Design of Smart Healthcare Monitoring Framework Using Cloud Computing and IOT

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Abstract
Modern technology is widely used in different fields to improve the quality of life for people.

One of the major challenges that have been identified as having a direct impact on both an individual's quality of life and the growth of the country is health-related difficulties. Avoiding medical supervision has harmful impacts in numerous areas. Healthcare is one of several significant industries where applications using the Internet of Things (IoT) platform have gained widespread acceptance. The creation of a smart healthcare monitoring framework utilizing cloud computing and IoT is presented in this method. The suggested architecture improves the effectiveness of biosensor-based data gathering and aggregation and, in the event of an emergency, informs the relevant doctor.In the situation of any intense conditions, it also results in the development of a real-time efficient decision support system. Giving patients access to appropriate and effective medical facilities is the research's suggested outcome.

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I. INTRODUCTION

Chronic patients who have access to regular healthcare monitoring systems are kept secure since they can self-manage their everyday activities [1]. Giving people access to quality healthcare today, especially in developing nations, is one of the most difficult problems. Many chronic diseases impact a large number of people every year for a variety of reasons. The first and most important thing to look after is ones health, which cannot be neglected. The research community is currently interested in IoT because to its accessibility, low cost, and ease of usage, among other factors [2]. A popular form of computing called cloud computing supports in increased handling and storage efficiency. IoT and cloud computing, two intelligent technologies, have recently concentrated mostly on healthcare-related challenges. The combination of these two technologies results in a full range of software and hardware components [3].

An essential component of the medical system is keeping track of the patient's condition indicators, such as their temperatures, hypertension, and heart rate. The critical care units in operating rooms frequently have a large number of monitoring devices that show the patient's vital signs. However, despite continuous monitoring for 24 hours, there may be some situations in which the doctor is unable to be informed in time when an emergency develops. Additionally, family members and other doctors who are experts in that subject cannot access the data remotely. Although many of these activities are made possible by technology, many individuals in underdeveloped countries lack access to and cannot afford this technology. Consequently, the Internet of Things can be used to resolve the problem.

The Internet of Things essentially combines all aspects of the analogue and digital worlds, transforming how people interact with and relate to objects and their characteristics while putting the objects themselves at the center. The Internet of Things connects the physical and virtual worlds, with user-controlled communication, in addition to linking various "things" (instruments, gadgets, and sensors), whether wirelessly or by wires. There are various ways that the Internet of Things (IoT) improves patient care [4]. IoT connected sensors such as wristbands, pressure sensor and medical devices in hospital are among the effective applications of this technology. Because it will decrease the need for human data collection and entry. Regular monitoring using IoT devices will help patients recover much more quickly in instances like the worldwide pandemic, when the number of infected people is continuously increasing.

Storage space in cloud computing can be made available to the general public or kept private and only accessible to authorized users. Most difficulties IoT devices encounter are caused by cloud computing. The user can access and run the applications utilized by IoT devices from any location. The platform provided by cloud computing is fundamentally useful for tasks like visualization, utility-based computing, which streamlines the auditing of IoT devices, and a number of products that address problems with client-side queries and storage [5].

People with disabilities, patients with chronic diseases, the elderly, or those who have major health difficulties require constant attention in the healthcare industry. Therefore, regular monitoring is necessary for taking measurements like body temperature, heart rate, and blood pressure. An Internet of Things-based system is required to solve this problem. Additionally, Industry 4.0 creates an autonomous system in the healthcare industry to decrease human effort. The main difficulties, however, reside in precisely measuring the health parameter, designing a wearable system, predicting a health condition, and putting the system in place in a way that allows different groups of people to use the service.

Currently, the Health-care Environment has organized information and science based on Wireless Sensing hub Technology [6]. Patients are dealing with an uncertain situation regarding the end of their prevision due to the specific explanation of cardiac problems and attacks, which is a result of the absence of successful treatment maintenance for patients at the necessary time. This is for specifically recognizing older patients, children, and informing specialists, friends, and family. Therefore, are considering a creative project to devise such unexpected passing rates using Patient Health Monitoring that utilizes sensor technology and utilizes the web to communicate with friends and family in the event of problems [7].

The analysis remaining sections are divided into the following sections: Section II discusses the literature review, described healthcare monitoring framework is presented in Section III, Section IV discusses on the result analysis and arguments, and Section V takes the paper to a conclusion.

II. LITERATURE SURVEY

Ibhaze, Augustus E, Ezimah C, Eleanor, Idachaba, and Francis Eet. al. [8] Elderly people's basic health metrics can now be measured using a new technology. When the patient's data exceeds a certain level, a system is also put in place to send a message, and the location is also sent to the doctor and caretaker by mobile phone via sim808 GPRS, GSM, or GPS.

Lo'ai A. Tawalbeh, Waseem Bakhader, Rashid Mehmood, Houbing Song et. al. [9] based on the Cloudlet concept, presents an effective and secure mobile cloud computing paradigm where users of mobile devices can connect directly to cloud resources utilizing less expensive technologies like Wi-Fi. The user will connect to the enterprise cloud once necessary and only if the service is not offered in the cloudlet. The proposed cloudlet-based architecture can be applied to a wide range of applications where efficiency and security are necessary. This model is more effective and trustworthy, according to the simulation findings, than alternative mobile computing models that don't make use of cloudlets.

Gope, Prosanta, Hwang, and Tzonelih et. al. [10] provides a body sensor network-based, secure Internet of Things-based healthcare platform. They utilized sensors such as blood pressure, EMG (electromyography), and ECG. Additionally, a mechanism for authentication is suggested to meet the security requirements.

IttipongKhemapech, et. al. [11] a new system named UbiNurSS - A Ubiquitous Nursing Support System - provides a Real-time Health Monitoring and Warning System. The UbiNurSS measures blood pressure and pulse using sensors. Also included was the Raspberry Pi, a more compact and inexpensive microprocessor. Real-time pulse report and warning generation is a possibility.

Alessio Botta, Walter de Donato, Valerio Persico, Antonio Pescap et. al. [12]focuses on the combination of IoT with cloud computing, the properties, attributes, and technical information required for both technologies are gathered. Most issues IoT devices encounter are caused by cloud computing. The differences and issues that arise while bridging the divide between cloud and IoT are compared.

Anurag, Sanaz Rahimi Moosavi, Tomi Westerlund,PasiLiljeberg,Amir-Mohammad Rahmani, Geng Yang, HannuTenhunen et. al. [13]highlights the use of two widely used wireless technologies, Wi-Fi and ZigBee, to develop IoT-based systems for remote health monitoring. This technique eliminates the need for specialized medical staff to monitor patients and enables patients to deliver high-quality healthcare while also leading regular lives. The authors address the acceptability of the abovementioned wireless communication technologies for various healthcare application domains after analyzing both architectures to determine their advantages and disadvantages.

Yunyong Guo, Mu-HsingKuo, Tony Sahama et. al. [14] describe key research tools for exchanging and merging health information in HC, and look at new issues and challenges. One of the Healthcare Cloud's (HC) long-standing objectives is cloud computing, which satisfies the demand for direct information sharing among various healthcare providers over the Internet. The authors outline a number of potential approaches to expand the options for EHR cloud implementation. Additionally, a collaborative healthcare research paradigm related to HC is developed and introduced, providing an example of how cloud computing will be used in future health informatics research.

Mina Deng, Milan Petkovic, Marco Nalin, Ilaria Baroni et. al. [15] works on a cloud-based healthcare solution for the home. It offers many use cases and designs a cloud-based architecture. The security and privacy engineering process is integrated into the software development lifecycle using a thorough approach. In particular, difficulties with security and privacy are found in the suggested cloud-based home healthcare system. The analysis concludes by discussing several mitigation strategies, with a particular emphasis on patient-centric control, policy enforcement through cryptographic technologies, and ultimately digital rights management and attribute-based encryption systems.

III. SMART HEALTHCARE MONITORING FRAMEWORK

The block diagram of smart healthcare monitoring framework using cloud computing and IoT design is represented in below Fig. 1.

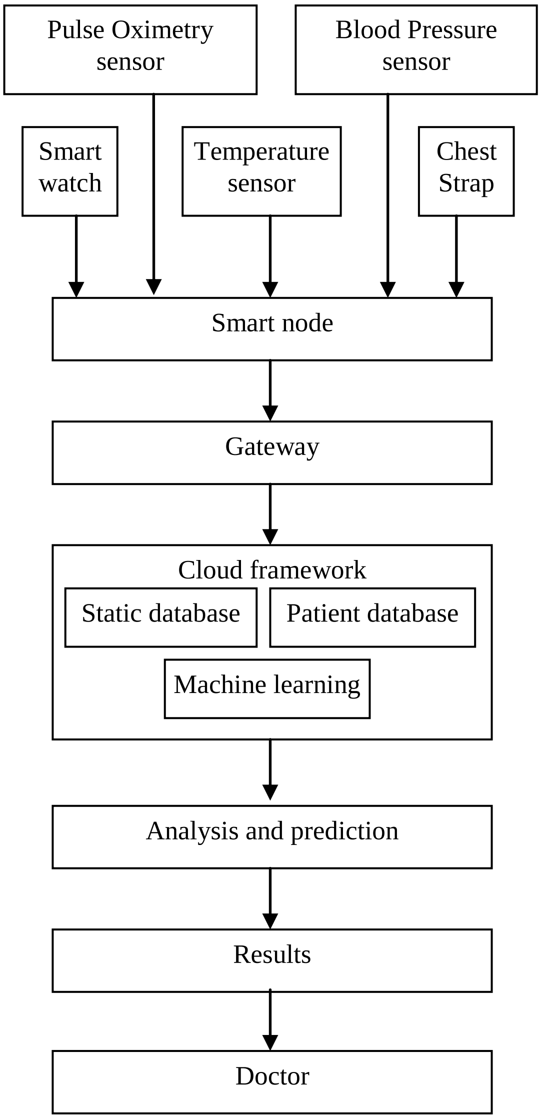

Fig. 1: SMART HEALTHCARE MONITORING FRAMEWORK

The developed model enhances health management and oversight with keeping monitors and other IoT devices compliant with the demands of cutting-edge clinical application. In order to do the same, it will be necessary to use a few of the devices that compensate the BAN in information processing processes like compressing and other procedures.

Modern smart gadgets that can detect and compute include smart watches, oximetry sensors, blood pressure sensors, and temperature sensors. These devices contain both the computational and physiological capabilities that are needed for new healthcare applications. It is possible to reduce the amount of power needed by the sensor device to transmit the detected data by using this technique to compress the data before sending it to the edge node. After that, a smart node will receive this small amount of processed data (may it be a smart phone, a laptop or a tab). A gateway, which serves as a mediator between sensor Shield and the Cloud platform, might be a router or a mobile phone personal hotspot. The sensor Shield and cloud server communicate through the HTTP

(Hyper Text Transfer Protocol) protocol to transfer data. Typically, a cloud server is a virtual computing server that users can connect to across a network. Operating systems (OSes) and different apps are integrated services that are provided by cloud servers. Data is then kept in a cloud database. This makes it possible for Cloud computing models like Software as a Service (SaaS) and Platform as a Service (PaaS) to have certain functionalities.

The data is packetized by adding headers like the user id, the first letters of the respective values, and f to indicate the end of the packet. The network is then used to transmit this data packet to the cloud. The packet will be delivered to the cloud, which will then extract its values. The database and CSV file will both store the values if they fall inside the defined range. Both the SQL (sequential) database and the static database, which simply stores the most recent entry for each user, exist. It will also appear on the patient's profile. After the patient or the doctor has given permission by logging into their account, the webpage that displays the patient data uses the data stored in the cloud. For the purpose of predicting future health conditions, this saved data is further examined and maintained.

The processing phase verifies that each parameter is within the predetermined range for each parameter. In the improbable event that the data falls inside the specified range, a report is generated for storage purposes. If the data is outside of the predetermined range, it indicates that the patient is in a critical or abnormal state and informs the physician. The specialist will evaluate the patient's treatment in perspective of the warning. On the cloud, the data is used for analytics and prediction. However, if it is outside of a specified distance, a doctor is informed about the patient's specific health situation. The remaining processing is completed here, and the doctors and medical personnel are then given the information through the internet. The smart-phone app can also be used to convey the patient's health information to verified family members and relatives, keeping them updated on the patient's condition.

The doctors can log in and view the patient's information with their login credentials. Doctors have access to all of a patient's medical history and can advise them on medications and medical advancements. Patients also receive a unique client id and password to access their records. The suggested system makes use of sensors to simultaneously detect the blood pressure, body temperature, heart rate, and amounts of oxygen in the patient's blood.

The method integrates the "items" of the Body Area Network (BAN) with computation, sensing, and some data processing at the BAN itself. As a result, this method integrates computation and sensing.

IV. RESULT ANALYSIS

The experiments and findings from this work are presented in this section. Software called LABVIEW is used to simulate the suggested design. Some of the outcomes have already been obtained while developing the model. To access the information, both the patient and the doctor must log into the system. Additionally, a new user can sign up by providing a username, email

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address, and password. After completing the authorization process, the user is logged into their account where they may view information about their profile, contacts, health condition, and entire day-by-day log. Based on the patient's medical history and the expected health state indicated on the left.

The performance of described Cloud and IoT based healthcare system is analyzed by using parameters as speed, Accuracy and backup data. The monitoring speed of described model is very fast compared to other monitoring tools, because the cloud will store the health data and transmits through IoT devices which show very fast and accurately to the specialized doctors or health care workers. Similarly doctor can see the patient previous health status through backup data at any time. This will helps a lot in particular emergency situations. Below Table represents comparative performance analysis of described model with monitoring model without cloud. Fig. 2 shows the graphical representation of comparative performance analysis.

Table 1: COMPARATIVE PERFORMANCE ANALYSIS

Parameters	Monitoring model without cloud	Monitoring model with Cloud+IoT
Speed	35 sec	12 sec
Accuracy	74%	95%
Backup data	Not possible	Possible

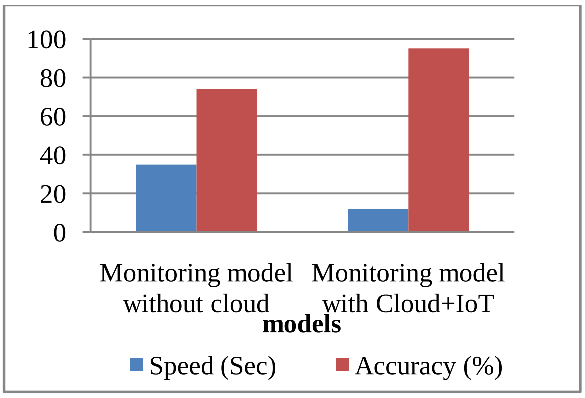

Fig. 2: COMPARATIVE PERFORMANCE ANALYSIS

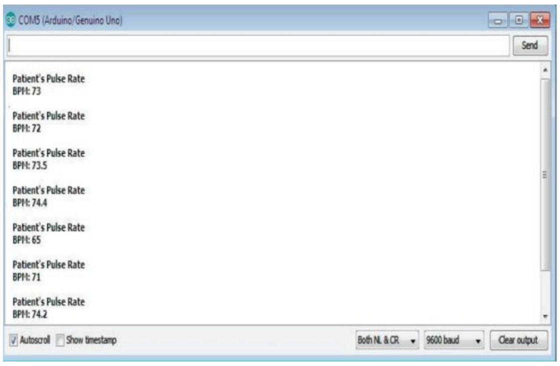

Fig. 3:BPM SIGNAL ANALYSIS

The patient, who is being watched, provided a heart rate of 121 BPM and an IBI of 1826 ms for this image. Data is gathered from the patient in two different states, one of which is relaxed and the other is stimulated. The calming mode position was recorded at 80–90 BPM, while the exciting mode which is linked to worry and stress was recorded at more than 120 BPM. Therefore, the final reading from the pulse sensor is displayed below.

One of the most important indicators of someone's health is their body temperature. Any changes in body temperature have an impact on blood circulation, which impacts heart rate. When the body temperature rises, the blood circulates around the body more quickly in an effort to return the temperature to a healthy rate. The body temperature fluctuation pattern while a patient was being observed is shown in the image below.

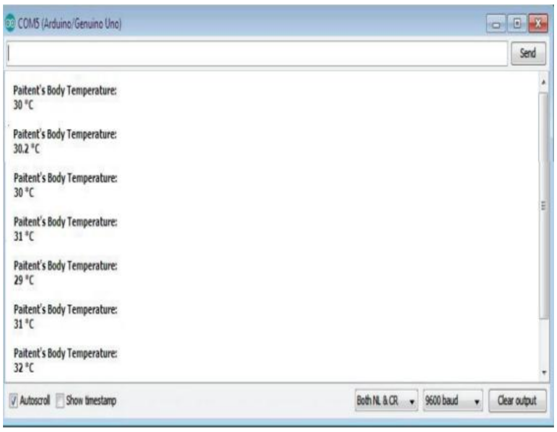

Fig. 4: READINGS FROM BODY TEMPERATURE SENSOR

The explanation of a rise in body temperature when the patients was under physiological stress, with environmental temperature also having an impact. The body temperature started to decrease to its appropriate level when the patient stopped moving and sat down to rest. Therefore, it is clear that when a patient's activity level significantly increases for any reason physical, psychological, or environmental their body temperature correspondingly changes, forcing their heart to beat more quickly or more slowly in order to change their blood circulation and return their body temperature to a healthy level.

Every time the sensor notices any large variations, the danger notification is enhanced and an SMS is sent to the physician. The suggested framework increases the usefulness of bio-sensor based data aggregation and collecting, which naturally results in higher performance and optimization by creating relatively low power signals that can prolong the lifetime of the BAN. Before they arrive at the emergency, the feature enables and diagnoses their patient and family members with the support of our project. Users are able to keep an eye on patients virtually without having to physically interact with them, opening up the possibility of virtual consulting.

V. CONCLUSION

In this analysis, the development of a smart healthcare monitoring framework that makes use of cloud computing and IoT is discussed. IOT-based cloud applications support patient health condition monitoring. It improves the quality of service by streamlining and optimizing the healthcare process. Different smart devices as smart watches, Oximetry sensor, Blood pressure sensor and temperature sensor are used in this monitoring method. HTTP (Hyper Text Transfer Protocol) protocol is used to transfer data from sensor Shield to Cloud server. From results it is clear that, performance of health monitoring system with cloud and IoT is better than health monitoring system without cloud in terms of Accuracy, speed and Backup data. This system's use can be extended to include persons with serious illnesses who require ongoing monitoring as well as elderly adults who require home care. This project’s feature informs and diagnoses the patient and their family members earlier to their arrival at the emergency.

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