DESIGN AND IMPLEMENTATION OF IOT BASED HEALTHCARE MONITORING SYSTEM FOR RURAL AND URBAN AREAS

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ABSTRACT

The adoption of Internet of Things (IOT) has revolutionized the way that the healthcare has great potential and enhanced a remarkable impact on both rural and urban settings. Our study introduces a inventive health monitoring platform harnessing the power of the Internet of Things (IOT). This system utilizes interconnected devices to gather, transmit and analyse health data in real time, both online and offline, from any location. By integrating IOT technology with healthcare services, our solution enables continuous monitoring of individual health parameters such as Pulse sensor, ECG sensor, DHT11 sensor, Air Quality sensor. Utilizing ESP32 microcontroller and GSM modules, the system can transmit sensitive health information to medical centres and caregivers promptly, facilitating immediate attention in case of abnormalities. The system stores the information on a centralized server named ThingSpeak which is an analytics platform service that allows you to aggregate, visualize and analyse live data streams in the cloud. Additionally, it offers access to patient's historical health records, empowering healthcare professionals to deliver personalized care and timely interventions. With its adaptability and potential impact, this system holds promise for both rural and urban areas in developing nations.

Keywords: Internet of Things, Sensors, ESP32 microcontroller, ThingSpeak server.

I. INTRODUCTION

In today's landscape, the Internet of Things has become increasingly pervasive, revolutionizing various aspects of daily life. IOT refers to the network of interconnected devices embedded with sensors, software and also other technologies that enable them to collect and exchange data over the internet. IOT technology facilitates seamless communication and automation, allowing for enhanced efficiency, convenience and productivity across diverse sectors. In homes, IOT devices enable remote control of appliances, energy management and security monitoring. In healthcare, IOT enables real time patient monitoring, personalized treatment and predictive maintenance of medical equipment. In agriculture, IOT facilitates precision farming through soil monitoring, irrigation control and livestock tracking. As IOT continues to evolve in this world, advancements in connectivity, data analytics and artificial intelligence further expand its capabilities and potential applications, driving innovation and transformation across various industries and sectors. Healthcare monitoring systems have been one of the most important system in the last decade, and they have become increasingly technological. Humans are facing various issue and untimely death due to multiple illness, and also lack of medical treatment for patients. To overcome this issue a real time health monitoring system has proposed based on IOT. The proposed system consists of GSM for continuous wireless monitoring of patients. The main aim is to create a dependable patient management system based on IOT so that healthcare professionals can monitor their patients who are either hospitalized or at home using an IOT based integrated healthcare system to ensure quality patient care. Sensors are used to track vital parameters, and the data collected by the sensors is sent to the cloud via WiFi module. A wireless healthcare monitoring system has created that can provide real time online information about patient's conditions. The system is made up of sensors, ESP32 microcontroller and software. The patient's temperature, room temperature and humidity, pulse rate, ECG and air quality are regularly monitored, displayed and stored by the system itself. Thus, IOT based real time health monitoring system systematically monitor the condition of patient's health and save their life on time.

II. LITERATURE SURVEY

Reddy, G. K. Achari, K.L. A healthy adult typically has a heart rate ranging from 60 to 100 beats per minute. On average, males have a pulse rate of 70 beats per minute, while females average around 75 beats per minute. Females aged 12 and above generally exhibit higher heart rates compared to males [2].

P.K. Sahoo, S. K. Mohapatra. In [5], it delved into the healthcare management system, focusing on the extensive patient data derived from diverse reports. Their analysis extended to health metrics for forecasting the future health status of patients or subjects. This was facilitated through a cloudbased big data analytics platform, employing probabilistic methods.

Kumar,R.Rajasekaran Raspberry Pi is the most common platform for IOT. It is a Linux-based low-cost device. Raspberry Pi and IOT have collectively ushered a new era in the field of healthcare systems. With the combination of sensors such as pulse rate sensor, temperature sensor, accelerometer, and respiration sensor, a Raspberry Pi can be transformed into a mini-clinic. These systems are being used in many parts of the world [8].

Kong, X., Fan,B., Nie, W., Ding, Y. Nowadays due to wide spread in mobile internet access, the combination of health service system with mobile internet using android open- source design has become very easy [11].

S. Tyagi, A. Agarwal, and P. Maheshwari. The role of IOT in healthcare and technical aspects to make it reality and identify the opportunities in which the medical data and information can be securely transferred, with the permission of patient and their family by building a network among the patient, hospital, doctors. The primary reason is to relieve patient from expensive clinical aid, overcome the shortage of doctors and therefore providing enhanced care and service to patients [15].

III. METHODOLOGY

The vital purpose of the proposed system is 24/7 continuous and monitors both health and room condition parameters of the patient with or without Wi-Fi. The patient, guardians, and medical professionals will have access to supervise the patient's health information within our system. The device sensors gather various body and environmental data from the patient and transmit it to the processing unit. We've prioritized key health parameters for prevalent health issues, including temperature and humidity, pulse rate, ECG and Air Quality. After processing, the health records are shown on the device and regularly sent to an cloud server via Wi-Fi from the processing unit. The server stores the data in a patient database and also the patient's location if necessary.

A block diagram depicted in figure 1,provides a visual representation of the system's overall operation, illustrating the flow of data from the patient's body or surroundings to the end user responsible for monitoring the health records.

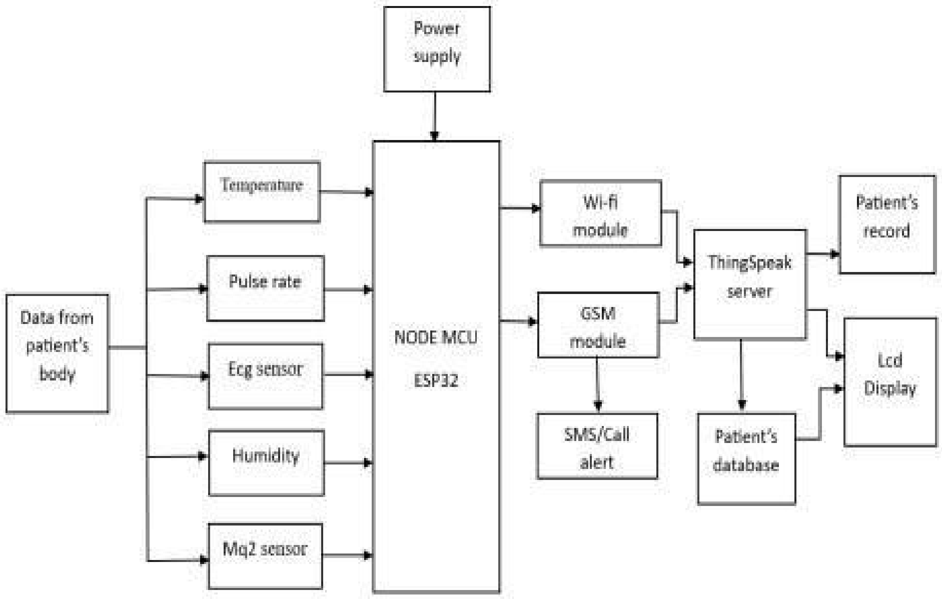

Fig.1. Block Diagram of the proposed system

In a typical health monitoring system utilizing ESP32 ,a range of sensors is integrated to captured data on vital health parameters such as temperature, pulse rate, humidity, ECG, and air quality. This data is processed and used to measure and display key metrics like temperature, humidity, ECG, air quality, and heart rate of the patient. The ESP32 microcontroller facilitates Wi-Fi connectivity, enabling the transfer of health information to a server. ThingSpeak, an open-source IoT application and API, serves as the platform for storing and retrieving data over the Internet or local networks. This IoT device captures pulse rate, ECG values, surrounding temperature, humidity, and air quality, updating them to the IoT platform. The Arduino Sketch running on the device manages various project functionalities, including reading sensor data, converting it into strings, transmitting it to the IoT platform, and displaying pulse rate and temperature on a character LCD. To access data on ThingSpeak, an API key must be generated for programming adjustments and data configuration. After assembling the circuit, the code is uploaded to the ESP32, and upon opening the serial monitor, automatic Wi-Fi connection and setup occur. Users can then view real-time data streaming by accessing channels on the ThingSpeak platform.

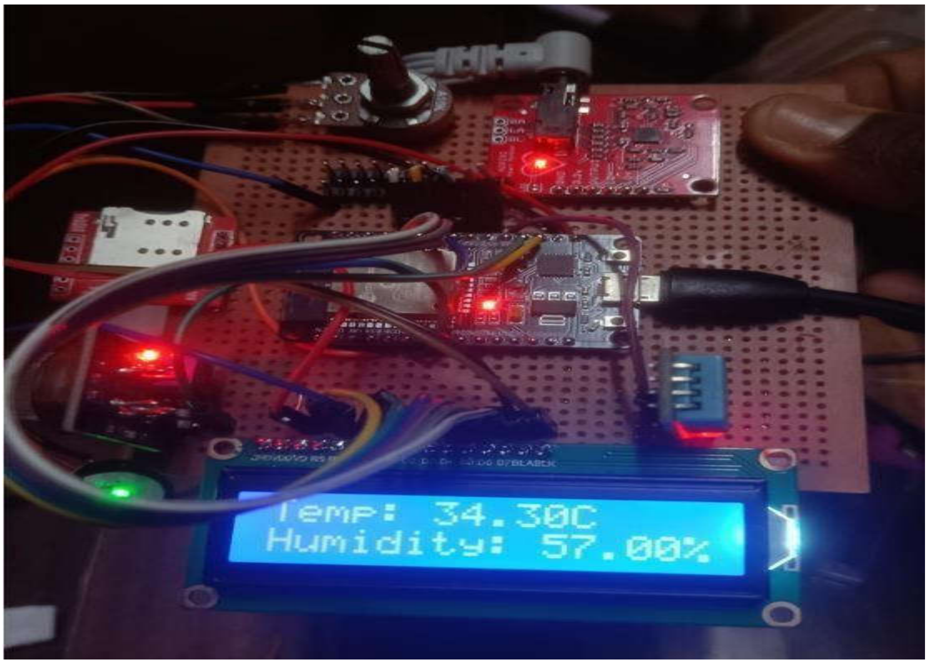

Fig.2. Internal Hardware setup

IV. RESULTS

The data obtained from the sensors and IOT platforms are suggested for system efficiency and reliable accuracy. Human sensor data in IOT is sent to the Thingspeak server with the internet.We have created an effective healthcare service that provides numerous opportunities. In this platform,we can observe vital information for the requirement specification during emergency conditions.

Fig.3. Thingspeak Platform

For further implementation of health care monitoring system, we have to add visualizations and create widgets in the Thingspeak platform. After creating widgets, source code is uploaded in the Arduino IDE. Now the code is successfully compiled and we have to upload the code to the ESP32 board.

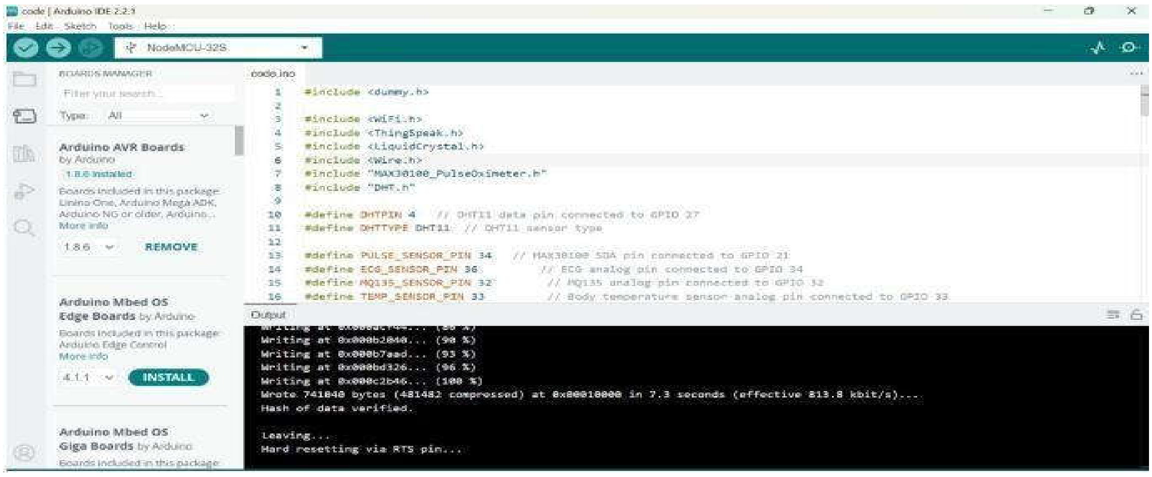

Fig.4. Uploading source code to the ESP32 board

When the code is uploaded to the ESP32 board ,connect the software code to the hardware through a uSB cable. After they are interconnected with each other ,the LCD display and the other sensors starts accepting the input from the user.

Fig.5. Overall setup of Hardware

Then the user starts checking his health condition using this health monitoring system by different sensors embedded in the hardware. Through the pulse sensor, we can check the pulse rate of the patient and the pulse rate is itself displayed on the LCD and also on the Thingspeak server. It is an IOT platform that allows us to visualize and analyse real time data and the data is stored for further analysis.

Fig.6. Checking Pulse rate

Fig.7. Pulse rate in Thingspeak

The same process is continued for measuring the Temperature and humidity (DHT11), ECG and Air Quality sensors. The patient's data is displayed and monitored on the LCD display and also on the Thingspeak channel and data is also stored for further analysis. Additionally, it also stores the historical health data of the patient for further proceedings.

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Fig.8. Checking Temperature and Humidity

Fig.9. Temperature in Thingspeak

Fig.10. Humidity in Thingspeak

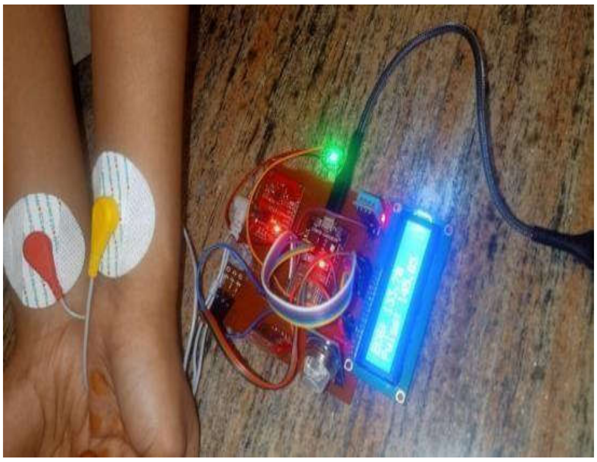

Fig.11. Checking ECG of patient

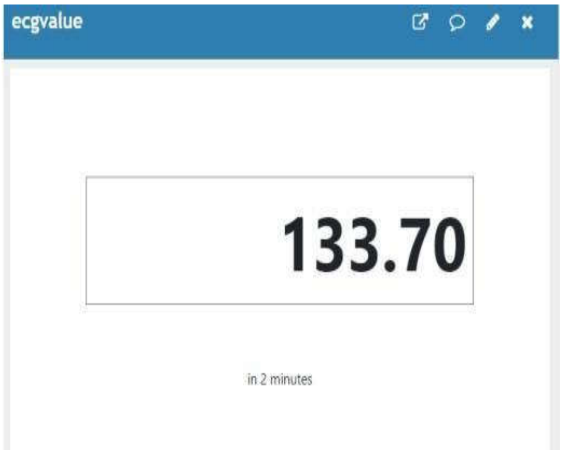

Fig.12. ECG value in Thingspeak

Fig.13. Detecting Air Quality

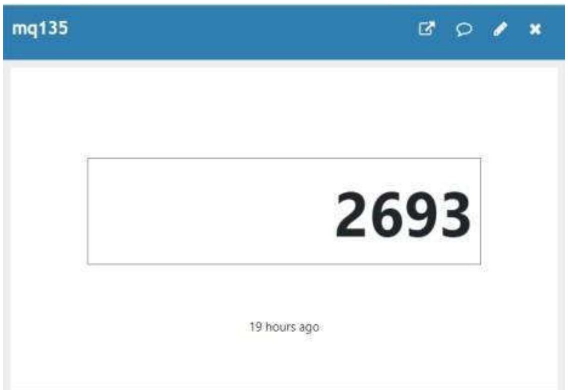

Fig.14. Air Quality in Thingspeak

V. CONCLUSION

Our envisioned health monitoring system aims to continuously update health parameters onto an IOT platform, offering significant benefits to both rural and urban areas. Given the distance from hospitals in these regions, our system addresses potential delays in emergency situations by enabling access to patient health data from anywhere. Utilizing the open source IOT platform ThingSpeak, our system allows patients, their guardians, and doctors to retrieve vital health information conveniently. With sensors measuring temperature and heart rate, data is seamlessly transmitted to the ThingSpeak web server, where it can be visualized through graphs and charts. Any deviations in parameter values prompt immediate monitoring by healthcare professionals or guardians. In essence, our solution presents a cost-effective and user-friendly approach to health monitoring, bridging the gap between patients and healthcare providers through IOT integration.

VI. REFERENCES

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