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A REVIEW ON MACHINE LEARNING ALGORITHM FOR EEG SIGNAL ANALYSIS

S.Dhivya
Assistant Professor
Departmentment of Electronics and Communication Engineering
M.kumarasamy College of Engineering,karur
dhivyas.ece@mkce.ac.in

A.Nithya
Assistant Professor
Departmentment of Electronics and Communication Engineering
M.kumarasamy College of Engineering,karur
nithyaa.ece@mkce.ac.in

Abstract:
The electroencephalogram (EEG) signal is used to represents and records the electrical activity of the brain. The information obtained from the signals is useful for diagnosing and analyzing various brain diseases and brain conditions. If the brain diseases are left unidentified it leads to death. The early detection of brain diseases is very important to reduce the modality rate. For easy analysis of various brain activities some machine learning techniques like SVM, k-Means, ANN, Linear Classifier and *XG Boost* ***have been reviewed in this paper.***

Keywords: Electroencephalogram (EEG), SVM, k-Means, ANN, Linear Classifier, XG Boost

I. INTRODUCTION:

Electroencephalogram (EEG) signals are obtained by placing the electrodes on the scalp. The 10-20 EEG placement system is used for recording the brain activities. It is an internationally recognized method to place the electrodes on the scalp. If we need to record more details we can add more electrodes with this system. The placement of electrode is shown in the figure1.1.[1]

The brain activities are stored as action potentials with the help data received; the brain activities can be monitor [2]. If there is a small change in the value then diagnosis of the signal is performed to check the abnormalities. The variation in the brain activities may be due to any change in the functioning or due to accidents happened to them. The major problems are dementia, brain tumor, epilepsy etc which affects the proper functioning of the brain [1].

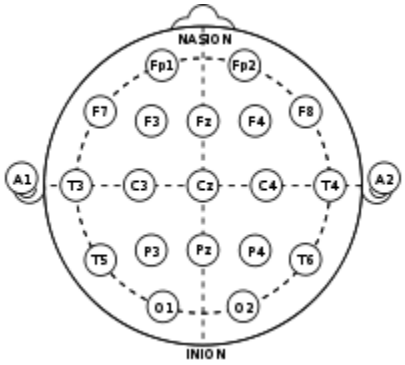

Figure 1.1 EEG Electrode Placements [3]

The signals obtained are classified by using various machine learning classifier techniques. Machine learning techniques are used for easy computation of the signals.

The various classification methods are discussed below. To classify the signals test data and trained data is used.

II.METHODOLOGY

The methodology for EEG signal diagnosis and analysis is explained with the help of a block diagram [4].

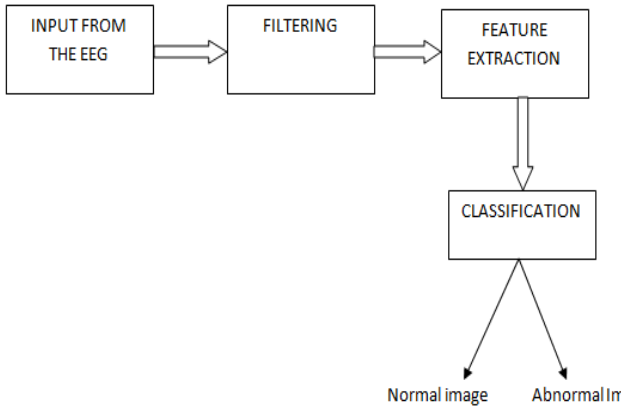

Figure 1.2 Block Diagram for EEG Signal Classification

(A) Data acquisition

The recorded data are used for classification. The trained data is already stored in the processing unit and the test data is given from the EEG Signal for further processing. The trained data is the already processed data with known results but test data is the data need to be diagnosed and analyze by comparing with the trained data. The waves recorded are useful to differentiate the various brain activities.

(B) Filtering

The received test data will have noise in it. To remove noise present in the signal proper filtering techniques are used. The noise present in the signal is either due to the equipment or may be change in body functioning. The signals obtained may vary due to change in the body functioning or other activities. There are many filtering techniques are there but the best choice is to use median filter. Median filter is used for noise removal since it prevents the edges while removing noise from the signal.

(C) Feature Extraction

The required feature is extracted from the de-noised or filtered signal. The feature extraction mainly depends upon the signal frequency. The change in frequency range helps to determine various diseases or changes in brain activities. Linear analysis is used for extracting the required feature from the signal obtained [11].

(D) Classifiers

The classifier is used to classify the signal either as diseased signal or normal signal with the help of change in the frequency of the signal. Some of the classifiers are reviewed in this paper. They are

(i) SUPPORT VECTOR MACHINE

It is a classification method, where each data item is plotted as a point in number of features-dimensional space with the value of each feature being the value of a particular coordinate. It is a one of the best machine learning classification method which produces results with high accuracy. It is a supervised classification technique [7]-[8].

(ii) K-Means CLUSTERING

It is a type of clustering algorithm which is used to solve the clustering problem and it is an unsupervised algorithm.

The algorithm is very simple and easy, the data inputs given will be classified with a certain number of clusters [6]. Data points inside a cluster are homogeneous and heterogeneous to peer groups. During clustering the following points are need to be considered:

1. The k points for cluster is picked and those points form a cluster called k-cluster
2. The centroid of each cluster based on existing cluster members. Here we have new centroids.
3. If new centroids are there, the step 2 and 3 is repeated. Then the closest distance for each data point from new centroids gets associated with new k-clusters. The process is repeated till no change in centroids. The K value is identified with the centroid in the cluster. The total square value of the cluster is calculated with the help of sum of square value of the difference between centroid and the data points within a cluster. It also becomes total when the sum of square values for all the clusters is added within sum of square value for the cluster solution [6].

(iii) LINEAR CLASSIFIER

A linear classifier classification is based on the value of a linear combination of the characteristics. A feature values are also known as object's characteristics and are typically presented to the machine in a vector called a feature vector.

(iv) ARTIFICIAL NEURAL NETWORK

An artificial neuron network (ANN) is a computational technique which is based on the structure and functions of biological neural networks. Information in the network affects the structure of the ANN if any change is sensed in input and output. The classification is based on weights in the hidden layer [9].

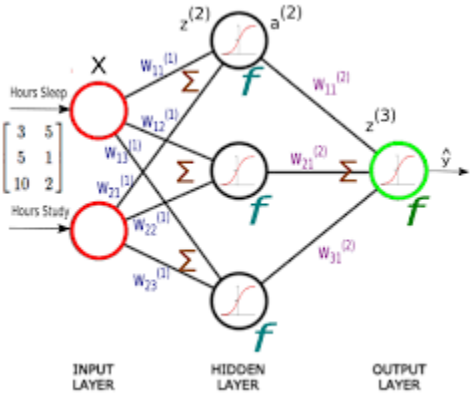

Figure 1.3 Architecture of ANN

(v) XGBoost

XGBoost is a gradient boosting algorithm based on decision between true and false value in some Kaggle competitions. It is highly predictable and highly accurate in events as it has both linear model and the tree learning algorithm; It is ten times faster than existing gradient booster techniques. It is mainly used for regression, classification and ranking process. It is also called as regularized boosting technique as it helps to reduce over fit modeling and also supports wide range of languages such as Scala, Java, R, Python, Julia and C++. XGBoost can also be integrated with cloud dataflow systems like Spark, Flink with a built in cross validation during each iteration of the boosting process

III. CONCLUSION

In this paper some of the classification method to classify the signal is discussed and the choice of the classifier is based on the application but all the above mentioned algorithm will have an best accuracy in signal classification since all the algorithm are computational machine learning algorithm.

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