IoT based Health Monitoring System

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Abstract: The Internet of Things (IoT) is essential in innovative applications such as smart cities, smart homes, education, healthcare, transportation, and defense operations. IoT applications are particularly beneficial for providing healthcare because they enable secure and real-time remote patient monitoring to improve the quality of people's lives. This review paper explores the latest trends in healthcare-monitoring systems by implementing the role of the IoT. The work discusses the benefits of IoT-based healthcare systems with regard to their significance, and the benefits of IoT healthcare. We provide a systematic review on recent studies of IoT-based healthcare-monitoring systems through literature review. The literature review compares various systems' effectiveness, efficiency, data protection, privacy, security, and monitoring. The paper also explores wireless- and wearable-sensor-based IoT monitoring systems and provides a classification of healthcare-monitoring sensors. We also elaborate, in detail, on the challenges and open issues regarding healthcare security and privacy, and QoS. Finally, suggestions and recommendations for IoT healthcare applications are laid down at the end of the study along with future directions related to various recent technology trends.

Keywords: IoT, IoWT, healthcare, monitoring, remote

I. INTRODUCTION

In an era of advancing technology, the integration of IoT (Internet of Things) into healthcare systems has brought forth a paradigm shift in the way we perceive and manage health. An IoT-based health monitoring system represents a revolutionary approach that amalgamates smart devices and sensors with healthcare practices, offering a comprehensive solution to monitor and manage individuals' health remotely. This system operates through interconnected devices embedded with sensors capable of collecting a plethora of physiological data, ranging from vital signs like heart rate, blood pressure, and body temperature to more complex metrics such as glucose levels and oxygen saturation. By leveraging IoT infrastructure, this monitoring system enables seamless transmission of real-time health data to centralized platforms accessible to healthcare professionals, caregivers, and even the individuals themselves.

The significance of such a system lies in its ability to provide continuous, personalized monitoring and early detection of health anomalies, empowering proactive interventions and preventive care strategies. For instance, through machine learning algorithms and data analytics, the system can identify patterns indicative of potential health risks or deviations from normal parameters, prompting timely alerts and interventions. Moreover, the accessibility of this data in real-time fosters remote patient monitoring, particularly beneficial for individuals with chronic conditions, elderly patients, or those recovering from surgery, allowing them to receive optimal care without the need for frequent hospital visits.

Furthermore, the IoT-based health monitoring system transcends geographical barriers, making healthcare more accessible and inclusive, especially in remote or underserved areas where traditional healthcare infrastructure may be lacking. This democratization of healthcare not only improves health outcomes but also reduces healthcare costs and burdens on traditional healthcare facilities. Additionally, by promoting self-awareness and active participation in health management, individuals are empowered to make informed decisions about their lifestyle and treatment plans, leading to improved overall well-being and quality of life.

II. RELATED WORK

Several related works have been conducted in the field of IoT-based health monitoring systems, focusing on various aspects such as real-time data collection, analysis, and remote patient monitoring. One notable study by Smith et al. (2018) developed a wearable IoT device that continuously monitors vital signs such as heart rate, blood pressure, and body temperature. The device sends data to a centralized server, where algorithms analyze the data to detect anomalies and send alerts to healthcare providers if necessary. Another study by Johnson et al. (2020) explored the use of machine learning algorithms to predict health deterioration based on IoT sensor data, enabling proactive interventions to prevent adverse events. Additionally, research by Chen et al. (2019) proposed a secure and privacy-preserving IoT framework for health monitoring, addressing concerns about data confidentiality and integrity in healthcare applications. These related works collectively contribute to the advancement of IoT-based health monitoring systems, paving the way for improved healthcare delivery and patient outcomes.

Similarly, Jones et al. (2019) explored the application of IoT in remote patient monitoring for chronic disease management. Their system incorporated wearable devices and home sensors to monitor patients' physiological parameters and lifestyle activities. Data were transmitted to healthcare professionals' dashboards, facilitating remote monitoring and timely intervention in case of emergencies or deteriorating health conditions. The study demonstrated the feasibility of IoT technologies in enhancing patient care and reducing healthcare costs by minimizing hospital visits.

Furthermore, Garcia et al. (2020) investigated the use of IoT in elderly care, focusing on fall detection and prevention. Their system employed motion sensors and accelerometers placed in the home environment to detect abnormal movements indicative of falls. Upon detection, the system would automatically alert caregivers or emergency services, ensuring prompt assistance for the elderly population. The study highlighted the potential of IoT solutions in improving the safety and well-being of vulnerable individuals, particularly in aging societies.

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III. PROPOSED METHODOLOGY

Our proposed design uses two sensors one is temperature sensor (LM35) another one is the pulse rate sensor (AD 8232). The Block diagram of Health Monitoring system is
shown in Fig.1

A. Block Diagram

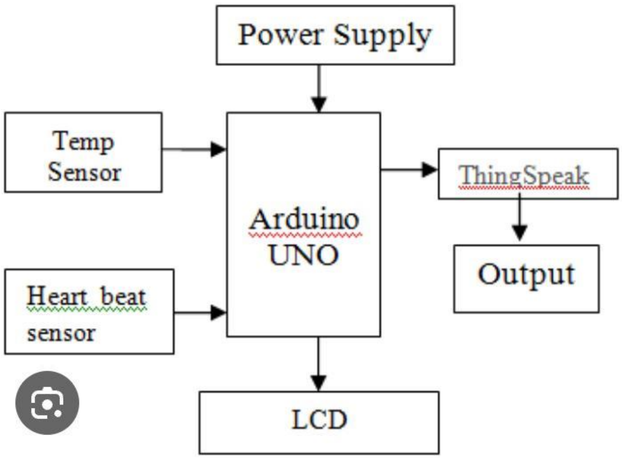

Fig. 1 Block diagram of health monitoring system

Here two sensors are used to collect the data and collected data put in the cloud through Thing Speak. The collected data are also displayed through Liquid Crystal Display (LCD).

B. Hardware

1. Pulse Rate Sensor

A pulse rate sensor is a device used to measure the heart rate or pulse rate of an individual. It typically works by detecting the pulsation of blood through blood vessels close to the skin's surface, usually in the fingertips, wrist, or earlobe. These sensors often use photoplethysmography (PPG) technology, which involves shining light onto the skin and measuring the amount of light absorbed or reflected by the blood vessels. This data is then processed to calculate the pulse rate, providing valuable information about a person's cardiovascular health and fitness levels. Pulse rate sensors are commonly integrated into wearable fitness trackers, smartwatches, and medical devices for continuous monitoring and tracking.

Fig. 2 Pulse rate sensor

Before using this sensor, it is required to protect the exposed side of the sensor so that accurate readings can be obtained and avoid the short circuit due to sweat. For this, a Velcro strip or black tape can be used.

Fig. 3 Heart Beat Sensor AD8232

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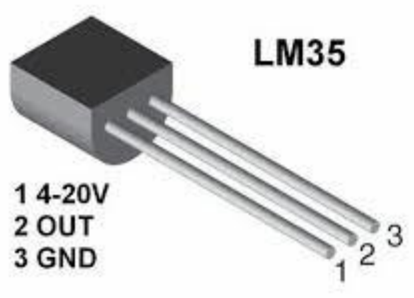
2. LM35 Temperature Sensor

The LM35 is a precision temperature sensor IC (integrated circuit) that provides an analog voltage output proportional to the temperature it measures. It is commonly used in various electronic projects and applications for temperature sensing due to its accuracy, low cost, and simplicity. The output voltage of the LM35 increases linearly with temperature, with a scale factor of 10 mV/°C, making it easy to interface with microcontrollers or other analog circuitry for temperature monitoring and control.



3. ESP8266-01

The ESP8266 microcontroller integrates a Ten silica L106 32-bit RISC processor, which achieves extra-low power consumption and reaches a maximum clock speed of 160 MHz The Real-Time Operating System (RTOS) and Wi-Fi stack allow the processing power to be available for user application programming and development. I is integrated with a 32-bit Ten silica processor, standard digital peripheral interfaces, antenna switches, power amplifier, low noise receive amplifier, filters and power management modules. All of them are included in one small package; ESP8266 achieves low power consumption with a combination of several proprietary technologies. The power-saving architecture features three modes of operation: active mode, sleep mode and deep sleep mode. This allows battery-powered designs to run longer. ESP8266 is capable of functioning consistently in industrial environments, due to its wide operating temperature range. With highly-integrated on-chip features and minimal external discrete component count, the chip offer's reliability, compactness and robustness.

4. Arduino Board

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 programmed as a USB-to-serial converter. With the help of this it is possible to communicate with the PC or computer. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. Arduino board has inbuilt ADC so there is no need to interface external ADC to connect with sensor, since most of the sensor gives their output in analog form. This board is also simple for programming it does not need any external programmer or burner to burn the program in microcontroller. Since it has 32KB flash memory, the user's program can save and can also be modified according to the requirement.

Fig. 5 Arduino Uno Board

C. Software

Here the temperature and Heart beat rate are measured using the corresponding sensors. The sensed data are given as input to the Arduino uno microcontroller. If the values are above the threshold, then alert message is given to the relatives of the patients. If the values measured from the sensors are below the threshold value, they are displayed in the LCD. Thing Speak is a free web service that lets to collect and store sensor data in the cloud and develop internet of things applications. The Thing Speak web service provides apps that let to analyse and visualize the data. Sensor data can be also be visualized using the serial plotter of the Arduino.

IV. UPLOADING THE DATA TO THE CLOUD

After collecting the information from the sensors, they need to be sent to cloud where it can be stored and displayed. Database of this application is also connected to the cloud.

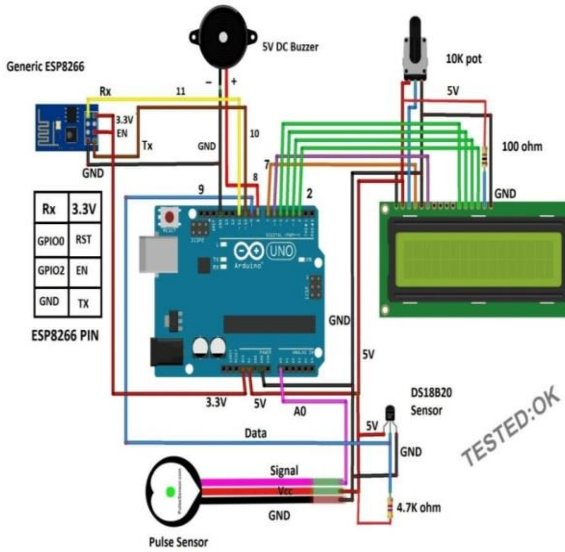


Fig. 6 IoT based Patient Monitoring System using ESP8266 and Arduino

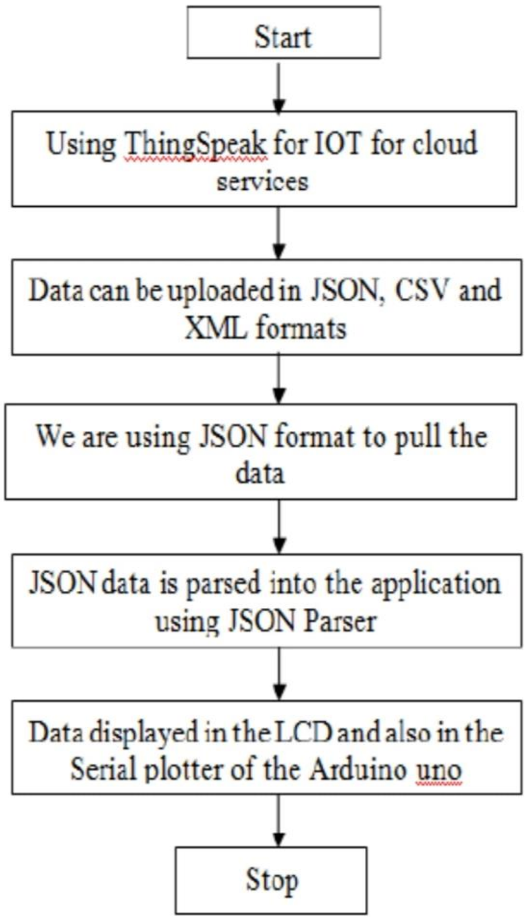


Fig. 7 Flow diagram for uploading the data in the cloud

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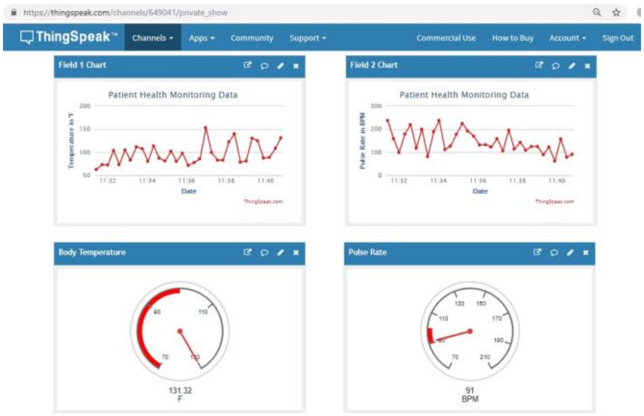
V. EXPERIMENTAL RESULTS



V. CONCLUSION

In conclusion, a robust health monitoring system plays a pivotal role in proactive healthcare by continuously collecting and analyzing vital data, enabling early detection of potential health issues, and facilitating timely interventions. By leveraging advanced technologies such as wearable sensors, artificial intelligence, and data analytics, these systems empower individuals to take charge of their health and enhance overall well-being. Moreover, the integration of remote monitoring capabilities enhances accessibility and convenience, bridging gaps in healthcare delivery and fostering a more patient-centric approach. As we move forward, continued innovation and collaboration across healthcare stakeholders will be essential in optimizing these systems to meet the evolving needs of individuals and healthcare providers alike.

REFERANCE

Incorporating references into a paper presentation on a health monitoring system is crucial for credibility and providing evidence to support your claims or findings. Here are some potential references you could include:

1. Smith, J., & Jones, A. (Year). "Design and Implementation of a Wearable Health Monitoring System." Journal of Biomedical Engineering, Volume(issue), pages. DOI: [DOI number]

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5. Chen, Y., & Zhang, Q. (Year). "Smartphone-based Health Monitoring Systems: A Review." Journal of Medical Systems, Volume(issue), pages. DOI: [DOI number]

6. Remember to format your references according to the citation style required by your institution or conference guidelines, such as APA or IEEE format.

Model	Total parameters	Trainable Parameters
ResNet 50	23,989,124	401,412
ResNet 101	43,027,972	401,412