SYSTEM TO RECORD BRAIN WAVES

Madhavi Repe[1] , Navneet Pandey[2] , Tarun Yadav[3] , Vyankatesh Jorwekar[4]
Department of Electronics and Telecommunication Engineering
[2,3,4] Dr.D.Y.Patil Institute of Technology, Pimpri Pune-411018
[1] Assistant Professor, Dr.D.Y.Patil Institute of Technology, Pimpri Pune-411018

Abstract- *In this paper, we proposed an approach to detect or record the brain waves using EEG sensor, which reflects certain brain waves functions. A MATLAB based algorithm has been developed to detect the brain wave signals obtained from a real time EEG data acquisition system corresponding to different moods of the subject people. EEG data of different peoples having different moods were used to verify the feasibility of the approach and the obtained results ensured its effectiveness*

I. INTRODUCTION

What is Brain Wave?

Brain waves are the language of the brain. The electrical activity sensed in the brain generates frequencies in waves which can be measured with Electroencephalography (EEG) and are calculated in two ways. The first is in frequency, which represents the number of times a wave repeats or cycles per second, called Hertz. The second is amplitude which measures the power of the electrical impulses in the distance between the peak and valleys that form the wave.

Brain waves are definitely attached with and are produced in our brain. Our emotions, chemical activities, thoughts are communicated through the neurons. Neurons, which are the brain cells and building block of central nervous system, communicate with each other in the form of electrical pulses and signals. Millions of signals communicate with each other producing electrical activity in our brain. This, in turn produces Brain waves around our scalp and can be measured by measuring electrical activities near the scalp. These electrical activities are called waves as these have wave type shape and nature.

Over-arousal- This leads to sleep disorders, impulsive behavior, spasms, anxiety disorders, anger and aggression Under-arousal- This leads to insomnia, depression, lack of attention span and chronic pain. Brainwaves can be detected through sensors that are placed on the scalp through a procedure known as electroencephalogram (EEG).

II. WHY BRAIN WAVES ARE IMPORTANT

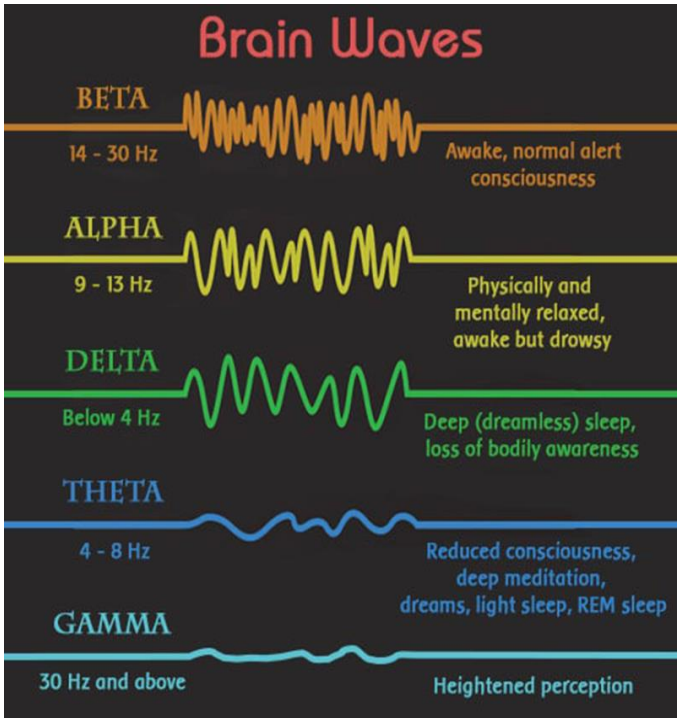
Brainwaves are important, because they are the "signatures" of what is happening inside the brain.

Research has shown that specific brainwave patterns mean that you're in a particular state of being. If an EEG reading shows you're emitting a 1Hz signal, there's no question about it – you will be in a deep, healing sleep. If you're at 10Hz, you're going to feel generally calm, detached, and relaxed and there are other patterns to be found. People encountering flashes of inspiration are often in very specific alpha frequencies, periodically sparking up into gamma. People with high focus levels are typically found at the 14Hz "sensor motor rhythm." People in a good mood are found with high serotonin levels, the release of which is triggered by the 10Hz frequency.

III.TYPES OF BRAINWAVES

The Brainwaves contain a spectrum of frequencies mainly between 1Hz – 100Hz. A picture of the spectrum, which I had taken while studying about the Brain wave, is shared below.
The spectrum is divided in 5 major types named as:
1. Delta Wave
2. Theta Wave
3. Alpha wave
4. Beta Wave
5. Gamma wave

Features of different brain waves



IV.BLOCK DIAGRAM

WORKING:

EEG SENSOR:

Electroencephalography or EEG, is the physiological method of choice to record the electrical activity generated by the brain via electrodes placed on the scalp surface. For faster application, electrodes are mounted in elastic caps similar to bathing caps, ensuring that the data can be collected from identical scalp positions across all respondents.

Despite its somewhat daunting name (and pronunciation), grasping the essentials of electroencephalography is surprisingly simple:

EEG:

•measures electrical activity generated by the synchronized activity of thousands of neurons (in volts)

•provides excellent time resolution, allowing you to detect activity within cortical areas -even at sub-second timescales

As the voltage fluctuations measured at the electrodes are very small, the recorded data is digitized and sent to an amplifier. The amplified data can then be displayed as a sequence of voltage values.

Price differences in EEG systems are typically due to the number of electrodes, the quality of the digitization, the quality of the amplifier, and the number of snapshots the device can take per second (this is the sampling rate in Hz).

EEG is one of the fastest imaging techniques available as it often has a high sampling rate. One hundred years ago the time course of an EEG was plotted on paper. Current systems digitally display the data as a continuous flow of voltages on a screen.

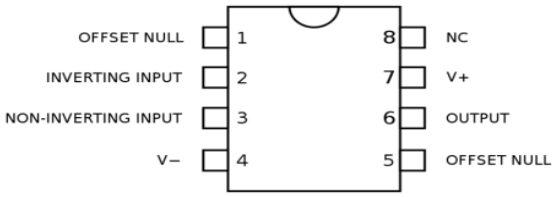
INSTRUMENTATION AMPLIFIRE:

Instrumentation amplifier is a kind of differential amplifier with additional input buffer stages. The addition of input buffer stages makes it easy to match (impedance matching) the amplifier with the preceding stage. Instrumentation are commonly used in industrial test and measurement application.

Instrumentation amplifiers are used where great accuracy and stability of the circuit both short and long-term are An instrumentation amplifier is a type of differential amplifier that has been outfitted with input buffer amplifiers, which eliminate the need for input impedance matching and thus make the amplifier particularly suitable for use in measurement and test equipment. Additional characteristics include very low DC offset, low drift, low noise, very high open-loop gain, very high common-mode rejection ratio, and very high input impedances required.

OPARATIONAL AMPLIFIRE:

An operational amplifier is a DC-coupled high-gain electronic voltage amplifier with a differential input and, usually, a single-ended output. In this configuration, an op-amp produces an output potential that is typically hundreds of thousands of times larger than the potential difference between its input terminals.



Operational amplifiers are linear devices that have all the properties required for nearly ideal DC amplification and are therefore used extensively in signal conditioning, filtering

or to perform mathematical operations such as add, subtract, integration and differentiation.

An Operational Amplifier, or op-amp for short, is fundamentally a voltage amplifying device designed to be used with external feedback components such as resistors and capacitors between its output and input terminals. These feedback components determine the resulting function or "operation" of the amplifier and by virtue of the different feedback configurations whether resistive, capacitive or both, the amplifier can perform a variety of different operations, giving rise to its name of "Operational Amplifier".

An Operational Amplifier is basically a three-terminal device which consists of two high impedance inputs. One of the inputs is called the Inverting Input, marked with a negative or "minus" sign, (–). The other input is called the Non-inverting Input, marked with a positive or "plus" sign (+).

Here for amplification we are using Operational amplifier i.e. Op-amp IC741.This IC comes in 8-pin package whose output pin is 6, inverting input is pin 2 and non-inverting input is pin 3. Pin 7 is Positive supply +Vcc and pin 4 is negative supply –VCC. Pin 1,5 and 8 are for offset null.
We have to build a non-inverting amplifier with gain 100
Therefore, G = 1+R1/R2 ….. the ratio of R1/R2 must be 99
So practical value of R1 will be 100Kohm and R2 will be 1kohm

G = 1+100k/1k
G = 1+ 100
G ~ 101

A/D Converter:

In electronics, an analog-to-digital converter (ADC, A/D, or A-to-D) is a system that converts an analog signal, such as a sound picked up by a microphone or light entering a digital camera, into a digital signal. An ADC may also provide an isolated measurement such as an electronic device that converts an input analog voltage or current to a digital number representing the magnitude of the voltage or current. Typically the digital output is a two's complement binary number that is proportional to the input, but there are other possibilities.

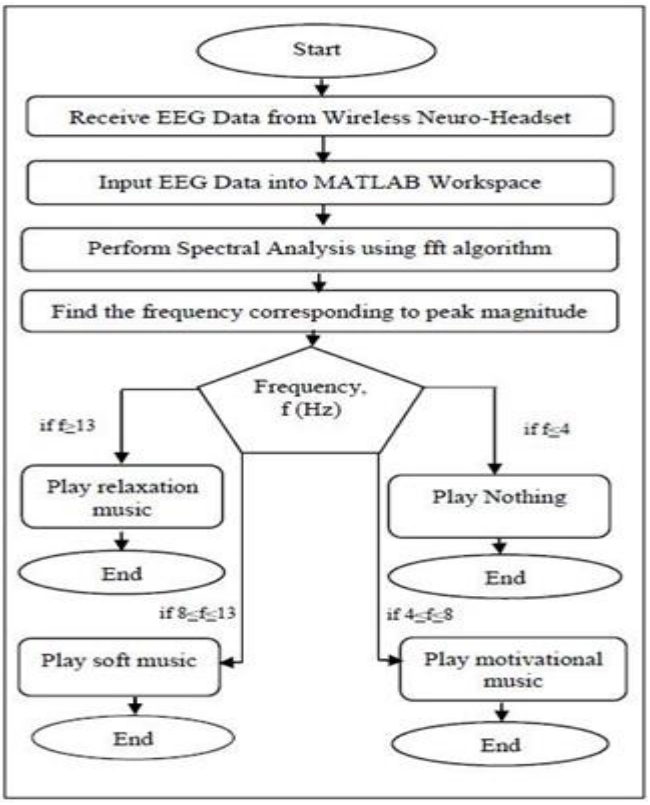
There are several ADC architectures. Due to the complexity and the need for precisely matched components, all but the most specialized ADCs are implemented as integrated circuits (ICs). A digital-to-analog converter (DAC) performs the reverse function; it converts a digital signal into an analog signal.

Almost every environmental measurable parameter is in analog form like temperature, sound, pressure, light, etc. Consider a temperature monitoring system wherein acquiring, analyzing and processing temperature data from sensors is not possible with digital computers and processors. Therefore, this system needs an intermediate device to convert the analog temperature data into digital data in order to communicate with the digital processors like microcontrollers and microprocessors.

Analog to Digital Converter samples the analog signal on each falling or rising edge of sample clock. In each cycle, the ADC gets of the analog signal, measures and converts it into a digital value. The ADC converts the output data into a series of digital values by approximates the signal with fixed precision.

We use MATLAB Software for processing.
For identifying the frequency of the brainwave we use FFT algorithm. In FFT the signal in time domain is converted into frequency domain and the frequency having highest magnitude will be the required result. In this way we can calculate the frequency.

V. FLOWCHART



VI.CONCLUSION

The analysis of Alpha and Beta brainwave affected by binaural beat utilizing the feature Energy Spectrum Energy (ESD). Result from DASS questionnaires shows majority of the subjects are stressed. All subjects claimed that they are stressed because of the examination period before EEG recording is conducted. For alpha wave, 61% of the subjects are having a positive effect after listening to the 10Hz binaural beat sound while 39% of the subjects are experiencing increment. Overall, from the results, it is shown that the binaural beats sound is indeed can give some effects on the brainwaves generally, alpha and beta waves specifically. The results could be refined by collecting more data in the future. The effects of the binaural beat could be further explored by increasing the number of days for the subjects to listen to the binaural beats. The number of the subjects are also should be increased in the future in order to have a more refine analysis.

The Brain Computer Interface has proved to be boon to the disabled persons by providing them independent environment not by manual control but by mere “thinking”.. This type of BCI system is cost effective, extendable and more accurate.. Through this the paralyzed people can communicate to the other persons. In this paper BCI used to switch on and off the devices through thinking. AS BCI technology further advances, brain tissue may one day give way to implanted silicon chips there by creating a completely computerized simulation of the human brain that can be augmented at will. Light reactive imaging which involve implanting a laser inside the skull. Futurists predict that from there, super human artificial intelligence be far behind.

VII.FUTURE SCOPE

Study on Brain wave has been a major part of all the Research Institutes and Education Centers across the globe including MIT , Yale etc . Many Researchers/ companies are also working on it and it is not far when we will see brain wave technology coming as a tsunami. Few companies working in this field are Mettl, MindFlex, Emotiv, NeuroSky, etc. The EEG module of NeuroSky has brought a major breakthrough in the research and many companies working presently on Brain Waves are using the Neurosky’s EEG module for research. This EEG module contains 6 filters which are used to filter noise and extra signals produces by brains and is used to give attention, meditation, delta, theta, alpha, beta, and gamma.

REFERENCES

[1] PL Nunez, Ramesh Srinivasan. Electric fields of the brain: the neurophysics of EEG. Oxford University Press, USA, 2006.

[2] J Panksepp, Affective neuroscience: The foundations of human and animal emotions. Oxford university press, 1998.

[3] Y. Liu, O. Sourina and M. K. Nguyen, "Real-Time EEG-Based Human Emotion Recognition and Visualization," Cyberworlds (CW), 2010 International Conference on, Singapore, 2010, pp. 262-269.

[4] P. Hoole et al., "Autism, EEG and brain electromagnetics research," Biomedical Engineering and Sciences (IECBES), 2012 IEEE EMBS Conference on, Langkawi, 2012, pp. 541-543.

[5] Andrew Campbell et al. "NeuroPhone: brain-mobile phone interface using a wireless EEG headset", Proceedings of the second ACM SIGCOMM workshop on Networking, systems, and applications on mobile handhelds, ACM, pp.3-8, 2010.

[6] S Sanei, JA Chambers, EEG signal processing. John Wiley & Sons, 2013.

[7] Christos Papadelis et al. "Using brain waves to control computers and machines", Advanced Human-Computer Interaction, vol. 2013. New York: Hindawi Publishing Corporation, pp.1-2, 2013.