Synopsis

1) Project Reference Number: **46S_BE_3208**
2) Title of the project: **EPILEPSY SEIZURE ALERT SYSTEM USING IOT**
3) Name of the College & Department: **Electronics and Communication Engineering, Vidya Vardhaka College of Engineering**
4) Name of the students & Guide(s):

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5) **Introduction:**

Epileptic seizure is a transient occurrence of signs or symptoms due to abnormal excessive or synchronous neuronal activity in the brain. They are difficult to diagnose and treat because of their unpredictable nature. This disease is most recognizable by its frequent seizures, which are caused by an electrical imbalance in the brain. There are mainly two types: 1. Partial Seizures and 2. Generalized seizures. There are several symptoms which can even cause fainting and is typically accompanied by body parts shaking. First aid can be provided for seizure attack which is serious if less than 5 minutes. if it does not end within five minutes, medical assistance is required.

EEG is widely used for monitoring brain activities. But in this wearable device it makes use of ECG sensors to monitor the cardiac signals of human beings and to update the system by means of IOT. Using Machine learning, we examine a predetermined data set of diseased cardiac signal, pulse rate and body temperature. Remote monitoring of the patient's heart rate and movement should be possible with this for alerting when seizures occur. Using GSM caretakers will receive a notification alert with a live location in the event of a seizure trigger.

6) **Objectives:**

- To provide continuous monitoring and early detection of seizure activity in patients with epilepsy
- To provide real-time monitoring and alerts and enable early intervention and treatment

- To improve the accuracy of seizure detection by using sensors such as the pulse sensor and the ECG that can provide precise data on the intensity and duration of seizure activity
- To reduce the burden on caregivers and medical professionals
- To provide valuable insights into the nature of the condition
- To enable remote monitoring of patients
- To improve the quality of life for patients with epilepsy
- To transmit data to a cloud server
- To use machine learning algorithms for analysis

7) Methodology:

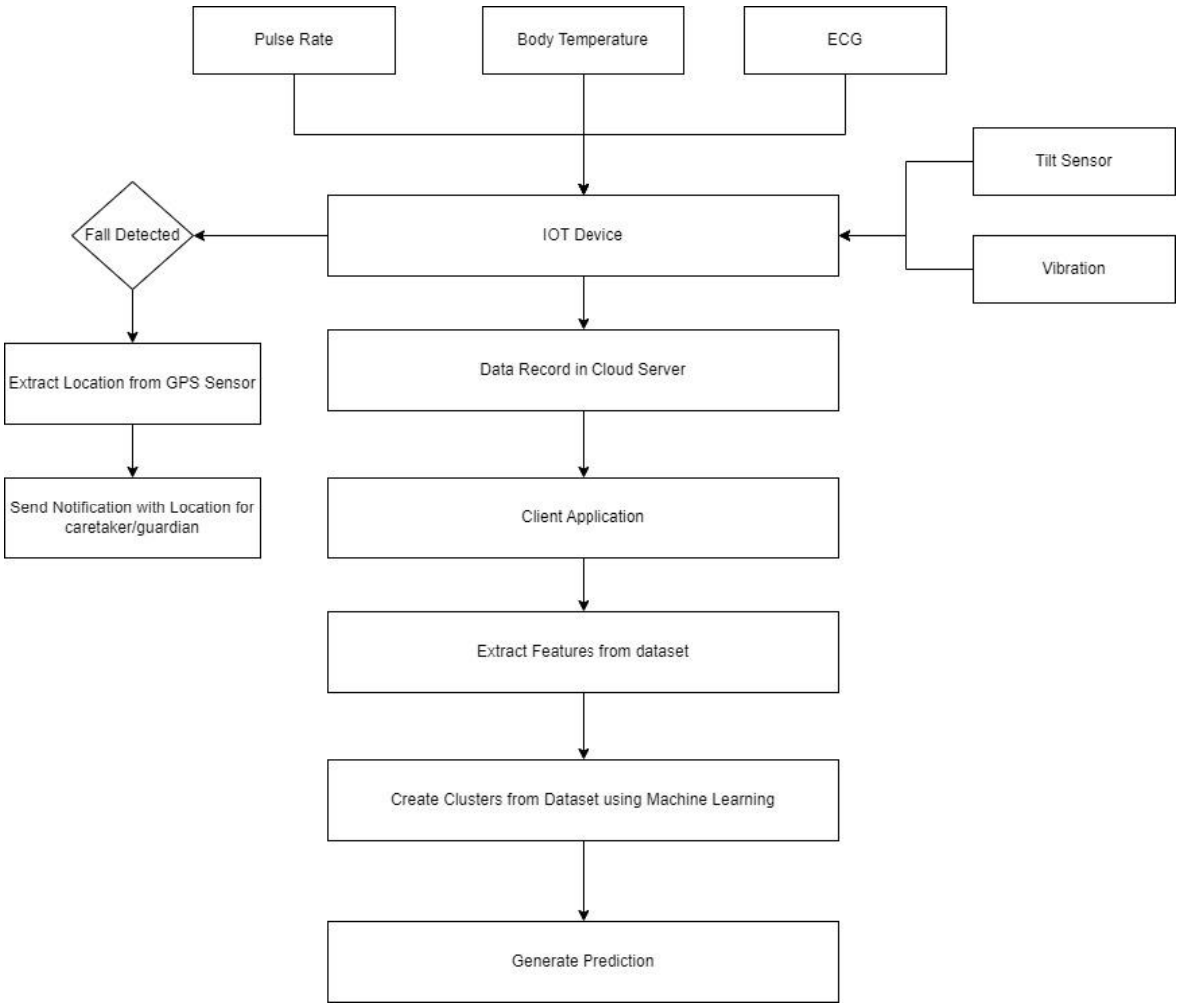

Fig 1. Flow diagram

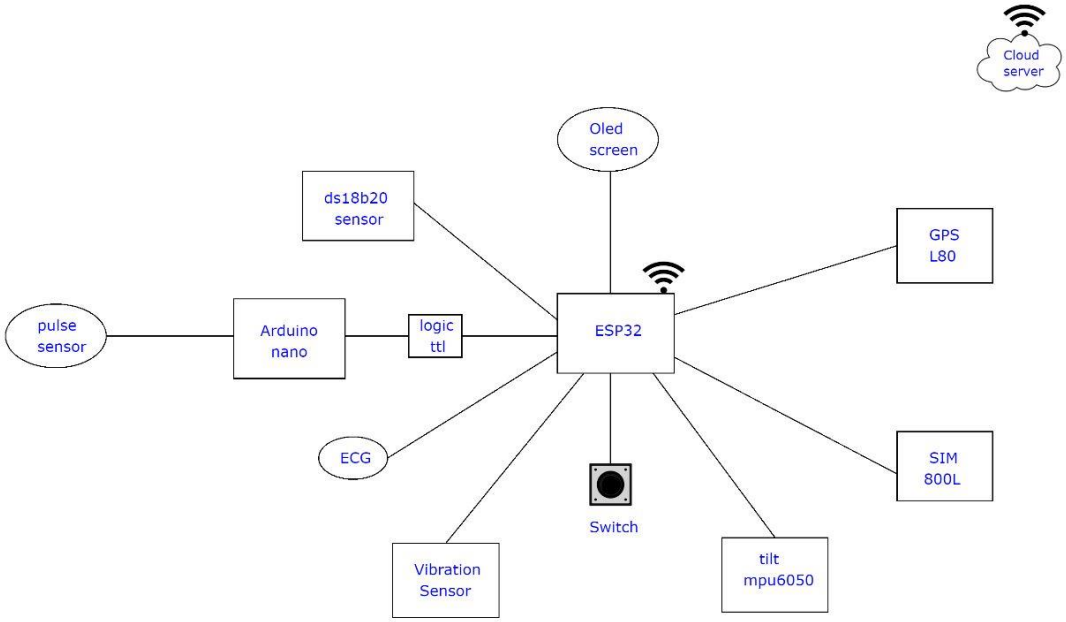

Fig 2. Block diagram

There are mainly 2 parts for the flow diagram as shown in Fig 1:

1. Detection system when seizures occur
2. Prediction of epilepsy using Machine learning

The working of an epilepsy management system using IoT devices involves the use of various sensors and data processing algorithms to monitor the patient's physical state and detect and predict seizure events. As seen from Fig. 2 the system consists of sensors such as 3-axis Tilt sensor mpu6050, vibration sensors, ECG, pulse sensor, and temperature sensor (using the ds18b20 sensor) that capture different types of data related to the patient's physical state. These sensors are connected to an IoT device ESP32, pulse sensor connected to Arduino Nano interfaced with ESP32, which collects the data and transmits it to a cloud server. It consists of GPS L80 module for live location and GSM Sim 800L to send SMS alerts.

The cloud server receives the sensor data and processes it using machine learning algorithms such as CNN, random forest, or logistic regression. These algorithms analyze the sensor data and detect any abnormal activity that may indicate an imminent seizure. Coming to the detection part when the person gets seizure attack, his body will experience vibration and he may fall. This fall is recorded by the tilt sensor where certain angle is set. So, through vibration and tilt sensor the seizure attack is detected and immediately the GSM module send the caretaker a notification with the live location of patient using GPS module.

As the ECG, pulse sensor and body temperature values are sent to cloud by ESP32, the data will be stored in Cloud server. The doctor or caretaker will be having an application or user interface where they can see all these data. The machine learning model then extracts the

features from dataset and will analyse the data. Then clusters are created based on sensors data like ECG, pulse and body temperature. Machine learning and deep learning algorithms like random forest, logistic regression and CNN algorithms are used to get prediction of seizure and that will be monitored by doctor or caretaker.

Health status can be monitored live with location by using Thinger.io open-source cloud. We have created a dashboard which displays all the information. It provides a convenient and easy-to-use interface for caregivers or medical professionals to control the system.

Later epilepsy predictor model is run by loading the dataset and processing it. It creates tables on 3 labelled datasets given i.e., ECG, pulse rate and body temperature and corresponding Seizure or Non-Seizure is detected. Likewise, three machine learning models are run and final Epilepsy is Likely or Epilepsy is Most Likely, either one of two outcomes come. Combined average accuracy of prediction model is shown at the end.

8) Results and Conclusions:

In order to detect and predict epileptic seizures, we have developed a system which is integrated along with multiple sensors connected to cloud through IoT and we have number of ML algorithms to provide us with utmost accuracy in described system. The system can provide continuous monitoring and early detection of seizure activity. The use of an OLED screen to display the data collected by the sensors provides caregivers and medical professionals with an easy-to-understand visual representation of the patient's condition shows when a seizure is detected, while the Wi-Fi connectivity and GPS technology enable remote monitoring. GSM module ensures timely alerts when a seizure is detected by sending an SMS to the caretaker’s phone.

Later epilepsy predictor model is run by loading the dataset and processing it. It creates tables on 3 labelled datasets given i.e., ECG, pulse rate and body temperature and corresponding Seizure or Non-Seizure is detected. Likewise, three machine learning models are run and final Epilepsy is Likely or Epilepsy is Most Likely, either one of two outcomes come. Combined average accuracy of prediction model is shown at the end. The individual accuracy of these algorithms varies, with CNN having an accuracy of 95-96%, random forest having an accuracy of 92-93%, and logistic regression having an accuracy of 93-94%. The system can also provide valuable data on the frequency and severity of seizures, using three ML algorithms which can help medical professionals to better diagnose and manage the condition.

Overall, the Epilepsy monitoring system using IoT devices has great potential for improving the management of epilepsy and other neurological disorders. With further development and testing, the system could become an essential tool for patients, healthcare professionals, and researchers working to better understand and treat these conditions.

9) Scope for future work:

There are several potential areas for future work and improvement in the detection of epilepsy using IoT technology. Some of these areas include:

- The development of more advanced machine learning algorithms to process the data captured by IoT devices. The accuracy of machine learning models can be improved by incorporating additional features and optimizing hyperparameters. The use of deep learning algorithms such as recurrent neural networks and long-short term memory networks can capture temporal patterns in the data and improve the accuracy of seizure prediction.
- Wearable technology, such as smartwatches and fitness trackers, can provide additional data on patient activity and health status with the epilepsy detection system to provide a more comprehensive picture of patient health.
- Development of sensors that are smaller, more accurate, and more sensitive to detect seizures and explore the use of new sensor technologies to improve the performance of the system.