



Smart Paroxysm Prediction Device and Life Saver System

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Abstract

Paroxysms, which are sudden episodes of abnormal activity or symptoms, can occur unpredictably and may lead to severe health consequences if not detected in time. This project proposes the design and development of a Smart Paroxysm Prediction Device using ESP8266 and MATLAB to continuously monitor vital physiological parameters and predict abnormal conditions leading to paroxysms. The system integrates heart rate, Galvanic Skin Response (GSR), temperature, and ECG sensors with an ESP8266 microcontroller. Sensor readings are displayed on an LCD screen, transmitted wirelessly to MATLAB, and processed using a fine decision tree machine learning algorithm to determine whether the parameters indicate normal or abnormal conditions. Additionally, an SOS button and GPS module are integrated for emergency alerts and real-time location tracking. Sensor data and prediction results are also sent to the ThingSpeak IoT platform for continuous monitoring and visualization, enabling proactive healthcare interventions.

Key terms:

IoT-Based Wearable Device, Heart Rate Variability (HRV), SpO₂ Monitoring, Galvanic Skin Response (GSR), SOS Alert System, AI-Powered Prediction

I. INTRODUCTION

Paroxysms are sudden occurrences of abnormal physiological or neurological events that can cause temporary impairment or pose significant risks to health. Early detection of abnormal patterns in vital signs can assist in preventing critical health emergencies. With advancements in IoT and machine learning, it is now possible to develop compact, real-time monitoring systems that can process health data efficiently and provide early

warnings. The proposed Smart Paroxysm Prediction Device continuously monitors multiple biosignals such as heart rate, skin conductivity, body temperature, and ECG readings. Data collected from the sensors is processed in MATLAB, where an advanced fine decision tree algorithm is employed to classify the condition as normal or abnormal. The inclusion of GPS tracking and SOS alerts further enhances patient safety, allowing caregivers or emergency services to respond promptly and Paroxysm diseases are the main explanation for death within the world these days, significantly in Republic of India. The requirement to predict this can be a serious necessity for rising the country's care sector. Correct and precise prediction of the guts illness in the main depends on EKG (ECG) knowledge and clinical knowledge. These data should be fed to a non-linear illness prediction model. This non-linear heart perform observance module should be able to find arrhythmias like cardiac arrhythmia, arrhythmia, infarction, atrial, cardiac arrhythmia, chamber flutters and PVC's. during this paper we've developed associate economical methodology to accumulate the clinical and graph knowledge, therefore on train the substitute Neural Network to accurately diagnose the guts and predict abnormalities if any. We tend to acquire the graph of the patient by customary three lead pre jellied electrodes. The nonheritable graph is then processed, amplified and filtered to get rid of any noise captured throughout the acquisition stage.

II. RELATED WORKS

[1] A Novel Wearable for Real-Time Automated Seizure Detection from EEG Signals The Smart Societal Optimization-based Deep Learning effectively enhances the prediction accuracy of paroxysms by leveraging societal inspired

optimization techniques for a result that is in a robust, high-performance seizure prediction model, facilitating early warning systems for epilepsy patients. Author : Mohanty, S. P. Kougianos and Sherratt, S.R Published Year : 2021 Proposed method :This paper demonstrates the successful application of Kriging methods for an effective seizure detection device in an edge computing environment by modeling the brain as a spatial panorama and the Parameters used are Reduced Feature Extraction Complexity and Signal Diagnosis also the advantages are Fast and Accurate Seizure Detection and Portable and Wearable Design. Limitations are Security, Privacy Concerns and Cost Accessibility.[2] A SMART approach to reducing paroxysmal atrial fibrillation symptoms: Results from a pilot randomized controlled trial Author : Gillian Gadenne, BS, Eric A. Macklin, PhD,x Jeremy N. Ruskin Published year: 2020 Proposed method : In this randomized, waitlist-controlled pilot trial, 18 subjects with PAF participated in an 8-week SMART Program delivered online immediately or 3 month later Parameters used are: Assesment and Allocation the advantage are Efficiency and Innovation the Limitation are Complexity and Data dependency. [3] Smart Societal Optimization-based d Deep Learning Convolutional Neural Network Model for Seizure Prediction Author :Pratibha S Sonawane and Jagdish B. Helonde Published year: 2019 Proposed method :The Smart Societal Optimization-based Deep Learning effectively enhances the prediction accuracy of paroxysms by leveraging societal-inspired optimization techniques for a result that is in a robust, high-performance seizure prediction model, facilitating early warning systems for epilepsy patients.Parameters used Accuracy andSensitivity.Advantage are Real-Time Monitoring Improved Prediction Accuracy.Limitations are Data Dependency and Hardware Constraints.[4] Epileptic Seizure Detection in EEG Signals Using Machine Learning and Deep Learning Techniques Author :hepseeba kode , khaled elleithy, laiali almazaydeh Published year: 2018 Proposed method :This study will be a pilot randomized controlled trial (RCT) designed to evaluate the feasibility and preliminary efficacy of a SMART (Specific, Measurable, Achievable, Relevant, and Time-bound) intervention to reduce symptoms of paroxysmal atrial fibrillation (PAF). Parameters are Optimization. Advantages are Early Seizure Detection and Automated Processes the Limitations are Computational Complexity and Interpretability.[5] Smart Societal Optimization-based Deep Learning Convolutional Neural Network Model for Seizure detection Author : Pratibha S Son S Sonawane and Jagdish B. Helonde Published year: 2022 Proposed method The Smart Societal

Optimization-based Deep Learning effectively enhances the prediction accuracy of paroxysms by leveraging societal inspired optimization techniques for a result that is in a robust, high-performance seizure prediction model, facilitating early warning systems for epilepsy patients.The Parameters are CNN modelling and Wavelet Processing Advantages are Real-Time Monitoring, Improved Prediction Accuracy .Limitations are Data Dependency and Hardware Constrains.

III. IMPLEMENTATION

Proposed Methodology:

The Smart Paroxysm Prediction Device will:

1. Interface heart rate, GSR, temperature, and ECG sensors with ESP8266 for data acquisition.
2. Display all sensor readings on an LCD screen for the user.
3. Transmit the sensor readings wirelessly to MATLAB for processing.
4. Implement a fine decision tree machine learning algorithm in MATLAB to classify conditions as normal or abnormal.
5. Integrate an SOS button for emergency alerts, triggering GPS data capture and notification.
6. Send all processed data and predictions to the ThingSpeak IoT platform for continuous monitoring and visualization.
7. Hardware Setup: Connect heart rate, GSR, temperature, and ECG sensors to ESP8266.

Interface an LCD to display live readings.

Connect GPS module for location data.

Add SOS button for emergency alerts.

8. Data Transmission:

Program ESP8266 to read sensor values and send them to MATLAB using Wi-Fi.

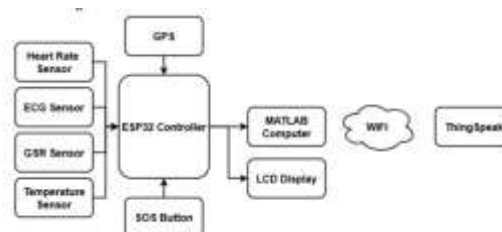
9. MATLAB Processing:

Acquire sensor data in real time.

Preprocess the data for noise removal and normalization.

Apply a fine decision tree machine learning model to classify the data into normal

HARDWARE IMPLEMENTATION



(Fig 3.1 Block Daigram of Smart Paroxysm Prediction and life saver system)

Heart Rate Sensor: In our Smart Paroxysm Prediction and Life Saver System, the heart rate sensor plays an essential role in continuously monitoring the patient's pulse. Seizures are often associated with sudden changes in heart rate, such as rapid increases or abnormal irregularities. By measuring beats per minute (BPM), this sensor provides crucial input to the ESP32 controller. The continuous tracking of heart rate ensures that our system can identify abnormal variations early, contributing to the timely prediction of paroxysms and safeguarding the patient.

ECG Sensor : The ECG sensor adds another layer of accuracy by recording the heart's electrical activity. Seizures can trigger abnormal cardiac patterns such as arrhythmias, spikes, or unusual waveform distortions, which are difficult to detect with just a pulse reading. In our system, the ECG sensor sends these detailed signals to the ESP32 controller for processing and further analysis in MATLAB. This helps predict seizure onset more reliably, making our project not just reactive but predictive in nature.

GSR Sensor: The Galvanic Skin Response (GSR) sensor is used in our project to measure the skin's electrical conductivity, which varies depending on sweat gland activity. Since seizures and stress activate the autonomic nervous system, the GSR sensor captures subtle skin resistance changes that often precede a seizure. By including this sensor in the system, we strengthen the accuracy of prediction by adding neurological and stress-related indicators, making the project more robust in real-world scenarios.

Temperature Sensor: In our design, the temperature sensor is used to monitor fluctuations in body temperature, which can sometimes accompany paroxysms. For instance, seizures may cause sudden rises or drops in body temperature due to metabolic or nervous system disturbances. By including temperature as an additional health parameter, our system ensures more comprehensive patient monitoring, supporting decision-making and improving the reliability of seizure prediction.

GPS Module: The GPS module in our project ensures that the patient's real-time location is always tracked. This is critical for emergencies because predicting a seizure is only useful if caregivers can respond quickly. When an abnormal condition is detected or when the SOS button is pressed, the GPS sends the patient's exact location to family members or healthcare providers. This guarantees timely assistance and transforms our system into a true life-saving solution.

SOS Button: The SOS button provides the patient with manual control in our project. If the patient feels a seizure coming or experiences discomfort before the system triggers an automatic alert, they can press

the SOS button to immediately send an emergency notification. This adds a human-driven safety feature to our automated monitoring system, ensuring that no critical event goes unnoticed.

ESP32 Controller: At the heart of our project is the ESP32 controller, which functions as the central processing unit. It collects data from all sensors—heart rate, ECG, GSR, and temperature—while also handling GPS inputs and SOS commands. The ESP32 preprocesses this data, displays results on the LCD, and communicates with MATLAB for advanced analysis. Its built-in Wi-Fi capability makes it the ideal choice for integrating IoT, making it the backbone of our smart prediction and life saver system.

LCD Display: The LCD display is used in our system to provide immediate, real-time information about the patient's condition. Parameters such as heart rate, ECG status, skin resistance, and temperature are shown directly, allowing the patient or nearby caregivers to track health status without requiring a smartphone or computer. This ensures that critical data is always visible locally in addition to being processed and transmitted remotely.

SOFTWARE IMPLEMENTATION

The Smart Paroxysm Prediction Life Saver System integrates hardware sensors with software tools to provide real-time health monitoring and emergency support.

Arduino IDE (for ESP8266 programming): The ESP8266 microcontroller is coded using Arduino IDE to acquire signals from sensors (heart rate, ECG, GSR, temperature) and transmit them wirelessly.

MATLAB with App Designer: MATLAB processes the received data, while App Designer creates an interactive user interface to display patient status.

MATLAB Machine Learning Toolbox: A Fine Decision Tree classifier is implemented to analyze biosignals and predict whether the condition is Normal or Abnormal.

ThingSpeak IoT Platform: Sensor readings and prediction results are uploaded to ThingSpeak, allowing caregivers to remotely track health data in real time.

Wi-Fi Network: Ensures continuous data transmission between ESP8266, MATLAB, and ThingSpeak for seamless monitoring. This combination makes the system a wearable, intelligent, and life-saving device, capable of early prediction of paroxysms and immediate emergency alerts with GPS support.



(Fig 3.2 Flow Chart of Smart Paroxysm Prediction and life saver system)

The proposed system workflow for smart health monitoring and emergency alert begins with the collection of physiological data from multiple biomedical sensors, including heart rate, galvanic skin response (GSR), temperature, and electrocardiogram (ECG). These real-time sensor readings are displayed on an LCD for immediate visualization by the user. The acquired data is then transmitted wirelessly using the ESP8266 Wi-Fi module to MATLAB for further processing. Within MATLAB, the data undergoes preprocessing to remove noise and standardize values, ensuring reliable input for analysis. A fine decision tree classification algorithm is applied to predict the health condition as either normal or abnormal. In the case of normal readings, the system continues monitoring and uploads the data to the ThingSpeak IoT platform for storage, visualization, and remote access. If an abnormal condition is detected, the system generates an alert and shares the data through the IoT platform for timely medical intervention. Additionally, an SOS mechanism is integrated to allow the user to manually trigger an alert in case of emergency. When the SOS button is pressed, the system captures GPS coordinates and sends an alert message with the location details to caregivers or emergency contacts. This dual-layered approach—automatic abnormality detection combined with manual emergency activation—ensures robust and reliable health monitoring. Finally, the continuous monitoring capability of the system enables real-time supervision of physiological conditions, enhancing patient safety and enabling proactive healthcare support decision support in medical image analysis. Overall, this approach provides a reliable tool for supporting timely and informed clinical decisions.

VI. RESULT

The simulation results highlight clear distinctions between normal and abnormal physiological states. Under normal conditions, heart rate, GSR,

temperature, and ECG signals remain within expected healthy ranges, showing stability with minimal fluctuations. In abnormal states, heart rate increases significantly, GSR values spike due to heightened stress, and body temperature rises above the normal range. The ECG waveform also exhibits amplified irregularities, indicating abnormal cardiac activity. These variations provide strong evidence that the system can effectively differentiate between healthy and risky conditions, enabling early detection of paroxysms and timely emergency alerts.



(Fig 3.3 Wave Forms and Output)

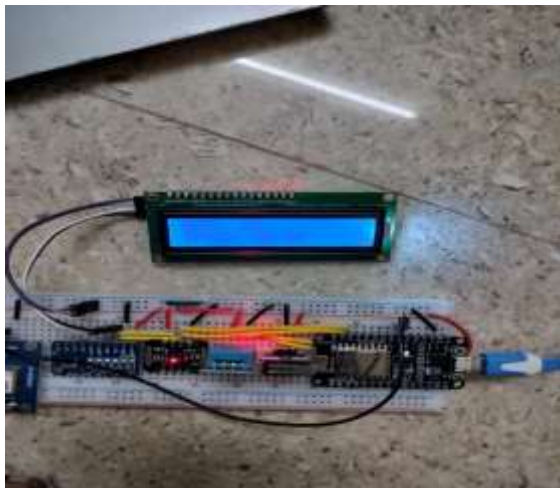
Heart Rate: Normal readings stay around 70–90 BPM, while abnormal conditions rise above 120 BPM.

GSR (Skin Conductance): Normal conditions show stable low variations, whereas abnormal states have sharp fluctuations due to stress or seizure onset.

Temperature: Normal body temperature is ~36.5–37.2 °C; abnormal states show elevated values (~38.5 °C).

ECG Signals: Normal ECG has stable rhythmic patterns, while abnormal ECG shows amplified

irregularities.



(Fig 3.4 Output)

V. CONCLUSION

The Smart Paroxysm Prediction Device successfully integrates IoT, machine learning, and real-time monitoring to address the challenges of unpredictable health episodes. By combining multi-sensor inputs such as heart rate, GSR, temperature, and ECG, the system ensures comprehensive health analysis. The implementation of a fine decision tree algorithm in MATLAB provides accurate classification of normal and abnormal conditions. With the addition of GPS and SOS functionalities, the device enhances patient safety by enabling rapid emergency response. Its IoT integration through ThingSpeak ensures continuous remote monitoring and visualization of patient health data. The portability and cost-effectiveness of the system make it suitable for both home-based care and clinical applications. This device not only provides early warnings but also empowers caregivers to take timely preventive actions. Overall, the system bridges the gap between conventional monitoring and predictive healthcare solutions. Hence, it stands as a promising innovation for improving medical response and patient well-being.

FUTURE SCOPE

Many patients particularly those in remote or isolated areas, lack access to constant medical supervision, with the increasing prevalence of IoT and AI technologies, it is now possible to provide continuous, realtime health monitoring and prediction without requiring hospital infrastructure. This project aims to harness the advancements to improve patient safety, response time, and healthcare monitoring outcomes, by using algorithms to detect abnormalities before critical events.

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