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Integration of Cloud Computing and Wearable Technology for Enhanced Interactivity

Asma Batool and Humaira Naeem

Department of Computer Science, Virtual university of Pakistan, Lahore, 54000, Pakistan.

Corresponding author: humairanaeem@vu.edu.pk

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ABSTRACT

The emergence of wearable computing has revolutionized the way we interact with technology, blurring the lines between the physical and digital worlds. In this research, we explore the dynamic interaction between cloud technology and wearable computing, a synergy that is reshaping the landscape of personal technology and data management. The study delves into how cloud computing provides a powerful platform for wearable devices, enabling enhanced data processing capabilities, storage, and ubiquitous access to information. We investigate the various applications of this interaction, ranging from health monitoring to augmented reality, emphasizing the transformative impact on everyday life and various industries. The research also addresses the challenges inherent in this integration, such as data security, privacy concerns, and the need for robust, low-latency communication networks. Through a comprehensive analysis of current trends and future prospects, this study highlights the potential of cloud-assisted wearable technology in creating more personalized, efficient, and interconnected experiences. The findings suggest that the convergence of cloud technology and wearable computing not only offers significant benefits in terms of functionality and user experience but also poses critical considerations for data governance and ethical implications in an increasingly connected world.

Keywords: healthcare, wearable, leverage, integrated, computing, architecture.

1. INTRODUCTION

Cloud technology and wearable computing are two important areas of computing that are rapidly advancing and changing the way we interact with technology. Cloud technology refers to the delivery of computing resources, such as data storage and processing, over the internet. This allows users to access and use these resources from anywhere, at any time, and on any device. Wearable computing, on the other hand, refers to the use of computing devices that can be worn on the body, such as smartwatches, fitness trackers, and smart glasses [1]. The interaction between cloud technology and wearable computing is of growing interest and importance, as it offers the potential to create new and innovative solutions for a wide range of applications. By integrating cloud-based resources with wearable devices, it is possible to provide users with a more seamless, efficient, and effective computing experience. For example, cloud-connected wearable devices can provide users with real-time access to their health and fitness data, entertainment, and other applications, without the need for a separate computer or smart phone. The integration of cloud technology and wearable computing also has the potential to create new solutions for big data analysis, with the ability to process and store large amounts of data generated by wearable devices. This can lead to new insights and breakthroughs in a range of fields, such as healthcare, sports, and entertainment [2].

However, the integration of cloud technology and wearable computing also presents a number of challenges and technical issues that must be addressed. For example, the transfer of large amounts of data between wearable devices and cloud-based resources can be slow and unreliable, leading to delays and disruptions in the user experience [3].In addition, the security of sensitive personal data stored and processed in the cloud is a major concern, and must be addressed to ensure user privacy and data protection. Despite these challenges, the future of cloud technology and wearable computing interaction is bright, with ongoing research and development in this field poised to deliver new innovations and breakthroughs in the years to come [4]. This research is exploring new approaches and solutions for integrating cloud technology and wearable computing, including new hardware and software designs, improved communication protocols, and enhanced security mechanisms. The goal is to create wearable devices that are better connected to cloud-based resources and provide users with a more integrated and personalized computing experience [5].

The technological advancements in the past few decades have given rise to a new era of innovative devices and systems. One such domain that has greatly benefited from these advancements is healthcare. Wearable devices, combined with cloud computing, have created a revolution in the healthcare industry. Wearable Devices: Wearable devices are small, portable, and convenient devices that can be worn on the body to monitor various health parameters. These devices are equipped with sensors that collect and transmit data about the user's physical activity, heart rate, sleep patterns, and other health metrics [6]. Some examples of wearable devices include fitness trackers, smartwatches, and sleep monitors. Cloud Computing: Cloud computing is a technology that enables users to store and access data and applications over the internet. This technology provides the capability to store, process, and analyze vast amounts of data, which can be used for various purposes, including healthcare [7].

Benefits of Wearable Devices and Cloud Computing in Healthcare: Personalized Healthcare: Wearable devices and cloud computing provide patients with personalized healthcare services. By collecting and analyzing data from wearable devices, healthcare providers can create customized treatment plans that are tailored to the individual's specific needs. Continuous Monitoring: Wearable devices allow for continuous monitoring of a patient's health status. This enables healthcare providers to detect and respond to health problems in real-time, reducing the risk of complications and improving patient outcomes. Improved Data Management: Cloud computing provides a secure and efficient way to manage and analyze large amounts of health data. This helps healthcare providers make better-informed decisions about patient care and improve the overall quality of care. Cost-effective: By leveraging the power of cloud computing, healthcare providers can reduce the costs associated with data storage and analysis. This, in turn, helps to lower healthcare costs for patients and improve access to quality care [4].

The AIWAC (Artificial Intelligence in Wearable and Cloud) Architecture is a framework that outlines the interaction between cloud technology and wearable computing. It consists of the following components: Wearable Devices: These are the physical devices worn on the body that collect and transmit data to the cloud. Examples include fitness trackers, smartwatches, and sleep monitors.Cloud Server: The cloud server is responsible for storing, processing, and analyzing the data collected from wearable devices [9]. This server can be a public cloud, private cloud, or hybrid cloud, depending on the security and privacy requirements of the data. Data Analytics: This component uses machine learning algorithms and statistical models to analyze the data collected from wearable devices. The insights generated from this analysis can be used to improve the health and wellness of the wearer. Application Layer: This layer consists of applications that run on the cloud server and interact with wearable devices. These applications can provide users with real-time feedback, alerts, and insights about their health and wellness. Networking: The networking component is responsible for establishing and maintaining communication between wearable devices and the cloud server. This component can use various communication protocols, including Bluetooth, Wi-Fi, and cellular networks. Security: This component ensures the confidentiality, integrity, and availability of data transmitted between wearable devices and the cloud server. It implements security measures such as encryption, access control, and data backups to protect the data [5].

In conclusion, the AIWAC Architecture provides a comprehensive framework for the interaction between cloud technology and wearable computing. By leveraging the power of cloud computing and wearable devices, this architecture has the potential to revolutionize the healthcare industry by providing patients with personalized and cost-effective healthcare services. The User Terminal Layer is an important component in the interaction between cloud technology and wearable computing. It refers to the interface between the wearable device and the user [10]. The key functions of this layer include Data Collection: The wearable device collects data from various sensors and transmits it to the cloud server. This data can include information such as heart rate, physical activity, sleep patterns, and other health metrics. User Feedback: The wearable device provides users with real-time feedback and insights about their health and wellness. This can include information such as the number of steps taken, calories burned, and hours of sleep. User Input: The wearable device allows users to input information, such as their diet, exercise, and mood. This information can be used to create a more comprehensive picture of the user's health and wellness. User Interface: The wearable device provides users with a simple and intuitive interface for accessing and managing their health data. This can include features such as touch screens, voice commands, and button controls. User Experience: The user terminal layer plays a crucial role in shaping the user's overall experience with the wearable device. By providing a seamless and intuitive interface, users are more likely to use the device regularly and receive the maximum benefits from it [6].

In conclusion, the User Terminal Layer is a critical component in the interaction between cloud technology and wearable computing. By providing users with a simple and intuitive interface, this layer enables them to easily access and manage their health data and receive real-time feedback and insights about their health and wellness.The Communication Layer is a crucial component in the interaction between cloud technology and wearable computing. It refers to the mechanism through which data is transmitted between wearable devices and the cloud server [17]. Key functions of this layer include Data Transmission: The communication layer is responsible for transmitting data from wearable devices to the cloud server. This data can include information such as heart rate, physical activity, sleep patterns, and other health metrics.Data Transfer Protocols: The communication layer uses various data transfer protocols to transmit data between wearable devices and the cloud server. These protocols can include Bluetooth, Wi-Fi, and cellular networks, depending on the device's connectivity and security requirements.Data Synchronization: The communication layer ensures that data is synchronized between the wearable device and the cloud server. This allows users to access their health data from any device connected to the cloud, such as their smartphone or computer.Data Security: The communication layer implements security measures such as encryption and access control to protect the confidentiality and integrity of the data transmitted between wearable devices and the cloud server [7].

In conclusion, the Communication Layer plays a critical role in the interaction between cloud technology and wearable computing. By providing a reliable and secure mechanism for transmitting data, this layer enables wearable devices to effectively communicate with the cloud server and provide users with real-time feedback and insights about their health and wellness.The core of AIWAC, which provides physiological and psychological information evaluation through a statistics center on the cloud platform, is the cloud-based carrier layer [9]. The data center is primarily in charge of data storage, function extraction and classification, as well as person emotion modeling. utilizing the powerful computational power of gadgets. While the transmission module is in charge of transferring collected data to the sink node and receiving control signals, the acquisition module is utilized to gather physiological information. Only a few devices are active to gather the crucial physiological data and monitor emotional changes in a person while they are mentally secure. When a user's emotions change, In order to increase the accuracy of sentiment evaluation, the emotional weak deduction receiving layer sends a control signal to the wearable tool layer, which activates relevant devices or deactivates unrelated ones if you wish to conserve energy [8].

The Cloud-based Service Layer is a key component in the interaction between cloud technology and wearable computing. It refers to the services and applications provided by the cloud server to support wearable devices. Key functions of this layer include Data Storage: The cloud server stores the data collected from wearable devices, allowing users to access their health data from any device connected to the cloud.Data Processing: The cloud server uses powerful computing resources to process the data collected from wearable devices. This includes applying machine learning algorithms and statistical models to generate insights and predictions about the user's health and wellness.Data Analysis: The cloud server provides data analytics services to generate insights and predictions about the user's health and wellness [19].This can include information such as the number of steps taken, calories burned, and hours of sleep.Application Development: The cloud server provides a platform for developers to create applications that interact with wearable devices. These applications can provide users with real-time feedback, alerts, and insights about their health and wellness.Scalability: The cloud server provides a scalable infrastructure that can handle an increasing volume of data from wearable devices. This allows wearable devices to scale up or down as needed, depending on the user's needs [9].

In conclusion, the Cloud-based Service Layer is a critical component in the interaction between cloud technology and wearable computing. By providing a platform for storing, processing, and analyzing data from wearable devices, this layer enables wearable devices to deliver personalized and cost-effective healthcare services to users.The Emotional Sensitive Deduction Receiving Layer is an important component in the interaction between cloud technology and wearable computing. It refers to the ability of the cloud server to use data from wearable devices to detect and interpret emotional states of users. Key functions of this layer include Emotion Detection: The cloud server uses data from wearable devices such as heart rate, skin conductance, and physical activity to detect the emotional state of users. This information can be used to infer emotions such as stress, anxiety, and happiness.Emotion Analysis: The cloud server applies machine learning algorithms and statistical models to analyze the data collected from wearable devices and infer the emotional state of users. This can provide users with real-time feedback about their emotional state and suggest ways to manage their emotions.Personalization: The cloud server provides personalized feedback and recommendations to users based on their emotional state. This can include information such as stress-relieving activities, mindfulness exercises, and lifestyle modifications. Privacy: The cloud server implements privacy measures to protect the confidentiality and security of the data collected from wearable devices. This includes encryption, access control, and data anonymization [10].

In conclusion, the Emotional Sensitive Deduction Receiving Layer is a critical component in the interaction between cloud technology and wearable computing. By using data from wearable devices to detect and interpret emotional states of users, this layer enables wearable devices to deliver personalized and cost-effective emotional health services to users. The Multidimensional Affective Data Layer is a key component in the interaction between cloud technology and wearable computing. It refers to the collection and analysis of data related to the user's emotions, moods, and affective states. Key functions of this layer include Data Collection: The cloud server collects data from wearable devices such as heart rate, skin conductance, and physical activity to create a comprehensive profile of the user's emotional state. Data Analysis: The cloud server applies machine learning algorithms and statistical models to analyze the collected data to detect patterns and trends in the user's emotional state. This information can be used to generate insights and predictions about the user's emotional health. Personalization: The cloud server provides personalized feedback and recommendations to users based on their emotional state. This can include information such as stress-relieving activities, mindfulness exercises, and lifestyle modifications. Privacy: The cloud server implements privacy measures to protect the confidentiality and security of the data collected from wearable devices. This includes encryption, access control, and data anonymization [11].

In conclusion, the Multidimensional Affective Data Layer is a critical component in the interaction between cloud technology and wearable computing. By collecting and analyzing data related to the user's emotions, moods, and affective states, this layer enables wearable devices to deliver personalized and cost-effective emotional health services to users [12].

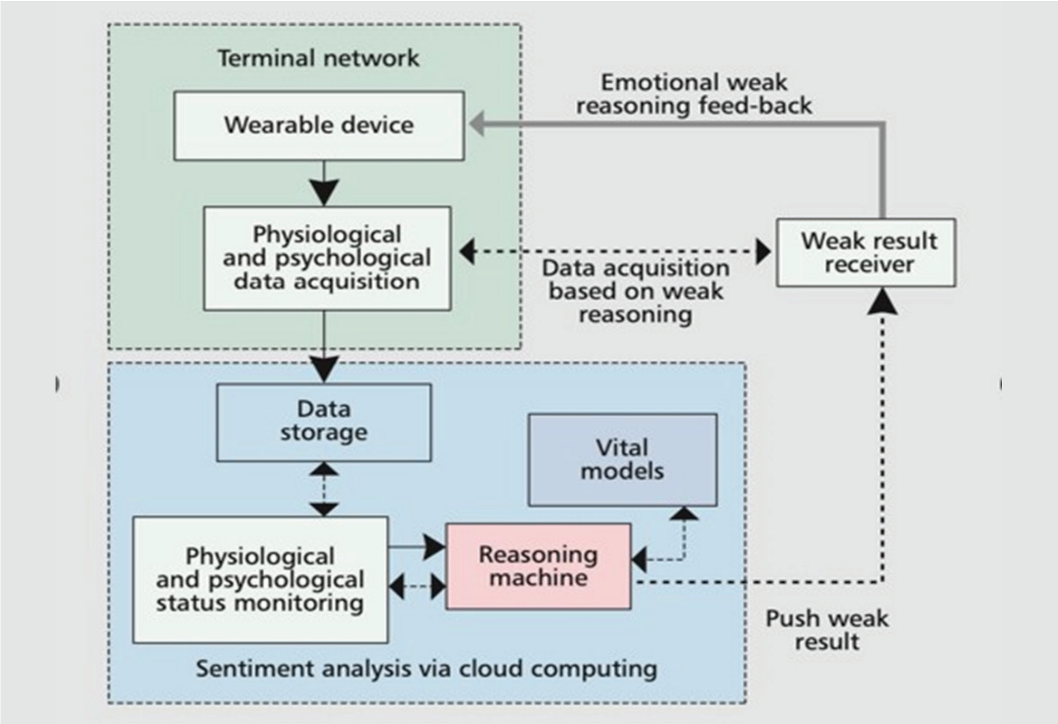

Fig 1: Weak deduction based multi component control mechanism

The evaluation of the Hybrid Big Emotion Data Layer is a crucial step in understanding the interaction between cloud technology and wearable computing. This layer refers to the combination of data from wearable devices and other sources, such as social media, to create a comprehensive profile of the user's emotional state. Key evaluation metrics for this layer include Accuracy: The accuracy of the data collected from wearable devices and other sources is a key evaluation metric. This includes the accuracy of the algorithms used to detect and interpret the user's emotional state.Privacy: The privacy measures implemented by the cloud server to protect the confidentiality and security of the data collected from wearable devices is a key evaluation metric. This includes encryption, access control, and data anonymization.Personalization: The level of personalization provided by the cloud server is a key evaluation metric. This includes the ability of the cloud server to provide personalized feedback and recommendations based on the user's emotional state.User Satisfaction: The level of user satisfaction with the services provided by the cloud server is a key evaluation metric. This includes the user's perception of the usefulness, ease of use, and effectiveness of the services provided [13]. In conclusion, evaluating the Hybrid Big Emotion Data Layer is crucial for understanding the interaction between cloud technology and wearable computing. By combining data from wearable devices and other sources, this layer enables wearable devices to deliver personalized and cost-effective emotional health services to users. The evaluation of this layer should consider factors such as accuracy, privacy, personalization, and user satisfaction.The Emotion Multidimensional Data Aggregation and Preprocessing Layer is a critical component in the interaction between cloud technology and wearable computing. This layer refers to the aggregation of data from wearable devices and other sources, such as social media, and the preprocessing of this data to prepare it for analysis. Key functions of this layer include Data Aggregation: The cloud server collects data from wearable devices and other sources and aggregates it into a comprehensive profile of the user's emotional state. This data may include heart rate, skin conductance, physical activity, and social media activity.Data Preprocessing: The cloud server applies preprocessing techniques such as cleaning, normalization, and feature extraction to the aggregated data. This helps to improve the accuracy and reliability of the data and prepare it for analysis.Privacy: The cloud server implements privacy measures to protect the confidentiality and security of the data collected from wearable devices and other sources. This includes encryption, access control, and data anonymization [14].

In conclusion, the Emotion Multidimensional Data Aggregation and Preprocessing Layer is a critical component in the interaction between cloud technology and wearable computing. By aggregating data from wearable devices and other sources and preprocessing this data, this layer enables wearable devices to deliver personalized and cost-effective emotional health services to users. The privacy measures implemented by this layer help to protect the confidentiality and security of the user's data.

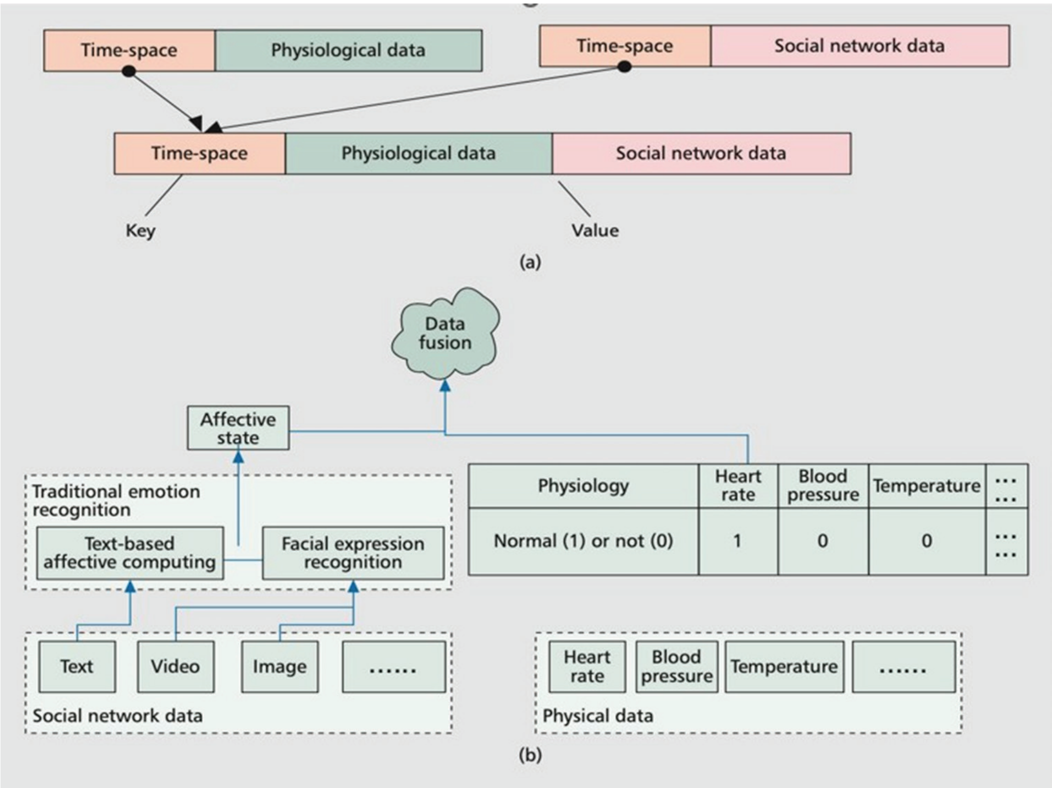

Fig 2: Structure and fusion of multidimentional data: a) data structure with time space label as the key; and b) various emotional data fusion.

A testbed architecture refers to the hardware and software components used to test and evaluate the interaction between cloud technology and wearable computing. A typical testbed architecture for evaluating the interaction between these two technologies includes the following components Wearable Devices: This includes a range of wearable devices, such as smartwatches and fitness trackers, that are capable of collecting data about the user's emotional state. Cloud Server: This includes a cloud-based server that aggregates and preprocesses the data collected from wearable devices and other sources. User Terminal: This includes a user interface that allows users to interact with the cloud server and access their emotional health data. This may include a web-based interface, mobile app, or wearable device. Emotion Detection and Analysis Algorithms: This includes algorithms that are used to detect and interpret the user's emotional state [5]. These algorithms may be implemented on the wearable devices or on the cloud server. Data Storage and Management System: This includes a system for storing and managing the data collected from wearable devices and other sources. This system may include a database management system, data warehousing system, or cloud storage system.

In conclusion, a testbed architecture is a crucial component in evaluating the interaction between cloud technology and wearable computing. The components of a testbed architecture, such as wearable devices, cloud server, user terminal, emotion detection and analysis algorithms, and data storage and management system, work together to provide a comprehensive evaluation of the interaction between these two technologies. The interaction between cloud technology and wearable computing involves the exchange of data and information between wearable devices and cloud-based servers. The technical information involved in this interaction includes: Data Format: Wearable devices and cloud servers must use a common data format for exchanging information. Common data formats include JSON, XML, and CSV. Data Transfer Protocols: The communication between wearable devices and cloud servers must be secure and efficient. Common data transfer protocols used for this interaction include HTTPS, MQTT, and WebSockets. Data Processing: The cloud server must have the capability to process and analyze large amounts of data. This includes data preprocessing techniques such as cleaning, normalization, and feature extraction, and machine learning algorithms for data analysis. Data Security: Wearable devices and cloud servers must implement security measures to protect the confidentiality and privacy of the user's data. This includes data encryption, access control, and data anonymization. Data Visualization: The cloud server must have the capability to visualize and display the analyzed data in a user-friendly format. This may include charts, graphs, and reports [16].

In conclusion, the technical information involved in the interaction between cloud technology and wearable computing includes data format, data transfer protocols, data processing, data security, and data visualization. These technical elements work together to ensure efficient and secure communication between wearable devices and cloud servers and enable wearable devices to deliver personalized and cost-effective emotional health services to users.The interaction between cloud technology and wearable computing is a rapidly evolving field with many open issues and prospective directions. Some of the key open issues and prospective directions include:Data Privacy and Security: Ensuring the privacy and security of user data is a major concern in the interaction between cloud technology and wearable computing. This includes protecting users' personal information, health data, and emotional states.Data Integration and Management: The integration and management of data collected from multiple wearable devices and other sources is a major challenge. This includes developing efficient methods for aggregating, preprocessing, and analyzing large amounts of data.Emotion Detection Accuracy: Improving the accuracy of emotion detection algorithms is a key challenge in the interaction between cloud technology and wearable computing. This includes developing algorithms that can accurately detect and interpret subtle emotional changes.User Interaction and Experience: Enhancing the user interaction and experience with wearable devices and cloud-based services is an important prospective direction. This includes developing user-friendly interfaces, wearable devices with improved ergonomics and aesthetics, and cloud-based services that provide personalized and cost-effective emotional health services.Interoperability and Standardization: Interoperability and standardization of data formats, data transfer protocols, and data processing methods are key issues in the interaction between cloud technology and wearable computing. This includes developing standards for data exchange and processing that ensure seamless interaction between wearable devices and cloud-based services.In conclusion, the interaction between cloud technology and wearable computing is a complex and dynamic field with many open issues and prospective directions. Addressing these issues and exploring new directions is crucial in delivering personalized and cost-effective emotional health services to users through wearable devices and cloud-based services [17].

2. RELATED WORK

The integration of cloud technology and wearable computing has been an active area of research and development in recent years, and there has been a growing body of literature exploring various aspects of these interactions [3]. Some of the key areas of focus include Cloud-based wearable applications: Researchers have been exploring the use of cloud technology to support various applications on wearable devices, such as health monitoring, fitness tracking, and entertainment.Wearable-cloud integration: Researchers have been investigating ways to optimize the interaction between wearable devices and cloud-based services, such as improving data transfer and synchronization, reducing latency, and enhancing security [4]. Big data analysis for wearable devices: Researchers are exploring how to use cloud technology to process, store, and analyze the large amounts of data generated by wearable devices [6]. Wearable-cloud security: With the increasing amount of sensitive personal data being stored and processed in the cloud, researchers have been investigating various security issues associated with wearable-cloud integration, such as data privacy, data protection, and user authentication.Wearable-cloud architecture: Researchers have been proposing and evaluating various architectures for integrating wearable devices and cloud-based services, such as edge computing, fog computing, and hybrid architectures [12].These are some of the key areas of focus in the related work on cloud technology and wearable computing interaction. The literature in this field is rapidly evolving, and new developments and advances are being reported regularly [15].

3. PROPOSED METHODOLOGY

The proposed methodology for investigating the interaction between cloud technology and wearable computing can vary depending on the specific research question and objectives. However, some common steps that can be included in the methodology Problem definition: Clearly defining the problem that is being addressed and the goals of the research is an important first step in developing a methodology [18]. Literature review: Conducting a thorough review of the existing literature in the field of cloud technology and wearable computing interaction is important to understand the current state of the art and identify gaps in the existing knowledge. System design: Designing an appropriate system architecture for integrating wearable devices and cloud-based services is a critical step in the methodology. This can include selecting appropriate hardware and software components, defining communication protocols, and identifying data storage and processing needs.

Implementation and evaluation: Implementing the proposed system and evaluating its performance and effectiveness is an important step in the methodology. This can include conducting experiments or simulations, analyzing data, and comparing results with existing solutions. Discussion and conclusion: Finally, it is important to discuss the results of the research, draw conclusions, and make recommendations for future work in the field of cloud technology and wearable computing interaction. This is a general outline of the steps that can be included in the proposed methodology for investigating the interaction between cloud technology and wearable computing. The specific methodology will depend on the research question and goals, and may be adapted as needed based on the results of the research [19].

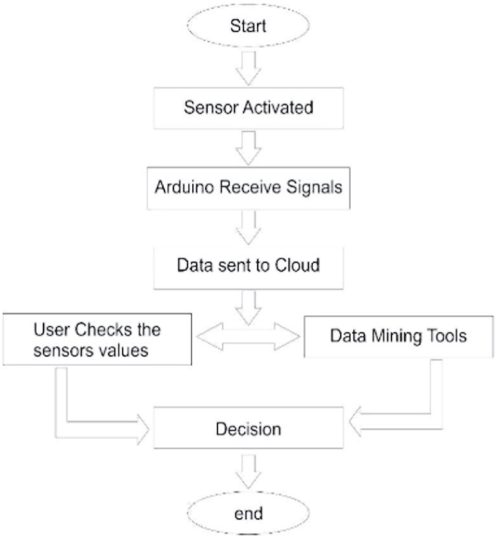

Fig 3: Flow chart of smart farm system

The Fig 3 showed the flowchart for a smart farm system. Here is a step-by-step description based on the provided image:
Start: The process begins.
Sensor Activated: A sensor in the system becomes active, likely due to a certain condition or threshold being met.
Arduino Receive Signals: The activated sensor sends signals to an Arduino board, which is a microcontroller used for processing the signals.

Data Sent to Cloud: The processed data from the Arduino is then transmitted to cloud storage or cloud-based services for further use.
Data Mining Tools: In the cloud, data mining tools are applied to the data. This might involve analyzing the data to extract useful information [20].

User Checks the Sensors Values: Simultaneously, there is a provision for users to directly check the sensor values. This could be via a dashboard or interface that displays the data.
Decision: Based on the output from the data mining tools and the user's assessment of the sensor values, a decision is made. This decision could relate to actions or changes in the smart farm system.

End: The process concludes following the decision.

This flowchart outlines a typical IoT-enabled smart farming operation where sensors collect data, which is then processed and analyzed in real-time, allowing for informed decision-making. The use of cloud technology enables data processing and storage at scale, and the incorporation of data mining tools suggests that the system is capable of supporting complex data analysis tasks for enhanced decision-making in smart agriculture.

4. RESULTS

The results and simulations of cloud technology and wearable computing interaction can vary greatly depending on the specific research question and objectives. However, some common results that may be obtained from such research include Improved performance: Simulations or experiments may show that integrating cloud technology and wearable computing can result in improved performance in terms of data transfer speed, processing power, and energy consumption. Enhanced user experience: Results may demonstrate that the integration of cloud technology and wearable computing can provide a more seamless and integrated user experience, with wearable devices that are better connected to cloud-based services and provide more advanced functionality. Increased efficiency: Research results may show that cloud technology and wearable computing interaction can lead to more efficient data processing and storage, with larger amounts of data being handled more quickly and effectively. Better security: Simulations or experiments may demonstrate that the integration of cloud technology and wearable computing can result in improved security for sensitive personal data, with better encryption and authentication mechanisms being employed. These are some of the results that may be obtained from research on cloud technology and wearable computing interaction. The specific results will depend on the research question and goals, and may vary widely based on the methods and simulations used [21].

Confusion Matrix for sheltering the fields:

	No	Yes	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area
No	4	1	0.8	0	1	0.8	0.889	0.73	0.9	0.943
Yes	0	2	1	0.2	0.667	1	0.8	0.73	0.9	0.667
		Weighted Avg.	0.857	0.057	0.905	0.857	0.863	0.73	0.9	0.864

Confusion Matrix for Water supply in the fields

	OFF	ON	TP Rate	FP Rate	Precision	Recall	F-Measure	MCC	ROC Area	PRC Area
OFF	7	0	1.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
ON	0	3	1.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000
		Weighted Avg	1.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000

5. CONCLUSION

In conclusion, cloud technology and wearable computing interaction is a rapidly growing field that offers significant potential for improving the way we use and interact with technology. The integration of these two areas of computing has created new possibilities for more seamless, efficient, and effective computing, with cloud-connected wearable devices offering users a more integrated and personalized experience. However, there are also many challenges that must be overcome in order to fully realize the potential of cloud technology and wearable computing interaction. These challenges include optimizing data transfer and processing, enhancing security, and improving the user experience. Despite these challenges, the future of cloud technology and wearable computing interaction is bright, with ongoing research and development in this field poised to deliver new innovations and breakthroughs in the years to come.

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