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Integration of IoT-Cloud in Healthcare and Agriculture

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Abstract **– This research paper aims to explore the integration of the Internet of Things (IoT) in healthcare and agriculture, highlighting its growing applications such as irrigation, fitness tracking, and health monitoring. To achieve this, we examine the architecture utilised in cloud-integrated IoT systems, focusing on enhancing monitoring and cultivation efficiency through the combination of IoT and Cloud Computing. Our study addresses key challenges like accuracy and power consumption, aiming to improve the effectiveness of cloud-based systems in these sectors. Methods employed include a comprehensive review and analysis of existing IoT and Cloud integration architectures, alongside a detailed examination of data management strategies used in cloud-based applications. We evaluate the efficiency, advantages, and disadvantages of these systems in both healthcare and agriculture. The results of our study indicate significant advancements in symptom identification, illness forecasting, and weather prediction through IoT Cloud integration. Additionally, implementing an integrated healthcare system using IoT and Cloud technology has shown benefits in monitoring individuals' health conditions. However, we also identify persistent challenges such as power consumption, resource availability, and security vulnerabilities due to the use of multiple devices. These findings contribute to a deeper understanding of the current state and future potential of IoT and Cloud Computing in enhancing healthcare and agricultural practices.**

Keywords **– Agriculture, Cloud, Healthcare, Internet of Things, Security.**

I. INTRODUCTION

In order to develop intelligent, data-driven urban environments, IoT technologies and cloud computing resources are used in smart cities. It's a theory that uses sensors and IoT devices to gather a tonne of data from a variety of city living factors, including infrastructure, security, energy, and transportation. For better decision-making for city planners, administrators, and citizens, this data is then processed, examined, and stored on cloud-based systems. This enables real-time monitoring, predictive analytics, and improved information gathering. Fig 1 below shows how IoT and Cloud are linked together.

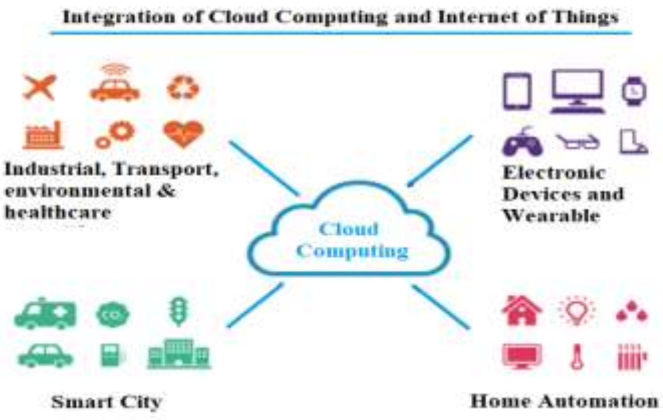

Fig. 1. IoT cloud integration.

1.1. *Internet of Things (IoT)*

The connection of actual physical items, machines, and even living creatures over the internet is defined as the "Internet of Things". It enables these "things" to collect, share, and process information as well as communicate with one another and their environment-often without the assistance of people. Key components of the IoT include devices and sensors, requiring a diverse range of coordinated hardware, software, and internet connectivity. IoT devices utilise various sensors, such as accelerometers, cameras, GPS receivers, and temperature sensors, for data collection about their environment. These devices are networked and rely on the internet for seamless information transfer. Additionally, IoT devices possess computational power for data processing, leading to essential outcomes like data analysis, which significantly influence decision-making. Furthermore, the IoT enables automation and control of systems and connected devices, and its interconnectivity feature allows for the creation of complex ecosystems as devices interact with one another.

1.2. *Cloud Computing*

Several different services and resources are delivered through the internet as part of the cloud computing paradigm in computing. Cloud computing utilises a distributed network of remote servers across the internet, rather than relying solely on local servers or individual computers, to operate applications and store data. Models and components offered by Cloud computing include:

1.2.1. *Service Models:*

Cloud computing services can be categorised into different models, each providing with particular set of functionality and control:

Infrastructure as a Service (IaaS):

It provides virtualized computer resources including networking, storage, and virtual machines. While outsourcing hardware administration and maintenance to the cloud provider, users can still oversee and control the underlying infrastructure.

Platform as a Service (PaaS):

Cloud service providers offer a platform that comes equipped with the resources and equipment required for the creation, deployment, and administration of applications.

Software as a Service (SaaS):

It offers entire software programmes for consumers to access and utilise using web browsers or specialised apps over the internet.

1.2.2. *Deployment Model*

Various ways to deploy cloud computing are:

Public Cloud:

A third-party cloud service provider hosts, manages, and makes resources accessible to the general public.

Private Cloud:

A single organisation is the only user of a private cloud. Either a third-party service or on-site hosting are options available.

Hybrid Cloud:

Data and applications can be exchanged between public and private cloud environments thanks to hybrid clouds, which blend the two.

Community Cloud:

Community clouds are used by many organisations with comparable goals or needs, like those in a specific sector. They allow for customised solutions while providing the advantages of shared infrastructure.

1.2.3. *Fundamental Qualities*

Cloud computing can be referred through various important attributes like:

On-Demand Self-Service:

Users can manage resources as needed without the requirement for a service provider's assistance.

Broad Network Access:

Cloud services are available online from a variety of locations and devices.

Resource Pooling:

Cloud service providers combine computing resources to serve a number of clients, promoting efficiency and resource sharing.

Rapid Elasticity:

The ability to quickly scale up or down resources to meet fluctuating demand.

Measured service:

Cloud usage is metered, and customers are charged only for what they really consume.

II. KEY ASPECTS

2.1. *Agriculture:*

2.1.1. *Precision Agriculture:*

IoT sensors placed in agricultural fields collect information regarding soil moisture, temperature, humidity, and crop condition. The gathered data is uploaded to the cloud, where it is processed and analysed, which enables the optimization of irrigation timing, fertiliser application, and pest management. By leveraging this data, farmers can make informed decisions aimed at enhancing both crop yield and quality.

2.1.2. *Livestock Monitoring:*

IoT devices like wearable sensors can monitor the health, behaviour, and location of livestock. Data collected from these devices can be sent to the cloud for analysis. If any issue or anomaly is detected early, it can lead to animal welfare or prevent a disease outbreak.

2.1.3. *Equipment Monitoring and Management:*

IoT sensors installed on agricultural machinery can track usage, performance, and maintenance needs. This data is stored for processing in the cloud to schedule predictive maintenance, optimise equipment utilisation, and reduce downtime.

2.1.4. *Supply Chain Management:*

Integrating IoT and cloud technologies helps in real-time monitoring of inventory storages, tracking of shipments, and making sure that the quality of the agricultural products remain intact throughout the supply of the product with proper safety. This improves traceability, reduces waste, and increases food safety standards.

2.1.5. *Environmental Monitoring:*

IoT sensors help in looking out for environmental factors such as air quality, weather conditions, and water quality. Data collected from these sensors is then sent to the cloud to assess environmental impact, mitigate risks, and ensure sustainable agricultural practices.

2.2. *Healthcare:*

2.2.1. *Remote Monitoring:*

IoT devices like wearable health trackers including medical sensors help in continuously monitoring Vitals, medication timings, and other health parameters can be continuously monitored with the help of IoT devices like wearable healthcare trackers and medical sensors. Data collected from these devices is sent to the cloud where it can be accessed by healthcare providers for real-time monitoring and analysis. This helps in early detection of any healthcare issues, better disease management, and personalised treatment plans.

2.2.2. *Telemedicine:*

Cloud-based platforms provide telemedicine services through secure video consultations, remote diagnostics, and electronic health record (EHR) management systems. IoT devices integrated with these platforms provide doctors with additional patient data, providing more informed decision-making and improving access to healthcare.

2.2.3. *Managing Chronic Diseases:*

Chronic diseases like diabetes, hypertension, and asthma can be remotely monitored and managed with the help of IoT devices and cloud-based analytics support. Patients can track their health metrics at home, and healthcare providers can remotely monitor trends, intervene when necessary, and adjust treatment plans in real-time to optimise outcomes and reduce hospital admissions.

2.2.4. *Hospital Asset Tracking:*

IoT sensors can be deployed in hospitals to track the location and status of medical equipment, supplies, and even patients. Cloud-based asset management systems can improve inventory control, reduce equipment downtime, and enhance operational efficiency within healthcare facilities.

2.2.5. *Healthcare Data Analytics:*

Cloud platforms provide infrastructure for storing and analysing data, including electronic health records, medical imaging, and genomic data. Advanced analytics techniques like machine learning and predictive modelling can put out valuable insights from this data, enabling personalised medicine, disease prediction, and accurate decision support.

III. METHODOLOGY

This study's approach comprised a thorough analysis of previous studies and literature on IoT based healthcare and agricultural systems. With a focus on IoT and cloud integration, the methodical methodology sought to collect insights about the state, developments, and problems of these fields at the moment. The following is an outline of the methodology's main elements:

Literature review (Section 4):

In order to find pertinent research articles, papers, and projects about IoT applications in healthcare and agriculture, the study started with a thorough assessment of the literature. A comprehensive exploration was carried out utilising scholarly databases, conference proceedings, and respected publications to guarantee a comprehensive portrayal of the extant corpus of information.

Categorisation of Literature:

Agriculture and Healthcare were the two primary divisions of the literature evaluation. Subtopics were examined in each area, along with particular research initiatives and developments in the corresponding fields. This classification made it easier to analyse important changes and new trends in-depth.

3.1. *Agriculture:*

Subsections in the agriculture area looked at things like blockchain-based security monitoring, smart agriculture models using IoT and cloud computing, secure IoT-based irrigation systems, and how 5G would affect intelligent agricultural IoT.

3.2. *Healthcare:*

A number of topics were covered in depth within the healthcare domain, including wearable ECG monitoring devices based on IoT-cloud integration, cloud-based IoT applications, and cognitive IoT-cloud integration for smart healthcare.

Description of Research Projects:

Comprehensive details on the goals, techniques, and technology used for each recognised research work were retrieved. To do this, a thorough analysis of the suggested fixes-which included frameworks, algorithms, and architectures tailored to particular problems in healthcare and agriculture was required.

Evaluation and Validation:

Information on the assessment and validation procedures applied in the selected research studies was carefully examined where it was available. Performance parameters, including power consumption, execution time, memory utilisation, and network latency, were specifically examined to evaluate the efficiency and effectiveness of the suggested solutions.

Fusion of Findings:

As part of the process, the results of the literature review were combined, links between various research projects were made, and overarching themes, trends, and issues were identified. This synthesis served as the foundation for the conclusion section, which offered suggestions for future study topics and summarised the review's findings.

IV. LITERATURE REVIEW

4.1. *Agriculture:*

4.1.1. *A Secure IoT-Based Irrigation System for Precision Agriculture using the Expeditious Cipher*

This paper addresses the challenges in smart agriculture, particularly in the context of smart irrigation systems using IoT technology. It emphasises the need for secure communication in IoT-based agriculture systems and proposes an encryption protocol [1], X-Cipher, to enhance security in the MQTT protocol. The increasing research interest in smart agriculture due to global population growth and decreasing agricultural labour has been discussed. The precision agriculture's use of wireless sensor networks to monitor farmland, collect data, and improve decision-making for farmers has also been highlighted. The paper also explores security threats in smart agriculture and presents a classification of these threats.

The main focus of the paper was on smart irrigation systems, where a secure IoT-based irrigation system architecture using MQTT protocol [1] was proposed. They introduce the lightweight X-Cipher protocol to address security challenges and present an IoT system architecture for secure smart irrigation. The proposed system includes a sensing layer with low-power sensors, communication using MQTT protocol, and a security layer employing the X-Cipher protocol.

Results from simulations and comparisons with other encryption protocols (AES and PRESENT) demonstrate that X-Cipher exhibits lower power consumption, memory usage, and higher throughput. The authors discuss the implications of their findings and highlight the suitability of X-Cipher for IoT devices with constrained resources.

In conclusion, the paper proposes a secure smart irrigation system using IoT technology and introduces a lightweight encryption protocol i.e., X-Cipher, to enhance security in MQTT communication. Simulation results in [1] show the effectiveness of X-Cipher, and future work is suggested, including integration with software-defined networking (SDN) technology for improved security algorithms [1].

4.1.2. *Smart Agriculture Based on IoT and Cloud Computing*

The paper [2] introduces the concept of utilising drones in agriculture, specifically for inspection in farms and crop monitoring. It highlights the significance of the IoT and Cloud Computing in enhancing agricultural practices. The literature review reveals a focus on automated irrigation systems and explores the use of IoT in agriculture, with some attention to cloud-based models. The proposed Smart Drone architecture comprises three modules: Sensing, Communication, and Coordination. The Sensing module employs synchronous sensors for data collection, including high-resolution cameras. The drone communicates using 4G/LTE and IoT wireless technologies, sending real-time data to the cloud. The Coordination block involves Mission Control, Mission Planning, and Sensor Data Analysis, ensuring effective drone deployment and data processing.

The paper [2] emphasises the potential of Smart Drones to cover large areas, provide real-time data to the cloud, and aid in agricultural decision-making. The coordination component handles both static and dynamic environments, with pre-planned paths calculated for efficient data collection. Cloud computing is proposed for agricultural Informa ionisation, facilitating analysis and planning based on production curves.

In conclusion, the paper [2] suggests that Smart Agriculture, coupled with IoT and Smart Drones, can enhance farming practices. The future work involves improvements to Smart Drones, including introducing a pluggable scheduler, an intelligent analyser, and security features. Additionally, the application cloud and data centre based on Cloud Computing are expected to offer more reliable virtualized platforms.

4.1.3. *Blockchain-Based Cloud-Enabled Security Monitoring using Internet of things in Smart Agriculture*

The paper [3] introduces the significance of agriculture in addressing global food needs and highlights the vulnerability of the agriculture sector to cyber-attacks. It emphasises the importance of smart agriculture in utilising IoT technologies and in monitoring various aspects such as soil conditions, crop growth, and environmental factors. The authors talk about the shortcomings of the security solutions that are currently on the market and suggest a blockchain and cloud-based solution that offers security monitoring for smart agriculture.

The proposed approach involves creating a smart-farm community with IoT sensor devices, where cloud components process sensor events and update the Ethereum blockchain with anomaly values. AWS IoT core and Lambda functions are utilised for real-time monitoring, and the Infura API is employed for Ethereum smart contract implementation. The blockchain-based system aims to enhance security, provide evidence for legal proceedings, and enable communication within the farming community.

The application utilising a sensor kit based on Arduino, AWS cloud, and the Ethereum blockchain is described in the paper [3], with an emphasis on real-time sensor data monitoring. When compared to previous blockchain-based smart contract implementations, performance evaluation shows low latency and good throughput. Future work, such as integrating the solution into the Ethereum 2.0 network and investigating machine learning for the purpose of detecting unusual network traffic, is mentioned in the debate.

In conclusion, the paper proposes an innovative blockchain and cloud-based monitoring solution for IoT applications with better security in the field of Agriculture, offering real-time alerts and fostering communication among farmers.

The study concludes with a novel security monitoring system for IoT applications in agriculture that is based on blockchain and the cloud and provides real-time notifications while encouraging farmer communication.

4.1.4. *Survey of Intelligent Agricultural IoT Based on 5G*

The paper [4] discusses the challenges in smart agriculture and focuses on smart irrigation systems based on IoT technology. In order to secure communication in smart irrigation, it presents X-Cipher, a lightweight encryption system, with a focus on the MQTT protocol. The proposed system architecture includes the integrati-

-on of X-Cipher on the NodeMCU platform [4].

In response to concerns about MQTT security, the authors in [4] suggest ChaCha20-Poly1305 Authenticated Encryption with Associated Data (AEAD) as a way to provide safe communication in nodes with limited resources. They introduce the proposed IoT system architecture, emphasising the lightweight cryptography layer for securing sensor data in agriculture IoT ecosystems. The results section validates X-Cipher through simulation, comparing it with PRESENT and AES. The evaluation demonstrates that X-Cipher consumes less power, requires less memory.

The integration of IoT with smart agriculture is emphasised in the conclusion, with a focus on the contribution of smart irrigation systems to water conservation. The X-Cipher protocol is found to be a better option than PRESENT for securing communication in smart irrigation since it uses less memory and offers a higher throughput. To improve security algorithms, further work will involve integrating the suggested system with SDN technologies.

In conclusion, the study investigates the use of IoT in smart agriculture, particularly smart irrigation, and suggests X-Cipher, a low-power encryption protocol, to improve communication protocol security.

4.2. *Healthcare*

4.2.1. *Challenges and Opportunities in IoT Healthcare Systems: a Systematic Review*

The review paper [5] explores the current state of IoT based healthcare systems, emphasising their architecture, applications, cloud integration, security, quantitative comparative analysis, and challenges. The use of IoT for remote patient monitoring, the adoption of cloud platforms for data storage, the role of big data in IoT for healthcare, security concerns, a quantitative evaluation of IoT in healthcare, and difficulties with data transmission, energy consumption, and machine learning applications are some of the important topics which are discussed. In addition to discussing alternative IoT healthcare architectures, the authors offer solutions for security concerns and cover applications such as early disease diagnosis and patient monitoring for chronic ailments. Despite the current effectiveness in scalability and reliability, the paper [5] suggests that improvements are needed in security, flexibility, and power consumption for future advancements in healthcare IoT systems.

4.2.2. *Cloud-Based IoT Healthcare Applications: Requirements and Recommendations*

This article [6] explores the possible advantages and difficulties of integrating cloud-based Internet of Things (IoT) in the healthcare industry. The paper addresses the distinctive features of the Internet of Medical Things (IoMT), recognizing the level of complexity brought about by a variety of network devices and dense traffic patterns. The development of a heterogeneous computing grid and wireless sensor networks are at the forefront of the global investigation of Internet of Things-based healthcare technologies. The emphasis on user-centric apps and developer-centric IoT healthcare services emphasises the need for secure solutions that satisfy a number of specifications, including scalability, confidentiality, and integrity.

The paper [6] introduces technologies like cloud computing, grid computing, and big data to enhance IoT-based healthcare services. It emphasises the importance of network architecture, particularly in cloud-based IoT networks with sensing, network, and application layers. The health monitoring infrastructure, relying on integrated cloud computing and IoT, utilises implantable sensors and a three-layer architecture for data analysis, aggregation, and storage. In order to improve IoT-based healthcare services, the paper presents technologies such as cloud computing, grid computing, and big data. It highlights the significance of network architecture, especially in cloud-based IoT networks with sensing, network, and application layers. The health monitoring infrastructure, which is based on integrated cloud computing and IoT, uses implantable sensors and a three-layer architecture for data aggregation, analysis, and storage. The importance of standardisation initiatives and frameworks for facilitating interoperability in the exchange of health data is emphasised. The goal of collaboration between health organisations and IoT academics is to create open standards that address protocol stacks, device interfaces, data aggregation, and communication layers.

“Embedded gateway services, security and privacy for cloud-based IoT, smart communities, federated IoT and cloud computing for pervasive patient health monitoring systems are just a few of the IoT applications in healthcare that are mentioned in the paper's conclusion. It also notes how quickly cloud-based IoT is being incorporated into healthcare, but it also points out obstacles to wider use. The ideas presented in [6] include mobile grid computing, an Internet of Things-based interconnection framework for mHealth and remote monitoring, and a network mobility solution based on 6LoWPAN hospital wireless sensor networks (NEMO-HWSN).”

4.2.3. *An IoT-cloud Based Wearable ECG Monitoring System for Smart Healthcare*

The paper [7] introduces a novel approach to ECG monitoring using Internet-of-Things (IoT) techniques, aimed at addressing the growing concerns in public healthcare due to the increasing population and medical expenses. The proposed system utilises wearable ECG sensors connected to a monitoring node, transmitting real-time data to an IoT cloud. Unlike existing systems, this setup doesn't rely solely on smartphones. “The ECG sensing network forms the foundation, employing wearable sensors to record physiological data over extended periods. Data transmission to the IoT cloud occurs through Wi-Fi, Bluetooth, or Zigbee, eliminating the need for a smartphone. The IoT cloud efficiently stores and analyses ECG data, aiding in the detection of potential heart diseases.” The monitoring node, equipped with an AD8232 ECG sensor, processes and transmits data via a high-performance Microcontroller Unit (MCU) and Wi-Fi module [7]. The cloud, based on web services and cloud computing, features storage, HTTP, and MQTT servers for efficient data handling. A user-friendly graphical user interface (GUI) provides easy access to real-time ECG data stored in the IoT cloud, benefiting both doctors and patients. Experimental results demonstrate the system's effectiveness in capturing essential ECG features, such as the QRS complex, for medical diagnosis.

In conclusion, the developed IoT-based ECG monitoring system presents a promising solution for long-term, cost-effective ECG signal detection [7]. It not only overcomes the limitations of existing systems but also offers real-time access to ECG data through a user-friendly interface, contributing to timely healthcare interventions.

4.2.4. *Cognitive IoT-Cloud Integration for Smart Healthcare: Case Study for Epileptic Seizure Detection and Monitoring*

The cognitive Internet of Things (IoT) is a cloud-based smart healthcare system that is introduced in this study. It analyses EEG signals to evaluate a patient's status and makes intelligent decisions based on that information. The system's goals are to deliver prompt, reasonably priced, and easily accessible healthcare services. The framework employs deep learning methods for EEG-based seizure monitoring and identification, including stacked autoencoders and a deep convolutional neural network (CNN). The paper [8] highlights the growing demand for real-time, intelligent, and remote healthcare services in smart cities, emphasising the need for cognitive IoT frameworks. The focus is on epilepsy as a neurological disorder that can significantly impact a patient's life, making a smart healthcare monitoring system crucial. The proposed framework, named Cognitive Healthcare-IoT (CHIoT), integrates smart sensors, IoT-aware technologies, and cloud computing for effective healthcare monitoring [8]. The study delves into the challenges of EEG seizure detection, citing the limitations of existing methods and the potential of deep learning techniques.

The Cognitive IoT-Cloud Smart Healthcare Scenario section explains how the system enables residents and medical practitioners to access health records remotely using smart sensors and cloud technologies. It details the patient-dependent healthcare monitoring and the role of smart city infrastructures in facilitating access to healthcare data. The System Architecture section outlines the proposed framework's structure, involving smart IoT sensors, local data processing, cloud processing, and a cognitive engine determining the need for emergency care. The cloud manager authenticates users and controls data flow, while the cognitive engine utilises multimodal data for real-time decision-making. The study utilises the CHB-MIT dataset for experimentation, which includes multiple channel scalp EEG recordings from paediatric patients affected by seizures [8]. The deep learning model, which consists of a deep CNN and stacked autoencoders, receives raw EEG data as input. The architecture and training procedures of the model are described in detail, highlighting its capacity to extract characteristics from unprocessed EEG data.

Conclusively, the results show promise, with the suggested deep CNN-stacked autoencoder model yielding an overall accuracy of 99.5% on the CHB-MIT dataset [8]. The study demonstrates its advantages in terms of accuracy and sensitivity for cross-patient seizure detection by comparing its performance with that of cutting-edge models. The success of the suggested cognitive smart healthcare monitoring framework is acknowledged in the research, along with the possibility of future advancements. It highlights that security concerns must be resolved prior to implementing such frameworks in real-world operational environments.

V. SUMMARY TABLE

Table 1. IoT Cloud in Agriculture and Healthcare.

S. No.	Title	Advantages	Limitations	Method/Technology	Future Scopes
1	Blockchain-Based Cloud-Enabled Security Monitoring using Internet of Things in Smart Agriculture [3]	Lower latency, better communication.	IoT gateway was not implemented. Instead, Home Wi-Fi was used as gateway to connect IoT sensor devices [3]	Arduino sensor kit, AWS cloud components, web application GUI, And blockchain technology [3]	Alternative for Ethereum, such as Cardano based blockchain to decrease the overall cost and using network anomaly as a transaction in blockchain for better security.
2	Smart Agriculture Based on IoT and Cloud Computing [2]	Drones (Data extraction, bird eye view, data evaluation, Real time status)		Sky drone FPV2, 4G/LTE Modem, ZigBee [2]	Use IoT and Cloud Computing to create data centres and provide reliable variations on virtualized platforms.

S. No.	Title	Advantages	Limitations	Method/Technology	Future Scopes
3	Survey of Intelligent Agricultural IoT Based on 5G [4]	Faster and real-time data transmission		Edge computing, AI, ML, Blockchain, Big Data, Precision Agriculture	Integrating 5G and precision agriculture, exploring 5G in livestock management.
4	A Secure IoT-Based Irrigation System for Precision Agriculture using the Expeditious Cipher [1]	Low processing time, better throughput and memory usage	Not providing specific values in evaluation metrics, lack of end-user perspectives.	MQTT, NodeMCU, Raspberry Pi, GSM module, [1]	Software-defined networking technology to offload security algorithms. [1]
5	Challenges and opportunities in IoT healthcare systems: a systematic review [5]	Addresses the security concerns, providing practical examples	Scope limitation, generalisation (overlooking variations)	PubMed, IEEE Xplore, science direct and other academic databases were used.	Standardised protocols and framework for better compatibility
6	Cloud-based IoT healthcare applications: Requirements and recommendation [6]	Distinction between services and applications,	Lack of specific examples, no regulatory compliance like HIPAA.	6LoWPAN hospital wireless sensor network [6]	providing patient access to real time health data, personalised insights through IoT technologies.
7	An IoT-cloud Based Wearable ECG Monitoring System for Smart Healthcare [7]	Improved health monitoring and diagnosis, increased accessibility across different platforms.	Connectivity issues can affect the accuracy and reliability of data.	Zigbee, IoT Cloud, HTTP and MQTT protocols, Redis [7]	Long-term Monitoring for continuous health monitoring, integration with other technologies like Artificial Intelligence and Machine learning to increase accuracy.
8	Cognitive IoT-Cloud Integration for Smart Healthcare: Case Study for Epileptic Seizure Detection and Monitoring [8]	High accuracy and sensitivity, better scalability and dataset size expansion.	Limited diversity in data sources, less discussion on false positives/negatives, high dependency on cloud connectivity	IoT, Cloud computing, Deep Learning methods	Real world deployment for validation, mobile health integration for better portability and accessibility, cost-effective analysis to check the economic feasibility.

VI. FUTURE SCOPE AND CONCLUSION

The paper concludes with a thorough summary of current studies in the areas of IoT-based agricultural and healthcare systems. The necessity of effective Internet of Things applications is highlighted by the emphasis on cloud-integrated systems and the difficulties with accuracy and power consumption. IoT and cloud computing integration provide a viable path towards the development of intelligent, data-driven systems in agriculture and healthcare, with continuous research efforts aimed at resolving current issues and enhancing overall system efficiency. The research looks at a variety of topics, such as cloud-based healthcare and agriculture data management techniques and IoT system design.

Innovative approaches to agriculture are included in the paper, including a blockchain-based security monito-

-ring system, an IoT-enabled smart agricultural model, and a secure irrigation system that uses lightweight encryption. These methods demonstrate how IoT may improve precision in agriculture by addressing security issues, data transfer, and real-time monitoring.

In healthcare, the article examines the opportunities and challenges in IoT and Cloud based healthcare systems, emphasising the effectiveness of remote patient monitoring and emergency care. Cloud-based IoT healthcare applications and an IoT-cloud based wearable ECG monitoring system are discussed [7], highlighting the evolving trends in data-driven clinical observation and intervention. Additionally, a cognitive IoT-cloud integration for smart healthcare, focusing on epileptic seizure detection and monitoring, demonstrates the potential of advanced technologies in improving patient care.

Future scope of the current review can include the advancement in the development of a computational model integrating both Cloud and IoT for real time analytics of data in healthcare and agriculture context.

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