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Assessment of Epileptic Seizure in Human using SVM Classifier and DWT

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ABSTRACT: Epilepsy is a standout amongst the major fields for requisition for EEG. Examination of EEG signs exhibits that the extent of repeat for epileptic seizure in a neurological issue which ought to be recognized at an early stage to know their particular needs and to help them make do with the issue. In this work, we propose a system for order of seizure and non-seizure conditions from recorded EEG signals. We utilized the Discrete Wavelet Transform (DWT) change for element extraction and got measurable parameter from the deteriorated wavelet coefficients and Support Vector Machine (SVM) is utilized for the order to classify. We measure EEG signals recurrence range identifying with seizure, partition them into five diverse space, for example, α, β, γ, δ and θ identified with the aggregate range, and dispose of recurrence circulation through DWT of EEG signs to think about the contrast amongst seizure and vigorous subject.

KEYWORDS: Discrete Wavelet Transform (DWT), Support Vector Machine (SVM), Electroencephalogram (EEG);

I.INTRODUCTION

An epileptic seizure ("a fit") is a typical neurological issue that has been with us since the old times and approx 50 million individuals on the globe dreadfully influenced by epilepsy. It might happen normally taking after physical or metabolic affront bringing about sudden surge of electrical action in the mind [1]. Clinically an epileptic seizure is a discontinuous, normally meaningless, conventional, disorder of awareness, behaviour, feeling, motor function or consciousness that is after effect of cortical neuronal release [2].

The expression "Epilepsy" is derivative of the Greek word *epilambanein*, which implies 'to seize or assault' [4, 5]. Anything that aggravates the typical prototype of cerebrum cells (neuron) movement from sickness to cerebrum harm to anomalous mental health - can prompt seizures. Having a seizure does not as a matter of course imply that a man has epilepsy. Just when a man has two or more seizures, he or she considered to have epilepsy. The seizure happens aimlessly to debilitate the ordinary capacity of the cerebrum. Patient experience distinctive sorts of manifestation through the period of seizures, it's relies on the area and expansion of the exaggerated brain tissue. The characterization of seizure has been institutionalized by the International League against Epilepsy (ILAE). Epilepsy is mainly classified into two types Namely, Partial Epilepsy and Generalized Epilepsy. Partial seizures influences tiny part of the brain and generalized seizures influences all parts of the brain [3].The categorization of epileptic seizure is shown below in Figure.1

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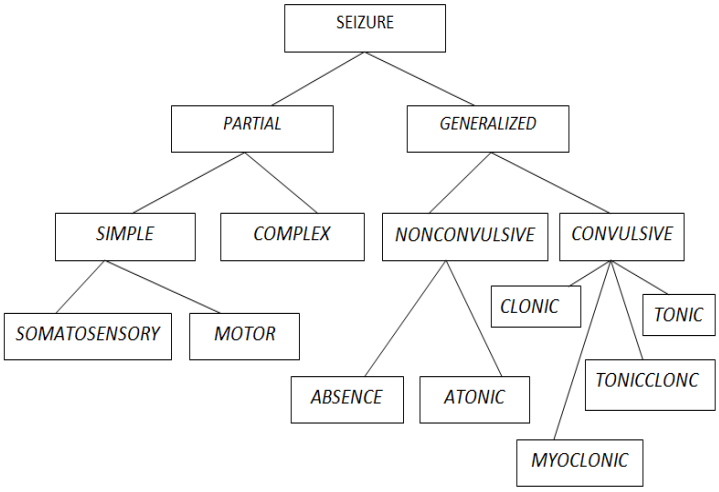

Fig.1. Characterization of Epileptic Seizure Activity

Epileptic Seizure are analysed by EEG signals, Electroencephalography (EEG) is the recording of electrical action along the scalp. EEG measures voltage variances coming out from ionic current streams inside the neurons of the mind.In neurology, the outline analytic use of EEG is on account of epilepsy, as epileptic action can make clear variations from the norm on a standard EEG study.[6] EEG is calculated using 10-20 electrode system as shown in Figure 2

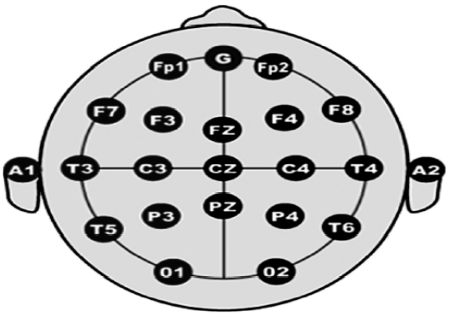

Fig.2 10-20 Electrode placement system

Electroencephalography is the most helpful and expense successful methodology for the analysis of epilepsy. The identification of these variations from the norm by the visual examination of EEG signs is mind boggling and time consuming procedure and it requires profoundly talented specialists. In the vast majority of the cases, epilepsy is controlled by the best possible therapeutic treatment. For that reason, the legitimate and prior determination of epilepsy is required. In some cases, surgical treatment for evacuation of the epileptic part is likewise accessible. Epilepsy is showed by a sudden and intermittent cerebrum glitch which has its starting point in extreme and hyper synchronous movement of neurons. The seizures happen indiscriminately and hinder the typical capacity of the mind. As of late, another technique is presented, in which, a portion of cerebrum is electrically re-enacted to maintain a strategic distance from the landing of seizure. Programmed discovery of seizure is vital part of such a treatment.

II.LITERATURE SURVEY

They have proposed the bi-spectrum examination of EEG for identification of epilepsy. Features separated from bi-spectrum of EEG are connected to neural system classifier to identify normal and epileptic EEGs (G. R. Kiranmayi et al, 2014).

They have executed a reliable automatic algorithm to recognize high and low amplitude interictal epileptic form releases in EEG recordings and composed a grouping strategy to remove spatial patterns of their propagation. For

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identification of seizure in EEG, they have utilized a sign envelope demonstrating method which recognizes measurable parameters of signals containing spikes. They have planned spike clustering algorithm to distinguish subsets of spikes with that of spatial profiles and likewise classified seizures (R.Janca et al, 2013).
With a specific end goal to classify five class of EEG information, they utilized ANN as classifier also and compared the execution of proposed technique with that of a current technique utilizing same EEG dataset and classifier. The proposed strategy for epileptic seizure order comprises of steps, for example, pre-handling, time-frequency examination, feature extraction and characterization. In pre-handling, explanatory representation of real EEG signal is gotten through Hilbert transformation (Partha Pratim Acharjee et al, 2012) [7].
They have done characterization of normal and epileptic EEG signal utilizing domain features of time-frequency through ANN subordinate on sliding window division. In feature extraction stage, ten features are separated and utilized for identification of seizures and they have utilized feed forward artificial neural network to categorize seizures (Anusha K.S et al, 2011).
For categorization of epileptic seizure, feature extraction is major step. They have utilized Discrete Wavelet Transform (DWT) also and Fast Fourier Transform (FFT) as feature extraction strategies. These features extracted then set as contribution to the feed forward neural network with back propagation training calculation to get classification precision (Azian Azamimi Abdullah et al, 2011).
They have actualized autoregressive model (AR) model. They have built up a novel AR-model based algorithm and tried for epileptic seizure identification that is reasonable for an implantable gadget. The AR model estimation has chosen for removing features from EEG signal (H. Kim et al, 2010).harjee et al, 2012).
They have exhibited the reasonableness of time-frequency analysis to characterize EEG fragments for epileptic seizures and they thought about a few techniques for t-f analysis of EEGs. They utilized short time Fourier change and a few t-f disseminations to compute power spectrum density (PSD) of every fragment. They have done examination of STF and familiar TFDs to get the non stationary characteristics of EEG signal with that of epileptic seizure recognition and grouped epileptic seizures in various classifications (T. T Alexandra's et al, 2009).

Strategy proposed for identification of epileptic seizure is Support vector machine. They have utilized GRB-SVM utilizing GRBF (Gaussian Radial Basis Functions). Neural network took after by a fuzzy network for characterization of seizures is utilized (Naseer Sadati, 2006).
They have proposed a three stage method in view of ANN for automatic recognition of epileptic form occasions. They have utilized various types of artificial neural system for characterization of seizures (Nurettin Actr et al, 2005).

III.METHODOLOGY

The proposed work aims at Classification of EEG signal as seizure and non-seizure, then do the frequency analysis of healthy and epileptic signal. This proposed work is implemented by dividing it into two phases: Train phase and Test phase as shown in below block diagram

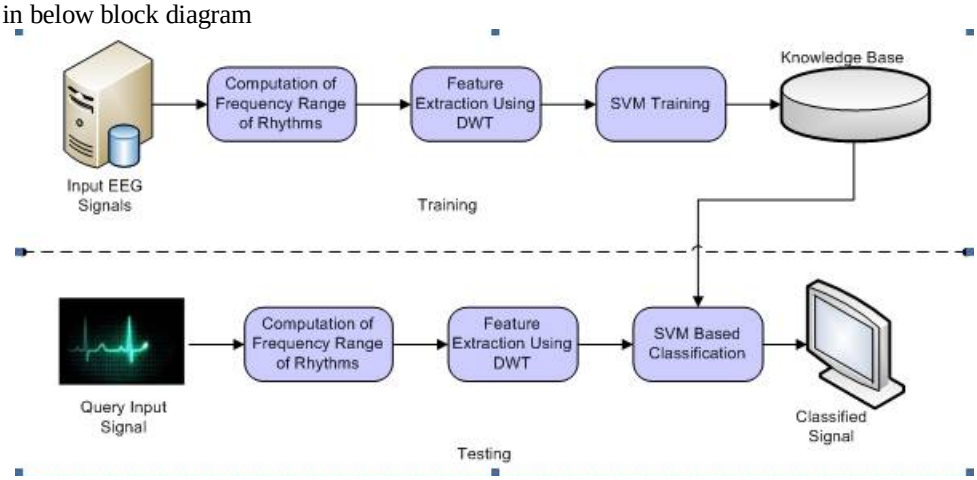

Fig.3. Block Diagram for Proposed work

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A. Data Acquisition: The EEG database for processing is extracted by the University of Bonn [8], [9]. This collection contains EEG information originating from different interval, to be specific, healthy subjects and epileptic subjects .The gathering these data contains five datasets recognized as: O, Z, F, N and S; each set have 100 sections of EEG signals of 23.6 seconds. Sets O and Z were gotten from healthy subjects with eyes open and shut individually; sets F and N were gotten among seizure free states in various zones of the mind and set S was gotten from a subject among seizure state [10]. Sets Z and S were utilized just for the outcomes reported here.

B. Generation of EEG signal using Dataset: We make use of the dataset to generate the EEG signal using MATLAB code. There are five sets of EEG dataset containing both healthy as well epileptic. We make use of both the signals to generate EEG signals. Each set have 100 signals, we take few in that and proceed for further process i.e. decomposition of these generated EEG signals.

C. Decomposition of EEG signals: Now we make use of these generated EEG signals and decompose it using Daubechies Wavelet Transform db8, which decomposes EEG signal to 8 levels. Based on the feature extraction, 8-dimensional feature sets (D1, D2, D3, D4, D5, D6 and D7 D8) for training and testing data were constructed.

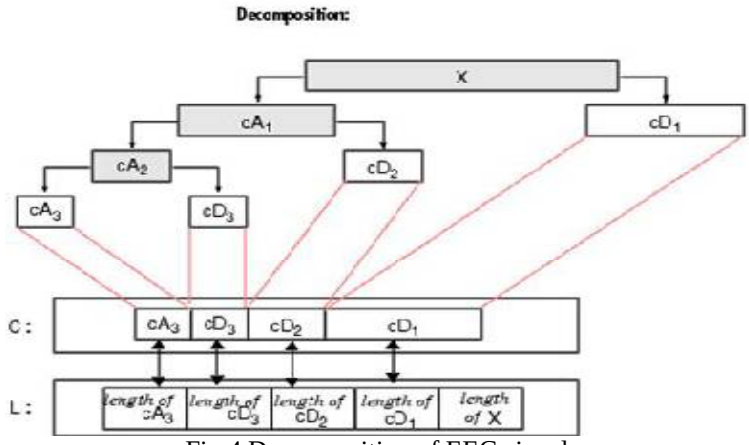

Fig.4.Decomposition of EEG signal

In above figure we see the decomposition using Daubechies, which decomposes the EEG signal into 8 levels as we are using db8. This decomposition of the signals gives us the co-efficient values and also the length of those co-efficient of different decomposed levels.

Wavelet coefficient	Frequency (Hz)	Signal information
D1	250 – 500	Noise
D2	125 – 250	Noise
D3	63 – 125	Noise
D4	32 - 63	Gamma
D5	16 - 32	Beta
D6	8 - 16	Alpha
D7	4 - 8	Theta
D8	0 - 4	Delta

Table -1 Wavelet coefficient and its signal data.

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The above table-1 shows the wavelet co-efficient frequency range and its signal information. After applying Daubechies Wavelet Transform db8 it decomposes EEG signal into 8 level i.e. 8 wavelet co-efficient as shown in above table1-.As we are interested only in extracting the characteristics of EEG signal i.e. alpha, beta, gamma, delta and theta and we eliminate the higher frequencies which are basically noise.

D. Feature extraction: Feature Extraction is a sort of dimensionality diminishment to proficiently represent the significant attributes of a signal that are valuable for effective classification of EEG signal. The feature vectors are extracted by Discrete Wavelet Transform.

The Discrete Wavelet Transform Series is only a sampled interpretation of CWT furthermore, its calculation may devour noteworthy sum of time and assets, contingent upon the determination required. The Discrete Wavelet Transform (DWT), which depends on sub-band coding, is found to yield a quick calculation of Wavelet Transform. It is anything but difficult to actualize and diminish the calculation time and assets required.

$$Y_{WT}(\tau,\lambda) = \frac{1}{\sqrt{|\lambda|}} \int x(t), \psi\left(\frac{t-\lambda}{\lambda}\right) dt \qquad (1)$$

Where Y_{WT} = wavelet Transform,
x(t)= signal to be analysed,
ψ(t)= Basis Function,
τ= Translation parameter,
s=1/frequency.

DWT is a type of transformation and generally utilized as a part of the image and signal preparing exploration to deteriorate the image/signals into diverse frequency and bands. DWT can be determined by low pass (LP) and high pass (HP) channels named as standard quadrature mirror channels [11]. These channels have cut-off frequency one-fourth of the calculated sampling frequency. The bandwidth of the original signal is double the bandwidth of the channel output, which produces down sampled output signals without losing any data as per the Nyquist hypothesis [12]. The down sampled signals from LP and HP channels contain the first-level estimate and points of interest of the original sample respectively. Accordingly, we likewise explore the viability of the DWT to concentrate some other measurable components, (for example, STD) effectively to characterize seizure and non-seizure signals. In our second method, we apply single-level one dimensional DWT on the EEG sample to identify the high frequency parts from the signal. At that point, we calculate the STD from the point of interest recurrence (i.e., high frequency) parts of the DWT coefficients and use as a feature. We make use of the entire high frequency segment for highlight extraction as DWT isolates the signals into low and high frequency segments. Later we select the frequency containing highest information and eliminate remaining frequencies which appears to be as noise.

E. Support Vector Machine (SVM) Training: The feature file created is given as input to the SVM toolbox for classification of EEG signal. SVM is chosen as a classifier because it is an efficient classifier for many real time applications. The goal is to correctly classify the given Data.

SVM is another sort of classifier that is inspired by two ideas. To start with, changing information into a high dimensional space can change complex issues (with complex choice surfaces) into less difficult issues that can utilize linear discriminant functions. Second, SVMs are inspired by the idea of training and utilizing just those inputs that are close to the choice surface since they give the most important data about the order. It is a sort of learning machine in view of statistical learning hypothesis.

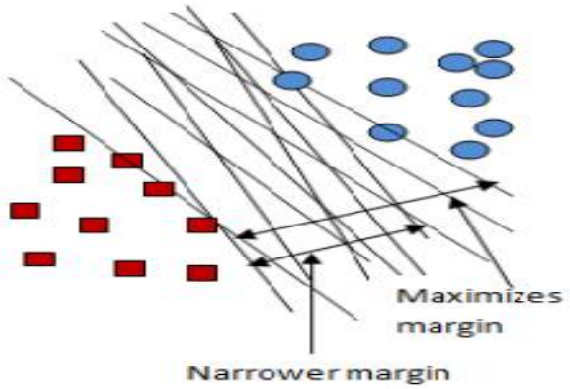

Fig.5.Support vector machine

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The essential thought of applying SVM to pattern classification can be expressed as follows: first the information vectors are mapped into one components space, conceivable in higher space, either linearly or nonlinearly, which is significant with the portion capacity. We have utilized the Kernel Adatron calculation for this reason. At that point, inside the feature space from the initial step, enhanced linear division, is looked for i.e. a hyper plane is developed which isolates two classes. It can be reached out to multi-class. SVMs training dependably look for a worldwide advanced arrangement and keep away from over fitting, so it has capacity to manage huge number of features.

IV.EXPERIMENTAL RESULTS

The experimental results for EEG signals at various stages are described below. Firstly, we create database which includes EEG signal values extracted from Bonn University, from this data we generate EEG signal as shown in Figure.6. Later Query signal is selected and decomposed using db8 as shown in Figure.7.Then feature vectors are calculated using DWT and given to SVM training to classify the signal. The classification results are shown in Figure.9 and Figure.10.

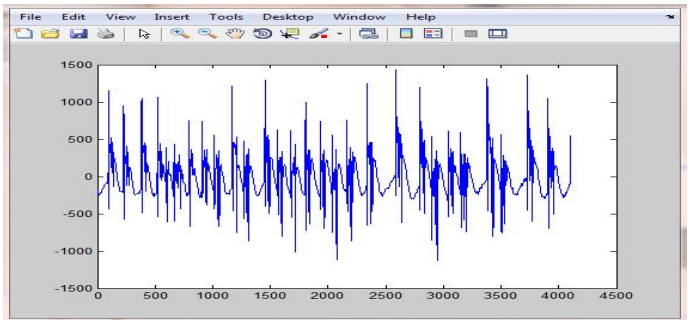

Fig.6.Generation of EEG signal

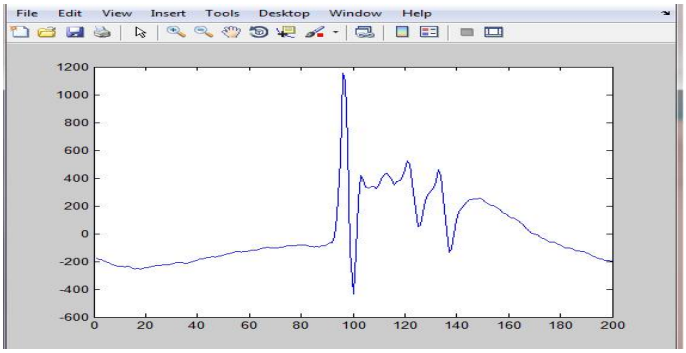

Fig.7.Sample of generated EEG

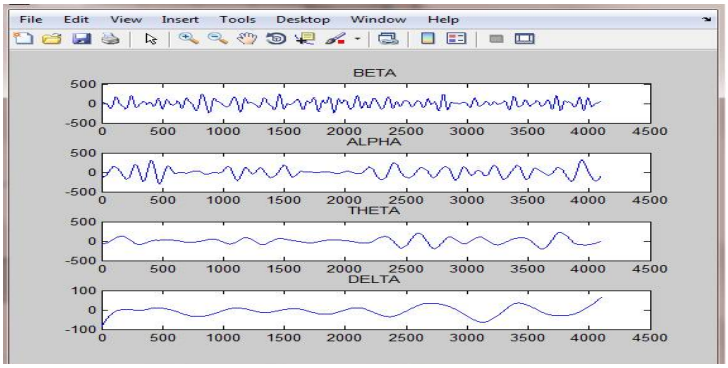

Fig.8.Decomposition of EEG signal

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Fig.9.Seizure signal detection

Fig.10.Non-Seizure signal detection

V.CONCLUSION

We have developed classification for seizure and non-seizure and frequency analysis for healthy and epileptic subject. The proposed work uses SVM on signal processing for training of the system. A set of feature were chosen which were calculated using DWT during future extraction phase and preserved in feature file which are used further for classification of signals as Seizure and Non-Seizure. This Computer-Aided technique is more reliable for classification of given EEG signal and also it helps to know the given signal is seizure or seizure free without the help of the neurologist. It is also time saving and efficient user friendly tool for the neurologist.

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