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Recording of Brain Waves Using Portable Non-Invasive Eeg Kit

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ABSTRACT

Technology is growing day by day at the same time humans are also affected by diseases. Usage of mobile phone has increased and the harmful radiations emitted from it, affects the brain. Generally, brain is an important and most sensitive organ in the body. The brain activities can be recorded by EEG. EEG means electro encephalography. The setup of EEG machine is so complicated which is done in hospitals. This research deals with the technology behind an EEG machine to be understood by the common man in simple way. Normally 256 electrodes are used to record the whole brain activity, but here the brain waves are recorded only with 3 electrodes, one for reference and two electrodes are for measure the voltage differences across the scalp made as a head set. The artifacts formed are filtered with notch filter, high pass filter and low pass filter. The output is generated by using MATLAB software. EEG helps to diagnose the epilepsy, head injuries, brain tumors and sleeping problems. A low cost, simple to use EEG electrode is designed which is compatible and the results show that using minimum electrodes provides near to accurate readings which is sufficient for diagnosing purpose.

Key words: Instrumentation amplifier, Scalp electrode, Filters, Quad-operational amplifier, MATLAB (software)

Brain is one of the most important organs in the body and it is located in the cranium box. Now a days peoples are facing so many brain problems like highly stress condition, drowsiness, brain tumour and epilepsy, due to that to diagnose the brain activity is difficult. The brain activities are recorded by a machine called EEG. EEG means electroencephalogram. Brain is also called Encephalon. The brain has the capability to store the data and act as a decision-making centre. Drastically the brain disorders are increases and the advanced technology is used to treat patient disorders by machines. Normally 256 electrodes are used to record the whole brain activities, it is difficult to setup the EEG machine.

The nervous system consists of central and peripheral parts. The central nervous system consists of brain and spinal cord, the peripheral nervous system comprises of all nerves and group of neurons from outside of the brain and spinal cord. The brain consists of three parts which are listed below:

Cerebrum: The cerebrum consists of right and left hemispheres.

Cerebellum: It acts as a microcomputer which intercepts various sensory and motor neurons. Its plays a vital role in the ability of the human to maintain their balance.

Brain stem

The brain stem connects the spinal cord to the centre of the brain. The essential part of the brain stem is medulla oblongata, pons, mid brain.

Medulla oblongata

It is the lowest part of the brainstem and it is associated with the control of the functions like heart rate, breathing and kidney functions

Pons

It is located just above the medulla oblongata. It acts as an interconnecting area, the main function of the pons is responsible for face expression and auditory system.

Frontal lobe

It is responsible for intelligence. It is located in the front part of the brain above the orbits of the skull.

Parietal lobe

The forward path of the brain contains special motor neurons and which is responsible for some control functions like eye movements. The parietal lobe consists of afferent neurons and efferent neurons.

Temporal lobe

It is mainly responsible for the long-term storage of memory and its plays a vital role in the hearing centre.

Occipital lobe: It is located in the back side of the head over cerebellum. This lobe is responsible for vision centre. The

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neuron is the basic functional unit of nervous system. A typical neuron consists of cell body, dendrites, axon hillock, nodes of ranvier. The action potential is transmitted from one neuron to

another neuron, the human body comprises of billions of neurons in the body and connect all body parts.

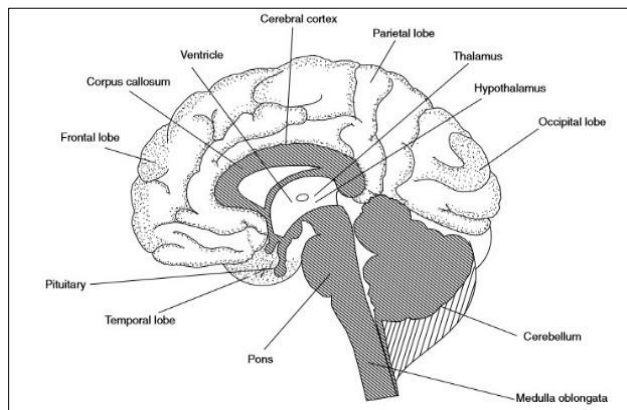


Fig 1 View of a brain and its parts

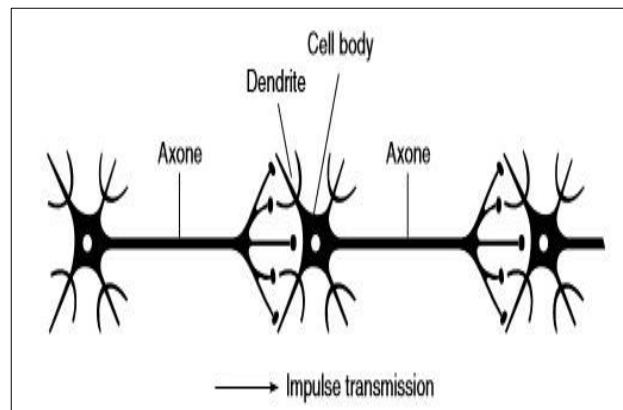


Fig 2 Structure of an neuron

The brain consists of three types of action potential. They are

IPSP: It means Inhibitory Post Synaptic Potential.

- If the transmitter substance is inhibitory, the membrane potential of the receptor neuron increases towards negative direction. so, it is called Inhibitory Post Synaptic Potential.

EPSP: It means Exhibitory Post Synaptic Potential.

- If the transmitter substances are Exhibitory, the membrane potential of the receptor neuron increases towards positive direction. So, it is called EPSP.

Evoked potential: The evoked potential is obtained from the brain and responses to external stimuli like light, sound. Generally, 10-20% system of electrodes is used to record the brain waves. the placement of electrodes starts from nasion to inion over the head and it is divided into 5 parts, frontal pole, frontal, central parietal, occipital. But in my project bipolar electrodes are used which is placed in nasion, inion and left mastoid.

MATERIALS AND METHODS

- They are so many EEG kits are developed by various methods like ARDUINO technology, but it cost is so high.
- My motto is to prepare an low cost portable EEG kit and the recording setup is simple.

Components required

Hardware components

1. Instrumentation amplifier
2. Filters
3. Capacitors resistors
4. Quad operational amplifier
5. Battery (9v)
6. Bi polar electrodes
7. Breadboard
8. Headset
9. USB cable
10. connecting wires

Software components

1. Matlab

Working

- This block diagram explains about how EEG works. connections are made as per the block diagram, the power supply 9v is given to Instrumentation amplifier.
- Ask the subject to sat on the chair and place the headset with electrode around the scalp (the reference electrode is placed on the back side of the ear and the remaining two electrode are placed on the forehead).
- The acquisition of brain signals are vary from person to person based up on their mental condition.
- The brain waves are fluctuating due to their mental condition and the brain waves are classified in to 5 types. They are
 1. **Alpha waves:** It is recorded from the occipital region of brain. The frequency range is 8 to 13 Hz. These waves can be measured when the person is in a resting position.
 2. **Beta waves:** It is recorded from parietal and occipital region of scalp. The frequency range is 13 to 30 Hz. These waves can be measured when the person is in light sleep.
 3. **Gamma waves:** The frequency range is >30 Hz. These waves can be measured when the person is in higher mental condition.
 4. **Theta waves:** It is recorded from parietal and temporal region of scalp. The frequency range is 4 to 8Hz. Usually theta waves are measured in children. It can be measured from adults when are in emotional stress.
 5. **Delta waves:** It is occurred in cortex region of the brain. The frequency range is 0.5 to 4 Hz. It is occurred in premature babies and the person is in deep sleep.
- The brain signals are obtained through scalp electrode and it is given to the instrumentation amplifier.
- The instrumentation amplifier increases the strength of the brain signals, and it is given to the active high pass and low pass filter.
- The main role of high pass and low pass filter is to remove the unwanted noises from the brain signals.
- The output of low pass and high pass filters is given to the notch filter.
- The role of post amplifier is to amplify the brain signals after filtration because the strength of the brain signals are very low.
- DAQ card means Data acquisition card the output was displayed in the computer

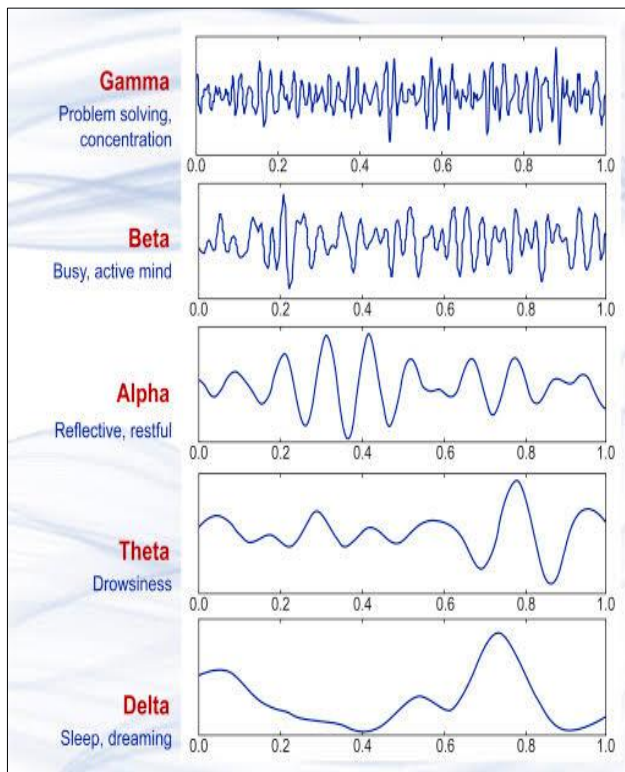


Fig 3 View of a types of brain waves

RESULTS AND DISCUSSION

The portable EEG kit is more beneficial to the humans. In this portable EEG kit the instrumentation amplifier AD620AN which play a vital role to get the outcome in an accurate manner. this portable EEG kit aid is to help the humans in an emergency condition by using this EEG kit to get the alpha waves as output when the patient is in rest condition. In this our proposed project we will be getting output through MATLAB software and data is displayed in the computer. The main motto of this project to record the brain waves using bipolar electrodes through headset.

CONCLUSION

The portable EEG kit is more beneficial to the humans. In this portable EEG kit the instrumentation amplifier AD620AN which play a vital role to get the outcome in an accurate manner. This portable EEG kit aid is to help the humans in an emergency condition by using this EEG kit to get the alpha waves as output when the patient is in rest condition and the frequency range is about 8 to 13 Hz. In this our proposed project we will be getting output through MATLAB software and data is displayed in the computer. The main motto of this project to record the brain waves using bipolar electrodes through headset. In this project we have used the Notch filter to pass the signals in a specific range, and remove the artifacts at the same time high pass filter and low pass filter are used to remove the noises and disturbances from the obtained brain signals. Hence finally the output has been shown in the pc by the using the mat lab software.

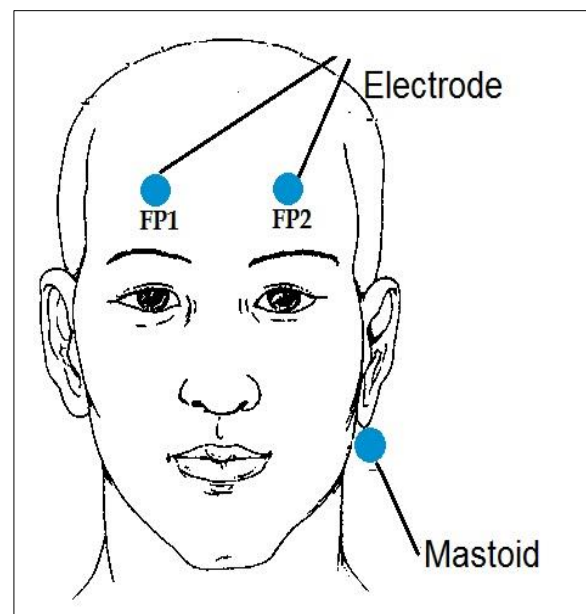


Fig 4 View of a placement of electrodes

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