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Health Monitoring System in Emergency Using IoT

Chetana Chavan[1, *], Manjunath Managuli[2], Ramesh Koti[3]

[1] PG Student, KLS GIT, Digital Communication & Networking, KLS Gogte Institute of Technology, Belagavi, Karnataka, India
Email: chetana.chavan99@gmail.com
[2] Associate Professor, KLS GIT, Electronics & Communication Engineering, KLS Gogte Institute of Technology, Belagavi, Karnataka, India
Email: manjunathm@git.edu
[3] Assistant Professor, KLS GIT, Electronics & Communication Engineering, City, KLS Gogte Institute of Technology, Belagavi, Karnataka, India
Email: rbkoti@git.edu
*Corresponding Author: Chetana Chavan, Email: chetana.chavan99@gmail.com

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Abstract

This work presents the development of a Health Monitoring System using an ESP8266 microcontroller (ESP01), MAX30100 pulse oximeter, LM35 temperature sensor, and an OLED display. The system continuously collects data on vital health parameters, including heart rate (BPM), blood oxygen saturation (SpO2), and temperature. Real-time feedback is provided through an OLED display, and data is periodically transmitted to the Thing Speak platform for remote monitoring. This system offers a user-friendly approach to health monitoring. This technology offers individuals a convenient and accessible means to monitor their health and has the potential to empower proactive health management. Future enhancements may include mobile app integration and additional sensors for comprehensive health monitoring. This system represents a significant step forward in personal health monitoring, fostering proactive health management.

Keywords

Wi-Fi Module, Sensor, Arduino, LED, Things-to-Speak, Buzzer.

1. Introduction

Health monitoring is a critical aspect of modern healthcare, enabling individuals to track and manage their well-being effectively. This project introduces a Health Monitoring System that leverages advanced technology to provide continuous and accessible monitoring of vital health parameters. The system's core components include the ESP8266 microcontroller Wi-Fi Module, the MAX30100 pulse oximeter,

and the LM35 temperature sensor.

In an era where health awareness is paramount, this system offers a versatile solution. It continuously records essential health metrics such as heart rate (BPM), blood oxygen saturation (SpO2), and body temperature. These metrics are not only collected but also presented in real-time through an OLED display, ensuring users have immediate access to their health data, this system extends its functionality by enabling remote health monitoring. Data, including BPM, SpO2, and temperature, is transmitted to the Thing Speak platform at predefined intervals. This feature allows users to access their health information from anywhere, fostering health awareness and early detection of potential issues.

As technology continues to evolve, this Health Monitoring System has the potential for further enhancements. Mobile app integration for data visualization and alert systems can be explored, making it even more user-friendly and informative. Additionally, the system's flexibility allows for the integration of additional sensors, expanding its capacity to monitor an even wider range of health parameters.

This project represents a significant step forward in empowering individuals to take control of their health and well-being. It aligns with the growing trend of proactive health management and serves as a valuable tool in achieving this goal. In the following sections, we will delve into the system's components, operation, and potential for future developments.

Key Features of This System Include:

- Continuous Data Collection: The system continually gathers data on heart rate (BPM), blood oxygen saturation (SpO2), and body temperature.
- Real-time Feedback: Users receive immediate feedback through an OLED display, which displays the current health metrics, enhancing their awareness of their health status.
- Remote Monitoring: Data is transmitted to the Thing Speak platform at regular intervals, allowing for remote monitoring and tracking of health trends.
- User-Friendly Interface: The OLED display provides an intuitive and user-friendly interface, making it accessible to a wide range of users.
- Future Potential: Future enhancements could include mobile app integration for enhanced data visualization and alert systems. Additionally, the system's flexibility allows for the integration additional sensors to monitor more health parameters.

Problem Statement:

Limited Accessibility to Health Monitoring Tools:

- There is a significant portion of the population that lacks convenient and

affordable tools for monitoring vital health parameters.

- Traditional health monitoring methods often require specialized and expensive equipment, making frequent monitoring impractical for many individuals.

Lack of Real Time Feedback:

- Current health monitoring solutions often do not provide immediate feedback to users.
- This lack of real-time information makes it challenging for individuals to stay informed about their health status and take timely actions.

Need for Remote Health Monitoring:

- There is a growing need for remote health monitoring solutions.
- Situations arise where individuals may not have immediate access to healthcare facilities, or continuous monitoring is required outside clinical settings.

Affordability of Health Monitoring:

- The cost of health monitoring equipment and services can be prohibitive for many people.
- Ensuring affordability is crucial to making health monitoring accessible to a wide range of individuals, irrespective of their economic status.

2. Literature Survey

It describes an innovative system that utilizes the Internet of Things (IoT) for emergency health monitoring [1-2]. This system is designed to continuously monitor individuals' health and detect critical health events that require immediate attention. [5] D. Priya and S. Sundar It Focuses on the development of a healthcare monitoring system powered by the Internet of Things (IoT) [4]. This system is designed to continuously monitor and collect health-related data, likely including vital signs and other relevant parameters. [3] S. R. Krishnan, S. C. Gupta and T this would delve into the technical aspects of the IoT infrastructure and connectivity used in this monitoring system [6]. It might discuss how the collected data is processed, stored, and potentially transmitted to healthcare providers for analysis [7]. This research represents a significant advancement in remote patient monitoring, with potential implications for improving healthcare outcomes and ensuring timely interventions [8].

Manasa and S. C. [10] Venkateswarlu to develop a comprehensive wearable health monitoring system by harnessing the power of Arduino and IoT technologies [9]. This system is designed to continuously track and collect data on various health parameters. By combining Arduino's versatility with IoT connectivity, the system

offers the potential to revolutionize health monitoring by providing real-time data and insights into individuals' well-being [11].

2.1. Objectives

a. Develop a system for continuous monitoring of vital health parameters (BPM, SpO2, and temperature.
b. Provide real-time feedback through an integrated OLED display.
c. Enable remote health tracking by transmitting data to Thing Speak.
d. Ensure affordability by using cost-effective components.
e. Empower users with continuous access to health data for informed decisions.
f. Explore integration with mobile apps for enhanced user experience.
g. Implement robust data security and privacy measures.
h. Create comprehensive documentation and a user guide.
i. Lay the foundation for future system enhancements and innovations.

3. Methodology

Figure 1 is a simple block diagram that explains the IoT Based Patient Health Monitoring System using, Arduino UNO, MAX30100, Buzzer, Led, ESP8266WiFi Module, LM35 Temperature Sensors measure BPM, SpO2 & Temperature respectively. Buzzer and Led will give the sound and light whenever it the sensor senses the heart rate.

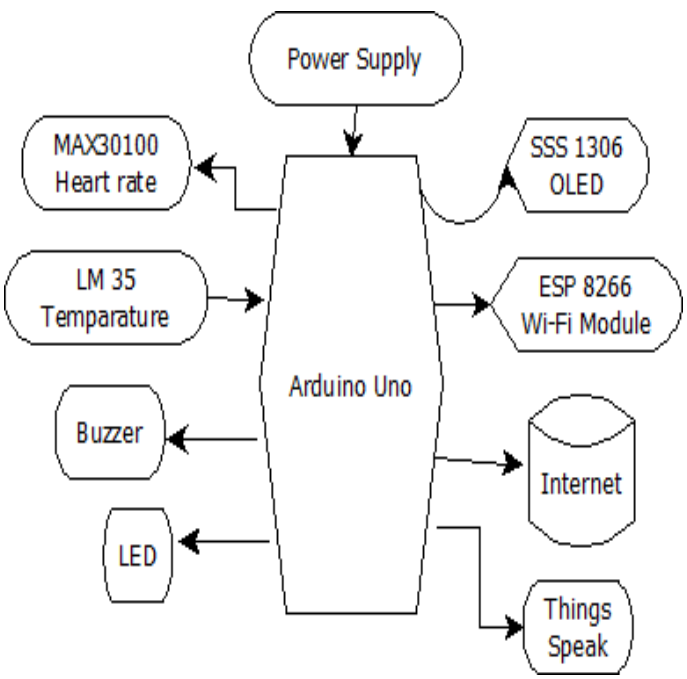

Figure 1. Block diagram of Health Monitoring system

Flow Chart

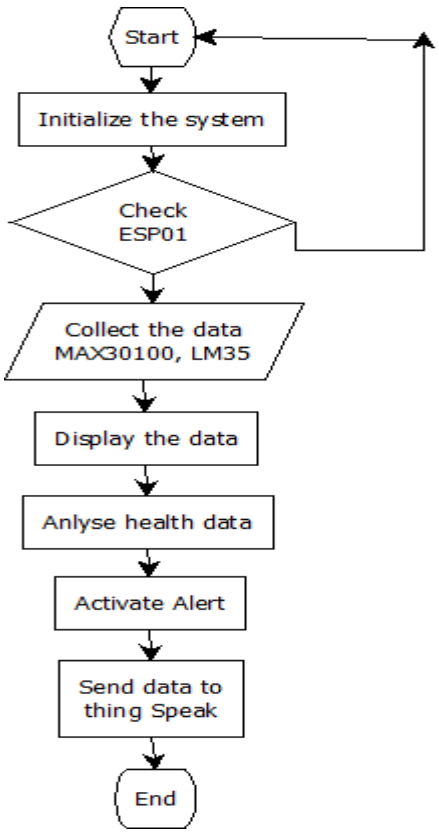

Figure 2. Flow Chart

The Arduino processes the code and displays it to OLED. ESP8266 Wi-Fi module connects to Wi-Fi and sends the data to IoT device server. The IoT server used here is Thing speak. Finally, the *Figure 2* data can be monitored from any part of the world by logging into the Thing speak channel.

The working of the Health Monitoring System involves a series of steps that allow it to continuously monitor vital health parameters, provide real-time feedback, and enable remote health tracking. Here's a detailed explanation of how the project works:

- **Sensor Data Acquisition**: The system begins by continuously collecting data from the connected health monitoring sensors. These sensors include the MAX30100 pulse oximeter for heart rate (BPM) and blood oxygen saturation (SpO2) and the LM35 temperature sensor for body temperature.

- **Data Processing**: The microcontroller (ESP8266) processes the acquired sensor data. It interprets and prepares the data for display and transmission, ensuring accuracy and reliability.

- **Real-time Feedback**: Processed health data, including BPM, SpO2, and temperature, is displayed in real-time on the integrated OLED display. Users can readily view their current health metrics, fostering health awareness.

- **Data Transmission**: At predefined intervals, the system uses Wi-Fi connectivity to transmit the processed health data to the Thing Speak platform. Thing Speak securely stores the data in the cloud, allowing for remote monitoring.

- **User Interaction**: Users can interact with the system through the OLED display. They can navigate through the user interface to access their health metrics, additional health information, and system settings.

- **Alerts and Feedback**: The system is equipped to provide visual alerts on the OLED display and auditory alerts through a buzzer. These alerts notify users of specific health events, such as the detection of a heartbeat, ensuring timely attention to changes in health status.

- **Data Security**: Robust security measures, including data encryption, protect the privacy of the transmitted health data. This ensures that user data remains confidential during transmission and storage.

- **User Empowerment**: By offering continuous access to their health data, the system empowers users to actively manage their health. Users can make informed decisions about their well-being and seek medical assistance if necessary.

- **Expandability**: The system's design allows for the integration of additional sensors. This expandability means that users can monitor an extended range of health parameters, tailoring the system to their specific needs.

4. Result & Discussion

The OLED display will show initialization messages. If the MAX30100 initializes successfully, it will display "SUCCESS" on the OLED. The pulse oximeter will continuously monitor heart rate and SpO2. Every 5 seconds, the LM35 temperature sensor will be read, and the temperature in Celsius will be displayed. The heart rate, SpO2, and temperature data will be sent to Thing Speak for remote monitoring. On the OLED, you'll see real-time heart rate, SpO2, and temperature readings. If a heartbeat is detected, the OLED will display a bitmap, the buzzer will play a tone, and the LED will briefly turn on. The serial monitor will show heart rate, SpO2, and temperature data in *Table 1*.

Table 1 Heart beat data

Temperature	Heart Rate	SPo2
24.3	69	95
36.2	72	97
50.4	80	98

The program is written in C/C++ in Arduino UNO Arduino IDE is a popular IDE developed by Arduino, this can be used to program. The software implementation of the Health Monitoring System is crucial for data processing, user interface interaction, and connectivity. Here's an overview of the software components and how they work together.

To upload it to your board, simply click on the arrow in the top left corner. This process takes a few seconds, and it is important to not disconnect the board during this process. If the upload is successful, the message "Done uploading" will appear in the bottom output area *Figure 3 & 4*.

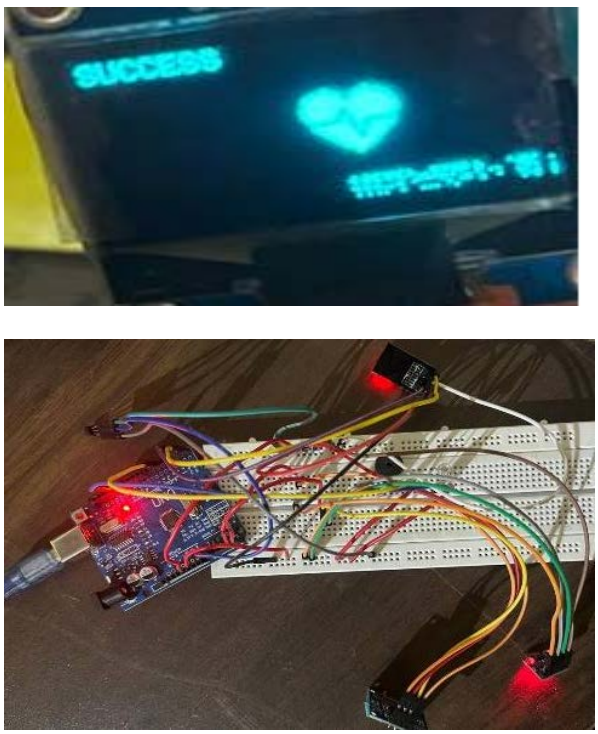

Figure 3. Temp, Heart Rate and SpO2 Reading in OLED

Figure 4. Thing Speak Data

5. Conclusion

The health monitoring system, built upon an ESP8266-based Arduino board, offers a robust solution for real-time health data collection and analysis. By seamlessly integrating sensors like the MAX30100 pulse oximeter and LM35 temperature sensor, it empowers users to monitor vital signs such as heart rate, blood oxygen saturation, and temperature. The system's alert mechanisms provide timely notifications, while data logging to Thing Speak enables remote tracking and historical analysis. With potential applications ranging from personal health monitoring to remote patient care, this system underscores the value of technology in promoting proactive healthcare management.

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Conflicts of Interest

There is no conflict of interest.

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