THE DIAGNOSIS AND ANALYSIS OF EEG SIGNALS USING BURG ALGORITHM AND ANN FOR EPILEPTIC SEIZURE

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ABSTRACT- *The most usual peripheral or nervous dysfunction disease in the world is "Epilepsy". The remarkable details or data about the epileptic action in human encephalon can be obtained using EEG (Electroencephalogram). As the diagnosis of the epileptic action needs scrutinizing of very lengthy EEG recordings by a specialist, analyst tend to improve automated detection systems for epilepsy in current years. In the proposed work, automatic detection of epilepsy is carried out using MATLAB based on EEG. Cascade, Feed Forward Back Propagation and Elman Neural Networks are the three types of Artificial Neural Networks (ANN) which are used for the stratification of EEG (peculiarity of epileptic seizure or not). Prior stratification activity, autoregressive model is used for data governance and to calculate the synergetic three different autoregressive model breakthrough. Pliable and optical utilization is provided by MATLAB to perceive normal as well as epileptic EEG and trial outcomes. Tutelage parameters and method of neural networks are determined by end users on the frontier. Conduct of the model which is proposed is estimated using universal perfection or exactness.*

Keywords- ***MATLAB1, Electroencephalogram2, Artificial Intelligence3, Epileptic Seizure4, Epilepsy5, Signal Processing6.***

1. INTRODUCTION

In the world, around 1 percent of population suffers from epilepsy. Generally, in human encephalon, encephalon activities lead or tend to normal low amplitude electrical signals. Intemperate and unrestrained impregnation of these electrical signals in the encephalon is results of epilepsy. Asymmetrical and capricious seizures are the vital attributes of Epilepsy. Seizures may cause blackout, physical damage and also quietus. The perception and analysis of epileptic seizure is a matter of concern. Electroencephalogram (EEG) is recording of electrical potential difference during brain activity [1-4]. For detection of encephalon action and diagnosis of neural dysfunction. To acknowledge epilepsy, EEG signals play a vital role as they contain prime data.

The proposed work is a system designed to diagnose epileptic seizure having its origin in artificial neural networks. Auto Regression is method which lessens the dataset to reduce processing time in prior processing step. Artificial neural networks (ANNs) have been widely used in many biomedical signal analysis because they not only model the signal, but also make a decision to classify the signal [5]. The proposed work uses Burg Algorithm so that the end user can collate behaviour. Further, Cascade, Elman and Feed Forward Back propagation Network types of Artificial Neural Network are used for Electroencephalogram (EEG) signal stratification. Effortless and supple usage to obtain finest stratification outcomes detecting epilepsy is provided by user friendly MATLAB.

2. MATERIALS AND METHODS

Electroencephalograph (EEG)

The method which bestows examining and supervising of encephalon neurological action using electrical signals is nothing but Electroencephalogram (EEG). The statistical data about effective assert of encephalon surpassing anatomical viability is bestowed using EEG. In EEG, small detectors which are also known as electrodes are positioned on the encephalon to record signals. Rate of occurrence diapason of EEG signals stretch is between 0.5Hz to 100Hz. According to the rate of occurrence diapason, EEG signals are classified into four rhythms namely; beta, alpha, theta and delta. The magnitude of EEG signal stretches between 1-100μV. During Seizure in epilepsy, the magnitude of the EEG signal increases excessively. Therefore, encapsulating enlarged amplitude substitutes are a sensible proposal to diagnose epilepsy.

Artificial Neural Network Classifier

Artificial Neural Networks are simply called Neural Networks. These are the computing systems vaguely motivated by Biological Neural Networks that comprise Human Brains. A neural network comprises of units (neurons), organized in layers, which transforms an input vector into some output. Every neuron takes an input, seeks a (often nonlinear) function

to it and then passes the output on to the next layer. Artificial Neural Network is a substantiated model which executes computations, decision making and swotting [9-14]. This method roots on human neurological system, thus ANN elements imitate biological neural network. In an ANN, processing element, weight, add function, activation function and exit correspond respectively to neuron, synapse, dendrites, cell body and axon in a biological neural network [6-8].

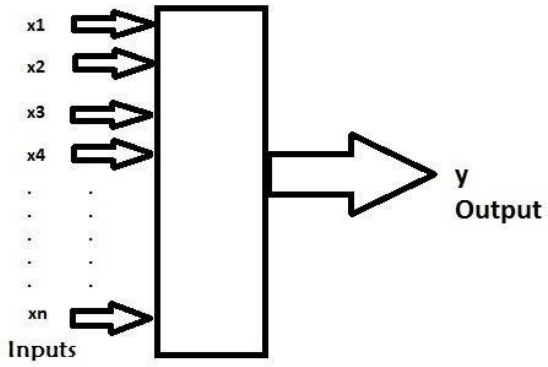

Fig.-1: Artificial neural Network

ANN is arranged as administrative training, individual training and brace learning in accordance with learning or training exemplar. ANN is stratified into two parts with concern to axons architectural composition, namely Feed Forward Neural Networks and Feed Backward Neural Networks.
The work is proposed uses three various ANN types, namely Cascade Neural Network, Elman Neural Network and Feed Forward Back Propagation. Error rate, speed, ease of use and parameters requirement can be chosen by user which are designed for user interface and comparison of mentioned parameters.

Autoregressive Burg Method

Another approach for modelling the signal spectrum is none other than autoregressive method. The proposed work uses Burg Algorithm to calculate the synergetic. For Burg algorithm the matrix $m_p(\boldsymbol{\tau})$ is as calculated below:

$$\begin{bmatrix} m_p(1,1) & m_p(1,2) & m_p(1,3) & \dots & m_p(1,\psi) \\ m_p(2,1) & m_p(2,2) & m_p(2,3) & \dots & m_p(2,\psi) \\ m_p(3,1) & m_p(3,2) & m_p(3,3) & \dots & m_p(3,\psi) \\ \vdots & & \vdots & & \\ m_p(\phi,1) & m_p(\phi,2) & m_p(\phi,3) & \dots & m_p(\phi,\psi) \end{bmatrix} \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ \vdots \\ b_\phi \end{bmatrix} = \begin{bmatrix} m_p(1,0) \\ m_p(2,0) \\ m_p(3,0) \\ \vdots \\ m_p(\phi,0) \end{bmatrix}$$

$$m_p(1,k) \quad \sum_{n=\tau}^{N-1} p_{n-1}\ p_{n-\tau}^{*}$$

where, p_n elements are accepted as Gaussian in Burg algorithm.

3. EXPERIMENTAL WORK

Proposed System

The initial step in the work proposed is data acquisition. EEG data were gained in two sets namely, normal and epileptic EEG Signals. Each of 10 healthy and 10 epileptic patients also known as subjects [15-21]. Single subject record has 4096 samples of single EEG time series. The dataset of EEG is obtained from Medical Department of Bharti University.

After data acquisition phase comes the data reduction with Burg autoregressive method. Each Patient sample is truncated from 4096 to 8by Burg method of auto-regression; prior training. The next step uses ANN for training and stratification. From the EEG datasets obtained, which include total of 14 patients EEG record, 7 healthy and 7 epileptic patients respectively. These patient datasets were used for training ANN[15-18]. The total of 6 patients record still remain, treated as test data as it were provided to the neural trained network. The comprehensive precision, exactness and execution framework is assessed to evaluate designed system. Block Diagram of proposed system is shown in figure below.

Results

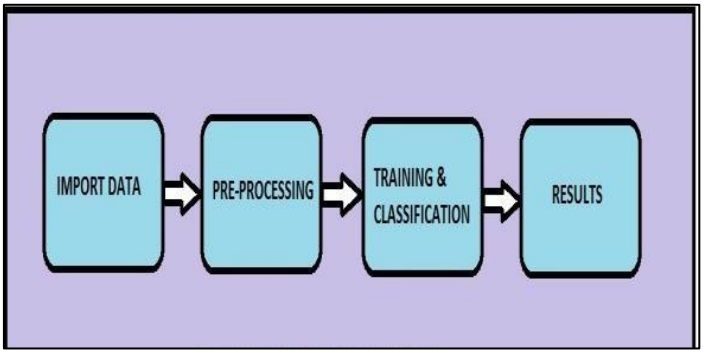

Fig.-2 : Proposed System Architecture

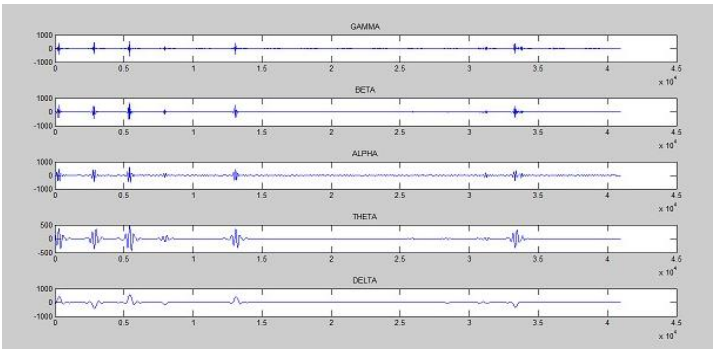

Fig.-3 : alpha, beta, gamma, theta and delta EEG bands.

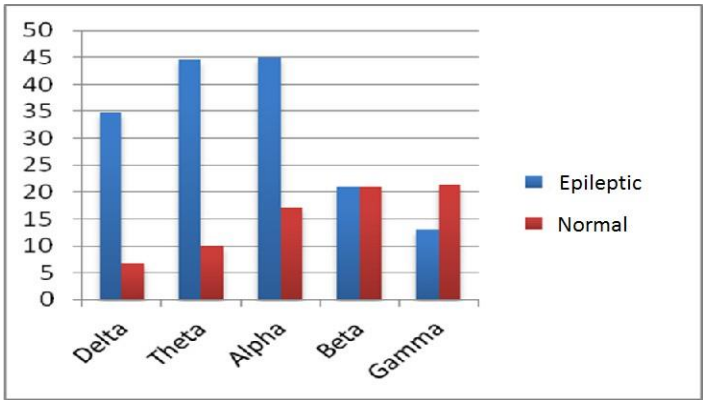

Fig.-4 : Computation of Power in various EEG bands.

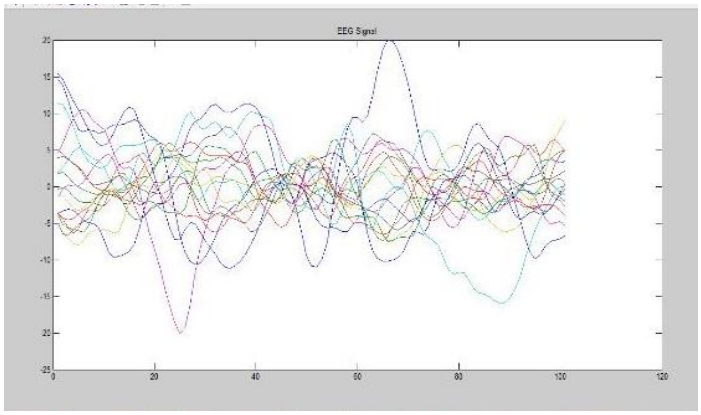

Fig.-5 : EEG signals.

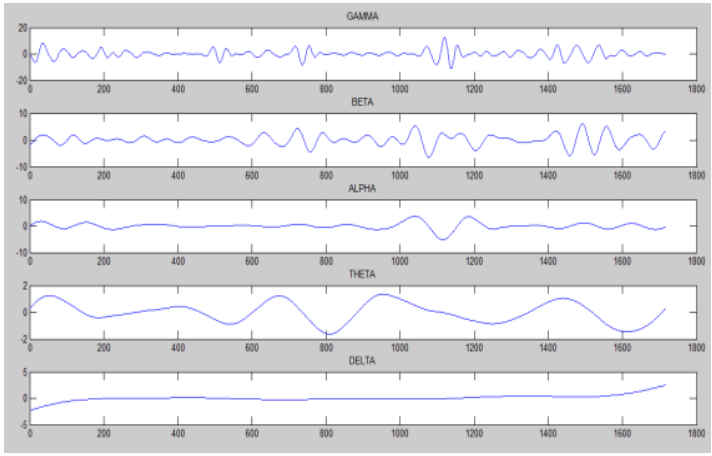

Fig.-6 : Separation of EEG bands.

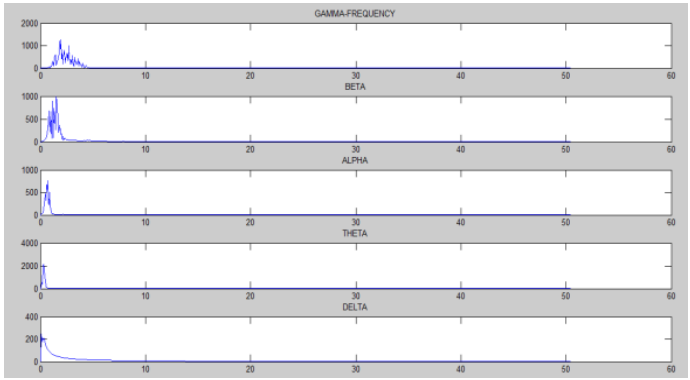

Fig.-7 : Spectogram.

CONCLUSION

Around one percent of the world's population suffers from the neurological disease known to be epilepsy. This study brings in a new system used for diagnosis to follow the medical terms of the patients and people suffering from epilepsy. Pliable and optical utilization is provided by MATLAB to perceive normal as well as epileptic EEG and trial outcomes.

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