International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 10 Issue: 04 | April - 2026 SJIF Rating: 8.659 ISSN: 2582-3930

Affordable Smart ECG Monitoring Using Arduino and Bluetooth Module

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Abstract - The Affordable Smart ECG Monitoring System is designed for real-time cardiac monitoring with enhanced alert capabilities. The system uses an Arduino mega as the main controller, interfacing with an ECG sensor to monitor heart activity and a temperature sensor to track body temperature. Readings are displayed on an LCD screen, while a buzzer alerts the user of abnormal conditions. In addition, a GPS module tracks the patient's location, and a GSM module sends an alert message with the location details to a caregiver or medical professional when any abnormality is detected. Data can also be transmitted via a Bluetooth module to a smartphone or computer for continuous monitoring. This low-cost, portable system ensures early detection of cardiac anomalies and rapid emergency response, making it suitable for home use, elderly care, or clinical settings.

Key Words: *ECG Monitoring, Arduino Mega 2560, Bluetooth Module, Temperature Sensor, GPS Module, GSM Communication, Real-Time Health Monitoring, Wireless Data Transmission, Heart Rate Monitoring, Smart Healthcare System.*

1. INTRODUCTION

Cardiovascular diseases (CVDs) are among the leading causes of death worldwide. Early detection and continuous monitoring of heart activity are essential for preventing severe complications and ensuring timely medical intervention. Traditional electrocardiogram (ECG) monitoring systems used in hospitals are often expensive, bulky, and require specialized medical personnel for operation.

With the advancement of embedded systems and wireless communication technologies, microcontroller platforms such as the Arduino Mega 2560 enable the development of compact medical monitoring devices capable of collecting, processing, and transmitting physiological data in real time. Integrating communication modules like Bluetooth, GSM, and GPS further enhances the system's ability to provide remote monitoring and emergency alerts.

2. LITERATURE SURVEY

Several studies from [1] to [4] have explored the development of low-cost and portable Electrocardiogram (ECG) monitoring systems using microcontroller platforms such as the Arduino Uno and ECG sensor modules like the AD8232 ECG Sensor Module. These systems aim to provide affordable cardiac monitoring solutions that can be used outside traditional hospital environments. Veera Chandra Kamati proposed a real-time ECG monitoring system that uses an Arduino Uno microcontroller and AD8232 ECG sensor to capture cardiac electrical signals. The system processes the signals and displays the PQRST waveform on a TFT SPI display and serial monitor.

Several models and methodologies have been proposed in previous research to design efficient ECG monitoring systems. One widely used approach involves the use of microcontroller-based data acquisition systems, particularly those built around the Arduino Uno or Arduino Nano platforms. Signal processing methods including noise filtering using resistors, analogy filters, and digital signal processing techniques are applied to remove interference and baseline drift. Wireless communication technologies such as Bluetooth modules are incorporated to transmit ECG data to smartphones or computers for remote monitoring.

3. EXISTING SYSTEM

Traditional ECG monitoring systems are mainly used in hospitals and medical centers. These systems require large and expensive equipment and continuous supervision by medical professionals. Patients need to visit hospitals regularly to check their heart activity, which is time-consuming and inconvenient. Most of the existing systems are not portable and cannot provide continuous monitoring for patients at home.

Limitations: Existing systems mainly focus on solving only one specific problem and do not provide complete health monitoring. There is also a lack of integration between different components such as sensors, communication modules, and alert systems.

4. PROPOSED SYSTEM

The proposed system presents an affordable and portable smart ECG monitoring system using Arduino and a Bluetooth module. The system continuously monitors the patient's heart signals using an ECG sensor and processes the data through the Arduino microcontroller. The collected ECG signals are displayed and analyzed in real time.

The system also integrates additional sensors such as a temperature sensor and GPS module to monitor the patient's health condition and location. If any abnormal ECG signal or body temperature is detected, the system activates an alert

through a buzzer and sends the information to a connected mobile device via Bluetooth.

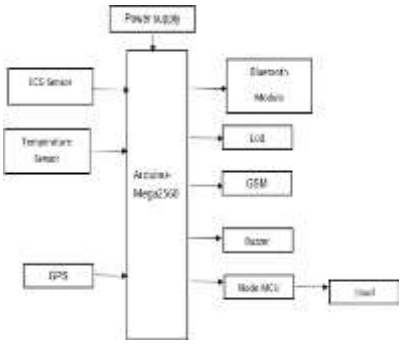

Fig.1: Block Diagram of the proposed system

5. IMPLEMENTATION AND RESULTS

Fig 1. shows the hardware implementation of the ECG heart monitoring system designed to monitor a patient's heart activity in real time. The system mainly consists of an Arduino microcontroller, ECG sensor module, temperature sensor, GPS module, LCD display, buzzer, and Bluetooth communication module. ECG electrodes are attached to the patient's body to capture the electrical signals of the heart.

The captured ECG signals are processed by the Arduino and the results are displayed on the LCD screen. The data can also be transmitted wirelessly using the Bluetooth module for remote monitoring. If any abnormal ECG or temperature condition is detected, the buzzer generates an alert and the GPS module helps in identifying the patient's location for emergency support.

Fig.2: ECG Heart Monitoring System Hardware Implementation

The system was successfully implemented using an Arduino-based platform. The results show that the proposed ECG heart monitoring system effectively monitors the patient's heart activity in real time. When abnormal values are detected, the buzzer generates an alert to notify nearby people. The Bluetooth module allows wireless transmission of the data for remote monitoring, while the GPS module helps to identify the patient's location in emergency situations.

Fig.3: Graphical Representation of ECG Signal

Fig.4 :Data is displayed on LCD

Fig.5: GPS Location Alert for Abnormal ECG Detection

6. DISCUSSION

The discussion of the proposed ECG heart monitoring system shows that the system is capable of monitoring the patient's heart activity effectively. The ECG sensor successfully captures the electrical signals of the heart and sends the data to the Arduino for processing. The processed information is displayed on the LCD screen, which allows real-time monitoring of the patient's condition.

Furthermore, the system provides additional safety features through the buzzer, Bluetooth, and GPS modules. When abnormal ECG signals or temperature values are detected, the buzzer gives an alert to notify nearby people. Overall, the system demonstrates reliable performance and can be useful for basic health monitoring applications.

7. CONCLUSION

The proposed system successfully demonstrates an affordable and integrated solution for continuous ECG monitoring using Arduino and Bluetooth technology. By using low-cost components such as an Arduino Mega 2560, ECG sensor, temperature sensor, LCD display, and buzzer, the system provides real-time monitoring of the patient's heart activity and body temperature.

The system also improves patient safety by providing alert and communication features. When abnormal ECG signals or temperature levels are detected, the buzzer generates an immediate warning. In addition, Bluetooth, GPS, and GSM modules help in transmitting the patient's health data and location information to caregivers for quick response during emergency situations.

ACKNOWLEDGEMENT

The authors sincerely thank Mr. K. Ravi Babu (Assistant Professor, ECE, PBR VITS Kavali) for his guidance, Dr. R. Sravanthi (Professor & HoD, ECE) for providing facilities, and

Dr. V. Anil Kumar (Principal, PBR VITS Kavali) for the academic environment that enabled this work.

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