# SMART HEALTH MONITORING SYSTEM USING IOT

**A Project Work Synopsis**

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## BACHELOR OF ENGINEERING

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# ABSTRACT

This project describes the creation of an Internet of Things-based smart health surveillance system that allows for the real-time data tracking of a person's vital signs. An ESP8266 Node MCU microcontroller is integrated with temperature, humidity, and heart rate sensors in the system to gather information on the user's body temperature, ambient humidity, and heart rate. A specially created Android mobile application shows the gathered data, which is wirelessly sent to a Firebase cloud database. With the use of the mobile app, users can easily create individualized profiles, view vital sign data, and get warnings. Early health issue diagnosis and proactive illness management are aided by successful implementation, which shows that low-cost IoT devices, cloud computing, and mobile technologies may all be used for effective remote health monitoring.

Keywords - Heart Rate, Temperature, Sensors, Smart Health Monitoring, Internet of Things, Humidity.

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# 1. INTRODUCTION

The incorporation of IoT technology in healthcare systems provides a promising solution to the limitations of conventional monitoring methods. IoT-based health monitoring systems leverage networked sensors, wearable devices, and data analytics platforms to collect, transmit, and analyze health data in real-time. This continuous stream of data offers valuable insights into patients' physiological characteristics, enabling healthcare practitioners to take proactive measures and tailor treatment plans according to individual needs.

This project explores the seamless integration of IoT technology with basic IOT sensors in smart health monitoring systems. It delves into the core concepts of sensor technology, data acquisition processes, communication protocols, and data analytics techniques employed in IoT-based health monitoring platforms.

## 1.1. PROBLEM DEFINITION

In today's fast-paced world, the prevalence of lifestyle-related health issues and chronic diseases has increased significantly. Monitoring vital signs such as body temperature, heart rate, and humidity levels plays a crucial role in early detection and proactive management of various health conditions. However, traditional methods of monitoring these parameters often require frequent hospital visits or the use of expensive medical equipment, making it inconvenient and inaccessible for many individuals. The Smart Health Monitoring System using IoT aims to address this challenge by providing a cost-effective and user-friendly solution for continuous remote monitoring of vital signs.

## 1.2. PROJECT OVERVIEW

In recent years, the merging of healthcare and technology has given rise to innovative solutions aimed at revolutionizing traditional healthcare delivery models. Among these technological advancements, the incorporation of Internet of Things (IoT) technology into healthcare systems has emerged as a promising frontier, offering unparalleled opportunities to enhance patient care, improve clinical outcomes, and optimize resource utilization. One of the most significant applications of IoT in healthcare is the development of smart health monitoring systems, which utilize interconnected devices and data analytics to enable continuous and personalized healthcare delivery.

## 1.3. REQUIREMENTS

**Hardware Components:**

a. ESP8266 NodeMCU

*Figure 1: ESP8266 NodeMCU*

Figure 1, the ESP8266 NodeMCU used in the research. The ESP8266 NodeMCU is commonly used in smart health monitoring systems based on IoT technology. These systems leverage the NodeMCU's capabilities to gather, process, and transmit health-related data for monitoring purposes. The NodeMCU, integrated with sensors like heartbeat sensors, temperature sensors, and blood pressure sensors, enables the real-time monitoring of vital health parameters such as heart rate, temperature, and blood pressure. By connecting these sensors to the NodeMCU, the system can analyze the data to detect normal or abnormal conditions, allowing for timely intervention and healthcare support. Additionally, the NodeMCU facilitates remote monitoring and notification functionalities, enabling doctors to receive alerts via mobile messages in case of abnormal health conditions, thus enhancing healthcare services and improving patient outcomes.

Heart rate Pulse Sensor sensor module

*Figure 2: Heart Rate Pulse Sensor Module*

Figure 2 shows the heart rate pulse sensor module used in the research. The heart rate pulse sensor module is a plug-and-play sensor designed for Arduino and compatible boards, allowing users to easily incorporate live heart rate data into

their projects. It features a compact and discrete design, making it suitable for wearables, medical devices, and various projects where space is a key consideration. This sensor is versatile and can be used in applications ranging from automation and robotics to environmental and industrial monitoring. However, it is essential to note that this heart rate sensor module is not intended for medical use and should not be used for diagnosing, preventing, or treating any medical condition. The measurements and statistics provided by this sensor are for informational and educational purposes only, not for medical purposes. Additionally, the heart rate pulse sensor module operates at a working voltage of 3 to 5 volts, with a working current of 4 mA at 5 volts, and provides connections for GND, VCC, and analog signal out. It is a valuable tool for STEM projects, helping users develop and enhance their skills in science, technology, engineering, and mathematics.

DHT11 Temperature and Humidity Sensor

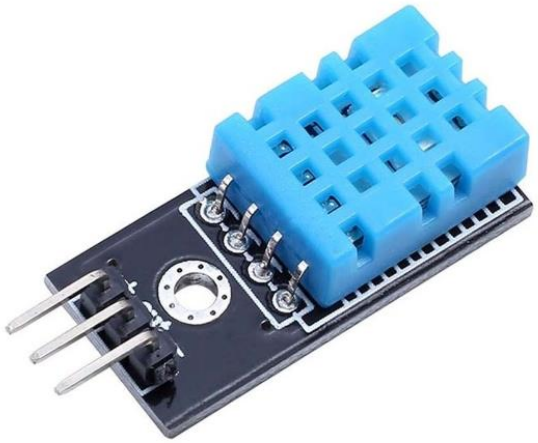

*Figure 3: DHT11 Temperature Sensor*

Figure 3, the DHT11 temperature and humidity sensor is a crucial component for smart health monitoring systems using IoT technology. This sensor plays a vital role in measuring room temperature (0-50 degrees Celsius) and humidity (20%-80% with an accuracy of +/- 5%). It utilizes a capacitive humidity sensor and a thermistor to provide accurate readings of the surrounding environment. In the context of health monitoring systems, the DHT11 sensor can be integrated with microcontrollers like Arduino and Raspberry Pi to monitor environmental conditions that are essential for patient comfort and well-being. By incorporating the DHT11 sensor into IoT-based health monitoring systems, healthcare providers can track and analyze temperature and humidity levels in real-time, ensuring optimal conditions for patients. Additionally, the sensor's simplicity of use, reliability, fast response time, and long-term stability make it a valuable tool for continuous monitoring of environmental parameters in healthcare settings.

Breadboard

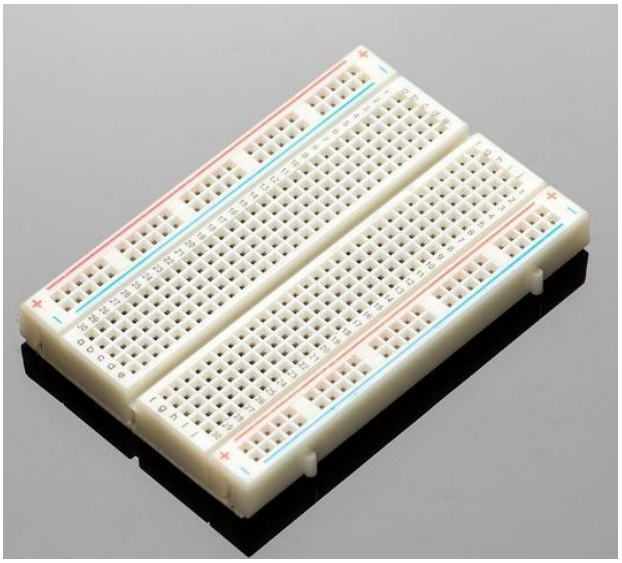

*Figure 4: Breadboard*

Figure 4, A breadboard is a fundamental tool in electronics used for building and testing circuits without the need for soldering. It is a solderless device that allows for easy prototyping and temporary circuit construction. Breadboards consist of multiple rows and columns of interconnected metal clips that hold components and wires in place. They are commonly used for creating prototypes, testing new parts, and analyzing circuits before finalizing a design. Breadboards come in various sizes, from tiny premium breadboards to half-sized premium breadboards, offering different tie points for accommodating circuits of varying complexity. These versatile tools are essential for both beginners and experienced electronics enthusiasts, providing a platform to experiment, learn, and develop electronic projects efficiently.

Jumper Wires

*Figure 5: Jumper Wires*

Figure 5, Jumper wires are essential components in electronics used for making quick and easy connections in low voltage circuits without the need for tools or soldering. They come in various forms, such as ribbons of multicolored wires or preformed breadboard jumper wire kits, offering different lengths and connector types to suit different circuit requirements. Jumper wires are commonly used with

breadboards and other prototyping tools to facilitate the easy modification of circuits as needed. These wires typically come in male-to-male, male-to-female, and female-to-female versions, each serving different connection purposes. While the colors of jumper wires do not have specific meanings, they can be used to differentiate between types of connections, such as ground or power. Jumper wires are versatile components that enable efficient circuit building and testing in electronics projects, making them indispensable for both beginners and experienced enthusiasts in the field.

**Software Components:**

Arduino IDE

The Arduino IDE plays a crucial role in smart health monitoring systems using IoT technology. It serves as the programming environment where developers can write, compile, and upload code to microcontrollers like Arduino and ESP8266 for health monitoring applications. By using the Arduino IDE, developers can easily program the microcontrollers to interact with sensors such as temperature sensors, pulse sensors, and other health monitoring devices. The IDE provides a user-friendly interface and a vast library of functions that simplify the development process, making it accessible for both beginners and experienced developers. Additionally, the Arduino IDE allows for seamless integration with IoT platforms like Thingspeak, enabling the transmission of health data to the cloud for remote monitoring and analysis. Overall, the Arduino IDE is a fundamental tool in the implementation of smart health monitoring systems, enabling the creation of efficient and reliable IoT solutions for healthcare applications.

Firebase

Firebase is a powerful tool for smart health monitoring systems using IoT technology. It serves as a real-time database that can store and synchronize data across multiple clients, making it ideal for monitoring and analyzing health data remotely. In the context of smart health monitoring systems, Firebase can be used to store patient health parameters, sensor readings, and alerts generated by the system. By integrating Firebase into the IoT infrastructure, health data can be securely stored and accessed from anywhere, enabling healthcare providers to monitor patients' conditions in real-time. Additionally, Firebase's real-time capabilities allow for instant updates and notifications, ensuring that doctors receive timely alerts in case of abnormal health conditions. This seamless data management and communication provided by Firebase enhance the efficiency and effectiveness of smart health monitoring systems, bridging the gap between healthcare providers and patients.

Android Studio (Java)

Android Studio, utilizing Java programming language, plays a pivotal role in smart health monitoring systems using IoT technology. It serves as the development environment for creating Android applications that interact with IoT devices and platforms to monitor and manage health data. In the context of smart health monitoring systems, Android Studio enables the creation of user-friendly mobile applications that can collect, display, and analyze health parameters obtained from IoT sensors. These applications can provide real-time monitoring of vital signs,

such as body temperature, heart rate, and oxygen levels, allowing healthcare providers and patients to access and track health data conveniently. Additionally, Android Studio facilitates the integration of IoT functionalities, such as data transmission to cloud services like Firebase, enabling remote monitoring and analysis of health information. Overall, Android Studio, in conjunction with Java programming, empowers the development of intuitive and efficient mobile applications that enhance the monitoring and management of health data in IoT-based health monitoring systems.

## 1.4. FEATURES OF THE SYSTEM

1. Real-time Monitoring:

The system should continuously monitor temperature, humidity, and heart rate data from the respective sensors in real-time, without any significant delays or lags.
The sampling rate for data collection should be configurable to meet the desired monitoring frequency and accuracy requirements.
The system should be capable of handling and processing data streams from multiple sensors simultaneously, ensuring seamless and synchronized monitoring.

2. Data Storage and Retrieval:

The sensor data collected from the ESP8266 NodeMCU should be securely transmitted to the Firebase real-time database using appropriate communication protocols and data formats.
The data should be organized and stored in the database in a structured manner, allowing for efficient retrieval and querying based on factors such as sensor type, timestamps, or user identifiers.
The Android application should be able to retrieve data from the Firebase database in real-time, enabling up-to-date display of sensor data and historical trends.
Appropriate data caching mechanisms should be implemented to ensure smooth data retrieval and minimize delays or interruptions in the application's user experience.

3. User-friendly Interface:

The Android application's user interface should follow best practices in design and usability, ensuring an intuitive and user-friendly experience.
The interface should be clean, uncluttered, and visually appealing, with clear labels and icons for easy navigation and understanding.
The application should support both landscape and portrait orientations, adapting the layout and content accordingly for optimal viewing on different device sizes and orientations.
Consideration should be given to accessibility features, such as support for different font sizes, color contrast, and compatibility with screen readers or other assistive technologies.

4. Data Visualization:

The Android application should incorporate data visualization techniques, such as line charts, bar graphs, or other suitable visualizations, to present sensor data in a clear and understandable manner.
The visualizations should be interactive, allowing users to zoom, pan, or filter data based on specific time ranges or sensor types.
Appropriate labels, legends, and color coding should be used to enhance the clarity and interpretation of the visualized data.
The application should provide options to switch between different visualization modes or types, catering to user preferences and specific use cases.

5. Notification System:

The system should have the capability to generate notifications or alerts based on predefined thresholds or rules related to the sensor data.
For example, if the temperature or heart rate exceeds a certain value, the system should generate an alert or notification to prompt the user or healthcare provider for appropriate action.
The notifications should be customizable, allowing users to set their preferred thresholds or rules based on their specific health conditions or requirements.
The notifications should be delivered through the Android application, as well as other channels such as push notifications, emails, or SMS (if integrated), depending on the user's preferences and the system's capabilities.

6. User Authentication and Data Privacy:

The Android application should implement secure user authentication mechanisms, such as username/password or biometric authentication (e.g., fingerprint or face recognition), to ensure data privacy and access control.
User data, including sensor readings and personal information, should be encrypted and securely stored in the Firebase database, adhering to industry-standard data privacy and security practices.
The application should implement role-based access control, allowing different levels of access and permissions for users, healthcare providers, or administrators.
Appropriate measures should be taken to ensure compliance with relevant data privacy regulations, such as GDPR or HIPAA, depending on the target region and application domain.

7. Portability and Accessibility:

The hardware components, including the ESP8266 NodeMCU, sensors, and associated circuitry, should be designed to be compact, lightweight, and easily transportable, enabling monitoring in various settings (e.g., at home, during physical activities, or in healthcare facilities).
The system should be powered by rechargeable batteries or other portable power sources, ensuring extended operation without the need for constant external power sources.

The Android application should be compatible with a wide range of Android devices and versions, ensuring accessibility and usability for a broad user base.
Consideration should be given to remote monitoring capabilities, allowing healthcare providers or caregivers to access and monitor sensor data from remote locations, enabling timely interventions and support.

# 2. LITERATURE SURVEY

## 2.1. EXISTING SYSTEM

Existing smart health monitoring systems using IoT include a variety of devices and sensors for remote patient monitoring, disease management, and healthcare in hospitals and other health centers. These systems rely on IoT devices and sensors to capture data such as heart rate, body temperature, room temperature, and other health metrics. Wearable healthcare devices are being integrated to enhance communication and user-friendliness. The main aim is to provide extensive research in capturing sensor data, analyzing it, and providing feedback to patients based on the data. Additionally, there are proposals for edge AI-enabled IoT healthcare monitoring systems for smart cities, which can significantly improve healthcare facilities

## 2.2. PROPOSED SYSTEM

The proposed design for the "Smart Health Monitoring System Using IoT" involves the integration of multiple sensors to monitor vital signs such as heart rate, blood pressure, and ECG. The data collected from these sensors will be sent to the cloud and made accessible to the user through a mobile app. The system will also utilize this data to predict potential heart-related medical conditions. The primary sensors used will be the heart rate sensor and the blood pressure sensor, integrated with an Arduino platform.
Overall, the proposed design for the "Smart Health Monitoring System Using IoT" encompasses the integration of multiple sensors, cloud connectivity, and a mobile app interface to enable real-time health monitoring and predictive analysis, leveraging the advancements in smart health technology and IoT concepts.

## 2.3. LITERATURE REVIEW SUMMARY

| Sr.No. | Author | Article | Tools/Techniques |
|---|---|---|---|
| 1. | Madhan Mohan, Sathya Pichandi | Smart Health Monitoring System through | ThingSpeak, IFTTT, Android Application |

| | | | |
|---|---|---|---|
| | | IOT | |
| 2. | Prajoona Valsalan, Ahmed Tariq, Ali Hussain | IOT based Health Monitoring System | Temperature sensor, Heartbeat sensor, IOT servers |
| 3. | Tarannum Khan, Manju K. Chattopadhyay | Smart Health Monitoring System | Arduino UNO, LCD Serial Monitor, Temperature sensor, Heartbeat rate sensor |
| 4. | Suliman Abdulmalek, Abdul Nasir abd ghafar bin, Waheb A. Jabbar Al-Areeqi, Mukarram A M Almuhaya | IOT-based Healthcare-Monitoring System towards Improving Quality of Life: A Review | IOT Gateway, Local server |
| 5. | Mohammad Monirujjaman Khan, Turki M. Alanazi, Amani Abdulrahman Albraikan, Faris A Almalki | IOT-based Health Monitoring System Development and Analysis | Arduino UNO, LM35, Bluetooth Module HC-05, MAX30100, LCD display, Jumper wires, Breadboard |
| 6. | Mansi Mhalsakant Gajare, Manas A Dani, Payal D Deshmukh, Pritesh Chaudhari | IOT based Health Monitoring System | ESP32, MAX30100, PCB, Blynk app, ML Prediction website |
| 7. | Salma Sultana, Sadia Rahman, Md. Atikur Rahman, Narayan Ranjan Chakraborty | An IOT based Integrated Health Monitoring System | ESP8266, LM35, SEN-11574, Breadboard, Jumper wires |

# 3. PROBLEM FORMULATION

To develop a system that can capture vital body data such as heart rate, temperature, and humidity using multiple sensors. The collected data will be transmitted to the cloud and made accessible to the user through a mobile application. Additionally, the system will be leveraged to predict potential heart-related medical conditions. The primary sensors to be employed include the pulse rate heart sensor, temperature and humidity sensor, and ESP8266. The project aims to address the need for remote health management and predictive analytics using sensor data in the context of a smart environment. The project also aligns with the broader application of IoT in healthcare monitoring systems and smart environments, emphasizing the potential for remote health management and predictive analytics using sensor data.

PLANNING TO IMPLEMENT:

- Sensor data acquisition and integration with Arduino: Utilize heart rate and blood pressure sensors for data acquisition. Integrate the sensors with Arduino for data processing and transmission.
- Cloud platform selection and setup: Selection of a suitable cloud platform for data storage and analysis. Set up the chosen cloud platform to ensure secure and reliable data transmission.
- Mobile app development: Develop a mobile application for data visualization and user interface. Ensure the app can securely retrieve and display the health data from the cloud.
- Predictive analytics algorithm implementation: Implement algorithms to analyze the acquired data for predicting heart-related medical conditions.

# 4. OBJECTIVE

- Develop a cost-effective solution for remote monitoring of vital signs.
- Continuously track body temperature, heart rate (BPM), and humidity levels.
- Integrate IoT technologies for wireless data transmission and cloud storage.
- Create a user-friendly Android app for real-time visualization of health data.
- Enable personalized profiles, customizable alerts, and historical data tracking.
- Empower individuals in managing their well-being and support informed healthcare decisions.

# 5. CONCLUSION

The designed system, which was developed with the help of Internet of Things technologies, has effectively shown that it is possible to use mobile applications, cloud computing, and inexpensive hardware components to achieve effective remote health monitoring. The system effectively monitors body temperature, heart rate (BPM), and ambient humidity levels by merging the ESP8266 Node MCU, temperature sensor, humidity sensor, and heart rate sensor. Real-time monitoring, customizable profile management, and timely notifications are made possible by the user-friendly Android mobile app and the wireless data transmission to the Firebase Realtime Database. The system has demonstrated its accuracy, dependability, and usefulness via rigorous testing and user input, supporting proactive disease management, early health issue diagnosis, and preventative care efforts. This initiative sets the stage for future developments in Internet of Things (IoT)-based healthcare solutions, giving people the ability to take charge of their health and assisting medical professionals in providing high-quality treatment.

# 6. TENTATIVE CHAPTER PLAN FOR THE PROPOSED WORK

**CHAPTER 1: INTRODUCTION**

This chapter will cover the overview, problem definition, requirements, and applications of the system.

**CHAPTER 2: LITERATURE REVIEW**

This chapter includes the literature available for our system and the findings of the researchers will be highlighted which will become the basis of the current implementation.

**CHAPTER 3: OBJECTIVE**

This chapter includes the major objectives of the proposed system.

**CHAPTER 4: CONCLUSION**

The major finding of the work will be presented in this chapter. Also, directions for extending the current study will be discussed.

# REFERENCES


[1] Mohan, Madhan & Pichandi, Sathya. (2019). Smart Health Monitoring System through IOT.

[2] Valsalan, Prajoona & Tariq, Ahmed & Hussain, Ali. (2020). IOT BASED HEALTH MONITORING SYSTEM. 2020. 10.31838/jcr.07.04.137.

[3] Khan, Tarannum & Chattopadhyay, Manju. (2017). Smart health monitoring system. 1-6. 10.1109/ICOMICON.2017.8279142.

[4] Abdulmalek, Suliman & bin, Abdul Nasir & Al-Areeqi, Waheb & Almuhaya, Mukarram & Bairagi, Anupam & Khan, Md. Al-Masrur & Kee, Seong-Hoon. (2022). IoT-Based Healthcare-Monitoring System towards Improving Quality of Life: A Review. 10.3390/healthcare10101993.

[5] Khan, Mohammad & Alanazi, Turki & Albraikan, Amani & Almalki, Faris. (2022). IoT-Based Health Monitoring System Development and Analysis. Security and Communication Networks. 2022. 1-11. 10.1155/2022/9639195.

[6] Gajare, Mansi & Dani, Manas & Deshmukh, Payal & Chaudhari, Pritesh. (2021). IOT based Health Monitoring System.

[7] Sultana, Salma & Rahman, Sadia & Rahman, Md & Chakraborty, Narayan & Hasan, Tanveer. (2021). An IoT Based Integrated Health Monitoring System. 549-554. 10.1109/ICCCA52192.2021.9666412.

[8] Sekhar, Y. Ravi. "Android based health care monitoring system." *Department Of ECE, Vignan's University, Vadlamudi, India*.

[9] D. A. M. Budida and R. S. Mangrulkar, "Design and implementation of smart HealthCare system using IoT," 2017 International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), Coimbatore, India, 2017, pp. 1-7, doi: 10.1109/ICIIECS.2017.8275903.

[10] H. Al-Hamadi and I. R. Chen, "Trust-Based Decision Making for Health IoT Systems," in IEEE Internet of Things Journal, vol. 4, no. 5, pp. 1408-1419, Oct. 2017, doi: 10.1109/JIOT.2017.2736446.