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## Smart Solar EEG with Bluetooth Transmitter

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**ABSTRACT:** EEG is used to diagnose epilepsy, dementia, sleeping disorders like narcolepsy and problems related to brain, spinal cord and nervous system. The EEG used in hospitals extremely work on line voltage. As 63% of rural areas in India have no electricity they are denied to access EEG machine. The cost per test is expensive leading to number of death in rural areas. In this project a portable, light weight, smart solar powered EEG capable of acquiring 30-35 hours of continuous EEG data is proposed. The device being solar powered eliminates the dependency on electricity and being low cost gives access to common man. The device is also smart in enabling to the user how much the charge is left with the device and the power is off during monitoring of an EEG. The EEG is also transmitted to mobile phones or computer using Bluetooth transmitter.

**KEYWORDS:** EEG, Solar Energy.

### I. INTRODUCTION

EEG is a method of recording electrophysiological activity of brain. It is typically non invasive in which the electrodes are placed on the scalp. EEG measures voltage fluctuations resulting from ionic current with the neurons of the brain. Therefore EEG is most often used to diagnose epilepsy. It is also used to diagnose coma, sleeping disorders, encephalopathies and brain death. EEG is used to diagnose tumours, stroke and other focal disorders. EEG is a continues and a valuable tool for research and diagnosis, especially when millisecond range temporal resolution (which is not possible with CT or MRI) is required.

The electroencephalogram is the electrical activity occurring at the surface of the brain. This activity of the brain is displayed on the screen of the EEG machine as waveforms of varying frequency and amplitude measured in voltage (specifically micro voltages and milli voltages). EEG waveforms are generally classified according to their amplitude, shape, area of placing the electrodes and their frequency at which they are recorded. The most familiar classification uses EEG waveform frequency (e.g. delta, theta, alpha, and beta).

The waveform frequency and shape information is together with the patient's age, sleep or state of alertness and location on the scalp to find the importance. In the normal EEG waveforms, many kinds of waveforms are briefly explained by analyzing their frequency, amplitude, and where it is located. Frequency (Hz) is used to define normal or abnormal EEG signals or rhythms. In the awake adult normally they find higher frequencies, mainly above 8Hz. In the awake adults the frequency will be 7Hz or less than 7Hz. It is mostly referred as abnormal. Even though they basically can be able to see in children or in adults who are not able to sleep. In this type of situations, EEG waveforms with an particular frequency for age and state of alertness are always considered to be abnormal because they occur at an inappropriate scalp location or amplitude and it may cause irregularities in rhythmicity. Few waves are identified by their shape, then the scalp location or spread and distribution of the waves, and symmetry. Certainly patterns are normal at some specific age or sleep and state of alertness. The characteristics of a waveform may similar to some specific shapes, such as vertex waves may seen over the vertex of the scalp region in the stage 2 sleep. This EEG wave is transmitted to mobile phones or computer using Bluetooth transmitter.<sup>[4][5]</sup>

### II. RELATED WORK

In conventional scalp EEG, the conductive gel or paste is applied on the electrodes of the scalp to record the EEG signal, commonly after preparing the scalp area by light excoriation to decrease impedance due to dead skin cells.

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Many scheme exhibiting the qualities of using electrodes, each of them is attached to a singular wire<sup>[8]</sup>. Some schemes use caps or nets into which electrodes are enclosed; this is particularly having no special distinction when high density arrays of electrodes are needed.

Electrode locations are nominative by the International 10–20 electrode system<sup>[9]</sup> for most clinical application and research (except when high density arrays are used. In some clinical applications, 19 electrodes (plus ground and system reference) are used for recording. To record EEG for neonates' smaller number of electrodes is used. Furthermore, electrodes can be added to the standard set up when a clinical applications or research application demands increased spatial resolution for a peculiar area of the brain. High-density arrays (specifically via cap or net) can incorporate up to 256 electrodes. Each electrode is connected to one input of a differential amplifier (1 amplifier per pair of electrodes); a common reference electrode is connected to the other input of each differential amplifier. The connected amplifiers amplify the voltage between the active electrodes. In analog EEG, the signal is filtered, and the EEG signal is output as the deflection of pens as paper passes on the downward side. Most EEG systems nowadays, however, the digital, and the amplified signal is digitized through by analog-to-digital converter, after being passed through an anti-aliasing filter.<sup>[5][7]</sup>

A series of activation procedures may be used during the recording period. These procedures may lead to normal or abnormal EEG activity. It also includes hyperventilation, photic stimulation (with a strobe light), eye closure, mental activity, sleep. During epilepsy monitoring, a patient's typical seizure medications may be withdrawn .The EEG signal is stored electronically. And it can be filtered for display.

### III.SYSTEM DESCRIPTION

Flexible Solar strip was used. The solar cell absorbs sunlight during the day and converts it into electricity. It is made up of monocrystalline silicon. It generates power about 12v and 5w. The charging time for the solar panel is about 4-5 hours and the will get charged by the sunlight. The output which is obtained by the solar panel is DC current. It can be either damaged by mechanical or moisture. We are used flexible thin film solar strip. Here, we are using 12V lead acid battery. The energy is produced by solar panel which is stored in battery. The circuit needed some external power supply for that the battery is used. By using EEG electrodes we are getting electrical signals. The electrodes used here is passive electrode, mainly 4 electrodes are used one is ground electrode and another one is reference electrode. There is a channel which is commonly called as electrode cabling, in this in one channel there is two electrodes will be available. One of the electrodes is positive and another one is negative and it is used to manipulate the input voltage difference. The positive input and negative input is used to reject the common mode signals.

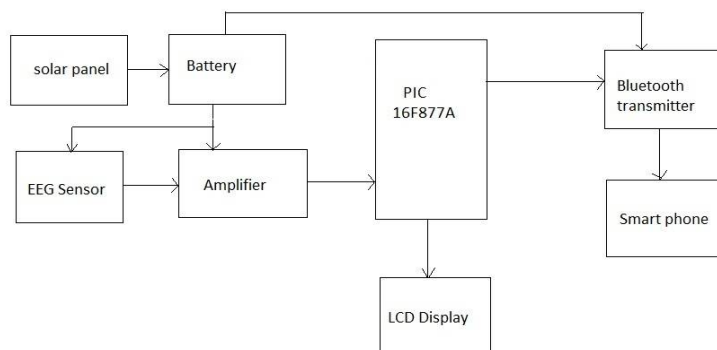


Fig.1 Block Diagram

The amplitude of the EEG signal is very low so that the amplifier circuit is used to amplify the incoming signal, we are using three different types of amplifier in this circuit, they are inverting amplifier, non inverting amplifier, and

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differential amplifier. For removing distortion or noise in the signal we used some filters called low pass filter, high pass filter and finally the notch filter. Typical range for the high pass filter and a low pass filter are 0.5-1 Hz and 35–70 Hz, respectively. The high pass filter removes the slow artifacts such as electro galvanic signals and movement artifacts and the low pass filter removes the high frequency artifacts such as, electromyography signals. Notch filter also does the same job but removes the electrical power line interference (range 50Hz).

The PIC used here 16F877A. For programming embedded c language is used. The reason for choosing PIC is it is very cheap while compare to all other microcontrollers and also ADC is inbuilt. It acts as 8-bit processor interface. It has 40 pins. In this controller, 'PORT A' is only 6bits (RA-0 to RA-7). PORT B, PORT C, PORT D is only 8bits. PORT C has only 3bits (RE-0 to RE-2). All these ports are bidirectional. The direction of the port is controlled by TRIS(X) registers. Analog input ports are used for interfacing analog inputs. TX & RX are the USART transmission and reception ports. The program for microcontroller is written in EPROM. While doing process for the program it is stored in the RAM. The reason for programming the PIC microcontroller to define the input port and to send the data from the LCD to Mobile phone. All the instruction are single cycle except for program branches which are 2 cycle. It uses 3 addressing mode like direct, indirect and relative.

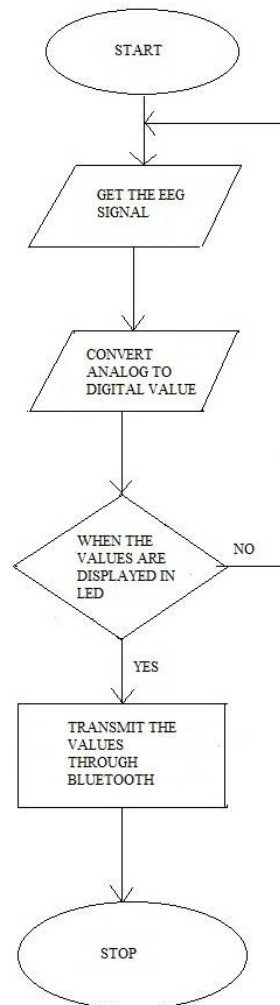


Fig. 2 Flow chart of Microcontroller Program

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The EEG values which is obtained in the LCD board, and In the LCD values will be in digital format. The LCD display used here is 16\*2. The frequency and the amplitude will be displayed in the LCD. The Bluetooth is connected with microcontroller and the digital values are converted into the analog form then it is displayed in the mobile phones it may be android versions. The version of the Bluetooth is 4.0. In the 4.0 Bluetooth versions we can send the information or data up to 24mega bit<sup>[1][2][6]</sup>. In smart phone, the version should be 4.0 then only we can send the information to other mobile phones otherwise we cannot share the data. But in the smart phone the app is not an inbuilt so we created a separate program to develop an app by the software called eclipse. In this eclipse mainly we developed a java application. It is mainly suitable for few OS such as LINUX, Mac OS X, Solaris, and Windows. Presently the version using for eclipse software is 4.5

### IV. EXPERIMENTAL RESULTS

The figure shows a noise free EEG waveform which can be used for diagnostic purposes by the clinician. It depends on patient and the waveform which we got is based on patient's brain activity and it shows whether the patient has any sleeping disorder or normal.

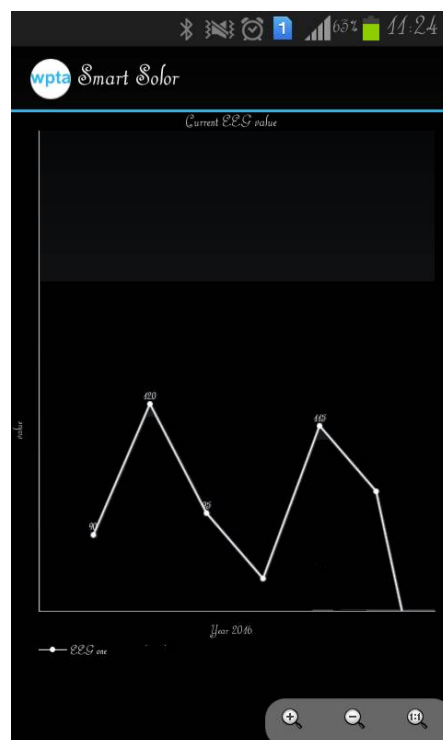


Fig.3 Output EEG waveform

### V. CONCLUSION AND FUTURE WORK

The EEG signal is acquired finally by placing the electrodes in the scalp of the humans. We are used smart solar panel so that we can use it from our own place and it is also easy to use and it can be transmitted to the physicians or doctors through the Bluetooth transmitter. But in the Bluetooth we can transfer the signals for only short distance such that it can be modified in future technology.

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