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Analysis Of Eeg Signal For The Detection Of Brain Abnormalities

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ABSTRACT

In the field of medical science, one of the major ongoing researches is the diagnosis of the abnormalities in brain. The Electroencephalogram (EEG) is a tool for measuring the brain activity which reflects the condition of the brain. EEG is very effective tool for understanding the complex behaviour of the brain. The aim of this study is to classify the EEG signal as normal or abnormal. It is proposed to develop an automated system for the classification of brain abnormalities. The proposed system includes pre-processing, feature extraction, feature selection and classification. In pre-processing the noises are removed. The discrete wavelet transform is used to decompose the EEG signal into sub-band signals. The feature extraction methods are used to extract the time domain and frequency domain features of the EEG signal.

1. General Terms

Methodology for Information in brain abnormality using EEG Signal.

2. Keywords

Electroencephalogram, brain diseases, wavelet transform, EEG waves, feature extraction

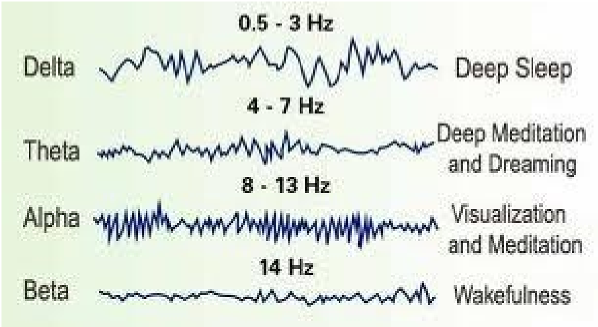
1 .INTRODUCTION

A disease is an abnormal condition that affects the body of an organism**.** Any deviation from the normal structure of a body part or organ is displayed by a characteristic set of symptoms and sign. Electroencephalogram is used for detecting the brain diseases. Electroencephalogram is the recording of electrical activity of the brain from scalp. It measures the voltage fluctuations resulting from ionic current flows within the neurons of the brain. Diagnostic applications generally focus on spectral content of EEG that is the type of neural oscillations that can be observed in EEG signals. EEG is painless and harmless. And it does not pass any electricity into your brain or body. The EEG signals are commonly decomposed into five EEG sub-bands: delta, theta, alpha, beta and gamma.

Alpha waves are rhythmic and its frequency range is from 8 to 13 Hz. The amplitude of the alpha wave is low. Each region of the brain has the characteristic of alpha rhythm but mostly it is recorded from the occipital and parietal regions. It oscillates from adult in awake and relaxed state with eyes closed.

Figure 1 Normal EEG waves

Beta waves are irregular and its frequency range is greater than 13 Hz. The amplitude of the beta wave is



very low. It is mostly recorded from temporal and frontal lobe. It oscillates from during the deep sleep, mental activity and is associated with remembering. Delta waves are rhythmic and its frequency range is 4 to 7 Hz. The amplitude of the delta wave.

2.RELATED WORK

Some literature work has been focused for the pre-processing of he eeg signalsFeature extraction,
Feature selection and classification methods.

ANALYSIS OF EEG SIGNALS,
1.Pre,processing.
2.Feauture Extraction
3.Feature Selection
4.Classification.

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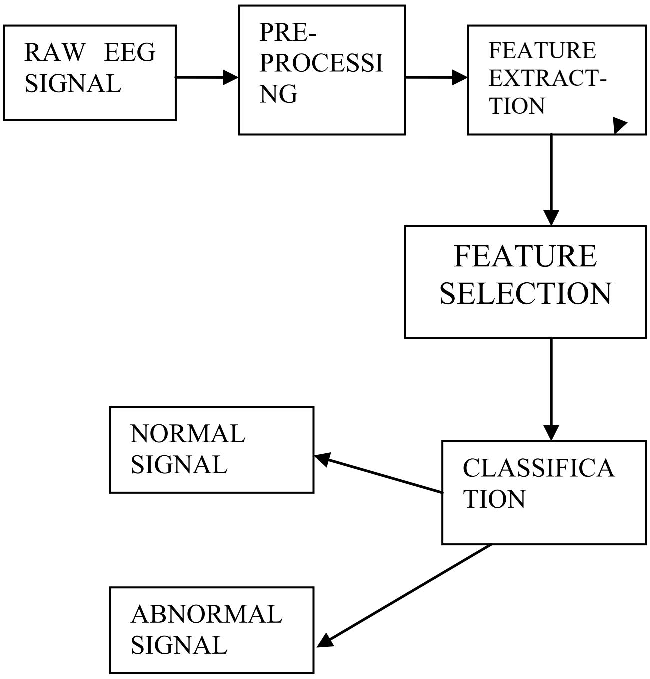

Fig 2.Frame work Analysis of EEG Signal

3.EEG Signal Pre-processing

The raw EEG signal contains some noises that occur due to eye blinking, muscle artifacts and breathing deeply at the testing time. These noises affect the edge function of the EEG signals and the structure of the wave form. The noises are removed by the discrete wavelet transform which decomposes the full-band signal into sub-band signals. The process of the discrete wavelet transform is as follows:

a) The EEG signal is processed with the deubechies wavelet which is used to remove the noises and decompose the signal into sub-bands signals.

b) Based on the frequency range the sub-band signals are separated as delta, theta, alpha, beta and gamma.

After the decomposition, the noises are reduced then the Error rate is calculated

Feature Extraction

The extraction methods are used to reduce the dimensionality of the features. Extracted features represent the characteristics of original signal without

redundancy. The features can be extracted from the EEG signal in two different domains such as Time domain features (TDF) and Frequency domain features (FDF)

4.SIMULATION ENVIRONMENTS

The implementation results contain raw EEG signal, EEG signal de-noising process, Feature extraction process and Classification process. The results of each module are given below:

Results of Pre-processing

The raw EEG signal contains some noises that occur due to eye blinking, muscular artifacts and deep breathing at testing time. The low pass filter is used to reduce the noises. It provides a smoother form of a signal removing the short term fluctuations and leaving the longer term trend.

Fig 3.1 Input EEG Signal

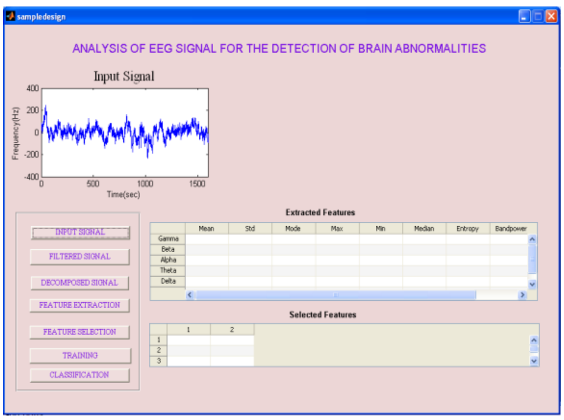

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Figure 3.1 shows the actual EEG signal. This EEG signal is taken from the Physionet EEG database. The x axis contains the time duration and y axis contains frequency.

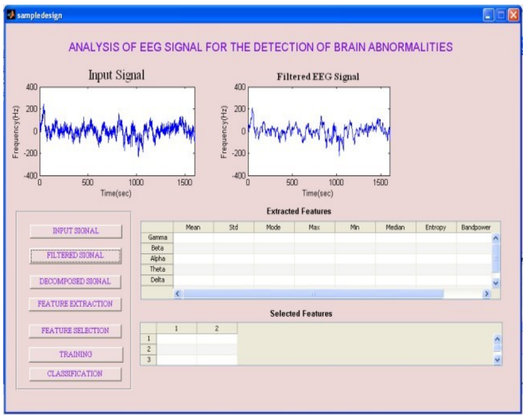
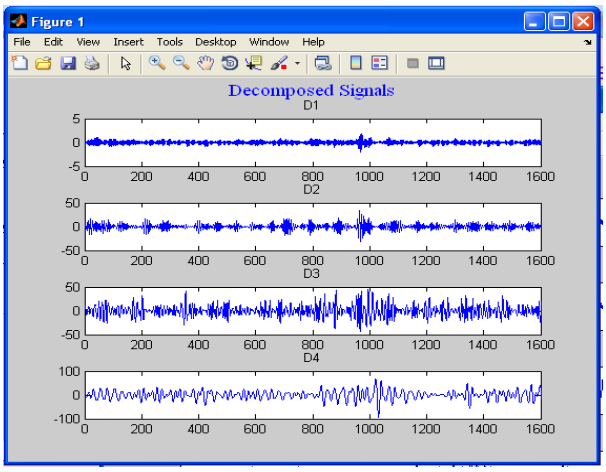


Fig 3.2 De-Noised Signal.

Figure 3.2 shows the de-noised signal. Low-pass filters are used to remove the noises and provide a smoother form of a signal, removing the short-term fluctuations, and leaving the longer-term trend.

The results of de-noised signal are decomposed by discrete wavelet transform. DB8 mainly based on the mother wavelet DWT function. The eight levels of DB8 decomposed approximation coefficient is based on de-noised signal.



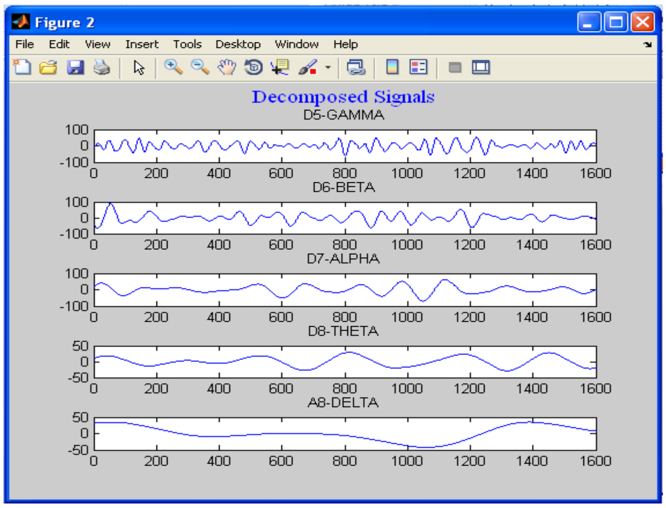


Fig 3.3 Decomposed Signals

Figure 3.3 shows the decomposed signal, based on the frequency range, the approximation coefficient isseparated as sub-band signals such as gamma, beta, alpha, theta and delta.

5.Results of Feature Extraction Process

The EEG signals are non-linear, it represents time vs. frequencies. So the Time domain and Frequency domain features are extracted. The EEG signal contains five types of waves such as delta, Theta, Alpha, Beta and Gamma waves. The features can be extracted from the EEG signal in two different domains such as Time Domain Features (TDF) and Frequency Domain Features (FDF).

Following Figure 3.4 shows the extracted features from the each decomposed signals. The time domain features such as mean, standard deviation, median, mode, max, min and entropy are extracted. The frequency domain features such as power and energy are extracted.

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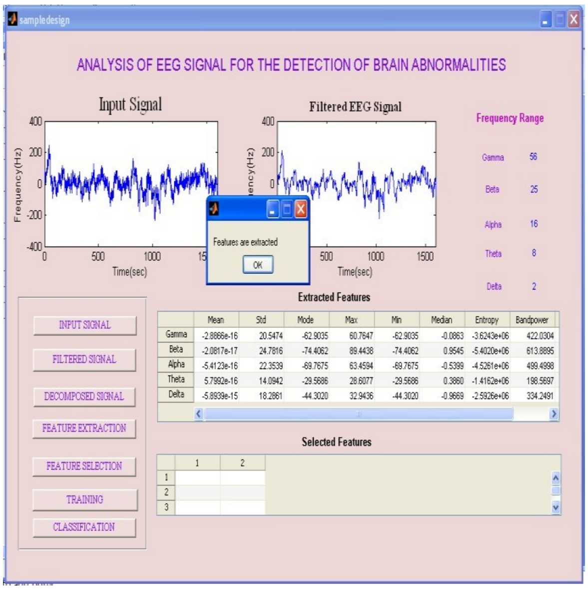

Fig 3.4 Results of Extracted Features

6.CONCLUSION

The analysis of EEG signal for the detection of brain abnormalities is a difficult process. So the PC based automatic system is needed for the detection of brain abnormalities.My proposed work can be a useful tool in studying normal and abnormal patients. The time and frequency domain features were extracted. The K-Means classifier wasused for classification. The alpha band has achieved the highest accuracy to classify the normal and abnormal in the EEG signals.

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