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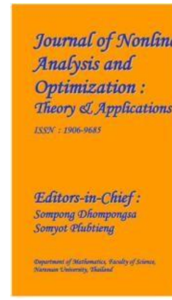


# IOT BASED SYSTEM FOR HIGH AND LOW HEARTRATE AND EPILEPSY(FITS) DETECTION

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**Abstract:** *This paper presents an IoT-based system designed to monitor heart rates and detect epileptic seizures, utilizing Photoplethysmography (PPG) for non-invasive heart rate detection. Comprising a Heart Rate module, Android application, and Node MCU for wireless communication, the system enables real-time monitoring of heart rates and early detection of anomalies such as high or low heart rates, indicative of potential heart issues. Additionally, it incorporates a feature for detecting epileptic seizures, enhancing patient care and well-being. Data collected by the system can be stored and analyzed for further medical evaluation, facilitating telemedicine practices and clinical investigations. This cost-effective and versatile system offers a valuable solution for continuous health monitoring, benefiting both patients and healthcare providers.*

**Keywords**: IoT, heart rate monitoring, Photoplethysmography, epilepsy detection, wireless communication, Node MCU.

## I. Introduction

In recent years, the integration of Internet of Things (IoT) technology into healthcare systems has revolutionized patient care by enabling remote monitoring and early detection of health issues. One critical aspect of healthcare monitoring is the continuous tracking of vital signs, particularly heart rate, which serves as a key indicator of cardiovascular health. Additionally, for individuals with epilepsy, timely detection of seizures is paramount for effective management and intervention. This paper introduces an innovative IoT-based system designed to address these needs, providing real-time monitoring of heart rates and detection of epileptic seizures through non-invasive techniques.

The proposed system leverages Photoplethysmography (PPG), a non-invasive method for detecting blood volume changes in peripheral tissues, to monitor heart rates. By capturing signals from the patient's fingertips, the Heart Rate module of the system acquires accurate heart rate data, which is transmitted wirelessly to a central monitoring unit via Node MCU. This wireless communication enables seamless integration with a variety of devices, including computers and Android applications, facilitating convenient access to real-time health data for both patients and healthcare providers.

The significance of continuous heart rate monitoring cannot be overstated, as it allows for the early detection of abnormalities such as high or low heart rates, which may indicate underlying cardiovascular conditions. Moreover, the inclusion of an epilepsy detection feature in the system adds another layer of monitoring for individuals with epilepsy, enabling prompt intervention in the event of a seizure. This comprehensive approach to health monitoring aligns with the principles of proactive healthcare management, where early detection and intervention can significantly improve patient outcomes and quality of life.

The versatility and scalability of the proposed IoT-based system make it suitable for integration into various healthcare settings, ranging from individual home monitoring to clinical environments. The ability to store and analyze collected data facilitates telemedicine practices, enabling remote consultation and diagnosis by healthcare professionals. Additionally, the system's cost-effectiveness and ease of use make it accessible to a wide range of users, including patients with limited access to healthcare facilities. Overall, the introduction of this IoT-based monitoring system represents a significant advancement in healthcare technology, offering a valuable tool for enhancing patient care and well-being.

In the subsequent sections of this paper, we delve deeper into the existing technologies and methodologies relevant to heart rate monitoring and epilepsy detection. We then present our proposed IoT-based system architecture, detailing the components utilized and the integration process. Through comprehensive discussions, we elucidate the functionality and advantages of each component within the system. Furthermore, we provide insights into the experimental results obtained from the implementation of the proposed system, including its efficacy in real-world scenarios and its potential impact on healthcare management. By examining both the existing landscape and the proposed innovations, this paper aims to contribute to the advancement of healthcare technology and provide valuable insights for researchers, healthcare professionals, and stakeholders in the field.

## II. Existing System

The existing system for heart rate monitoring and epilepsy detection typically involves standalone devices or separate monitoring solutions for each health parameter. Traditional heart rate monitors often rely on chest straps or wrist-worn sensors to track heartbeats, while epilepsy detection systems may include wearable devices or seizure detection algorithms integrated into specialized medical equipment. However, these systems often lack seamless integration, requiring users to manage multiple devices and platforms for comprehensive health monitoring. Moreover, existing solutions may be costly, cumbersome, and limited in their ability to provide real-time data analysis and remote monitoring capabilities.

To address these limitations, our proposed IoT-based system offers a unified platform for simultaneous heart rate monitoring and epilepsy detection, leveraging the latest advancements in IoT technology and non-invasive monitoring techniques. By integrating Photoplethysmography (PPG) for heart rate monitoring and incorporating seizure detection algorithms, our system provides a comprehensive solution for continuous health monitoring. Through wireless communication and data transmission via Node MCU, the system enables seamless integration with smartphones, computers, and other IoT-enabled devices, facilitating real-time monitoring and remote access to health data.

The integration of existing technologies, such as PPG-based heart rate monitoring and seizure detection algorithms, ensures the reliability and accuracy of our system while also leveraging the advantages of IoT connectivity for enhanced accessibility and usability. By consolidating multiple health monitoring functions into a single platform, our system offers a cost-effective and user-friendly solution for individuals with cardiovascular conditions and epilepsy, as well as healthcare professionals seeking to streamline patient care and improve treatment outcomes.

## III. Literature survey

Several studies have explored the use of signal processing and machine learning algorithms for epileptic seizure detection. Ghassemi et al. [1] proposed a method based on the Tunable-Q Wavelet Transform (TQWT) and ensemble learning for accurate detection of epileptic seizures in EEG signals, achieving promising results. Similarly, Shoeibi et al. [2] conducted a comprehensive comparison of handcrafted features and convolutional autoencoders for seizure detection, highlighting the effectiveness of deep learning approaches in this domain. Other research efforts have focused on feature extraction and classification techniques to enhance seizure detection accuracy. Bhattacharyya et al. [3] introduced a Tunable-Q Wavelet Transform-based multiscale entropy measure for automated classification of epileptic EEG signals, demonstrating improved performance compared to traditional methods. Additionally, Zazzaro et al. [5] applied data mining techniques for EEG signal analysis to detect epileptic seizures, highlighting the potential of machine learning in identifying seizure patterns. Moreover, there has been increasing interest in exploring complementary imaging techniques for epilepsy diagnosis and localization of brain lesions. Kulaseharan et al. [4] utilized morphometric and textural analysis of magnetic resonance images (MRI) to identify lesions in pediatric epilepsy patients, offering insights into the structural abnormalities associated with the condition. Pianou and Chatziioannou [7] discussed the role of positron emission tomography/computed tomography (PET/CT) imaging in epilepsy surgery, emphasizing the importance of accurate localization of epileptogenic regions. The integration of multimodal neuroimaging techniques such as magneto encephalography (MEG) and EEG has shown promise in detecting epileptic form activity and localizing seizure foci. Van Klink et al. [6] investigated simultaneous MEG and EEG to detect ripples in individuals with focal epilepsy, providing valuable insights into the spatiotemporal dynamics of epileptic activity.The literature survey highlights the diverse approaches and methodologies employed for epileptic seizure detection, ranging from signal processing algorithms to advanced imaging techniques. These studies underscore the importance of interdisciplinary research and collaboration in advancing our understanding of epilepsy and improving diagnostic accuracy and treatment outcomes for patients.

## IV. Proposed system

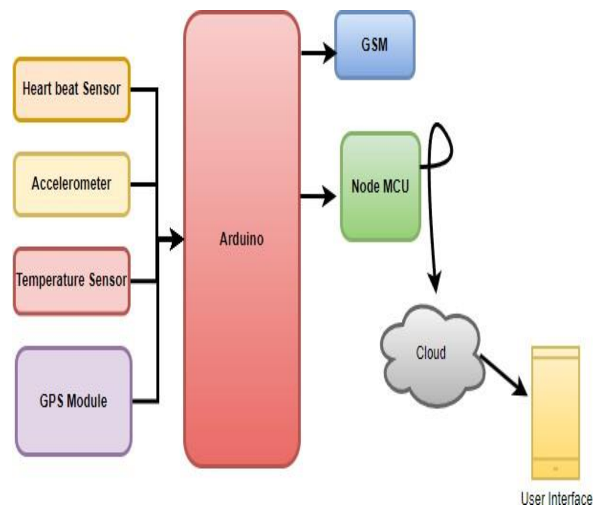


**Fig 1: proposed System Block diagram**

The proposed IoT-based system offers a comprehensive solution for continuous health monitoring by integrating Photoplethysmography (PPG) for non-invasive heart rate detection and seizure detection algorithms. Comprising a Heart Rate module, Android application, and Node MCU for wireless communication, the system facilitates real-time monitoring of heart rates and early detection of anomalies, including high or low heart rates indicative of potential heart issues, as well as epileptic seizures. By incorporating these features, the system enhances patient care and well-being, providing timely alerts and enabling prompt intervention. Moreover, the collected data can be stored and analyzed for further medical evaluation, supporting telemedicine practices and clinical investigations. With its cost-effective design and versatility, this system offers a valuable tool for both patients and healthcare providers, contributing to improved health outcomes and efficient healthcare management.

## V. Component use and description

**Arduino Uno:** Arduino Uno is a microcontroller board based on the ATmega328P chip. It serves as the brain of the system, controlling the operation of other components, processing data, and executing programmed tasks. Arduino Uno is responsible for interfacing with sensors, collecting data, and controlling actuators based on predefined conditions.

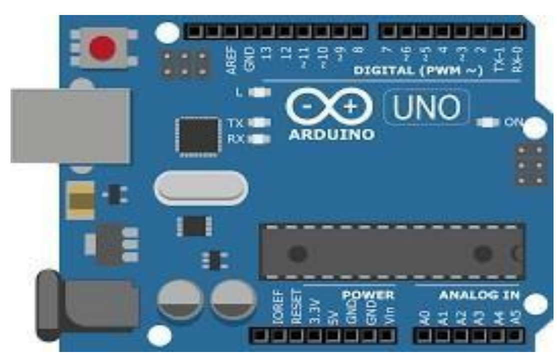


**Fig 2: Arduino Uno**

**Node MCU:** Node MCU is a low-cost open-source IoT platform based on the ESP8266 Wi-Fi module. It enables wireless communication and connectivity to the Internet, allowing the system to transmit data to remote servers or mobile devices. Node MCU facilitates remote monitoring and control of the system, making it suitable for IoT applications.

**Fig 3: Node MCU**

**GPS (Global Positioning System):** GPS modules receive signals from satellites to determine the precise location coordinates (latitude and longitude) of the device. In the proposed system, GPS is used to track the location of the patient or device wearer. It enables real-time tracking and geolocation-based services, such as alerting emergency services or caregivers in case of emergencies.

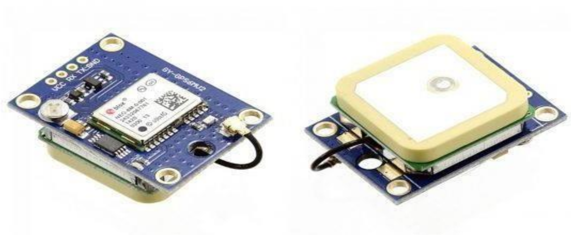

**Fig 4: GPS Module**

GSM (Global System for Mobile Communication): GSM modules enable communication over cellular networks, allowing the system to send SMS alerts or make voice calls. In the context of healthcare applications, GSM can be used to send emergency notifications to caregivers or such as sudden changes in heart rate or detected seizures.


**Fig 5: GSM Module**

**Accelerometer:** An accelerometer measures acceleration forces, enabling the detection of motion, orientation, and changes in velocity. In the proposed system, an accelerometer can be used to detect falls or sudden movements, triggering alarms or alerts for assistance. Additionally, it can monitor physical activity levels or detect abnormal movements associated with seizures.

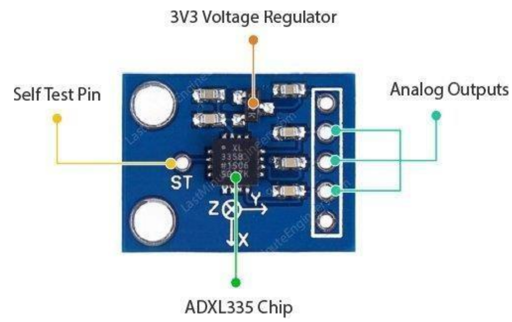


**Fig 6: Accelerometer**

**Heart Rate Sensor:** A heart rate sensor measures the heart rate by detecting changes in blood volume or pulse rate. It is commonly used in wearable devices for continuous monitoring of heart rate. In this system, the heart rate sensor provides real-time data on heart rate variations, enabling early detection of abnormalities such as high or low heart rates.

**Fig 7: Heartbeat sensor**

**Temperature Sensor:** Temperature sensors measure ambient temperature, providing data on environmental conditions. In healthcare applications, temperature sensors can monitor body temperature, detecting fever or hypothermia. In the proposed system, a temperature sensor can be used to monitor the patient's body temperature, providing additional health data for analysis

and diagnosis.

**Fig 8: Temperature sensor**

## Working Algorithm:

**Initialization:** Initialize all sensors (heart rate sensor, temperature sensor, and accelerometer) and communication modules (GSM, GPS, Node MCU).

Set up communication protocols and establish connections with external devices or services.

**Data Acquisition**: Continuously read sensor data at predefined intervals. Acquire heart rate, body temperature, and motion data from respective sensors.

**Data Processing**: Process the acquired sensor data to obtain relevant parameters (e.g., heart rate, temperature, motion intensity). Perform basic signal processing techniques such as filtering or smoothing to remove noise from the sensor data.

**Anomaly Detection:** Apply predefined algorithms or thresholds to detect anomalies in the sensor data. For heart rate monitoring, detect abnormal heart rates (e.g., tachycardia, bradycardia).For motion detection, identify sudden movements indicative of falls or seizures. For temperature monitoring, detect fever or hypothermia based on predefined thresholds.

**Decision Making**: Based on the detected anomalies, make decisions regarding the appropriate actions to take. If abnormal heart rates or seizure-like patterns are detected, trigger emergency alerts. Determine the severity of the detected anomalies and prioritize response actions accordingly.

## Results

The figure 9 shows the physical setup of the proposed system, showcasing the integrated components such as Arduino Uno, sensors (heart rate sensor, temperature sensor, accelerometer), communication modules (GSM, GPS), and Node MCU for wireless communication. It provides a visual representation of how the hardware components are interconnected and mounted within the system, demonstrating the practical implementation of the proposed solution.

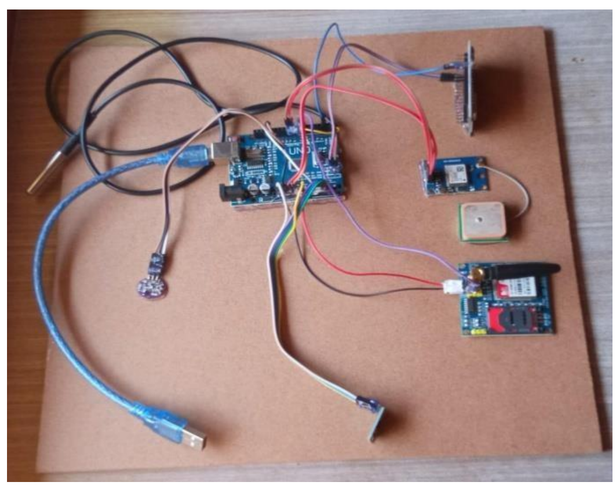

**Fig 9: Showing developed Proposed Hardware system**

The figure 10 presents a representation of the real-time data collected by the sensors in the proposed system. It displays plots or charts showing the fluctuations in temperature and heart rate over time, allowing for the observation of trends and variations. Additionally, the figure may include indicators or alerts for critical conditions, such as abnormal heart rates or detected seizures, providing visual feedback on the patient's health status.

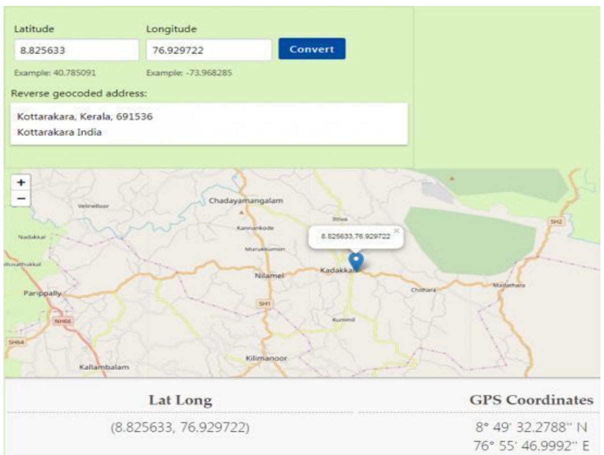


**Fig 10: Showing the real time values in IoT app**

This figure 11 illustrates a real-time map generated based on the location data obtained from the GPS module in the proposed system. It displays the patient's current location or movement trajectory on a map interface, providing visual context and geographical information. The map may include markers or annotations indicating specific points of interest, such as home location, healthcare facilities, or emergency services, enabling caregivers or healthcare providers to track the patient's whereabouts and respond promptly to emergencies.

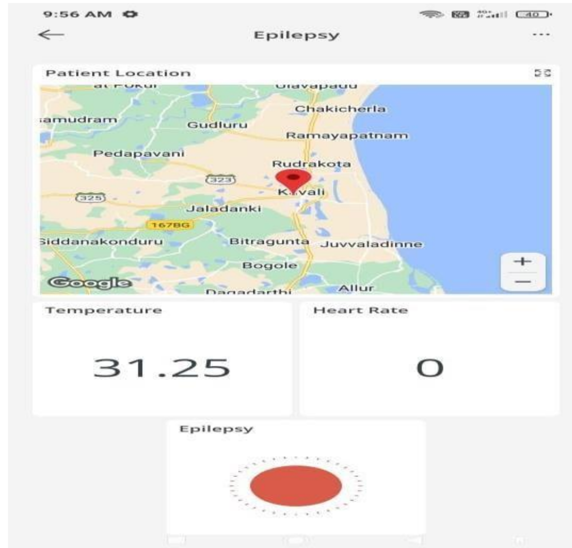


**Fig 11: Showing the map based on location**

## Conclusion:

The proposed IoT-based system offers comprehensive remote health monitoring, integrating vital sign tracking, location-based services, and communication functionalities. Through real-time data visualization and emergency response capabilities, the system facilitates timely intervention and enhances patient care. Further development and refinement hold promise for broader applications in telemedicine and home healthcare.

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