of diet provides your body with the essential nutrients it needs to function optimally.

This research examines the development and analysis of a cutting-edge fitness app, employing a mixed-methods approach that combines both qualitative and quantitative components. Employing advanced technologies such as React Native, XAMPP, MySQL, Android Studio, Firebase, Bootstrap, and JavaScript, the study aims to achieve a comprehensive understanding of the application development process.

The use of apps results in the reinforcement of already established behaviours and the adoption of new behaviours [2]. With a focus on well-defined objectives, the process encompasses UI development using React Native, Bootstrap, and JavaScript, local server development through XAMPP, and backend data storage using MySQL. Ensuring user authentication security, the app incorporates Google Firebase. Furthermore, performance optimization is prioritized by leveraging native Android capabilities through interaction with Android Studio. Emphasizing security protocols and scalability considerations, the study aligns with the overarching goal of using wireless technology to promote healthier lifestyles.

It was found that users' desire to maintain their lifestyle using fitness applications was influenced by their social-cognitive traits and the quality-related attributes of the app, by 39.3% and 1.6%, respectively [3]. The app's cross-platform benefits, facilitated by React Native, contribute to its flexibility and accessibility. The development of this technical solution aligns with the broader objective of promoting healthy eating and effective weight management to address health issues such as obesity and related diseases. The study recognizes the importance of personalized diet plans tailored to individual needs and emphasizes the significance of incorporating well-designed exercise routines. The system's innovative approach aims to eliminate the need for physical visits to dietitian offices, offering personalized health solutions through wireless technology. The subsequent sections of this research paper will delve into the methodology, development, and evaluation of this wireless technology-driven health promotion system, examining its potential to foster healthier lifestyles.

A good diet does more than help your body grow and provide energy; it also enables you to maintain a healthy weight. This is important because it can prevent chronic diseases like obesity, diabetes, and heart problems. Having a balanced diet also offers numerous other benefits, including strengthening your immune system, improving digestion, and helping your mind stay clear and focused. In today's digital age, when the young generation is increasingly drawn to

technology, it is essential to integrate fitness and health aspects into it to achieve fruitful results [4]. The suggested exercises come with clear instructions to help even beginners get started with working out. However, because people have different eating habits and health conditions, the system is designed to create custom meal plans for each person.

A special feature of this system is that it aims to eliminate the need for people to visit dietitian offices in person or waste time searching through hundreds of websites and applications. A system that can be further scaled up to the extent that it can coexist with wearable devices, which opens the door to the convenience of older adults [5]. People can easily get their personalized diet plans and exercise routines using wireless technology. This new approach aims to make health tips more accessible to a broader audience. The main contributions of this study are as follows:

- To address the current lack of comprehensive answers in existing applications, we developed a single fitness app that integrates customized exercise regimens with personalized dietary advice.
- Because it included guided rehabilitation activities with visual aids, the program was accessible to people with diverse physical abilities and recovery needs.
- It utilized technologies such as Firebase and React Native to ensure secure user authentication and seamless operation across both iOS and Android platforms.
- It allowed users to target specific muscle groups, select activity levels, and track their progress toward specific health objectives (*e.g.*, cardiovascular, muscular, or weight loss).
- With the help of a strong tech stack and a flexible system, it was possible to integrate wearable technology and real-time health monitoring in the future.

The following sections of this research paper will examine how this system is designed and utilized, as well as whether it helps people lead healthier lives.

LITERATURE SURVEY

The study examines two primary categories of features: those focused on personal fitness goals (personal-oriented) and those that promote social interaction (social-oriented). The findings suggest that both types of features significantly improve exercise adherence and social engagement among users. Interestingly, the impact of social features on exercise behaviour seems to be weaker for users with higher exercise proficiency. Additionally, high social engagement strengthens users' commitment to their exercise routines. Both exercise adherence and social engagement contribute to a sense of well-being, although they may influence different aspects of it. Ultimately, the study highlights that utilizing a fitness app,

Wages Authentication System for Labor's Welfare

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Abstract: Workers and laborers rapidly become the targets of wage fraud, which is making it difficult for them to earn a living. We have examined Section 33(c) of the Industrial Disputes Act, 1947. As a result, we have decided to establish a mechanism under government control to verify contractors and laborers for transparent transactions involving everyday routine work. Additionally, it has the capability of handling any employee complaints. An employee can file a lawsuit against their employer under Section 33(c) of the Indian Industrial Disputes Act, 1947, to recover unpaid dues. A claim for the recovery of overdue money may be made by the employee himself or by someone acting on his behalf. If an employee passes away, either the authorized person or their heirs can claim the recovery of due money by writing to the labor court. This article presents the proposed approach, which involves creating an online web app to ensure the security of workers' regular payment of daily wages by the construction manager. It includes authentication combined with authorization, *i.e.*, Two-way Authentication. It utilizes a Convolutional Neural Network (CNN) for face recognition to mark the attendance of laborers. The experimental results reveal that the proposed architecture yields satisfactory output for wage authentication and payment.

Keywords: CNN, Face recognition, Labor welfare, Wages authentication system.

INTRODUCTION

The labor community is struggling to make a living due to the increasing prevalence of wage fraud. Additionally, the COVID-19 pandemic's effect on migrants and daily wage employees has been particularly upsetting and has contributed to the recession in our economy. We have examined Section 33(c) of the Indian Industrial Disputes Act and, as a result, have decided to develop a government-controlled system to verify contractors and laborers, ensuring transparency in routine daily transactions. Additionally, the system is capable of addressing employee complaints. For workers, salaries are not only a source of

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income for their families but also essential for securing necessities such as shelter, clothing, and food. Therefore, salary arrears can significantly hinder both current livelihoods and future employment opportunities [1]. The Ministry of Employment and Labor performed a survey, which revealed that both the quantity and frequency of unpaid salaries in India are rising annually. Due to the flaws in multilevel subcontracting and regular employment in the construction sector, employees are solely responsible for any damages resulting from unpaid salaries [2].

Additionally, there is a severe lack of job security and substandard housing for construction workers. More than 50 percent of construction workers do not receive their due payments, particularly in cases involving events such as company bankruptcy or the departure of team leaders (work foremen, supervisors). To address this issue, we propose the development of a secure online web application that streamlines wage transactions while maintaining comprehensive records of both laborers and managers. In cases of wage arrears, workers must first file a complaint with the Ministry of Labor. The labor inspector from the Ministry of Employment and Labor then investigates the matter and verifies the outstanding wages. Once the amount is confirmed, a payment order is issued; if the payment is successfully made, the case is subsequently closed [3].

The primary objective of the proposed approach is to create a web-based authentication system in compliance with Section 33 (c) of the Indian Industrial Dispute Act, to safeguard the earnings of industrial workers. The key goals and objectives are fourfold: first, to establish and verify the profiles of both workers and builders; second, to ensure the verification of payments made by builders to workers; third, to maintain the security of these payments throughout the transaction process; and fourth, to provide a mechanism for workers to file complaints regarding unpaid wages with the appropriate government authorities. To achieve these objectives, a comprehensive web portal is proposed, designed to serve the needs of both constructors and workers. The worker's portal will employ HTML, CSS, and JavaScript for the frontend, offering user-friendly interfaces for adding services and work details within the construction portal, as well as for submitting complaints and applying for work opportunities. The backend will utilize PHP and MySQL to handle data storage, processing, and user authentication. The anticipated outcomes of this project are manifold. Currently, daily wage workers often remain unpaid for their labor, leading to impromptu walkouts and strikes demanding fixed wages. This recurring disruption not only delays the timely completion of construction projects but also perpetuates the unjust non-payment of salaries. The proposed web application aims to resolve these issues by efficiently verifying workers' identities, monitoring their work activities, and ensuring that payments from constructors are securely processed.

By doing so, it reduces worker dissatisfaction and labor strikes, while offering a transparent and user-friendly platform for all stakeholders, thereby streamlining operations and promoting fair labor practices [4]. This paper presents a dual-authentication wage verification framework that combines biometric face recognition via CNN with secure web-based transaction monitoring, adhering to Section 33 (c) of the Indian Industrial Disputes Act.

Unlike standalone biometric systems or manual ledger-based wage management systems, our approach integrates biometric verification with a real-time, IoT-enabled web portal that synchronizes worker identity, attendance, and payment transactions. This tight coupling ensures that fraudulent wage claims are drastically reduced. Data science enables dynamic anomaly detection in wage patterns (*e.g.*, sudden spikes in work hours), while IoT sensors could be integrated in future extensions for on-site presence verification. Compared to traditional payroll systems, our integrated model provides higher traceability, faster dispute resolution, and secure cloud-based record-keeping. The main contribution is the development of a comprehensive end-to-end solution that:

- Validates worker attendance through facial biometrics to guarantee that only registered laborers are compensated.
- Records and tracks wage transactions in a centralized database to ensure transparency and facilitate dispute resolution.
- Provides a grievance redressal mechanism that is directly connected to regulatory authorities.
- Exhibits a modular and scalable architecture suitable for implementation in practical construction environments.

LITERATURE REVIEW

The increasing prevalence of wage fraud has necessitated the development of robust wage authentication systems to safeguard labor welfare. Various studies have explored technological interventions, particularly biometric authentication, to ensure transparent and secure wage transactions.

Biometric authentication has emerged as a pivotal technology in enhancing the security and efficiency of wage payment systems. In India, the Aadhaar program—a national digital biometric identity system—has been implemented to streamline payments and subsidize food distribution to the underprivileged. However, concerns regarding data protection and privacy have been raised, highlighting the need for robust safeguards in such large-scale implementations [1]. The integration of biometric systems in employment contracts and wage payments has also been examined. While these systems aim to reduce fraud and

Ensemble Learning for Heart Disease Prediction Using Lifestyle Parameters: A Comparative Analysis of Models

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Abstract: This study presents a detailed examination and modeling of a healthcare dataset with the primary aim of predicting various disease prognoses at the patient level. The dataset is characterized by a diverse set of features, including 'age', 'sex', 'general health', 'checkup', 'exercise', 'smoking history', and the presence of 'heart disease'. Our exploratory data analysis revealed significant differences in the distribution of various disease cases, highlighting the impact of different health and lifestyle factors on disease risk. We also encountered missing data in several features, highlighting the need for effective methods to impute missing data in healthcare prediction tasks. We then used different kinds of ensemble models to analyze which one yields the best accuracy score.

Keywords: Correlation matrix, Confusion matrix, Ensemble learning, Heart disease prediction dataset, Machine learning.

INTRODUCTION

Heart disease and other cardiovascular conditions continue to be the world's leading causes of death and morbidity. Heart disease prevention is still a significant public health problem, and early and accurate diagnosis is still challenging despite advancements in medical research and technology. Their lifestyle choices largely determine a person's susceptibility to heart disease. These factors encompass a wide range of variables, such as diet, physical activity, smoking habits, and stress levels, which collectively shape an individual's overall health. In this era of big data and machine learning, leveraging these lifestyle parameters to predict the presence of heart disease presents a promising avenue for enhancing patient care and alleviating the burden on healthcare systems [1].

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Ensemble learning, a robust technique in the realm of machine learning, has gained popularity due to its ability to combine the predictive power of multiple models, thereby enhancing the accuracy and generalization of predictions. This approach proves invaluable when dealing with complex and multifaceted datasets, like those found in heart disease diagnosis, where lifestyle parameters interact in intricate ways. By leveraging ensemble learning algorithms, we can harness the collective intelligence of diverse models, each designed to capture unique facets of the heart disease prediction problem [2].

This study aims to investigate the potential of ensemble learning methods for the early identification of heart disease based on lifestyle parameters. We strive to create a predictive model that not only improves the accuracy of heart disease diagnosis but also provides valuable insights into the specific lifestyle factors that most strongly influence an individual's risk of developing this condition. In doing so, we strive to contribute to the evolving field of preventive medicine and personalized healthcare, fostering a paradigm shift from curative to preventive measures in the fight against heart disease [3].

This work examines the technique, dataset, ensemble learning methods, and outcomes of thorough testing. The ultimate objective is to support the development of a valuable and expandable tool that enables medical practitioners to make informed decisions about the risk and prevention of heart disease. With the increasing availability of health-related data and the continuous advancement of machine learning techniques, this research stands at the forefront of a transformative approach to cardiovascular health management. As we embark on this journey towards a more proactive approach to managing heart disease, this research paper serves as a crucial stepping stone, bridging the gap between lifestyle parameters and the prediction of heart disease through the power of ensemble learning [4].

This study examines the application of ensemble learning methods for the early detection of heart disease by utilizing lifestyle parameters. The primary contribution lies in the comparative evaluation of various advanced machine learning models, including Random Forest, Extra Trees, XGBoost, CatBoost, LightGBM, Voting, and Stacking, to identify the most effective approach for heart disease prediction [5]. A novel aspect of this research is the development of feature-engineered variables that encapsulate critical lifestyle interactions, such as checkup frequency, exercise, diet, smoking, and alcohol consumption. These features improve the models' predictive capabilities and provide interpretable insights into the impact of behavior on cardiovascular health. The findings show that while all models achieved comparable accuracy (~91.7–91.8%), LightGBM emerged as the most efficient, and Stacking achieved the highest F1 score and

recall, making it ideal for scenarios where sensitivity is paramount. The study highlights the feasibility of using machine learning as a proactive tool in healthcare, enabling early intervention and personalized preventive strategies for heart disease [7].

LITERATURE REVIEW

Cardiovascular diseases, including heart disease, continue to be a significant global health concern. In recent years, the application of machine learning and ensemble learning techniques has gained considerable traction in predicting heart disease, particularly through the integration of lifestyle parameters. This literature review presents an overview of key research in this area, highlighting the diverse approaches and innovations that have shaped the field [1].

Motwani *et al.* (2017) emphasized the significance of machine learning in predicting all-cause mortality in patients with suspected coronary artery disease. Their work emphasized the potential of machine learning for risk stratification, with implications for early intervention and personalized patient care [2].

Machine learning and ensemble learning have emerged as powerful tools for the early detection of heart disease. Dey, Roy, and Chakraborty (2019) explored the application of ensemble machine learning in cardiovascular disease prediction, underscoring the potential for enhancing prediction accuracy. They recognized the complexity of cardiovascular diseases and the need for comprehensive predictive models that take into account lifestyle parameters [3].

Krittanawong, Zhang, and Wang (2017) highlighted the role of artificial intelligence in precision cardiovascular medicine, suggesting that machine learning models can provide valuable insights into individualized healthcare. Their study focused on the utility of machine learning for risk assessment and management [4].

Machine learning has not only been employed in risk prediction but also in the early detection of heart disease. Attia *et al.* (2019) highlighted the potential of machine learning-enabled electrocardiograms for identifying cardiac contractile dysfunction. This innovative approach demonstrates the versatility of machine learning in cardiac diagnostics [5].

Ensemble learning, a powerful approach to enhance prediction models, has also made its mark. Ahmed, Mahmood, and Hu (2017) employed an ensemble of weak learners to predict heart disease, emphasizing the complementary nature of ensemble techniques in improving prediction accuracy. Similar research by Aljan-

Section 2: Data Science

CHAPTER 7

Systematic Review of Innovative Blockchain-Based Method for Secure Healthcare Data in Cloud Applications

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Abstract: The healthcare industry has seen a notable surge in opportunities and challenges due to the emergence of the Internet of Things (IoT), which encompasses wearable technologies. The integration of intelligent devices generates substantial quantities of health-related data. Cloud computing, in conjunction with big data analytics, has the potential to extract significant and valuable insights from data outputs. These insights may then be used to enhance decision-making processes. Hospitals and other healthcare institutions may use the collected data to integrate with existing Electronic Medical Record systems, aiming to strengthen health monitoring, identify illnesses, and facilitate accurate diagnoses. To address the above scope, we propose a system for effective data management that utilizes the IoT and blockchain environment. The four algorithms have been proposed: hash generation, transaction mining, smart contract, and consensus with majority voting. The IoT healthcare data has initially been stored in the blockchain, providing a general view to the user group. Through extensive experimental analysis, we have demonstrated the efficiency of blockchain and the trustworthiness of the data it provides.

Keywords: Blockchain, Electronic health records, Hash generation, IoT, Mining, Proof of stake, Proof of work, Smart contract.

INTRODUCTION

The exponential growth of industrial IoT, as well as service-based networks, has played a pivotal role in the significant expansion of interconnected devices. The aforementioned application devices are capable of gathering industrial data in real-time through a dedicated sensor unit [1]. The change in the interaction between systems and physical and logical entities may be attributed to the progress in industrial development and the direction provided by technology. The

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assessment of critical IoT components, such as identity management, and the transmission of real-time industrial data, is made possible by a centralized architecture [2]. The feasibility of a single failure point may be attributed to the use of this often-employed approach [3]. One notable challenge associated with the IoT is the complexity involved in maintaining and managing numerous interconnected devices [4]. A network system can engage in interactive communication *via* the process of adaptive self-configuration.

Data security is a crucial concern in the domain of IoT systems. Since these systems are constructed by interconnecting several IoT devices [6]. The information generated by these devices is saved in cloud-based storage systems and sent across various networks.

A cyber attack against an innovative healthcare system has the potential to significantly impair the system's capacity to generate and distribute electrical power. Besides the potential financial implications, cyber-attacks on innovative healthcare systems may result in operational disruptions, power failures, the unauthorized acquisition of sensitive information, and severe breaches in security [7]. Cybersecurity professionals face challenges in effectively monitoring and identifying potential threats and attacks within the vast network of a smart grid. Despite the growing significance of machine learning in the realm of cybersecurity, a notable challenge lies in the need for specialized methodologies and theoretical perspectives to effectively manage the vast quantities of data generated and transmitted across multiple networks within a smart grid [8].

The remaining portions of the paper can be divided into the following categories. In Part 1, the research carried out by various researchers is discussed in detail. In part 2, a system model is proposed for the healthcare medical record-sharing scheme. This system utilizes blockchain technology and smart contracts.

Additionally, the design's goals are outlined in this section. An evaluation of the system, along with a security analysis, is presented. This section also includes some discussion on the outcomes of the findings. In Part 4, the conclusion, as well as the future scope, is discussed.

This study presents a systematic review and a novel blockchain-integrated system model for securing and managing healthcare data in an IoT-enabled cloud environment. The proposed architecture employs a four-layered security mechanism that comprises hash generation, transaction mining, smart contracts, and consensus algorithms to facilitate secure and decentralized data management. By embedding IoT devices with blockchain connectivity, the system ensures traceability, integrity, and user-controlled access to Electronic Health Records (EHRs). Experimental evaluation indicates that the system offers robust

performance with minimal overhead, addressing key challenges such as single-point failures, latency, and data breaches. The framework supports real-time data sharing, enhances identity management through the use of smart contracts, and maintains data privacy through decentralized validation. In addition to the proposed model, this paper presents an in-depth literature review and taxonomy of blockchain-based healthcare data security systems, highlighting emerging trends, comparative insights, and opportunities for future enhancements in eHealth infrastructure.

CHALLENGES OF IOT INTEGRATION WITH BLOCKCHAIN

Certain restrictions and their intricate architecture provide challenges for IoT access control systems. IoT devices require a low-latency, lightweight access control system for the battery, central processing unit, and memory [7 - 9]. IoTs use edge concepts to control monitors. To some extent, this issue may be mitigated by the use of computers and the Internet.

It is covered in numerous articles. The primary concern is the security issue [10]. To address a variety of current challenges, their remedies, and the future of the suggested or current approaches, studies examine and compare the data that is already accessible. Initially, there are three main kinds of nodes in blockchains. An inactive station, or verifying node, is the first. Block information is received and stored by it. They can't start transactions or create fresh blocks. The mining network that can build a block. It checks the transaction. Proof-of-Work (PoW) and Bitcoin, the consensus mechanism, are connected—nodes mine to receive payment for adding new transactions. Blockchain requires a decentralized architecture and a distributed computer configuration around the globe. Blockchain applications demonstrate the rapid development of cryptocurrencies. It is dependent on P2P systems that are decentralized, meaning there is no central controller and every node is equal in status. The following are some advantages of a blockchain system. Maintain a connection based on trust and avoid relying on outside assistance. The resilience of the system cannot be impacted by damage to a few nodes. The operational guidelines and data records are traceable and transparent.

Credibility is ensured through consensus procedures, a chain of data structures, and secure trust documentation. Block centralization is one helpful characteristic. If the system can create a new decentralized blockchain trust paradigm using Chain [24, 25], the accuracy is increased by 5% using a blockchain-based detection method of 15% [21, 26]. Processing large amounts of data takes longer than expected. The old technique is five times larger than the blockchain-dependent techniques. There are still several issues with blockchain-based trust

Decentralized Marketplace for Educators Leveraging Blockchain Technology for Transparent and Secure Content Monetization

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Abstract: The digitalization of education has transformed the landscape, offering educators new opportunities to disseminate knowledge and monetize their content. However, centralized platforms prevalent in the industry often present challenges such as exorbitant fees, opacity in revenue distribution, and inadequate protection of intellectual property rights. To address these issues, this paper proposes the development of a decentralized marketplace tailored for educators, leveraging blockchain technology. This marketplace endeavors to furnish educators with a transparent, secure, and efficient platform for disseminating and monetizing educational content. By harnessing the power of smart contracts and the InterPlanetary File System (IPFS), the proposed system aims to automate content management, streamline royalty payments, and establish robust licensing agreements, thereby ensuring equitable compensation for educators and unfettered access for learners. This paper presents a comprehensive exploration of the design and implementation of a decentralized marketplace, closely aligned with the architectural principles outlined in the provided IET sample paper on blockchain. Through meticulous attention to detail and adherence to the prescribed template, this research endeavors to illuminate the transformative potential of decentralized technologies in revolutionizing the educational landscape.

Keywords: Blockchain technology, Content monetization, Decentralized marketplace, Education, Efficiency, Intellectual property rights, InterPlanetary File System (IPFS), Security, Smart contracts, Transparency.

INTRODUCTION

In recent years, the digitalization of education has catalyzed a paradigm shift in the dissemination of knowledge, offering educators unprecedented opportunities

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to engage with learners and monetize their content. The proliferation of online learning platforms and digital resources has democratized access to education, empowering both educators and learners alike. However, despite these advancements, traditional centralized platforms continue to dominate the educational landscape, posing significant challenges to stakeholders.

Centralized platforms often impose prohibitive fees on educators, thereby limiting their ability to monetize their content effectively. Moreover, the lack of transparency in revenue distribution undermines trust and hampers collaboration within the educational ecosystem. Furthermore, the inadequate protection of intellectual property rights exposes educators to the risk of content piracy and unauthorized use of their work.

In response to these challenges, this paper advocates for the development of a decentralized marketplace explicitly tailored for educators. By harnessing the innovative potential of blockchain technology, this marketplace endeavors to address the shortcomings of centralized platforms and usher in a new era of transparency, security, and efficiency in the education sector.

This research presents the design and implementation of a decentralized marketplace tailored for educators, addressing critical issues in traditional centralized education platforms, such as a lack of transparency, high transaction fees, and weak protection of intellectual property. By integrating blockchain technology, smart contracts, and the InterPlanetary File System (IPFS), the proposed system offers a secure and transparent environment for publishing and monetizing educational content. The marketplace enables educators to manage content publishing, automate royalty payments, and issue licensing agreements through specialized smart contracts. This ensures equitable compensation and immutable ownership records while empowering learners with transparent access to authentic materials. The system architecture is fully decentralized, enhancing resilience and reducing reliance on third-party intermediaries. The successful implementation, including innovative contract development and UI integration, demonstrates the feasibility and transformative potential of blockchain-based content platforms in the education sector.

LITERATURE SURVEY

Existing research on decentralized marketplaces has explored various aspects, including design principles, incentive mechanisms, and governance models. Buterin *et al.* (2014) introduced the concept of Decentralized Autonomous Organizations (DAOs) to govern decentralized applications (DApps), shedding light on governance structures [1]. Backstrom, Dwork, and Kleinberg (2018) pro-

posed a decentralized marketplace for digital services, emphasizing the importance of trust, privacy, and security [2].

Blockchain technology has been extensively studied in the context of decentralized applications and smart contracts. Antonopoulos (2014) discusses the application of smart contracts in Ethereum-based decentralized applications, highlighting their potential for automating trustless transactions [3].

Antonopoulos (2018) provides a comprehensive overview of blockchain technology and its applications beyond cryptocurrencies, highlighting its potential for enabling decentralized systems [4]. Moreover, research by Qiu, Wang, and Wang (2020) explores the integration of blockchain with IPFS for secure and efficient content distribution, demonstrating its potential for enhancing data integrity and accessibility in decentralized systems [5].

The use of IPFS for storing and retrieving content in decentralized applications has gained traction in recent years. Benet (2014) introduced IPFS as a peer-to-peer hypermedia protocol, offering a decentralized alternative to traditional web hosting [6]. Additionally, Gupta, Jain, and Sharma (2020) reviewed blockchain-based copyright protection mechanisms, emphasizing the importance of immutability and transparency in content authenticity verification [7].

Smart contracts play a pivotal role in decentralized marketplaces by automating various processes, including content management, royalty payments, and licensing agreements. Tapscott and Tapscott (2017) explore how blockchain can transform the future of education, emphasizing its role in securing credentials and verifying the authenticity of educational content [8 - 10].

This literature survey provides a comprehensive overview of the existing research on decentralized marketplaces, blockchain technology, and IPFS integration. By synthesizing insights from these studies, this paper aims to contribute to the discourse on the development of a decentralized marketplace for educators.

Blockchain and smart contracts offer transformative solutions for managing and monetizing educational content, streamlining processes such as licensing, royalty distribution, and copyright protection. John Smith (2014) highlights their role in automating content management and ensuring copyright authenticity, while David Miller (2017) emphasizes their potential to simplify licensing agreements and improve transparency in contractual processes. Sarah Davis (2020) highlights the use of blockchain for providing immutable proof of copyright ownership, thereby enhancing trust in educational materials. Similarly, Emily Brown (2019) explores the automation of royalty distribution, promoting fairness and transparency in payments. Despite these benefits, challenges such as the need for technical

CHAPTER 9

Automated Web and Video Summarization Tool Using NLP Techniques

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Abstract: This paper proposes a tool that helps people summarize any information available on the internet, whether in web data or video format. The proposed tool emphasizes reviewing the text or video from the internet. The length of text and video data is increasing daily, and people have less time to acquire knowledge from this vast amount of data. In today's world, the internet has become a vital and rapidly growing resource for consumers to acquire and share knowledge. Reading the entire text or watching the whole video can be challenging, as people often don't have time to consume everything.

Additionally, the internet, media, and other data sources are constantly inundated with a massive influx of data. Hence, a system is needed to help consumers understand this data in more straightforward terms. So, a tool is required for these consumers, which would ease them from the trouble of reading the entire text or watching the whole video. This would be useful for any consumer who wants to get an overview rather than spending lots of time gathering information. These systems or tools would be beneficial and an excellent time-saver for these consumers.

Keywords: Automation, Data science, Deep learning, Extension, Natural language processing, Summarization.

INTRODUCTION

In the digital age, where enormous amounts of information or data are available on the internet, it's also essential to find advanced techniques to process the data quickly and efficiently. It's a complicated process for mortal beings to extract the summary from a large text or videos manually. There's plenty of data, such as text

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data, available on the internet. Therefore, there's a problem in searching for essential and necessary data from the vast amount of available data and extracting helpful and precise information from it [1]. To address the former issues, automatic summarization of this text data is indeed important and necessary [2].

Additionally, the consumption of video content is widespread, with platforms like YouTube offering a vast repository of instructional and entertaining videos [3]. Still, the time needed to watch lengthy videos can frequently be a headache for busy individuals. There's a need for effective summaries that distill the key points from lengthy video content, allowing consumers to easily grasp the crucial information without the time investment of watching the entire video [4].

This issue is particularly applicable for online educational content, lectures, and other instructional videos [5, 6]. In pursuit of an innovative result, this paper proposes a system that generates a concise summary of web and video content from the internet. It seeks to contribute to the ongoing conversation on making web and video content more accessible. To address this issue, this paper presents a check and analysis of video and web content summarization using Natural Language Processing (NLP). Natural Language Processing (NLP) is a capability of a program to understand text and perform operations on it to resolve a specific query [7]. There are numerous libraries available for Natural Language Processing, but choosing the most applicable and suitable one for particular problems is essential [8]. The proposed result involves a well-defined and methodical process, driven by advanced NLP techniques and intuitive API design. Saving the precise time of the user by making web and video content available in the form of text through text summarization can be achieved using Natural Language Processing techniques.

Automated web and video summarization tools can help address the challenges mentioned above by providing consumers with brief and informative summaries of web and video content. This tool utilizes natural language processing (NLP) to extract the most essential information from web pages and videos, and also generates a summary tailored to meet the user's requirements [8]. Automated web and video summarization tools can save consumers time in several ways. First, they eliminate the need for consumers to read or watch entire texts or videos to obtain the information they need. Second, they help consumers to easily identify the most crucial information from the web and videos [9]. This can be particularly helpful for scholars, experimenters, and professionals who regularly need to consume large quantities of information.

This paper introduces a comprehensive automated summarization tool that uniquely supports both web and video content summarization through a browser-

based extension. The system combines web scraping, audio-to-text conversion, and abstractive Natural Language Processing (NLP) techniques to generate high-quality summaries for YouTube videos, even those without transcripts, and for any webpage. Unlike previous approaches, which often handle only one content type or require manual input *via* separate interfaces, the proposed tool streamlines summarization *via* an integrated browser extension. Additionally, the system offers multilingual support through the Google Translate API and read-aloud functionality utilizing Speech Synthesis Markup Language (SSML), making it highly accessible to a diverse range of users. The use of the Facebook/Bart-large-CNN model ensures abstractive summarization with enhanced coherence and informativeness. Experimental evaluation demonstrates the system's superior performance, achieving a BLEU score of 0.7069 and a model accuracy of 84.41%, outperforming existing tools in both efficiency and output quality.

LITERATURE SURVEY

A Flask-based backend server powers a YouTube transcript summarization system, featuring user-friendly functionalities such as translation, speech synthesis, downloads, and email sharing, as employed by Vijaya *et al.* It retrieves YouTube video subtitles, uses a default CNN model for summarization, and leverages NLP techniques. This practical project aligns with NLP and text summarization research, enhancing content consumption efficiency and sharing [1].

A text summarization framework that summarizes text data from the internet, proposed by Varagantham *et al.* The author employed a system based on the extractive summarization approach. The system is based on clustering techniques for generating summaries. The clustering of sentences is done based on the score or rank of the sentences based on word frequency [2]. AI-based video summarization using NLP techniques is a system that utilizes FFmpeg, a Python library for extracting important information from videos. Then, AssemblyAI is used to recognise speech in the video, and NLP techniques are applied to summarize the video by Wankhede *et al.* [3]. A video summarization system using NLP-based Latent Semantic Analysis for YouTube videos. This system relies on YouTube's transcript API and MoviePy for efficient subtitle extraction from a YouTube video. LSA is an algebraic-statistical system that gives meaningful sentences by scoring them based on term frequencies [4, 5].

Tharun *et al.* describe extractive and abstractive methods for automatic text summarization. Extractive focuses on key sentences, while abstractive creates new ones. Techniques such as tree-based, template-based, rule-based, and graph-based methods are used for extractive methods. Abstractive methods, on the other

Analysis of Daily Usage of Smartphone Apps and their Effect on Students' Performance and Work

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Abstract: The rapid development of mobile technology has had a significant influence on numerous facets of society, most prominently work and learning. This study examines the intricate relationship between daily mobile and social media application usage and its effect on school performance and work productivity. The study goes in-depth on how people interact with mainstream applications like YouTube, Instagram, Snapchat, WhatsApp, and Twitter, using surveys and data analysis in R. It examines the effect of app usage in several areas of life, including the academic performance of students, the work-life of adults, sleeping patterns, and exercise habits. One of the key findings from this study is that excessive screen time can harm students' academic performance. People of all ages use these apps in various ways, according to the survey. Teachers, employers, and app developers all have a stake in using these findings to design work and learning environments that promote concentration and productivity. In addition to statistics, this report offers valuable guidance to help users make informed app selections. By following these recommendations, individuals can achieve balance and succeed in both the workplace and the classroom.

Keywords: Academics, Mobile phones, R programming, Social media, Work.

INTRODUCTION

The arrival of mobile technology has been revolutionary in every sense of the word, transforming the way individuals communicate, access information, and conduct their daily activities. The widespread adoption of mobile phones, combined with the many applications available, has had far-reaching impacts on personal life, education systems, and the workplace. In the education system, the influence of mobile technology is wide-ranging. Learners have access to the entire wealth of educational tools and resources, and as such, they can learn anywhere

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and at any time. These tools range from e-books and online courses to interactive learning apps and virtual classrooms. Mobile technology gives students personalized learning experiences in which they learn at their own pace and acquire knowledge that is pertinent to their needs.

Yet, mobile and social media app usage is also a double-edged sword, being both a great learning tool and a powerful distraction. While Khan Academy, Duolingo, and Coursera are learning enhancers, Instagram, Snapchat, and YouTube are distractions from study time and concentration. This double-edged nature highlights the need to understand the multifaceted impact of daily mobile and social media app usage on learning. It is essential to determine how the apps can be utilized to optimize learning and minimize their capacity to distract. In the business world, mobile technology has revolutionized the nature of work, enabling seamless communication and collaboration across geographical boundaries. Slack, Zoom, and Microsoft Teams are applications that have streamlined the process of remote work, making it more efficient and allowing teams to stay connected and collaborate in real-time.

This technological revolution has brought increased flexibility, allowing workers to work from home, thereby enhancing work-life balance and employee satisfaction. The pervasive nature of these applications has, however, also brought in issues of reduced productivity and heightened levels of stress for employees. Connectedness blurs distinctions between work and life, leading to burnout and reduced performance. Reminders and the tendency to look at social media can interrupt the workflow, decreasing attention and productivity. Balancing one's perspective regarding the impact of using mobile and social media applications on job performance and wellness is therefore vital. There should be measures in place to enhance the benefits of these technologies with minimal adverse consequences for promoting a healthy and effective working culture.

This research aims to explore the complex relationship between the overuse of mobile and social media applications and their impact on school performance among students and work performance among employees. Using quantitative research methods, such as questionnaires and statistical analysis, this study will be able to analyze broad trends, user behavior, and its impact on school and work performance. The research will examine a range of variables, including the nature and duration of app use, user demographics, and the environment in which these apps are used. The research will aim to investigate the relationship between these variables and their impact on learning outcomes and work performance. The research also aims to identify best practices and provide guidelines for the practical application of mobile technology in the learning and work environments. This research is relevant in its ability to offer informative results to teachers,

employers, and app developers. Understanding the trends and influence of mobile app use, these stakeholders can develop environments that enhance learning and work efficiency.

For teachers, this translates into incorporating effective mobile learning technology into the classroom and educating students on how to manage potential distractions. For managers, this involves establishing policies for the responsible use of technology, such as designating days off and limiting after-work communication to reduce stress levels. For app developers, this requires building features into the software that support user welfare, *e.g.*, focus modes or time management functions. Lastly, the research aims to educate users in making responsible decisions regarding their use of apps, balancing the benefits of mobile technology with the limitations of mitigating its harmful influence. Through more reflective and intentional use of social media and mobile apps, the research aims to enhance both education and job performance.

Main Contribution of the Study

This study makes the following key contributions:

- **Holistic Behavioral Analysis:** This approach provides a comprehensive examination of how daily smartphone and social media app usage patterns (including Instagram, WhatsApp, YouTube, Snapchat, *etc.*) are linked to academic performance, work hours, sleep duration, and physical activity across diverse demographic groups.
- **Gender-Based Usage Insights:** The study reveals significant gender differences in time spent on various apps, using a wide range of visualizations to highlight patterns in digital behavior between male and female respondents.
- **Predictive Modeling of Academic Performance:** A K-Nearest Neighbors (KNN) algorithm is applied to predict academic performance based on mobile screen time and demographic variables, achieving a prediction accuracy of 76.97%.
- **User-Centric Recommendations:** It provides practical insights for educators, employers, and app developers, offering strategies such as structured mobile usage policies, the inclusion of focus-oriented app features, and awareness programs to promote healthier tech engagement.
- **Multidimensional Visualization:** Through graphical techniques such as scatter plots and bar charts, the study presents multidimensional relationships between behavioral factors, facilitating more straightforward interpretation of complex interactions.

This research stands out by combining quantitative behavioral data, machine learning, and visual analytics to understand and predict how digital habits affect

Section 3: Internet of Things

Implementation of IoT-Enabled Cloud-Based Healthcare System

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Abstract: The speedy development of technology has ushered in a new age in healthcare *via* the Internet of Things (IoT) and cloud computing. This paper examines the deployment of an Internet of Things (IoT)- enabled cloud-based healthcare device. The study emphasizes the transformative ability of integration and offers insights into how it affects record analytics, remote tracking, and patient care, with a focus on real-time data collection, analysis, and exchange. Through an assessment of technical subtleties, demanding situations, and advantages, this study aims to impart to IT students a nuanced understanding of the dynamic landscape at the intersection of healthcare, IoT, and cloud computing. The study emphasizes the importance of fine statistics management practices and privacy measures as it tackles the ethical issues surrounding the collection and use of health data in an Internet of Things environment.

Keywords: Cloud computing, Data analytics, Healthcare system, Implementation challenges, Internet of things, IoT, Security measures.

INTRODUCTION

The convergence of the contemporary generation is changing the conventional paradigms within the healthcare industry. The convergence of cloud computing with the Internet of Things (IoT) is a revolutionary advancement that opens up new avenues for data-driven healthcare solutions. It is more important than ever to leverage IoT-enabled, cloud-based healthcare solutions as we undergo a period of digital innovation. The purpose of this introduction is to provide a comprehensive overview of the current state of healthcare, the features of IoT, and the importance of cloud-based solutions. In Fig. (1), the healthcare industry is undergoing a thorough transition toward digitalization, having previously been characterized by its reliance on manual operations and disjointed data structures. Using wearable sensors and related scientific systems, along with various IoT devices, has made it

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easier to collect fitness information in real-time. Healthcare experts have never-before-seen opportunities to enhance treatment plans, gain deeper insight into patients' ailments, and improve the quality of care they provide.

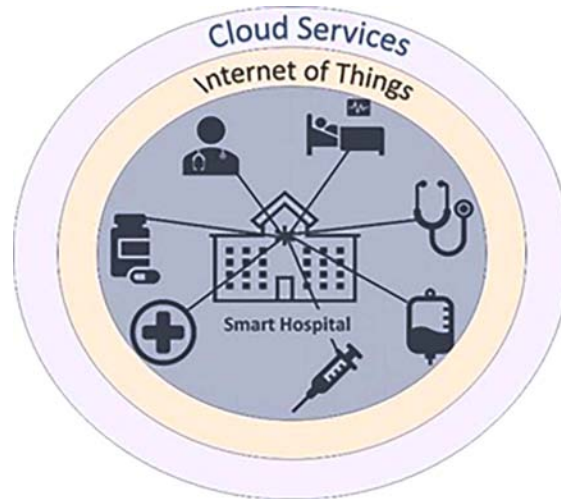


Fig. (1). IoT in healthcare.

The integration of cloud computing, which provides a scalable and accessible infrastructure for storing and processing large volumes of healthcare data, lies at the heart of this digital revolution. Healthcare organizations may also now overcome lengthy status constraints concerning data storage and accessibility to cloud-based technologies. Cloud structures' scalability ensures that healthcare systems can manage the growing quantity of information produced by IoT devices, laying the groundwork for packages that utilize advanced analytics and machine learning.

The convergence of cloud computing and IoT presents a particularly promising avenue for addressing the significant challenges faced by the healthcare sector. Cloud-based healthcare systems with IoT capabilities are expected to deliver numerous essential benefits, including enhanced patient care, remote monitoring, and data-driven decision-making. These trends may improve the quality of healthcare services, increase the utilization of available resources, and yield more effective and personalized patient outcomes.

Although there may be no denying that IoT and cloud computing have the potential to revolutionize the healthcare industry, integrating them will present several challenges that must be overcome. Among the crucial factors that require close inspection are protection issues, interoperability problems, and technical complexity. To offer IT practitioners and students a comprehensive understanding

of the complexities surrounding the adoption of IoT-enabled cloud-based healthcare systems, this research aims to explore these challenges.

We will delve into the literature within the sections that follow in this newsletter to examine the role of IoT in healthcare and the impact of cloud computing on record management. The advised device design, the technologies used, and the safety precautions put in place will all be covered extensively in the method phase. To provide a comprehensive understanding of the topic, case studies, advantages, challenges, and answers will be carefully examined. Insights into upcoming trends and tips will round out the study, contributing to the ongoing conversation about IoT and cloud computing integration in healthcare.

This paper presents a comprehensive framework for designing and implementing an IoT-enabled, cloud-based healthcare system aimed at enhancing patient care, facilitating real-time data analytics, and supporting remote monitoring. The system integrates wearable sensors and innovative medical devices with a secure cloud infrastructure to collect, store, and process health data efficiently and securely. A stepwise methodology is provided, covering technical design, security protocols, data integration, and scalability optimization. The study addresses critical challenges, including interoperability, privacy compliance, and system performance, and offers practical solutions, such as encryption techniques and regulatory alignment. Real-world case studies add depth to the research by demonstrating tangible benefits such as personalized care, enhanced diagnostics, and resource optimization. Additionally, the paper examines emerging trends and provides recommendations for future research, thereby contributing to the broader discussion on the digital transformation of healthcare through the convergence of IoT and cloud technologies.

Background

The healthcare sector, which has disjointed record structures and manual tactics, has been struggling with issues of scalability, accessibility, and data control. Healthcare structures have consistently struggled to keep up with the growing quantity and complexity of patient data. A paradigm shift has been brought about in the healthcare industry through the introduction of the Internet of Things (IoT), which enables the continuous and immediate collection of patient data through connected devices. This digital revolution now encompasses wearable sensors, smart clinical devices, and remote monitoring equipment as key components.

However, making effective use of this abundance of medical statistics requires a strong and expandable infrastructure. Here's where cloud computing shines as a game-changer, offering advanced processing power, seamless accessibility, and expandable storage. The longstanding issues facing the healthcare sector are

CHAPTER 12

Transforming Agriculture: Enabling Informed Decision-Making with a Real-Time Smart Scale Management System (AgriScale-Pro)

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Abstract: This paper presents an innovative solution for empowering farmers by integrating a display system with AgriScale-Pro, providing real-time pricing information and intelligent recommendations for optimal vegetable selling locations. Through a sophisticated algorithm, farmers can make well-informed decisions to maximize profits, enhancing transparency and efficiency in the agricultural supply chain. The literature review contextualizes the project within the broader trend of utilizing technology for farmer empowerment, highlighting its alignment with current advancements in agricultural technology. Results from the project highlight its success in integrating technology into agriculture, providing tangible benefits for farmers, and positively impacting the efficiency of the farm supply chain. The methodology, centered around Arduino and a liquid crystal display, delineates the system's structure and functionality. This opens avenues for future improvements and scalability, suggesting the potential for ongoing advancements in technology-driven agricultural solutions. In summary, this project signifies a groundbreaking initiative that not only integrates technology into the farming landscape but also plays a pivotal role in fostering economic empowerment for farmers. Revitalizing local agricultural markets stands as a testament to the transformative potential inherent in bridging the gap between traditional farming practices and modern technological advancements.

Keywords: Agricultural supply chain, Agriculture technology real-time pricing, AgriScale-pro, Algorithmic recommendations, Display system, Economic sustainability, Farmer empowerment.

INTRODUCTION

Introducing an unprecedented project at the intersection of technology and agriculture, this transformative initiative establishes a seamless connection bet-

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ween farmers and consumers, driven by real-time information. The project's core lies in integrating a display system with a precision AgriScale-Pro [1], creating a dynamic platform for farmers to showcase the current market prices of vegetables [2]. However, its impact extends beyond a mere pricing display, incorporating a sophisticated algorithm that strategically determines the optimal selling locations [3].

This strategic insight enables farmers to make informed decisions, strategically positioning their produce in markets that promise maximum profitability. Beyond the immediate benefits to farmers, this initiative plays a pivotal role in enhancing the efficiency and transparency of the entire agricultural supply chain [4, 5]. The project stands as a testament to the unparalleled transformative power of technology in fostering a more equitable and sustainable future for agriculture. In heralding a new era for the agricultural landscape, technology emerges as a catalyst for positive change [6]. By harmonizing traditional farming practices with cutting-edge display and algorithmic technologies, this system not only enhances the economic prospects of farmers but also improves the overall efficiency of the agricultural ecosystem [7]. Real-time pricing information empowers farmers with a comprehensive understanding of market dynamics. This understanding allows farmers to make timely and informed decisions critical to their livelihoods [8].

The intelligent algorithm adds an extra layer of sophistication, going beyond information provision to actively suggest optimal selling locations [9]. This not only streamlines the selling process but also maximizes returns, showcasing the project's commitment to practical and impactful innovation. In essence, this project serves as a beacon of innovation, forging a vital connection between rural agriculture and modern technology. Its overarching goal is to contribute significantly to the economic empowerment of farmers and initiate a revitalization of local agricultural markets [10].

In addition to benefiting farmers and the agricultural supply chain, this project promises broader societal advantages. By providing farmers with real-time pricing information and intelligent recommendations, it fosters a more competitive and equitable marketplace [11]. This, in turn, could boost local economies and enhance food security in the region by streamlining the selling process and maximizing returns. Moreover, this project sets a precedent for future collaborations between technology and agriculture. Its successful integration of cutting-edge technology into traditional farming practices demonstrates the potential for innovation to address longstanding challenges in the agricultural sector [12]. As such, it serves as a blueprint for similar initiatives aimed at improving efficiency, transparency, and sustainability throughout the global food system [13].

This paper presents the development of AgriScale-Pro, an innovative real-time smart scale management system designed to empower farmers through intelligent pricing and market recommendations. The system integrates a load cell, Arduino controller, and LCD interface to measure vegetable weight and display corresponding prices in real-time. Beyond introductory pricing, a linear regression algorithm is employed to analyze historical data and predict optimal selling locations, enhancing profitability. The solution is intentionally designed to be low-cost and easy to implement, making it suitable for rural agricultural settings. The system promotes informed decision-making, enhances economic outcomes, and increases transparency throughout the agricultural supply chain. AgriScale-Pro not only bridges the gap between traditional farming practices and modern technology but also offers a scalable framework for future innovations such as environmental sensing and cloud-based analytics. The project's successful integration of hardware and software provides a replicable model for future agri-tech developments that aim to enhance food security and farmer welfare.

LITERATURE REVIEW

A meticulous and exhaustive examination of the vast body of literature surrounding the intricate relationship between technology and agriculture reveals a wealth of knowledge that serves as the cornerstone upon which the current project is built [14, 15]. At its core lies the innovative integration of a display system with a precision AgriScalePro, symbolizing the harmonious fusion of technological advancement and agricultural innovation, which serves as a beacon of hope amidst the myriad challenges faced by farming communities worldwide [14].

Embedded within this expansive and multifaceted landscape of scholarly discourse is a profound recognition of the pivotal role of the current project within a broader movement aimed at harnessing the transformative potential of technology to address the multifaceted challenges inherent in the agricultural sector. This movement is characterized by a seismic shift of farming practices, marked by an increased emphasis on empowering farmers through enhanced access to information and decision-making capabilities [15, 16].

Central to this profound paradigm shift is the critical acknowledgment of real-time pricing data as the linchpin for informed decision-making among farmers, serving as a potent catalyst for economic empowerment and resilience-building within agricultural communities. The literature underscores the indispensable role of technology integration in driving efficiency, sustainability, and profitability within agricultural supply chains, heralding a departure from traditional farming paradigms towards more adaptive and resilient approaches tailored to meet the evolving needs of the sector [16, 17].

Digital Content Authenticity and Verification System Using Blockchain

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Abstract: In today's digital age, the expansion of content creation and dissemination has led to a pressing need for robust mechanisms to verify the authenticity and integrity of digital assets. The Blockchain-based Content Authenticity Verification System (BCAVS), a unique solution to this problem, is presented in this paper. By utilizing blockchain technology, this system provides users with incredible transparency and trust by offering end-to-end tracking and verification capabilities for digital content, including its origin, modification history, and ownership. The technology creates distinct digital fingerprints of registered materials using cryptographic techniques and then stores those digital fingerprints securely as transactions on a decentralized blockchain network. BCAVS automates the verification process and ensures immutability by regulating the terms and conditions for content registration and ownership transfers through smart contracts. By comparing stored hashes with recalculated hashes, users can query the platform to verify the legitimacy of digital content and detect any tampering or unauthorized modifications. Furthermore, BCAVS maintains an extensive record of ownership transactions, which aids in ensuring legal compliance and accountability.

Keywords: Blockchain, Cryptography, Decentralized application, Digital content, Hash key, Smart Contract.

INTRODUCTION

In today's digital landscape, the proliferation of misinformation, fake news, and digital forgeries has created a pervasive challenge in ensuring the integrity and authenticity of digital content. As society increasingly relies on digital media for information and communication, the need for reliable solutions to verify the legitimacy of digital assets has never been more critical. In response to this pressing demand, the pioneering solution is introduced: The Blockchain-based

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Content Authenticity Verification System (BCAVS). BCAVS represents a ground-breaking advancement in content verification, harnessing the transformative potential of blockchain technology to offer unparalleled transparency and trust in the digital realm. In this paper, the innovative features and functionalities of BCAVS are explored, highlighting its ability to revolutionize content verification across various media, including images, videos, and documents.

Key Components and Functionalities:

- Content Registration
- Blockchain Integration
- Verification Mechanism
- Ownership Tracking
- User Interface and Integration

In summary, BCAVS represents a paradigm shift in content verification, offering a reliable and transparent solution to combat digital manipulation and misinformation. By leveraging blockchain technology and innovative functionalities, BCAVS aims to foster trust and integrity in the digital content ecosystem, paving the way towards a more secure and authentic digital future. Join us on this journey towards a brighter, more trustworthy digital landscape with BCAVS.

This paper presents BCAVS (Blockchain-based Content Authenticity Verification System), a novel decentralized framework designed to authenticate and verify the integrity of digital content in an era of increasing misinformation and digital manipulation. The system utilizes blockchain technology to provide immutable, transparent records of content registration, origin, and modification history. By combining SHA-256 cryptographic hashing with intelligent contract automation, BCAVS enables secure, tamper-resistant verification of digital assets across various formats, including images, documents, and videos. The platform supports user roles, including content creators and verifiers, ensuring accountability and ease of use through an intuitive interface. Through seamless integration of blockchain infrastructure (*e.g.*, Ethereum), smart contracts, and a scalable verification process, BCAVS empowers users to establish trust in digital content while addressing key concerns around authenticity, ownership, and provenance. The system holds significant potential for application in media verification, academic research integrity, intellectual property protection, and e-commerce trust systems.

BLOCKCHAIN

Blockchain and Ethereum

Since its inception in 2008 by Satoshi Takemoto to address the double-spending problem in digital payment systems, blockchain technology has evolved into a robust solution for secure and transparent transactions on the internet. Initially associated with cryptocurrencies like Bitcoin, Blockchain has expanded its scope to encompass various applications, including Ethereum, Hyperledger Fabric, and Solana. Each block contains its data and the hash of the previous block, ensuring a secure and immutable structure. Blockchain is a decentralized, distributed ledger technology that enables the safe and transparent recording of transactions across a network of computers. Any alteration to the data in a block would necessitate changes to the hashes of all subsequent blocks, rendering tampering practically infeasible. Moreover, blockchain operates on a peer-to-peer network, where all participating nodes store transaction records, enhancing transparency and security. Public and private keys are integral components of transactions. Public keys represent wallet addresses and are visible to all participants. Private keys, similar to unique signatures, are used for authentication and remain confidential to the owner. The following are some of the main features of blockchain technology:

- **Decentralization:** Blockchain operates on a distributed system of computers (nodes), as opposed to conventional centralized systems, where data is held and managed by a single entity. By limiting any one entity from controlling the network as a whole, this improves security and resilience.
- **Transparency:** Every transaction registered on the blockchain is publicly accessible to all network members. This transparency ensures that anyone can verify the integrity of transactions and the state of the ledger, fostering trust among users.
- **Immutability:** A transaction is almost impossible to change or remove once it is registered on the blockchain and validated by the network. Every block is cryptographically connected to the one before it, forming an unchangeable chain of blocks.
- **Security:** To safeguard transactions and ensure the accuracy of data stored on the network, blockchain utilizes cryptographic algorithms. Consensus techniques, including Proof of Stake (PoS) and Proof of Work (PoW), are employed to verify transactions and preserve the ledger's integrity.
- **Ethereum** is a decentralized platform that enables the creation of smart contracts and decentralized applications (dApps). Vitalik Buterin put forth the idea in late 2013, and development on it began in early 2014. On July 30, 2015, the network went live. The concept of programmable blockchain was first introduced by

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