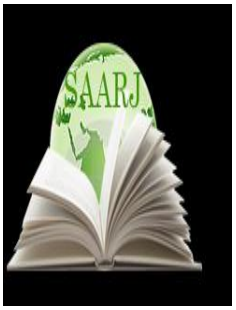

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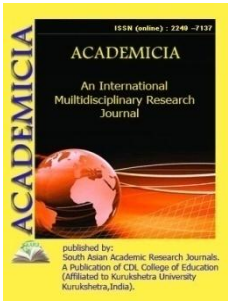

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SMART HEALTH CARE SYSTEM USING INTERNET OF THINGS

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ABSTRACT

Health is a fundamental need. It is also a human right to have access to high-quality health care. Due to a lack of resources, India is now dealing with a slew of health problems. This review article discusses the concept of utilizing cutting-edge technology, such as the Internet of Things, to solve health problems. It provides an architectural assessment of a smart health care system based on the Internet of Things that aims to serve everyone with high-quality health care. Patients' bodily parameters may be measured in real time using this system design. Sensors gather patient body characteristics and send them to an Arduino Uno, which then sends the data to the cloud via a Wifi module. This information is saved in a MySql database server, which handles information and makes it accessible. The Android App may be used to see this information. Which may be installed on a smartphone, tablet, or computer. Authentication, privacy, security, and data management are all handled via cloud computing. If the data is abnormal, the patient and caretakers will be notified through email. Different decision-making algorithms may be used to make choices, and individuals can access the database based on them. The patient has access to their medical records. As a result, this system offers everyone with high-quality health care as well as error-free and seamless contact with patients.

KEYWORDS: *Internet of Things, Cloud server, Patient, Monitoring, Smart Health.*

1. INTRODUCTION

In today's society, health monitoring is a significant issue. Patients suffer from severe health problems as a result of a lack of appropriate health monitoring. There are several IoT devices available these days to monitor a patient's health via the internet. Health professionals are also using these smart gadgets to keep tabs on their patients[1]. IoT is quickly changing the health care sector, thanks to a slew of new healthcare technology start-ups. In this project, we'll create

an IoT-based health monitoring system that monitors the patient's heart rate and body temperature and sends an email/SMS warning when those readings exceed crucial thresholds. Thing view records pulse rate and body temperature data so that patient health may be tracked from anywhere in the world through the internet[2]. A buzzer is connected to the kit near the patient so that the patient's family are aware of the patient's severe state. The suggested system is primarily designed for situations in which physicians and patients are separated by a significant distance, and it is critical to provide the doctor with complete information on the patient's heart rate and temperature.

In terms of obtaining medical data, IoT technology offers both possibilities and difficulties. Because the data utilized is massive (Big Data), computer resources are a problem. As a result, the data must be dispersed. Furthermore, since the data is diverse in nature and is dispersed, the software method to dealing with it is via the cloud computing platform. These are made to work along with the hybrid data. To cope with the heterogeneous data, a cloud platform has been created. For industrial applications, an IoT for health care data is utilized. Sensors are used to gather information. Data is gathered using a hard wired in evaluating operational performance, and the data is linked with the technician's measurements, allowing the performance to be reviewed and determined on the basis of data[1].

The Internet of Things (IoT) is a system of interconnected computing devices, mechanical and digital machines, livestock, or people with unique identifiers that connects any object to the Internet, performs information and correspondence exchange, and realizes object intellectualized recognition, localization, tracking, monitoring, and management. It provides services based on the integration of Information Technology (IT), which is the use of computers to store, retrieve, transfer, and modify data without the need for human-to-human or human-to-computer interaction. IoT is described as "a dynamic global network architecture with self-configuring capabilities based on standard and interoperable communication protocols where physical and virtual objects have identities, physical characteristics, and virtual personalities" in this context. The IoT idea may be brought to life in the real world by combining a number of promising technologies. IoT may include identification, sensing, and communication technologies. RFID tags that interact with IoT may be identified by a unique identifier and applied to items in terms of identification technology. RFID devices may be used to track things in real time, making RFID a viable option for a sophisticated healthcare system. In terms of sensing and communication technologies, wireless sensor networks combined with IoT may provide peer-to-peer communication, while other computing and communication options in a passive system are asymmetric. It is obvious that the Internet of Things may be used to detect and communicate for a better healthcare system[3].

As a result, our study uses the Internet of Things (IoT) to gather data using sensing technologies and to communicate in order to create a smart healthcare system. Rather of applying IoT to a specific job with a limited scope, IoT may be approached with a broad scope. The Service Oriented Architecture (SOA) often necessitates the use of middleware to bridge the gap between the technical and application levels. IoT may be linked to the development of a particular application in middleware architecture[3].

Despite the fact that many academics are working on IoT middleware, there is no general middleware that can be used across all conceivable smart devices, such as smart homes, smart

vehicles, smart hospitals, smart cities, and so on. Nonetheless, by expanding the scope of IoT, we want to offer a notion of a smart hospital in this research. The power of many kinds of systems. As a result, RFID sensor networks can support sensing, and this study uses machine learning to analyze big data stored in cloud computing, which is a model for providing a simple, ubiquitous, on-demand network approach to a shared pool of configurable computing environments with minimal management effort[3]. IoT sensing devices must gather data, connect networks to store data, and evaluate data as experts to support a truly smart healthcare system. Machine learning is required to transform data into knowledge. The use of machine learning models in the area of healthcare for human illness diagnosis aids medical personnel in identifying diseases based on characteristics that are visible to the patient. In the medical sector, machine learning may be used to convert human expertise knowledge and abilities acquired via clinical experience into application software. By using machine learning, software can make correct diagnostic and treatment choices, reducing the number of needless tasks for medical personnel. As a backdrop, we examine our past research in healthcare systems focuses on contemporary technology that may be used to improve the healthcare system in two ways: research and industry[4]. We provide the blueprints for our smart healthcare system concept. The logical architecture of IoT healthcare. For improved healthcare systems, technology and data processing technology may be key high technologies[5]. The Internet of Things (IoT) aims to connect a range of activities and items in the environment so that they may interact and conduct business "anytime, anywhere, with anything and anybody, preferably utilizing any route, network, or service." By incorporating IoT into a healthcare system, it is possible to expand healthcare systems.The Internet of Things (IoT) is a system that combines ubiquitous communication, connection, and computation with ambient intelligence[6]. It is a cyber-physical paradigm in which all real-world components may remain linked. The Internet of Things (IoT) allows people to organize their daily activities by integrating real-world components such as electronic gadgets, smart phones, and tablets that can interact both physically and wirelessly. The Internet of Things aids in the management of practically any number of devices. It seeks to bring the advantages of the internet, such as remote access, data sharing, and connection, to a variety of different application areas, including healthcare, transportation, parking, agriculture, and surveillance.

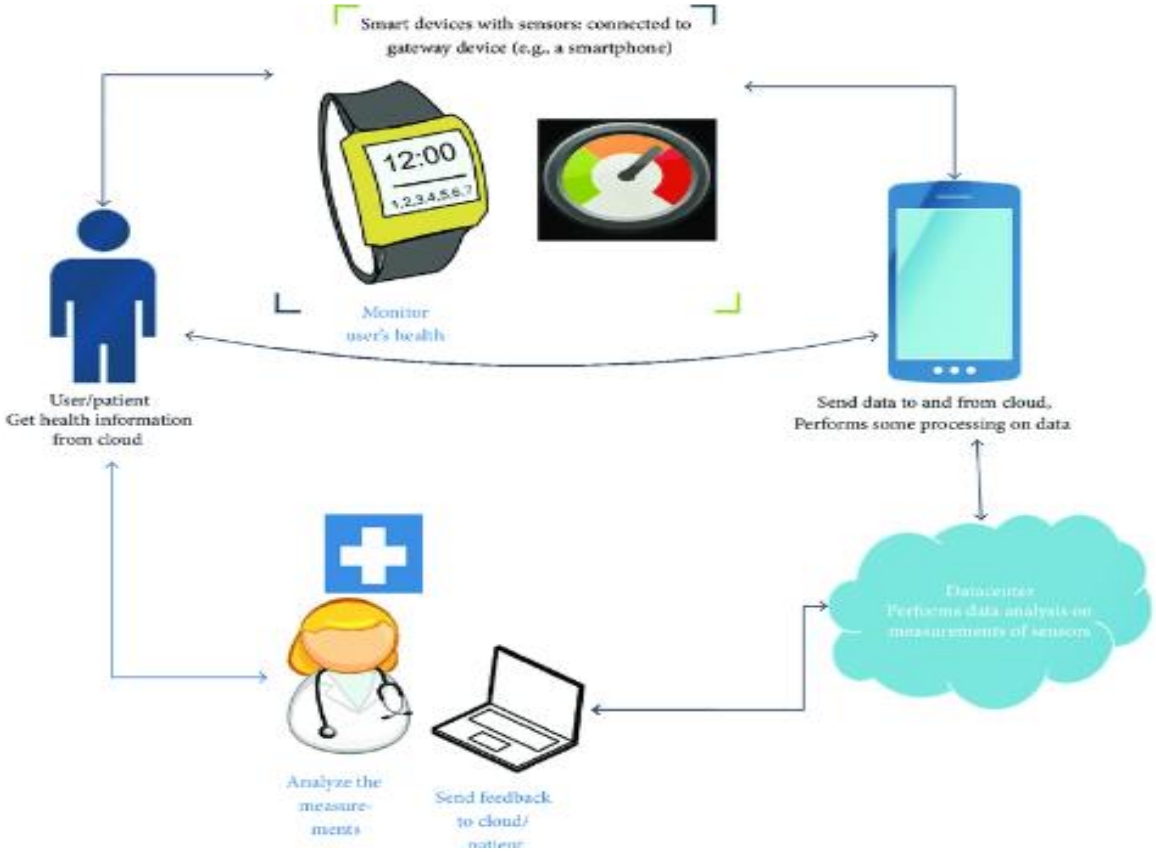

Figure 1: Diagrammatic Representation Of Smart Health Care System [RESEARCHGATE]

Using sensors, smart health monitoring devices assess the health status, such as pulse rate, body temperature, respiration rate, blood glucose rate, body posture, ECG and other factors. Various microcontroller-based systems, such as Arduino, Raspberry Pi, and others, are used to connect and operate the sensors. Sensors are used by the microcontroller to gather data. Typically, biological data is gathered and kept on servers. The gadget can determine if the patient's state is normal or abnormal based on the recorded data. This gadget gives physicians and medical assistants with real-time health care observation that they may access at any moment [7]. The device's primary benefit is its low power consumption, improved performance, great sensitivity, and ease of setup. By 2020, there are expected to be between 26 and 50 billion network-connected devices, with 100 billion by 2030. The Raspberry Pi is the most popular IoT platform. It's a low-cost Linux-based gadget. Raspberry Pi and the Internet of Things have ushered in a new age in healthcare systems. A Raspberry Pi may be turned into a mini-clinic using a combination of sensors such as a pulse rate sensor, temperature sensor, accelerometer, and respiration sensor. In many areas of the globe, these systems are in use . The primary controller of the systems is a microcontroller unit (MCU), however it does not allow parallel data processing.

The IoT is an important component of smart healthcare, since it provides significant advantages and characteristics such as identity, location, sensing, and connection. The Internet of Things

(IoT) may be used to create a smart healthcare system in a variety of ways, from calibrating medical equipment to creating a customized monitoring system. The Internet of Things (IoT) plays a major role in healthcare applications, ranging from controlling chronic illnesses on one end of the spectrum to tracking daily physical activity that may aid in achieving fitness objectives on the other[1]. The Internet of Things may be used to track medical equipment deliveries and oversee the manufacturing process. Medical data may be collected from users via IoT-based systems. The Internet of Things serves as a link between the doctor and the patient by allowing remote access, which allows the doctor to keep an eye on the patient and provide remote consultations. The Internet of Things (IoT) combines sensors, actuators, microcontrollers, CPUs, and cloud computing to provide precise findings and make healthcare accessible to everyone. The use of the Internet of Things in healthcare has prompted researchers all around the globe to develop potential frameworks and technologies that may offer everyone with convenient medical help. In addition to improving the user experience, the Internet of Things pushes the industry to automate, allowing for more research to be conducted across many platforms. A sensor/actuator, a local area network (or, in some cases, a body area network), the internet, and the cloud are all essential components of the IoT in smart healthcare. The specifications of each of these four essential components may vary greatly depending on the application and needs of the particular healthcare system.The term "smart health" refers to the use of various biometric sensors to collect human bodily data. And that sensor data may be utilized to offer smart health in a variety of ways.

- Smart health is a result of the internet of things, and the emphasis is on increasing operational efficiency and creating a cost-effective system while preserving quality, providing health records, and protecting data privacy. As a consequence, consumers get high-quality health care[8].
- One may access his or her medical data and get understanding of their physical fitness by using smart. In this area, several mobile apps and notifications are also utilized to provide alerts when data is aberrant[9].
- The pathway for smart health care is shown in the diagram below.The cloud is utilized to send data from the sensor to the patient, health care practitioner, or caretaker, who can then access the data and check on the patient's health condition[10]. Smart health care enables two-way communication between the patient and the caregiver or provider of health care.

Figure 2: Diagrammatic Representation of Pathway of Smart Health Care System [RESEARCHGATE]

1.1 Component of smart health care system:

- *Intelligent Network:* IoT-driven sensors gather real-time monitoring data from smart sensors as part of the data collecting function. Sensor technology advances in the handling of data in bio optic sensors. EEG biotelemetry, ECG sensor, cardiac bit rate sensor, blood pressure monitoring, glucose monitoring, virus monitoring, and a healthcare watch are just a few of the features available. The Wireless Sensor Network (WSN) is a critical component of the IoT HEALTHCARE intelligent network. WSN technologies based on IP may be a viable option for common items. Any item, such as sensors, computers, RFID tags, or smart phones, will be able to dynamically join to the network, communicate, and cooperate effectively to accomplish various tasks when given a unique address. To be effectively controlled and maintained, the data gathered from the sensors should be accessible in cloud computing systems. As a result, data from sensors that are remotely dispersed is manipulated by a single point of software. Furthermore, industrial operations need the use of wireless communication systems to send signals obtained by distant sensors monitoring the control loop (due to the hostile environment and difficult access to the locations). This is why the study, design, and development of a remote wireless system for an industrial process have already been completed28. The communication of information technology devices within the range of a personal space, usually within a range of about 10 meters, is known as a personal area network (PAN). PAN is a helpful tool for tracking the movements of elderly individuals. To create an intelligent network for IOT HEALTHCARE, WSN, PAN, and a generic network are sufficient.
- *Cloud Computing:* Cloud computing, often known as on-demand computing, is a kind of Internet-based computing environment that allows computers and other computing resources to access shared processing devices and data on-demand. Through virtualization, dynamic data integration, and integrating data from many, the cloud computing paradigm offers

flexible, dependable, and powerful storage and computing resources that enable high scale computation. Cloud computing's main aim is to provide scalable and easy-to-use computer resources and IT services. It is difficult to exchange patient data in a specific hospital since the data format is incompatible with others. Exams must be repeated if a patient has to be transferred to another hospital. It's a waste of time and money. As a result, hospitals must exchange patient information in a secure manner. Furthermore, each hospital is not required to retain all raw data gathered in order to evaluate a patient's condition. As a result, cloud computing is the best solution for a storage system in IOT HEALTHCARE.

- *Data Analysis:* Machine learning is used by the data analysis module. The science of teaching computers to behave without being explicitly programmed is known as machine learning. Machine learning has given us clever cars, practical speech recognition, efficient online search, and a far better knowledge of how to maximize a performance criteria using example data or previous experience. Machine learning must be used to summarize relevant results from stored data; otherwise, computers would spend processing time dealing with insignificant data. Machine learning is accelerated by improved data collecting, networking, and faster computers, while human specialists struggle to extract information from vast amounts of data. The degree of dependability in the analysis results is improved by using an algorithm approach. Figure 5 depicts the algorithm's approach. Because the definition of "enough data" is unclear, it is considered a condition of enough data if it has been recognized as a successful practice for more than three times. The study' findings help the system offer real-time advice and warnings to medical personnel and assistants about changes in vital signs or patient transitions, as well as significant changes in environmental factors, so that preventive treatment may be provided.

DISCUSSION

A smart health monitoring system based on the Internet of Things (IoT) is a patient monitoring system that can monitor a patient 24 hours a day, seven days a week. In today's world, the Internet of Things (IoT) is transforming the technological infrastructure. IoT has allowed us to implement many complicated systems such as smart home appliances, smart traffic control systems, smart office systems, smart environment, smart cars, and smart climate control systems in very little area by enabling easy interaction among different modules. One of the most well-known IoT applications is health monitoring. Many different designs and patterns have previously been developed to use IoT to monitor a patient's health. A review of IoT-based smart health monitoring systems is given in this article. The newest novel technologies created for IoT-based smart health monitoring systems have been addressed, along with their benefits and drawbacks. The goal of this study is to identify common design and implementation trends for intelligent IoT-based smart health monitoring devices for patients.

CONCLUSION

It has been outlined how IoT is being used in health monitoring systems. Despite the fact that IoT is being utilized in all areas of medical science, there is always space for development and study. Early detection of any health issue may assist the patient in taking the required emergency steps, which may save his or her life. In this case, the Internet of Things (IoT) may assist. Patients may be monitored in real-time by IoT-based health monitoring devices, which can alert

them to any anomalies. However, the IoT architecture must include features that guarantee sensitive data is kept secure. In addition, the sensors utilized must be small enough to be readily integrated into a variety of systems. Finally, the application of different machine learning and deep learning methods may improve the accuracy and robustness of the systems. The concept of a smart health monitoring system based on IoT architectures is a new addition to medical research that will help to decrease health problems and prevent unnecessary deaths.

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