AUTOMATED ALGORITHM FOR EXTRACTING α, β, δ, θ OF A HUMAN EEG

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ABSTRACT:

EEG is a powerful tool for tracking brain changes during different phases of life. EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time, usually 20–40 minutes, as recorded from multiple electrodes placed on the scalp.EEG is commonly recorded at sampling rates between 250 and 2000 Hz in clinical and research settings, but modern EEG data collection systems are capable of recording at sampling rates above 20,000 Hz if desired. Based on the frequency range extract theα, β, δ, θ.By analysing the various parameters of EEG signal to detect the various diseases which is related to brain. EEG has been used for many purposes besides the conventional uses of clinical diagnosis and cognitive neuroscience.

Key Terms:MATLAB, ELECTROENCEPHALOGRAM, ALPHA, BETA, GAMMA, THETA, DELTA.

1. INTRODUCTION:

Electroencephalography (EEG) is the recording of electrical activity along the scalp.EEG measures voltage fluctuations resulting from ionic current flows within the neurons of the brain.The EEG recording can be analyzed using various programs; e.g., using free open-source software like BrainBay, toolboxes for Matlab, such as, EEGLAB, Fieldtrip, NBT, SPM, or commercial software packages such as Brainvision Analyzer.The brain's electrical charge is maintained by billions of neurons. Neurons are electrically charged (or "polarized") by membrane transport ions that pump ions across their membranes. Neurons are constantly exchanging ions with the extracellular milieu, for example to maintain resting potential and to propagate action potentials. Ions of similar charge repel each other, and when many ions are pushed out of many neurons at the same time, they can push their neighbours, who push their neighbours, and so on, in a wave.EEG activity therefore always reflects the summation of thesynchronous activity of thousands or millions of neurons that have similar spatial orientation. If the cells do not have similar spatial orientation, their ions do not line up and create waves to be detected. Pyramidal neuronsof the cortex are thought to produce the most EEG signal because they

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are well-aligned and fire together. Because voltage fields fall off with the square of distance, activity from deep sources is more difficult to detect than currents near the skull.Based on the method, obtaining the sample datas of EEG signal. By using the sample datas to extract the alpha, beta, gamma, delta and theta signal.

2. ALGORITHM:

- Generation of EEG signal from input samples.
- Performing filtering operation.
- α, β, δ, θ wave extraction for the generated EEG signal.

EEG signal was generated from the data samples and it is given to the input of the Butterworth filter.Then the parameters are extracted from the input EEG signal. Based on the parametersgenerating the alpha, beta, delta and theta waves. Based on the frequency range, analyzing the signal as normal and abnormal of EEG signal.

2.1 PARAMETRIC ANALYSIS:

By analysingthe obtained parameters are given as the training parameter for a network. A raw signal can be fed to the network which can detect the signal as normal or abnormal by the identified parameter.From that to analyse the various diseases like brain tumor, brain death, loss of consciousness, sleep disorder.

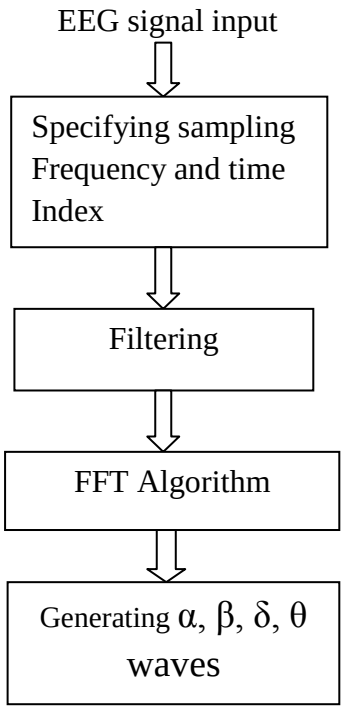

Fig:1Flow Chart for extracting α, β, δ, θ waves

Specifying Sampling Frequencyand Time Index

The alpha waves range is rhythmic of 8-13 Hz, mostly on occipital lobe voltage of 20-200 μ V,it will be normal,relaxed awake rhythm with eyesclosed. The Beta waves range isirregular, 14-30 Hz, mostly on temporal and frontal lobe it monitor the mental activity and excitement. The theta waves range is rhythmic, 4-7 Hz,it monitor the Drowsy, sleep. The delta waves range isslow < 3.5 Hz. it will monitor in adults of normal sleep rhythm. Based on this to determine the diseases by using EEG.

Filtering

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Low- pass filtering is used for smoothening the brainwaves and high-pass filtering is used for sharpening thebrainwaves in order to make the signals more clearly to the viewer. According to the patients EEG hardwaredata collected we have shown in our project two types of filtering technique options such as – Low – passfrequency filters and High- pass frequency filtersFor the low – pass frequency filters generally setting the maximum range till 1Hz and for high – passfrequency filters setting the maximum range till 70Hz because this the standard limit of filters.

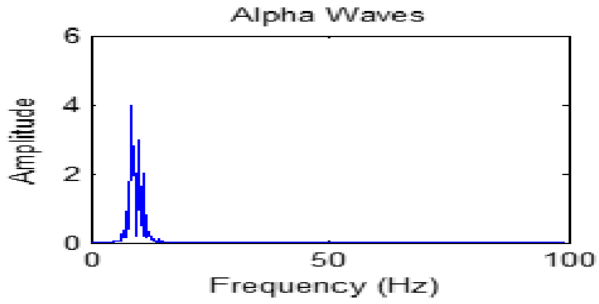
FFT Algorithm

A Fast Fourier Transform is an algorithm to compute the discrete Fourier Transform and its inverse. Fourier analysis converts time(or space) to frequency (or wave number) and vice versa. The best known FFT algorithm depends upon the factorization of N, but there are FFT's with o(N log N) complexity for all N,event for prime N. An FFT compute the DFT and produces exactly the same result as evaluatingthe DFT directly.FFT is much faster than DFT.

The combines signals lacks the vast majority of spikes that are present in the raw signal and it. The raw EEG signal which possibly contaminated by noise. It includes the combination of EEG with functional magnetic resonance.

3. RESULT AND DISCUSSION:

By generating the different types of EEG signal



Based on the upper cut off frequency(w3=16/fs) and lower cut off frequency (w4=22/fs) extract the alpha signal in the of range of 8-12Hz by combining with raw signal.

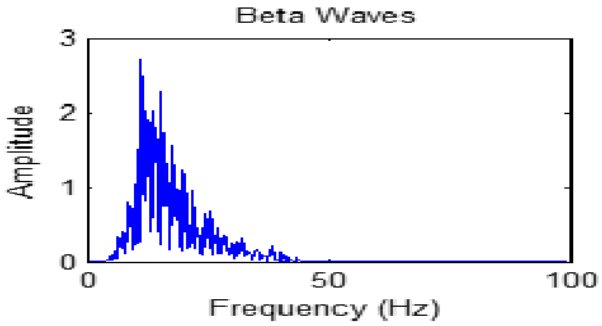


Fig:3 Beta Wave

Based on the upper cut off frequency(w5=22/fs) and lower cut off frequency (w6=18/fs) extract the Beta signal in the of range of 12-40Hz by combining with raw signal

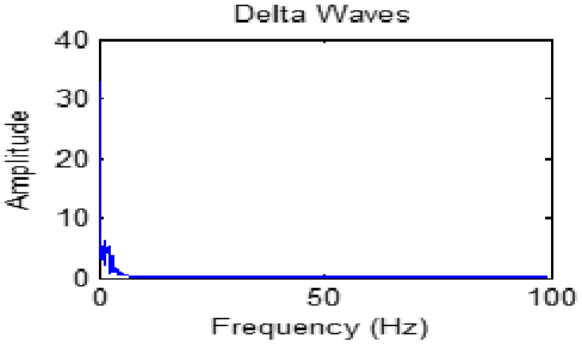


Fig:4 Delta Wave

Based on the cut off frequency(wn_d=5/fs) extract the delta signal in the of range of 0-4Hz by combining with raw signal

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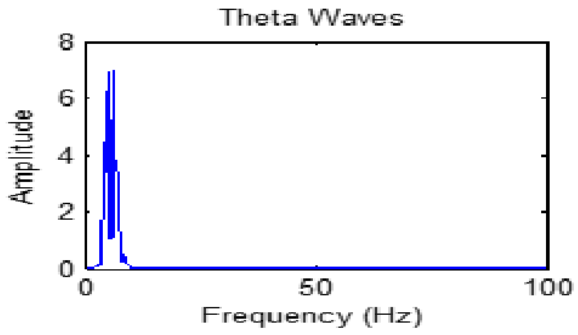

Fig:5 Theta Wave

Based on the upper cut off frequency(w1=8/fs) and lower cut off frequency (w2=14/fs) extract the Theta signal in the of range of 4-8Hz by combining with raw signal

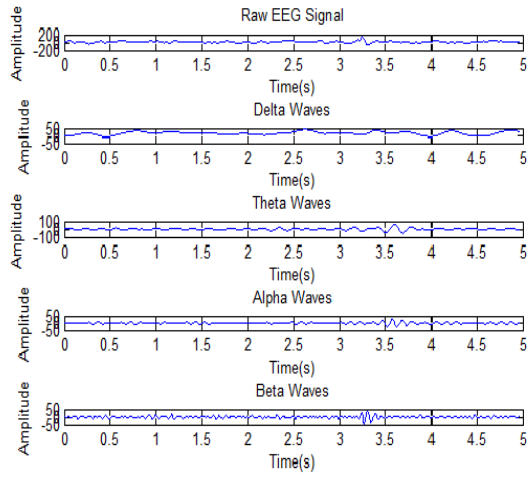

Fig:6 Extracting EEG signal

Combining the waves alpha, beta,theta, delta,to extract the above results of EEG signal based on required frequency range.

4. FEATURE EXTRACTION:

Several other methods to study brain function exist,including Functional Magnetic Resonance Imaging (fMRI),nuclear magnetic resonance spectroscopy, electrocorticography, AND Event related optical Signal (EROS). Despite the relatively poor spatial sensitivity of EEG, it possess multiple advantage over this techniques.EEG sleep analysis can indicate significant aspects of the timing of brain development, including evaluating adolescent brain maturation. By comparing the time interval of the normal and abnormal EEG signals the type of Brain abnormalities can be easily detected.

5. CONCLUSION:

EEG signal can be used as a reliable indicator of Brain diseases. In this method, the various abnormalities can be effectively detected by using above mentioned steps.A raw signal can be fed to the network which can detect the signal as normal or abnormal by the identified parameter. The signal if identified as abnormal then few investigation are performed on the signal to find variousbrain related abnormalities Here MATLAB tool is used effectively to detect the Brain diseases.

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