



A review on Electroencephalogram(EEG) signal for identification of various Brain activities.

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Abstract

In any human body, brain is a very essential and complex part. It is also called as the control system of body. It is made up of hundred billion nerves that communicate in trillions of connections which are called as synapses [4]. EEG is more about the various electrical activities going in the brain which is measured as voltage at different points of brain [5]. EEG signals can be used successfully to study the mental states related to the brain. The inherent issue with the EEG signal is that it is highly nonlinear in nature [7]. Various brain activities can be identified from Electroencephalogram (EEG) signals. EEG signals comprises of five types of rhythms named as gamma, beta, alpha, delta and theta.

Keywords : EEG signals, lobes, rhythm, bandwidth

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Introduction

Brain diseases are one of the largest and most serious challenges for the 21st century. In today's digital world, various diseases related to brain are serious threat not only in youth but also in every age group. It affects millions of people worldwide and also includes wide spectrum of diseases. As brain controls human body and also it regulates growth, development and various bodily functions. Due to unhealthy lifestyles, the number of patients increases gradually.

Many international and national healthcare organizations conclude different statistics like World Health Organization (WHO) states that 17.9 million deaths is due to neurological disorders projected to increase to 103 million in 2030. The National Institute of Mental Health and Neurosciences (NIMHANS) reveal that 9.8 million teenagers suffer from depression and other mental health disorders. Therefore, different brain diseases are severe threats to

the world, and extensive research needs to be done in these areas.

To study the brain is an important research area for humans to explore the mysteries of life [6]. Study of brain focuses on studying the working and structure of the brain [1]. Electroencephalogram (EEG) seems to be very helpful in examining any type of electrical activities in brain.

Electroencephalogram (EEG) signal

A process to record the various electrical activities of the brain is called Electroencephalogram (EEG). It measures different changes in those electrical activities that are produced by brain. Electroencephalogram scans are performed by putting EEG sensors, which are also called EEG electrodes, on scalp of head. These EEG sensors record the different electrical activity in the brain. After this, all collected EEG signals are then digitized, and sent to any computer system



for its storage and data processing. Electroencephalogram (EEG) is the most useful diagnostic procedure for identification of various brain diseases.

By analyzing the EEG data, it helps in various areas as follows:-

- a) It helps doctors in establishing a medical diagnosis
- b) It helps researchers to understand the brain processes that underlie human behavior
- c) It also helps individual persons to improve their productivity and wellness.

Brain is divided into various lobes as shown in figure 1. These lobes are responsible for problem solving, judgment, manage sensation, body position, memory etc.

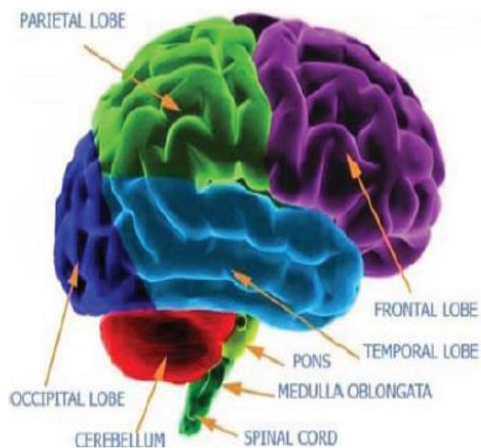


Figure 1. Various lobes of Human Brain [3]

Various rhythm of EEG signal

EEG signal has various rhythm and these are as follows:-

- a) Gamma: It has a frequency of 30-80 Hz. Gamma rhythms match up with attention and movement. It is often disrupted in neurological disorders. It firstly occurs during alert brain states which are symbolized by desynchronized EEG.
- b) Beta: It has a frequency of 13-30 Hz. It is normally seen on both sides in symmetrical distribution. It may be absent in the areas where some cortical damage is present.

c) Alpha: It has a frequency between 8-13 Hz. It usually seen in the back regions of the head on each side with larger in amplitude on the supreme side.

d) Theta: It has a frequency between 4-8 Hz. It is known as slow activity. It is likely normal in children up to 13 years and also in a situation of sleep but it is abnormal in condition of awake adults.

e) Delta: It has a frequency between 0.5-4 Hz. It likely to be lowest waves but highest in amplitude. It is normal in infants up to one year.

Figure 2 shows the formations of these rhythms and table 1 shows the description of each rhythm.

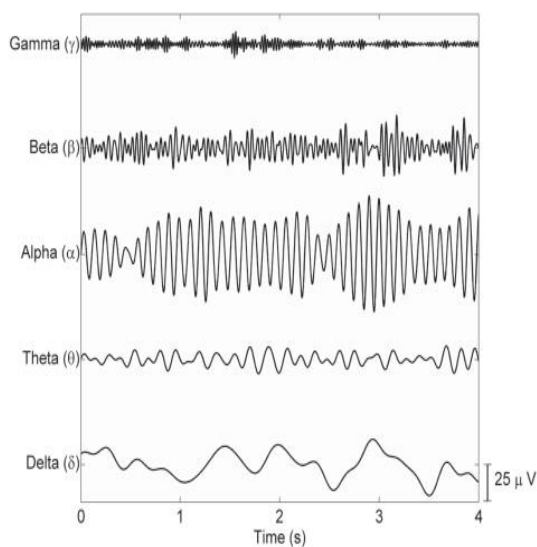


Figure 2. Electroencephalogram (EEG) rhythms during close eyes [2].



Rhythm	Bandwidth	Description
Gamma (γ)	[30, 40] Hz	Low in amplitude; can indicate event brain synchronization and be used to confirm some brain disorders.
Beta (β)	[13, 30] Hz	Indicates an alert state, with active thinking and attention.
Alpha (α)	[8, 13] Hz	Indicates a relaxed state, with little or no attention or concentration.
Theta (θ)	[4, 8] Hz	Indicates creative inspiration or deep meditation; can also appear in dreaming sleep (REM stage).
Delta (δ)	[0.5, 4] Hz	Primarily associated with deep sleep or loss of body awareness, but can be present in the waking state.

Table 1: Description of EEG rhythms [2]

Above study shows how the various rhythm involves in different activities of brain and help in finding the disorders if any.

Conclusion

This paper identifies the various activities with the help of EEG signals. The EEG signals acquired a huge importance not only in the field of biomedical science but also in other fields like in artificial intelligence, deep learning etc. The improvement in technology and always the high demands make the researchers encouraged to ascertain new methods for analyzing EEG signals [5].

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