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Design of a Smart Alert System for Epileptic Seizure Detection

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***Abstract*:**
This work addresses the problem of detecting seizures experienced by a epileptic patients. Earlier solutions to this problem are mostly based on detectingthe jerking motion due to seizures which are less accurate because of large number of false detection alarms. We seek a alternative that can sense epileptic seizures by sensing the variations in skin conductance of patient due to variations in electrical activity of brain. Since this moniters the electrodermal activity it provides high detection accuracy. The Galvanic Skin Response(GSR) sensor is used to detect this changes in the skin conductance. The Hybrid Neural Network which is a combination of Convolutional Neural Network(CNN) and Recurring Neural Network(RNN)is used fordataset classification of the GSR sensor output into occurrence of epileptic seizures and ordinary motions. Thus GSR sensors could potentially be used to detect epileptic seizures as the successfully detected the simulated seizures with small errors only in differentiating ordinary motion and no motion and give emergency alert using wifi module ESP8266 in nodeMCU.

Keywords:Epilepsy, Seizures, Galvanic Skin Response, NodeMCU, Hybrid Neural Network

INTRODUCTION:

Epilepsy is a common neurological disorder which occurs due to abnormal electrical activity of our brain and affects over 50 million people around the world.Epileptic patients generally have repeated seizures that start in the brain making it a physical abnormaility too. Seizures could be generally described as ‘fits’ or ‘attacks’.And they generally occur when there is an interruption in the normal activity of brain.Around 87 people are diagnosed with epilepsy every day. Nearly 12 million people out of 70 million worldwide epileptic patients belong to India which is approximately one-sixth of the global population. Patients with epilepsy have a high risk for injuries due to seizures. Sudden unexpected death in epilepsy (SUDEP) may also occur due to seizures. A smart seizure detection device will be a significant tool for helping these patients.We investigate the use of Galvanic Skin Response(GSR) sensors to sense the skin conductance which varies directly as the neural signals of the central nervous systems. Its output is classified from non-seizure signals using Hybrid Neural Network (HNN) algorithm in NodeMCU and notify caretaker and doctor using wi-fi. This HNN algorithm combines the Convolution Neural Network (CNN) and the Recurring Neural Network (RNN) thus making it more efficient than the other algorithms.

LITERATURE SURVEY:

Existing detection systems uses**Passive InfraRed Sensors** [1] to detect seizures of patient during sleep. It classifies seizure and non-seizure movements using **Machine Learning and 1D and 2D ConvNet** algorithms. The main drawback in this is that it could sense seizures only during sleep. And since it is non contact type it is less accurate and may give high amount of false alarms.

A similar existing system uses **3D Accelerometer** and **Electromyogram**[2] for inertial measurement and muscular activites to detect nocturnal seizures. It has a False detection rate of 5%.The main drawback here is that accelerometers may also detect non seizure movements many times. Also Electromyogram(EMG) sensor does not give a constant output all the time.

If we investigate application of other sensors for detecting epileptic seizures [3] demonstrates the use of **Galvanic Skin Response** (GSR) sensor in measuring **Mental health of a person**. It also the senses **ECG, temperature and motion** for a multimodal sensing capability. From this work we could extract the use of GSR to sense mental activity in order to specifically detect epileptic seizures for epilepsy patients and create an alert to the caretakeras well as doctor regarding patient’s current situation.

In another study [5] they design a wearable sensor that measures Electrodermal Activity (EDA) to monitor the activity of sympathetic nervous system during epileptic seizures, This work investigates the sudden surge in EDA during two types of seizures that are Generalized Tonic Clonic Seizures (GTCS) and Complex Partial Seizures (CPS), But this does device any method to distinguish seizures from normal movement and indicate them.

BLOCK DIAGRAM:

The basic architecture of the smart alert system for epilepsy detection can be represented with the help of a block diagram; the simplest one in shown in Figure 1.

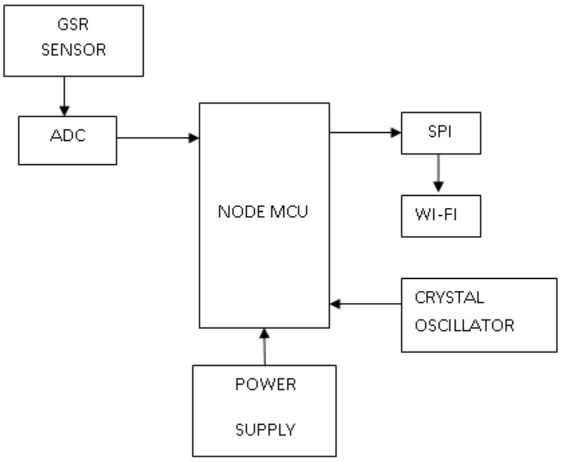


Figure 1:BLOCK DIAGRAM OF EPILEPTIC SEIZURE DETECTION SYSTEM

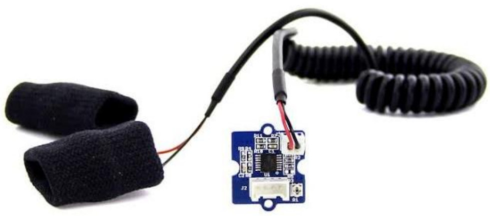
HARDWARE AND SOFTWARE SPECIFICATIONS:

- **Galvanic Skin Response(GSR) sensor**

  Usedtodetectskin conductance variation which varies as the electrical activity of brain changes.

Input voltage – 3.3v-5v

Sensitivity – adjustable using potentiometer



- **NodeMCU(ESP 8266)**

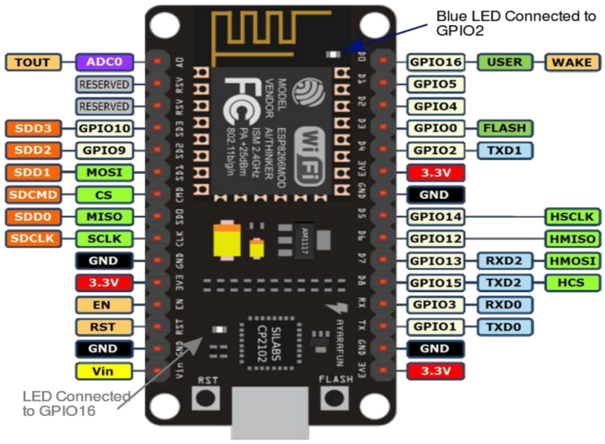
  NodeMCU is an open source IoT platform. It consists of a firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

Memory: 128kBytes

CPU: ESP8266(LX106)

Storage: 4MBytes

Power: USB



- **12V POWER SUPPLY**

  Acts as a source of power for the

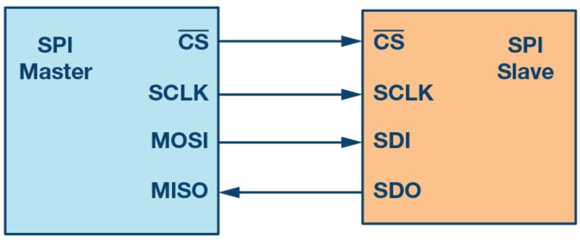
whole device and facilitates non wired

operation of the device

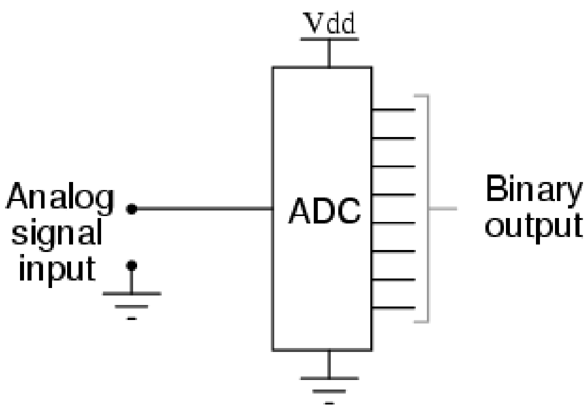
- **SPI:**

Serial Peripheral Interface(SPI) is an interface bus which is commonly used for communication between microcontroller and serial peripheral devices like sensors, SD cards etc.,.SPI communicates in a full duplex mode with a single master. The master device originates the frame for reading and writing. This supports multiple slave devices using selection methods involving selection with individual slave select (SS), sometimes called chip select (CS) lines.

Sometimes SPI is a *four-wire* serial bus, which is a contrast to the three, two and one wired serial buses. The SPI is a Synchronous Serial Interface (SSI), but differs from the SSI protocol, which is afour-wiredsynchronous serial communication protocol. The SSI protocol provides only a single simplex communication channel and employs differential signaling . SPI communicates by single master and multiple slave.



- **ADC:**
ANALOG TO DIGITAL CONVERTERS are used for Data acquisition.ADC is a system which is used to convert the input anolog signal which comes from the GSR sensor into digital signal,so that NodeMCU can read, process and store the data



- **SOFTWARE REQUIREMENTS**

Arduino IDE for programming the NodeMCU containing ESP8266 WiFi Module

WORKING:

In this system, we use NodeMCU(ESP8266) which acts as brain of the system, because the entire system program instructions are stored in it. Here we have used GSR sensor to monitor electrodermal activity of patient by sensing the skin conductance. Skin conductance varies due to variation in electrical activity of central nervous system. Hence seizure related signals could be identified from Non-seizure activities by Hybrid Neural Network(HNN) which is a combination of Convolutional Neural Network and Recurring Neural Network.Once an epileptic seizure is detected caretaker of the patient and a doctor could be notified through WiFi.

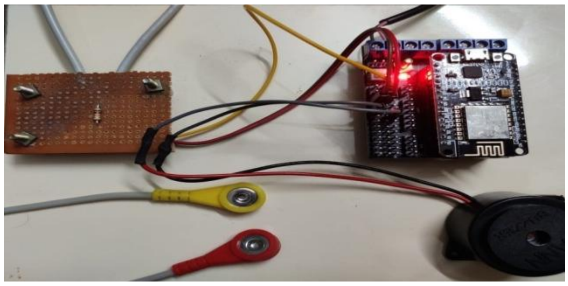


Fig.Proposed system

The architecture of a simple Hybrid Neural Network is depicted as follows.

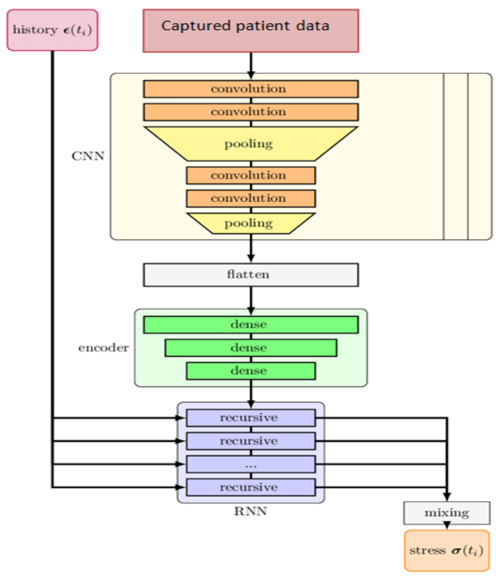
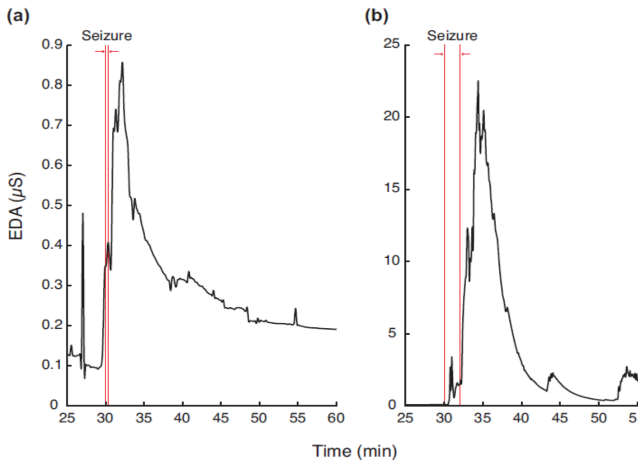


Figure 2: FLOW DIAGRAM OF HYBRID NEURAL NETWORK

RESULTS:



EDA changes during a (a) CPS and (b) GTCS

The above figure shows the variation of EDA (Electrodermal Activity) during twodifferent types of seizures. Fig (a) shows thatEDA increases around 0.7 µS in Complex Partial seizures (CPS) whereas during the General Tonic Clonic Seizures (GTCS)(Figb), EDA increases by around 20 µS. The EDA values shows a rapid shootup during both type of seizures, this surge remains for a certain time period and then shows a slow decay.

CONCLUSION:

This HNN based epileptic seizure detection device proved to be useful in detecting seizures and intimating the caretakers and doctors about it using wifi. Its detecting efficiency could be further improved by integrating multiple sensors with this device.

REFERENCES:

1. Ouday Hanosh1 Rashid Ansari2 Khaled Younis3 A.Enis Cetin4 "Real-Time Epileptic Seizure Detection during Sleep using Passive Infrared (PIR) Sensors" 1558-1748 (c) 2018 IEEE
2. Mostafa Gheryani, Osman Salem, and Ahmed Mehaoua "An Effective Approach for Epileptic Seizures Detection from Multi-Sensors Integrated in an Armband" 2017 IEEE 19th International Conference on e-Health Networking, Applications and Services (Healthcom)
3. Bruno M. G. Rosa*, Member, IEEE and Guang Z. Yang, Fellow, IEEE"A Flexible Wearable Device for Measurement of Cardiac, Electrodermal and Motion Parameters in Mental Healthcare Applications" 2168-2194 (c) 2019 IEEE.
4. "Pediatric Sleep Stage Classification Using Multi-Domain Hybrid Neural Networks" YONGHOON JEON1, SIWON KIM 2, HYUN-SOO CHOI2, YOON GI CHUNG1, SUN AH CHOI3,4, HUNMIN KIM 3, SUNGROH YOON 2,5, (Senior Member, IEEE), HEE HWANG 3, AND KI JOONG KIM6,7, VOLUME 7, 2019 IEEE Access
5. "Continuous Monitoring of Electrodermal Activity During EpilepticSeizures Using a Wearable Sensor" Ming-Zher Poh, Student Member, IEEE, Tobias Loddenkemper, Nicholas C. Swenson, Shubhi Goyal,Joseph R. Madsen and Rosalind W. Picard, Fellow, IEEE. 32nd Annual International Conference of the IEEE EMBSBuenos Aires, Argentina, August 31 - September 4, 2010