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DIAGNOSIS OF NEURAL DISORDER USING ELECTROENCEPHALOGRAPHY (EEG)

Dr. D. BINU [1]

[1] *ECE Department, Sri Ramakrishna Institute of Technology, Coimbatore*.

Abstract - Electroencephalography is the process of recording of electrical activity along the scalp. The EEG signal reflects the potential changes which occurs on pyramidal cell. Depending on the received signals, epileptic seizure and sleep patterns can be monitored and diagnosed**.** Wearable Electroencephalography is envisioned as the evolution of ambulatory EEG units. Recent systems are made smaller in size with long lasting capacity. For low-power, easy to use, portable systems, the channel count should be minimized without affecting the diagnostic accuracy. The signals from the electrodes are amplified and digitized via an analog to digital converter, and it is transmitted to the computer using ZIGBEE module and further analysis is made. By using, MATLAB coding waveforms are obtained. Then the disorder can be diagnosed by the doctors at hospital. Also, there is no need to go hospital for often checking. The readings are noted in home and it is sent to doctors by internet, doctors will diagnose the disorder and send the prescriptions.

***Key Words*:** electrical activity, diagnostic accuracy, sleep patterns,EEG.

1.INTRODUCTION

Brain's spontaneous electrical activity is recorded using multiple electrodes placed on the scalp for a short period of time, normally 20-40 minutes[1]. In conventional scalp EEG, the recording is obtained by placing electrodes on the scalp with a conductive gel or paste, usually after the preparing the scalp area by light abrasion to reduce impedance due to dead skin cells. Some systems use caps or nets into which electrodes are embedded; this is particularly common high-density arrays of electrodes are needed. High density arrays can contain up to 256 electrodes more or less evenly spaced around the scalp. Electrode locations and names are specified by the international 10-20 systems for most clinical and research applications. 10-20 systems – actual distance between adjacent electrodes either 10% or 20% of the total front-back or right-left distance of the skull.

A person's brain wave patterns and muscle stimulation can be measured and recorded using almost identical measurement techniques[2]. With accurate results, researches will soon be able to show a detailed direct relation between mental thought and physical motion, improve communications with lacking motor skills, and much more[3]. EEG signals are measured by placing electrodes on the head around the brain. Between certain electrodes, a potential difference is measured and converted into a waveform (EEG signal)[4]. EEG diagnosis millisecond range temporal resolution which is not possible with CT or MRI.

A typical adult human EEG signal is about 10 microvolt to 100 microvolt in amplitude when measure from the scalp. Presently, there are already many uses for EEG and EMG. EEG testing can be used to diagnose seizure disorders, head injuries, tumours, causes of confusion, and a lot of other brain related abnormalities[5][6]. EMG testing can be used to diagnose neurological disorders and muscle injuries. In neurology, the main diagnostic application of EEG is in the case of epilepsy which is a disorder of nervous system causing convolution and loss of consciousness, coma, encephalopathy and brain death, studies of sleep and sleep disorders [7].

2. DIAGNOSIS OF NEURAL DISORDER USING PROPOSED ELECTROENCEPHALOGRAPHY

EEG may also used to monitor Depth of anaesthesia and Cerebral perfusion in carotid endarterectomy. EEG mostly used in intensive care units(ICU) for brain function monitoring in order to monitor for non-convulsive seizures/non-convulsive status epileptics and to monitor the effect of sedative/anaesthesia in patients in medically induced coma.

2.1.Block Diagram

Electrode, EEG amplifier, PIC microcontroller, UART, ZIGBEE transmitter and receiver, LCD display are used in the project. The block diagram is represented in Fig.1.

The EEG waves from the brain are detected by the electrodes. The electrodes are placed on the scalp, over a EEG sticker. The outputs from electrodes are sized in micro volts, so the signal has to be amplified. The Amplifier stage is used to amplify the voltage of the incoming signal. The amplified signal is in the range of 0 to 5volts. This signal is an analog signal. This analog signal has to be converted into digital for processing in microcontroller, so the signal is given to the ADC. The PIC microcontroller has inbuilt analog to digital convertor.

The conversion process is carried out here and thus the analog signal is converted into digital format. The converted signal is given to the microcontroller for further process to be carried out and then it is stored in the memory. It can also be viewed in LCD. The stored data is transmitted to the Personal Computer through UART in the microcontroller using ZIGBEE. The data received by the computer, in which the MATLAB coding is done and it is converted into waveforms.

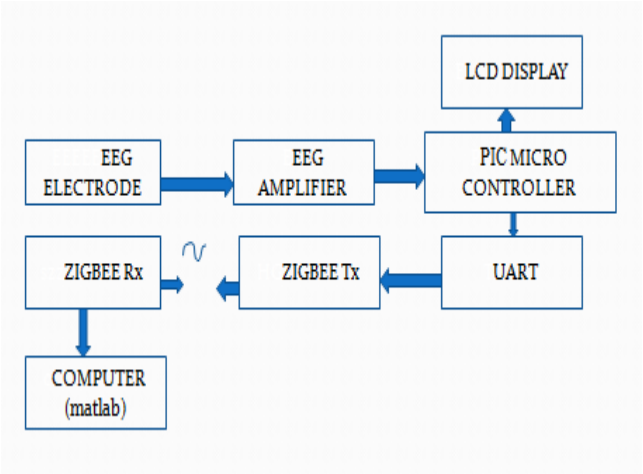

Fig -1: Block Diagram of EEG Measurement

The brain waves are collected by the EEG electrodes and it is interfaced with computer using serial cable. The voltage levels are collected by the electrodes and it is stored in the microcontroller. By using, MATLAB coding we are converting the voltage levels read by the electrodes into waveforms. The waveform which is generated is compared with the waveform in the database at hospitals. Then the disorder is diagnosed. Also, there is no need to go hospital for often checking. The readings are noted in home and it is sent to doctors by internet or any other person other than the patient can take it to hospital. If it is sent by internet, doctors will diagnose the disorder and resend the prescriptions to be followed.

2.2. EEG Electrode

- WET OR CONTACT ELECTRODES
- DRY OR NON-CONTACT ELECTRODES
- FLEXIBLE ELECTRODES

3. RESULT AND DISCUSSION

The brain waves which are collected using electrodes are amplified by EEG amplifier, converted to digital format and also connected with RS232 converter and LCD using PIC microcontroller. The varying output voltages are viewed in LCD. This value is viewed also in computer by connecting RS232 serial communication port. The prototype model of the proposed system is shown in fig.2.

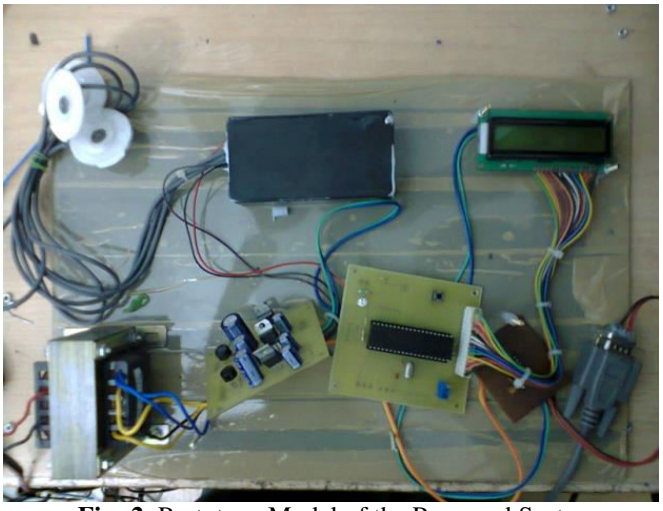

Fig -2: Prototype Model of the Proposed System

3.1. Simulation Result Using Proteus Software

The result shows the transferring and receiving of the varying EEG voltages are displayed in LCD using proteus software is shown in Fig.3.

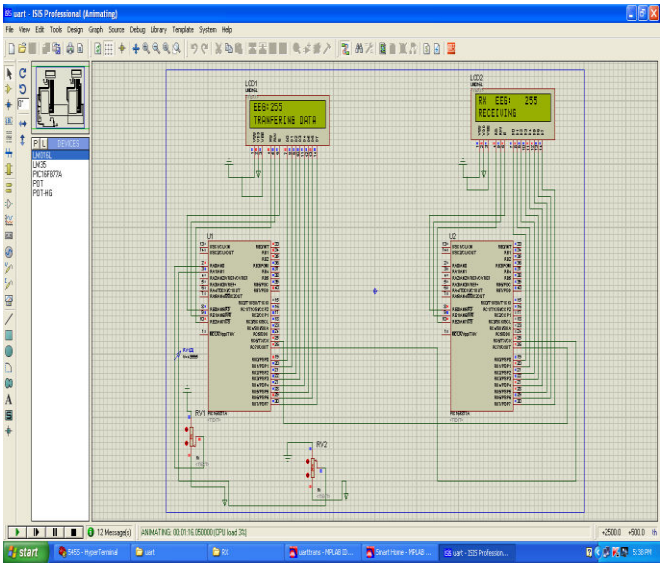

Fig -3: EEG voltages using proteus software

The voltages from the EEG results by simulation using MATLAB software is shown in Fig.4.

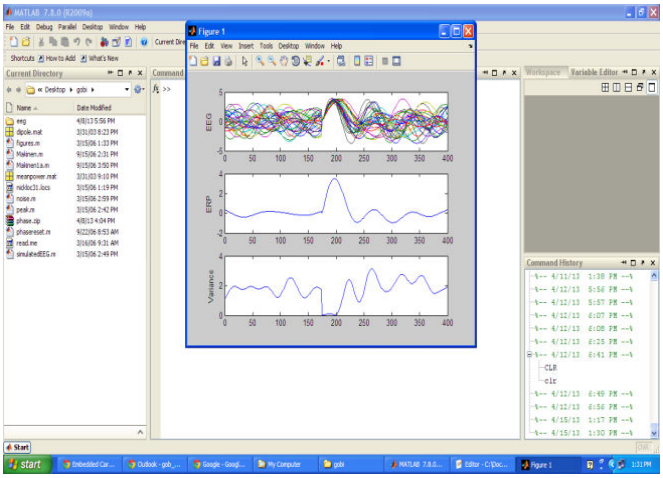

Fig -4: EEG Signal using MATLAB Simulation

The simulated ERP result is shown in Fig.5.

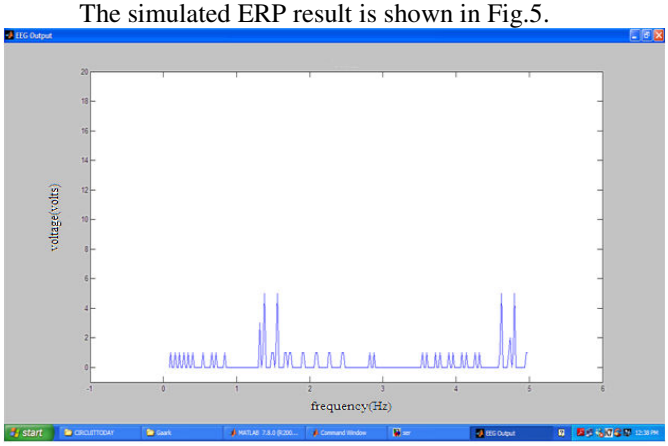

Fig -5: EEG OUTPUT-ERP SIGNAL

3.1. Comparison Graph

The Noice Vs Frequency is calculated by :

N=(1-(1/a.v))f-(1/o.v)f -------(3.1)

where, N=Noise
a.v=actual value
o.v=observed value
f=frequency

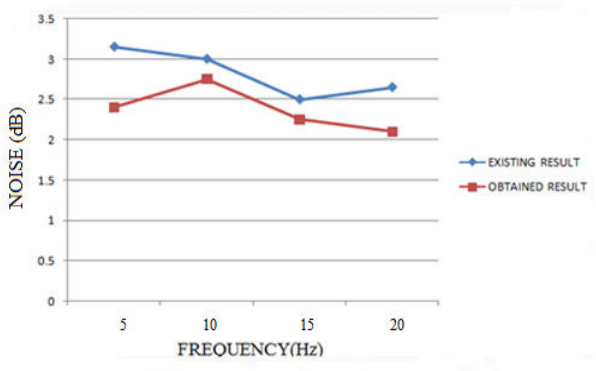

Fig -6: Noise Vs. Frequency Graph

The Accuracy Vs Voltage is calculated by:

A=(a.v*(a.v-o.v))/a.v ----------(3.2)

where, A=accuracy
a.v=actual value
o.v=observed value

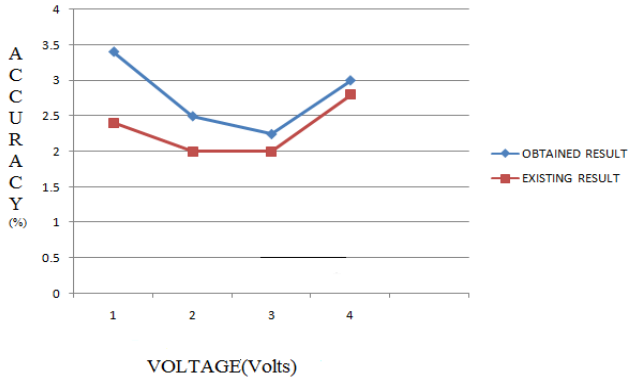

Fig -7: Accuracy Vs Voltage Graph

3. CONCLUSIONS

EEG testing can be used to diagnose seizure disorders, head injuries, tumours, causes of confusion, and a lot of other brain related abnormalities. Features of EEG testing are that certain frequencies of operation determine one's state of consciousness. This type of signalling demonstrates a high probability that a random user will be capable of intentionally generating and controlling a generic alpha band signal which assist the person who lost the speech and physical motion activities. Another huge area of research interest is the ability to relate mental thought with physical motion through accurate EEG observations. The main application of this technology thus far, is neuro-feedback training. Neuro-feedback training is a mental training method in which the patient becomes consciously aware of the general activity in the brain. This improves many mental capabilities and helps explore one's consciousness. This has huge medical applications for the paralyzed, epileptic and others. The future applications of EEG are as awe inspiring as they are concerning. Imagine if EEG became so precise that a computer automatically knew what you were thinking. Disabled people could communicate freely. Virtual reality video games could be played by simply thinking about the desired action.

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