CLASSIFICATION OF EEG SIGNALS FOR BRAIN AND COMPUTER INTERFACES

[1]Chinmaya Kumar Pradhan, [2]Swati Sharma, [3]Devendra Nagal
[1]PhD Scholar, Dept. of Electrical Engineering, JNU, Jodhpur
[2]Faculty, Dept. of Electrical Engineering, JNU, Jodhpur

***Abstract*—Electroencephalogram EEG can be regarded as a brain signal which can reveal the brain function and neurological disorders. Classification of EEG can be performed into two ways called epilepsy and non-epilepsy. The extraction of EEG images can be done with the help of Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT). To perform the operations with the computer to interact with the brain signals EEG is more useful. Classification of EEG can reveal the solutions to the many problems of human psychological diseases. Support Vector Machine is a kernel based algorithm to analyse the EEG signals to find the accuracy of the signals. In this paper the analysis of EEG has been done using Support Vector Machines, Logistic Regression and Auto Associative Neural Networks to find the accuracy of the signals. The experimental results have revealed support vector machine method is providing the highest accuracy of EEG signals for analysis.**

Key Words: Electroencephalogram, Classification, support vector machine, Logistic Regression, comparative results

I. INTRODUCTION

TOinvestigate the disease of human the new technique has been introduced with the introduction of Brain Computer Interface. Using this technique the Electrophysiological signals are revealing the central nervous system reflections. This has revealed how the people have lost their voluntary muscle control. The new techniques and methods are used to find the brain activities from the classification of EEG signals. EEG signals will be classified by different methods. These are Support Vector Machines, Logistic Regression and Auto Associative Neural Networks. Support vector machines will be classifying the kernel based unlabelled and labelled data. The data will be clustered and analysed with the existing clustered data stored in the kernel. The classification method is predominant and proven to provide high accuracy. Similarly Logistic Regression is another method to get the signal accuracy of EEG in the analysis. In this project we have done the analysis with the predominant method called Auto Associative Neural Networks which is also equal to Support Vector Machine algorithm.

EEG will be used in different kinds of methods to find the specific disease of the human beings. Different diseases can be detected by instigating different methods like PET, ECoG, MEG etc. In the previous experiments SVM is extensively used to classify the EEG signals to integrate the Brain Computer Interface (BCI). SVM stands for Kernel Logistic regression. This kernel logistics regression methods are used to produce the probability outputs for classification problems by using k-fold cross validations. SVM algorithms are using parametric methods in finding the accuracy of the signals. EEG classification based BCI is prominently providing the efficient identification of patient's diseases with intensity. The classification is BCI is performed using non-probabilistic methods with the help of support vector machine algorithms. These methods are producing the predictive probability outputs in practical recognition circumstances.

II. RELATED WORK

In the recent years the classification of EEG signals is performed into epilepsy and non-epilepsy categories. EEG image features are taken from the methodology called Discrete Cosine Transform and Discrete Wavelet Transform to be used in model generation. SVM is implemented to observe the distribution of the EEG features. Linear and adaboost support vector machines are also used to classify the EEG signals to reveal the BCI (Pazhanirajan.S, et.al.(2014)). Actually the EEG signals can be recorded in a short span of time with the help of electrodes keeping on distinct positions of the scalp. The EEG signals can be obtained from the clinicians where they apply methods to absorb the research results. Results can be obtained in five sets from different human beings. Predominantly the first set would be taken from the healthy human and the others can be taken from different patients of different diseases (Neelam Rout (2014)).

EEG signals are providing the information about the brain. The extraction of EEG signals can be obtained by expert clinicians. The signals are classified by using different motor imagery tasks and classification algorithms. The main aim of the classification of EEG signals is to identify the root cause of the disease and help the patients to recover faster with adequate measures. To perform the classification and obtain the results for getting treatment will be done by Brain Computer Interface methodology (Siuly (July, 2012)). BCI techniques are used to assist clinical diagnoses. The BCI applications can be classified as Cross-correlation Based Logistic regression, Modified CC-LR with diverse features sets and Cross-correlation based latest square support vector machines (MingjunZhong et.al.

(2014)).

The EEG signals problem setting can be solved by the single trail of an imaginary motor movement. The binary classification problem can resolved with the imaginary movement called positive or negative class. The common spatial pattern based on classifiers can be implemented with the help of conventional method. The patient's disease diagnosis can be investigated with the help of Classification of Common Spatial Patterns of Motor Imagery signals. The CSP based classifiers can be built with the help of generalized eigenvalue problems EQ and equating with the smallest and largest eigenvectors. Finally by arriving the LDA classifier on with the help of eigenvectors. (RyotaTomioka, et.al.(2014)).

III. THE METHODOLOGY

In the proposed system EEG has been analysed by using Support Vector Machines, Logistic Regression and Auto Associative Neural Networks. The results have been extracted and compared in a detailed table to reveal the accuracy of the signals. In this project the implementation of analysis using the three methods and algorithms.

Support vector machine algorithms is implemented for classification of EEG patterns to perform brain – computer interfaces. The functionality of the SVM algorithms is to identify the patterns of brain activity with the help of classification method on unlabelled and ladled data. EEG signals are consists of poor signal-to-noise ratio. It is used in BCI features with noisy or outliers. EEG signals should be measured with high dimensionality, non-stationarity and with small training sets.

The classification methods are Generative-discriminative, static – dynamic, stable- unstable and regularized. These classifications have some problems with BCI research. These are the curse of dimensionality, Bias Variance trade off. The classification is the final part to send the signals to BCI classification to find the patients diseases.

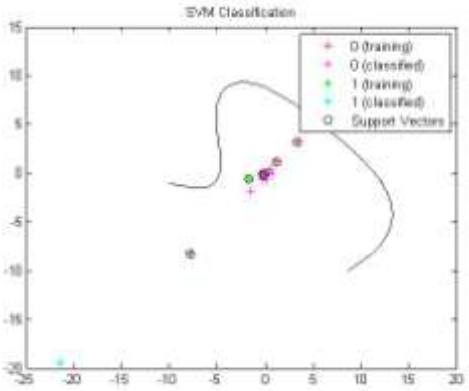
The proposed experiment has been done with the Logistic Regression and Auto Associative Neural Networks. The results have been published here under.

IV. RESULTS

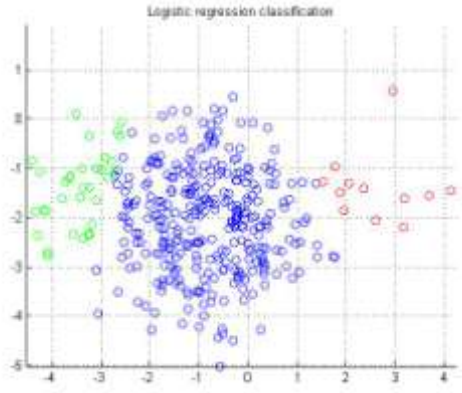
Classification Method	TPR	FPR	Accuracy (%)
Support Vector Machine	1.4512	0.1499	90.6371
Logistic Regression	1.4489	0.1504	90.5985
Auto Associative Neural Networks	1.4222	0.1764	88.9635

.Results showing the accuracy percentage of EEG classification through various methods. It is proved that the Support Vector Machines method is predominant .

The following diagrams demonstrate the graphical representations of the various methods and results.



The above picture demonstrate the SVM classification of EEG signals.



The above picture demonstrate the Logistic Regression Classification for EEG signals.

V. CONCLUSION

Electroencephalogram EEG is used as a mesure for brain signal. The signals can reveal the brain function and neurological disorders. Support Vector Machine is a kernel based algorithm to analyse the EEG signals to find the accuracy of the signals. In this paper the analysis of EEG has been done using Support Vector Machines, Logistic Regression and Auto Associative Neural Networks to find the accuracy of the signals. The experimental results have revealed support vector machine method is providing the highest accuracy of EEG signals for analysis. Brain

Computer Interface is used for classify the disease of the patient. The classification is BCI is performed using non-probabilistic methods with the help of support vector machine algorithms. These methods are producing the predictive probability outputs in practical recognition circumstances. In this paper the support vector machines mehtod is proven to be the best classification algorithm for EEG signals.

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