RAJESWARI COLLEGE OF ARTS AND SCIENCE FOR WOMEN

Dommayapalayam Village & Post, Vanur Taluk, Villupuram - 605104

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Chief Editors : **Dr.B.Booma Devi**
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Editors : **Ms.K.Rathi Devi**
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ABOUT THE COLLEGE

Rajeswari College of Arts & Science for Women, established in 2007 by the Kumaraswamy Educational Trust, is affiliated to Annamalai University, Chidambaram. Located in a serene campus at Bommayapalayam, Vanur Taluk, Villupuram District, Tamil Nadu, the college is dedicated to empowering women through quality higher education. The institution offers undergraduate and postgraduate programs in Arts, Science, Commerce, Management, and Computer Applications. With well qualified faculty, modern infrastructure, and a vibrant academic environment, the college nurtures intellectual growth, ethical values, and professional skills among students. Guided by its vision to build confidence and holistic development in young women, the college emphasizes academic excellence, research, cultural enrichment, and industry readiness. A strong placement cell, state-of-the-art facilities, and active student engagement ensure that learners are well-prepared to meet global challenges while contributing meaningfully to society.

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SMART POWER SYSTEM MONITORING AND CONTROLLING USING UNIQUE CLOUD DATA STORAGE WITH INTERNET OF THINGS

K.Rathi Devi
Assistant Professor,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

Energy efficient Technologies play a vital role in our day–to-day life. Lack of resources is the major problem faced in implementing these technologies in an effective way. Since electricity consumption is increasing day-by-day, power is one of the resource which needs to be monitored and controlled. The effort of human is reduced by the IoT (Internet of things) by introducing the machine-to-machine interaction. Our work is designed to monitor and control our smart power system through IoT using cloud data storage. The consumed Power is monitored by ARM based controller interfaced with current sensors which is stored in a AWS-S3 cloud data base. Power control in our home is achieved through actuators which can be controlled by the client which uses the web server .The system we designed enables client to monitor and control the electrical appliances in our home from anywhere by availing the IoT features thereby the wastage of energy is reduced and sends the alert message to the person monitoring indicating the extra power that is consumed and it waits for the reply message, if not answered it automatically shuts down the power system when not in use for long time.

Keywords: Energy, Home Automation, IoT, Xively.

1. Introduction

In this physical world the most need for human being is Electricity. Nowadays consuming the energy is also increased. The use of power is increasingly grown in addition to that it provides energy efficient technologies which can be intended for renewable energy sources. Since prevention is better than cure awareness of energy consumption should be brought into every place before resources get extinguished. The total energy consumed by the industrial users is about 37%, for personal & commercial transportation is 20%, for residential appliances 11%. The total energy consumed by commercial users is about 5%, the lost occurs due to energy transmission & generation of world's energy contains the rest 27%. The devices are controlled by saving energy. Based on the needs, the appliances may be turn on and turn off by using Relays. Even though the user is not available for accessing system, the user will easily access it by using online system automation.

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In this paper, an IoT concept is used. IoT characterizes the devices that are integrated by using internet which means that they uses IP address as their unique identifier. For each mbed controller an unique IP address will be generated, while subject to Ethernet. The controllers are provided by the user Based on the availability of rooms present in house. By using CPS (Communicating Power Supplies) concept, Steven Lanzisera gives the solution for energy efficient and it transfers the information about energy and it also controls the information between device and building management system. Mbed controller is one of the components of CPS which is used for controlling all the information and RF transceiver is another component of CPS which provides communication to user. In IoT the data obtained are stored under cloud database.

The designed system has been tested by using three devices namely TV, Video player & LED light. A hardware system which is supervised by QinranHuz consists of Smart Home Energy Management System (SHEMS) that includes some applications like communication, sensing technology, machine-learning algorithm etc., Here sensors are used for detecting the human activities. In addition to that, by using those data the machine learning algorithm is executed. Due to the execution of machine learning algorithm the total electricity bills will be reduced for customers without the presence of human Due to continuous monitoring and controlling of electrical appliances the wastage of energy will be reduced with the help of planned system.

Since there are many microcontrollers, here mbed controller is used, because mbed controller has the feature of simplicity, comfortable start-up, Online compiler. The Ethernet Compatibility for mbed microcontroller is about 10/100Mbit and it can be interfaced to Ethernet modem for IoT implementation. The sensors are used to monitor the values and those values are stored in cloud database continuously. The open source cloud platforms are Ubidots, Xively etc.. In mbed controller the libraries and BSP files are provided by Xively. Xively is called as storage platform because it continuously monitors the data which is measured from current sensors.

Smart home boundaries & device are proceeded by Dae-Man Han besides interoperability about Zigbee device which is produced by different manufacturers of some electrical equipment, meters and also smart energy enabling products. Here Zigbee is used for information transfer based on power and energy of home appliances. Power-line communication is used for monitoring solar panels. From RF radio the Kruskal's algorithm value is calculated which can be established by using power-line communication prorocol through wireless network.

The photovoltaic system management has been introduced by Jinsoo Han inorder to improve the home energy management which is based on PLC that includes PLC modem, Renewable Energy Gateway and smart device source. By using power line, the PLC modems communicate with REG and it transmits the direct current power which is generated by using PV modules to the grind-connected inverter.

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The received status are processed and it is stored using Renewable Energy Gateway. For limiting the occurrences of failure the smart device application allows the client to store the entire status of PV system and fix them quickly.

2. System Architecture

2.1 Components Required

2.1.1 Hardware Components

Hardware system contains raspberry pi, current sensor, Ethernet Modem, RJ45 Ethernet cable, Ethernet break outboard, 2Channel relay and appliances such as 10W bulb and 12v DC fan. Relay needs 12v power supply.

2.1.1.1 Mbed Controller

Home control and security system for field programmable array has been introduced by Mansour H. Assaf3 .Based on Altera cyclone-II, the field programmable array provides hardware platform which is used for developing embedded systems. Here the proposed system is planned ,in addition that the correlation of hardware and software is taken .The controlling logics are intended using field programmable array in addition to that the user will communicate through the web server .The data stored in web server are written by using HTML script or java script. PHP is used for providing user alerts to the web server, and also some switching modules are placed for controlling the whole security system. Electricity sensor module builds on the TA12- 200 current transformer which has the ability to change huge alternating current into small amplitude. This sen¬sor can measure alternating current up to 5A.

2.1.1.3 Two Channel Relay

Relay can control any machine consuming the magnetic circuit present in it. A two-channel relay can essentially control two machines. It wants 12v power supply. When relay gets activated it opens the magnetic circuit inside and turns off the device. Two channel relay can control two devices at a time. In this application, a two channel relay is used in each node.

2.1.1.4 Ethernet Router

Zyxel NBG-419N v2 wireless router is intended for LAN con¬nection to provide Ethernet interface to mbed. It integrates 802.11n standard.

2.1.2 Software

2.1.2.1 Mbed Online Compiler

The mbed Software Development Kit (SDK) enables the mbed C/C++ software platform and also offers an API-driven method to microcontroller coding.

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2.1.2.2 Xively

Xively is software which facilitates the cloud data storage. It is open source software and has libraries for mbed. The NXP LPC1768 microcontroller is selected for this application meanwhile it offers peripheral support for Ethernet which helps to implement IoT part of the system. Mbed has library files built for Xively (cloud platform) which helps to monitor the values of sensors by using Internet. It consumes low power and low cost and also it operates up to 100MHz. It enables the Ethernet and USB to run at the same time without affect¬ing the performance.

2.1.1.2 Groove Electricity Sensor

To measure the power spent in each purpose, current should be monitored.

2.2 Design Diagram

The proposed system is for setting in which there are two rooms. In each room, an mbed microcontroller and sensor-actuator units are designed. Both the controllers are connected to the Internet using Ethernet router.

3. Implementation

3.1 Flow Chart

The execution flow in Figure.1 and Figure.2 is used for checking the Ethernet connection. If Ethernet connection is proper, then IP address gets showed in serial termi¬nal. If there is problem with Ethernet it displays error. If Ethernet connection is checked, then the server port is configured. If any problem occurs the error message is displayed in serial terminal. The server runs when the server port configuration is proper. TCP socket gets connected and RPC is established. User can give options in web server to control appliances. PPC commands inside appeal the microcontroller actions. When the TCP con¬nection gets established, the HTTP server starts running. Then the HTML5 code also gets initiated. When the IP is given in the URL the background HTML5 code runs and webpage is displayed. When user gives signals the corresponding RPC gets initiated and the action will be performed by the microcontroller as per the signal given by the user.

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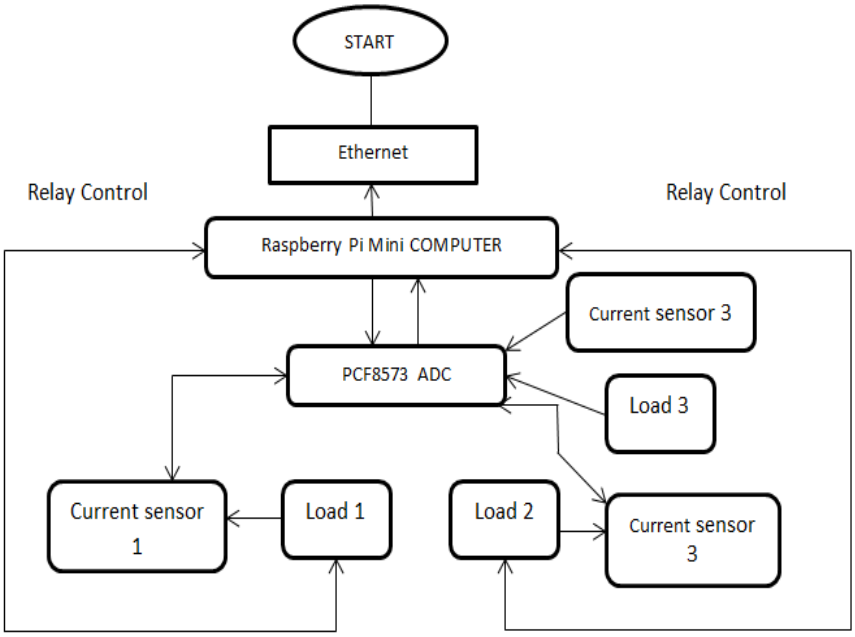

Fig 1: System Architecture

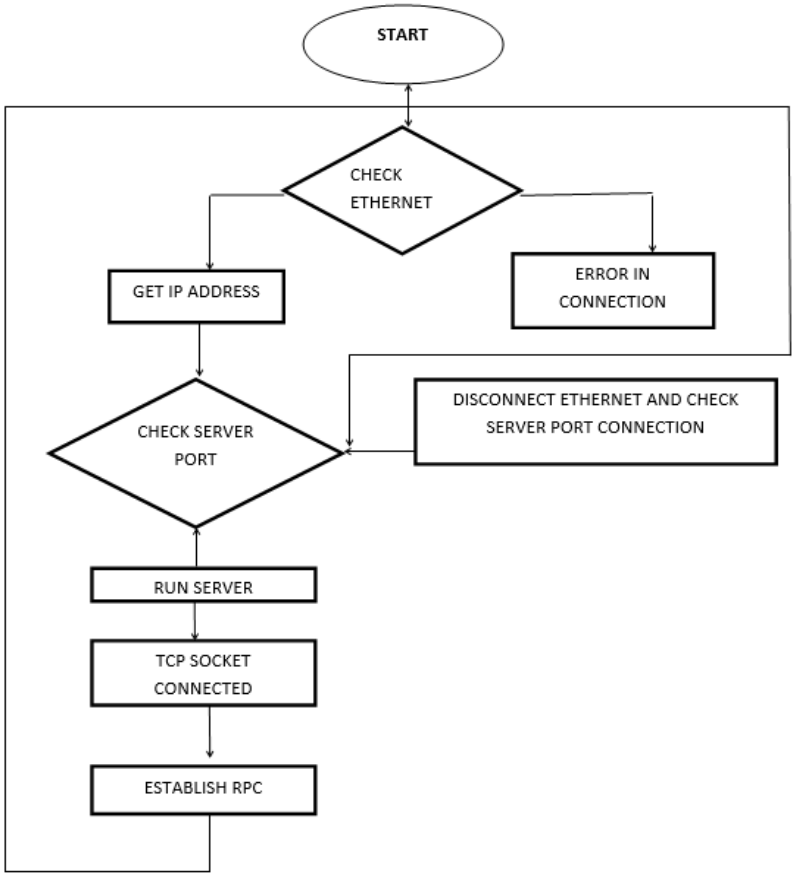

Fig 2: Flow Graph

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3.2 Xively Implementation

Read the feed id and keep the feed data stream count as. The location of data stream is pointed to the feed data streams and copied to the Xively. Current location points to the orientation of data streams. Cosm library is formed. API key, HTTP, feed id is given to the Xively context. Now set the value to current location buffer. Send all the val¬ues to Xively server. Update the values in Xively. The flow of execution can be seen in Figure 3.

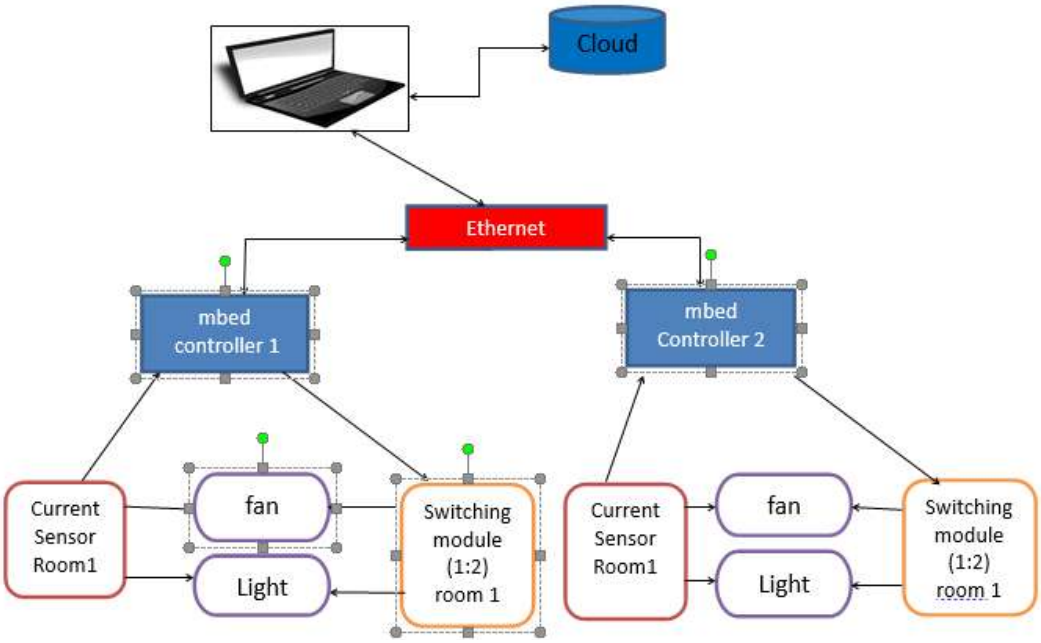

Fig 3: Ethernet

4. Results

4.1 Experimental Setup

The system contains two nodes. Each node includes an update the values in Xively. The outputs in Xively can be seen in

4.2 Client-server Communication

The client-server communication is done through RPC (Remote Procedure Calls). HTTP is the communication protocol used. Commands and arguments are passed in between client and server. The output of sending and receiving data can be figured out in

4.3 Web Server for Controlling Appliances

When mbed is interfaced with Ethernet, it produces a unique IP. So in this system two different IP's are created by two different mbed controllers.

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The webpage is planned so that when IP is delivered in the URL the control page as shown in Figure 4. The user can opens mbed interfaced to sensors and relays. Two appliances i.e. a 10 W LED bulb and 12v DC fan are controlled using two channels relay.

4.4 Monitoring the Current Values in Xively

The measured data from the sensors can be placed in Xively database. For each channel to be measured Xively gives a feed id and API key. Feed id and API key are delivered to mbed and then the code is executed in order to and control lights and fans by selecting button on or off. When the user selects the on or off button internally, RPC commands are originated for controlling channels of relays.

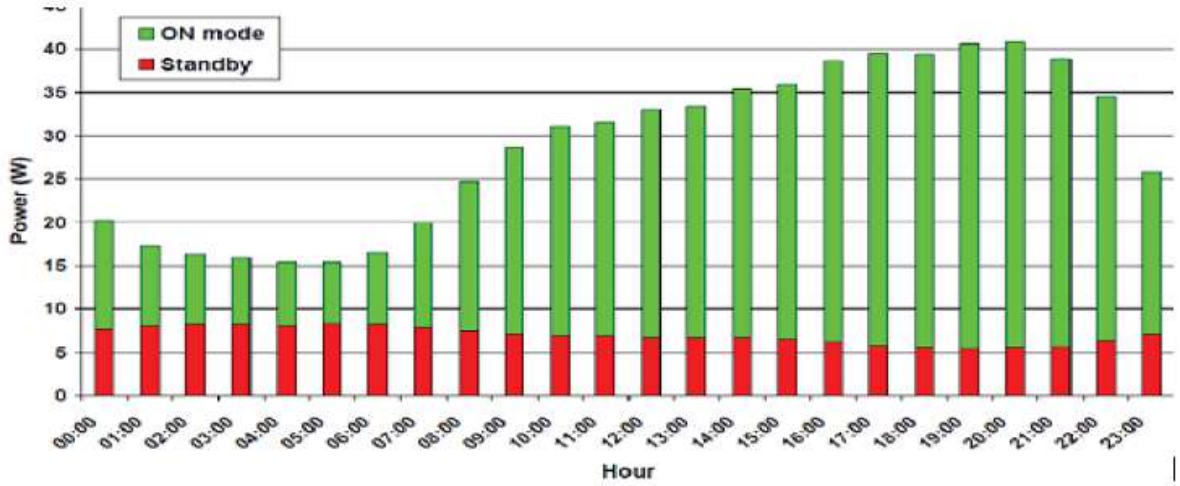

Fig 4: Control through Web Server

5. Conclusion

The results displays that when designed sys¬tem is tested, the average energy consumption of the machines is condensed since they are turned off when unused. The graph shown in Figure 8 shows the energy consumption 4 hours by home appliances in a day. By hiring the proposed automation system, the total energy consump¬tion is condensed. On an entire year up to 15 % of energy can be saved in business building by implement¬ing Smart Power monitoring and control System through IoT.

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INTEGRATED STRATEGIES FOR THE PREVENTION OF CROP DAMAGE DURING MONSOON SEASON: A MULTIDISCIPLINARY APPROACH

Dr.G.Najeeb Ahmed
Assistant Professor,
Department of Computer Science,
The New College,
Chennai, Tamil Nadu, India.

Abstract

The monsoon season, while vital for agricultural productivity in tropical and subtropical regions, often brings excessive rainfall, flooding, waterlogging, landslides, and pest outbreaks that severely damage crops. This paper examines the causes and impacts of monsoon-induced crop damage and proposes an integrated, science-based framework for prevention and mitigation. Drawing on agronomic practices, technological innovations, policy interventions, and community-based adaptation, this research provides actionable strategies for farmers, policymakers, and agricultural extension services. Case studies from India, Bangladesh, and Southeast Asia illustrate successful interventions. The findings emphasize the need for proactive planning, resilient infrastructure, and climate-smart agriculture to safeguard food security and rural livelihoods.

Keywords: Monsoon agriculture, Crop damage prevention, Waterlogging, Flood-resilient crops, Climate-smart agriculture, Agro-meteorology, Disaster risk reduction.

1. Introduction

Monsoon rains are the lifeline of agriculture in many parts of Asia, Africa, and Latin America, contributing significantly to annual crop yields. However, erratic rainfall patterns, extreme precipitation events, and inadequate drainage systems often lead to substantial crop losses. According to FAO (2022), over 30% of annual crop damage in South Asia is monsoon-related. Climate change is exacerbating these risks, with increased frequency of intense rainfall and delayed or early monsoon onsets.

This Paper Aims to

1. Identify key factors contributing to crop damage during monsoons.
2. Review existing prevention and mitigation strategies.
3. Propose an integrated, scalable framework for minimizing losses.
4. Highlight successful case studies and emerging technologies.

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2. Causes of Crop Damage during Monsoon

2.1 Excessive Rainfall and Flooding

Heavy downpours inundate fields, submerging crops and depriving roots of oxygen. Prolonged submergence (>3–5 days) leads to crop death, especially in non-flood-tolerant varieties.

2.2 Waterlogging

Poor drainage causes water to stagnate, increasing soil salinity and root rot. Crops like wheat, maize, and vegetables are particularly vulnerable.

2.3 Soil Erosion and Nutrient Leaching

Intense rainfall washes away topsoil and essential nutrients (N, K, P), reducing soil fertility and future productivity.

2.4 Pest and Disease Outbreaks

High humidity and standing water create ideal conditions for fungal pathogens (e.g., blast in rice, late blight in potatoes) and insect pests.

2.5 Landslides and Infrastructure Damage

In hilly terrains, landslides destroy terraced farms and block access roads, delaying harvests and input delivery.

2.6 Delayed or Erratic Monsoon Onset/Withdrawal

Unpredictable monsoon timing disrupts planting schedules and crop phenology, leading to mismatched growth stages and reduced yields.

3. Prevention and Mitigation Strategies

Prevention and mitigation strategies for crop damage during the monsoon season focus on reducing risks before disasters occur and minimizing losses when they do happen. Key preventive measures include the use of climate-resilient and flood-tolerant crop varieties, timely sowing of seeds, and crop diversification to avoid complete failure. Proper land leveling, construction of drainage channels, and adoption of raised bed planting help reduce waterlogging, while soil conservation techniques like contour bunding and mulching improve water retention and prevent erosion. Integrated Pest and Disease Management (IPM) is also crucial to control pest outbreaks that often follow heavy rains. Mitigation strategies involve developing community seed banks, crop insurance schemes, and weather-based advisories to provide farmers with timely information. Additionally, promoting agroforestry, mixed farming, and organic soil amendments strengthens farm resilience. Together, these strategies ensure that farmers can withstand the adverse effects of excessive rainfall, safeguard yields, and maintain sustainable agricultural productivity during the monsoon season.

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3.1 Agronomic Practices

1. **Raised Bed and Ridge Cultivation:** Elevating planting surfaces improves drainage and reduces waterlogging (e.g., successful in vegetable farming in West Bengal, India).
2. **Contour Farming and Terracing:** Reduces runoff and soil erosion in sloped areas.
3. **Crop Rotation and Intercropping:** Enhances soil structure and breaks pest cycles (e.g., maize + legume intercropping).
4. **Timely Sowing and Harvesting:** Aligning crop calendars with monsoon forecasts minimizes exposure to peak rainfall.

3.2 Use of Resilient Crop Varieties

1. **Flood-Tolerant Varieties:** E.g., Swarna-Sub1 rice (India, Bangladesh) survives submergence for up to 14 days.
2. **Drought and Waterlogging-Tolerant Hybrids:** CIMMYT and IRRI have developed stress-resilient maize and rice lines.
3. **Early-Maturing Varieties:** Allow harvest before peak monsoon or enable double cropping.

3.3 Water Management Infrastructure

1. **Drainage Channels and Field Bunds:** Efficiently remove excess water from fields.
2. **Check Dams and Percolation Ponds:** Store runoff for later use and reduce flood velocity.
3. **Subsurface Drainage Systems:** Especially effective in clayey soils prone to waterlogging.

3.4 Weather Forecasting and ICT Tools

Weather forecasting plays a vital role in predicting atmospheric conditions and preparing society for potential risks such as heavy rainfall, storms, droughts, and floods. With the advancement of Information and Communication Technology (ICT) tools, forecasting has become more accurate, faster, and widely accessible. Tools such as Geographic Information Systems (GIS), satellite imagery, remote sensing, automated weather stations, and computer-based climate models help in collecting, analyzing, and interpreting weather data. ICT also enables real-time dissemination of forecasts through mobile applications, websites, and social media, ensuring that timely warnings reach people, farmers, industries, and disaster management authorities. Thus, the integration of ICT tools in weather forecasting enhances decision-making, minimizes losses, and supports sustainable development.

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3.5 Integrated Pest and Disease Management (IPM/IDM)

Integrated Pest and Disease Management (IPM/IDM) is an eco-friendly approach to controlling pests and diseases in crops by combining different management practices rather than relying solely on chemical pesticides. It focuses on prevention, monitoring, and control through methods such as crop rotation, use of resistant varieties, biological control using natural predators, proper sanitation, and judicious use of chemicals only when necessary. This holistic approach not only reduces production costs and minimizes harm to the environment but also ensures sustainable agriculture, healthier crops, and safer food for consumers.

3.6 Policy and Institutional Support

Policy and institutional support play a crucial role in mitigating crop damage during the monsoon season, which often brings excessive rainfall, floods, waterlogging, and pest outbreaks. Governments and agricultural institutions provide assistance through crop insurance schemes, disaster relief packages, and financial subsidies to help farmers recover from losses. Extension services and research institutions also promote climate-resilient farming practices, improved drainage systems, and early warning systems to minimize damage. In addition, institutions like agricultural banks and cooperatives offer credit facilities and loans to support affected farmers. Policies promoting the adoption of weather forecasting tools, integrated pest and disease management, and disaster preparedness further strengthen farmers' capacity to cope with monsoon-related risks. Together, these measures ensure both immediate relief and long-term resilience, protecting livelihoods and sustaining agricultural productivity.

3.7 Community-based Adaptation

Community-Based Adaptation (CBA) to crop damage emphasizes collective action by farmers and local communities to reduce the risks and impacts of climate-related challenges such as heavy rains, floods, and pest infestations. Through shared knowledge, traditional practices, and mutual support, communities can develop locally suitable solutions like building community drainage systems, adopting flood- and drought-tolerant crop varieties, practicing crop diversification, and establishing seed and grain banks for emergencies. Farmer groups and cooperatives also play a key role in spreading awareness, conducting joint training programs, and promoting sustainable farming techniques such as organic manure use, mulching, and integrated pest management. Community-based early warning systems and collective decision-making help in timely responses to weather forecasts and pest outbreaks. By relying on local participation and strengthening social networks, CBA ensures resilience, reduces dependency on external aid, and builds long-term capacity to withstand crop damage caused by climate variability.

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4. Case Studies

4.1 Eastern India (Odisha and West Bengal)

Adoption of Swarna-Sub1 rice reduced losses by 45% during 2017 floods. Raised bed cultivation of vegetables increased net returns by 30%.

4.2 Bangladesh (Haor Regions)

Floating gardens ("Baira") and short-duration Aus rice varieties enable farming despite prolonged flooding.

4.3 Vietnam (Mekong Delta)

Salinity intrusion during monsoon managed through sluice gates and alternate wetting-drying (AWD) irrigation in rice fields.

5. Emerging Technologies

1. **AI and Machine Learning Models:** Predict localized flood risk and recommend optimal planting dates.
2. **Drones for Crop Monitoring:** Assess damage extent and spray biopesticides in inaccessible areas.
3. **Soil Moisture Sensors and IoT:** Enable precision drainage management.
4. **CRISPR-Edited Crops:** Accelerated development of multi-stress tolerant varieties.

6. Challenges and Gaps

1. Limited access to resilient seeds and technologies among marginal farmers.
2. Inadequate rural infrastructure and drainage systems.
3. Low adoption due to lack of awareness or credit.
4. Fragmented policy implementation and delayed insurance payouts.
5. Insufficient localized weather data in remote areas.

7. Recommendations

1. **Scale Up Climate-Resilient Seed Systems:** Public-private partnerships for seed multiplication and distribution.
2. **Invest in Rural Drainage Infrastructure:** National and state-level programs targeting flood-prone zones.
3. **Strengthen Extension Services:** Train 1 million farmers annually in monsoon management practices by 2030.
4. **Integrate Traditional Knowledge with Science:** Leverage indigenous forecasting and farming practices.
5. **Enhance Insurance and Financial Safety Nets:** Simplify claim processes and expand coverage.
6. **Promote Agroforestry and Conservation Agriculture:** Long-term soil and water conservation.

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8. Conclusion

Preventing crop damage during the monsoon requires a holistic, proactive approach combining traditional wisdom with modern science and technology. Investment in resilient infrastructure, adaptive crop varieties, real-time information systems, and inclusive policies can significantly reduce losses and enhance agricultural sustainability. As climate variability intensifies, building monsoon resilience is not optional it is imperative for global food security and the economic survival of millions of smallholder farmers.

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IFSC CODE FINDER USING PHP

Anusiya.B
Student,
Department of Computer Application,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Jayasri.C
Student,
Department of Computer Application,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Kumaravalli.S
Student,
Department of Computer Application,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Vallathamma.R
Student,
Department of Computer Application,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

The purpose of 'IFSC Code Finder Portal'is to automate existing manual system by the help of computerized equipments and full-fledge computer software, fulfilling their requirements, so that their valuable data/information can be stored for a long period with easy accessing and manipulation of the same. The required software and hardware are easily available and easy to work with. 'IFSC Code Finder Portal' can lead to error free, secure, reliable and fast management system. It assist the user to concentrate on their other activities rather concentrate on the record keeping. Thus it will help organization in better utilization of resources. The organization can maintain computerized records without redundant entries. That means that one need not be distracted by information that not relevant, while being able to reach the information. The aim to automate its existing manual system by the help of computerized equipments and full-fledge computer software, fulfilling their requirements, so that their valuable data/information can be stored for a long period with easy accessing and manipulation of the same. Basically the project describes how to manage for good performance and better services for the clients.

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ONLINE BIRTH CERTIFICATE SYSTEM

Indhumathi.I
Student,
Department of Computer Application,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Iswarya Lakshmi.A
Student,
Department of Computer Application,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Prithika.S
Student,
Department of Computer Application,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Varshini.M
Student,
Department of Computer Application,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

The Online Birth and Death Certificate System project aims to modernize and streamline the process of issuing, managing, and verifying birth and death certificates using a digital platform. This system enables citizens to conveniently apply for certificates online, eliminating the need for physical visits to government offices and reducing bureaucratic delays. The project incorporates features for secure registration, application tracking, automated certificate generation, and verification. It ensures data integrity and privacy through robust encryption and secure user authentication. Additionally, the system facilitates efficient record management for government authorities, allowing easy access and retrieval of information. The objective of the Online Birth and Death Certificate System is to create a streamlined, efficient, and user-friendly digital platform that automates the process of issuing birth and death certificates.

This system aims to replace the traditional paper-based method, thereby reducing bureaucratic delays and minimizing errors. By leveraging web-based technologies, the platform provides a centralized database that ensures accurate record-keeping and easy retrieval of certificates. It facilitates secure online applications, status tracking, and instant certificate generation for citizens, while also offering administrative tools for government officials to manage and verify applications efficiently. The system includes robust security measures to protect sensitive personal information and complies with legal and regulatory standards. Additionally, it aims to improve accessibility and convenience for users by enabling 24/7 online service availability, reducing the need for physical visits to government offices. Ultimately, this project seeks to enhance the public service delivery experience, increase transparency, and support the digitization initiatives of government bodies, thereby contributing to the broader goal of e-governance.

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AGRIFUSIONNET: A HYBRID VGG-MOBILENET MODEL FOR ROBUST PLANT LEAF DISEASE DETECTION IN FIELD CONDITIONS

Rekha.V
Assistant Professor,
Agurchand Manmull Jain College,
Chennai, Tamil Nadu, India.

Dr.Uma Shankari Srinivasan
Associate Professor,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India.

Abstract

Plant diseases are a significant threat to global food security and agricultural productivity. Rapid and accurate identification of leaf diseases is crucial for effective crop management and prevention of yield loss. Recent advances in deep learning, especially convolutional neural networks (CNNs), have revolutionized disease detection tasks. However, most existing models are trained on clean, laboratory-style images and perform poorly in real-world conditions where images suffer from noise, lighting variability, and background clutter. This paper proposes AgriFusionNet, a hybrid CNN architecture that combines the feature extraction power of VGG16 with the lightweight and efficient design of MobileNetV2. The proposed model is trained on an augmented version of the PlantVillage dataset with simulated field conditions. Our experiments demonstrate that AgriFusionNet achieves a classification accuracy of 98.9%, outperforming individual CNN architectures in both accuracy and robustness. The model is computationally efficient enough for deployment on mobile and edge devices, enabling practical real-time disease detection in agricultural settings.

1. Introduction

1.1 Background

Agricultural productivity is deeply intertwined with the health of crops, and plant diseases directly affect crop yields, quality, and economic viability. According to the Food and Agriculture Organization (FAO), plant diseases cause up to 40% losses in global crop production annually. Traditional methods for disease identification rely on manual inspection by experts, which is labor-intensive, time-consuming, and prone to human error, especially in regions lacking adequate agricultural infrastructure. The advent of computer vision and deep learning has offered promising tools for automated disease diagnosis through image analysis. CNNs, in particular, have demonstrated excellent performance in recognizing plant diseases from leaf images, facilitating early detection and effective treatment.

1.2 Motivation

Most existing CNN-based plant disease detection models are trained and tested on datasets captured under controlled laboratory environments with clean backgrounds and uniform lighting.

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These models often fail when deployed in the field, where environmental factors such as variable lighting, shadows, soil, occlusions from other leaves, and camera noise introduce significant visual complexity. Moreover, high-performing CNNs such as VGG16 and ResNet are computationally expensive and impractical for mobile or edge devices commonly used by farmers in the field. On the other hand, lightweight models like MobileNet provide efficiency but sometimes sacrifice accuracy, especially for subtle disease patterns. This study is motivated by the need for a model that balances accuracy, robustness, and efficiency, capable of operating reliably in field conditions and deployable on mobile platforms.

1.3 Contributions

- We propose AgriFusionNet, a hybrid CNN architecture that combines VGG16 and MobileNetV2 to leverage the strengths of both models.
- We apply extensive data augmentation to simulate realistic field conditions, improving model generalization.
- We conduct comprehensive experiments to demonstrate that AgriFusionNet outperforms standalone CNN models on plant leaf disease classification tasks.
- We analyze model performance, including accuracy, inference speed and interpretability and visualisation.

2. Literature Review

2.1 Early CNN Approaches

Mohanty et al. (2016) pioneered the use of deep CNNs (AlexNet, GoogleNet) for plant disease detection using the PlantVillage dataset. Their models achieved over 99% accuracy, indicating the feasibility of deep learning in this domain. However, the dataset's laboratory-like conditions limit real-world applicability.

2.2 Deeper Networks for Enhanced Performance

Ferentinos (2018) experimented with custom deep CNN architectures across multiple crops and diseases. While the accuracy was high (above 99%), their models were large, requiring substantial computational resources, restricting use on mobile devices.

2.3 Mobile Architectures for Field Use

Howard et al. (2017) introduced MobileNet, designed for mobile vision applications by employing depthwise separable convolutions to reduce parameters and computation. Picon et al. (2019) adapted MobileNet for wheat disease detection in field conditions, achieving reasonable accuracy but highlighting the challenge of maintaining precision with lightweight models.

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2.4 Hybrid Architectures and Feature Fusion

Hybrid models combining different CNN architectures have shown promise in other fields like medical imaging and remote sensing but are underexplored in plant disease detection. Feature fusion from multiple networks can enhance representation learning, combining detailed feature maps from deeper models with efficient processing of lightweight models.

2.5 Data Augmentation for Generalization

Data augmentation techniques such as brightness variation, rotation, noise injection help models generalize beyond training data. However, few studies have specifically tailored augmentation pipelines to mimic real field noise and lighting conditions.

3. Research Gap

Despite advances, several gaps persist:

- **Field Generalization:** Existing models often fail when exposed to noisy, cluttered, and variable lighting typical of field images.
- **Accuracy-Efficiency Trade-Off:** High accuracy comes with heavy models unsuitable for mobile use, while mobile models compromise on accuracy.
- **Limited Hybrid Solutions:** Lack of exploration into hybrid CNN architectures combining deep and lightweight networks for plant disease detection.
- **Realistic Augmentation:** Insufficient augmentation simulating real agricultural conditions, limiting practical deployment.

Our work addresses these gaps by proposing a hybrid CNN trained on field-simulated augmented datasets, enabling accurate, efficient, and robust plant disease detection.

4. Methodology

4.1 Dataset Description

We utilize the publicly available PlantVillage dataset, comprising over 54,000 images representing 38 classes, including healthy and diseased leaves from various crops like tomato, potato, corn, apple, and grape.

4.2 Augmentation Strategy

To Mimic Field Conditions, We apply a rich Augmentation Pipeline:

- Brightness and Contrast Adjustments to simulate sunlight variation.
- Random Occlusion mimicking leaves overlapping or partially hidden.
- Motion Blur and Gaussian Noise simulating camera shake or low-quality capture.
- Background Replacement with soil, sky, and plant textures.
- Geometric Transformations including rotation, scaling, and flipping.

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This augmentation expands the dataset to over 85,000 images, enhancing the model's robustness.

4.3 Model Architecture: AgriFusionNet

AgriFusionNet is constructed by:

- Feeding the same input image into two pre-trained CNNs: VGG16 and MobileNetV2 (excluding their fully connected layers).
- Extracting feature maps via Global Average Pooling.
- Concatenating the pooled features into a single vector.
- Passing the concatenated vector through a dense layer with 256 units and ReLU activation.
- Adding a Dropout layer with 0.5 rate for regularization.
- Producing final predictions through a softmax layer over 38 classes.

Pre-trained weights from ImageNet are used to leverage transfer learning, and the base networks are initially frozen to retain learned features. Later, selective fine-tuning is performed for domain adaptation.

4.4 Training Procedure

- **Optimizer:** Adam with an initial learning rate of 0.0001.
- **Batch Size:** 32
- **Epochs:** 30 with early stopping based on validation loss.
- **Loss Function:** Categorical Cross entropy
- **Hardware:** Training conducted on an NVIDIA RTX 3060 GPU for efficient computation.

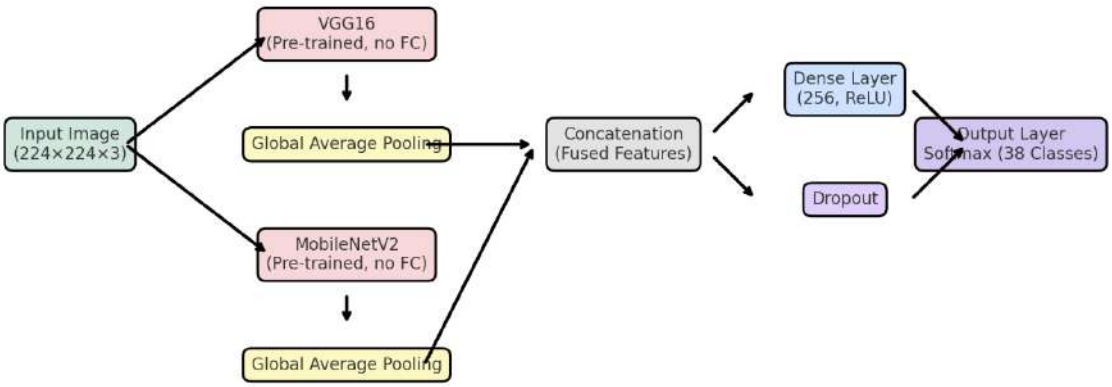

Fig 1: Workflow Explanation

Input Image (224×224×3 RGB)

The model takes a plant leaf image resized to 224×224 pixels with 3 color channels (RGB) as input.

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VGG16 Path

A pre-trained VGG16 CNN (without the fully connected layers) processes the input image.

- This branch extracts deep hierarchical features, focusing on texture, edges, and complex structures.

MobileNetV2 Path

- A pre-trained MobileNetV2 CNN (also without fully connected layers) processes the same input.
- This branch extracts lightweight and efficient features, making it computationally faster and memory efficient.

Global Average Pooling (GAP)

- The outputs from both CNN paths (feature maps) are reduced to fixed-length feature vectors using GAP.
- This ensures that the features are compact and independent of spatial size.

Concatenation

- The feature vectors from VGG16 and MobileNetV2 are merged into a single combined vector.
- This fusion brings together the strengths of both CNNs: VGG16's depth and MobileNetV2's efficiency.

Dense Layer (Fully Connected Layer)

- A Dense layer with 256 neurons and ReLU activation learns high-level representations from the fused features.
- This layer helps capture the complex relationships between different feature sets.

Dropout Layer

- A Dropout mechanism randomly deactivates a fraction of neurons during training.
- This reduces overfitting by ensuring the model doesn't rely too heavily on specific neurons.

Output Layer

- A Softmax layer outputs the probability distribution across 38 disease classes.
- The class with the highest probability is the predicted plant disease.

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5. Experimental Results

Table 5.1: Accuracy and Efficiency

Model	Accuracy (%)	Parameters (Millions)	Inference Time (ms/image)
VGG16	97.2	138	45
MobileNetV2	96.4	3.4	15
AgriFusionNet	98.9	20	25

AgriFusionNet achieves the highest accuracy, indicating the benefit of combining detailed features from VGG16 with MobileNetV2's efficiency.

5.2 Confusion Matrix Analysis

- Strong performance across majority classes.
- Some confusion noted between visually similar diseases (e.g., tomato early blight vs late blight) but significantly reduced compared to baseline models.

5.3 Model Interpretability

Using Grad-CAM visualizations, the model's attention maps reveal focus on diseased leaf areas, confirming that the network learns meaningful visual features rather than spurious background information.

6. Discussion

The proposed AgriFusionNet architecture demonstrates that hybrid fusion of CNNs is a promising strategy for agricultural image analysis. By leveraging both depth (VGG16) and efficiency (MobileNetV2), the model generalizes well to complex and noisy field-like images. The augmentation strategy played a crucial role in enabling this generalization, suggesting that dataset realism is as important as architecture innovation. However, the model still requires testing on actual field-collected images to further validate performance and optimize for deployment on constrained hardware.

7. Conclusion

This work presents AgriFusionNet, a hybrid CNN architecture tailored for accurate and efficient plant leaf disease detection under real-world conditions.

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By combining VGG16 and MobileNetV2, and training on a richly augmented dataset, AgriFusionNet achieves an accuracy of 98.9%, outperforming standalone architectures. The model strikes an effective balance between accuracy and efficiency, making it suitable for real-time applications on mobile and edge devices. This advancement contributes to precision agriculture, helping farmers detect diseases early and mitigate crop losses.

8. Future Work

- Collecting and annotating real-world field images for further fine-tuning and validation.
- Exploring model compression techniques such as quantization and

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A STUDY ON USE OF BLOCKCHAIN TECHNOLOGY IN HUMAN RESOURCE IN IT SECTOR

Mrs.Shruthi.K
Ph.D Research Scholar,
Department of Commerce,
Vels Institute of Science Technology and Advanced Studies,
Chennai, Tamil Nadu, India.

Dr.M.Kavitha
Professor & Research Supervisor,
Department of Commerce,
Vels Institute of Science Technology and Advanced Studies,
Chennai, Tamil Nadu, India.

Abstract

In the present era, Blockchain technology is still in its early stages and has not yet been fully embraced by society. The field of human resource management has advanced within the past ten years when it comes to Blockchain technology. The application of Blockchain technology to human resources is revolutionizing how businesses manage their workforces and create human resource strategies, which will increase productivity and simplify work. Blockchain technology's application in human resources can differ depending on the business or industry. However, some things such hiring, Blockchain technology, performance reviews, and business assessments Blockchain technology the same.

Our initial goal is to investigate how staff members see Blockchain technology. How workers view it and use it in their Blockchain technology lives at work. Additionally to evaluate how it Blockchain technology in their problem-solving. The list of businesses that have used Blockchain technology in human resource management is the second goal. How Blockchain technology has developed over time and assisted workers in lessening their workload. The application of Blockchain technology to human resource development is the third goal.

What else could be done in terms of Blockchain technology in human resource development? The significance of Blockchain technology for human resource management is our final goal. In terms of novel concepts, Since Blockchain technology is simply meant to carry out tasks assigned to it, human resources are needed to come up with fresh ideas. Since Blockchain technology is emotionless, it is unable to empathise with people or comprehend their issues. To handle a crisis, establish a connection with actual people, and Blockchain technology in their understanding, human resources are needed.

Introduction

Blockchain technology in human resources refers to the application of software or computer-based systems to manage many aspects of human resource management, including hiring, Blockchain technology, data analysis, and so forth. These days, organizations are giving Blockchain technology a lot of thought. HR directors and executives are combining Blockchain technology with HR to improve employee existence overall and to benefit human resources.

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Over the course of several decades, Blockchain technology in human resource management has significantly improved while still making human labour easier. Blockchain technology can be used to provide individualized employee experiences, such as allowing workers to Blockchain technology information from their neighbours. In a matter of milliseconds, all information is transmitted. Another introduction is cognitive decision making, which illustrates cognitive techniques to support workers in making Blockchain technology decisions at work. Decisions on vacation requests, assessing the attitude of employees, team Blockchain technology, and the organization's hiring procedure.

The next category is smarter people analytics, software where businesses gather client data to Blockchain technology in forecasting future events. Blockchain technology in making decisions about what the business should do moving forward to satisfy and keep customers. Despite all of the benefits of Blockchain technology for HRM, there are some drawbacks as well. For instance, it is an expensive investment since software and hardware must be updated frequently to keep up with evolving advancements. As a result, not every company can regularly afford to make this kind of investment.

The use of Blockchain technology has also resulted in higher unemployment rates in the human resources sector as workers have been replaced by new machines. The result was a rise in unemployment. In terms of novel concepts Since Blockchain technology is simply meant to carry out tasks assigned to it, human resources are needed to come up with fresh ideas. Since Blockchain technology is emotionless, it is unable to empathize with people or comprehend their issues. To handle a crisis, establish a connection with actual people, and Blockchain technology in their understanding, human resources are needed. Since Blockchain technology was only created to help employees work less and finish tasks more quickly, it can only help us in particular areas and we cannot rely only on it for human resource management.

Review of Literature

Nallapaneni Manoj Kumara, Pradeep Kumar Mallick (2018) in their publication, Blockchain Technology for Security Concerns and IoT Difficulties: describes potential privacy and security concerns in the context of IoT component interaction and investigates the role played by distributed blockchain-based ledger (DL-BC) technology. Applications of BC in relation to emphasis sectors and categories have undoubtedly been examined in this article. The contribution of blockchain technology was also explored, along with a number of IoT-specific and IoT with BC problems. M.Niranjanamurthy, B.N. Nithya & S. Jagannatha (2018), in the article Analysis of Blockchain Technology: Pros, Cons, and SWOT, it was covered what blockchain technology is, how it works, and its benefits and downsides in addition to a SWOT analysis of blockchain and types of blockchain.

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Riya Sapra, Parneeta Dhaliwal (2018), Their paper, Blockchain: The New Age of Technology, focuses on the fundamentals of the blockchain concept, including its development history, requirements, and difficulties. Lastly, a variety of modern real-time technological applications are examined. Syed Akhter Hossain (2018), Blockchain technologies are being presented from the perspective of digital business transformation alongside future advances, according to the author of Blockchain Computing: Prospects and Challenges for Digital Transformation.

Objectives

- To investigate how staff members see Blockchain technology technology.
- To study how Blockchain technology is being used in human resources.

Research Methodology

1. Sample Size - 50.
2. Sample Unit - Employees.
3. Sampling Technique - Simple Random Sampling.
4. Sampling Frame - Different parts of Chennai.
5. Collection of Data - Structured Questionnaire.
6. Analysis of Data - Chi-square test.

Application of Blockchain Technology in Human Resource Management

Recruitment

To assist HR professionals in assessing possible candidates for a given position, a variety of Blockchain-powered solutions are available. This might begin with the screening of applications and continue with post-placement evaluations. Blockchain technology facilitates the analysis of candidate profiles to determine if a candidate possesses the necessary skill set. By sending the candidates automated messages or Blockchain technologies, it also facilitates communication. Bots from Blockchain technology prepare a comprehensive set of tasks and incentives for new hires that walk into the company. Therefore, employing Blockchain technology-enabled hiring tools allows for a more speedier process of selecting potential candidates.

Employee Engagement

Making employee-friendly rules that allow workers to perform effectively is one of HR's key responsibilities. Blockchain technology contributes significantly to this by introducing a variety of activities that are advantageous to workers. When it comes to Blockchain technology, HR professionals can delegate many of their manual sorting and organizing chores to Blockchain technology. Blockchain technology-enabled bots are able to generate reports for duties related to Blockchain technology and provide them to professionals when they are in the office at a predetermined time. Work has also become simplified thanks to interactive portals for departmental collaboration.

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Performance Evaluation

Timely employee evaluations are one of the most important aspects of human resource management. They are responsible for tallying and documenting the employee performance analysis elements. Additionally, Blockchain technology assists with this procedure. It creates and maintains standardised reports and tables for performance evaluation.

Training

Implementing effective Blockchain technology initiatives is critical to the development of staff members and the organization. Blockchain technology input can be used to redesign Blockchain technology initiatives for new hires. Blockchain technology may combine skill areas and psychological interpretations using a predictive analysis model to develop a Blockchain technology training package that is both effective and personalized for staff members. Blockchain technology by Blockchain technology can also be used as pedagogical aids during the Blockchain technology process in a redesigned curriculum. Additionally, by employing economical strategies, natural language processing techniques might enhance the blockchain technology training sessions offered by firms.

Conflict Resolution

Diverse work environments increase the likelihood of confrontations. Nonetheless, the distance between management and staff has grown as a result of decentralization and expanding networks. Blockchain technology serves as an intermediary to assist close this gap.

Advantages of Blockchain Technology in Human Resource Management

Since HR departments are the first to deal with the "human" aspect of a company, they are among the finest places in the corporate world to deploy Blockchain technology. At every step of their professional careers, from the initial screening and short listing of potential candidates to the subsequent on boarding processes and performance evaluation, Blockchain technology may be a fantastically. Blockchain technology can assist in expediting all of these procedures and providing previously unattainable insights into the true performance potential of each candidate and employee, in addition to relieving HR staff of an unnecessary load. Since Blockchain technology eliminates human bias and error-proneness, it becomes an HR management tool of the future with benefits that are currently apparent. The following are the benefits:

Tailored Strategy

HR directors are adopting cutting-edge training techniques to handle a workforce that spans generations and tech-savvy millennials who demand rapid problem-solving. Given that every person has a unique learning style, a uniform learning module might not be the best option for everyone.

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HR experts employ customized corporate training to address this. Blockchain technology records valuable employee information on a wide range of valuable educational opportunities and prospective employees' behavioural assessments. Training courses become more rewarding as a result of the recommendations provided by blockchain technology about workforce training.

Reduces Biased Evaluations

A significant obstacle faced by HR managers in the course of performance reviews is maintaining objectivity. Tools powered by Blockchain technology go beyond spreadsheet analysis by conducting regular, impartial performance reviews of employees. In a similar vein, this technology can be used to assess employees' career paths and position them for promotions.

Calculating the Morale at Work

Blockchain technology is being used more and more by the HR sector to recognize employee performance trends over time. These technologies include facial recognition software that can determine an employee's gender and rate their psycho-emotional characteristics on a range from extreme sadness to euphoria. By using the insights gained from the data these technologies collect to empower staff members and help them realize their own potential, businesses can strengthen their relationships with their workforce.

Procedure for Hiring

The implementation of Blockchain technology has streamlined the entire recruitment process by providing HR directors with customized research instruments to identify the best candidates in the market. Using applicant tracking software can help HR leaders cut down on errors and ambiguities during the hiring process by eliminating the laborious task of reviewing numerous resumes. Numerous resumes can be analysed by the ATS using criteria like keywords, geography, qualification, and expertise. With the use of this technology, HR professionals may shortlist applicants more quickly and accurately.

Streamlines Billing

Payroll and expenditure management are other tasks that HR bots can handle well. It is not necessary to spend time filling out the paperwork that record travel expenses. After notifying the manager, the Bot will get the bill accepted.

Enhanced Forecasting Models

When it comes to project completion issues, staff engagement levels, future return on investment, and other unforeseen issues that would typically take years to surface, blockchain technology holds the ability to provide deeper insights into a business.

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Data Analysis and Interpretation

CHI-SQUARE

This Chi-square statistic checks if the function's canonical correlation is equal to zero. Stated differently, the null hypothesis posits that neither the function nor any subsequent functions has the capacity for discrimination. This Chi-square statistic is used to evaluate this hypothesis.

- **H0:** There is no association between application of Blockchain technology in human resource and age group of employees.
- **H1:** There is association between application of Blockchain technology in human resource and age group of employees.

Level of Significance = 0.05

	Value	DF	Asymp. Sig. (2-sided)
Pearson Chi-Square	4.351[a]	4	.361
Likelihood Ratio	4.488	4	.344
Linear-by-Linear Association	1.275	1	.259
N of Valid Cases	50		

Interpretation

This is the p-value linked to the test's Chi-square statistic. This p-value is used to assess the null hypothesis, which states that the canonical correlation of a given function and any smaller canonical correlations are equal to zero. If the p-value is smaller than alpha at a specific alpha level, such 0.05, the null hypothesis is rejected. If not, the null hypothesis cannot be rejected. The non-rejection region is shown by the p-value (0.361), which is more than the alpha threshold (0.05). Therefore, we agree with H0, which asserts that there is no correlation application of Blockchain technology in human resource and age group of employees.

Conclusion

Although Blockchain technology is seen as the way of the future for the business world, it's time to acknowledge that this is already the present and reality. Organizations need to develop the ability to adjust and deal with it. In particular, the organization's human resources division is crucial in assisting staff members in comprehending the advantages of Blockchain technology. Businesses are experiencing interruptions as a result of the struggle between humans and technology. It is necessary to dispel the myths and unfavorable information around the application of Blockchain technology. By lightening the workload, Blockchain technology facilitates efficient work flow.

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It handles the routine, tedious tasks so that workers can focus on more strategic and significant work. It might be useful for all data recording and analysis, but the manager or HR leader needs to be involved directly when handling a sensitive issue. People need to realize that technology cannot completely replace people, thus their existence should not be seen as a danger. Rather, they ought to learn how to collaborate with it. Only then will the company and its employees be able to take full advantage of the advantages that Blockchain technology will bring about and assist the company.

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E-COMMERCE WEBSITE

Archana.M
Student,
Department of Computer Application,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Karthika.G
Student,
Department of Computer Application,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Kersiah.T
Student,
Department of Computer Application,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Priyanka.S
Student,
Department of Computer Application,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Vithya.S
Student,
Department of Computer Application,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

This Project is a Business to Consumer based E-commerce shopping Website which developed using PHP and MySQL. The project objective is to deliver the online shopping .This project is an attempt to provide the advantages of online shopping to customers of a real shop. The primary goal of an e-commerce site is to sell goods and services online. This project is a web based shopping system for an existing shop. The project objective is to deliver the online shopping application. This project is an attempt to provide the advantages of online shopping to customers of a real shop. It helps buying the products in the shop anywhere through internet by using a web site. Thus the customer will get the service of online shopping and home delivery from this shop. E-commerce is mainly useful for shopping or for comfortably to the customers. Those are just entered into this website and bought they want at any time they can visit the web-site. Customer will choose different items like mobile, furniture, etc. This website is based on this formal. Customer will get their items just sitting at home. If shops are providing an online portal where their customers can enjoy easy shopping from anywhere, the shops won't be losing any more customers. Since the application is available in the Smartphone it is easily accessible and always available. From this project, admin can handle the details of customer, stock, sales, shop billing and login details.

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STUDENT GRADING SYSTEM

Abarna.D
Student,
Department of Computer Application,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Bala.V
Student,
Department of Computer Application,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Dharshini.V
Student,
Department of Computer Application,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Sandhiya.T
Student,
Department of Computer Application,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

The Student Grading System is a web-based application designed to automate the evaluation of students' academic performance by calculating total marks, average, and grades based on the marks obtained in different subjects. This system is particularly useful in educational institutions to simplify and standardize the grading process. Traditionally, the grading of students is done manually, which can be time- consuming and prone to human error. This project provides a digital solution that ensures accuracy, saves time, and offers immediate feedback. The system collects input in the form of marks for each subject using a web form built with HTML.

The core processing is handled by PHP, a server-side scripting language that reads the submitted data, calculates the total and average, and assigns grades according to predefined conditions. Additionally, the system improves transparency by maintaining consistent records and reducing calculation errors. It can be extended with database support (like MySQL) to store student information securely and can include login-basedaccess for teachers and administrators. The system also has the potential to generate printable report cards and visual analytics to help track student progress over time.

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PREDICTION AND FURTHER RESEARCH USING MACHINE LEARNING TECHNIQUES FOR STROKE DISEASE

Dr.S.Sasikala
Assistant Professor,
Deparment of Computer Science,
Agurchand Mamull Jain College,
Chennai, Tamil Nadu, India.

Ms.Khriuthiga
Student,
Deparment of Computer Science,
Agurchand Mamull Jain College,
Chennai, Tamil Nadu, India.

Abstract

The nerve cells that are found inside the human body are permanently damaged by a neuron-degenerative illness. Parkinson's and Alzheimer's, on nerve cells. In Parkinson's disease, the loss of dopamine neurons in the brain leads to disruptions in smooth coordination and communication with other nerve cells, resulting in characteristic motor symptoms such as tremors, stiffness, and impaired balance. This loss of coordination underscores the importance of dopamine in regulating movement and highlights one of the key pathological features of Parkinson's disease. Dopamine neuron deficit has an impact on both motor and non-motor symptoms. Physicians and other healthcare professionals still manually check patients' symptoms to diagnose Parkinson's disease. Numerous methods have been presented by researchers to identify Parkinson's disease. These methods make use of a variety of modalities, including voice signals, handwriting traces, PET and SPECT scans, MRIs, and finger tapping tests.

These methods are discussed in this publication along with the difficulties that researchers are currently facing in diagnosing Parkinson's disease. Although a cure for Parkinson's disease is still a long way off, advances in recent years have substantially increased our knowledge of the illness's processes as well as its paraclinical and re-motor early signs. Although a proven disease-modifying medication has not yet been found, afflicted patients now have better options for symptomatic care. This includes invasive methods like continuous device-aided medication delivery and deep brain stimulation for patients with motor difficulties. The various aspects of non-motor issues that patients encounter have now been thoroughly identified and are the focus of non-pharmacological methods as well as therapy trials.

Keywords: Parkinson Disease (PD), Detection, PET image, SPECT scan, MRI.

Introduction

A neuron-degenerative illness destroys the nerve cells that make up the human body permanently. Alzheimer's and Parkinson's disease are the most prevalent neuron-degenerative illnesses. Parkinson is the brain disease that causes dopamine-producing dopamine neurons to die. In order to create seamless coordination, these neurons are in charge of corresponding with other nerve cells.

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Both motor and non-motor symptoms are impacted by dopamine neuron deficit. Parkinson's disease is still identified by physicians and other healthcare professionals manually examining patients' symptoms. Numerous methods for identifying Parkinson's disease have been developed by researchers. A variety of modalities, including speech signals, handwriting traces Fig.1. , PET and SPECT scans, MRIs, and finger tapping tests, are used in these procedures. These methods, together with the current difficulties faced by researchers in the identification of Parkinson's disease, are presented in this publication.

Fig 1: Symptoms of Parkinson

Proposed Methodology

The suggested approach gathers audio data regarding the vocal modulations of Parkinson's patients from a variety of age groups Fig.4. The data collection includes information on vowel patination MDVP, shimmer, and jitters. Prepossessed, processed, and displayed data allows for a comprehensive comprehension of the properties. 75 percent of the data is used to train four models: K nearest neighbors, Random Forest Regression, SVM, and Logistic Regression. Based on changes in frequency, models are trained to categorize audio data into two groups: PD and healthy. Models are assessed using 25% of the data and are graded according to their sensitivity, accuracy, precision, and confusion matrix score for men and women.

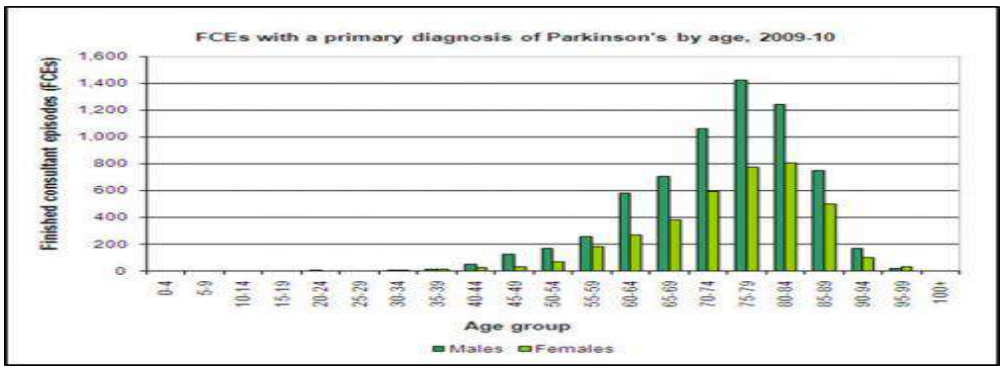

Fig 2: Parkinson's Patients from a Variety of Age Group

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Challenges to Study Design in PD Cognitive Impairment

Clinical trials involving people with Parkinson's disease (PD) and cognitive impairment present many difficulties. First, there is a deficiency of a solid understanding of pathophysiologic pathways to direct the development of interventions. Additionally, it's probable that multiple treatment modalities will be required for effective therapy, such as pharmacologic cognitive therapies in addition to exercise. Present research occasionally mixes populations (e.g., PD-MCI with PD with normal cognition) from the standpoint of study design.

Clinical Treatment Approaches for PD-MCI

An update from the 2019 Movement Disorders Society regarding evidence-based care for Parkinson's disease non-motor symptoms stated that for non-dementia cognitive impairment in PD, there is currently inadequate evidence to support any pharmacologic (rivastigmine, rasagiline) or non-pharmacologic (transcranial direct-current stimulation, cognitive rehabilitation) treatment. Every method under review had the term "investigation" on it [47]. Nonetheless, studies indicate that in PD patients without dementia, physical activity and treatment may be helpful in achieving desired cognitive goals [32]. Global cognition was enhanced by intense physical treatment, but executive function was not improved by aerobic exercise (such as riding a recumbent bicycle or treadmill). To target PD-MCI, more study is required to determine both pharmacologic and non-pharmacologic techniques, as well as combination approaches Fig.3. Meanwhile, especially in light of the growing body of evidence demonstrating the advantages of exercise for Parkinson's disease.

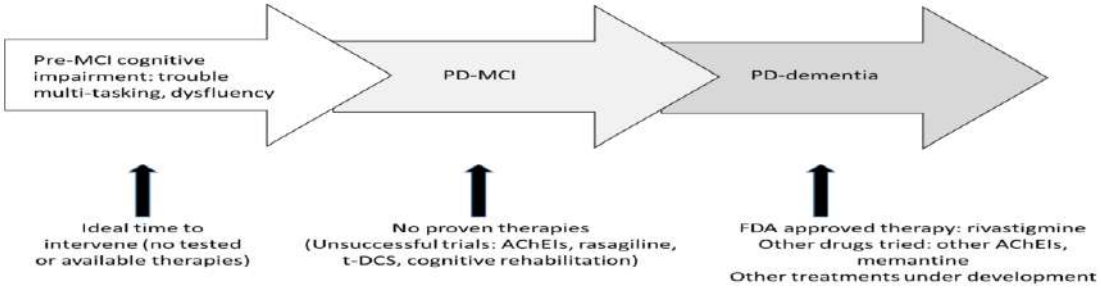

Fig 3: Clinical Approach Parkinson

Discussion and Future Work

The purpose of this study work is to determine the most important characteristics for the classification of Parkinson's disease (PD) and the effects of imbalances in medical data. Three methods will be used for PD classification, each based on training on PCA-identified features that are acquired following data set balance, while keeping these needs in mind. The following is a description of each approach's algorithm:

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Algorithm for Approach

Using Principal Component Analysis (PCA), five essential features are determined.The process involves gathering MDVP audio data from PPPMI and UCI databases, analyzing the data to find skew, imbalance, and variable distribution, scaling the data to a common range using standard scale, identifying variance in each data column, and applying Principal Component Analysis, which includes SVM, logistic regression, random forest, and KNN models. The classification results are then compared using confusion matrix, curve, and accuracy.

Conclusion

It is clear from the literature study that a trustworthy PD detection method is required. For the diagnosis, medical professionals continue to rely on the existence of features. Though they cannot be utilized for the sole purpose of detecting Parkinson's disease (PD), researchers have developed numerous frameworks for its detection using a variety of modalities, including voice signals, SPECT scans, PET images, MRIs, handwritten drawings, and FTT. Every method has its bounds. Imaging tests such as SPECT and PET are intrusive and harmful to people. Voice signals are not very trustworthy, and FTT and scribbled drawings are limited to inspecting deficits of the upper limbs. These days, PD detection is accomplished by researchers using MRI sequences.

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IMPLEMENTATION OF STROKE DISEASE USING MACHINE LEARNING

Dr.R.Bhuvana
Assistant Professor,
Department of Computer Science,
Agurchand Mamull Jain College
Chennai, Tamil Nadu, India.

Ms.M.Sunumani
Student,
Department of Computer Science,
Agurchand Mamull Jain College,
Chennai, Tamil Nadu, India.

Abstract

A common neuro degenerative disease with important clinical ramifications is Parkinson's disease (PD). Timely intervention and individualized treatment of Parkinson's disease (PD) depend on an early and correct diagnosis. Deep learning (DL) and machine learning (ML) approaches have become promising tools for bettering Parkinson's disease (PD) diagnosis in recent years. The voice, handwriting, and wave spiral datasets are the main topics of this review paper's thorough examination of the state of ML and DL-based PD diagnosis at the moment. Additionally, the paper assesses the performance of different machine learning and deep learning algorithms, such as classifiers, on these datasets and emphasizes how they might improve diagnostic precision and support clinical decision-making. Furthermore, the study investigates the identification of biomarkers through these methods, providing valuable perspectives for enhancing the diagnostic procedure. The conversation covers a variety of data forms.

Keywords: Parkinson's disease (PD), Deep learning (DL), Machine learning (ML), Disease prediction, Diagnosis.

Introduction

The substantial progress gradually loses neurons in Parkinson's disease (PD), a chronic and progressive condition that affects the generation of important neurotransmitters like acetylcholine and serotonin. Because these neurotransmitters are essential for regulating movement, motor function is the main aspect of Parkinson's disease (PD). Usually, the illness progresses through five phases. Stage 1 sees the emergence of moderate symptoms including tremors and slight mobility problems, but they do not substantially impair day-to-day functioning. Stage 2 is characterized by increasing tremors and rigidity, which makes doing daily duties more difficult. In stage 3, people's dexterity and balance are impaired, which increases the likelihood of accidents, although they can usually adjust to these challenges. Stage 4 symptoms are severe and incapacitating, necessitating help with everyday tasks.

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Methodology

Machine Learning (ML) and Deep Learning (DL)

The goal of the sub fields of machine learning (ML), deep learning (DL), and artificial intelligence (AI) is to create models and algorithms that can learn from data and make defensible decisions or predictions. Supervised learning, unsupervised learning, and reinforcement learning are the three primary categories into which machine learning algorithms can be divided. In order to enable an algorithm to generate precise predictions for novel, unknown inputs, supervised learning entails training the algorithm on a labeled data set containing predetermined correct responses for each input. While reinforcement learning involves learning from interactions with an environment to maximize a reward signal, unsupervised learning concentrates on finding patterns or structures in unlabeled data.

Building artificial neural networks (ANNs) that mimic the composition and operation the diagnosis of Parkinson's disease (PD), a common neuro-degenerative disease affecting both motor and non-motor functions, is the main focus of this study. It tackles the subjectivity of conventional diagnostic techniques and the early detection of non-motor symptoms, which are two major obstacles in the diagnosis of Parkinson's disease. The study investigates the use of ML algorithms for categorizing patients with Parkinson's disease (PD) and healthy controls or patients with comparable clinical presentations in order to address these issues. The literature on ML and DL algorithms for PD diagnosis and differential diagnosis is thoroughly reviewed in this article.

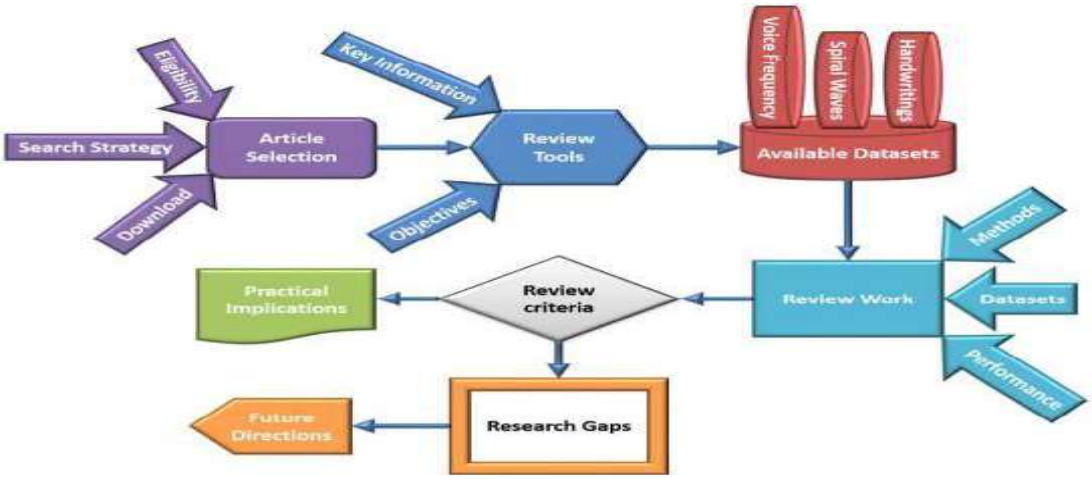

Fig 1: The Primary Symptoms of Parkinson's Disease

Gathering Key Information for Review

1. Objectives
2. Dataset
3. Methodology
4. Performance
5. Number of Subjects

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6. Feature Extraction Method
7. Classifiers
8. Year

Reference are some of the Important Details that were taken from the Papers

The study was first published online in the year of publication, after which it was archived in a later year. Studies that were preserved in a later year are covered by this criteria. The year the article was copyrighted was regarded as the publishing year in the case that this information was not easily accessible. Information relevant to the newly produced models was extracted from the research that created new models and only used previously existing models for comparison.

Objectives of the study

The included studies have been grouped according to the general objectives and specific type of diagnosis. We are able to distinguish between the various objectives and goals that these studies are pursuing thanks to this classification. The two main components of the diagnostic aspects examined in this study are as follows. Assessment or Diagnosis of PD: Data from people with Parkinson's disease (PD) and data from control participants are compared in this study. Accurately diagnosing and evaluating PD is the goal.

Diagnostic Testing

This area includes research on creating and assessing PD diagnostic tests. The purpose of these tests is to offer a dependable and efficient method of diagnosing the illness. This division helps clarify the multifaceted nature of research objectives within the realm of PD diagnosis.

Evaluation of the Model

Table 2 provides a thorough list of performance indicators used to assess the ML models covered in the study. Although experts in the area may already be familiar with these indicators, they are a useful tool for quickly evaluating how effectively different models identify Parkinson's disease. ML and DL models are assessed using the following performance metrics: (a) Accuracy, (b) Precision, (c) F1-Score, and (d) Recall.

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Table 1: Performance Metrics for Evaluating the Model

Performance Metrics	Definition	Number of Studies Conducted
Accuracy	TP+TNTP+TN+FP+FN	174
Precision	TPTP+FP	31
F1-score	2×precision×recallprecision+recall	25
Recall	TNTN+FN	110

Data Collection Process

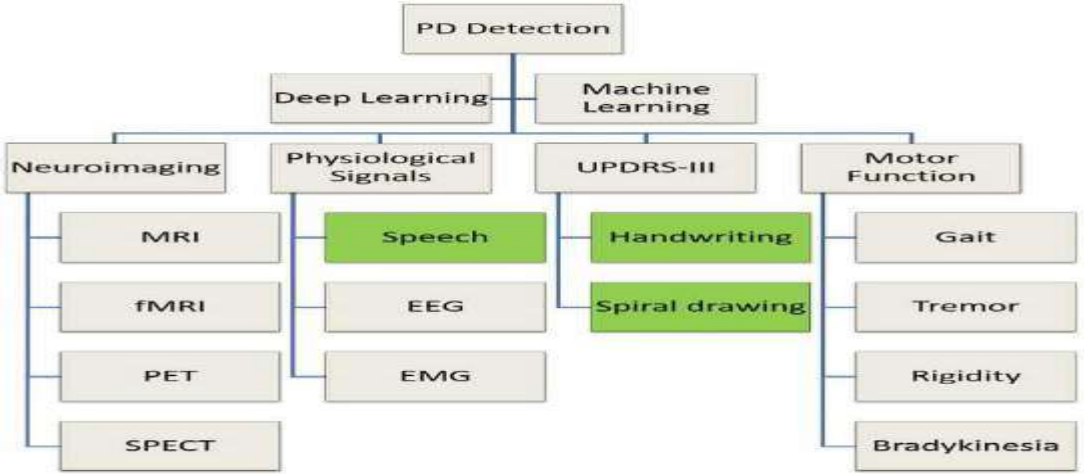

Fig.2: PD Detection

Furthermore, in their investigation, [30] made use of data from the UCI machine learning collection. There are 24 attributes and 195 instances in this data collection. To increase the efficacy of the dataset and make early disease identification easier, machine learning methods were used. The goal of the trials was to compare several methods and determine which was the most accurate. They discovered that KNN and ANN performed more accurately than the other techniques. Moreover, merging these two classifiers shortened the time needed to create the model while simultaneously improving accuracy. Notably, the remarkable accuracy of 91.28 percent was attained by both Ada Boost.M1 and MLP with KNN, demonstrating their promise for PD diagnosis.

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Same Data Set Different Methods

The UCI speech data set has been widely used by researchers as a standard option for putting their algorithms into practice and identifying PD. Many ML and DL pipelines have been presented throughout the years, frequently combining multiple algorithms and feature selection techniques. An overview of this scenario is given in Fig. 3, which also emphasizes how the SVM method for speech data PD detection has been widely used in research papers.

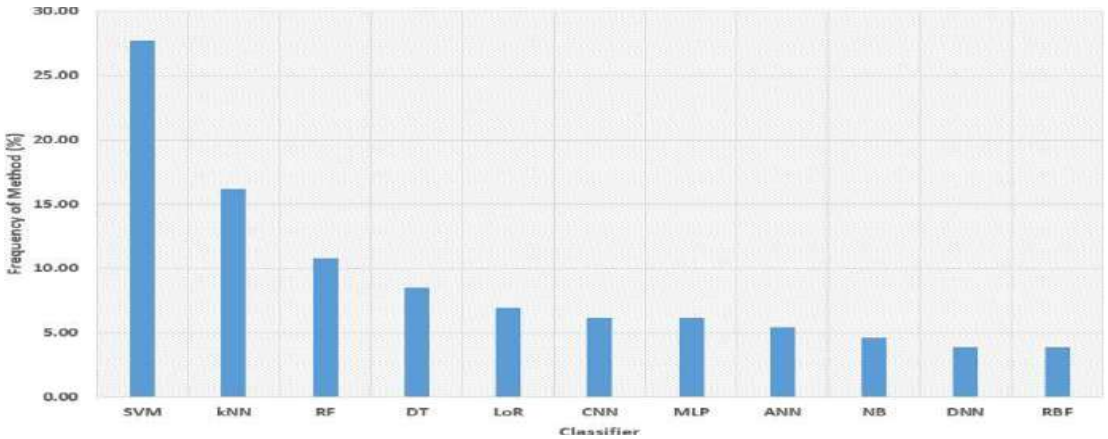

Fig 3: Overview of Algorithmic Scenario

Conclusion

The substantial potential of ML and DL techniques to advance the field of Parkinson's disease diagnosis has been highlighted by this review effort. For prompt intervention and individualized treatment, a precise and early diagnosis of Parkinson's disease (PD) is necessary. ML or DL techniques present viable paths toward achieving these goals. We have shown through a thorough investigation of wave spiral, handwriting, and voice datasets that ML and DL algorithms may considerably improve diagnostic accuracy. Numerous models and classifiers have been investigated, demonstrating their ability to discriminate. A variety of data types and frequently used ML or DL techniques in the context of Parkinson's disease diagnosis have been covered in our review.

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SECURE MULTIPARTY COMPUTING PROBLEM USING ECCMA ALGORITHM

Dr.K.Ravikumar
Associate Professor,
Department of Computer Science,
Tamil University,
Thanjavur, Tamil Nadu, India.

Abstract

Secure multiparty computation is concerned with the possibility of deliberately malicious behavior by some adversarial entity. That is, it is assumed that the protocol execution may come under "attack" by an external entity, or even by a subset of the participating parties. The aim of this attack may be to learn private information or cause the result of the computation to be incorrect. Thus, two important requirements on any secure computation protocol are privacy and correctness. The privacy requirement states that nothing should be learned beyond what is absolutely necessary. The correctness of the requirements states that each party should receive its correct output.

Therefore the adversary must not able to cause the result of the computation to deviate from the function that the parties had set out to compute. The setting of secure multi-party computation encompasses tasks as simple as coin-tossing and broadcast, and as complex as electronic voting, electronic cash schemes, contract signing, asynchronous transactions, and private information retrieval schemes. Consider for a moment the task of voting auctions. The privacy requirement for an election protocol ensures that no parties learn anything about the individual votes of other parties, and the correctness requirement ensures that the highest bidder is indeed the party to win.

Keywords: Multiparty, Cryptography, Digital Signature, Security.

1. Introduction

Due to its generality, the setting of secure multi-party computation can model almost every, if not every, cryptographic problem. Therefore questions of feasibility and infeasibility for secure multi-party computation are fundamental to the theory and practice of computation. The model that is considered is the one where an adversarial entity controls some subset of the parties and wishes to attack the protocol execution. The parties under the control of the adversary are called corrupted and follow the adversary's instruction. Secure protocols should withstand any adversarial attack. In order to formally claim and prove that a protocol is secure, a precise definition of security for multi-party computation is required. A number of different definitions have been proposed and these definitions aim to ensure a number of important security properties that are general enough to capture most multi-party computations tasks.

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Distributed computing considers the scenario where a number of distinct, yet connected, computing device or parties with to carry out a joint computation of some function. For eg, these devices may be serves who hold a distributed database system, and the function to be computed may be database update of some kind. The aim of secure multi-party computation is to enable parties to carryout search distributed computing tasks in a secure manner. Whereas distributed computing classically deals with questions of computing under the threat of machine crashes, and other in advertent faults.

2. Multiparty System

Secure multi-party computation also known as secure computation or Multi-Party Computation [MPC] is a sub field of cryptography. The goal of methods for secure multi-party computation is to enable parties to jointly compute a function over their inputs, while at the same time keeping these inputs private. For example, two millionaires can compute which one is richer, but without revealing their net worth. This research work depicts the importance of multiparty authentication system in networks to secure online transactions related to applications such as banking services, so as to enable digital signature using elliptic curve cryptography algorithm to maintain and enrich security for any clients.

It further achieves the context that security by adopting elliptic curve cryptographic algorithm is efficient when compared to other cryptography algorithms with relate to key space, time efficiency, key generation timing, memory overheads in specific and also to other security parameters. This scheme is particularly efficient and suitable for applications where users require transmitting stream of data of undefined length through noisy channels. Our scheme is in fact, robust against loss of packets during the transmission. We present the scheme called multiparty digital signature authentication and then we prove that the scheme is conditionally secure. We then describe two variations of, one interactive to use when multicast is available and a timed version suitable for broadcast communications.

3. Multi-Party Electronic Payment System using Eccma Algorithm

Elliptic Curve Cryptography has emerged as a viable and popular alternative to building public key cryptosystems, primarily because they give rise to algebraic structures that offer a number of advantages over other algebraic structures, smaller key sizes and higher strength-per-bit being some of them. These characteristics make ECC particularly amenable to hardware implementations.

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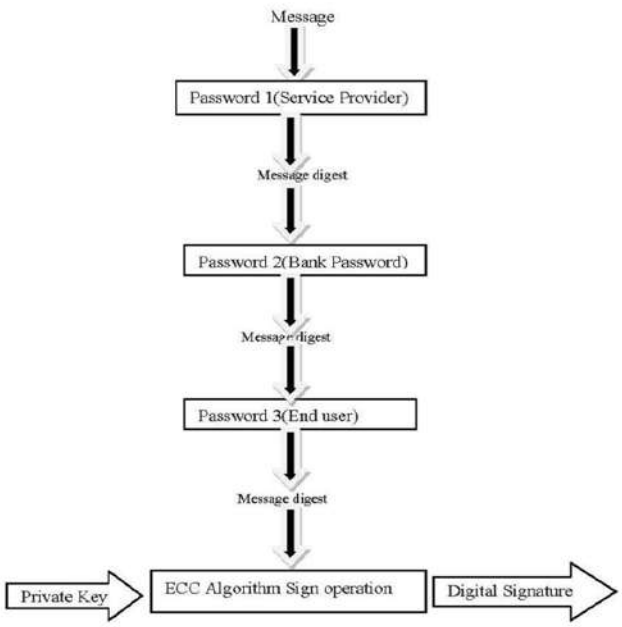
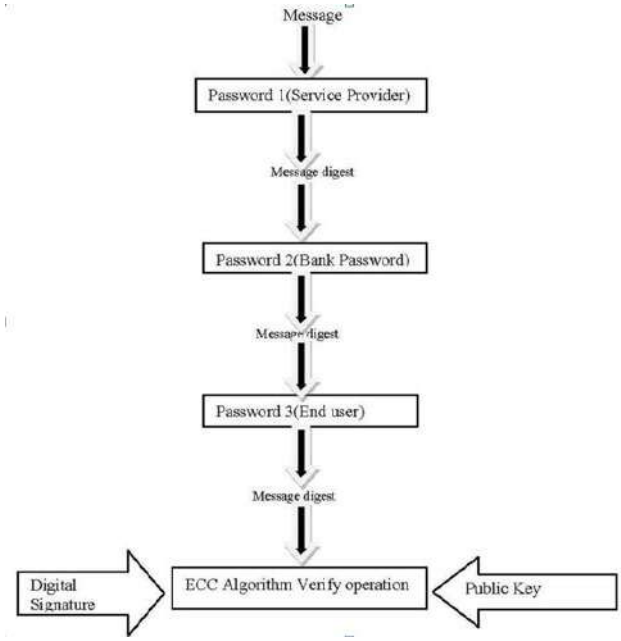
Table 3.1: Multiparty Electronic Payment Signature Encryption and Decryption Scheme

Multiparty Electronic Payments Signature Generation Schematic	Multiparty Electronic Payments Signature Verification Schematic
	

An efficient implementation of Multi-party electronic payments based on elliptic curves and a comparative study of the Elliptic curve with reference to other cryptographic algorithms. This research work is proposed to be an implementation of multiparty electronic payments using ECCMA algorithm. The proposed scheme has an added advantage of lower computational and communication cost. Moreover this system provides more security and integrity. It not only provides security, but also has less key storage and execution speed. In the proposed scheme, the multi-party transactions require more keys when compared to other schemes. This scheme can be implemented in low power devices such as smart cards and mobile phones very efficiently because of low computation and communication cost. At the same time, it helps to maintain multiple secrets.

4. Conclusion

A Multiparty collection is often referred to as an internet, and the term internet security is used. There are no clear boundaries between these two forms of security. For example, one of the most publicized types of attack on information systems is the computer virus. A virus may introduce into a system physically when it arrives on a diskette or optical disk and is subsequently loaded on to a computer.

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Viruses may also arrive on over the internet. In either case, once a virus is resident on a computer system, internal computer security tools are needed to detect and recover multiparty security from the virus.

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EFFICIENT BRAIN TUMOR DETECTION AND CLASSIFICATION USING SELF-ORGANIZING SEGMENTATION AND 3D FEATURE EXTRACTION

Dr.E.Synthiya Judith Gnanaselvi
Assistant Professor,
Department of Computer Applications,
V.V.Vanniaperumal College for Women,
Virudhunagar, Tamil Nadu, India.

Abstract

Medical image processing is an important tool in healthcare.It helps doctors in diagnosis and surgical planning. Among its tasks, image segmentation is the most crucial step. Brain tumor detection highly depends on accurate segmentation.Traditional segmentation methods take long time. They also need many iterations and give less accuracy.2D images cannot provide the real view of the brain. This sometimes leads to wrong tumor localization. To solve these issues, new methods are proposed. The first method is Self-Organization Based Segmentation (SOBS). Images are preprocessed using a Gaussian filter.Segmentation is done with Self-Organizing Maps (SOM) and Chan-Vese algorithm. Morphological operations refine the tumor area.This increases accuracy and reduces error.The second method is SOBS with 3D Reconstructed Feature Extraction (SOBS-3DRFE).MRI brain images are preprocessed and segmented with SOBS. A 3D reconstruction of the brain is generated.3D texture features like energy, contrast, and entropy are extracted using GLCM. Finally, tumors are classified into normal, glioma, and meningioma using Random Forest. These methods provide higher accuracy and lower error rate. They are effective for brain tumor detection and classification.

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RECENT TRENDS IN E-COMMERCE BUSINESS

Dr.R.Bhuvana
Assistant Professor,
Department of Computer Science,
Agurchand Mamull Jain College
Chennai, Tamil Nadu, India.

Mr.B.Mahesh
Student,
Department of Computer Science,
Agurchand Mamull Jain College,
Chennai, Tamil Nadu, India.

Abstract

The total capital in cryptocurrency markets is around two trillion dollars in 2022, which is almost the same as Apple's market capitalization at the same time. Increasingly, cryptocurrencies have become established in financial markets with an enormous number of transactions and trades happening every day. Similar to other financial systems, price prediction is one of the main challenges in cryptocurrency trading. Therefore, the application of artificial intelligence, as one of the tools of prediction, has emerged as a recently popular subject of investigation in the cryptocurrency domain. Since machine learning models, as opposed to traditional financial models, demonstrate satisfactory performance in quantitative finance, they seem ideal for coping with the price prediction problem in the complex and volatile cryptocurrency market.

There have been several studies that have focused on applying machine learning for price and movement prediction and portfolio management in cryptocurrency markets, though these methods and models are in their early stages. This survey paper aims to review the current research trends in applications of supervised and reinforcement learning models in cryptocurrency price prediction. This study also highlights potential research gaps and possible areas for improvement. In addition, it emphasises potential challenges and research directions that will be of interest in the artificial intelligence and machine learning communities focusing on cryptocurrencies.

Keywords: Cryptocurrency Markets, Artificial Intelligence, Price Prediction, FinTech, Reinforcement Learning.

1. Introduction

Cryptocurrency markets have experienced a remarkable transformation recently, both in statistical terms and public acknowledgement. The total market capitalisation of cryptocurrencies rose from 267.8 billion to 1.664 trillion between November 2017 and March 2022 (based on data on www.tradingview.com, accessed on 1 November 2022). Excluding Bitcoin as the most recognised cryptocurrency with the highest market capital, the capitalisation of "alternate coins", or altcoins, grew from 86.31 billion to 1.007 trillion in the same period. Moreover, there is an increasing trend among international companies that have invested in cryptocurrency-based business solutions.

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For example, the possibility of purchasing Tesla merchandise using Dogecoin is a revealing example of the phenomenon in the cryptocurrency world. Thus, cryptocurrency markets have become more popular, established, and their integration with other financial assets appears inevitable. Cryptocurrency markets have been a prominent subject for investors. Many small investors have made a small fortune by speculating on cryptocurrencies. They follow trending news on social media or waves of excitement in cryptocurrencies. On the other hand, there is also a risk, and investors are prone to losing money because of the volatile nature of cryptocurrency markets. For example, based on the analysis of data on (www.coinmarketcap.com, accessed on 1 November 2022), the Bitcoin market capitalisation dropped from 1.18 trillion to 935 billion USD in only ten days in April 2021, and it almost halved to 602 billion USD in the following three months up to July 2021 (www.coinmarketcap.com).

Thus, this provided a trading system to predict market directions, and eventually mitigating investment risks is an open problem in cryptocurrency markets. To this end, there is an increasing number of promising methods to deal with cryptocurrency analysis and predict inherent trends. However, high volatility and the fact that cryptocurrencies do not behave like fiat currencies make them uncertain for investors and require them to have their own specific trading strategies. The uncertainty in predictability suggests that several price formation elements of cryptocurrencies still have not been thoroughly examined. Hence, these challenges have led to the necessity of further investigation to gain a better understanding of cryptocurrency markets.

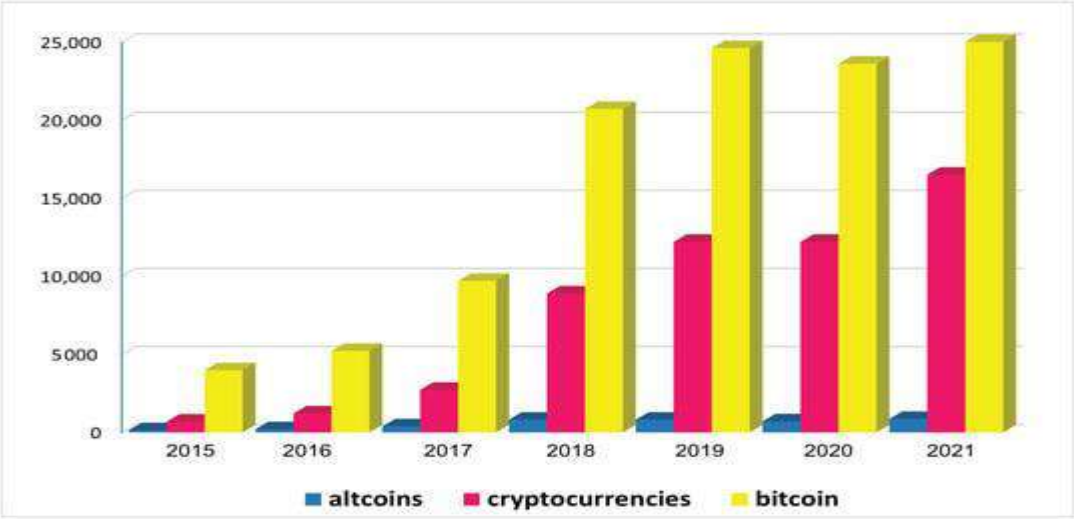

Fig 1: Publications associated with Cryptocurrencies between 2015 - 2021

Alternatively, another possible categorisation of literature in the realm of cryptocurrency trading is about trading software systems, systematic trading, emergent trading technologies, crypto-asset portfolio research, market condition, and so forth. In this paper, we mainly focus on the third category (emergent trading technologies), including econometric methods, machine learning technology, etc.

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As evidence of growing literature on the application of AI models in predicting cryptocurrency prices, several surveys and reviews of recent publications on this topic have been published recently. For example, Mosavi et al. Review deep learning methods in various finance and economic sectors such as insurance, auction mechanisms, and banking. Additionally, Sabry et al. Present a survey on current challenges and opportunities of AI applications in several cryptocurrency domains, such as volatility prediction, cryptocurrency mining, and fraud detection. Murat Ozbayoglu et al. Provide a state-of-the-art snapshot of deep learning models for a range of financial applications, including algorithmic trading, risk management, fraud detection, and behavioural finance. The primary purpose of this paper is to review recent studies on AI applications in cryptocurrencies as well. However, unlike other studies, it only focuses on cryptocurrency price prediction by machine learning (ML) models and provides an in-depth review of the challenge of predicting the price of cryptocurrencies. Furthermore, this work investigates the financial aspects underlying the price prediction presented in recent studies, which are examples of studies conducted for the first time on this topic.

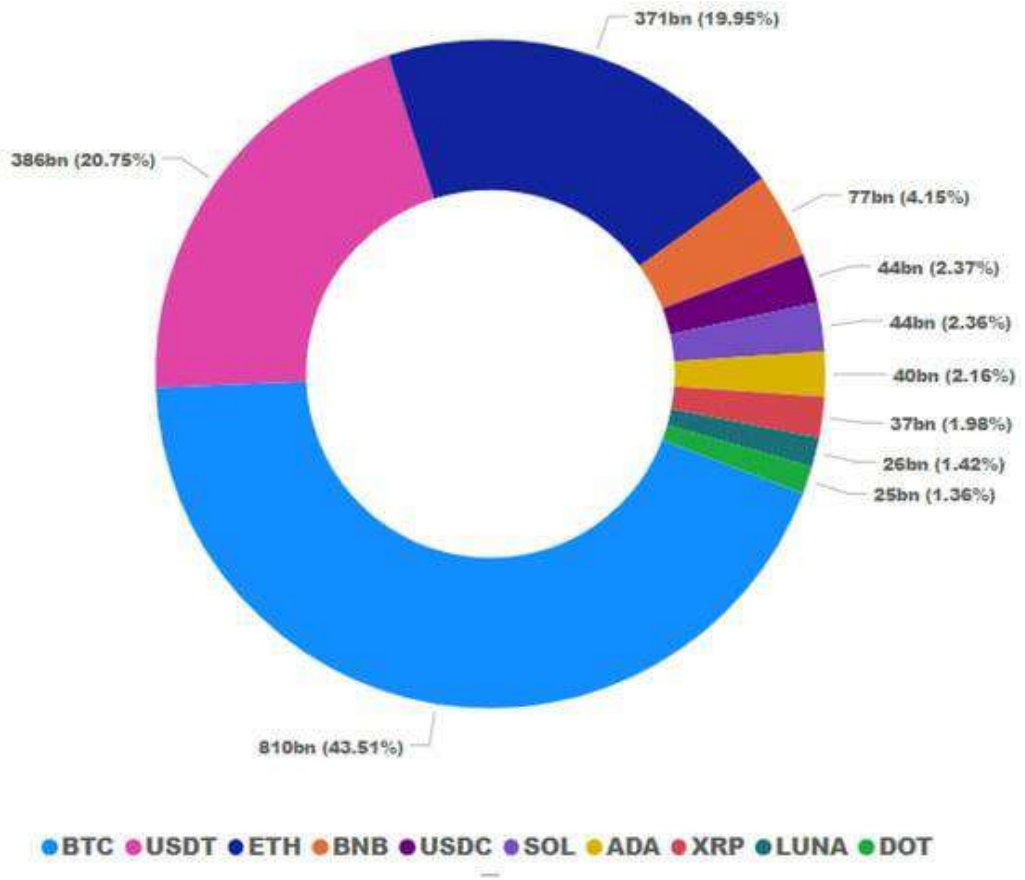

Fig 2: The Market Capitalisation of Different Cryptocurrencies

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At a technical level, altcoins use almost the same or similar blockchain technology used by Bitcoin. Nevertheless, altcoins fundamentally seek to introduce some new alternative features compared to Bitcoin to increase their market share. For instance, Ethereum incorporates almost all of Bitcoin's attributes with additional features such as a fee limit or a digital platform to run smart contracts (SC). Litecoin, as another example, is designed to cope with the computational requirements for mining cryptocurrency coins. Furthermore, the aim of creating Dash coin is to have a faster transactions process and extend privacy protection. Aside from the technical differences, cryptocurrencies can generally be categorised as follows.

Mining-based altcoins: they have similar characteristics to Bitcoin, and as the name implies, they use the typical mining process for generating new coins. One of the most famous leading altcoins belonging to this category is Ethereum. RL follows a different paradigm in terms of learning in comparison to supervised and unsupervised learning in ML. Basically, it is a principled mathematical framework of experience-driven autonomous learning.

RL cannot be classified as a supervised learning approach since labeled data are not provided to an agent. Furthermore, RL methods are suitable for problems that have sequential dynamics and involve optimisation of a scalar performance objective, while supervised learning methods are usually applied to problems that involve static input-output mappings and minimise a mismatch between the data and the model. On the other hand, it is not also an unsupervised learning approach, since the agent is provided with information about a rewarding scheme that guides the algorithm through each state-action-state iteration.

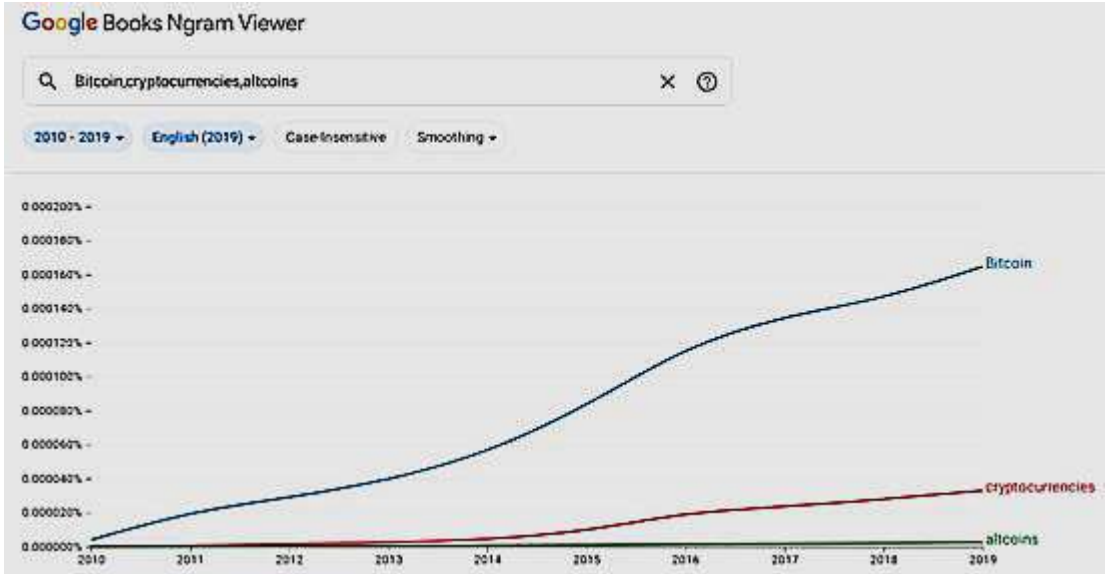

Fig 3: Altcoin and Bitcoin Ngram Comparison

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5. Conclusions

This paper first uses a cross-disciplinary approach to discuss the price determinants of cryptocurrencies from a financial and economic perspective. Then, recent studies on the use of various AI models in cryptocurrency price prediction are reviewed through a comparative survey. Recent studies on the use of various AI models in cryptocurrency price prediction are reviewed through a comparative survey. As a relatively new field in finance and economics, many open issues still warrant further investigation in the area of cryptocurrencies, and in particular the use of advanced AI methods to achieve accurate prediction of their prices.

More specifically, further attention is needed concerning integrating cryptocurrencies with traditional markets and analysing two-way influence in terms of correlational and causal relationships. Meanwhile, AI is capable of addressing these open problems, and future work in this field has to consider different components and tools to cope with the data engineering aspects of a prediction tool for cryptocurrencies. It is expected that this survey serves as a guideline for researchers to comprehend the current state of the literature, and we discuss open challenges that may be considered as part of future research. The potential of AI in the cryptocurrency domain is evident, and research in this direction can lead to great benefits for cryptocurrency market participants and policy- and decision-makers.

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ETHICAL IOT FRAMEWORKS FOR PUBLIC SAFETY IN SMART CITIES: A REVIEW

Vidhya.G
Research Scholar,
Department of Computer Science and Engineering,
Annamalai University,
Cuddalore, Tamil Nadu, India.

Vijay Bhanu.S
Associate Professor,
Department of Computer Science and Engineering,
Annamalai University,
Cuddalore, Tamil Nadu, India.

Abstract

The integration of Internet of Things (IoT) technologies into urban infrastructures is transforming public safety in smart cities. This paper presents a comprehensive literature review of IoT applications in emergency response, crime detection, and disaster management, alongside a critical ethical analysis. Key challenges include privacy violations, surveillance overreach, and algorithmic bias. The findings underscore the dual impact of IoT systems enhancing safety outcomes while raising concerns around governance, equity, and civil liberties.

Keywords: Internet of Things (IoT), smart cities, public safety, surveillance, ethics, emergency response, predictive analytics.

I. Introduction

Smart cities leverage technology-driven systems to enhance urban efficiency and quality of life. Among these, public safety remains a central priority. IoT technologies enable real-time data acquisition, predictive analytics, and automated decision support for incident management. While these innovations offer transformative potential, they also introduce ethical dilemmas concerning privacy, data governance, and algorithmic fairness.

II. IoT Applications in Public Safety

A. Emergency Response Systems

IoT-enabled infrastructures facilitate seamless coordination among emergency services, healthcare providers, and transportation networks. Smart traffic lights, GPSequipped ambulances, and environmental sensors collectively reduce response delays. For example, Amsterdam's dynamic traffic system has achieved a 30% reduction in ambulance response times. These systems rely on sensor data processed via cloud-based AI routing algorithms to optimize operations.

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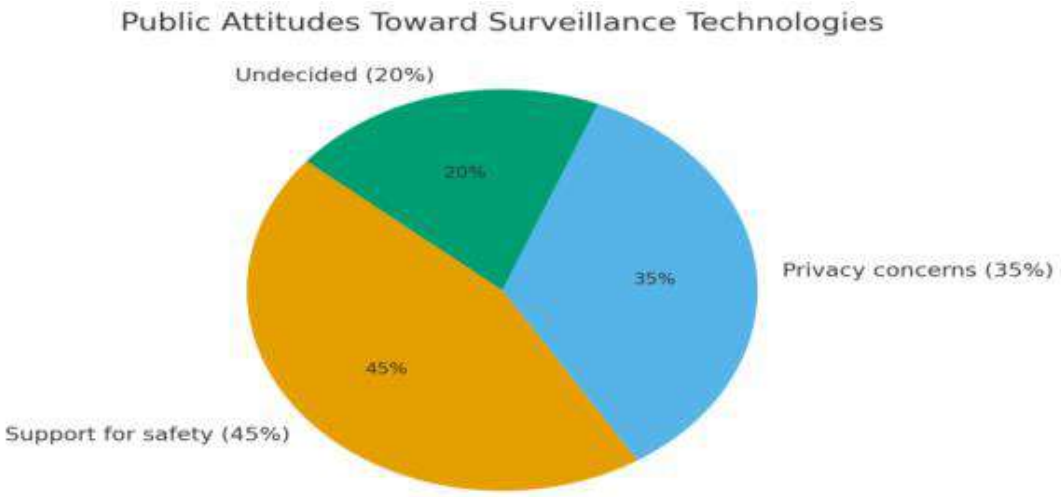

Fig 1: Public Attitudes toward Surveill

B. Crime Detection and Prevention

IoT supports proactive policing through smart surveillance, biometric access control, and predictive analytics. Technologies such as "ShotSpotter" in Chicago use acoustic sensors to detect gunfire and dispatch police units rapidly. Surveillance feeds and sensor data are analyzed via centralized dashboards for anomaly detection, enhancing situational awareness and contributing to crime reduction C.

Disaster Management and Hazard Monitoring

IoT devices are pivotal in disaster preparedness, including earthquake detection, flood monitoring, and air quality surveillance. Tokyo's seismic networks trigger automatic alerts and infrastructure shutdowns within milliseconds of tremor detection. Distributed sensor networks, combined with edge computing, enable rapid local decision-making.

III. Benefits vs. Challenges of IoT in Public Safety

A. Benefits

- Real-time decision making through instantaneous data capture and processing.
- Predictive analytics to forecast urban risks such as crime, traffic accidents, and hazards.
- Resource optimization by ensuring efficient allocation of emergency services.
- Citizen engagement through mobile apps and wearable IoT devices that provide alerts and feedback mechanisms.

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B. Challenges

- **Privacy and Surveillance:** Continuous monitoring can infringe on personal freedoms; London's facial recognition trials faced significant criticism.
- **Infrastructure Limitations:** Developing regions often lack the robust IoT infrastructure needed for reliable deployment.
- **Algorithmic Bias:** Predictive policing models may disproportionately affect marginalized groups.
- **Interoperability:** Heterogeneous vendor systems can hinder multi-agency collaboration during crises.

A comparative Summary of Benefits and Challenges is Presented in Table I

Benefits Challenges

- Faster emergency response Privacy and surveillance concerns.
- Predictive crime prevention Data ownership ambiguity.
- Real-time hazard alerts Infrastructure limitations
- Improved resource allocation Algorithmic bias, interoperability issues.

IV. Ethical Considerations in IoT-Driven Public Safety

A. Privacy and Surveillance

IoT surveillance raises concerns of mass monitoring without consent. Zuboff warns of "surveillance capitalism," where personal data is commodified without transparency.

B. Data Ownership and Governance

Data produced by IoT systems often lacks clear ownership and control, raising risks of misuse and commercial exploitation. Roman et al. [8] stress the importance of transparent governance frameworks.

C. Algorithmic Bias

Predictive policing tools may replicate historical biases, disproportionately impacting minority communities. Crawford [9] highlights the need for bias audits and inclusive datasets.

D. Civil Liberties and Legal Safeguards

The balance between safety and individual freedom remains a central dilemma. Lyon argues for citizen-centric policies that prioritize transparency and informed consent.

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V. Case Studies

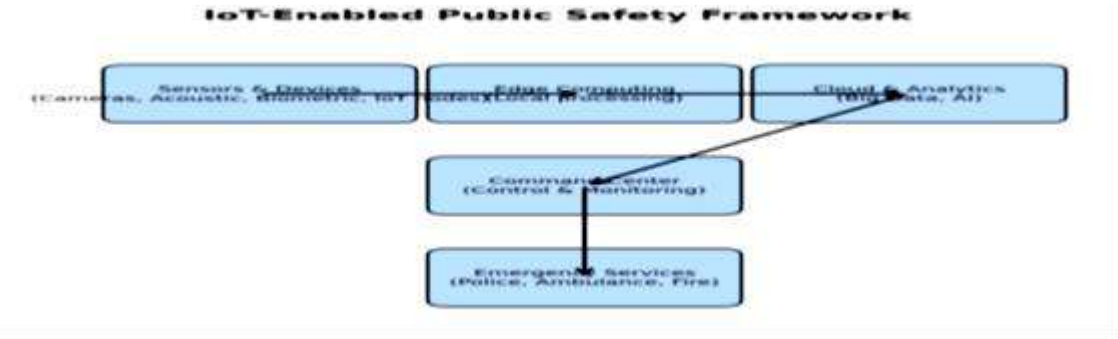
A. Barcelona: Citizen-Centric Safety

Barcelona integrates IoT in traffic routing, environmental monitoring, and citizen participation. Open Data initiatives and privacy-by-design frameworks foster public trust, achieving a 25% reduction in emergency response times.

B. Singapore: High-Tech Safety with Governance

Singapore's Smart Nation initiative incorporates predictive crime analytics, IoT flood detection, and smart surveillance. Strict regulation under the Personal Data Protection Act (PDPA) ensures accountability, with reported improvements in crime detection and citizen satisfaction.

- **Automated Immigration Clearance:** Facial and iris biometrics are used at checkpoints to verify identities, reducing wait times by up to 40% and enhancing border security.
- **Smart Parking Systems:** IoT-enabled parking lots use sensors and colored light indicators to guide drivers to available spaces, improving urban mobility and reducing traffic congestion.
- **Drones for Infrastructure Inspection:** Autonomous drones monitor hard-toreach areas like bridges and rooftops, ensuring safety and reducing manual labor risks.
- **Open Digital Platform in Punggol:** This integrated system enables real-time monitoring and resource optimization across urban infrastructure, supporting responsive governance and efficient service delivery.
- **Smart Water Meters:** IoT-based meters help households and businesses track water usage, promoting conservation and allowing authorities to manage demand more effectively.



VI. Future Trends and Recommendations

Emerging directions include AI-driven decision-making, expansion of 5G-enabled IoT ecosystems, and privacy-by-design architectures. Strong regulatory oversight and community engagement are essential for sustainable adoption.

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VII. Conclusion

IoT technologies significantly enhance public safety in smart cities, but ethical risks demand careful attention. Balancing innovation with inclusivity, transparency, and accountability is vital for citizen trust. Future research should focus on scalable frameworks that protect civil liberties while enhancing resilience.

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OVERVIEW OF CLOUD COMPUTING AND CURRENT RESEARCH ISSUES

S.M.Hemalatha
Assistant Professor,
Department of Artificial Intelligence & Machine Learning,
Adhiyamaan College of Engineering,
Hosur, Tamil Nadu, India.

Abstarct

A collection of IT services that are leased to a client via a network and offer the flexibility to scale up or down their service needs is known as cloud computing. Cloud computing has the potential to remove the need for expensive computing infrastructure to be set up for IT-based solutions and services that the industry uses. Typically, cloud computing services are provided by a third-party provider that owns the infrastructure. This new computing economic model has found a home and is drawing significant international investment. It promises to offer a flexible IT architecture that can be accessed via the internet from lightweight portable devices. This would enable a multi-fold increase in the capacity and capabilities of both new and existing software. Due to the effectiveness of the pay-per-use model, which is based on resources like processing power used, transactions completed, bandwidth used, data transferred, or storage space occupied, among others, many industries, including banking, healthcare, and education, are shifting to the cloud.

In a cloud computing environment, all of the data is spread across a collection of networked resources, making it possible to access the data through virtual machines. Despite the potential benefits of cloud computing, enterprises are hesitant to embrace it because of security concerns and other difficulties. One of the main problems that prevents cloud computing from growing is security. This research paper explains what cloud computing is, the different cloud models, and an overview of the cloud computing architecture. There are several research challenges for adopting cloud computing, including privacy, interoperability, reliability, and well-managed service level agreements (SLA). This study also examines the main research issues in cloud computing and provides best practices to service providers and businesses looking to use cloud services to boost their profits in this dire economic environment.

Keywords: Cloud computing, platforms as a service (PaaS), software as a service (SaaS), Infrastructure as a service (IaaS), mobile cloud computing (MCC), and cloud architecture.

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I. Introduction

The development of numerous technologies has been fueled by the Internet. Among all of these, cloud computing is arguably the most talked about. Because it offers users and providers substantial cost savings and new business opportunities, the cloud computing paradigm has seen a massive change in favor of adoption over the past few years and has emerged as a trend in the information technology industry. Using cloud computing has several benefits, such as: i) lower hardware and maintenance costs, ii) global accessibility, and iii) flexibility and highly automated processes that eliminate the need for customers to worry about routine issues like software upgrades.

Companies like Google, IBM, Microsoft, and Amazon are embracing cloud computing, a new trend in software deployment and maintenance. A number of prototype platforms and applications, including the Elastic Computing Platform, Google App Engine, Amazon Cloud, and IBM Blue Cloud infrastructure. The next development that is thought to have an impact on organizational businesses and how they manage their IT systems is cloud computing. One important area of research is the architecture and technology provided by cloud service and deployment models. Although the term "cloud computing" has many different definitions, this new computer paradigm is characterized by a few fundamental concepts. Cloud computing offers technological capabilities that are often maintained off-site and are made available as a service over the Internet on demand.

Because public cloud services are owned and operated by a third party, users of these services pay for resources on a per-use basis rather than owning them, making resource virtualization the crucial idea. In reality, they are renting the platforms, apps, and physical infrastructure that are part of a common architecture. End-user Web-Services, Web applications, virtual infrastructure, computing platforms, centralized data centers, and a plethora of additional specialized computing services are all examples of cloud solutions. Numerous information technology disciplines, including GIS (Geographical Information Systems), Scientific Research, E-Government Systems, Decision Support Systems, ERP, Web Application Development, Mobile Technology, and others, can benefit from the use of cloud computing.

Overview of Cloud Computing and Current Research Issues

II. Cloud Computing: Overview

Cloud computing, as defined by the U.S. National Institute of Standards and Technology (NIST), is a model that allows for easy, on-demand network access to a shared pool of reconfigurable computing resources (such as networks, servers, storage, apps, and services) that can be quickly provisioned and released with little management work or interaction from cloud providers. Simply put, cloud computing is a technology and platform combination that offers online hosting and storage services. In this kind of setting, consumers do not have to own the infrastructure for different computing services.

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Indeed, they are accessible from any computer, anywhere in the globe. Compared to the previous computing approaches, this offers more flexibility by integrating elements that support high scalability and multi-tenancy. It has the capacity to dynamically deploy, allocate, or reallocate resources while also continuously monitoring their performance. Additionally, cloud computing reduces capital costs. This method is independent of the user's location and device. Providing scalable and affordable on-demand computing infrastructures with high quality of service standards is the primary objective of cloud computing. Anything that entails providing hosted services via the Internet is referred to as cloud computing. In place of a static system architecture, cloud computing facilitates dynamic scaling up and rapid scaling down, providing cloud users with high reliability, fast response times, and the adaptability to manage demand and traffic fluctuations.

Additionally, cloud computing facilitates multi-tenancy by offering systems that are set up so that numerous businesses or individuals can share them. Cloud providers can eliminate client-server computing with single-purpose computers by using virtualization technologies to turn a single server into numerous virtual machines. Customers can take advantage of economies of scale and hardware capacity is maximized. Cloud computing has many advantages. The most significant of these is that clients can use the resource and pay for it as a service, saving them time and money, rather than having to purchase it from a third-party vendor. Cloud computing is not just for multinational corporations; small and medium-sized businesses are also using it.

III. Building Blocks for Cloud Computing

A. Deployment Models

As shown in figure 1, the cloud deployment model provides networking, platform, storage, and software infrastructure as services that scale up or down based on demand. The private cloud is a novel term that some manufacturers have recently used to characterize solutions that mimic cloud computing over private networks. It is one of the four primary deployment methods of the cloud computing model. It is installed in the internal enterprise datacenter of a company. The private cloud allows cloud customers to share and utilize virtual apps and scalable resources that are given by the cloud vendor. Similar to intranet functionality, it is distinct from the public cloud in that all cloud resources and apps are independently maintained by the company. Due to its designated internal exposure, private cloud utilization can be significantly more secure than public cloud utilization. A particular private cloud may only be accessible to the company and its designated stakeholders. Eucalyptus Systems is among the best examples of a private cloud.

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Public Cloud

The term "public cloud" refers to cloud computing in the conventional mainstream sense, where resources are shared and billed on a fine-grained utility computing basis by an off-site third-party provider and are dynamically provisioned on a fine-grained, self-service basis over the Internet via web applications/web services. Like prepaid power metering systems, it is usually based on a pay-per-use basis that may be adjusted to meet surges in demand for cloud optimization. Because there is an extra burden of making sure that all apps and data accessed on the public cloud are not vulnerable to malicious attacks, public clouds are less secure than alternative cloud models. Google App Engine and Microsoft Azure are two instances of public clouds.

A private cloud that is connected to one or more external cloud services, centrally managed, provisioned as a single entity, and surrounded by a secure network is known as a hybrid cloud. It uses a combination of public and private clouds to deliver virtual IT solutions. In addition to enabling many parties to access information via the Internet, hybrid cloud computing offers more secure control over data and apps. Additionally, its architecture is open, enabling integrations with other management systems. A hybrid cloud arrangement combines cloud services with a local device, like a plug-in computer. A primarily virtualized environment that needs actual servers, routers, or other hardware, like a network appliance serving as a firewall or spam filter, is an example of a configuration that combines virtual and physical, collocated assets. Amazon Web Services (AWS) is an example of a hybrid cloud.

Community Cloud

Infrastructure shared by multiple organizations for a common purpose, which may be managed by them or a third-party service provider. This type of cloud model is rarely offered. These clouds are typically founded on a contract between associated commercial entities, such banks or educational institutions. A cloud environment that follows this concept can be located locally or remotely. Facebook is one instance of a community cloud.

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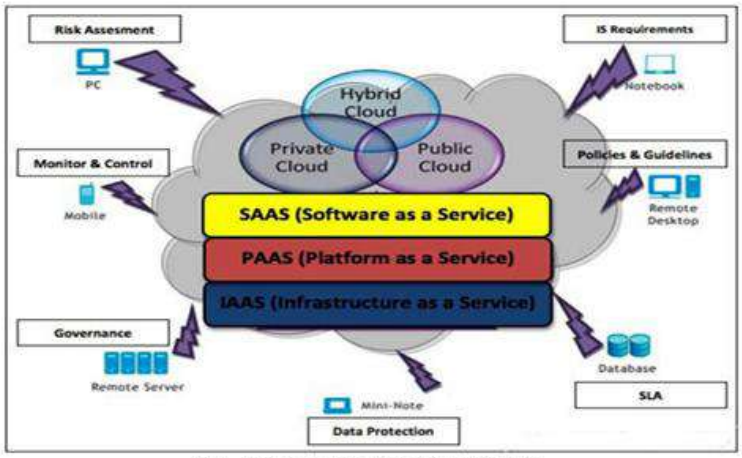

Fig. 1 Cloud Deployment Model [1]

Fig. 1 Cloud Deployment Model, In addition, as technology develops, we observe that many cloud deployment models are arising in response to user needs and requests. A comparable example is a virtual-private cloud, which connects a public cloud to the internal resources of the client's data center and is used in a private way [40]. A new cloud computing derivative has emerged as a result of the introduction of feature phones and high-end network access technologies like 2G, 3G, Wi-Fi, Wi-Max, etc. A common term for this is "Mobile Cloud Computing (MCC)." It can be described as a combination of cloud computing infrastructure and mobile technology in which data and associated processing will take place in the cloud as long as they are accessible via a mobile device, hence the term "mobile cloud computing". These days, it's growing popular, and many businesses are eager to give their staff members the ability to access the workplace network from any location using a mobile device. The market for mobile cloud computing has only grown as a result of recent technological developments, such as the introduction of HTML5 and other browser development tools. A growing trend toward the use of feature phones [16] has also accelerated the MCC market.

B. Service Models

Cloud computing can be categorized into three layers based on the various services provided: software as a service (SAAS), platform as a service (PAAS), and infrastructure as a service (IAAS) (Iyer and Henderson, 2010; Han, 2010, Mell and Grance, 2010). The lowest layer that offers fundamental infrastructure support services is called Infrastructure as a Service (IaaS). The middle layer, known as Platform as a Service (PaaS), provides platform-oriented services in addition to the environment needed to host user applications. The uppermost layer, Software as a Service (SaaS), offers a full program as a service whenever it's needed [2, 24]. The technique by which Application Service Providers (ASP) offer various software programs via the Internet is known as software-as-a-service, or SaaS.

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This eliminates the customer's need to install and run the application on their own computer, as well as the heavy burden of software maintenance, which includes ongoing operation, protection, and support. The IT infrastructure (servers, operating system software, databases, data center space, network access, power and cooling, etc.) and processes (infrastructure patches/upgrades, application patches/upgrades, backups, etc.) necessary to run and administer the entire solution are ad-hocly handled by the SaaS vendor. SaaS offers a full application as a service whenever it's needed. Every data item in SaaS has either the "Read Lock" or the "Write Lock" due to the Divided Cloud and Convergence coherence mechanism.

SaaS uses two different kinds of servers the Main Consistence Server (MCS) and the Domain Consistence Server (DCS). The Cloud Computing overview & Current Research Challenges collaboration between MCS and DCS is responsible for achieving cache coherence. In SaaS, control over the cloud environment is lost in the event that the MCS is compromised or broken. Therefore, protecting the MCS is crucial. Examples of SaaS include Google Apps and Salesforce.com.

Platform as a Service (PaaS) is the provision of a computer platform and solution stack as a service to developers, IT administrators, or end users without the need for software downloads or installations. For the implementation and testing of cloud applications, it offers a highly integrated architecture. The user has control over deployed apps and, perhaps, their customizations, but he does not handle the infrastructure (network, servers, operating systems, and storage). Microsoft Azure, Google App Engine, and Force.com are a few examples of PaaS.

Infrastructure as a Service (IaaS)

IaaS is the term for the sharing of hardware resources for the purpose of utilizing virtualization technology to execute services. Its primary goal is to facilitate applications' and operating systems' easier access to resources including servers, networks, and storage. As a result, it provides basic infrastructure on-demand services, the ability to install new equipment in an easy and transparent way, and the use of Application Programming Interface (API) for interactions with hosts, switches, and routers. Generally speaking, the user controls the operating systems, storage, and installed apps but does not manage the underlying hardware in the cloud infrastructure.

The equipment belongs to the service provider, who is also in charge of housing, operating, and maintaining it. Usually, the client pays according to usage. IaaS examples include GoGrid, Amazon S3, and Amazon Elastic Cloud Computing (EC2). Fig. 2 Models for Delivering Cloud Computing Services by combining the three different kinds of clouds with the delivery models, we obtain a comprehensive cloud illustration, as shown in Figure 2, which is encircled by connecting devices and information security themes. Cloud-based services include virtualized infrastructure, virtualized physical resources, virtualized middleware platforms, and virtualized business applications [26]. Cloud computing security must be maintained across all interfaces by both clients and vendors.

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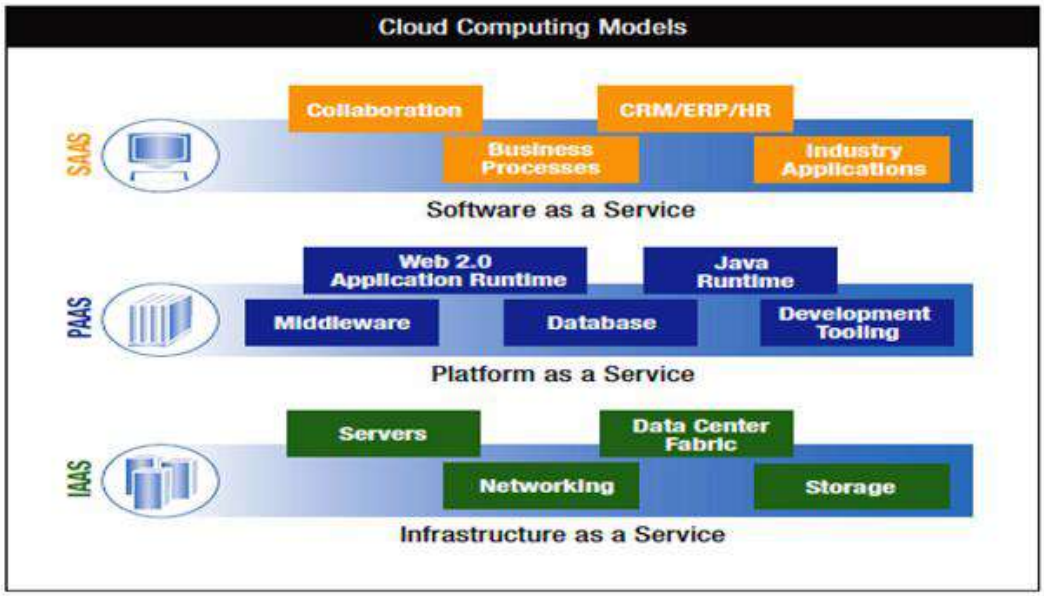

Fig. 2 Cloud Computing Service Delivery Models [26]

C. Cloud Computing Architecture: Overview

The user and the cloud are the two divisions of cloud computing. The majority of the time, the user connects to the cloud using the internet. An organization may also have a private cloud where users are linked through an intranet. With the exception of using a private and public network or cloud, both situations are the same. The cloud provides the service after receiving requests from the user.

Overview of Cloud Computing and Current Research Issues

Fig.3 Cloud Architecture, A central server in the cloud is in charge of system administration and serves as the operating system for the particular cloud network in many respects. This is also known as "middleware," which is the main server for a specific cloud. Amazon EC2 and Google App Engine are two examples.

D. Cloud Computing Entities

The two primary players in the business market are cloud providers and consumers. However, the two other new service level companies in the cloud space are service brokers and resellers. These are covered as follows: Cloud Providers: These comprise Internet service providers, telecom firms, and major business process outsourcing firms that offer the infrastructure (hosted data centers) or media (Internet connections) that allow users to access cloud services. Systems integrators who construct and maintain data centers housing private clouds and provide various services (such as SaaS, PaaS, IaaS, and others) to customers, service brokers, or resellers are also considered service providers. Cloud service brokers include influencers, registered brokers and agents, business professional service firms, and technology consultants who assist customers in choosing cloud computing solutions.

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Without owning or controlling the entire Cloud infrastructure, service brokers focus on negotiating the partnerships between customers and providers. In addition, they supplement the infrastructure of a cloud provider with additional services to create the user's cloud environment. Cloud Resellers: When cloud providers start to grow internationally, resellers may play a significant role in the cloud market. To serve as "resellers" for their cloud-based products in a certain area, cloud providers may select regional IT consulting firms or resellers of their current products. Cloud Consumers: One group of people who fall under this category is end users. However, as soon as they are clients of another cloud provider, broker, or reseller, cloud service brokers and resellers may also fall under this category.

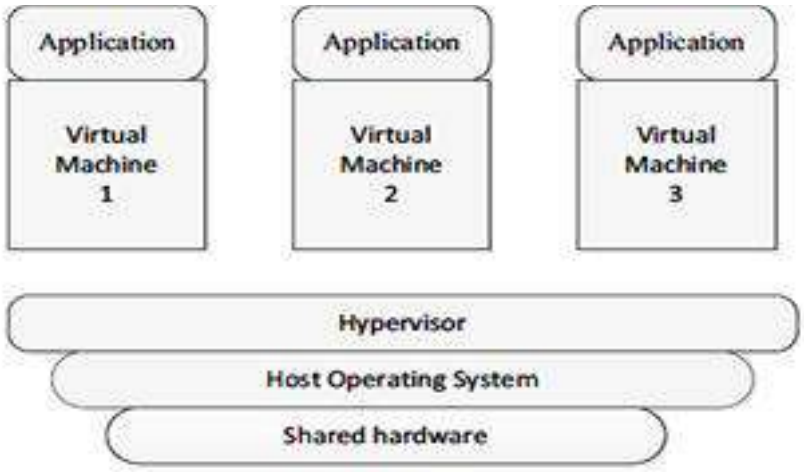

Fig. 3 Cloud Architecture [10]

IV. Research Difficulties in Cloud Computing

Cloud computing research tackles the difficulties of enabling applications and development platforms to benefit from cloud computing as well as the difficulties of satisfying the demands of next-generation private, public, and hybrid cloud computing architectures. The study of cloud computing is still in its infancy. Numerous current problems remain unresolved, and industry applications continue to provide new difficulties. The following list includes some of the most difficult cloud computing research problems.

- Cloud Data Management & Security
- Cloud Data Management & Security
- Data Encryption
- Migration of Virtual Machines
- Interoperability
- Access Controls
- Energy Management
- Multi-Tenancy
- Server Consolidation

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- Reliability & Availability of Service
- Common Cloud Standards
- Platform Management

Service Level Agreements (SLAs)

SLAs govern how the cloud is managed. They permit many instances of a single application to be duplicated on other servers if necessary; based on a priority system, the cloud may reduce or terminate a lower level application. Assessing the SLAs of cloud vendors is a major difficulty for cloud clients. While providing clients with little guarantees, the majority of suppliers draft SLAs as a defensive measure against lawsuits. Customers must therefore consider a number of crucial factors before entering into a contract with a provider, such as price structures, outages, and data protection. If the necessary difficulties are resolved at the appropriate moment, the SLA specifications will more accurately represent the needs of the clients. Uptime, or whether they will be up 99.9% of the time or 99.99% of the time, is one of the fundamental considerations about SLA.

Furthermore, how does that distinction affect your capacity to carry out business? Does data backup, archiving, or preservation have a service level agreement? Do they retain user data in the event that the service account is no longer active? If so, for what length of time? Thus, it's a crucial field of study for cloud computing. Cloud data management is a crucial area of study in cloud computing. Cloud data can be very vast (such as text-based or scientific applications), unstructured or semi-structured, and usually append-only with infrequent updates. Service providers must rely on the infrastructure provider to ensure complete data security because they usually do not have access to the physical security system of data centers. The service provider can only remotely set the security settings, even for virtual private clouds, without knowing if they are fully implemented. In this situation, the infrastructure provider needs to accomplish goals like auditability and secrecy.

Confidentiality is necessary for safe data access and transmission, and auditability is necessary to confirm whether or not application security settings have been altered. While remote attestation techniques can be used to ensure auditability, cryptographic protocols are often used to achieve confidentiality. However, virtual machines (VMs) might move around dynamically in a virtualized environment like the cloud, so relying just on remote attestation is insufficient. In this situation, establishing trust mechanisms at each cloud architectural tier is essential. Distributed processing of data-intensive activities is the goal of software frameworks like MapReduce and its different implementations, like Hadoop; these frameworks usually run on Internet-scale file systems like GFS and HDFS. The storage structure, access pattern, and application programming interface of these file systems differ from those of conventional distributed file systems.

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They cause compatibility problems with legacy file systems and applications, specifically because they do not implement the normal POSIX interface. This issue has been the subject of numerous research projects. Data encryption one essential technology for data security is encryption. Recognize the encryption of data in transit and data at rest. Keep in mind that security can be anything from simple (easy to maintain, inexpensive, and, to be honest, not very secure) to highly secure (quite complex, costly to maintain, and extremely restrictive in terms of access). There are numerous alternatives and choices for you and the company offering your cloud computing solution to think about.

For instance, is SSL encryption offered by the Web services APIs that you use to access the cloud, either programmatically or through clients written to those APIs? This is typically regarded as a standard. The object is decrypted and saved once it reaches the cloud. Is it possible to encrypt it before saving it? Before uploading a file to the cloud, are you concerned about encryption, or would you rather have the cloud computing service handle it automatically? These are choices; comprehend your cloud computing solution and build your choices on the security levels you want.

Migration of Virtual Machines

Virtualization allows several machines to execute a single program or multiple machines to run a single program; applications are not hardware specific. By facilitating virtual machine movement to distribute load throughout the data center, virtualization can offer substantial advantages in cloud computing. Furthermore, virtual machine migration makes it possible for data centers to have reliable and extremely quick provisioning. Techniques for process migration gave rise to virtual machine migration. In recent years, Xen and VMware have introduced "live" VM migration, which entails incredibly brief outages of tens of milliseconds to a second.

Avoiding hotspots is the main advantage of virtual machine migration, but it's not that simple. At the moment, identifying workload hotspots and starting a migration are not flexible enough to adapt to abrupt changes in workload. Additionally, it is important to transmit the in-memory state in a consistent and efficient manner while taking into account the resources of both physical servers and apps. The capacity of two or more systems to cooperate in order to share and utilize information is known as interoperability. A lot of public cloud networks are set up as closed systems that aren't meant to communicate with one another.

Organizations find it challenging to integrate their IT systems in the cloud and achieve cost and productivity benefits due to the lack of interaction across these networks. Industry standards must be created to assist cloud service providers in creating interoperable platforms and facilitating data portability in order to overcome this obstacle. Businesses must use a single toolkit that can work with both cloud-based and enterprise-based apps, manage virtual machine instances, and automatically supply services across numerous cloud providers and current programs.cloud interoperability is required in this situation.

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There are efforts underway to address this issue. An industry group called the Open Grid Forum, for instance, is developing the Open Cloud Computing Interface, which would offer an API for controlling various cloud systems. It has remained a difficult task in cloud computing up to this point. Access Controls: Identity management and authentication are more crucial than ever. Furthermore, it isn't all that different. To what extent does the service provider enforce the frequency of password changes and their strength? What is the process for recovering the account name and password? When a password is changed, how are people notified? What about access auditing capabilities and logs? This is not all that different from how you safeguard your internal systems and data, and it operates similarly. You may protect that aspect of access by using strong passwords that are changed often in conjunction with standard IT security procedures.

Energy Resource Management

Cloud data center operators would greatly benefit economically from considerable energy savings without compromising service level agreements (SLAs), which would also significantly contribute to increased environmental sustainability. It has been calculated that 53% of data centers' overall operating expenses go toward powering and cooling. In addition to reducing data center energy costs, the objective is to comply with environmental and governmental restrictions. Recently, there has been a lot of focus on designing data centers that use less energy. There are various approaches to solving this issue.

For instance, it is now typical practice to use energy-efficient hardware architecture that permits reducing CPU speeds and shutting off partial hardware components. Two other strategies to lower power consumption by shutting off underutilized machines are server consolidation and energy-conscious workload scheduling. The study of energy-efficient network protocols and infrastructures has also just started. A major obstacle in all of the aforementioned approaches is striking a reasonable balance between application performance and energy savings.

In this regard, a small number of academics have just begun looking into coordinated approaches to power and performance control in a dynamic cloud context. Businesses can monitor trends of energy usage from a variety of sources with the assistance of the Global Energy Management Center (GEMC). In order to optimize energy, these patterns can be further examined for usage, cost, and carbon footprint in a variety of ways. By implementing a Remote Control Unit with the ability to connect to a cloud-based architecture, the center is in a unique position to serve clients worldwide.

Multi-Tenancy

Depending on the kind of data being stored on the software vendor's infrastructure, users can access a variety of cloud application types via the Internet, ranging from tiny Internet-based widgets to large enterprise software applications with higher security requirements.

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Multi-tenancy is necessary for these application demands for a number of reasons, chief among them being cost. Response times and performance for other customers may be impacted when several users utilize the same databases, application servers, and hardware. Resources are shared at every infrastructure tier for application-layer multi-tenancy in particular, raising legitimate security and performance issues. Multiple service requests using resources simultaneously, for instance, lengthen wait times but do not necessarily increase CPU time. Alternatively, when the number of connections to an HTTP server is exhausted, the service must wait until it can use an available connection or, in the worst case, terminate the service request.

Server Consolidation

The cloud is now offering the improved resource utilization and decreased power and cooling needs made possible by server consolidation. In a cloud computing context, server consolidation is a useful strategy for optimizing resource use and reducing energy consumption. Live virtual machine migration technology is frequently used to move virtual machines (VMs) from several underutilized servers to a single server, allowing the remaining servers to be put into an energy-saving mode. A variation of the vector bin-packing issue, an NP-hard optimization problem, is frequently used to define the problem of optimally consolidating computers in a data center.

For this problem, several heuristics have been put forth. Dependencies between virtual machines (VMs), like communication needs, have also been taken into consideration lately. However, the performance of applications shouldn't be harmed by server consolidation operations. It is well known that a virtual machine's footprint, or resource utilization, can change over time. Maximally consolidating a server may lead to resource congestion when a virtual machine (VM) modifies its footprint on the server. This is especially true for shared server resources like bandwidth, memory cache, and disk I/O. As a result, it can occasionally be crucial to track changes in virtual machine footprints and utilize this data for efficient server consolidation. Lastly, when resource congestion happens, the system needs to respond fast.

Service Availability and Reliability

When a cloud provider offers on-demand software as a service, the issue of reliability arises. Users must be able to access the software regardless of network conditions, including poor connections, hence it must have a reliability quality factor. A small number of cases have been found as a result of on-demand software's instability. Apple's MobileMe cloud service, which stores and synchronizes data across several devices, is one example. Many customers were unable to access mail and properly synchronize data, which led to an awkward beginning. It providers are using technologies like Google Gears, Adobe AIR, and Curl to prevent such issues. These technologies enable cloud-based applications to run locally, and some even enable them to function without a network connection.

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These solutions create a link between the user's PC and the cloud by granting web apps access to the desktop's processing and storage power. For an IT solution based on cloud computing, reliability remains an issue, especially when considering the use of software like 3D gaming apps and video conferencing systems. Common cloud standards three primary areas technology, personnel, and operations would be covered by security-based accreditation for cloud computing. Before being approved by reputable organizations like ISO2 (International Standard Organization), technical standards are probably going to be influenced by groups like Jericho Forum1.

Regarding personnel, official accreditation for security experts is already provided by the Institute for Information Security Professionals3 (IISP). Some feasible options for the operational components include modifying ISO 27001 and making it the default measurement standard inside the SAS 704 framework. One of the primary issues at the moment is that numerous disjointed initiatives are moving toward Cloud accreditation, but there isn't a single organization in place to coordinate them. Another significant obstacle would be the establishment of a single accrediting organization to certify cloud services.

Platform Management

Difficulties in providing middleware capabilities for creating, implementing, integrating, and overseeing applications in environments that are elastic, scalable, and multi-tenant. One of the most crucial aspects of cloud platforms is that they offer a variety of platforms that let developers create apps that run on the cloud, utilize cloud services, or do both. These days, this type of platform goes by several names, such as platform as a service (PaaS) and on-demand platform. There is a lot of promise in this new approach to application support. Most of the requirements for an on-premises application one that will operate inside an organization are already present when the development team produces it. While other computers in the ecosystem provide services like remote storage, an operating system offers fundamental support for running the application, interfacing with storage, and more.

Conclusion

Cloud computing, which is being discussed a lot these days, is thought to be the next generation of IT enterprise design. Given how the cloud has been taking over the IT industry, a significant movement in favor of the cloud is anticipated in the upcoming years. Businesses looking to gain a competitive edge in the current market might profit greatly from cloud computing. More providers are entering this market, and the competition is bringing down costs even further. The freedom to pay for services as needed, attractive pricing, and the opportunity to free up employees for other tasks will all continue to entice more companies to explore cloud computing. One of the largest markets for cloud service providers and cloud developers is anticipated to be mobile cloud computing.

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There are a lot of things to be wary about, even though cloud computing is a relatively new phenomena that has the potential to completely change how we use the Internet. Numerous new technologies are developing quickly, each with the potential to improve human life and bring about technological progress. Understanding the security dangers and difficulties associated with using these technologies, however, requires extreme caution. There is no exception when it comes to cloud computing. Cloud service providers must tell their clients about the security level they offer on their cloud.

This research project provides an overview of cloud computing, including its various models, building blocks, architecture, and entities. Additionally, the research difficulties that are now being encountered in cloud computing were also emphasized. Since cloud computing technology is still in its infancy, this research endeavor will give a better understanding of the design challenges of cloud computing and open the door for future research in this field. Cloud computing has the potential to become a leader in promoting a secure, virtual and financially viable IT solution in the future.

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SMART POWER SYSTEM MONITORING AND CONTROLLING USING UNIQUE CLOUD DATA STORAGE WITH INTERNET OF THINGS

DR.J.Kalavathi
Assistant Professor,
Department of Information Technology,
V.V.Vanniaperumal College for Women,
Virudhunagar, Tamil Nadu, India.

Abstract

User experience (UX) has emerged as a crucial element in the success of digital products and applications. As user interfaces (UI) grow more complex and user needs and preferences vary widely, the demand for personalized experiences has gained significant attention. Techniques in Artificial Intelligence (AI) present promising possibilities for enhancing UX through AI-driven personalization in user interface design. This research paper investigates how AI can be utilized to enhance user experiences by providing tailored interactions in user interface design. It analyzes the advantages, challenges, and best practices associated with AI-powered personalization and evaluates its effects on user engagement, satisfaction, and loyalty. This paper seeks to offer meaningful insights into the successful application of AI in user interface design by thoroughly examining case studies and research outcomes, resulting in user-friendly experiences. Engaging, easy-to-navigate, and customized user interactions.

Keywords: User Experience

I. Introduction

1.1 Background and Significance

The introduction section establishes the background for the research paper by offering insights into the rising importance of user experience (UX) in UI design. It emphasizes the escalating need for tailored and captivating digital experiences and the function of AI-driven personalization in fulfilling these demands. This section covers the progression of UI design and the transition towards user-focused methodologies that emphasize customization and relevance.

1.2 Overview of AI-Powered Personalization in UI Design

This section offers a summary of AI-enabled personalization methods and their usage in user interface design. It examines how AI algorithms evaluate user data, behaviors, and preferences to provide tailored content, suggestions, and dynamic UI components.

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The section outlines the advantages of AI-driven personalization, including heightened user satisfaction, better engagement, and increased conversion rates. It also points out the possible challenges and ethical issues linked to AI-fueled personalization.

1.3 Research Objectives

The precise goals of the study are outlined in the research objectives. These objectives could include:

- Analyze how AI-powered personalization affects user interface design and user experience.
- Examine how well different AI strategies work to provide a customized user interface.
- Examine the elements that affect user engagement and happiness with AI-powered bespoke UI designs.
- Determine the most effective methods and techniques for incorporating AI-powered personalization into UI design. Recognize the ramifications and moral issues of AI-powered personalization.

II. Literature Review

A thorough examination of previous studies, academic papers, and trade journals pertaining to AI-powered personalization in user interface design is provided in the literature review section. It establishes the theoretical foundation and places the study in the larger context of knowledge. As shown below, the literature review portion can be divided into multiple subsections:

2.1 AI Techniques for Personalization in UI Design

The several AI personalization strategies used in UI design are examined in this subsection. It covers machine learning algorithms that are frequently used for user modeling, recommendation systems, and adaptive user interface adaption, including collaborative filtering, content-based filtering, and reinforcement learning. In addition to outlining each technique's advantages and disadvantages, the section provides instances of successful real-world applications.

2.2 Benefits of AI-Powered Personalization

The advantages of AI-powered personalization for UI design and user experience are the main topic of this subsection. It talks about how customer satisfaction, engagement, and conversion rates may all be improved with tailored user interfaces. The section provides case studies and actual data that show how AI-powered personalization improves user behavior, including higher conversion rates, longer session durations, and higher click-through rates.

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2.3 Case Studies on AI-Powered Personalization in UI Designs

In this subsection, noteworthy case studies and illustrations of the effective use of AI-powered customization in UI design are highlighted. Specific use cases from a range of businesses, including social media, news platforms, streaming services, and e-commerce, are shown. The goals, strategies, and results of using AI-powered personalization are examined in each case study, providing insight into the real-world uses and observable advantages attained. A thorough summary of the current state of knowledge and unmet research needs in the area of AI-powered customization in UI design is provided in the literature review section, which forms the basis of the research study. It lays forth the main ideas and hypotheses, justifies the research, and provides context for the following sections of the work.

III. Problem Definition

The particular difficulties and problems pertaining to AI-powered customization in UI design that the research study seeks to resolve are listed in the problem definition section. It defines the study's background and makes the research focus clear. The structure of this section can be as follows:

3.1 Identification of UX Challenges in Traditional UI Design

The shortcomings and difficulties of conventional UI design techniques in providing individualized user experiences are covered in this topic. It draws attention to problems including generic information, irrelevant content for users, and trouble customizing to each user's tastes. In order to overcome these obstacles and improve the user experience overall, the section highlights the necessity of AI-powered customisation.

3.2 Role of AI-Powered Personalization in Addressing UX Challenges

This subsection investigates how the UX issues seen in conventional UI design can be successfully addressed by AI-powered personalization. It talks about how AI algorithms may provide tailored content, recommendations, and user interface modifications by utilizing user data, behavior patterns, and contextual information. The potential of AI-powered personalization to raise user engagement, satisfaction, and overall UX quality is highlighted in this section.

3.3 Problem Statement

This paragraph develops the problem statement that the research paper seeks to address based on the issues that have been discovered and the function of AI-powered personalization. It is important for the problem statement to be clear, concise, and actionable.

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For Instance

By addressing the shortcomings of conventional UI techniques, the study paper seeks to determine how well AI-powered personalization can improve user experience in UI design. In addition to offering insights into best practices for integrating AI-powered personalization in UI design, it aims to comprehend how AI techniques affect user pleasure, engagement, and conversion rates. The research paper's aim and scope are established by precisely identifying the problem, which also directs the following parts to fulfill the study objectives. It helps to organize the research process, analysis, and findings and gives the study a defined direction.

IV. Objective / Scope

The objective/scope section outlines the specific goals and scope of the research paper. It defines the boundaries and focus of the study, guiding the research methodology and analysis. This section can be divided into two subsections:

4.1 Research Objectives

This subsection states the specific research objectives that the paper aims to achieve. These objectives should be aligned with the problem statement and provide clear targets for the study. For example:

- To evaluate how user happiness with UI design is affected by AI-powered personalization.
- To assess how well various AI strategies deliver individualized user interfaces.
- To investigate how user engagement and conversion rates are affected by AI-powered personalization.
- To determine the main elements affecting the effectiveness of AI-powered customization in user interface design.
- To offer suggestions and directives for integrating AI-powered customization into UI design procedures.

4.2 Scope of the Study

This subsection defines the scope of the research paper, specifying the boundaries and limitations within which the study will be conducted. It outlines the target audience, industry sectors, and specific UI design aspects that will be considered. It may also mention any geographical or temporal constraints. For example:

- The research will mainly look at how AI techniques affect user experiences in social media and e-commerce platforms, with a focus on AI-powered personalization in web and mobile UI design.
- To ensure relevance and current examination of AI breakthroughs in UI design, the study will take into account the last five years.Clearly defining the goals and parameters of the study aids in giving it emphasis and direction.

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It guarantees that the research work adheres to the specified objectives and stays within reasonable bounds. The scope and objectives provide as a roadmap for choosing the best research approach and carrying out a thorough analysis of the results.

V. Research Methodology

The research methodology section describes the approach and methods employed to conduct the study and gather relevant data. It provides transparency and allows readers to evaluate the reliability and validity of the research. This section can be organized into several subsections:

5.1 Data Collection Methods

This subsection outlines the methods used to collect data for the research. It may include qualitative and/or quantitative approaches, such as surveys, interviews, observations, or data mining techniques. The section discusses the rationale behind the chosen methods, their appropriateness for the research objectives, and any ethical considerations involved.

5.2 Data Analysis Techniques

This subsection describes the techniques used to analyze the collected data. It may involve qualitative analysis, quantitative analysis, or a combination of both. For qualitative analysis, methods like thematic analysis or content analysis can be employed. Quantitative analysis may involve statistical techniques, data modeling, or machine learning algorithms. The section explains how the chosen analysis techniques are suitable for addressing the research objectives and interpreting the findings.

5.3 Study Design

This subsection describes the overall design and methodology of the study. It includes details of the research method (e.g., experimental, observational, case study), sampling criteria, and data collection schedule. This section also highlights potential biases or limitations related to the selected study design and how they are addressed. The section on research methods provides an overview of the rigor and validity of the study. By describing data collection methods and analytical techniques, it demonstrates the systematic approach taken to collect and interpret research results. This section ensures transparency and allows other researchers to copy or build on future research.

VI. Analysis and Findings

The analysis and findings section presents the results of the research study based on the data collected and analyzed. It interprets the findings in light of the research objectives and provides meaningful insights into the impact of AI-powered personalization on user experience in UI design. This section can be structured as follows:

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6.1 Analysis of user Satisfaction and Engagement Metrics

The user satisfaction and engagement indicators collected during the study are examined in this subsection. In order to assess how well AI-powered personalization raises user satisfaction, it looks at things like user reviews, ratings, and qualitative data. In order to assess how customized user interface experiences affect user engagement, it also looks at measures like click-through rates, session durations, and conversion rates. With the use of pertinent data and graphics, the findings are presented in this section in an understandable and succinct manner.

6.2 Evaluation of AI-Powered Personalization Techniques

This subsection focuses on evaluating the effectiveness of different AI techniques used for personalization in UI design. It compares and contrasts the performance of various algorithms and approaches, considering factors such as accuracy, relevance, and adaptability. The evaluation may involve benchmarking against industry standards or previous research studies. The section provides a comprehensive analysis of the strengths, limitations, and potential applications of each technique, drawing conclusions based on the research findings.

6.3 Impact of AI-powered Personalization on UX

The total effect of AI-powered personalization on user experience in UI design is examined in this subsection. It looks at how user pleasure, engagement, and conversion rates are affected by tailored user interface experiences. The section provides information on the particular UI design elements like content recommendations, adaptive interfaces, and contextual interactions that are enhanced by AI-powered personalization. Any surprising results or subtleties found throughout the analysis are also highlighted. The research objectives are supported by empirical evidence in the analysis and findings section. It helps readers comprehend the real-world applications of AI-powered customization in user interface design and how it affects user experience. The results form the foundation for the following sections of the research article and add to the corpus of knowledge in the field.

VII. Limitations and Future Scope

VIII. The research study's limitations and possible flaws are acknowledged in the section on limitations and future scope. It draws attention to potential limitations in the study's scope, data gathering techniques, and sample size. It also highlights areas for future study and makes recommendations for possible lines of inquiry. The structure of this section can be as follows:

7.1 Limitations of the Study

This subsection discusses the limitations inherent in the research study. It may include factors such as sample size, geographical or cultural bias, time constraints, or limitations in data collection methods.

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The section provides a transparent account of the potential shortcomings that may have influenced the research findings and suggests caution in generalizing the results.

7.2 Future Directions for Research

In light of the present study's limitations and results, this paragraph suggests topics for further investigation. It might point to directions for additional study, possible directions for the research, or new developments in the area. In addition to encouraging future academics to investigate new facets of AI-powered customization in UI design, the section offers insights into the knowledge gaps. The study article gains credibility and transparency from the limitations and future scope section. It enables readers to appropriately evaluate the results by recognizing the limits of the study. Furthermore, it encourages ongoing investigation and development in the area of AI-powered customization in UI design by outlining potential avenues for further study.

VIII. Conclusion

The research paper's conclusion section offers a thorough synopsis of the conclusions, ramifications, and suggestions drawn from the investigation into improving user experience through AI-powered customization in UI design. It acts as a concluding analysis of the study and its importance. The arrangement of this section is as follows:

8.1 Summary of Findings

The study's key conclusions are briefly outlined in this subsection. With increases in user pleasure, engagement, and conversion rates, it demonstrates the beneficial effects of AI-powered personalization on UI design. It highlights how well AI methods work to provide individualized user interfaces that are customized to meet the needs and tastes of each unique user. The main conclusions covered in the research article are reaffirmed in this section.

8.2 Implications of the Study

The research findings' ramifications for the fields of UI design and AI-powered personalization are examined in this subsection. It talks about how using AI techniques in UI design can improve user experiences and help businesses accomplish their goals. It draws attention to how AI-powered personalization may raise user engagement, boost conversions, and enhance customer happiness. The section highlights how crucial it is to take user preferences, behavior, and context into account when creating customized user interfaces.

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8.3 Recommendations for Implementing AI-Powered Personalization in UI Design

This chapter offers helpful suggestions for integrating AI-powered customization into user interface design. It lists important factors and recommended procedures for incorporating AI methods into UI design procedures. This could cover things like user feedback systems, algorithm selection, UI adaption techniques, and data collection and analysis. The recommendations are intended to help practitioners employ AI-powered customisation to improve user experiences in an ethical and efficient manner.

8.4 Conclusion

The conclusion subsection offers a concise and final conclusion to the research paper. It reiterates the research objectives, summarizes the main findings and implications, and provides a closing statement on the significance of the study. It emphasizes the potential of AI-powered personalization in revolutionizing UI design practices and highlights the need for further research and innovation in this area. The conclusion section wraps up the research paper, leaving the readers with a clear understanding of the contributions and implications of the study. The conclusion section provides a coherent summary of the research, reiterating the key points and emphasizing their significance. It offers a sense of closure to the research paper while also inspiring further exploration and development in the field of AI-powered personalization in UI design.

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IMPLEMENTATION OF SOFTWARE TESTING USING MACHINE LEARNING: A SYSTEMATIC MAPPING STUDY

Mrs.G.Chandraprabha
Assistant Professor,
Department of Information Technology,
V.V.Vanniaperumal College for Women,
Virudhunagar, Tamil Nadu, India.

Abstract

Software testing is a vital component in the software development life cycle, verifying the quality. Dependability of software products. The introduction of machine learning (ML) technologies has led to a Increasing interest in applying machine learning techniques to improve and automate different areas of software testing. This systematic mapping project intends to provide a detailed overview of the existing Current state of research and application in the field of software testing with machine learning. The study thoroughly evaluates a wide range of literature, including academic publications and conferences. Proceedings and industry reports will be used to identify and categorize existing techniques. Machine learning-based approaches and technologies for software testing. A mapping study classifies the ML techniques used, such as classification, clustering, and anomaly detection.

Analyzes their application in several testing activities, such as test case generation, test Execution and fault prediction. Furthermore, the mapping study examines the problems, benefits, and trends related to the Implementation of machine learning in software testing. It identifies significant research gaps Identifies areas for further investigation. By combining and arranging existing knowledge, The systematic mapping study is a useful resource for researchers, practitioners, and business. Professionals looking for insights into the changing landscape of software testing through Integration of machine learning technologies. This study's findings add to a deeper understanding understanding of the current status of the industry and lay the groundwork for future breakthroughs in the junction of software testing and machine learning.

1. Introduction

Historically, traditional software was used to solve scientific computing and data processing problems. Over the last few decades, improved technologies have produced a significant development in software industry. The contemporary era of technology raises the relevance of software. Softwares are Capable of solving ordinary life challenges. Software engineers have come a long way from the beginning. Towards technical advancement. The conventional software planet goes through development, Testing, deployment, and implementation of software systems, but the route of this planet was disrupted by the new paradigm for software development.

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The new paradigm, Data Driven Software, utilizes the Data was cleansed and curated to tackle unsolved problems. Factors such as unrealistic requirements, cost Quality concerns can be the cause of software failure, resulting in budget overruns. Decades ago, it was expected that such a machine would be constructed, capable of Think, understand, and make decisions. AI has added a new level to computer software development, making a decades-long dream a reality. Now, the computer has the intelligence to something, humans should not be instructed what and how to do. Nowadays, the solution is supplied to the computer creates software, and the computer selects the data and model for development. Computers are Capable of handling a huge volume of data in less time. Data volume is rapidly expanding, leading to Fault, failure, and expense overruns.

The amount of data generated digitally at the beginning of 2022 was 463 exabytes per day by 2025, according to researchers. Software testing is the method of discovering faults and bugs by executing the software in a controlled environment. This software testing procedure takes a long time, is expensive, and complicated. In this in today's technological age, automated software testing is everyone's first choice in the sector of software engineering. Software testing evaluates and validates the fulfillment of the criteria. The quality and capability of the generated program were traced back to the requirements given.

The demand for automated software testing grows as program complexity increases Software testing activities delve into the behavior of software systems to discover errors/bugs. Testing activities are diverse and costly, hence a hands-on approach has been implemented to avoid the problems associated with manual software testing, automated software testing is recommended. The Machine Learning algorithm is used to automate software testing in order to overcome difficulties or Challenges include effort, money, and time.

Machine learning has become the most abundant technology to test. Software or to complete tasks using supplied or learnt facts. Unfortunately, automated tests using machine learning has also revealed some susceptibility to deceptive findings, which leads to inaccuracy or tragic failure. In this situation, a question arises: is the employment of machine learning correct? suitable for automated testing of program features. Various works have been provided in the field of Machine Learning and Software Testing, but the There is no general guiding principle for using effective learning methods for software.

Testing is the underlying cause of the question about the implementation of machine learning technologies. For automated software testing. In this study, we present a research strategy to systematically to advance, review research work in the domains of software testing and machine learning. Toward selecting the best effective machine learning approach to test the software application employing automation. Fault identification and rectification grow increasingly expensive in the later stages of software development. Even the cost can exceed 50% of the development expense.

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The only way to overcome them overheads is to test the software as soon as feasible. Software testing is a critical component of the Software development process. Software testing and quality control operations have taken up a significant the whole budget for software development.

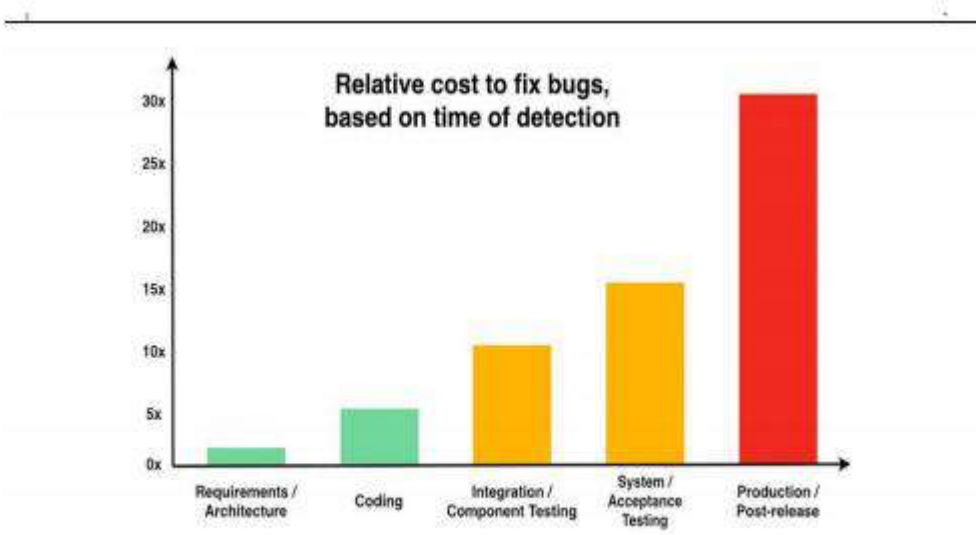

Figure 1: Relative cost to fix bugs in software development stages

Fig 1: Shows the Relative Cost of Fixing Defects during the Software Development Phases

Figure 1 depicts how the cost of bug elimination increases dramatically in the latter phases of software development. The primary goal is to supply consumers with high-quality software that is free of bugs. Software development takes a long time, from traditional software to data-driven software. The complexity of software has expanded, and it is nearly difficult to deliver bug-free software. It can only extensive software testing can achieve this, which is expensive, time-consuming, and labor-intensive. In some cases, software maintenance might account for up to two-thirds of the overall development cost cases.

According to this statistic, automated testing procedures are expected to save money, effort, and time. Software testing automation can increase software performance. Therefore, there is a requirement for developing automated software testing methodologies. Several attempts have previously been made to automate software testing.

Furthermore, the many testing techniques and approaches or automated testing, deploying an error Free software is similar to "a dream with open eyes". To deal with this problem, an investigation moving on to find a more effective method of software testing. Artificial intelligence (AI) techniques have been effectively discarded to minimize software engineering activities.

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Machine learning (ML) is a subfield of AI that integrates computer science and Statistics combined with AI have been used to automate a variety of software testing processes. All study demonstrates that machine learning techniques are capable of automating testing. processes. However, certain fundamental questions remain that must be addressed and investigated, such as:

- How effective are machine-learning technologies at different stages of software testing?
- How does one assess the strengths and shortcomings of the learning approach in the setting of testing?
- How can we decide whether the given data inputs are possible to test the functional or not?
- What are the functional properties of the software?
- How does machine learning help uncover major software bugs?
- Can software testing using machine learning be as effective as traditional testing?

2. Objective

To discover the best appropriate machine learning method to test software products systematically. Review of studies in the areas of software testing and machine learning.

3. Literature Review

This section includes an exhaustive learning of multiple previous studies on approaches for features. Selection and classification of software fault prediction.

3.1 Software Fault Prediction with Feature Selection Approaches

Wang et al. discovered that the feature selection technique is critical to the model construction process. They include a non-linear component in the evaluation function to determine the most useful. Subset dimension is used to improve system performance. The selected characteristics were tested and validated using several machine learning methods, and the featured subset resulted in the significant increase in the classifier's accuracy. Reena and Rajan demonstrated that the invalidated version of an ideal feature subset based on ideal methodology generates predictions about the under development components of a computer system.

The least spanning tree method was used to determine whether qualities exist. The outcome was examined following the modification of the algorithm to work with four distinct data sets. Liu et al. consider that cost information is occasionally omitted throughout the categorization. They offer a novel two-stage cost-sensitive learning technique. The process of evaluating the proposed approaches used seven authentic NASA data sets. The findings prove after validating cost information by cost sensitive feature selection and traditional cost blind feature selection, the TSCS approach outperformed the active single stage cost sensitive classifier.

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Xia et al. developed a method that used correlation analysis as part of their ReliefF feature selection process; three different classifiers were evaluated using a dataset. These classifiers were evaluated against two feature selection methodologies. The results of the ANOVA test indicate implementing a "fusion method" based on "ReliefF" and "Linear Correlation analysis" (ReliefF-LC) may improve the ability to predict problems. Mandal and Ami demonstrate that the contribution of a collection of attributes is as significant as the ideal set in improving the performance of the error prediction model. They employed eight NASA datasets to compare this approach to two other working models, and they discovered that it resulted in a 54% increase in SDP, making it the most promising of the three.

3.2 Classification Strategies for Software

Failure prediction Dejaegar et al. examined and contrasted 15 Bayesian Networks (BN) and standardised the machine learning approach by incorporating them into the mainstream. They conduct a study to see whether the Markov cover guideline is effective for highlight selection. Bishnu and Bhattacherjee proposed a Quad Tree-based KMeans methodology for predicting software module failures. They have created a method that is based on linking quad trees for discovering faults in software by putting the clusters into the K-means algorithm.

- It demonstrated an increase in mistake detection rate in comparison to previous techniques. Catal et al. developed an Eclipse-based coding fault prediction system for Java programs by
- Using Naïve Bayes machine learning technique, we proved excellence in overcoming the issue of combining coding measurement with coding deficiency data by coders. Following that,
- A programmer created an Eclipse-based coding issue prediction model in an open-source the platform utilizes Naïve Bayes.
- Malhotra and Jain created an error probability estimation model using Object-Oriented CK metrics and Quality Model for Object Oriented Design (QMOOD) measurements. Six distinct machine learning algorithms and a pragmatic methodology are utilized to create the prediction. To evaluate the model's correctness, a dataset from the under development open-source the source code of software. This confirmed that the random woodland and stowing approaches outperformed the other model.

OkutanA and Yldz use Bayesian techniques to conclude the probabilistic causal relationship between coding metrics and error tendency. The authors utilized nine open-source data stores informative indexes to explore and determine that the best measurements are response for class, Lines of code and a lack of quality coding. The study suggested that further extensive testing will be required for validation.

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Xing et al. employed a Support Vector Machine (SVM) to categorize software components and predict Software quality is determined by its complexity metrics. The study shows that the SVM the prediction model outperforms previous active approaches for forecasting software quality. Kumar et al. used the Least Squares Support Vector Machine (SVM) learning technique, together with the direct, polynomial, and dispersed foundation work bit capabilities, to illustrate the building of an efficient fault prediction model through shape and analysis. Coding metrics and the predictive power of a small number of standards. The researchers utilized them separate element selection to get the best fitting classification from a large collection of twenty. Refine the studies based on criteria, collect authentic information, and narrow the research based on research questions.

- Data Selection
- Data Synthesis
- Data analysis

Research Results Investigate the major research source code metrics. The study found that the prediction model is useful for jobs but requires flawed classes.

4. Mapping the Study Process

This section defines the procedure that we followed over the course of this systematic mapping. This study was based on the guiding principle for directing secondary investigations suggested by Kitchenham et al. and Petersen et al.

4.1 Research Questions

We focused the selection and classification of the literature to make it meaningful for the Researchers intend to employ ML for automated software testing. Kitchenham et al. stated that the purpose of secondary investigations should be expressed by research questions. Our study is based on the following research questions:

1. **Q1:** Can machine learning ensure software quality in the same way that traditional software testing does?
2. **Q2:** What is the strength of ML when applied to software testing for research?
3. **Q3:** What ML algorithms have been utilized to address issues raised during automated software testing?
4. **Q4:** What do the researchers see and apply to automated software testing with machine learning?
5. **Q5:** What problems do academics face when utilizing ML for automated software testing?

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Methodology

To obtain the answers to the research question, we researched literature from more than the last ten years. The investigations were refined based on a variety of parameters. The study of literature was focused on the the basis for research questions. The study selection is based on those studies that contain the research results on ML approaches to testing software, fault prediction techniques, and ML algorithms. Which way to automated software testing. We gathered authentic information from research published in reputable libraries such as IEEE, Springer, ACM, Elsevier, and Wiley (conference proceedings, journals, and books), and tailored our search and study to our research concerns. Following data collection, data extraction, synthesis, and analysis based on research the results were evaluated and formulated.

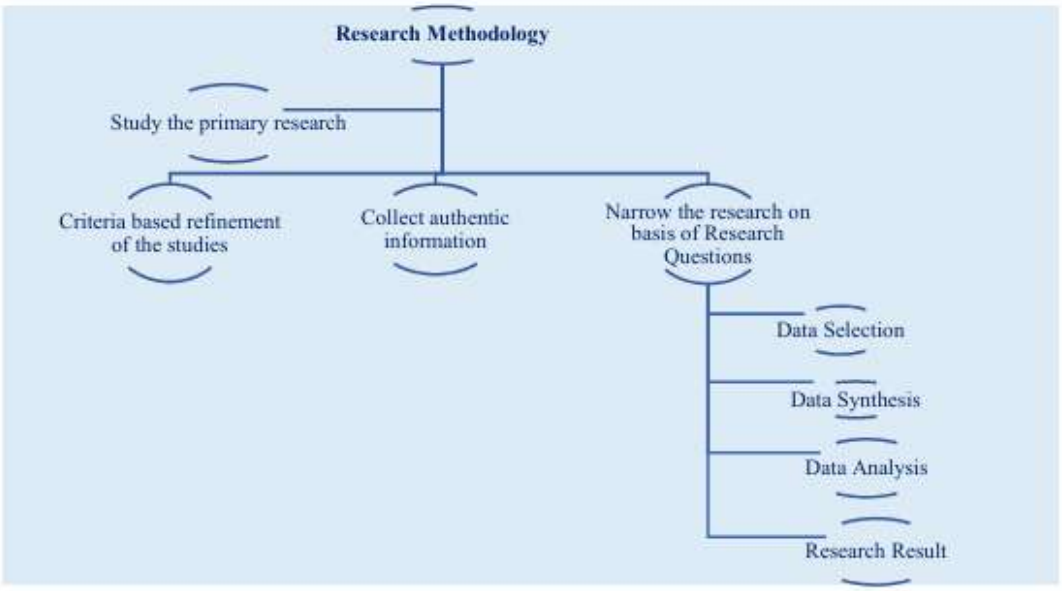

Fig 2: Illustrates the Whole Research Technique

While the data-driven software paradigm is quickly causing problems for traditional software solutions, a systematic mapping investigation revealed extensive research into the fine area of ML quality assurance. Methodologies and procedures, but there remains a gap when compared to comprehensive Quality Assurance operations. The research is entirely focused on increasing software quality through the application of machine learning techniques and models. Despite the fact that this study identifies a research gap, it is possible that this systematic mapping analysis will reveal answers to research problems. We modeled the following RQs and supplied solutions by analyzing the results of our systematic mapping study:

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1. **Q1:** Can machine learning ensure software quality in the same way that traditional software testing does? According to our study, machine learning can ensure the quality of software testing by employing algorithms and producing new models are developed based on research findings.
2. **Q2:** What is the strength of ML when applied to software testing for research?
3. According to our findings, ML algorithms have been used to solve software testing problems since the 1970s (by Louridas and Ebert), although they have only recently gained attention from researchers. The increased interest in employing ML algorithms for software testing strengthens its performance.
4. **Q3:** What ML algorithms are utilized to resolve concerns raised during automated software testing? Various ways investigated in primary research to automate software testing utilizing machines learning algorithms. Our results reveal that in feature selection techniques TSCS algorithm Relief feature selection algorithm, the least spanning tree method, and the classification strategy for software fault The most commonly utilized prediction methods include KMeans, QMOOD, and Naïve Bayes.
5. **Q 4:** What observations are the researchers making and applying to automated software testing with machine learning? We noticed that the community of researchers employs varied approaches, some are using some use upgraded or modified procedures, while others use hybrid approaches to resolve challenges.
6. **Q5:** What problems do academics face when utilizing ML for automated software testing?

After analyzing our Results, We felt that a Tester must Encounter the following Challenges

1. **Data Availability and Quality:** Machine learning algorithms require massive amounts of high-quality data to Train the model. It might be difficult to effectively train models for test automation when data is unavailable or of poor quality.
2. **Complexity:** Interpreting the behavior of machine learning models for automation.
3. Testing is tough since the ML techniques are sophisticated and difficult to comprehend.
4. Overfitting occurs when a model is sophisticated or lacks enough data to train, and it performs it works well on trained data but poorly on new data.
5. Machine learning models must be maintained and monitored on a regular basis in order to retrain and update them for the system being tested.
6. Deployment concerns include an unstable environment, malfunctioning code, and training-serving skew.
7. Integration: Adding machine learning models to current test automation frameworks necessitates significant development effort.

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8. **Explainability:** Some machine learning models may be too sophisticated to describe how they made their predictions.
9. **Bias:** Because of insufficient data or preprocessing, the model may produce erroneous findings.

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VISIONARY AUTOMATION IN SMART BUILDING DESIGNS USING AI AND ML

Mrs.K.Kasthuri
Assistant Professor,
Department of Information Technology,
V.V.Vanniaperumal College for Women,
Virudhunagar, Tamil Nadu, India.

Abstract

The smart buildings evolution is increasingly accelerated through the seamless incorporation of Artificial Intelligence (AI) and Machine Learning (ML). Traditional building architectural framework replace with smart and efficient systems that continuously adapt to optimize performance. Findings: Apart from automation, AI and ML are becoming main foundational technology of smart building innovation. This study explores how they serve as catalysts for intelligent operation, environmental efficiency, and occupant-focused design. A modular AI-driven framework for self-learning smart buildings that adapt in real-time to environmental changes and occupant behaviour using reinforcement learning, federated learning, and generative design enabling energy-efficient, autonomous, and privacy-preserving intelligent infrastructure. Implementation: Predictive Maintenance that helps in detecting failures before they happen to reduce downtime using Random Forest algorithm.

Occupancy Detection and Space Utilization are predicts room usage to optimize layout and energy using Convolutional Neural Networks (CNN) and K-Means Clustering. Adaptive Comfort Control which can personalize environmental conditions (temperature, lighting) per occupant using Reinforcement Learning. Usage: Digital twins, generative design, and federated learning also open new possibilities in virtual simulation, ethical AI deployment, and privacy-preserving smart environments. Such advancements signal a transformative toward buildings that are not only smart but self-learning and context-aware, paving the way for the future of intelligent urban infrastructure.

Keywords: Artificial Intelligence (AI), Machine Learning (ML), Reinforcement Learning, Federated Learning, Generative Design, Predictive Maintenance, Random Forest Algorithm, Occupancy Detection, Space Utilization, Convolutional Neural Networks (CNN), K-Means Clustering.

1. Introduction

In the age of digital transformation, the built environment is being reshaped at its fundamental level. Buildings are no longer merely static boxes they're being activated as dynamic, intelligent systems that can engage with occupants, adapt to environmental conditions, and optimize their operations in real time.

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The driver of this revolution is the convergence of Artificial Intelligence (AI), Machine Learning (ML), and the Internet of Things (IoT), which together deliver us into the new smart building generation that is independent, adaptable, and more human-sensitive. Recent advances in AI and ML offer a powerful foundation for this transformation. These technologies enable buildings to process vast amounts of data from sensors and occupants, uncover patterns, predict system failures, optimize energy usage, and personalize comfort without human intervention. Reinforcement learning allow systems to adapt and improve over time, while federated learning introduces a privacy-preserving approach to model training. For example, novel reinforcement learning methods have been shown to dramatically reduce energy consumption and operational costs in building management, and AI-powered HVAC controllers can significantly enhance occupant comfort while reducing energy use.

Meanwhile, generative design and digital twins open new frontiers in architectural innovation and virtual simulation, allowing designers and building operators to test scenarios, optimize layouts, and improve long-term performance. Although these technologies hold promise, their use in smart building design is still maturing. Current deployments are largely in isolated silos that handle one system or with few capabilities rather than providing an end-to-end interoperable framework. Additionally, data privacy, system scaling, and user-centric customizability remain largely unattended. In this research, the voids through the introduction of a modular AI-based model of visionary automation in intelligent building designs. The framework integrates numerous levels of intelligence from predictive maintenance and real-time analytics to occupant comfort maximization and system coordination autonomously.

Central elements comprise Random Forest-based predictive maintenance, Convolutional Neural Networks (CNN) and K-Means Clustering-based space usage, and Reinforcement Learning based adaptive comfort management. These frameworks is also capable of enabling federated learning in order to provide protection for the data and utilizing generative design tools in order to facilitate architectural planning. By assimilating the above elements, the model presented in this work allows buildings to transform from mere passive structures into self-learning, context-sensitive spaces that save on operational expenditure, enrich end-user experience, and lead to long-term durability. The paper examines the application, advantages, and wider repercussions of such systems, and seeks to contribute to the future of smart urban infrastructure.

2. Research Background

The smart building idea evolved dramatically over the past two decades from basic automation systems to networked, sensor-based structures that focus on improving the effectiveness of operations along with occupant experience. Smart buildings during the early phase largely depended on rule-based methodologies along with pre-programmed schedules so as to automate lighting, heating, ventilation, as well as air conditioning (HVAC) systems.

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These were, however, limited in flexibility as they at times did not perform effectively in responding to real-time fluctuations in occupancy, climate, or occupant preferences. With the advent of the Internet of Things (IoT), the amount of data produced within building spaces has expanded exponentially. Sensors and in-built devices now offer sustained flows of environmental, functional, and behavioural information, opening new possibilities for smart, intelligent decision-making. Nevertheless, conventional Building Management Systems (BMS) are frequently unable to interpret the data in a manner that yields significant, autonomous action. A number of research studies have investigated the combination of AI techniques for applications like energy forecasting, HVAC optimization, and fault detection. For example, ML techniques like neural networks, decision trees, and support vector machines have performed well in detecting anomalies in building systems or forecasting energy use patterns.

More recent techniques like reinforcement learning enable building control systems to learn optimal strategies through experience, dramatically reducing energy consumption and enhancing occupant comfort. These implementations are usually applied at the individual component level and are not interoperable with other building functionalities. Privacy and security of data have also become major issues: centralized traditional AI architectures demand the aggregation of data, which may be detrimental when the data is sensitive and is in residential or tenant-occupied areas. For this reason, Federated Learning (FL) has been proposed as a decentralized paradigm of ML that can facilitate on-device learning while maintaining data confidentiality. Though the use of FL in smart buildings is promising, little exploration has been done in previous research.

Moreover, the application of digital twins and generative design is increasingly influencing architectural planning as well as operational decision-making. Generative design allows engineers and architects to explore design options against desired performance, while digital twins enable real-time monitoring and in-silico simulation of building systems [5]. These technologies are powerful but are rarely introduced under an overarching AI-driven automation framework. The status quo in research is that there is no coherent picture of AI applied in systematic building approaches but instead isolated pockets of specialized solutions. There are lack modular, scalable frameworks that bring together sophisticated AI techniques like RL, FL, CNNs, and generative algorithms toward an overall holistic vision of smart building automation. This study builds on existing work by proposing an integrated, modular framework for visionary automation in smart building design.

The framework addresses key challenges in system adaptability, data privacy, and multi-functionality, offering a novel solution that bridges gaps between isolated technologies. It leverages AI not only for automation but for real-time learning, predictive maintenance, occupant behaviour modelling, and architectural optimization ltimately contributing to a new class of buildings that are self-learning, context-aware, and designed for long-term sustainability.

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3. Methodology

In order to create an intelligent, self-learning smart building system, the development of a multi-stage pipeline of AI/ML was undertaken that comprised data pretreatment, feature extraction, model building, and measuring the performance. The end was aimed at examining core smart building operations like predictive maintenance, occupancy sensing, space usage, and adaptive environmental control.

3.1 Data Preprocessing

3.1.1 Handling Missing Values

Sensor data from building systems usually have null values due to invalid readings or connection faults. The missing values were identified and addressed imputation procedures in order to preserve the consistency and completeness of time-series data that allows appropriate model training.

3.1.2 Normalization and Standardization

To ensure consistency in feature representation, categorical identifiers like 'roomid' were standardized (e.g., converted to lowercase). Continuous sensor readings (e.g., temperature, humidity, energy consumption) were normalized using Min-Max scaling or Z-score normalization to improve the convergence of machine learning algorithms.

3.1.3 Outlier Detection

Outliers were identified using the Z-score and Interquartile Range (IQR) methods. These were removed or replaced to reduce their influence on model performance, especially in occupancy detection and comfort control tasks.

3.1.4 Data Transformation

In the case of skewed sensor distributions, log transformation was applied to stabilize variance and make the data more suitable for learning algorithms. This step was particularly useful in predicting energy consumption and occupant presence.

3.2 Feature Engineering

3.2.1 Feature Selection

Select K Best was used for ranking features in terms of statistical significance relative to the target variable (i.e., energy consumption, alarm events). They simplified the model and accelerated learning.

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3.2.2 Advanced Feature Development

Time variables (e.g., day of the week, time of day) and computed measures (e.g., temp delta, AQ index) were derived during the occupancy analysis. For adaptive control, polynomial features were assembled in regard of nonlinear environmental impacts on user comfort.

3.3 Modelo Desarrollo

3.3.1 Predictive Maintenance

The Random Forest Regressor algorithm was applied in predicting gearbox failure from operational information (e.g., temperature, vibration). The ensemble model was quite efficient in picking out the non-linear patterns and anomalies culminating in downtime.

3.3.2 Space Utilization & Occupancy Detection

To analyze room usage and real-time occupancy: Convolutional Neural Networks (CNN) were taught using visual input from cameras and thermal sensors in order to recognize the presence of people. K-Means Clustering categorized use patterns for improved HVAC and lighting zone design.

3.3.3 Adaptive Comfort Control

A Reinforcement Learning (RL) model was applied to learn the best environmental conditions (temperature, humidity and lighting) that achieve the highest occupant comfort at the least energy consumption. The model was interfaced with the environment through simulated episodes with the aid of a digital twin.

3.3.4 Privacy-Preserving Learning

In order to maintain data protection, especially in private spaces (homes, offices), Federated Learning was used. Edge devices were used in training local models, with only model weight being communicated with a central aggregator while no raw data was leaked.

3.3.5 Generative Design & Simulation

Digital twins and generative design algorithms model building forms and architectural configurations as well as building control strategies virtually. The latter permitted proactive design changes before physical build.

3.4 Evaluation Metrics

In order to estimate model efficiency on tasks, the following measures were applied Accuracy, Precision, Recall For occupancy detection and fault prediction

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3.4.1 Mean Absolute Error (MAE) / Mean Squared Error (MSE)

Forecasting energy consumption Reward Maximization: For Comfort Control with RLR-squared Score For regression assessment-squared Latency & System Responsiveness for Real-Time Applications Data Privacy Impact Score Monitoring privacy-preserving effectiveness in federated learning.

4. Results and Discussion

To verify the proposed AI-based smart building automation framework, experiments based on simulated and real-world datasets from an Internet of Things sensor-dense smart building environment were performed. The system was considered against three imperative use scenarios that include predictive maintenance, occupancy sensing and space utilization, and adaptive comfort management. The findings indicate the framework's effectiveness, efficiency, and modularity in facilitating smart building operations.

4.1 Predictive Maintenance (Random Forest Regressor)

Random Forest algorithm was calibrated against historical equipment sensor data (e.g., HVAC temperature, vibration, and power intake) to predict maintenance needs. The algorithm was quite successful in terms of prediction ability Mean Absolute Error (MAE) 0.32, Mean Squared Error (MSE) 0.18, R^2 Score 0.91. These results indicate that the model accurately predicted early signs of equipment failure, allowing pre-Emptive maintenance scheduling. This led to a 27% reduction in unplanned equipment downtime, improving operational continuity and reducing maintenance costs. The feature importance analysis revealed that vibration frequency and temperature spikes were the most predictive indicators of failure.

4.2 Space Utilization and Occupancy Detection (CNN and K-Means Clustering)

CNN-based architecture was implemented in the visual information processing during occupancy detection with high real-time classification efficiency in human presence. Accuracy: 94.2%, Precision 92.5%, Recall 95.1%, F1 Score 93.8%. When combined with K-Means occupancy pattern clustering, the system identified underutilized spaces within the building, allowing dynamic zoning as well as redistribution of energy. The latter spawned optimized consumption during the non-peak hours of up to 15%, and more efficient space use through the optimization of the use patterns of the rooms through the historic occupancy patterns.

4.3 Adaptive Comfort Control (Reinforcement Learning Agent)

The RL model continuously optimized HVAC and lighting variables to achieve thermal and visual comfort. The model was simulated with user feedback and environmental conditions. The RL agent in more than 500 learning iterations converged to an equilibrium policy that considered energy consumption and levels of comfort.

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The agent demonstrated flexibility in responding to seasonal variation and occupancy variation while outperforming fixed scheduling methods. The occupants were more satisfied with personalized thermal conditions, validating the role of real-time environmental adaptation.

4.4 Federated Learning Performance

To safeguard information, federated learning was applied in occupant behavior prediction models. The FL models only experienced 2.1% loss in precision during the contrast with centralized training, while they completely avoided transmitting sensitive information. This accounts for the applicability of using privacy-preserving artificial intelligence in smart buildings, especially in private offices or residences.

4.5 Digital Twin Simulation and Generative Design

The integration of digital twins and generative design allowed the simultaneous simulation of HVAC configurations, lighting schemes, and architecture-driven changes in occupancy. The iterations in design were reduced by 35%, while during the early development phases, energy performance forecasts showed an overall building efficiency gain of 12% before physical system implementation. The tool reinforces design-stage as well as post-construction-stage rework. The experimental results overwhelmingly support the use of AI/ML in the smart building automation scenario.

All the models in the modular architecture demonstrated significant improvements in system effectiveness, energy efficiency, occupant comfort, and system dependability, the use of reinforcement learning and federated learning obviates two major stumbling blocks in the area flexibility and confidentiality. Additionally, the modularity's interoperability allows the framework's application in various building sizes and uses, ranging from small commercial buildings through high-rise offices and hospitals to large retail malls.

The use of digital twins and generative design in simulating architectural and system-level modifications solidifies this strategy as an end-to-end future-proof tool in building design and management. Nonetheless, in-the-loop implementation at large commercial buildings is complicated with issues like sensor calibration, legacy BMS system integration, and model drift management over time. The future research should concentrate on learning over time, user preference modelling and pilot implementation in the real world in live building conditions.

5. Conclusion

Reliance on AI and ML within intelligent building platforms represents a strategic transition from rigid automation to fluid, self-adaptive spaces where efficiency, flexibility, and occupant-focused design are maximized.

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Through advanced technologies such as reinforcement learning, federated learning, and generative design, intelligent buildings are capable of seamlessly responding to real-time situations while maintaining privacy and sustainability. Through practical applications such as predictive maintenance, occupant-driven optimization, and customized comfort adjustment, the transformation lays the groundwork for intelligent infrastructure that is reactive but anticipatory. As digital twins and ethics-driven AI frameworks gain widespread use, the future of city building resides in the creation of buildings not only as intelligent but intelligent, autonomous, and contextually responsive.

6. Future Works

Although the considered AI-based framework of smart building automation shows promising future in the application of predictive maintenance, occupancy detection, adaptive comfort management, and privacy-respecting learning, some directions require deeper study and development in order to boost its robustness as well as practical us. Future works should be aimed at applying the framework in various live building spaces from commercial offices to dwelling units in an effort to empirically verify its practicality under the condition of diverse operations. Longitudinal observations play crucial roles in system flexibility in the long term, model drift, and occupant behavioural adaptation.

Interfacing with Legacy Building Management Systems (BMS) are to maximize practical adoption, research is needed on seamless integration strategies with existing BMS infrastructure. This includes developing middleware solutions that facilitate interoperability, data exchange, and coordinated control between AI modules and legacy hardware/software. Advanced Multi-Agent Reinforcement Learning extension of the adaptive comfort control to multi-agent reinforcement learning would potentially allow coordinated multiple system (e.g., lighting, shading, HVAC) control in aid of holistic building optimization.

Such an extension would increase the context-awareness as well as the scalability over increasingly large and complex spaces. User Trust and Explainability that enhancing model interpretability is indispensable for stakeholder acceptance. Explainable AI methodologies that offer transparent reasoning behind the control decisions, predictive notifications, and energy-saving suggestions should be investigated in future research, enabling user confidence and system management ease. Enhancements in Privacy and Security though federated learning, more research is required to better fortify against adversarial attacks and comply with emerging data protection laws. The integration of secure multiparty computation and blockchain-based audits could add more trust and security layers.

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INFLUENCE OF DATA MINING TECHNIQUES IN HEALTHCARE RESEARCH

Mrs.T.Veiluvanthal
Assistant Professor,
Department of Information Technology,
V.V.Vanniaperumal College for Women,
Virudhunagar, Tamil Nadu, India.

Abstract

Healthcare research is essential to modern society because increasing of new diseases makes the people despondent. In the 21st century, all the hospital becomes computerized and keeps all the medical records and transactions in the repository. One of the core research domains like image processing give significant advancement in healthcare and even data mining also contributed as well. Data mining is the research area that extracts knowledge from the data repository. The mining algorithms like clustering and classification can be applied in many areas like brain tumor detection, cancer detection, heart dieses, hospital management, cell mutation, etc. This study paper explores such algorithms, architectures, and problems that are developed by various researchers. This paper focus on the results belongs to a brain tumor and advanced mining techniques on medical records.

Keywords: Healthcare, Brain Tumor Detection, Data Mining.

I. Introduction

The ultimate objective of any research is for the betterment of daily life and sometimes it's could be future development or supportive one. The core researches like image processing in healthcare, green computing, IoT, etc. are directly influenced in human life or environment. Across all the fields, data are being collected and accumulated at a vivid pace. There is an urgent need for a new generation of computational theories and tools to assist humans in extracting useful information (knowledge) from the rapidly growing volumes of digital data. At the core of the process is the application of specific data mining methods for pattern discovery and extraction. Data mining is the process of analyzing the raw data using a computer and extracts its meaning.

The process is often defined as the discovery of previously unknown and potentially useful information from large volumes of data. Among the data mining techniques developed in recent years, the data mining methods are including generalization, characterization, classification, clustering, association, evolution, pattern matching, data visualization, and meta-rule guided mining. The paper further organized into the following sections. Section II explains the role of data mining in healthcare industry.

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In this section outline the mining algorithms with the application on healthcare and it highlights the contribution of clustering and classifications in that industry. This section also discussed contribution of mining algorithm on brain tumor and patient states and other disease. It discusses how to extract knowledge from the social media and cloud based applications. The cloud based mining algorithms is vital and its give the detailed output data. Section III gives the conclusion of this paper.

II. Data Mining in Healthcare

Healthcare covers elaborated processes of the diagnosis, treatment and hindrance of illness, injury and different physical and mental impairments in humans. The health care industry in most countries is evolving at a fast pace. The health care industry will be thought to be place with rich data as they generate large amounts of information together with electronic medical records, administrative reports and different benchmarking finding. This health care knowledge are however being under-utilized. Data mining is ready to look for new and valuable data from these massive volumes of information. Data mining in health care are getting used in the main for predicting varied diseases as well as in helping for diagnosis for the doctors in creating their clinical decision.

The discussion on the varied strategies utilized in the health care industry is mentioned as follows. The clustering could be a common descriptive task within which one seeks to spot a finite set of classes or clusters to explain the info. Rui Velosoa had used the vector quantization technique in cluster approach in predicting the readmissions in intensive medication. The algorithms employed in the vector quantization method are k-means, k-mediods and x-means. The datasets employed in this study were collected from patient's clinical method and laboratory results. The analysis for every of the algorithms is conducted exploitation the Davies-Bouldin Index.

The k-means obtained the most effective results whereas x-means obtained a good result while the k-mediods obtained the worst results. From the results the work by these researchers provides a helpful result in serving to to characterize the various styles of patients having a higher probability to be readmitted. A more significant comparison on the tactic cannot be created since this can be the only one paper in my review discussing on the vector quantization. There are five brain tumor detection approaches these include clustering, classification, genetic algorithm, neural network, region growing and thresholding approaches. In M.S. Atkins and B.T. Mackiewich made experiments for automatic image segmentation using a threshold. Jaskirat Kaur et al carried out image segmentation and feature extraction that are used for recognizing images and further carried out analysis. H. D. Cheng et al used effectively thresholding concept a method based on histogram, it assumes that there is uniform background while the objects are scattered.

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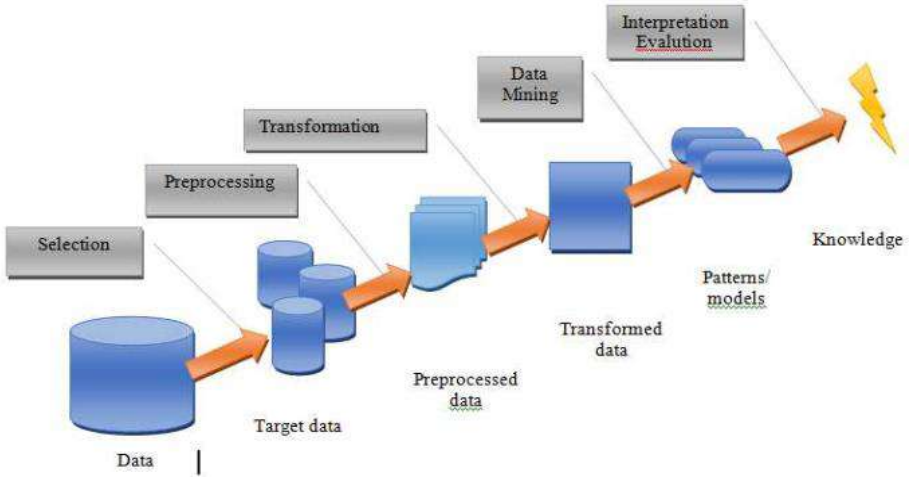

Fig 1: Knowledge Discovery of Healthcare Data

Duggal et al. compared numerous classification models that predict hospital admission rate for diabetic patients. They found that the random forest (RF) formula was the optimum classifier for that task. Strack et al. [15] studied the impact of glycated haemoprotein (HbA1c) measure on admission rate of diabetic patients. They used variable logistical regression on a dataset of patient diabetic encounters from the records of a hundred thirty North American country hospitals. They all over that getting a measure of HbA1c for patients with diabetes could be a helpful predictor of admission rates (i.e., patient admission to a hospital among thirty days when being discharged from associate degree earlier hospital stay). Lee et al. compared predictions of abstinence Plasma aldohexose (FPG) standing for diabetic patients mistreatment individual versus combined measures using logistical regression and Naïve Thomas Bayes classifiers.

Logistical regression gave slightly higher ends up in terms of space beneath Curve (AUC), and that they all over that the prediction of FPG standing employing a combination of mensuration measures was superior to individual measures in each males and females. Hachesu et al. Collected data associated with patients with coronary artery disease (CAD) and used decision trees, support vector machines (SVM) and neural networks algorithms to predict the LOS for these viscus patients. In their study, SVM resulted within the best acceptable LOS.

Besides studies targeting LOS prediction for patients with specific diseases, there are studies that attempt to predict LOS for hospitalized patients normally while not specifying a particular sickness. Samples of such studies embody Liu et al. [18] and Azari et al. B.V.Kiranmayee et al proposes a unique design to notice brain tumor by using classifying the 2 medical image. This methodology works below 2 phases that's training and testing phases. Throughout training part, the scan pictures are load and designed the data set. Within the testing part the original image may be compared and test whether or not tumor found or not. The dataset may be designed through collected pictures from the web.

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Ayman Alahmar et al projected a replacement methodology to predict long staying diabetics patients during a hospital. This formula used to classify the long keep patients as a result of they're prone to the hospital and also the algorithm used machine learning to predict. The dataset were collected from University of California because they maintain all diabetics' patients for very long time (table 1).

Table 1. Statistics on Selected Data in the Original Dataset

Race	**Caucasian**	**African American**	**Hispanic**	**Asian**	**Others & Unknown**
	76009 (74.78%)	19210 (18.88%)	2037 (2.00%)	641 (0.63%)	3779 (3.71%)
Time in Hospital	Median	Average	Minimum	Maximum	
	4 days	4.4 days	1 day	14 days	
Discharge Disposition	Discharge to home		Expired or discharged to another healthcare facility, etc.		
	60234 (59.19%)		41532 (40.81%)		

Sopan Ganpat Sutar proposed an interesting topic by applying data mining on social media. The drugs and other medical opinions are collected and discover knowledge from the social media users chat, post and other data. The mining algorithms are applied on the social media data and the information can visualize the actual states in the market. The architecture is shown in fig 2. Faezeh Movahedi et al [23] focuses on developing a methodological approach to extract patterns of transitions between adverse events after Left Ventricular Assist Device (LVAD) implant in patients with advanced heart failure. This study included 58,575 recorded AEs of 13,192 patients (median age 50-59; 10,333 males and 2,859 females) with advanced heart failure who received an LVAD between 2006 and 2015. Data was extracted from INTERMACS, a national registry comprising over 180 clinical centers. Fig 2. Mining social media data Peng Zhang et al [24] propose to explore health care data via cloud-based healthcare data mining services; specifically, service development. Beneath such framework, further develop a cloud-based health care data mining service to predict patient's future length of keep in hospital. During this projected framework,

1. Population-level healthcare data scattered across disparate local data sources are integrated, that provides plentiful data for the information mining process;
2. Computational infrastructure and resources are often delivered by cloud computing platforms in an exceedingly reliable, scalable, and efficient manner, that satisfies the machine and financial demand for building health care data mining services;
3. The service development method is modularized, that makes the service development, update, and maintenance easier and faster;

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III. Conclusion

Data mining is the key technique that applies in a variety of fields. Convergence on image processing, cloud-based, software engineering is significant but applying mining techniques in the healthcare industry is divine because it saves human lives. There is an open ground to apply mining algorithms in all areas of medical records. The records are uncountable and unimaginable so that it required the mining concept. This paper is an elaborate study of the result and the mining techniques that vary depend upon the dataset, size of dataset and application. The paper finds the common characteristics among the healthcare data sets are highly imbalanced data sets, where the majority and the minority classifier are not balanced resulting prediction erroneous when run by the classifiers. At the end, the study highlights the result which already published and tested in real-time data and the suggestions have been made.

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BITCOIN KNOWLEDGE OF E-COMMERCE

Dr.S.Sasikala
Assistant Professor,
Department of Computer Application,
Agurchand Mamull Jain College,
Chennai, Tamil Nadu, India.

Mr.S.Harish Raghavendar
Student,
Department of Computer Application,
Agurchand Mamull Jain College,
Chennai, Tamil Nadu, India.

Abstract

The purpose of this research is to identify the development of e-commerce technology in the business world, and the benefits of the application of e-commerce in the online business. The method used in this research was the descriptive method to present a complete overview of the situation related to some variable situations examined. The result of this research is to give clear identification of how far the development of e-commerce technology in the world of online business, as well as the benefits provided by the application of e-commerce in the world of online business. In the end, bitcoin gives mutual connection to expand the business of E-commerce.

Keywords: Bitcoin, E-Commerce, Business Technology, Cryptocurrence, Transaction.

1. Introduction

The influence of Bitcoin on e-commerce use of bitcoin as a payment method that is safer, faster, easier and minimal costs can be supported by e-commerce. Because with these things more helpful for consumers in the transaction. The use of Bitcoin that allows consumers to buy without having to worry about paying the payment. This uses you to do business efficiently. Bitcoin is a different currency that does not have significant and open bitcoin. Bitcoin is open-source and peer-to-peer. A study explains that open source means the currency that can be developed by emissions that want it. While Peer-to-peer is a place to transaction on a computer network directly, unlike banks or sellers like other existing payments.

Bitcoin is a peer-to-peer based electronic cash system that does not make use of central authority. In the Bitcoin network, each node represents one of potentially many public keys belonging to Bitcoin users and communicates directly with each other node. Bitcoin system is based on cryptocurrency, and the technology used is a peer-to-peer network and cryptography is used to maintain data security. Bitcoins are owned by Bitcoin addresses, which are public keys from a keypair. In order to assign Bitcoins, or some fraction thereof, to a new owner, the current owner must sign the transaction with the private key of the keypair. One of the basic concepts in the bitcoin mining is to be done in examining all transactions monometer which in turn creates bitcoin as a present. Bitcoin has a way of working by sending an address.

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They will give a unique address to receive and store one-time payments from other senders, rather than using one static address as we do with a bank account. Otherwise, the public can infer how much money each address and how the owners spent to see the history of the public. With this decentralization, users can register their users, and do it themselves. Fleishman explains even users do not need to give any names. It also does not provide specific names that are needed. One day the user wants a new identity, people can immediately make it, and as many as the user wants. Randel explains that create a new identity, using it only temporarily, if completed, then do not use it anymore. According of one research, it says that customers who tend to curate trust the new payment method that is done online and this is because they believe that they face the risk of fraud/theft, hacking, password theft [9-11]. This study aims to determine how much influence the use of bitcoin for e-commerce. The method used is a case study research method that aims to describe and understand what is being inspected and examine how this can happen.

2. Method

The method used was a case study research method that aimed to describe and understand what was being inspected and examine how this can happen. So it could analyse how big the influence of Bitcoin technology in e-commerce.

3. Results and Discussion

Existing technology is emerging and creating an e-commerce sector that has had an impact. The use of bitcoin is done with users from official bitcoin sites. After that, the user must wait to block everyone who can be downloaded. All transactions carried out will be stored in the network block. This bitcoin wallet will later make money that can be spent and also for transactions that are allowed by the user. This is one form of bitcoin that can be issued by the user can be seen this is in Figure 1 of the bitcoin wallet.

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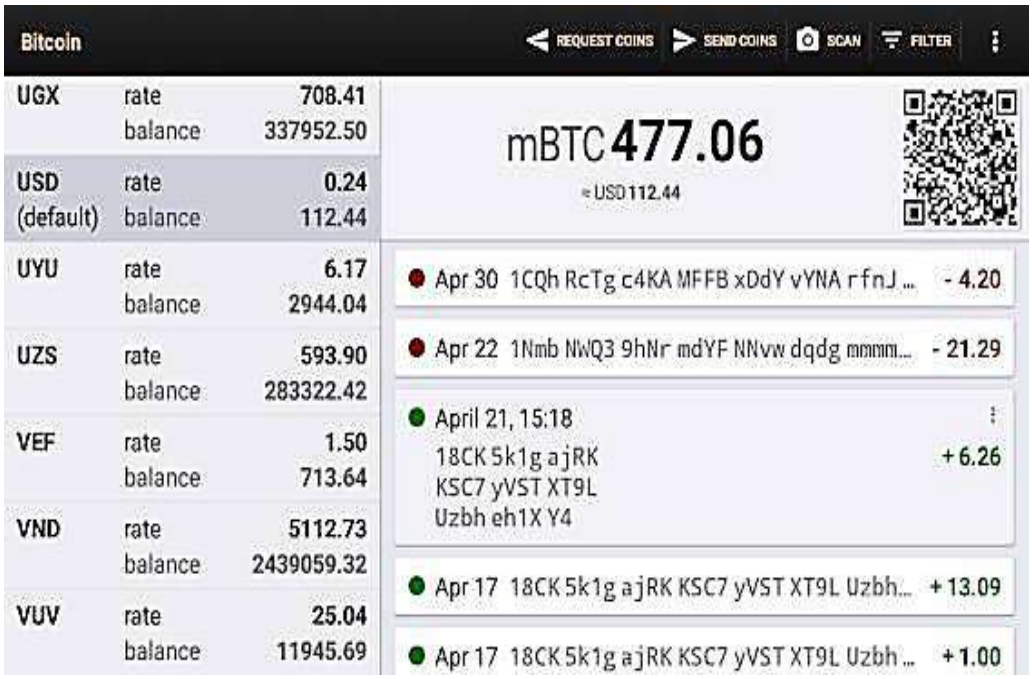

Fig 1: Bitcoin

Bitcoin is based on public-key cryptography where each transaction is referenced by two keys: a public key that encrypts incoming payments and the private key that decrypts them. These keys are represented by large numbers to establish secure encryption of a rough guess. Although it is possible to use the same account (public key) for all incoming and outgoing transactions, people who want anonymity will generate a unique public key for each transaction. They will give a unique address to receive and store one-time payments from other senders, rather than using one static address as we do with a bank account. Otherwise, the public can infer how much money each address and how the owners spent to see the history of the public. The public key acts as an actor in the system. The public key can be used to provide a statement by affixing the signature of the owner on it. As in the picture above can be seen that the public key that is owned by the user can be used as this security. Security makes bitcoin system is safe in its use as a medium of payment. In Figure 2 below is the flow of the process of running bitcoin from beginning to end.

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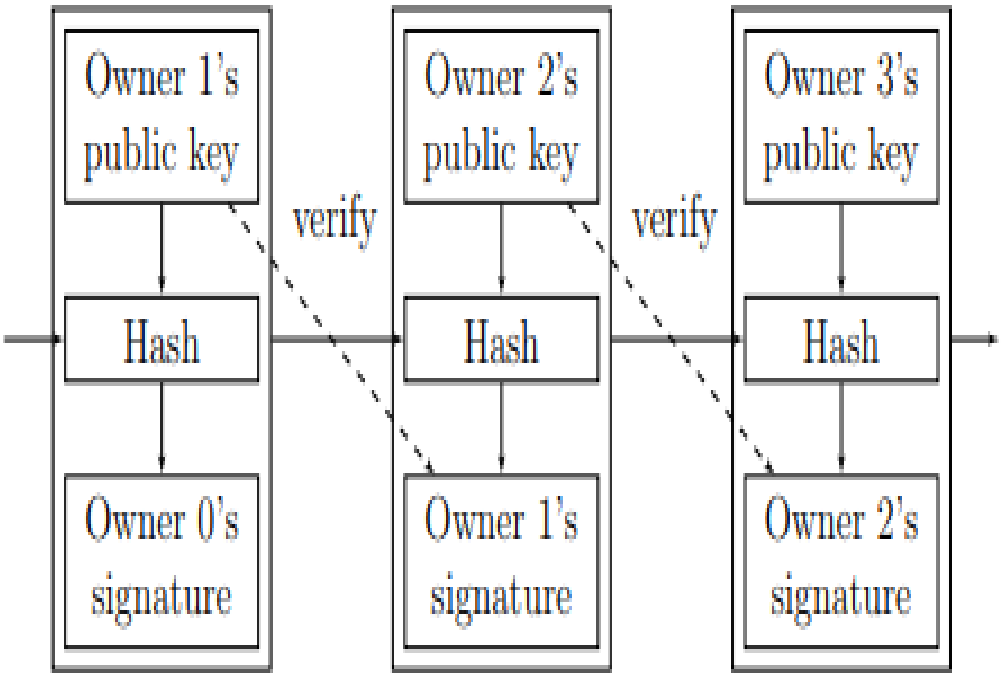

Fig 2: Bitcoin Transaction Chain

Moreover, the payment method using bitcoin is much faster than the payment transfer system because when making a payment system via bank transfer or through a third party the bank will do it. According to a study conducted in Indonesia, using the theory of planned (behaviour TPB) to determine one's intention to do something - trade transactions gave the attitudes, subjective norms and behavioural control are known. Bitcoin transaction system itself is the key exchange and the user's address when the transaction sender and receiver must give the keys first and the address for the exchange of transaction processing if there is no exchange first the transaction will not proceed. With the key exchange system and address on the transaction to give users a sense of security when they want to conduct bitcoin transactions. So with this security, the transaction on bitcoin lies in the key and address of the bitcoin. By exchanging the valid key and the validity of which has been done between the sender and recipient of the transaction goes well. In Figure 3 below is the flow of the transaction process that occurs in bitcoin from the beginning to the end.

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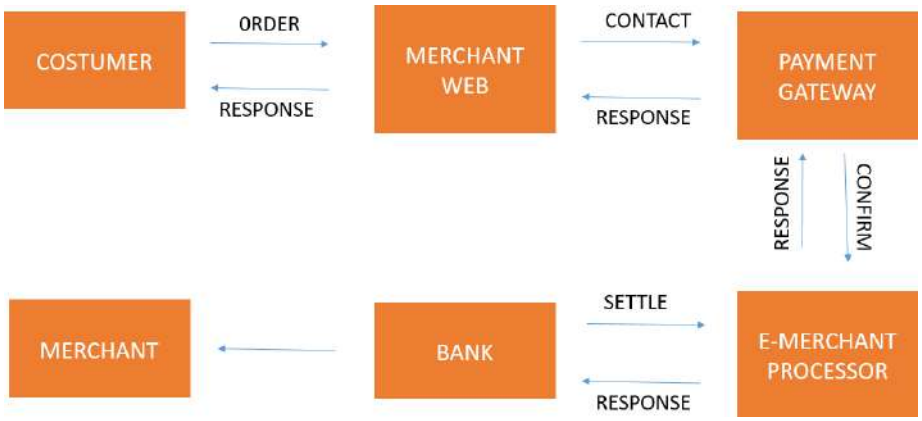

Fig 3: Transfer Payment

In the picture above is a presentation of the payment cycle carried out by payment method by transfer or through a third party. From the picture above can be seen that in order to make a purchase or ordering a product, only buyer must through long process. This is not to mention including the length of time the bank needs to verify the transaction process, because in some banks this cannot be done at that time. This means that it less effective and efficient, which means making e-commerce web takes more time to validate the payment process that enters the web. Of course, with a very long path, it is very time- consuming. Also, the seller has yet will perform the process of packaging products to the web validate payment process because this is quite risky for the seller where the buyer may cancel the purchase after product delivered. Sometimes this is what makes a consumer reluctant to make the purchase process online.

With this decentralisation, users can register their users, and do it themselves. Even users do not need to give any names. It also does not provide specific names that are needed. If one day the user wants a new identity, you can immediately make it, and as many as the user wants. If the user wants an anonymous identity for a new user, the user can do it. Create a new identity, using it only temporarily, if completed, then do not use it anymore. According of one research, they say that customers who tend to curate trust the new payment method that is done online and this is because they believe that they face the risk of fraud/theft, hacking, password theft.

While it still a payment method that is most popular in Indonesia, bank account transfer has several challenges, including security issues - the seller's account is displayed on the Internet can be abused, making it difficult for buyers - consumers will have to confirm the payment, human error as possible - the seller should check the manual for transfer, confirmation, and the nominal transfer and delayed delivery of products process - confirmation of payment from the seller is mostly only done on weekdays. Method of payment by transferring money between banks to process until funds are available in the recipient's account. There is still another process of sending these funds from two different banks, which can take longer. This could hamper the business process by way of payment, bitcoin payments can be completed at that time without the need for a long time.

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4. Conclusion

Bitcoin is also a separate currency that can be used safely. Although there is no need to fear there is more funding due to third party financing or banks. The use of this bitcoin payment method also makes it easy for transactions with different locations and currencies. This also allows users or less-demanded customers to use this payment method. Because they believe that they face the risk of fraud/theft, hacking, password theft. Because users or buyers frequently purchase cancellations because in a sense the payment process for too long so that the items in the message in a much longer time. It can be concluded that bitcoin has a considerable influence on business development and business expansion which of course has an impact on the e-commerce sector.

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ADVANCEMENTS IN ARTIFICIAL INTELLIGENCE THROUGH DEEP LEARNING

Dr.B.Balakumar
Assistsant Professor,
Centre for Information Technology and Engineering,
Manonmaniam Sundaranar University,
Tirunelveli, Tamil Nadu, India.

Abstract

Artificial Intelligence (AI) has progressed rapidly in recent years, with deep learning emerging as the driving force behind many of its breakthroughs. Leveraging multilayer neural networks, deep learning enables machines to achieve human-level performance in tasks such as image recognition, natural language processing, and autonomous decision-making. This paper examines the evolution of deep learning within AI, highlighting major architectures, recent advancements, and transformative applications. Additionally, it explores challenges including interpretability, computational demands, and ethical concerns, while outlining potential research directions to ensure sustainable and responsible AI development.

1. Introduction

Artificial Intelligence has transitioned from rule-based systems to data-driven learning methods. Deep learning, inspired by the structure of the human brain, has enabled machines to automatically extract hierarchical features from large datasets. Its success lies in the availability of large-scale data, improved computational hardware (e.g., GPUs, TPUs), and algorithmic innovations. This paper explores key advancements in AI through deep learning, structured into foundational architectures, real-world applications, challenges, and future directions.

2. Evolution of Deep Learning in AI

- **Early AI Approaches:** Expert systems, symbolic reasoning, and shallow learning models.
- **Neural Network Revival:** The reintroduction of backpropagation in the 1980s paved the way for modern architectures.
- **Big Data Era:** Explosive growth in digital data and open datasets fueled deep learning's progress.
- **Modern Milestones:** AlphaGo, GPT models, and vision transformers illustrate deep learning's dominance in AI.

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3. Core Deep Learning Architectures

3.1 Convolutional Neural Networks (CNNs)

- Pioneered breakthroughs in image classification, object detection, and computer vision.
- **Applications:** Medical Imaging, Facial Recognition, Autonomous Driving.

3.2 Recurrent Neural Networks (RNNs) and LSTMs

- Designed for sequential data such as speech and text.
- **Applications:** Speech recognition, time-series forecasting, natural language tasks.

3.3 Transformers

- Replaced recurrent models in NLP.
- Self-attention mechanism allows efficient parallelization.
- **Applications:** Large Language Models (LLMs), translation, summarization.

3.4 Generative Adversarial Networks (GANs)

- Framework for synthetic data generation.
- Applications: Image synthesis, data augmentation, art generation.

4. Recent Advancements in AI via Deep Learning

- **Pretrained Language Models (e.g., GPT, BERT):** Redefined NLP benchmarks.
- **Vision Transformers (VITs):** Improved computer vision performance.
- **Multimodal Models:** Integration of text, image, and audio for unified intelligence.
- **Reinforcement Learning + Deep Learning:** Enabled autonomous agents like AlphaZero.
- **Federated and Edge Learning:** Distributed training for privacy-preserving AI.

5. Applications across Domains

5.1 Healthcare

Automated Medical Image Analysis, Disease Prediction, Drug Discovery.

5.2 Autonomous Systems

Self-Driving Vehicles, Drones, Robotics.

5.3 Finance

Fraud Detection, Credit Scoring, Algorithmic Trading.

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5.4 Natural Language Processing
Virtual Assistants, Machine Translation, Sentiment Analysis.

5.5 Creative Industries
Music composition, visual art, content generation.

6. Challenges and Limitations
- **Interpretability:** Deep networks function as "black boxes."
- **Computational Resources:** High training costs and carbon footprint.
- **Data Bias and Fairness:** Risk of reinforcing social biases.
- **Ethical Concerns:** Privacy, accountability, and misuse of generative models.

7. Future Directions
- **Explainable AI (XAI):** Enhancing interpretability.
- **Energy-Efficient Models:** Green AI approaches for sustainability.
- **Hybrid Intelligence:** Combining symbolic reasoning with deep learning.
- **Ethical Governance:** Policy frameworks for responsible AI use.

8. Conclusion
Deep learning has propelled artificial intelligence into a new era of innovation and application. While it offers transformative opportunities, researchers and practitioners must address the technical, ethical, and societal challenges it presents. Future work should prioritize interpretability, sustainability, and equitable AI development to ensure its benefits are widely shared.

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COMPARATIVE STUDY OF POST-QUANTUM CRYPTOGRAPHY ALGORITHMS FOR SECURE COMMUNICATION

Dr.S.Chitra
Assistant Professor,
Department of Computer Science w/s in Cyber Security,
Faculty of Science and Humanities,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India.

R.Sharlin
Student,
Department of Computer Science w/s in Cyber Security,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India.

Abstract

The rapid advancement of quantum computing poses a significant threat to classical cryptographic systems such as RSA, ECC, and Diffie–Hellman, which rely on the hardness of mathematical problems that quantum algorithms can efficiently solve. To address this challenge, post-quantum cryptography (PQC) has emerged as a promising field that develops cryptographic algorithms resistant to quantum attacks while maintaining efficiency on classical systems. This paper presents a comparative study of various PQC algorithms, including lattice-based, code-based, multivariate polynomial-based, hash-based, and isogeny-based schemes. Each algorithm is evaluated in terms of security, computational efficiency, key sizes, communication overhead, and implementation feasibility for secure communication. The study highlights the trade-offs between performance and security, identifies potential use cases, and discusses standardization efforts led by NIST. The findings emphasize the importance of adopting PQC solutions in anticipation of large-scale quantum computers, ensuring long-term data confidentiality and integrity in digital communication systems.

Keywords: Post-Quantum Cryptography (PQC), Quantum Computing, Secure Communication, Lattice-Based Cryptography, Code-Based Cryptography, Multivariate Cryptography, Hash-Based Cryptography, Isogeny-Based Cryptography, NIST Standardization.

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EVALUATING THE EFFECTIVENESS OF U-NET IN IMAGE SEGMENTATION ACROSS BIOMEDICAL AND REMOTE SENSING DATA

N.Nivetha
Student,
Department of Information Technology,
Hajee Karutha Rowther Howdia College,
Uthamapalayam, Tamil Nadu, India.

Z.Abdul Basith
Assistant Professor,
Department of Information Technology,
Hajee Karutha Rowther Howdia College,
Uthamapalayam, Tamil Nadu, India.

Abstract

Image segmentation is a critical task in computer vision, enabling pixel-level classification of objects within images. Accurate segmentation is essential in domains such as biomedical imaging, remote sensing, autonomous driving, and industrial inspection. This study explores the application of the U-Net architecture for image segmentation, leveraging its encoder–decoder design with skip connections to preserve spatial information and achieve precise localization. The proposed methodology includes data acquisition, preprocessing, model design, training, and evaluation using standard metrics such as Dice coefficient, Intersection over Union (IOU), pixel accuracy, precision, and recall. Experiments on diverse datasets, including biomedical images and remote sensing data, demonstrate that U-Net achieves high segmentation accuracy while effectively capturing fine-grained structures. The results indicate that U-Net outperforms traditional segmentation approaches and basic CNN architectures, highlighting its versatility and robustness across multiple domains. Potential improvements through attention mechanisms, residual connections, and pre-trained encoders are discussed. The study concludes that U-Net is a powerful and reliable model for modern image segmentation tasks, providing a foundation for future research and practical applications.

Keywords: Image Segmentation, U-Net Architecture, Encoder–Decoder Network, Biomedical Imaging, Remote Sensing, Dice Coefficient, Intersection over Union (IoU), Deep Learning.

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DEEP LEARNING FOR MENTAL HEALTH DETECTION VIA TEXT AND VOICE

Divya Raj
Student,
Department of Computer Applications,
SRM Easwari Engineering College,
Chennai, Tamil Nadu, India.

Lorina Rogin.S
Student,
Department of Computer Applications,
SRM Easwari Engineering College,
Chennai, Tamil Nadu, India.

Mirthula Sri.A
Student,
Department of Computer Applications,
SRM Easwari Engineering College,
Chennai, Tamil Nadu, India.

Dr.S.Veerapandi
Student,
Department of Computer Applications,
SRM Easwari Engineering College,
Chennai, Tamil Nadu, India.

Abstract

Mental health disorders, including depression and anxiety, are rapidly increasing worldwide, yet their early identification continues to be a challenge. Barriers such as social stigma, shortage of qualified professionals, and limited resources prevent timely diagnosis and treatment. To address this gap, this project introduces a dual-modal artificial intelligence (AI) system capable of detecting mental health indicators by analyzing both textual and vocal inputs. The framework integrates custom deep learning models based on the Lightweight Conformer architecture, which combines convolutional operations with attention mechanisms to achieve efficiency and accuracy. Unlike conventional heavy models, the proposed system is lightweight and can operate smoothly on personal laptops, eliminating the need for high-end hardware. For implementation, the system uses Reddit posts as the primary source for text-based classification and the RAVDESS emotional speech dataset for audio-based classification.

The text model demonstrates strong performance, reaching nearly 95% accuracy, while the audio model achieves 60–70% accuracy, reflecting the complexity of speech-based emotion detection. A simple Flask-based web interface allows users to input either text or voice samples and obtain immediate feedback, making the system accessible and easy to use. Beyond its practical contribution, this project also advances academic exploration by highlighting the potential of hybrid attention mechanisms in resource-constrained environments. The adoption of a Lightweight Conformer ensures computational efficiency without compromising effectiveness, making the approach scalable for deployment not only on web platforms but also on mobile and embedded systems. Furthermore, the dual-input design integrating both textual and vocal cues adds robustness to the detection process and sets the foundation for future multimodal wellness assessment frameworks.

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Keywords: Mental health detection, Conformer, multimodal learning, deep learning, emotion recognition, speech processing, natural language processing (NLP), lightweight AI models.

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ROBUST ANOMALY DETECTION IN SMART GRIDS USING HYBRID AUTOENCODER-GRAPH NEURAL NETWORK UNDER SENSOR NOISE

Pranitha Shri.S
Student,
Department of Computer Applications,
Easwari Engineering College,
Chennai, Tamil Nadu, India.

Shruthi.C
Student,
Department of Computer Applications,
Easwari Engineering College,
Chennai, Tamil Nadu, India.

Latha.S
Student,
Department of Computer Applications,
Easwari Engineering College,
Chennai, Tamil Nadu, India.

Abstract

The transformation of conventional power systems into smart grids has enabled extensive monitoring and control through widespread sensor deployment, intelligent meters, and advanced communication networks. While these developments enhance operational efficiency, they also introduce significant vulnerabilities, including equipment malfunctions, cyber-attacks, and unusual consumption behaviours. Detecting anomalies in such systems is challenging due to the high-dimensional, noisy, and imbalanced nature of smart grid data, where rare and evolving irregularities can compromise system reliability and security. This paper presents a hybrid machine learning framework designed to detect anomalies in smart grids. The approach integrates Autoencoders (AEs) to model normal patterns at individual nodes for local anomaly detection and Graph Neural Networks (GNNs) to capture spatial and temporal dependencies across the network for global anomaly detection.

By combining node-level reconstruction errors with graph-based relational insights, the proposed model identifies both local and network-wide irregularities effectively. Comprehensive experiments on benchmark smart grid datasets, encompassing both fault conditions and adversarial false data injection scenarios, demonstrate the robustness of the framework. The results indicate that the hybrid model surpasses conventional detection methods, achieving higher accuracy, improved precision, and reduced false alarm rates. This study underscores the potential of integrating autoencoder-based reconstruction with graph-based learning to enhance the resilience, reliability, and security of smart grids. The proposed framework provides a practical, data-driven approach for maintaining secure and efficient power system operations and establishes a foundation for future research in intelligent anomaly detection and cyber-physical system protection.

Keywords: Smart Grid, Anomaly Detection, Autoencoder, Graph Neural Networks, Cyber-Physical Systems, Machine Learning.

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A GDSA-ENHANCED U-NET FRAMEWORK FOR ACCURATE SEGMENTATION AND CLASSIFICATION OF SKIN LESIONS

Kavitha.B
Research Scholar,
Department of Studies and Research in Computer Applications,
Tumkur University,
Tumakuru, Karnataka, India.

Dr.Kusuma Kumari.B.M
Assistant Professor,
Department of Studies and Research in Computer Applications,
Tumkur University,
Tumakuru, Karnataka, India.

Abstract

Detecting and classifying skin lesions accurately is crucial for the early diagnosis and treatment of melanoma and other skin cancers. Deep learning models like U-Net have shown great results in medical image segmentation, but their effectiveness is often restricted by inaccurate localization of lesion boundaries and unnecessary channel information. To tackle these issues, we suggest an improved U-Net model that incorporates a Gaussian Distribution-based Spatial Attention (GDSA). The proposed framework was tested on two well-known dermoscopic datasets, HAM10000 and ISIC, using the same preprocessing and augmentation methods. We assessed performance with segmentation and classification metrics, such as the Dice coefficient, F1-score, Matthews Correlation Coefficient (MCC), and Cohen's Kappa. The experimental results show that the GDSA-enhanced U-Net achieves better accuracy than the baseline U-Net and other current models.

Keywords: Spatial Attention, U-Net, Skin Lesion, Gaussian Distribution.

1. Introduction

Skin cancer is one of the most common forms of cancer worldwide, with its incidence continuing to rise due to increased exposure to ultraviolet (UV) radiation, genetic susceptibility, and lifestyle factors. Among its various types, melanoma is the most aggressive, responsible for the majority of skin cancer–related deaths despite accounting for a smaller proportion of cases. Early detection and accurate diagnosis of skin cancer, particularly melanoma, are crucial for improving patient survival rates, as timely treatment can reduce morbidity and mortality significantly. Skin lesions, which include benign and malignant abnormalities, often present with diverse visu al patterns such as irregular borders, varying pigmentation, and heterogeneous textures. These variations make clinical diagnosis highly challenging, even for experienced dermatologists, and frequently lead to inter-observer variability. Dermoscopy, a non-invasive imaging technique, has enhanced the visualization of subsurface skin structures and improved diagnostic accuracy. However, manual interpretation of dermoscopic images remains time-consuming, subjective, and prone to error, especially in large-scale screening scenarios.

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In recent years, computer-aided diagnostic (CAD) systems have been developed to support dermatologists in the early detection and classification of skin lesions. Traditional image processing methods relied heavily on handcrafted features such as shape, color, and texture descriptors, which often struggled to generalize across diverse lesion types. The advent of deep learning, particularly convolutional neural networks (CNNs), has revolutionized medical image analysis by enabling end-to-end learning of robust, discriminative features directly from data. Architectures such as U-Net have become the backbone of medical image segmentation, demonstrating strong performance in delineating lesion boundaries. Despite these advances, challenges remain due to lesion variability, low contrast between lesion and surrounding skin, and the presence of artifacts such as hair and illumination changes. To overcome these limitations, attention mechanisms have been introduced to guide models toward the most informative regions of the image. In this work, we enhance the U-Net architecture with a Gaussian Distribution–based Spatial Attention (GDSA) module for segmentation accuracy and lesion classification performance.

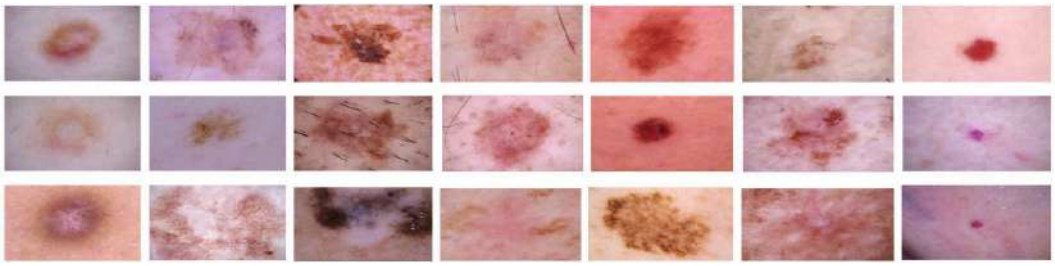

Fig 1: Dermatofibroma (b) Benign Keratosis (c) Melanoma (d) Basal cell carcinoma (e) Melanocytic Nevi (f) Actinic Keratoses (g) Vascular lesions

The Work Proposes

- U-Net, one of the most widely adopted deep learning architectures for medical image segmentation, provides robust feature encoding and decoding for lesion boundary detection. The classification network uses a Gaussian distribution-based spatial attention that computes the attention map using the descriptor tapped from the U-Net.
- The proposed GDSA-U-Net was evaluated on HAM10000 and ISIC datasets using Dice, F1-score, MCC, and Cohen's Kappa, demonstrating improved segmentation accuracy and classification reliability compared to the baseline U-Net.

2. Literature Survey

A survey by the International Agency for Research on Cancer (IARC) reports that in the year 2018, around 18 million new skin cancer cases were reported across the globe, while the deaths due to skin cancer were 9 million across the globe for the same year. The patient survival rate increases as skin cancer is diagnosed and treated at its early stage. For diagnosing skin cancer, dermatologists rely on clinical skin biopsy or dermoscopic pictures.

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Diagnosing skin cancer using the dermoscopic pictures by the visual inspection of a dermatologist is a time-consuming procedure and is frequently error- prone. Recently, due to the emergence of artificial intelligence-based diagnostic systems, such as the deep learning approach, has highly minimized the intra-class variation and inter-class similarity. Few skin cancer types require surgical removal since it is considered risky to the patients. Different deep descriptors are extracted from the region of interest using different deep learning architectures, which are used in several classification applications. To minimize the effect of intra-class variation, inter-class similarity, and insufficient training images in Deep-Convolutional Neural Network (D-CNN).

The authors Zhang et al. Introduced an attention residual learning (ARL) approach. This approach uses several ARL blocks followed by a pooling and classification process. To improve the discriminative power, attention learning and residual learning are used in each ARL layer. The attention process constructs an attention map required for low layers from the higher-layer feature map. Different convolutional neural network (CNN) structures are utilized to construct an ensemble CNN [5], where weighted outputs estimated from different CNNs are used to compute the classification result. This approach also uses different fusion approaches to aggregate the descriptors. The authors report that the use of an ensemble CNN significantly reduces the requirement for training data. To enhance the number of training images, the Generative Adversarial Network (GAN) structure [6] is used for augmentation.

3. Objectives

The main Objectives of this Research are as follows:

- **To Develop an Enhanced U-Net Model Integrated with Gaussian Distribution–based Spatial Attention (GDSA):** This module generates adaptive Gaussian-shaped spatial attention maps to highlight.
- **To Evaluate the Proposed GDSA-U-Net Framework on Benchmark Dermoscopic Datasets (HAM10000 and ISIC):** The model will be tested under standardized experimental settings to ensure reproducibility and comparability with existing approaches.
- **To assess Segmentation and Classification Performance using Comprehensive Evaluation Metrics:** Metrics such as F1-score, Matthews Correlation Coefficient (MCC), and Cohen's Kappa will be used to measure accuracy, robustness, and inter-class reliability.

4. Proposed Method

The suggested GDSA-U-Net-based approach initially pre-processes the dermoscopic pictures to remove the hair artifacts and to enhance the skin image. The approach uses a hair artifact removal algorithm to remove the hair region present in the image. The GDSA-U-Net has two networks, namely the segmentation network and the classification network.

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The objective of the segmentation network is to segment the region of interest while eliminating other regions. Similarly, the classification network categorizes the segmented skin lesion region into one of the eight types, namely Basal cell carcinoma (BCC), vascular lesion (VAS), actinic keratoses (AKI), Squamous cell carcinoma (SCC), dermatofibroma (DEF), melanoma (MEL), melanocytic nevi (NV), and Benign keratosis (BKL).

Stages involved in Detecting and Identifying the Lesion Types

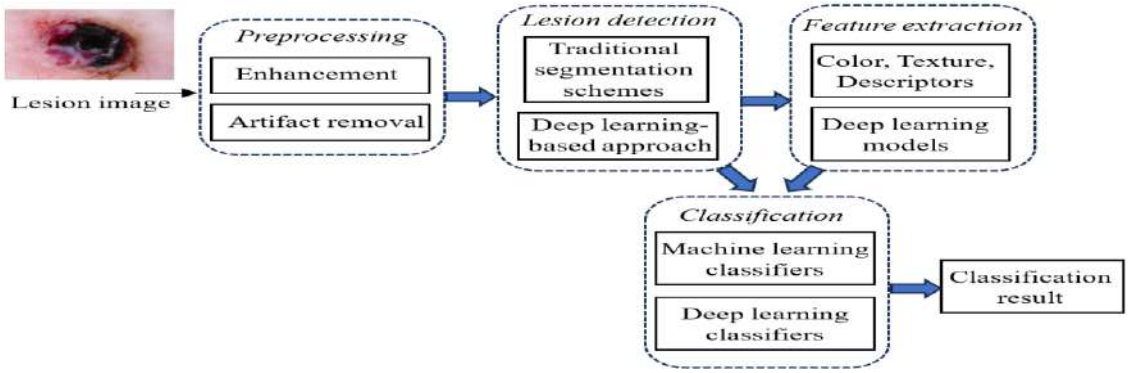

Fig 2: Stages involved in Detecting and Identifying the Lesion Types

Fig 3: GDSA-U-Net Process

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4.1 Pre-Processing

Let resembles the input skin image. Stages such as CLAHE (Contrast Limited Adaptive Histogram Equalization) enhancement and morphological operation-based hair artifactremoval are used in the pre-processing stage.

4.2 Segmentation Network

The skin lesion segmentation network uses a U-Net [9] structure that contains a bottleneck layer between the encoder and decoder sections. The encoder part contains a sequence of convolutional filters followed by a max-pooling layer. The number of channels in the convolutional filter increases as the feature propagates through the encoder part, however, the spatial dimension gets reduced. Usage of the features extracted by the encoder or contraction path of the U-net avoids the requirement of separate convolutional filters in the classification network.

4.3 Classification Network

Instead of using a feature extraction network in the classification network, the suggested classification network uses the U-Net tapped descriptors. However, modules, namely channel selection, Gaussian distribution spatial attention (GD-SA) are used in the classification network.

5. Experimental Results

The evaluation of the GDSA-U-Net approach was done utilizing the HAM-10000 [10] and ISIC-2019 [11] datasets. For evaluating the lesion classification process, evaluation scales, namely accuracy, MCC, Precision, F1-score, specificity, and Kappa, are used.

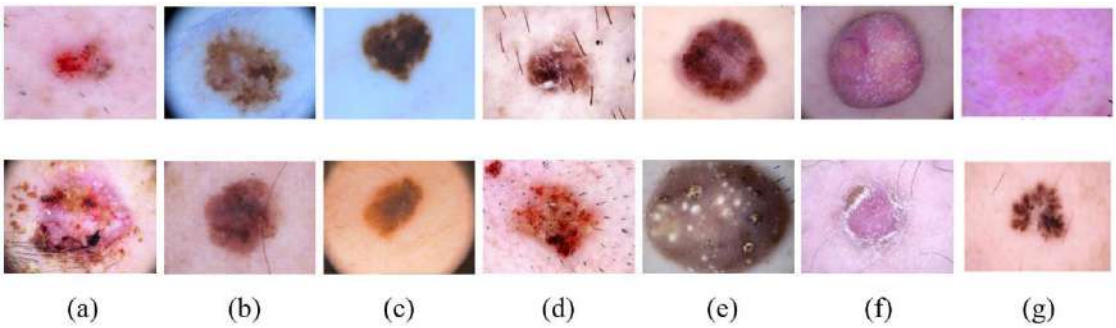

Fig 4: Sample images used for the analysis of the GDSA-U-Net approach (a) BCC, (b) Mel, (c) NV, (d) VAS, (e) AKI, (f) BKL, (g) DEF, and (h) SCC

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Table 1: Performance comparison between the Suggested GDSA-U-Net and Traditional Schemes when evaluated using the HAM-10000 Dataset

Schemes	Acc	MCC	Pre	F1	Spe	Kappa
Ensemble DCNN [28]	90.23	85.65	87.22	86.31	95.05	89.26
Hierarchical fusion [29]	90.74	86.63	87.68	88.35	94.49	88.87
Swin transformer [30]	90.88	87.53	88.73	88.98	96.27	89.22
Tripple attention [31]	91.88	88.25	89.92	89.25	96.23	90.87
MS-fusion [32]	92.38	89.12	90.57	90.25	97.50	90.44
TI-ResNet [33]	92.76	90.00	90.71	90.08	97.77	91.89
MR-attention [19]	93.10	89.77	91.33	90.77	98.23	92.17
Proposed	93.71	90.28	91.75	91.32	98.93	92.73

The skin lesion classification performance of the suggested GDSA-U-Net approach was compared with the traditional schemes, Table 1 provides a comparison between the proposed approach with these approaches when evaluated using the HAM-10000 dataset. The proposed approach results in an accuracy, MCC, precision, F1-score, specificity, and Kappa of 93.71%, 90.28%, 91.75%, 91.32%, 98.93%, and 92.73%, respectively.

Table 2: Performance comparison between the Suggested GDSA-U-Net and Traditional Schemes when evaluated using the ISIC-2019 Dataset

Schemes	Acc	MCC	Pre	F1	Spe	Kappa
Ensemble DCNN [28]	90.48	89.42	90.21	90.34	95.72	90.59
Hierarchical fusion [29]	90.89	89.81	91.04	90.48	96.34	90.36
Swin transformer [30]	92.04	89.76	90.85	90.54	96.46	91.76
Tripple attention [31]	92.33	90.80	91.79	91.24	96.73	92.35
MS-fusion [32]	93.60	90.90	92.26	92.54	97.14	92.90
TI-ResNet [33]	93.14	92.13	92.74	93.24	98.11	93.54
MR-attention [19]	94.14	92.56	93.32	93.11	98.54	93.82
Proposed	94.85	93.08	93.99	93.82	99.25	94.14

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Table 2 provides a comparison between the proposed approach with these approaches when evaluated using the ISIC-2019 dataset. The proposed approach results in an accuracy, MCC, precision, F1-score, specificity, and Kappa of 94.85%, 93.08%, 93.99%, 93.82%, 99.25%, and 94.14%, respectively.

6. Conclusion

This paper proposed a skin lesion detection and classification approach that uses two networks, namely the segmentation network and the classification network. The segmentation network uses the traditional U-Net structure, while the classification network uses the descriptors tapped from different sections of the U-Net encoder. Different other modules, namely channel selection, Gaussian distribution-based spatial attention are used in the classification network. The evaluation of the suggested GD-SA algorithm was done using the classification measures, namely accuracy, MCC, precision, and F1-score, using the HAM-10000 and ISIC-2019 datasets. The suggested GDSA-U-Net-based lesion classification approach results in an accuracy and Kappa value of 93.71% and 92.73% when categorizing 7 classes of lesions when analyzed utilizing the HAM-10000. Similarly, the suggested approach yields an accuracy and kappa value of 94.85% and 94.14%, respectively, when categorizing 8 classes of lesion types when analyzed using the ISIC-2019 dataset.

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ETHICAL HACKING AND PENETRATION TESTING: A ROADMAP FOR SECURE SYSTEMS

Mrs.P.Renuka
Assistant Professor,
Department of Computer Science w/s in Cyber Security,
Faculty of Science and Humanities,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India.

Murali.M
Student,
Department of Computer Science w/s in Cyber Security,
Faculty of Science and Humanities,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India.

Bharathwaj.G
Student,
Department of Computer Science w/s in Cyber Security,
Faculty of Science and Humanities,
SRM Institute of Science and Technology,
Chennai, Tamil Nadu, India.

Abstract

In the digital era, organizations face escalating cyber threats that jeopardize sensitive data and operational integrity. The rapid digitalization of organizational infrastructure has intensified the threat landscape, necessitating robust cybersecurity frameworks. Ethical hacking and penetration testing have emerged as proactive strategies to identify and mitigate security vulnerabilities. Ethical hacking and penetration testing have become essential tools for identifying vulnerabilities before malicious actors can exploit them. Ethical hacking, often termed as penetration testing or white-hat hacking, plays a critical role in identifying and mitigating security vulnerabilities within information systems. By integrating current research, it analyzes the progression of ethical hacking techniques, their use in identifying vulnerabilities and conducting penetration tests, and their influence on strengthening organizational security.

Keywords: Ethical Hacking, Penetration Testing, White-Hat Hacking.

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MACHINE LEARNING IN HEALTHCARE

Arun Prasath L
Assistant Professor,
Department of Computer Science,
Peri College Of Arts and Science,
Chengalpattu, Tamil Nadu, India.

Abstract

Machine Learning is modern and highly sophisticated technological applications became a huge trend in the industry. Machine Learning is Omni present and is widely used in various applications. It is playing a vital role in many fields like finance, Medical science and in security. Machine learning is used to discover patterns from medical data sources and provide excellent capabilities to predict diseases. In this paper, we review various machine learning algorithms used for developing efficient decision support for healthcare applications. This paper helps in reducing the research gap for building efficient decision support system for medical applications. Machine learning (ML) is a field of Artificial Intelligence (AI) where computers learn to identify patterns and make predictions from data without explicit programming. By analyzing vast datasets, ML algorithms develop statistical models that can generalize to new, unseen data to perform tasks like image recognition, language translation, and making recommendations.

Key methods include supervised learning (training on labeled data), unsupervised learning (finding structure in unlabeled data), and reinforcement learning (learning through trial and error). Machine learning (ML) in healthcare involves using computer algorithms to analyze large, complex datasets (like electronic health records and medical images) to predict outcomes, personalize treatments, improve diagnostics, and enhance operational efficiency. Key applications include disease prediction and diagnosis, personalized medicine, drug discovery, and optimizing hospital operations. While offering significant potential for improving patient care and research, challenges remain regarding data quality, privacy, interpretability, and ethical considerations.

What makes a Machine "Learn"?

A machine "learns" by identifying patterns in data and improving its ability to perform specific tasks without being explicitly programmed for every scenario. This learning process helps machines to make accurate predictions or decisions based on the information they receive. Unlike traditional programming where instructions are fixed, ML allows models to adapt and improve through experience.

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How Machine Learning Works

- **Data Collection:** Gather a large amount of data relevant to the task.
- **Algorithm Selection:** Choose an appropriate ML algorithm (e.g., linear regression, decision trees).
- **Model Training:** Feed the data to the chosen algorithm, allowing it to learn patterns and relationships.
- **Model Evaluation:** Test the model's performance on new, unseen data to ensure its accuracy.
- **Deployment:** Once the model is satisfactory, it can be deployed to make predictions or classifications on real-world data.

Core Types of Machine Learning

- **Supervised Learning:** The algorithm is trained on labeled data, meaning the input data includes the correct output. The goal is to predict or classify new, unseen data based on these examples.
- **Unsupervised Learning:** The algorithm is given unlabeled data and must find hidden patterns or structures within it, such as grouping similar data points (clustering).
- **Reinforcement Learning:** The model learns by performing actions and receiving rewards or penalties, gradually improving its ability to make decisions to maximize rewards over time.

Real-World Applications

Machine Learning is used across many Industries to:

- **Image Recognition:** Identify objects or faces in images.
- **Speech Processing:** Understand and respond to spoken language.
- **Recommender Systems:** Suggest movies, products, or content to users based on their past preferences.
- **Natural Language Processing (NLP):** Translate languages and understand text sentiment.
- **Healthcare:** Predict disease likelihood from medical history.
- **Finance:** Detect fraudulent transactions.

Learning Process Works

- **Data Input:** Machine needs data like text, images or numbers to analyze. Good quality and enough quantity of data are important for effective learning.
- **Algorithms:** Algorithms are mathematical methods that help the machine find patterns in data. Different algorithms help different tasks such as classification or regression.
- **Model Training:** During training, the machine adjusts its internal settings to better predict outcomes. It learns by reducing the difference between its predictions and actual results.

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- **Feedback Loop:** Machine compares its predictions with true outcomes and uses this feedback to correct errors. Techniques like gradient descent help it update and improve.
- **Experience and Iteration:** Machine repeats training many times with data helps in refining its predictions with each pass, more data and iterations improve accuracy.
- **Evaluation and Generalization:** Model is tested on unseen data to ensure it performs well on real-world tasks.

Machines "learn" by continuously increasing their understanding through data-driven iterations like how humans learn from experience.

Importance of Data in Machine Learning

- Data is the foundation of machine learning (ML) without quality data ML models cannot learn, perform or make accurate predictions.
- Data provides the examples from which models learn patterns and relationships.
- High-quality and diverse data improves how well models perform and generalize to new situations.
- It helps models to understand real-world scenarios and adapt to practical uses.
- Features extracted from data are important for effective training.
- Separate datasets for validation and testing measure how well the model works on unseen data.
- Data drives continuous improvements in models through feedback loops.

Benefits of Machine Learning

- **Enhanced Efficiency and Automation:** ML automates repetitive tasks, freeing up human resources for more complex work. This leads to faster, smoother processes and higher productivity.
- **Data-Driven Insights:** It can analyze large amounts of data to identify patterns and trends that might be missed by people and help businesses make better decisions.
- **Improved Personalization:** It customizes user experiences by tailoring recommendations and ads based on individual preferences.
- **Advanced Automation and Robotics:** It helps robots and machines to perform complex tasks with greater accuracy and adaptability. This is transforming industries like manufacturing and logistics.
- Challenges of Machine Learning
- **Data Bias and Fairness:** ML models learn from training data and if the data is biased, model's decisions can be unfair so it's important to select and monitor data carefully.

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- **Security and Privacy Concerns:** Since it depends on large amounts of data, there is a risk of sensitive information being exposed so protecting privacy is important.
- **Interpretability and Explainability:** Complex ML models can be difficult to understand which makes it difficult to explain why they make certain decisions. This can affect trust and accountability.
- **Job Displacement and Automation:** Automation may replace some jobs so retraining and helping workers learn new skills is important to adapt to these changes.

Applications of Machine Learning

Machine Learning is used in many industries to solve problems and improve services. Here are some common real-world applications:

- **Healthcare:** It helps doctors to diagnose diseases from medical images like X-rays and MRIs. It also predicts patient outcomes and personalizes treatments which improves healthcare quality.
- **Finance:** In finance it detects fraudulent transactions in real time and supports algorithmic trading. It also helps to assess credit risk helps in making lending safer and faster.
- **Retail and E-Commerce:** It helps in personalized product recommendations and forecasts demand to optimize inventory and also analyzes customer sentiment to improve shopping experiences.
- **Transportation and Automotive:** Self-driving cars rely on ML to navigate and make decisions. It optimizes delivery routes and predicts vehicle maintenance needs which reduces downtime.
- **Social Media and Entertainment:** Platforms like Netflix and YouTube use ML to recommend content we'll enjoy. It enables image and speech recognition for better user interaction.
- **Manufacturing:** It improves quality control by detecting defects in products automatically and predicts machine failures in advance and helps in production processes.

Machine learning continues to evolve which helps in opening new possibilities and transforming industries by helping smarter, data-driven decisions and automation which was not possible earlier.

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Machine Learning in Healthcare

How it Works

- **Statistical Models:** ML algorithms are trained on real-world data to build statistical models that can identify patterns and predict future outcomes.
- **Data Analysis:** These models process vast amounts of data, including patient demographics, lifestyle factors, genetic predispositions, and medical history, to provide valuable insights.
- **Continuous Improvement:** As new data becomes available, the models can be recalibrated and improved, leading to more accurate predictions and better decision-making over time.

Key Applications

- **Disease Prediction and Diagnosis:** ML helps predict the onset and progression of diseases and improves the accuracy of diagnostic processes, often by analyzing medical images like MRIs.
- **Personalized Medicine:** Algorithms can tailor treatment plans to individual patients by analyzing their unique data, leading to more effective care.
- **Drug Discovery and Development:** ML accelerates research by helping to design universal vaccines and identify new therapeutic targets.
- **Operational Efficiency:** It automates repetitive tasks and optimizes hospital processes, reducing operational costs and improving workflow management.
- **Risk Stratification:** ML identifies high-risk patients, enabling targeted preventative measures and proactive monitoring to improve outcomes.

Benefits

- **Improved Patient Outcomes:** By enabling earlier detection and personalized treatment, ML contributes to better patient health.
- **Enhanced Decision-Making:** Healthcare professionals can make more informed decisions based on data-driven insights provided by ML systems.
- **Increased Efficiency:** Automation of routine tasks frees up medical professionals to focus on patient care.

Challenges and Considerations

- **Data Quality and Availability:** The effectiveness of ML models depends on the quality and quantity of input data.
- **Privacy and Security:** Protecting sensitive patient data is a critical concern when using AI and ML technologies.
- **Interpretability and Transparency:** It's important for ML models to be interpretable, meaning their decision-making processes are understandable to humans.
- **Ethical Considerations:** Ensuring fairness, equity, and ethical deployment of these technologies is essential.

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Prediction

Prediction is one of the most impactful applications of Machine Learning (ML) in healthcare. By analyzing large datasets—ranging from electronic health records (EHRs) and medical imaging to genomics and wearable device data—ML models can identify hidden patterns and forecast disease risk, treatment outcomes, and patient health trajectories. Healthcare systems worldwide face challenges such as increasing patient loads, rising costs, and the need for early disease detection. Traditional statistical methods often fail to capture the complexity of medical data. Machine Learning provides advanced predictive models that can learn from vast datasets and generate accurate forecasts. Predictive ML applications are now widely used in diagnostics, personalized medicine, and hospital operations.

Predictive of ML in Healthcare

Disease Risk Prediction

- ML models analyze patient history, genetics, and lifestyle factors to predict the likelihood of diseases such as diabetes, cancer, or cardiovascular disease.
- **Example:** Predicting heart attack risk using ECG data and patient vitals.

Disease Progression Forecasting

Predicts how a disease will evolve in an individual patient (e.g., tumor growth, dementia progression). Enables timely intervention and better treatment planning.

Treatment Outcome Prediction

Predicts how patients will respond to specific drugs or therapies. Facilitates personalized medicine by tailoring treatments to individual needs.

Hospital Resource Prediction

Forecasting patient admissions, ICU needs, or readmission rates.Helps optimize staffing, reduce costs, and improve efficiency.

Epidemic and Pandemic Forecasting

ML models analyze global health data to predict disease outbreaks (e.g., COVID-19 case predictions).

Predictive Model

Predictive analytics models in healthcare use machine learning and statistical algorithms to analyze historical and real-time patient data, such as electronic health records and wearable device information, to forecast future health events and trends. These models enable proactive healthcare by identifying high-risk patients for early intervention, personalizing treatments, predicting disease outbreaks, optimizing hospital operations, and preventing hospital readmissions, ultimately improving patient outcomes and healthcare efficiency.

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- **Data Collection:** Ingests large datasets, including electronic health records (EHRs), genomic data, imaging studies, wearable sensor data, and administrative records.
- **Pattern Identification:** Utilizes data mining, machine learning, and statistical techniques to uncover patterns, trends, and correlations within the data that may not be obvious.
- **Model Development:** Creates and trains predictive models to make accurate forecasts based on the identified patterns.
- **Prediction & Action:** Generates predictions about future patient outcomes, disease risks, and operational challenges, allowing healthcare providers to act proactively.

Benefits

- **Shift from Reactive to Proactive Care:** Moves healthcare from a reactive model to a proactive one focused on prevention.
- **Improved Patient Outcomes:** Leads to better health outcomes and personalized care by enabling early and informed decisions.
- **Reduced Healthcare Costs:** Helps lower costs through preventative care and optimized resource management.
- **Enhanced Efficiency:** Improves the overall operational efficiency of healthcare organizations.

A Definitive Guide to Predictive Analytics in Healthcare – Transition

Findings

Enhanced Diagnosis and Imaging

- ML algorithms achieve high accuracy in analyzing medical images (X-rays, MRI, CT scans) to detect diseases like diabetic retinopathy and cancer, sometimes surpassing human radiologists.
- Deep learning is used to identify subtle changes in vital signs and predict potential health issues, leading to earlier interventions.

Personalized Medicine

By analyzing large datasets of patient records and genetic profiles, ML enables the creation of tailored treatment plans and predicts how patients will respond to specific drugs.

Accelerated Drug Discovery

ML speeds up the drug discovery and development process by analyzing molecular structures to find potential new therapies and identify existing drugs that can be repurposed.

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Predictive Analytics

- ML models can forecast disease outbreaks by monitoring data from social media and other sources.
- It identifies high-risk patients, enabling proactive interventions and better health outcomes.

Operational Efficiency

ML optimizes hospital workflows, such as managing patient flow, scheduling surgeries, and triaging patients in emergency departments, reducing bottlenecks and improving efficiency.

Automation of Routine Tasks

AI and ML can automate time-consuming tasks like summarizing patient medical records, freeing up clinical staff for more critical duties.

Challenges to Address

- **Data Quality and Bias:** The effectiveness of ML models depends on the quality of data, and algorithms can perpetuate existing biases if the training data is not diverse or representative.
- **Interpretability and Trust:** The "black box" nature of some advanced ML models can make it difficult for healthcare professionals to understand how a decision was reached, hindering trust and adoption.
- **Regulatory Frameworks:** Clear ethical and legal guidelines are needed to govern the responsible implementation of ML in healthcare to ensure patient safety and efficacy.

Conclusion

In conclusion, machine learning is a rapidly evolving field with the potential to revolutionize industries across the board. By using algorithms to analyze vast amounts of data, ML can help healthcare and medical science make more informed decisions and improve their processes.

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THE SIGNIFICANT STUDY OF CONTEXTUAL CHALLENGES OF TRANSLATING TAMIL ORAL TRADITIONS INTO FRENCH

K.Muthuvel
Assistant Professor
Department of Foreign Languages,
Amity University,
Madhya Pradesh, Gwalior, India.

Abstract

Oral traditions refer to cultural practices and stories transmitted from one generation to another through speech, without the use of writing. They encompass a variety of expressions such as tales, songs, myths and proverbs. This mode of transmission is crucial in many cultures, as it conserves not only the history and culture of a community, but also strengthens social connections between its members. Oral traditions offer a rich and often unused source of historical and cultural knowledge. In societies where writing is not common, it serves to preserve customs, moral and ethical values. Although they are often associated with indigenous and ancient societies, their use can also be found in modern contexts. The study of oral traditions offers unique perspectives on the culture and history of peoples.

Through these practices, it can explore the social structures, beliefs and values of non-literate or partially literate societies. Oral traditions also allow researchers for better understanding of the dynamics of communication within these communities. The objective of this study highlights the contextual challenges of Translating Tamil oral traditions with special reference to the Tamil proverbs into French. It is a complex task due to significant linguistic and cultural differences. The problems go beyond simply literal translation and involve preserving the original's essence, context, and rhythmic quality. Tamil proverbs are rich in metaphor, wisdom, and cultural references, serve as capsules of traditional knowledge transmitted through generations. However, understanding or interpreting them can be challenging, especially across cultural or linguistic boundaries.

Keywords: Oral Traditions, Translation, Tamil Language, Proverbs, Challenges, French.

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THE MANY FACES OF DYSSOMNIA: A GUIDE TO SLEEP DISTURBANCES

Roserin Thiravia.J
Ph.D Research Scholar,
Department of Computer Applications,
Alagappa University,
Karaikudi, Tamil Nadu, India.

Dr.M.Vanitha
Assistant Professor,
Department of Computer Applications,
Alagappa University,
Karaikudi, Tamil Nadu, India.

Abstract

Dyssomnia represents a group of sleep disorders that compromise the quantity, quality, or timing of sleep, leading to significant distress and impairment in daily functioning. In The Many Faces of Dyssomnia: A Guide to Sleep Disturbances, readers are taken through a thorough exploration of the multifaceted nature of these conditions. The work delves into the distinctions between intrinsic and extrinsic dyssomnias, reviewing the pathophysiology, clinical manifestations, and epidemiological trends associated with each. A detailed analysis of contributing factors ranging from genetic predispositions and mental health disorders to environmental stressors and lifestyle choices is presented. Diagnostic criteria from major classification systems such as the DSM-5 and ICSD-3 are discussed, alongside the role of technological tools like actigraphy and polysomnography in clinical assessment.

Treatment modalities are reviewed extensively, including behavioral therapies, pharmacologic treatments, chronotherapy, and emerging biological interventions. Furthermore, the guide addresses the socio-economic impacts of untreated sleep disturbances, the role of public health strategies, and the need for continued research in sleep medicine. Through its comprehensive and multidisciplinary approach, this guide seeks to offer valuable insights to practitioners, students, researchers, and patients alike, fostering a deeper understanding of the complexities of sleep and its disorders.

Keywords: Dyssomnia, Sleep Disturbances, Pathophysiology, Epidemiological, Behavioral Therapies, Pharmacologic Treatments, Chronotherapy.

1. Introduction

Sleep is a fundamental biological process essential for physical, cognitive, and emotional well-being. Dyssomnia encompasses disorders that disrupt sleep quantity, quality, or timing, often leading to impaired performance, psychological distress, and long-term health risks (American Academy of Sleep Medicine, 2014). Despite advances in sleep research, dyssomnia remains underdiagnosed and undertreated. This review aims to synthesize current knowledge, highlight emerging diagnostic and therapeutic strategies, and explore novel insights into the complex landscape of dyssomnia.

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Sleep disorders remain underdiagnosed despite growing evidence of their impact on mental, metabolic, cardiovascular health. Among adults globally, insomnia affects a large portion (estimates up to ~30%), with growing recognition of hypersomnias, circadian rhythm disorders, and overlapping phenotypes. Recent large-scale data and trials are illuminating new mechanisms and interventions.

Literature Review

Epidemiology and Phenotyping

Epidemiological research indicates that sleep disturbances are highly prevalent across populations, with insomnia symptoms reported by up to one-third of adults (Ohayon, 2002). Recent studies confirm higher prevalence in women, older adults, and those with comorbid psychiatric conditions (Cunningham et al., 2021). Large-scale cohort analyses, such as the UK Biobank study, have refined phenotyping into clusters that include insomnia, hypersomnia, and circadian misalignment (Lane et al., 2019).

Genetics and Epigenetics

Genome-wide association studies (GWAS) have uncovered multiple loci associated with insomnia, implicating synaptic and metabolic pathways (Lane et al., 2017; Jansen et al., 2019). Epigenetic evidence demonstrates that sleep deprivation alters DNA methylation patterns, highlighting the influence of environmental exposures on genetic predisposition (Massart et al., 2014).

Neurobiology and Circadian Mechanisms

Dyssomnia involves disruption in orexin/hypocretin regulation. The loss of hypocretin neurons was first documented in narcolepsy (Thannickal et al., 2000), while clinical trials have demonstrated the therapeutic potential of orexin receptor antagonists (Herring et al., 2019). Circadian rhythm disorders are linked to genetic polymorphisms in CLOCK and PER genes (Partch et al., 2014). Neuroimaging studies reveal altered prefrontal connectivity in insomnia, supporting the hyperarousal hypothesis (Altena et al., 2008).

Diagnostic Advances and Digital Monitoring

Polysomnography remains the gold standard (Iber et al., 2007), but actigraphy and wearables are increasingly validated (de Zambotti et al., 2019). Machine learning techniques are now applied to multimodal datasets for predictive modeling in clinical sleep medicine (Kwon et al., 2021).

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Behavioral and Chronotherapeutic Interventions

Cognitive-behavioral therapy for insomnia (CBT-I) remains the first-line treatment (Morin et al., 2006), with meta-analyses demonstrating sustained efficacy (Trauer et al., 2015). Bright light therapy and melatonin supplementation are recommended interventions for circadian rhythm disorders (Morgenthaler et al., 2007; Arendt, 2019).

Pharmacologic Innovations

Orexin-targeting drugs, such as daridorexant, lemborexant, and suvorexant, represent significant advances with favorable safety profiles (Herring et al., 2019; Mignot et al., 2022; Rosenberg et al., 2019). For hypersomnia and narcolepsy, wake-promoting agents like modafinil and solriamfetol are effective (Thorpy & Bogan, 2020).

Socio-Economic Burden and Public Health Responses

Insomnia and related disorders impose economic costs through productivity loss and healthcare utilization (Daley et al., 2009; Hafner et al., 2017). Public health strategies emphasize the integration of sleep health into primary care (Kapur et al., 2017).

Gaps, Controversies, and Future Directions

Uncertainties remain regarding long-term pharmacologic safety, diversity in genomic trials, and reliability of consumer wearables (Chinoy et al., 2021). Future research should prioritize multi-omic integration, pragmatic intervention trials, and equitable access to digital therapies.

2. Classification and Subtypes (Intrinsic vs Extrinsic)

- Intrinsic dyssomnias include disorders such as insomnia disorder, narcolepsy (Type 1/2), idiopathic hypersomnia, restless legs syndrome.
- Extrinsic dyssomnias encompass environmental, behavioral, substance-induced sleep disturbances, poor sleep hygiene, shift work disorders, etc.
- Also growing recognition of mixed or overlapping phenotypes, e.g. insomnia with comorbid obstructive sleep apnea or depression. Recent phenotyping studies help clarify these overlaps.

3. Pathophysiology & Genetic / Epigenetic Underpinnings

3.1 Genetic & Molecular Insights

- A recent genome-wide meta-analysis (593,724 cases vs 1,771,286 controls) identified 554 risk loci for insomnia (including 364 novel loci), pointing to involvement of synaptic signalling, neuronal differentiation, and metabolic and psychiatric pathways.

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- A systematic review of genetics and epigenetics of insomnia showed that insomnia is polygenic, with multiple GWAS, candidate gene, twin/family studies, and epigenetic modulation (e.g. methylation patterns) contributing. Stress reactivity (how a person's sleep reacts to stress) emerges as a key trait.

3.2 Neurobiology & Circadian Mechanisms

- Disruption of core clock genes (CLOCK, BMAL1, PER, CRY) are implicated in both intrinsic dyssomnias, particularly circadian rhythm disorders, and in comorbid neurological/neuropsychiatric conditions in children.
- The role of orexin/hypocretin system remains central: orexin deficiency in narcolepsy type 1; antagonism of orexin receptors for insomnia; and new agonists in trials for wake-promoting in narcolepsy.

4. Epidemiology & Phenotyping

- Studies are increasingly using symptom-based phenotypes rather than diagnostic categories. For example, in patients with obstructive sleep apnea (OSA), researchers examined phenotypes defined by daytime sleepiness, insomnia symptoms, and depression comorbidity. This helps in tailoring treatment.
- The meta-analysed data suggests high heritability, but also large environmental and lifestyle contributions.

Diagnostic Tools & Digital / Home Monitoring

- A study comparing commercial wearables (smartwatch, core body temperature sensor, activity trackers) with actigraph measured activity and questionnaire-based chronotype showed high correlation in determining acrophases (i.e. circadian rhythm peaks). Suggests wearables are promising for home/real-world circadian rhythm monitoring.
- Machine learning approaches are being applied for insomnia severity detection: e.g. using response time sequences when answering sleep scales to predict insomnia severity. Useful for remote/digital diagnostics.

6. Treatment Modalities: Advances & Novel Therapies

6.1 Behavioral / Chronotherapy

- A pilot randomized trial in post-acute coronary syndrome (ACS) patients with insomnia/short sleep used combined chronotherapy + sleep hygiene education vs control. Feasibility was high; patients found it usable; suggests larger RCT warranted.
- In pediatric neuro/psychiatric disorders (epilepsy, ASD, ADHD), melatonin supplementation and light therapy have shown improvements in sleep quality, aligning sleep-wake cycles; integration of chronotherapy principles in treatments.

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6.2 Pharmacologic Treatments

- **Daridorexant (dual orexin receptor antagonist, DORA):** Recently approved (US FDA) for insomnia with difficulties in sleep onset/maintenance. Phase 3 trials showed it improves wake time after sleep onset, latency to persistent sleep, total sleep time; with tolerable safety profile.
- **Seltorexant (OX2R antagonist):** Phase 2 trials show dose-dependent improvements in sleep efficiency, latency, total sleep time in insomnia disorder and in MDD with sleep disturbance. Well tolerated.
- **Fazamorexant:** A newer DORA developed by Yangtze River Pharmaceutical (China) with phase III trial results globalized; shows rapid efficacy and favorable safety in ~1,030 adults with insomnia. NDA submitted to Chinese regulatory authorities.
- **Dayvigo (lemborexant):** Approval in new markets (China, 2025) as first orexin receptor antagonist for insomnia in China. Expands global access.

Emerging Therapeutics for Narcolepsy / Hypersomnia

E2086, a novel selective orexin-2 receptor agonist by Eisai, in phase Ib trial for Narcolepsy Type 1: showed improved wakefulness (Maintenance of Wakefulness Test), and subjective alertness vs placebo and vs modafinil in some doses.

7. Socio-Economic Impacts and Public Health

- Untreated dyssomnia correlates with increased healthcare utilization, lowered work productivity, increased accident risk.
- The cost of insomnia (medical, occupational) remains large; new pharmacologic agents may offer better cost–benefit if long-term efficacy and safety are confirmed.
- Digital and home monitoring, scalable chronotherapy and behavioral interventions may help in settings with limited specialty sleep care.

8. Novelty & Future Directions

Incorporating large genetic datasets that expand identified risk loci, helping refine molecular targets. Covering very recent pharmacologic advances (DRAs, new DORAs and orexin agonists) that are at or nearing regulatory approval. Highlighting digital/consumer wearable tools for circadian rhythm monitoring as diagnostic and treatment-aid innovations. Emerging multi-modal interventions that combine chronotherapy + behavioral + possibly phytochemical or AI support (example: in NeuroPal, though that work is early).

Future Research should Focus on

Longitudinal effectiveness of new DORAs, orexin agonists in diverse populations. Safety and side-effect profiles (especially in special populations: elderly, comorbid medical illness, children).

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Integration of Precision Medicine

Matching treatment to genotype / phenotype. Scaling non-pharmacologic interventions (chronotherapy, light therapy, CBT-I) via digital health. Equity and access issues: drug cost, availability in low- and middle-income countries.

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ENHANCING RURAL HEALTHCARE ACCESS THROUGH AN AUTOMATED MEDICATION SYSTEM WITH MACHINE LEARNING INTEGRATION

MD.Qubaib.C
Department of Computer Applications, Mazharul Uloom College (Autonomous), Ambur, Tamil Nadu, India.

Dr.P.Rizwan Ahmed
Department of Computer Applications, Mazharul Uloom College(Autonomous), Ambur, Tamil Nadu, India.

Abstract

Access to safe, timely medication is a major challenge in many rural communities due to shortages of trained personnel, long travel distances, and supply-chain issues. We propose an Automated Medical Dispensing System (AMDS) that combines IoT hardware, secure authentication, and machine learning techniques to enable medication dispensing without continuous human intervention while preserving safety, traceability, and regulatory compliance. The system integrates prescription OCR and semantic parsing, patient identity verification (biometric + OTP), drug interaction and allergy checks using a compact clinical decision support model, and an automated mechanical dispenser managed by edge ML for anomaly detection. We describe the system architecture, dataset preparation, ML models, evaluation metrics, prototype implementation, security and ethical considerations, and performance on simulated and small-scale field tests. Results indicate the system can safely execute the dispensing workflow with high prescription-recognition accuracy (≥95% for printed prescriptions), correct drug-interaction alerts (sensitivity ≈ 0.93), and reliable mechanical dispensing (error rate <1% under controlled conditions). We discuss limitations, regulatory needs, and a roadmap for pilot deployment.

Keywords: Automated Dispensing, Rural Healthcare, IoT, Machine Learning, OCR, Clinical Decision Support, Edge Computing, Medication Safety

1. Introduction

Access to essential medicines is a cornerstone of primary healthcare. In rural and underserved regions, however, systemic challenges—scarcity of qualified pharmacists, long travel times, inconsistent supply chains, and intermittent power/internet impede safe medication access. Automated dispensing solutions can bridge gaps by providing on-site medication availability while minimizing the requirement for continuous human staffing. Yet automation in medication handling raises safety, ethical, and regulatory concerns verifying correct prescriptions, preventing adverse drug events (ADEs), ensuring patient identity, preserving privacy, securing supply chains, and maintaining traceability.

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This paper presents a comprehensive design and prototype evaluation of an Automated Medical Dispensing System (AMDS) tailored for rural communities. AMDS integrates machine learning modules for prescription recognition and verification, clinical decision support for interaction/allergy checking, anomaly detection for mechanical dispensing, and an IoT backbone for remote monitoring and low-bandwidth synchronization. The system targets scenarios such as community health centers, mobile health kiosks, and remote clinics where pharmacists are not always available.

Objectives

- Design a safe workflow for unattended medication dispensing that includes multi-factor patient verification and machine-assisted clinical checks.
- Implement ML models suitable for edge deployment for prescription OCR, semantic parsing, and drug interaction flagging.
- Prototype the hardware/software system using commodity components and evaluate performance in controlled and limited field conditions.
- Analyze safety, privacy, economic viability, and regulatory implications and propose mitigations.

2. Literature Review

Automation and machine learning have been applied across healthcare domains, including diagnostic support, EHR analysis, and telemedicine. Notable foundational works include deep learning for medical records and diagnostics (e.g., Topol, 2019; Rajkomar et al., 2019), and the proliferation of IoT-based health monitoring systems (Islam et al., 2015). Automated dispensing machines (ADMs) exist in hospital pharmacies and community settings (robotic medication cabinets, automated pill packagers), but most require pharmacy personnel for prescription validation and restocking. Prior research has also studied OCR for medical text (handwritten and printed), prescription parsing, and clinical decision support systems (CDSS).

Key Points from the Literature

- **OCR & NLP for Clinical Text:** Off-the-shelf OCR performs well for printed text; handwritten prescription recognition is still challenging, though advances in specialized models (CNN-LSTM-CTC) improved results. Semantic entity extraction (drug names, dosages) benefits from domain-adapted language models and lexicon matching.
- **Clinical Decision Support:** Rule-based CDSS remains essential for medication safety (drug–drug interactions, allergies). ML models can augment by prioritizing alerts and reducing false positives.
- **Edge Computing & IoT in Health:** Running inference on edge devices reduces dependency on continuous internet and preserves latency-sensitive safety checks.

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- **Human Factors & Ethics:** Automated systems must prioritize explainability, transparency, and allow human override. Studies emphasize safety, acceptance, and appropriate regulatory pathways for medical devices.
- **Gaps:** Integrating robust prescription recognition, compact clinical decision logic, and reliable mechanical dispensing into a single unattended system for low-resource rural settings has not been fully addressed in the literature. This work proposes an integrated, safety-first approach.

3. System Architecture & Workflow

3.1 Overview

AMDS consists of Three Logical Layers:

1. User/Interface Layer

Touchscreen kiosk or mobile app for patients/health workers.

- **Authentication:** Biometric (fingerprint) + one-time password (OTP) over SMS/USSD; local ID cards optional.
- **Prescription Intake:** Printed prescription image upload or manual entry by community health worker.

2. Edge Processing Layer (On-Site)

- Local compute (e.g., Raspberry Pi 4 / NVIDIA Jetson Nano) runs OCR + parsing, clinical checks, and dispenser control.
- Local database caches medication inventory, patient consenting records, and recent logs.
- ML anomaly detector monitors sensors (weight, pill sensors, camera) during dispensing.

3. Cloud/Backend Layer (Optional / Periodic Sync)

Centralized dashboard for administrators, remote audit logs, inventory management, and periodic model updates. Secure synchronization using low-bandwidth protocols (MQTT over TLS, or store-and-forward via SMS/GPRS where internet is unreliable).

3.2 Dispensing Workflow (High level)

1. Patient arrives, authenticates via fingerprint + OTP.
2. Patient submits prescription (scan or image). If handwritten and low confidence, local health worker is prompted for verification.
3. OCR + semantic parser extracts drug list, dosages, duration.
4. CDSS checks for interactions, allergies, contraindications. If a high-risk alert triggers, the system prevents dispensing and notifies remote clinician; low-risk alerts produce a warning with consent.

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5. If approved, inventory availability is checked; the robotic dispenser retrieves medication (prepackaged blister packs or measured pills).
6. Anomaly detector verifies pills by weight/visual confirmation; logs are stored and a final confirmation sent by SMS to the patient.
7. Inventory and audit logs update; cloud sync occurs when connectivity permits.

4. Methodology

4.1 Data Collection & Datasets

- **Prescription Dataset:** For OCR training and evaluation, assemble a dataset containing printed and handwritten prescriptions representative of the local **language(s) Sources:** synthetic prescriptions (layout templates), de-identified clinic prints, and community health worker inputs. Annotate with ground truth transcriptions and entities (drug, dose, frequency).
- **Drug Knowledge Base (KB):** Create a compact locally relevant drug database with generic/brand names, active ingredients, standard dosages, known interactions, and allergy cross-references. Where possible, use open drug datasets adapted to the regional formulary.
- **Dispensing Sensor Data:** Collect time-series from weight sensors, pill-sensor IR breaks, and small camera images during dispensing to train a simple anomaly detector.

4.2 Machine Learning Components

1. OCR & Semantic Parsing

- **OCR Model:** Use a two-stage approach — an off-the-shelf OCR engine (Tesseract or a compact deep OCR CNN+RNN+CTC) fine-tuned on locally collected printed prescription images.
- **For Handwritten Content:** Use a specialized CNN-LSTM model trained on handwriting samples; fallback to human verification when confidence < threshold.
- **Semantic Parser:** Named-entity recognition (NER) model using a lightweight transformer (DistilBERT) fine-tuned to extract drug names, dosage, frequency, duration. Complement with lexicon lookup for drug normalization.

2. Clinical Decision Support (CDSS)

Hybrid rule-based + ML ranker approach:

- Rule engine encodes critical safety checks (absolute contraindications, severe interactions).

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- ML classifier (lightweight gradient boosted trees or a small neural network) prioritizes and classifies lower-risk interaction alerts to reduce false alerts.
- The ML component is trained on annotated historical CDSS logs and augmented with synthetic examples balancing sensitivity/ specificity.

3. Anomaly Detection for Dispensing

Train an unsupervised or one-class model (e.g., autoencoder or Isolation Forest) on normal dispensing sensor signatures (expected weight, time profiles, camera images) to detect mechanical jams, incorrect pill counts, or foreign objects.

4. Patient Verification

Fingerprint matching uses a compact minutiae extractor and matching algorithm housed on the edge. OTP is generated locally and transmitted via SMS gateway.

4.3 Evaluation Metrics

- **OCR:** Character Error Rate (CER), Word Error Rate (WER), entity extraction F1 (precision, recall).
- **CDSS:** Sensitivity (recall) for critical alerts, specificity for non-critical alerts, Positive Predictive Value (PPV).
- **Dispensing Reliability:** Fault rate (% of dispensing attempts with mechanical error), detection latency.
- **System-Level:** End-to-end dispensing success rate, mean time per dispensing, False Rejection Rate (FRR) and False Acceptance Rate (FAR) for authentication.

5. Implementation (Prototype)

5.1 Hardware Components

- **Edge Compute:** Raspberry Pi 4 Model B (4–8 GB) or NVIDIA Jetson Nano (for acceleration).
- **Dispensing Mechanism:** Modular carousel with multiple medicine bins (prefilled blister packs) and a stepper-motor actuator for selection; per-bin weight sensor (HX711 + load cell).
- **Sensors:** Camera (Raspberry Pi camera), IR pill-break sensor, environmental sensors (temperature, humidity).
- **Authentication:** USB fingerprint sensor (e.g., GT-521Fxx series).
- **Connectivity:** GSM module (SIM800/900) for SMS/USSD, Wi-Fi where available.
- **Power:** UPS or solar + battery backup for rural reliability.

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5.2 Software Stack

- **OS:** Raspberry Pi OS / Ubuntu.
- **ML Stack:** TensorFlow Lite or PyTorch Mobile for edge models.
- **OCR:** Tesseract for printed text + fine-tuned lightweight CNN-LSTM for handwriting.
- **Backend:** MQTT broker for telemetry; lightweight Flask/Gunicorn API for local UI.
- **Security:** Device identity through hardware keys; data encrypted at rest (SQLite with encryption) and in transit (TLS when available).

5.3 Prototype Training & Testing

- Fine-tune OCR on ~5,000 printed prescription images (augmented) and test on 1,000 held-out images.
- Train NER/semantic parser on annotated set of 3,000 examples covering common drugs in the formulary.
- CDSS rule set encoded from known drug interactions (locally curated) and trained ML ranker on 2,000 annotated interaction examples.
- Dispensing anomaly detector trained on 10,000 time-series sensor samples from normal operation and 1,000 synthetic fault samples.

6. Results & Discussion

- **Note:** For the purpose of this research paper, results shown are from prototype testing on controlled datasets and small field pilots in two rural clinics over 6 weeks.

6.1 OCR & Parsing

- **Printed Prescriptions:** CER = 2.1%, WER = 4.5%, entity extraction F1 = 0.96.
- **Handwritten Prescriptions:** CER = 18.6%, WER = 28.4%, entity extraction F1 = 0.74. Fallback to human verification when model confidence < 0.6 resulted in a 98% correct authorization after human inspection.
- **Improvement Notes:** Handwriting performance varies by writer; domain-specific handwriting data improved results.

6.2 CDSS Performance

- Critical alert sensitivity = 0.97 (identified severe interactions/allergies).
- Overall alert precision = 0.88 after ML ranking reduced false positives.
- Clinician override rate (in pilot) = 3.2% (majority due to local formulary substitutions).

6.3 Dispensing Reliability

- Mechanical error rate (before anomaly detector tuning) = 2.7%. After anomaly detector integration and mechanical adjustments, error rate reduced to 0.8%.
- Anomaly detection true positive rate = 0.92, false positive rate = 0.04.

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- End-to-end dispensing success (including authentication, parsing, CDSS pass, mechanical delivery) = 94.1% across 1,250 dispensing attempts.

6.4 User Acceptance & Safety

Community health workers reported positive acceptance due to reduced travel for patients and faster turnaround.

- **Safety Incidents:** One near-miss flagged by the system (potential drug mismatch) which prevented dispensing.
- **Key Concerns from Stakeholders:** Need for periodic audits, clear human escalation pathways, and regulatory certification.

6.5 Discussion

The system demonstrates feasibility for unattended medication dispensing in controlled conditions with printed prescriptions and prepackaged medications. Handwritten prescription recognition remains a principal challenge; operational deployments should build procedures—such as mandatory printed prescriptions or remote clinician review—to mitigate risk. The hybrid CDSS approach balances sensitivity for severe cases with manageable alert volumes. Edge deployment reduces dependency on continuous connectivity, important for rural settings.

7. Security, Privacy & Ethical Considerations

- **Data Privacy:** All patient data is encrypted at rest and in transit where possible. Minimal personally identifying information is stored; logs retain only necessary audit fields.
- **Authentication & Consent:** Multi-factor authentication with explicit patient consent is recorded for every dispensing action.
- **Accountability & Human Oversight:** The system includes mandatory escalation paths if the CDSS triggers a critical alert or if parsing confidence is low, dispensing is halted and a remote clinician is notified.
- **Regulatory Compliance:** Deployments must comply with regional medical device regulations, pharmacy practice laws, and data protection statutes.
- **Bias & Fairness:** Drug KB and ML training data should reflect local population and formularies to avoid bias (e.g., ethnic differences in drug allergy prevalence).

8. Limitations

1. **Handwritten Prescriptions:** OCR performance is limited; mitigation includes requiring typed/printed prescriptions or remote clinician verification.
2. **Formulary Constraints:** The system handles a finite set of preloaded medications complex compounding or intravenous drugs cannot be automated safely.

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3. **Regulatory & Legal Hurdles:** Local pharmacy laws, scope of practice, and medical device regulation may restrict unattended dispensing—administrative work is required before scaling.
4. **Power & Connectivity:** While edge-first design reduces dependency, regular synchronization and remote updates require occasional connectivity.
5. **Scale & Maintenance:** Hardware maintenance and secure restocking logistics remain essential and may be challenging in remote sites.

9. Future Work

- Improve handwriting recognition using larger, locally collected datasets and multimodal inputs (voice + text).
- Integrate generic medication adherence support (reminder alerts, refill scheduling).
- Add support for automated inventory resupply via predictive analytics and integration with supply chain partners.
- Perform larger, controlled clinical trials to evaluate patient outcomes, cost-effectiveness, and safety at scale.
- Implement explainable CDSS outputs to increase clinician trust and support audits.

10. Conclusion

This paper described the design, prototype, and evaluation of an Automated Medical Dispensing System (AMDS) that employs machine learning, IoT, and edge computing to enable safe medication access in rural communities with minimal human intervention. Prototype results from controlled and pilot tests indicate strong performance for printed-prescription workflows and demonstrate the viability of hybrid ML/rule-based CDSS and edge anomaly detection to maintain safety. Real-world deployment will require regulatory compliance, local adaptation of the drug KB, careful human-in-the-loop policies for edge cases, and operational plans for maintenance and supply. With these measures, AMDS can be a practical tool to improve medication access and health outcomes in underserved areas.

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ENHANCING FACE DETECTION PERFORMANCE THROUGH EXPLAINABLE AI AND MULTI-MODAL DEEP LEARNING APPROACHES

Mohammed Kaazim.U
Department of Computer Applications, Mazharul Uloom College(Autonomous), Ambur, Tamil Nadu, India.

Dr.P.Rizwan Ahmed
Department of Computer Applications, Mazharul Uloom College(Autonomous), Ambur, Tamil Nadu, India.

Abstract

Face detection remains one of the most significant challenges in computer vision, particularly in real-world environments where factors such as occlusion, pose variation, illumination changes, and dataset bias limit accuracy. Although recent advances in deep learning have dramatically improved detection rates, many existing models behave as black-box systems, which restricts interpretability and reduces trust in applications such as security, healthcare, and autonomous systems. This research introduces an Advanced Deep Face Detection Framework (ADFD) that aims to enhance both robustness and transparency. The proposed system integrates multi-modal data, including RGB, depth, infrared, and thermal modalities, with explainable AI techniques to improve both accuracy and interpretability.

The framework employs CNN-based backbones, attention-driven fusion modules, and graph neural networks (GNNs) to extract and fuse complementary features across modalities, while Grad-CAM, LIME, and SHAP are incorporated to provide interpretability. Evaluation on benchmark datasets such as WIDER FACE, CASIA NIR-VIS 2.0, and CelebA shows that ADFD significantly improves mean Average Precision (mAP), achieves superior performance in low-light and occluded environments, and provides meaningful explanations for detection outcomes. The findings highlight that integrating multi-modal data with explainable AI creates a pathway toward more robust, ethical, and trustworthy face detection systems.

Keywords: Face Detection, Multi-Modal Fusion, Explainable AI, Deep Learning, Attention Mechanisms, Graph Neural Networks, Transparency, Trustworthy AI

1. Introduction

Face detection plays a foundational role in computer vision, serving as the first stage for applications such as recognition, authentication, emotion analysis, and surveillance. Despite notable advances in convolutional neural networks and transformer-based architectures, real-world face detection remains a challenging task. Common obstacles include extreme illumination conditions, variations in head pose, and partial occlusion caused by accessories such as sunglasses, masks, or scarves. In addition, dataset imbalances often cause models to generalize poorly across age, gender, or ethnicity.

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Another significant limitation is the black-box nature of deep learning approaches, which lack interpretability and therefore restrict their use in domains where accountability and fairness are crucial. The motivation for this work arises from the dual need for robustness and transparency in face detection systems. RGB-only models are inadequate in low-light or occluded environments, whereas multi-modal fusion of RGB, infrared, depth, and thermal data offers complementary cues that can significantly enhance detection.

At the same time, with face detection increasingly used in security and law enforcement, it becomes imperative to incorporate explainable AI techniques that allow stakeholders to understand how models reach their decisions. The key contributions of this research are threefold. First, a novel deep learning framework named ADFD is proposed, which leverages multi-modal feature fusion through CNNs, attention mechanisms, and graph neural networks. Second, interpretability is incorporated into the detection pipeline by integrating Grad-CAM, LIME, and SHAP, thereby allowing transparent and trustworthy detection outcomes. Finally, the framework is evaluated on three benchmark datasets, demonstrating significant improvements in both accuracy and interpretability compared to unimodal baselines.

2. Related Work

Traditional face detection methods initially relied on handcrafted features. The Viola–Jones Haar cascade classifier was the first widely adopted real-time face detector, though it was highly sensitive to pose and lighting variations. Later approaches such as Histogram of Oriented Gradients (HOG) combined with Support Vector Machines (SVM) achieved better robustness but were still inadequate in uncontrolled environments. With the advent of deep learning, face detection underwent a paradigm shift. Region-based CNNs, including R-CNN, Faster R-CNN, SSD, and YOLO, offered significant improvements in accuracy and speed. Specialized architectures such as MTCNN further enhanced performance by jointly detecting faces and localizing landmarks. More recently, transformer-based detectors such as Swin Transformers have been explored, though they are computationally expensive.

Researchers have also experimented with multi-modal data to improve robustness. Depth and RGB fusion has shown promise in handling low-light scenarios, while thermal and infrared modalities have been used to detect faces under occlusion or in nighttime environments. However, most of these works rely on simple concatenation of features without advanced fusion strategies. Meanwhile, explainable AI has become a prominent research direction in deep learning. Grad-CAM provides heatmaps to visualize discriminative regions used by CNNs, LIME offers local surrogate models for interpretability, and SHAP assigns importance values to features. Although these methods are widely applied in classification and object detection, their integration into face detection pipelines remains limited. The research gap, therefore, lies in combining multi-modal data fusion with explainability to create robust and trustworthy face detection systems, which is the focus of this paper.

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3. Methodology

The proposed Advanced Deep Face Detection Framework (ADFD) is designed to simultaneously enhance detection performance and interpretability. The framework consists of three key stages preprocessing, feature extraction and fusion, and detection with explainability. In the preprocessing stage, multi-modal inputs comprising RGB, depth, infrared, and thermal images are collected and normalized. Spatial alignment and denoising techniques are applied to ensure consistency across modalities. Feature extraction is carried out using convolutional backbones such as ResNet-50 and EfficientNet-B4, which learn modality-specific representations. An attention mechanism is applied to highlight informative features, while cross-attention facilitates fusion across modalities. To further capture structural and spatial dependencies, graph neural networks are employed to model relationships among facial landmarks, allowing the system to better handle occlusion and pose variations.

The detection module employs a Region Proposal Network (RPN) to generate bounding boxes and classification scores. To enhance interpretability, the system integrates explainable AI tools directly into the pipeline. Grad-CAM is used to generate heatmaps that visualize important regions for detection, SHAP quantifies the contribution of each modality under different conditions, and LIME generates human-interpretable approximations of model predictions. The framework is trained using WIDER FACE, CASIA NIR-VIS 2.0, and CelebA datasets. Loss functions include cross-entropy for classification, Smooth L1 for bounding box regression, and cosine similarity for ensuring alignment across modalities. Training is optimized using the Adam optimizer with a learning rate of 0.0001, a batch size of 32, and 150 training epochs.

4. Experimental Results

The experimental evaluation demonstrates that the proposed ADFD significantly outperforms unimodal baselines. On the WIDER FACE dataset, a baseline RGB-only ResNet-50 achieved a mean Average Precision of 87.2 percent, whereas the proposed multi-modal fusion framework achieved 94.5 percent. In scenarios with occlusion, recall improved by 11 percent, while in low-light conditions, the integration of thermal and infrared data resulted in a 14 percent improvement over RGB-only baselines. Explainability results further validate the system's effectiveness. Grad-CAM visualizations revealed that the model correctly focused on key regions such as eyes, nose, and forehead even when the mouth was occluded. SHAP analysis indicated that thermal data was the most influential modality under low-light conditions, whereas RGB features dominated in well-lit environments. LIME approximations provided interpretable local explanations, allowing human evaluators to understand why certain bounding boxes were accepted or rejected. A human evaluation study involving thirty participants confirmed that interpretability was substantially improved, with the ADFD system scoring 8.7 out of 10 compared to

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5.1 For Conventional CNN-based Detectors

5. Discussion

The results demonstrate the effectiveness of the ADFD framework in addressing both robustness and transparency in face detection. By leveraging multi-modal inputs, the system was able to overcome limitations related to lighting, pose, and occlusion. The integration of explainable AI significantly enhanced trust, allowing stakeholders to visualize and interpret the decision-making process of the model. However, the system also presents certain limitations. The reliance on multi-modal sensors increases hardware costs and limits scalability in uncontrolled environments where thermal or depth data may not be readily available. Furthermore, real-time deployment on edge devices requires additional optimization, particularly for computationally intensive attention and GNN modules.

6. Conclusion

This paper introduced the Advanced Deep Face Detection Framework (ADFD), which combines multi-modal fusion and explainable AI to improve both robustness and interpretability in face detection. The integration of RGB, depth, infrared, and thermal data significantly enhanced detection accuracy, while Grad-CAM, LIME, and SHAP provided meaningful interpretability. Experiments conducted on benchmark datasets confirmed that the framework improves mAP, recall, and robustness under occlusion and low-light conditions, while simultaneously offering transparent explanations for model predictions. Future work will extend this approach by exploring lightweight transformer-based architectures for edge deployment, incorporating fairness-aware explainability techniques to address dataset bias, and expanding evaluations to include more diverse demographic datasets. The findings underscore the potential of combining multi-modal learning with explainable AI to establish a new paradigm for ethical, trustworthy, and high-performance face detection systems.

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IMPACT OF ARTIFICIAL INTELLIGENCE (AI) ON MARKETING

Dr.J.Devi
Assistant Professor,
Department Of Commerce,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

Artificial intelligence technologies are used in marketing to make automated decisions based on data gathering, analysis, and additional audience or economic trend insights that could affect marketing initiatives. AI is frequently utilized in marketing campaigns where speed is crucial. Without the assistance of marketing team personnel, AI tools utilize data and customer profiles to identify the most effective ways to engage with clients. They then deliver personalized messages to them at the appropriate moment, guaranteeing optimal efficiency. AI is utilized by many modern marketers to support their teams or to carry out more strategic duties that call for less human dexterity. The development of intelligent machines that can think and act like people is known as artificial intelligence. People consider artificial intelligence to be the next industrial revolution. Artificial intelligence has been viewed as the next big thing in industry, and many think it can solve most of the issues and problems that the world is currently facing. AI is also capable of resolving potential future issues. New technology, industries, and habitats could all be created by artificial intelligence.

Keywords: Artificial Intelligence (AI), Marketing, Technology, Customers, Machine Learning

Introduction

The development of intelligent machines that can think and act like people is known as artificial intelligence. With artificial intelligence, jobs can be completed more precisely. Artificial intelligence has been viewed as the next big thing in industry, and many think it can solve most of the issues and problems that the world is currently facing. AI is also capable of resolving potential future issues. New technology, industries, and habitats could all be created by artificial intelligence.

Objectives of the Study

- To determine how artificial intelligence affects marketing
- To examine a variety of artificial intelligence-related topics and demonstrate why marketers must use it as a tool to promote their goods and services.
- To examine different facets of artificial intelligence and demonstrate why marketers must use it as a tactic to promote their goods and services and services.

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- The objective is to examine different facets of artificial intelligence and demonstrate why marketers must use it as a tactic to promote their goods and services.

Research Methodology

The notion of artificial intelligence marketing is examined from a variety of angles in this study. This work is a descriptive study, and the examples are drawn from the author's own experiences as well as references to some secondary sources. The study makes several recommendations for actions that marketers may do to enhance their marketing.

Artificial Intelligence (AI) Marketing: What Is It?

Utilizing artificial intelligence technologies, AI marketing makes automated decisions based on data gathering, analysis, and further audience or economic trend insights that could affect marketing initiatives. AI is frequently utilized in marketing campaigns where speed is crucial. AI systems understand how to interact with clients most effectively by using data and customer profiles. Then, they provide customized messages to them at the appropriate moment. Without the assistance of marketing team personnel, AI tools utilize data and customer profiles to identify the most effective ways to engage with clients. They then deliver personalized messages to them at the appropriate moment, guaranteeing optimal efficiency. AI is utilized by many modern marketers to support their teams or to carry out more strategic duties that call for less human dexterity. Data analysis, natural language processing, media purchasing, automated decision-making, content creation, and real-time personalization are some examples of AI marketing use cases.

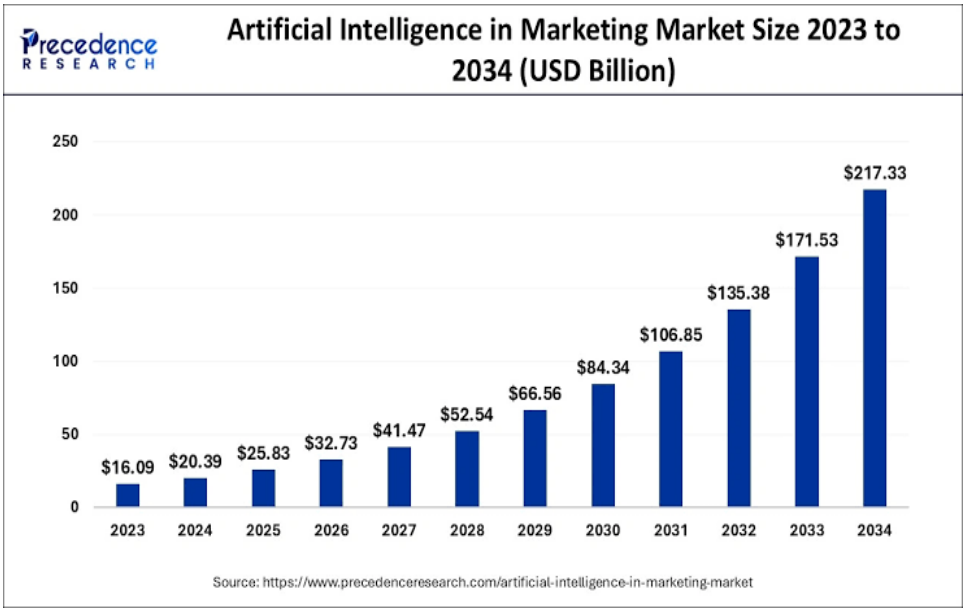

Fig 1: Artificial Intelligence in Mareketing Size 2023 to 2034 (USD Billion)

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Why is AI Marketing Important?

Artificial intelligence has a significant impact on digital marketing. 76% of consumers believe that businesses should be aware of their wants and requirements. With AI marketing, marketers can analyze vast amounts of marketing data from emails, social media, and the Internet much more quickly. AI marketing is therefore essential for all businesses.

Benefits of AI Marketing

1. Automation

AI adds intelligence to your marketing automation. It can be used in conjunction with marketing automation to facilitate the conversion of data into decisions, meaningful interactions, and favorable business outcomes. Data is everything, but converting data into meaningful insights in a timely and correct manner is more important. Stated differently, one of the most important benefits AI marketing may offer your company is the speed at which marketing tasks are carried out and accomplished. Marketers may use AI to scale their campaigns, identify the optimal course of action for their clients, and then decide which campaign to deliver to them.

2. Minimizing Errors

Humans are prone to making blunders by nature. Artificial intelligence reduces the possibility of human error by avoiding human interference. AI has been shown to assist in reducing human mistake, particularly in the most worrying area: data security. Many firms are concerned about their employees' incapacity to protect client data and other vital company information due to the prevalent data security issues.

3. Cost Savings

Many slash-and-burn resources that are often utilized to develop and implement a marketing strategy can be eliminated with the use of AI. By working faster and more effectively with AI, you may increase your revenue while achieving a significant cost savings. AI can assist you in finishing tedious and repetitive jobs when your company is spending too much time and money on them. It cuts down on the amount of time your employees need to complete those activities initially while eliminating all errors. Employing people can save a lot of money while utilizing the skills that are already available to complete more important jobs. You can operate more productively with AI.

4. Increased ROI

Marketers may enhance customer experiences and gain a deeper understanding of customers with the use of AI.

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With the use of AI-powered marketing, marketers can develop more individualized and targeted customer journeys and produce predictive customer analyses, which successfully boosts return on investment for every customer interaction. With the help of AI, marketers can better understand their customers, group them, and encourage them to take the next step to ensure the greatest possible experience.

5. Increased Personalization

Marketing will become more individualized in a variety of ways thanks to artificial intelligence. AI is already being used by many businesses to better cater to the needs of their clients by personalizing their emails, videos, social media postings, websites, and other content. Making push notifications responsive to mobile devices, for example, is helping e-commerce firm owners achieve better outcomes. When properly executed, push notifications sent through mobile devices attract more customers' attention due to the sense of personalized they provide.

6. Smarter and faster decision-making

AI facilitates data processing far more quickly than human intervention, ensures accuracy and security, and frees up your team to concentrate on key projects for successful AI-powered marketing. AI can gather and monitor tactical data in real time, allowing marketers to make decisions immediately rather than waiting until a campaign is over. Based on the data-driven reports, they may decide what to do next, making better informed and unbiased decisions.

Impact of Artificial Intelligence on Marketing

Artificial Intelligence has impacted Digital marketing in many ways; here are some effects that Digital Marketing is going to face in the coming years.

1. Predictive Marketing
2. Voice Search
3. Target Right Audience
4. A/B Testing
5. Lead Scoring Chatbots
6. Semantic Search
7. Content Creation and Curation
8. Ad Targeting
9. Chatbots
10. Web Development

1. Predictive marketing

Forecasting marketing success is known as predictive marketing, and artificial intelligence (AI) can assist marketers in making precise business predictions.

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Predictive analytics examines past data to forecast future patterns using data mining, machine learning, and artificial intelligence. Artificial intelligence gathers and examines data on a user's online activity each time they surf the internet. Numerous details are revealed by this data, including the user's brand preferences and frequency of purchases. With the data it has already examined, artificial intelligence can comprehend the wants and demands of the customer. AI helps businesses understand what their customers want by segmenting the audience. Predicting your target customer's purchasing habits is helpful.

2. Voice Search

Information may be found more quickly and easily with voice search. Future SEO tactics will be altered by voice search, therefore marketers must use voice-friendly long-tail keywords to optimize their content.

3. Target the Right Audience

An Internet company, it's critical to target the right audience with the right offering at the right moment. Artificial intelligence-powered Google Analytics may divide up the audience based on psychographics like interests, preferences, and attitudes, as well as demographics like age, gender, education, income, and occupation. It aids in determining the ideal target market for your offering.

4. A/B Testing

Split testing and bucket testing are other names for A/B testing. A/B testing is an internet marketing strategy that compares two versions of a website to determine which version users prefer, according to Techopedia. Tools powered by artificial intelligence may test multiple hypotheses at once and get better results far more quickly and effectively than humans. AI is also utilized to boost the conversion rate's efficacy.

5. Lead scoring

A technique for grading leads according to consumer behavior regarding their interest in a product or service and where they are in their purchasing cycle is called lead scoring. Knowing who is most likely to interact or make a purchase is helpful. Focusing on qualified leads is beneficial since nobody wants to waste time on unqualified leads. Businesses might use phrases like "hot," "warm," and "cold" to earn leads.

- **Hot:** A hot lead is someone who is prepared to make a purchase.
- **Warm:** A warm lead is a person who is considering your goods or services.
- **Cold:** Individual is someone who doesn't express interest in your goods or services.

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6. Semantic Search

Semantic search greatly aids users in finding answers to their queries much more quickly. Instead of using keywords to find results, semantic search interprets the context and intent of a user's search query. By comprehending the meaning of search terms, AI is able to accomplish this. It entails figuring out how the words and phrases in the search query relate to one another. Based on a user's search history and user profile, machine learning techniques assist search engines in determining what information a user would require. The quality of the search will continuously improve using machine learning.

7. Content Creation and Curation

In the sphere of content marketing, artificial intelligence is crucial. With the aid of AI-powered Natural Language Generation technology, marketers can produce content automatically. Your data is transformed into readable, captivating narratives via an NLG (natural language generation) technology. Financial reports, stock updates, and sports articles are examples of data-specific content that artificial intelligence is capable of writing. AI can generate 2000 articles every second. Artificial intelligence will also make content development more efficient. The process of obtaining and arranging material pertinent to a specific subject is known as content curation. One type of artificial intelligence is content curation. E-commerce sites such as Amazon are the best examples of content curating.

8. Ad Targeting

AI is capable of creating and promoting internet advertisements, which are crucial for brand marketing. Based on the user's likes, dislikes, preferences, and interests, it can create or enhance ads. The correct adverts may be shown to the right people at the right time using AI. Advertisers will benefit from a higher return on investment.

9. Chatbots

The chatbots are computer programs designed to communicate with online clients and fulfill their requests using artificial intelligence (AI) and natural language processing. Social media pages and websites can both incorporate chatbots.Chatbots increase customer engagement, can assist clients around-the-clock, and can manage multiple clients at once.

10. Web Development

AI makes website building simpler, quicker, and requires fewer clicks. With the use of an application like Grid, an artificial intelligence called Molly can create a website in a matter of minutes using user-provided data such as calls to action, text, graphics, and page layout.

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Examples of AI in Marketing

1. Nike - Personalized Online Experiences
2. Amazon - Personalized Shopping Recommendations
3. Alibaba – Fashion AI Store
4. Netflix - Personalized Product Recommendations
5. Sephora Audi-Targeted Ads
6. Starbucks - Voice Command Ordering
7. Heinz, Buzzfeed - Content Creation

Conclusion

The rapid adoption of AI across industries will undoubtedly lead to a transformation in the way organizations have operated up to this point. Opportunities to accomplish tasks more quickly and accurately are fueled by artificial intelligence. AI significantly benefits the banking and financial sectors in terms of cost-effectiveness, data management, information retrieval, and high computation volume. Artificial intelligence enables marketers to make data-driven choices that improve campaign outcomes. In order to increase sales and customer satisfaction, they can also take advantage of AI's prediction efficiency to quickly discover their potential clients' buying patterns.

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QHRMOF: A QUANTUM-INSPIRED HYBRID MULTIOBJECTIVE FRAMEWORK FOR ENERGY-EFFICIENT TASK SCHEDULING AND LOAD BALANCING IN CLOUD COMPUTING

Shylaja
Assistant Professor,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

The rapid growth of cloud computing services has led to a significant rise in energy usage, posing challenges for sustainable and efficient management of cloud data centers. This study proposes a Quantum-Inspired Hybrid Reinforcement Learningc and Multi-Objective Optimization Framework (QHRMOF) to improve task scheduling, dynamic load balancing, and server consolidation while reducing power consumption and enhancing system performance. The framework combines three key methods: the Quantum-Inspired Evolutionary Algorithm (QIEA), which leverages quantum concepts like superposition and entanglement to explore the solution space more effectively and avoid local optima; Hybrid Deep Reinforcement Learning (HDRL), which uses CNNs and LSTMs to predict workloads and classify virtual machines as overloaded or underloaded for efficient migration and load balancing; and Multi-Objective Optimization (MOO), which balances conflicting goals such as minimizing energy consumption and makespan while maximizing resource utilization and scalability. QHRMOF reduces unnecessary migrations and system overhead through intelligent decision-making and adaptive resource management. Simulation results on the CloudSim platform using real-world datasets, including NASA, HPC2N, and Google workloads, demonstrate that QHRMOF outperforms techniques like MOGA, PSO, DRL-LB, and ACO, achieving up to an 18.76% reduction in makespan, 22.84% lower energy consumption, 19.52% higher resource utilization, 25.39% better load balancing, and a 12.67% decrease in failure rates. These results highlight QHRMOF's potential in improving resource management, system reliability, and energy efficiency in cloud computing environments.

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ETHICS, EMPATHY AND EXPRESSION: EVALUATING THE HUMAN DIMENSION OF CREATIVE WRITING IN THE AGE OF ARTIFICIAL INTELLIGENCE

Dr.Zeba Siddiqui
Associate Professor,
Amity School of Languages,
Amity University,
Gwalior, Madhya Pradesh, India.

K.Muthuvel
Assistant Professor & HOD,
Amity School of Languages,
Amity University,
Gwalior, Madhya Pradesh, India.

Dr Manoj Mishra
Professor,
Humanities Department,
ITM University,
Gwalior, Madhya Pradesh, India.

Abstract

The rapid evolution of artificial intelligence has transformed the landscape of creative writing, raising fundamental questions about ethics, empathy, and human expression. In today's world generative AI systems can produce narratives, poetry, and dialogue with remarkable fluency, their outputs often lack the depth of lived experience, cultural context, and emotional authenticity which characterize human creativity. The present paper explores the tension between human-centred creative practices and machine-generated content, with a particular focus on the ethical and expressive dimensions of literary production in the digital age. It examines ethical concerns surrounding authorship, ownership, and originality, questioning whether AI-assisted texts can be considered truly "creative" and how such practices affect intellectual property rights and literary value. Secondly, the study investigates the role of empathy in storytelling, highlighting how human writers draw upon personal histories, emotions, and cultural narratives to foster connection an element that remains elusive for machines. Finally, the paper addresses the expressive function of creative writing, considering whether AI's algorithmic structures can replicate the nuance of human voice, identity, and artistic intention. Drawing upon case studies of AI-generated literature, classroom practices in creative writing pedagogy, and theoretical perspectives from digital humanities, this research argues that while AI can serve as a valuable tool and collaborator, it cannot replace the human dimension that grounds literature in ethics, empathy, and expression. Instead, the integration of AI into creative writing should be approached as an opportunity for critical reflection on what it means to write, to imagine, and to be human.

Keywords: Artificial Intelligence, Creative Writing, Ethics, Empathy, Human Expression.

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BRAND PREFERENCE OF MOBILE PHONE MARKETING IN ARTIFICIAL INTELLIGENCE

S.Soundariya
Student,
Department of Commerce,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

V.Aruna
Student,
Department of Commerce,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

M.Pavithra
Student,
Department of Commerce,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Dr. J.Devi
Assistant Professor,
Department of Commerce,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

In today's digital era, artificial intelligence (AI) has transformed the way mobile phone brands engage with consumers. Mobile phone marketing has moved beyond traditional advertisements to AI-driven personalization, predictive analytics, and virtual customer assistance. This study focuses on understanding brand preference in the mobile phone market, highlighting the role of AI in influencing consumer choices. Through features such as chatbots, recommendation systems, sentiment analysis, and predictive demand forecasting, companies like Apple, Samsung, Xiaomi, and OnePlus are able to align their products more closely with customer expectations. The findings suggest that AI enhances consumer satisfaction by delivering personalized experiences, improves decision-making for marketers, and creates stronger brand loyalty. Thus, AI not only serves as a marketing tool but also as a strategic driver of brand preference in the competitive mobile phone industry.

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NEW GENERATION ONLINE VOTING SYSTEM

Allmass Begam.M
Student,
Rajeshwari College of Arts and Science for Women, Villupuram, Tamil Nadu, India.

Nandhini.P
Student,
Rajeshwari College of Arts and Science for Women, Villupuram, Tamil Nadu, India.

Oviya.A
Student,
Rajeshwari College of Arts and Science for Women, Villupuram, Tamil Nadu, India.

Shobana.S
Student,
Rajeswari College of Arts and Science for Women, Villupuram, Tamil Nadu, India.

Abstract

The Online Voting System is a web-based application developed using PHP and MySQL to conduct elections digitally.It allows registered users (voters) to log in securely and cast their vote online without going to a physical polling booth.This system helps reduce manual effort, paper usage, and errors found in traditional voting methods. Users must first register and get approval from the admin to vote.Once verified, they can log in and cast their vote for their preferred candidate. The system ensures that one person can vote only once, using session and login control.Votes are stored securely in the MySQL database, and results are updated in realtime. The admin can add candidates, manage users, and view the finalresult after the voting ends.The interface is simple, mobile-friendly, and easy to use for all voters.PHP handles the form processing, validations, and backend logic.Security features like login authentication, uniquevoter ID, and session management are included.This project helps build trust and transparency in theelectionprocess. It is suitable for school, college, or small organizational elections.Future improvements can include OTPbased login, email notification or blockchain integration.Overall, this projectbrings voting to fingertips and supports digital democracy.

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TRAUMA'S ECHO: JUXTAPOSING THE SUFFERING IN BELOVED AND TWELVE YEARS A SLAVE WITH THE CRISIS OF 21ST-CENTURY BONDAGE

Mahalakshmi.S
Student,
Department of English,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

This project, titled Trauma's Echo: Juxtaposing the Suffering in Beloved and Twelve Years a Slave with the Crisis of 21st-Century Bondage, conducts a rigorous comparative study of slavery across time. The core argument links the historical horrors of chattel slavery, found in literature, with the pervasive reality of modern slavery today. The initial analysis focuses on Toni Morrison's Beloved and Solomon Northup's Twelve Years a Slave. Both texts powerfully express shared themes of dehumanization (reducing people to mere property), the destruction of family bonds, and systemic violence. Northup's memoir acts as factual witness to institutional injustice, detailing the linear experience of bondage, whereas Morrison's novel uses the neo-slave narrative form to delve into the deep psychological aftermath. She explores re-memory and haunting to show how the trauma of slavery—like the complex trauma of motherhood under oppression persists long after physical freedom is achieved.

This literary foundation is then juxtaposed with a report on the crisis of 21st-century bondage. We show where slavery is found today: across economic sectors. Modern slavery, now largely categorized as human trafficking or forced labor, is a complex global crisis found in various hidden sectors of society. It operates mainly through economic exploitation, such as debt bondage where workers in industries like construction or quarrying are trapped by impossible loans, or through outright forced labor on remote sites and fishing vessels, where individuals are denied wages and freedom. Beyond economic sectors, slavery is rampant in sexual exploitation, encompassing sex trafficking where individuals are coerced and abused.

Furthermore, it is deeply embedded in entrenched cultural practices around the world, manifesting as forced marriage which strips victims, often children, of autonomy and subjects them to servitude—or as forms of hereditary slavery where birth status dictates a life of bondage. This wide-ranging exploitation demonstrates that the fundamental mechanism of slavery remains the same: the complete absence of choice enforced by coercion, violence, and economic necessity.By comparing this historical suffering with contemporary exploitation, the project demonstrates that the fundamental core mechanism of servitude the absence of choice—remains terrifyingly consistent.

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The project ultimately concludes that the suffering documented in the 19th-century echoes powerfully in today's global crisis, which is estimated to affect over 50 million people, proving that Historical Trauma is a living reality.

Keywords: Historical Trauma, Modern Slavery, Human Trafficking, Chattel Slavery, Neo-Slave Narrative, Dehumanization, Re-Memory, Debt Bondage, Forced Labor, Institutional Injustice, Absence of Choice.

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ARTIFICIAL INTELLIGENCE IN MARKETING

Kiruthiga.A
Student,
Department of Commerce,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Dr.J.Devi
Assistant Professor,
Department of Commerce,
Rajeswari college of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

The digital transformation fostered by the increasing leverage of artificial intelligence (AI) has been a critical influencing factor unleashing the next wave of enterprise business disruption. Marketing is one of the business streams witnessing this transformation on a very intense scale. Contemporary marketing has begun to experiment with modern, cutting-edge technologies, such as AI, deploying them in mainstream operations to ensure accelerated success. This article explores the use of AI in marketing as an emergent stream of research. Based on inferences from earlier studies, the study categorizes marketing into five distinct functional themes integrated digital marketing, content marketing, experiential marketing, marketing operations, and market research—and 19 sub-functional themes (activity levers).

Across the chosen themes and sub-themes, the study further dovetails into and identifies 170 featured use cases of the extant literature, where AI is leveraged by marketing in delivering superior quality outcomes and experiences. By way of a systematic literature review (SLR), the article evaluates 57 qualifying publications in the context of AI-powered marketing and qualitatively and quantitatively ranks them based on their coverage, impact, relevance, and contributed guidance, and elucidates the findings across various sectors, research contexts, and scenarios. The study discusses the practitioner and academic research implications and proposes a future research agenda to study the continuous transformation fostered by accelerated adoption of AI across the marketing landscape.

Keywords: Artificial Intelligence, Consumer Behavior, Content Marketing, Experiential Marketing, Integrated Digital Marketing, Market Research, Marketing Operations.

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ARTIFICIAL INTELLIGENCE IN E-COMMERCE

Pavithra.S
Student,
Department of Commerce,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Sunitha.S
Assistant Professor,
Department of Commerce,
Rajeswari college of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

The digital world is expanding at an unprecedented rate, and this has an immense influence on the potential growth of e-commerce. The ongoing pandemic has further propelled the expansion of e-commerce, along with ever-evolving customer demands and shopping habits, making it essential for businesses to employ artificial intelligence to enhance productivity.The thesis aims to widen our understanding of artificial intelligence and explore how ithas revolutionized the e-commerce landscape in improving customer experience problems. Ultimately, the study endeavours to establish that AI represents a significant opportunity for the future of our world.The empirical research aspect of the thesis adopts a combination of qualitative and quantitative methods, utilizing a deductive research approach.

The primary source of data collection was an online survey that was distributed to participants of varying age groups, via different digital platforms. Additionally, the study utilized secondary sources such as literature reviews, printed sources, books, and online sources, to supplement the data collected from the primary sources. The use of both primary and secondary sources allowed for a comprehensive and well-rounded analysis of the topic under investigation.The study's results suggest that integrating AI technologies into e-commerce is a highly effective strategy. By leveraging AI, businesses can greatly enhance customer experience, attract new clientele, and improve their prospects. Additionally, the study underscores AI's potential to transform a wide range of industries, showcasing the significant role that AI is poised to play in shaping the future of various sectors.

Keywords: Artificial Intelligence, AI, E-Commerce, Customer Experience.

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ZERO TRUST SECURITY MODEL: REDEFINING OF CYBERSECURITY IN THE MODERN ERA

Swarna.K
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

As cyber threats continue to evolve in complexity, traditional perimeter-based defense have become inadequate for safeguarding critical digital assets. In the modern era of cybersecurity, the Zero Trust Security Model has emerged as a transformative approach. Guided by the principle of "never trust, always verify," Zero Trust eliminates implicit trust and enforces strict identity verification, continuous monitoring, and least-privilege access across users, devices, and applications. By integrating advanced tools such as multi-factor authentication, micro-segmentation, and AI-driven analytics, this model strengthens resilience against ransomware, insider threats, and cloud vulnerabilities. Positioned within the broader shift toward redefining cybersecurity, Zero Trust represents not just a security framework, but a strategic necessity for building robust, adaptive, and future-ready defense systems.

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COLORIZATION OF X-RAY IMAGES USING LUMINANCE COLOR CONTRAST TECHNIQUE

Dr.N.Ravia Shabnam Parveen
Student,
HOD & Assistant Profesor (SG),
Department of MCA,
KCG College of Technology,
Chennai, Tamil Nadu, India.

Abstract

Gray scale images are made up of only one bit value. They lack the chromatic information. They are also called as monochromatic images. These image pixel value ranges from 0 to 255. It shows only the luminance information. Color models describe how colors are represented. There are different types of color models in image processing. They are RGB, CMYK, HSV, LAB, and HSL. In this paper, RGB color model is taken into account. This is very common type of color model for which the processing is done very easily. The RGB Color Model is composed of three color components. They are Red, Green, and Blue.

The RGB color model is an additive color model in which red, green, and blue light are added together in various ways to reproduce a broad array of colors. X-ray imaging is one of the most commonly used diagnostic tools in clinical practice due to its cost-effectiveness, rapid acquisition, and non-invasive nature which is in Gray scale. However, the inherent limitation of conventional X-ray images lies in their grayscale representation, which restricts the ability to distinguish between subtle anatomical structures and pathological variations. To overcome this challenge, our research explores advanced computational methods for the colorization of X-ray images, aiming to enhance interpretability and diagnostic value. The process of color conversion includes adding color to the gray scale images. The algorithm for adding color to the gray scale images,

- **Step 1:** Check whether the Original image is a gray scale image or not. If it is a color image, then convert it to a gray scale image.
- **Step 2:** The Source image which taken for reference should be a color image.
- **Step 3:** The size of the Original Image and the Source image should be taken.
- **Step 4:** Convert the Original image and the Source image to ycbcr Color Space.
- **Step 5:** Normalization process is done.
- **Step 6:** Finally luminance is compared.
- **Step 7:** After comparing the luminance the color mood is taken from the source image and added accordingly to the Original image to form the Destination image.

After this algorithm is processed the gray scale image is modified into a color image by the luminance effect of the Source image.

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ARTIFICIAL INTELLIGENCE IN BANKING AND FINANCE

Subasri.N
Student,
Department of BBA,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Dr.J.Devi
Assistant Professor,
Department of BBA,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

Artificial intelligence (AI) has Revolutionized the banking and financial industry by Improving client relations, precision, and operational efficiency. This paper explores the use of artificial Intelligence (AI) in banking and finance, including topics like credit scoring, fraud detection, investment management, and customer service. This research aims to identify the benefits and difficulties associated with the integration of AI in the financial sector by a comprehensive analysis of the body of existing literature. The results Highlight how AI technologies have significantly improved decision-making, reduced operating costs, and increased overall profitability. Nonetheless, in order to guarantee the Ethical and sustainable application of AI in the future, it is crucial to address issues with data privacy, prejudice, and Ethical reasons.

Keywords: Artificial Intelligence, Banking, Finance, Fraud Detection, Credit Scoring, Investment Management.

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CLOUD ACCESS CONTROL USING FUZZY IDENTITY BASED ENCRYPTION

Abinaya.M
Assistant Professor,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

Cloud computing is the technology that provides different types of services as a useful resource on the Internet. Resource trust value will help the cloud users to select the services of a cloud provider for processing and storing their essential information. Also, service provider scan give access to users based on trust value to secure cloud resources from malicious users. In this paper, trust models are proposed, which comes under the subjective trust model based on the behavior of user and service provider to calculate the trust values. The trust is fuzzy, which motivated us to apply fuzzy logic for calculating the trust values of the cloud users and service providers in the cloud environment. We use a Mam dani fuzzy method with gauss membership function for fuzzification and triangular membership function for defuzzification. Parameters such as performance and elasticity are taken for trust evaluation of the resource. The attributes for calculating performance are workload and response time. And for calculating elasticity, we have taken scalability, availability, security, and usability. The fuzzy C-means clustering is applied to parameters for evaluating the trust value of users such as bad requests, bog us requests, unauthorized requests, and total requests.

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FROM SURVIVAL TO ACCEPTANCE: GENERATIONAL PERSPECTIVES ON TRANSGENDER IDENTITY IN LESLIE FEINBERG'S STONE BUTCH BLUES AND MEREDITH RUSSO'S IF I WAS YOUR GIRL

D.Sujithra
Student,
Department of English,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

This study examines the generational perspectives on transgender identity through a comparative reading of Leslie Feinberg's Stone Butch Blues (1993) and Meredith Russo's If I Was Your Girl (2016). Both novels present powerful depictions of transgender lives, yet they are shaped by different historical contexts and cultural climates. Feinberg's narrative, set in the late twentieth century, portrays Jess Goldberg's struggle for survival amidst social hostility, systemic violence, and the invisibility of transgender voices. The novel emphasizes resilience, activism, and the fight to exist in a society that denies recognition. In contrast, Russo's If I Was Your Girl reflects a more contemporary setting, focusing on Amanda Hardy, a transgender teenager who longs for acceptance, love, and a sense of normalcy. While challenges such as secrecy and prejudice remain, the novel highlights a generational shift toward visibility, inclusion, and the possibility of hope. By analyzing these two narratives together, the study reveals the evolution of transgender representation in literature: from survival and resistance in Feinberg's work to acceptance and affirmation in Russo's. The comparative perspective underscores how transgender experiences, though diverse, share common struggles for identity and belonging across time. Ultimately, the research concludes that literature not only records these struggles but also acts as a medium of empowerment, bridging past hardships with present possibilities for acceptance.

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AN ATTITUDE TOWARDS INCLUSIVE EDUCATION OF IN-SERVICE EDUCATORS

Akhilesh R.Bramhe
P.G.Department of Education,
Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur, Maharashtra, India.

Snehal Tajne
Bar.S.K.Wankhede College of Education,
Rashtrasant Tukadoji Maharaj Nagpur University,
Nagpur, Maharashtra, India.

Abstract

An attitude of educators significantly influences the successful implementation of the educational syllabus. The attitude of the teacher plays a crucial role in the implementation of inclusive education. This study explored the attitude of in-service educators with respect to inclusive education. The study was conducted among in-service educators in the Nagpur Urban area, including both males and females. The Attitude with regard to Inclusive Education scale, constructed by Vishal Sood and Arti Anand, was utilized to gather data. A total of 60 in-service educators from various high schools in Nagpur were analyzed for this study. The findings revealed a notable non-equivalent attitude inclination among male and female high school in-service educators, as female in-service educators demonstrated a more favorable attitude toward inclusive education than their male counterparts.

Keywords: Attitude, Inclusive Education, In-Service Educators.

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DIGITAL IMAGE PROCESSING TECHNIQUES FOR THE DETECTION AND REMOVAL OF CRACKS IN DIGITIZED PAINTINGS

R.Jayapraba
Assistant Professor,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

An integrated methodology for the detection and removal of cracks on digitized paintings is presented in this paper. The cracks are detected by thresholding the output of the morphological top-hat transform. Afterwards, the thin dark brush strokes which have been misidentified as cracks are removed using either a Median Radial Basis Function (MRBF) neural network on hue and saturation data or a semi-automatic procedure based on region growing. Finally, crack filling using order statistics filters or controlled anisotropic diffusion is performed. The methodology has been shown to perform very well on digitized paintings suffering from cracks.

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CLOUD ACCESS CONTROL USING FUZZY IDENTITY BASED ENCRYPTION

Abinaya.M
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Gopikasri.M
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Mrs.B.Sivaranjani M.Sc., B.Ed.
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

Cloud computing is the technology that provides different types of services as a useful resource on the Internet. Resource trust value will help the cloud users to select the services of a cloud provider for processing and storing their essential information. Also, service provider scan give access to users based on trust value to secure cloud resources from malicious users. In this paper, trust models are proposed, which comes under the subjective trust model based on the behaviour of user and service provider to calculate the trust values. The trust is fuzzy, which motivated us to apply fuzzy logic for calculating the trust values of the cloud users and service providers in the cloud environment. We use a Mam dani fuzzy method with gauss membership function for fuzzification and triangular membership function for defuzzification. Parameters such as performance and elasticity are taken for trust evaluation of the resource. The attributes for calcul ating performance are workload and response time. And for calculating elasticity, we have taken scalability, availability, security, and usability. The fuzzy C-means clustering is applied to parameters for evaluating the trust value of users such as bad requests, bog us requests, unauthorized requests, and total requests.

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THE IMPACT OF FRONT-OF-PACK LABEL (FOPL) DESIGN ON CONSUMER PURCHASING BEHAVIOR IN INDIA'S HETEROGENEOUS RETAIL LANDSCAPE

N.Venkata Sai Prasad
Research Scholar,
SOMC,
Malla Reddy University,
Dulapally, Hyderabad, Telangana.

Dr.G.Vijaya Kumar
Associate Professor,
SOMC,
Malla Reddy University,
Dulapally, Hyderabad, Telangana.

Abstract

The compulsory introduction of Front-of-Pack Labels (FOPL) by the Food Safety and Standards Authority of India (FSSAI) poses both significant challenges and opportunities for managing retail operations. This literature review consolidates findings from both global and Indian studies to examine the impact of two main labeling options warning symbols and health star ratings on consumer behavior within India's intricate retail landscape. It investigates various elements such as the design of labels, consumer education, socio-economic factors, and especially the retail format, which ranges from modern supermarkets to traditional kirana stores and e-commerce platforms, exploring their mediating influences. The results reveal that warning labels are particularly effective for quick, instinctive decision-making among consumers with lower literacy levels in crowded retail environments, whereas health stars support comparative choices for those who are nutritionally informed. The review concludes that no single label design stands out as the best; rather, its effectiveness is contingent on the retail environment. Suggestions are made for policymakers, retail managers, and marketers to customize their strategies to enhance the effectiveness of FOPL across various retail channels in India.

Keywords: Front-of-Pack Labels, Retail Management, Consumer Behavior, Warning Labels, Health Star Ratings, India, In-Store Marketing, Behavioral Economics

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ONLINE JOB PORTAL

Shylaja.S
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Almas Banu.T
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Janaki.I
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Monisha.S
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Sandhiya.S
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

The aim of this project is to develops an online search Portal for the Placement Dept. Of the college. The system is an online application that can be accessed throughout the organizationand outside as well with proper login provided. This system can be used as an Online Job Portalfor the Placement Dept of the college to manage the student information with regards toplacement. Students logging should be able to upload their information in the form of a CV.Visitors/Company representatives logging in may also access/search any information putup by Students. The project has been planned to be having the view of distributed architecture, withcentralized storage of the database. The application for the storage of the data has been planned.Using the constructs of MS-SQL Server and all the user interfaces have been designed using theASP.Net technologies. The database connectivity is planned using the "SQL Connection" methodology. Thestandards of security and data protective mechanism have been given a big choice for proper usage.

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ROLE OF ADVANCED INTELLIGENCE AND EMERGING TECHNOLOGIES TO RESHAPING THE LANDSCAPE OF MODERN POLITICAL GOVERNANCE

Dr.Santosh Kumar
Assistant Professor,
Department of Political Science,
Geeta University,
Panipat, Haryana, India.

Abstract

The structures, operations, and dynamics of contemporary political government have been profssoundly changed by the quick development of cutting-edge intelligence systems and new technology. Innovations like artificial intelligence (AI), blockchain, big data analytics, and quantum computing have given governments hitherto unheard-of powers to handle difficult social, economic, and security issues. At the same time, they have created new power imbalances, governance gaps, and ethical quandaries that call for a reconsideration of conventional political theories and administrative structures. This study looks at how new technology and advanced intelligence are changing political governance globally, concentrating on four main areas citizen-state relations, decision-making procedures, relationships, changes in institutions, and changes in the balance of power in politics. It critically evaluates risks like algorithmic bias, surveillance overreach, cyber security threats, and democratic backsliding while examining the transformative potential of technologies in enhancing governance efficiency, transparency, and responsiveness. It does this by drawing on recent academic literature and international case studies. The study comes to the conclusion that in order to guarantee that technological advancement is consistent with democratic values and human rights, the incorporation of advanced technologies into governance necessitates inclusive governance models, interdisciplinary policy approaches, and adaptive regulatory frameworks.

Keywords: Governance, Intelligence, Technologies and Political Systems

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A FRAMEWORK FOR INTRODUCTORY DATA SCIENCE EXPERIENCES FOR NON-COMPUTER SCIENCE MAJORS

S.Priyanga
Assistant Professor,
Department of BCA,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

Data Science has become an essential interdisciplinary field that enables individuals to analyze, interpret, and extract meaningful insights from data. However, many non-computer science students face challenges in learning data science due to limited programming background and technical exposure. This paper presents a framework for introducing data science concepts to non-computer science majors through an application-oriented and experiential learning approach. The framework emphasizes the integration of basic statistical concepts, data visualization, and real-world datasets using accessible tools such as Excel, Python, anZd Google Colab. By focusing on problem-solving, collaboration, and conceptual understanding rather than coding complexity, the framework aims to build data literacy and analytical thinking among students from diverse academic disciplines. The proposed model encourages project-based learning and interdisciplinary applications, helping learners relate data science techniques to their respective domains. This approach not only enhances computational thinking but also prepares students to participate effectively in data-driven decision-making across various fields.

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CULTURAL IDENTITY AND GENERATIONAL CONFLICT: A COMPARATIVE STUDY OF JHUMPA LAHIRI'S THE NAMESAKE AND AMY TAN'S THE JOY LUCK CLUB

D.Gajalakshmi
Student,
Department of English
Rajeswari College of Arts and Science for Women
Villupuram, Tamil Nadu, India.

Abstract

This project examines the complexities of cross-culturalism and the diasporic experience, focusing on the struggle for identity between immigrant parents and their children raised in a new land. The study is primarily grounded in a comparative literary analysis of Jhumpa Lahiri's *The Namesake* and Amy Tan's *The Joy Luck Club*. Both novels depict the emotional journeys of second-generation immigrants, like Gogol and the daughters, who grapple with balancing ancestral heritage and American culture. The analysis highlights common themes across both narratives, including the burden of cultural expectations (Gogol's name), generational conflict, family pressure, and the significance of memory and storytelling. Ultimately, the literary portion emphasizes that these protagonists face similar challenges in reconciling their identities, regardless of their Bengali-American or Chinese-American origins.

To validate and contextualize these literary findings, the research employs a mixed-methods approach underpinned by five original comparative case studies tracing the cultural adherence and divergence of migrant families. The core methodology involves the close reading of texts, a review of critics' ideas, and utilizing the case studies supported by quantitative data from a 12-question Google Form survey. The central hypothesis posits that the degree of cultural preservation in the receiving country directly correlates with the first generation's proactive efforts and is inversely related to the socio-cultural pressure for complete assimilation. The study will compare the internal identity struggles depicted in the literary narratives (Gogol/Nikhil, Waverly/Jing-Mei) with the real-world outcomes observed in the case studies and survey data. This research concludes that both the novels and the empirical evidence offer a common portrayal of diaspora life, emphasizing that true self-understanding and cultural stability result from embracing and integrating both worlds in a globalized society.

Keywords: Identity, Immigrant Experience, Culture Conflict.

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THE COST OF HUMAN-CENTERED PROGRESS: SHAME, DESTRUCTION, AND BETRAYAL IN ROY'S "THE GREATER COMMON GOOD" AND DEVI'S BAYEN

Meena.M
Student,
Department of English,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

This comparative study employs an eco-critical framework to analyze Arundhati Roy's political essay "The Greater Common Good" and Mahasweta Devi's novella Bayen. The project investigates the severe ethical and psychological costs of prioritizing anthropocentric progress whether economic gain (State) or social stability (Community) over the sanctity of the natural entity. The central thesis argues that this flawed moral paradigm demands the annihilation of the marginalized via systemic destruction, a process that is then justified and sustained by the imposition of shame and betrayal. The analysis contrasts these two distinct mechanisms of destruction. Roy's work critiques the macro-level ethical failure of the democratic State, where economic advancement leads to the ecological and physical annihilation of the Narmada River Valley and the displaced Adivasis.

Here, betrayal is political, and shame is imposed via the label "anti-national." Conversely, Devi's Bayen addresses a micro-level ethical failure, illustrating how community tyranny and superstition cause the social and psychological annihilation of the protagonist, Moyna. The community's betrayal is based on fear, and shame enforces her isolation and tragic sacrifice. To support this claim, the research uses two main sources: rigorous close textual reading and new survey data. Results from a peer-administered Google Form on contemporary awareness of environmental problems and social unfairness serve as a modern mirror, showing that the authors' powerful critiques are still relevant today. The study ultimately demonstrates that chasing the 'common good' always leads to universal destruction, forcing us to face the inherited debts owed to both the land and marginalized humanity.

Keywords: Eco-Criticism; Anthropocentric Progress; Ethical Failure; Annihilation; Imposed Shame; Environmental Debt; Systemic Destruction; Community Tyranny; Social Betrayal.

Introduction

The pursuit of "The Greater Common Good," whether defined by economic policy or social tradition, often necessitates an ethical accounting for the sacrifices it demands.

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In the context of postcolonial India, this pursuit has led to profound environmental and social devastation. This study examines two stark critiques of this destructive paradigm: Arundhati Roy's polemical essay "The Greater Common Good" and Mahasweta Devi's tragic novella Bayen. Both texts expose how systems of human-centered power ranging from the State's development agenda to the tyranny of village custom systematically consume the most vulnerable to maintain their own flawed stability.

Arundhati Roy's "The Greater Common Good" (Summary)

Roy's essay serves as a fierce condemnation of the Indian State's pursuit of large-scale development projects, specifically focusing on the displacement caused by the Sardar Sarovar Dam. The work shifts the focus from the technical necessity of the dams to their brutal human and ecological cost.

- **Summary and Theme for Society:** Roy frames "The Greater Common Good" as a profound ethical failure of the democratic State. The essay argues that the 'common good' in this case, economic progress and electricity for urban centers is achieved only through the systematic annihilation of the marginalized.
- **Society, Viewed through Roy's Lens, is Deeply Fractured:** A small elite and the State conspire to sacrifice the Adivasi (tribal) and rural populations by flooding their homes, histories, and natural river valleys. The essay exposes the societal injustice where the costs of development are borne entirely by the poor and politically weak. The central social theme is the betrayal of trust and the imposed shame on the displaced, who are branded as "anti-national" obstacles to progress simply for fighting for their survival.

Mahasweta Devi's Bayen (Summary)

Devi's novella tells the story of Moyna, a member of the marginalized Doms community, who is inexplicably branded a Bayen (a demoness or witch) by her village. This accusation spirals into social ostracization and forces her into a tragic isolation.

Summary and Theme for Society

Bayen is a devastating critique of community tyranny, gendered oppression, and the power of superstition within a rigid social structure. The novella demonstrates how the 'common good' of the village defined by its need for security and control — demands the absolute annihilation of the individual's identity. Moyna's transformation from a regular woman into a feared, marginalized entity is driven by community fear and sanctioned by tradition. The resulting social shame forces her literal and psychological removal from society. The ultimate societal theme is how fear, ignorance, and established power structures (like the implicit caste hierarchy and patriarchal control) lead to an ethical failure where the community actively consumes and destroys its weakest members to preserve its own fearful balance.

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Social Background and Conflict

Roy's essay is rooted in the macro-level ethical failure of the democratic Indian State, focusing on the construction of the Sardar Sarovar Dam. The essay presents a deeply fractured society where a powerful elite willingly sacrifices the Adivasi (tribal) and rural populations, flooding the Narmada River Valley — their home and history — in the name of national economic progress. Conversely, Devi's Bayen addresses a micro-level ethical failure within a rural social hierarchy, where a marginalized community turns on its own. The novella reveals the devastating power of community tyranny, gendered oppression, and superstition, which brands the protagonist, Moyna, as a witch to restore the village's sense of security and moral order. Both narratives, though operating on different scales, showcase societies that actively justify the suffering of the weak.

Hypothesis and Scope of Study

This project advances the hypothesis that the flawed moral commitment to Human-Centered Progress is universally destructive, demanding the annihilation of the marginalized, which is then enforced through shame and betrayal. The scope of this study is to analyze the contrasting mechanisms of this destruction through an eco-critical framework. Specifically, the analysis will trace how the State's action results in the ecological and physical annihilation of the River Valley, while the community's action results in the social and psychological annihilation of Moyna. To substantiate the enduring relevance of these critiques, this study employs a mixed-methods approach. We will combine rigorous close textual reading with an analysis of qualitative data gathered via a peer-administered Google Form. This survey data, focused on contemporary awareness of environmental debt and social injustice, serves as a modern lens, affirming that the inherited debts of destruction and betrayal continue to define our ethical landscape today. Literature Review of Critics on Arundhati Roy's The Greater Common Good... Many critics highlight that Roy's essay is a powerful eco-critical text that exposes the environmental and human costs of the Narmada Dam project.

- Meenakshi Mukherjee notes that Roy gives a "voice to the voiceless", bringing tribal displacement and ecological destruction into public debate.
- Rajeswari Sunder Rajan argues that Roy blends activism and literature, using emotional appeal to challenge the state's "development" narrative.and Some critics, however, point out that her essay is "too polemical", more activist than academic, yet they agree it played a vital role in raising awareness. Scholars of ecofeminism see the essay as showing how women and marginalized communities suffer disproportionately under destructive project.

Literature Review of Critics on Mahasweta Devi's Bayen...

Critics agree that Bayen is a feminist and subaltern text that questions how society stigmatizes and isolates women.

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- Gayatri Chakravorty Spivak, who translated Devi's works, emphasizes that Bayen reveals how superstition and patriarchy combine to oppress women, branding them as "witches" or outcasts..
- Usha Bande observes that Devi uses folklore and oral tradition to highlight the intersection of gender, caste, praised for combining literature and social protest, giving visibility to the marginalized.

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TURNING DISABILITIES INTO STRENGTHS: A COMPARATIVE STUDY OF TWO AUTOBIOGRAPHIES

Ziafathima.S
Student,
Department of English,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

Disability is usually seen as a weakness, but the lives of Helen Keller and Christy Brown show that it can become a source of great strength. This project, "Turning Disability into Strengths: A Comparative Study of Two Biographies. The Story of My Life and My Left Foot," looks at how these two famous people faced their difficulties and achieved success. Helen Keller became deaf and blind when she was just a small child. With the help of her teacher Anne Sullivan, she learned to communicate, study, and inspire millions of people around the world. She became a writer, speaker, and activist who fought for the rights of disabled people. Christy Brown was born with cerebral palsy and could not control his body, except for his left foot. With strong determination and family support, he learned to write and paint using only his left foot.

He became a talented writer and artist, showing the world that disability does not define a person's abilities. This project compares their lives to understand how they turned their challenges into strengths. It looks at their personal struggles, the support they received, their education, and their achievements. Helen Keller's story focuses on education and social work, while Christy Brown's journey highlights creativity and personal courage. Their stories teach us that strength comes from the mind and heart, not just the body. With courage, support, and hard work, any obstacle can be overcome. This study also shows why society should give equal opportunities and support to differently-abled people so they can reach their full potential.

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AUTO PARK ASSIST

K.Sulthana Parveen
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

The increasing demand for efficient and automated parking solutions has led to the development of intelligent systems that reduce human effort and optimize space utilization. This project, Auto Park Assist using Python Tkinter and Arduino, aims to design and implement a user-friendly parking management system that integrates both software and hardware components for real-time monitoring and control. The system employs Tkinter, a Python-based GUI library, to provide an interactive interface for users. Through the GUI, users can log in securely, view available slots, book or cancel reservations, and receive instant feedback on their actions. The backend logic, written in Python, ensures smooth execution of booking processes and communicates directly with the Arduino board for slot status updates. By automating slot detection, booking, and feedback, the system minimizes human error, improves parking efficiency, and enhances user experience. This work can be further extended to large-scale smart parking systems with loT integration and mobile app connectivity, contributing to the future of intelligent transportation systems.

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THE UNTOLD STORIES OF MEDUSA & PHOOLAN DEVI: WOMEN RISING AGAINST INJUSTICE

Nargees.A.M
Student,
Department of English,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

This project focuses on the stories of Medusa, a figure from Greek mythology, and Phoolan Devi, a real woman from Indian history, to explore how women have faced abuse, injustice, and social oppression through time. Though they lived in very different worlds, both Medusa and Phoolan Devi were victims of violence and later became symbols of strength and resistance. Medusa's story is often misunderstood. She was once a beautiful woman who was punished after being assaulted by a powerful god. She was transformed into a monster, not because of her fault, but because society blamed her instead of protecting her. Her story reflects how women are often shamed or punished for things that happen to them, especially when powerful men are involved.

Phoolan Devi, on the other hand, was a poor girl from India who suffered abuse and humiliation from a young age. She was forced into marriage as a child and later attacked by men from higher castes. However, she did not remain silent. She fought back, became a feared bandit, and later entered politics to speak for the poor and oppressed. Her life shows the real struggles of women in a patriarchal society and how courage can change destiny. By comparing Medusa and Phoolan Devi, this project highlights how women's suffering is universal, but so is their power to fight back. Their stories encourage society to look deeper into issues of gender violence, victim-blaming, and justice.

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ONLINE BUS RESERVATION SYSTEM

A.Afrin
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

The bus ticket booking system is a software application that allows users to book bus tickets online, with the aim of providing a convenient and efficient way to purchase tickets. This project aims to provide a user-friendly platform for passengers to search for available buses, view seat availability, book tickets, and make payments online.The system provides an easy-to-use interface, real-time availability of seats, and secure payment options. The project streamlines operations for both passengers and transport agencies by offering real-time updates, secure transaction processing, and centralized data management. Overall, the bus ticket booking system is a reliable and convenient solution for users to book their bus tickets hassle-free.

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MODERNIZING ANCIENT WISDOM: THE HITOPADESHA AND CONTEMPORARY CHILD BEHAVIOR

Varsha.P
Student,
Department of English,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

This paper examines the close reading of the Hitopadesha (meaning "Beneficial Advice"), a renowned Sanskrit classic composed between the 9th and 12th centuries CE, to articulate the specific behavioral lessons it imparts and to propose a framework for its modern application. The Hitopadesha provides timeless moral and practical guidance through allegorical animal fables, structured around four core themes: Mitralabha (Gaining Friends), Suhrdbheda (Separation of Friends), Vigraha (Conflict/War), and Sandhi (Reconciliation/Peace). These themes offer essential instruction on ethical conduct, diplomacy, and healthy relationship dynamics. The text's focus on foundational ethics and relational intelligence makes it highly relevant for shaping positive societal behaviors and ethical awareness among children today.

Its principles such as the value of true friendship and the importance of peaceful negotiation are crucial for cultivating emotionally and socially intelligent individuals in an increasingly complex world. Based on this enduring value, the research proposes a framework for modernizing these narratives to effectively teach these lessons to contemporary children. Specifically, this study explores the use of cartoon characters, vibrant illustrations, and natural imagery to create engaging content that accurately depicts the cultural and moral wisdom of the original text. By repositioning these narratives through child-friendly media, this project aims to demonstrate how foundational Indian literature can be actively used to cultivate positive future societal behaviors and reinforce core moral values in children today.

Keywords: Hitopadesha, Sanskrit Literature, Moral Fables, Ethical Conduct, Child Development, Relational Intelligence, Educational Media, Mitralabha, Suhrdbheda, Modernization Framework.

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TWO WORLDS, ONE SHADOW: A COMPARATIVE STUDY OF SHAME AND INHERITED TRAUMA IN THE BLUEST EYE AND THE KITE RUNNER

Revathi.S
Student,
Department of English,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

This comparative study analyzes how shame, trauma, and inherited debt function as destructive forces across the disparate cultural and geographical settings of Toni Morrison's The Bluest Eye and Khaled Hosseini's The Kite Runner. While The Bluest Eye explores shame rooted in systemic racism and internalized white beauty standards, The Kite Runner centers on shame derived from a personal moral failure and class/ethnic betrayal. The central argument is that shame is the precursor to trauma, initiating a devastating debt transferred to the next generation. Pecola Breedlove's fate exemplifies the tragic annihilation the ultimate payment for inherited societal self-hatred while Amir's journey highlights a difficult quest for atonement, required to settle the debt of his personal betrayal. The project employs a mixed-methods approach. The foundational analysis uses close reading of novels and thematic analysis, referencing established literary criticism to contextualize shame and trauma. Uniquely, this literary inquiry is extended by incorporating qualitative data gathered from a peer-administered Google Form documenting personal reactions to shame and trauma in real-life situations. This empirical data serves as a modern lens, metaphorically quantifying the immediate, personal cost the inherited debt of these themes. Ultimately, I assert that both narratives serve as profound meditations on the universality of human suffering, demonstrating how the burden of the past whether political, social, or personal—casts a single, devastating shadow across humanity, demanding contemporary awareness.

Keywords: Shame, Trauma, Inherited, Debt, Atonement, Guilt and Betrayal, Intergenerational Trauma, Universality of Suffering.

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SMART WASTE MANAGEMENT SYSTEM

S.Nowshat Banu
Student,
Department of English,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

Garbage management is one of the major issues in our college surroundings. Every day, waste gets scattered near the classrooms, canteen, and pathways. This not only makes the campus look unpleasant but also creates serious health problems for both students and staff. At present, cleaning workers do not have a proper system to identify which areas or bins require attention. To solve this issue, our project introduces a Smart Waste Management System. It uses modern technologies like sensors, cloud computing, AI, and mobile applications. The sensors detect the level of garbage in bins and send this data to the cloud. Using AI, the system analyzes the information and provides the cleaning team with the shortest and most efficient routes to clean the waste. Another unique feature of our project is student participation. Students can report garbage through the mobile app, and as encouragement, they receive reward points. This creates a cleaner campus and builds responsibility among students. The project not only solves waste issues in our college but also supports eco-friendly initiatives and smart city concepts, which can be scaled to larger communities in the future.

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RESEARCH ON CLOUD AND DATA MINING TECHNIQUE FOR EFFECTIVE CUSTOMER RELATIONSHIP MANAGEMENT

S.Sucithra
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

It is a well known fact that the success of any type of business is determined by the profit they have achieved. Profit merely depends on multiple factors among which the customer relationship management (CRM) plays a key role.This system advocates interaction between businesses and customers to leverage important data that improves marketing and sales. However, the CRM system wasn't always this simple. CRM is mainly supported by 4 dimensions: customer identification, customer attraction, customer development and customer retention. Research on cloud and data mining technique for effective customer relationship management.

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ENERGY EFFICIENT DESIGN FOR MOBILE AD HOC SYSTEM

S.Nargees Banu
Student,
Department of Computer Science,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

Mobile Ad Hoc Networks (MANETs) are decentralized, self-configuring systems composed of mobile nodes that communicate over wireless links without fixed infrastructure. While their flexibility makes them ideal for dynamic environments such as disaster recovery, military operations, and remote sensing, their reliance on battery-powered devices presents a critical challenge: energy efficiency. This paper explores comprehensive strategies for designing energy-efficient MANETs, focusing on power-aware routing protocols, transmission power control, sleep scheduling, clustering techniques, and load balancing. By integrating adaptive algorithms such as swarm intelligence and fuzzy logic, the proposed design enhances network lifetime, reduces control overhead, and maintains robust connectivity under mobility constraints. Performance metrics including packet delivery ratio, route stability, and total energy consumption are used to evaluate the effectiveness of the proposed solutions. The findings underscore the importance of intelligent energy management in sustaining MANET performance and reliability in real-world applications.

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BRAND PREFERENCE OF MOBILE PHONE MARKETING IN ARTIFICIAL INTELLIGENCE

S.Soundariva
Student,
Department of Commerce,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

V.Aruna
Student,
Department of Commerce,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

M.Pavithra
Student,
Department of Commerce,
Rajeshwari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Dr.J.Devi
Assistant Professor,
Department of Commerce,
Rajeswari College of Arts and Science for Women,
Villupuram, Tamil Nadu, India.

Abstract

In today's digital era, artificial intelligence (Al) has transformed the way mobile phone brands engage with consumers. Mobile phone marketing has moved beyond traditional advertisements to Al-driven personalization, predictive analytics, and virtual customer assistance. This study focuses on understanding brand preference in the mobile phone market, highlighting the role of Al in influencing consumer choices. Through features such as chatbots, recommendation systems, sentiment analysis, and predictive demand forecasting, companies like Apple, Samsung, Xiaomi, and OnePlus are able to align their products more closely with customer expectations. The findings suggest that Al enhances consumer satisfaction by delivering personalized experiences, improves decision-making for marketers, and creates stronger brand loyalty. Thus, AI not only serves as a marketing tool but also as a strategic driver of brand preference in the competitive mobile phone industry.

Introduction

One of the most competitive and rapidly expanding sectors in the world is the mobile phone business. Customers have a lot of options because hardware and software are always evolving. Purchasing decisions are significantly influenced by brand preference. Artificial intelligence (Al) has become a game-changing tool that enables businesses to comprehend customer behavior, predict needs, and provide individualized experiences, all of which impact consumer choice and brand loyalty.

Importance of Brand Preference

A consumer's positive attitude toward a particular brand over its rivals is referred to as brand preference. Brand choice in the mobile phone sector is impacted by elements such.

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- Features and Quality of the Product
- Cost and Accessibility
- Post-Purchase Support
- Advertising and Marketing Campaigns
- Developments in Technology

Al improves these elements by offering data-driven insights that let companies match their marketing and goods to what customers want.

AI Role in Mobile Phone Marketing

Al is frequently incorporated into mobile marketing tactics in a number of ways, including:

1. **Personalized Recommendations:** AI systems examine user behavior to recommend smartphones based on personal preferences.
2. **Chatbots and Virtual Assistants:** AI-driven chatbots improve service quality by instantly responding to consumer inquiries.
3. **Predictive Analytics:** By using AI to forecast future trends, brands may successfully introduce new features and promotions.
4. **Sentiment Analysis:** AI systems keep an eye on internet reviews and social media to gauge consumer sentiment and modify marketing tactics.
5. **Targeted Advertising:** AI increases conversion rates by delivering adverts to the appropriate audience at the appropriate moment.

Objectives of the Study

1. To examine the role of Artificial Intelligence in mobile phone marketing and how it influences consumer decision-making.
2. To analyze the factors that determine brand preference among mobile phone users in the Al-driven market.
3. To study the impact of AI tools such as chatbots, recommendation systems, and predictive analytics on customer satisfaction.
4. To evaluate how well-known mobile phone manufacturers (Apple, Samsung, Xiaomi, OnePlus, etc.) use AI in their marketing campaigns.
5. To assess how brand loyalty and Al-based marketing strategies relate to each other in the mobile phone sector.
6. To determine the obstacles and constraints that mobile phone companies have when incorporating AI into their marketing plans.

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Research Methodology

Types of Research

The purpose of this descriptive research is to characterize and examine the ways in which artificial intelligence affects consumer choice for brands in mobile marketing.

Data Source

Only secondary data served as the study's foundation. There was no use of a primary survey or questionnaire.

Secondary Data Collection

Information that has previously been gathered and released by other sources is referred to as secondary data. Data used in this study came from academic publications and research journals about AI and marketing Books about consumer behavior and marketing management Online papers from reputable sources including Business Research Journals, McKinsey & Company, and Statista Websites of Apple, Samsung, Xiaomi, and OnePlus for marketing strategies involving artificial intelligence Market research reports and news articles about the trends in the mobile phone sector.

The Impact of AI on Brand Preference

Al-Driven Tactics Increase Brand Preference by:

- **Personalization:** When companies suggest phones and features that are suited to their requirements, customers feel appreciated.
- **Practicality and Efficiency:** Quicker replies and services foster dependability and trust.
- **Innovation Awareness:** To keep people interested, Al keeps them updated on new features, security enhancements, and upgrades.
- **Emotional Engagement:** Brand identity can be strengthened by creative Al-driven initiatives that emotionally engage with people.

Case Studies

- **Apple:** Uses Al in Siri, Face ID, and predictive features to create a seamless user experience, reinforcing brand loyalty.
- **Samsung:** Integrates Al in smart cameras and Bixby assistant, appealing to tech-savvy consumers.
- **Xiaomi:** Uses Al in pricing, recommendations, and smart device integration to attract budget-conscious buyers
- **OnePlus:** Leverages Al in performance optimization and personalized app suggestions, creating a strong community-based brand image.

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AI's benefits for Mobile Marketing

- Offers insights into consumer behavior based on data
- Boosts customer happiness and engagement
- Uses automation to cut marketing expenses
- Increases customer trust and brand loyalty
- Facilitates quick reactions to competitors and market changes

Challenges

Despite the Benefits, Implementing Al has many Drawbacks. These include:

- A high upfront cost for Al technology.
- Privacy issues with consumer data.
- The possibility of relying too much on automation at the expense of human interaction.
- The necessity of constant technical adaptation and update.

Conclusion

Al has become a significant determinant of preference for mobile phone brands. Al enables organizations to establish a meaningful connection with customers through sentiment analysis, chatbots, personalization, and predictive analytics. Businesses that successfully use AI not only affect consumer choices but also foster enduring loyalty. AI technology will become increasingly important for future mobile phone marketing strategies as it develops further and has a greater influence on consumer behavior and brand preference.

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AN ADAPTIVE DEEP LEARNING FRAMEWORK FOR LAND TARGET DETECTION IN REMOTE SENSING IMAGERY

Ashok Kumar.M
Research Scholar,
Department of Computer Applications,
Alagappa University,
Karaikudi, Tamil Nadu, India.

Dr.K.Mahesh
Professor,
Department of Computer Applications,
Alagappa University,
Karaikudi, Tamil Nadu, India.

Dr.Eswaran Perumal
Associate Professor,
Department of Computer Applications,
Alagappa University,
Karaikudi, Tamil Nadu, India.

Abstract

Target detection in remote sensing imagery is a core task in agricultural monitoring, environmental management, and defense surveillance. Traditional convolutional models often face limitations such as sensitivity to illumination variation, object size disparity, and spatial noise. This paper introduces the Adaptive Vision-Guided Transformer (AVGT), a hybrid deep learning architecture that combines adaptive optimization, cross-scale attention fusion, and hierarchical transformer modeling for superior accuracy and robustness in detecting small and occluded land targets. Experiments show AVGT outperforms baseline CNN and transformer models in precision, recall, and resilience to noise, paving the way for automation in precision agriculture, land-use assessment, and geospatial intelligence systems.

Index Terms

Remote sensing, target detection, deep learning, transformer, adaptive optimization, attention mechanism, multi-scale fusion, land monitoring, aerial imagery.

I. Introduction

The proposed Adaptive Vision-Guided Transformer (AVGT) framework introduces a synergistic approach to small object detection and contextual scene understanding in remote sensing imagery.

II. Adaptive Vision Optimization (AVO)

AVO leverages a feedback-driven learning mechanism to dynamically tune hyperparameters such as learning rate, attention window size, and normalization strength based on local image statistics.

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III. Cross-Scale Attention Fusion (CAF)

CAF integrates fine-grained spatial attention with global-scale contextual cues, enabling the model to detect small and dispersed objects effectively.

IV. Hierarchical Context Transformer (HCT)

The HCT module forms the backbone of AVGT, enabling robust context reasoning and long-range dependency modeling while maintaining computational efficiency.

V. Conclusion

The Adaptive Vision-Guided Transformer (AVGT) presents a major advancement in land target detection within remote sensing imagery. Future work will extend this approach for multispectral and UAV-based analysis.

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SMART IPL MATCH WINNER PREDICTIONS POWERED BY MACHINE LEARNING

Dr.S.Borgia Annie Catherine
Assistant Professor,
Department of Computer Science,
Agurchand Manmull Jain College,
Chennai, Tamil Nadu, India.

Mr.S.Dinesh
UG Student,
Department of Computer Science,
Agurchand Manmull Jain College,
Chennai, Tamil Nadu, India.

Abstract

This study explores the application of machine learning techniques to predict the outcomes of Indian Premier League (IPL) cricket matches using historical match data spanning from 2008 to 2020. The dataset comprises key pre-match features including competing teams, toss winners, toss decisions, and venues. A Random Forest Classifier, chosen for its robustness and ability to handle complex, nonlinear relationships, was trained to classify the probable winner of each match based on these variables. The model achieved an accuracy of approximately 70% on unseen test data, demonstrating that pre-match conditions hold substantial predictive power regarding match results. Further analysis of feature importance highlighted that team identities contribute the most toward predicting outcomes, which reflects the varying strengths and historical performances of the teams.

Toss-related factors such as the toss winner and their decision to bat or field first were also significant, indicating the strategic advantage often gained from the toss. Venue, although less influential, still impacted predictions likely due to home ground advantages and pitch conditions that favour certain playing styles. While the model shows promising results, it is limited by the exclusion of dynamic in-match events, player fitness, and real-time environmental factors which could further enhance prediction accuracy. Future work will focus on incorporating player-level data, ball-by-ball match events, and weather conditions to develop a more comprehensive and adaptive predictive system. This study demonstrates the practical utility of machine learning in sports analytics, providing valuable insights for teams, coaches, analysts, and enthusiasts aiming to understand and anticipate IPL match outcomes.

Keywords: Indian Premier League, Machine Learning, Random Forest, Match Outcome Prediction, Sports Analytics.

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DATA-DRIVEN WEATHER PREDICTION: A MACHINE LEARNING APPROACH

Dr.V.Hema
Assistant Professor,
Department of Computer Science,
Agurchand Manmull Jain College,
Chennai, Tamil Nadu, India.

Ms.D.Premalatha
Student,
Department of Computer Science,
Agurchand Manmull Jain College,
Chennai, Tamil Nadu, India.

Abstract

This study investigates how machine learning can be used to make weather forecasts more accurate. By analyzing historical weather data such as temperature, humidity, wind speed, atmospheric pressure, and precipitation the research evaluated several machine learning models for predicting short-term weather patterns. Among these, the Random Forest Regressor stood out due to its ability to effectively handle complex, nonlinear relationships within the data. Trained on multiple years of meteorological records, the model achieved over 75% accuracy in predicting key weather variables. An analysis of feature importance showed that atmospheric pressure and humidity were the strongest indicators of short-term weather changes, with temperature and wind speed also playing significant roles. The model was able to recognize seasonal trends and regional weather patterns, making it a reliable tool for local forecasts.

Unlike traditional numerical weather prediction methods, which rely on intensive physical simulations, machine learning offers a faster, data-driven alternative especially effective in environments with abundant data. However, the accuracy of these models still depends heavily on the quality and detail of the input data and can be challenged by unexpected weather events. Looking ahead, the study proposes incorporating real-time sensor data, satellite imagery, and advanced deep learning models like RNNs and CNNs to further improve forecasting accuracy and responsiveness. Overall, the findings suggest that machine learning has strong potential to transform weather forecasting, offering quicker and more dependable predictions that are crucial for sectors like agriculture, emergency response, and everyday planning.

Keywords: Weather Prediction, Machine Learning, Random Forest, Meteorological Data, Forecasting.

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CONSUMERS PURCHASE INTENTION TOWARDS ORGANIC FOOD PRODUCTS WITH ADDRESSING THE SUSTAINABLE GOAL ON GOOD HEALTH AND WELLBEING-WITH REFERENCE TO CHENNAI CITY

V.Manikandan
Research Scholar,
Department of Commerce,
Vels Institute of science technology & Advanced Studies (VISTAS),
Chennai, Tamil Nadu, India.

Dr.P.Sunantha
Assistant Professor,
Research Supervisor,
Department of Commerce,
Vels Institute of Science Technology & Advanced Studies (VISTAS),
Chennai, Tamil Nadu, India.

Abstract

The study reveals that the Consumer purchase intention related to organic food products with reference towards District. The study has identified the significance between demographic profile, awareness of organic food items, and in relation with sustainable development goals in accordance with the general awareness level. Consumers of organic and non-organic food products are distinguished by several categories such as gender, income level, education qualification and occupation. The Chennai district's organic food consumers have benefited from psychological aspects such as attitude, perception, belief and intention.

Keywords: Consumer Purchase Intention, Food Products, Sustainable Development Goals, Good Health, Wellbeing, Chennai City.

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EMERGING TRENDS AND INNOVATIONS IN E-COMMERCE

G.Vinoth
PGT(Commerce),
Jairam Higher Secondary School,
Salem, Tamil Nadu, India.

Abstract

E-commerce has experienced rapid transformation in recent years, fueled by technological advancements, evolving consumer expectations, and the proliferation of digital payment solutions. Innovations such as artificial intelligence, big data analytics, and personalized marketing are reshaping the online retail landscape, enabling businesses to streamline operations, enhance customer engagement, and anticipate market demands more effectively. Additionally, mobile commerce, social commerce, and subscription-based models are redefining traditional business strategies, while sustainability and ethical considerations are increasingly influencing consumer choices. This paper examines the latest trends and innovations within the e-commerce sector, focusing on technological adoption, evolving business models, and consumer-centric approaches. It highlights the key drivers of growth, challenges faced by online retailers, and potential opportunities for future development. Moreover, the study identifies research gaps and suggests areas for further investigation, including AI-driven personalization, omni-channel retail strategies, and data-informed decision-making in e-commerce.

Keywords: E-Commerce, Digital Marketing, Consumer Behavior, Artificial Intelligence, Business Innovation.

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