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K-Means Clustering and PCA Classifier for Epilepsy Classification From ECG Signals

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Abstract: **The people who are suffering from epilepsy can be controlled by the help anti-epileptic drugs. For some people to overcome epilepsy specialists are required. The general practitioner plays a major role for coordinating both the treatment and diagnosis. If people maintain a healthy lifestyle, for most patients epilepsy can be controlled. Those people who are suffering from epilepsy should not get strained themselves, avoid excess alcohol, dehydration and drugs. To detect the epilepsy Electroencephalography (EEG) signal are analyzed. The EEG signals shows specific patterns and different space, frequency and time, for epileptic patients, during a particular seizure. By the help of Factor Analysis the dimensions of EEG signals are reduced and then it is classified with the help of K Means clustering and PCA classifier.**

Keywords – Epilepsy, EEG, Factor analysis, K-means Clustering, PCA classifier

I. INTRODUCTION

The abnormal electrical activities may occur in both specific area of the brain or whole area of the brain, respectively called partial and generalized seizures. Partial seizures can be classified into simple or complex. Initially, seizures may partial and later it becomes generalized. Generalized seizure can be classified into many types such as absence, tonic, atonic, tonic-clonic and myoclonic. The type of seizures in perfect diagnosis is difficult for understanding and determining the type of medication which would be most effective for healthy lifestyle. The EEG is obtained By placing the electrodes on the scalp of the head and by recording activities of the cerebral cortex. The electrodes are well positioned on the scalp and then it records all the events which are electrical in nature that are present in the underlying cortex. The EEG is highly useful, very high spatial and temporal resolution. In real time the range of milliseconds are allows detecting all the events, thus its applicability is easier for detecting seizure disorders. The potential difference is recorded in the EEG signals by synchronization level of the activities of neurons.

The EEG recordings are done which is lengthy and time consuming procedure from the epileptic patients. Firstly a skillful or a expert person is required for sleuthing the problems related to epilepsy, the EEG waveforms should be observed by respective person. The peaks, spectrum and etc can be observed only by the dependence on their observation, The identification of disease from which the patient is suffering is done. There are lot of negative thoughts among the experts as this issue of sorting of epilepsy from EEG signals is quite subjective in nature. The automated diagnosis systems are very useful to identify the changes in activities of the seizure. The materials and methods are discussed followed by the usage of Factor Analysis as a dimensionality reduction technique.

II. LITERATURE SURVEY

Anderson C W and Sijercic Z “Classification of EEG signals from four subjects during five mental tasks Solving Engineering problems with neural network.” proc. Int. Conf. On Engineering Applications of Neural Networks, EANN 1996. In his work he divided the classification algorithms are used to design BCI systems into different categories: linear classifiers, neural networks, non-linear Bayesian classifiers and combinations of classifiers.It is necessary to extract features from EEG signals.Transfer function performance is the lowest[1].C. Guger, H. Ramoser, and G. Pfurtscheller “Real-Time EEG Analysis with SubjectSpecific Spatial Patterns for a Brain–Computer Interface (BCI).”IEEE TRANSACTIONS ON REHABILITATION ENGINEERING, VOL. 8, NO.4, DECEMBER 2000.This paper demonstrates that the method of common spatial patterns can be used to analyze the EEG in real time in order to give feedback to the subject. The method was utilized to give fast, continuous, and accurate feedback during left- and right-hand movement imagination.spatial patterns is a promising method for an

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EEG-based brain–computer interface.For practical applications, the training time must be minimized to increase the acceptance of the system and motivation of the BCI operator[2].F. Lotte, M. Congedo, A. Lécuyer, F. Lamarche, and B. Arnaldi “A review of classification algorithms for EEG-based braincomputer Interfaces.” Journal of Neural Engineering, 4:R1–R13,2007.This paper proposed Band power (BP) features are known to be efficient for motor imagery classification.A strong real-time constraints that are imposed when using a BCI online prevent the use of non-linear inverse solutions as they are computationally demanding.In the off-line scenario can evaluate the performance of a number of classifiers using a benchmark dataset[3].

III. MATERIALS AND METHODS

A. *Review Stage*

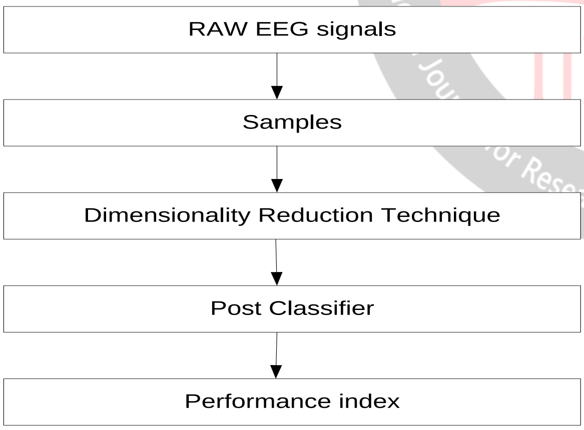
The research is to detect and identify the non-focal epileptiform from focal epileptiform similar to the methodology detected by the visual encephalographs. There following are four stage are in this research:

1. The sampling and digitizing of the EEG data is done by data acquisition.

2. Dimensionality reduction techniques are the application of Factor analysis.

3. By the help of post classification techniques the dimensionality reduced EEG data and then it processed

B Block Diagram



To reduce the dimensions of the EEG data dimensionality reduction technique is used and then by the help of post classifier it classified the best epilepsy risk level classification. On the scalp of the epileptic patients the electrodes are placed. All the 16 channels of EEG are done by recording and the referential montages. The electrodes are referenced for common potential points like bipolar montages and ear. Each electrode is referenced to the nearby adjacent electrode.

The recordings of the EEG signals are performed for various stages like random movement of muscle stage, photonic stimulation stage, eyes closed and open period.

EEG signals is done by amplification of the EEG-machine.

The cleaning of the scalp should be done and with light abrasion, between the skin and the electrode the electrode paste is smoothly applied and then electrode is placed on it. The EEG signals are easily broken down in epochs by entire recordings for dimensionality reduction. The most important statistical characteristics of the EEG signals capture and frame which depict the evolution of seizures,it is long enough. For digitizing the EEG signals the sampling rate is considered as 200 Hz . Using the MATLAB R2010a version, the analysis of the EEG data was done. Therefore total number of samples to be processed for all patients is too high and Factor Analysis is used as a dimensionality reduction technique.

IV. FUNCTIONAL AND NON-FUNCTIONAL REQUIREMENTS

Functional requirements:

Take the input datasets which should be of related attributes.

Apply k-means clustering approach to cluster datasets.

To classify the input dataset, consider PCA approach.

Non-functional requirements:

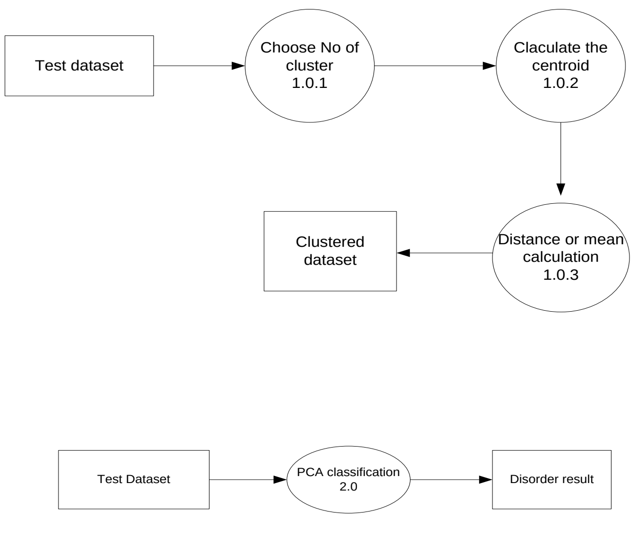
Modularity: the project is decomposed into modules. So that separate modules can be implemented easier.

Availability: in this project, we need a dataset and the complete project works in open source platforms.

Portability: the project can be moved to any place. Project works on open source java platform.

V. FIGURES

A. Data flow diagram



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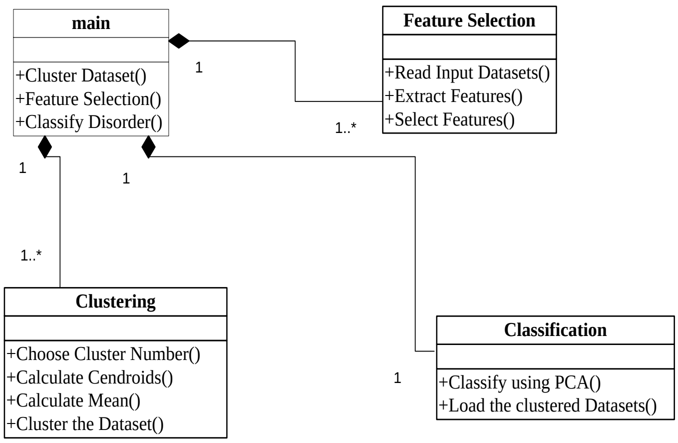
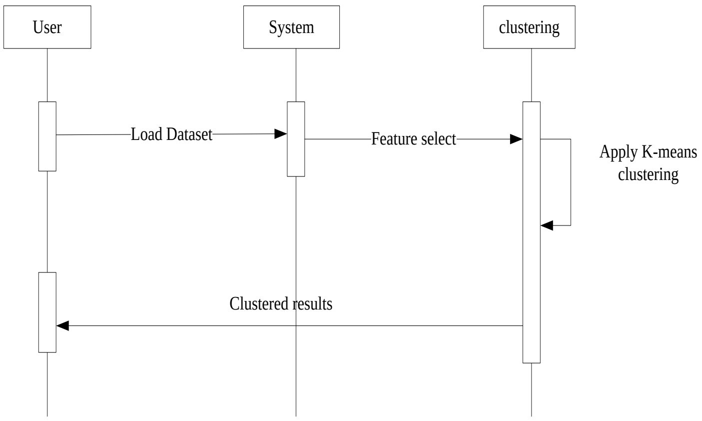
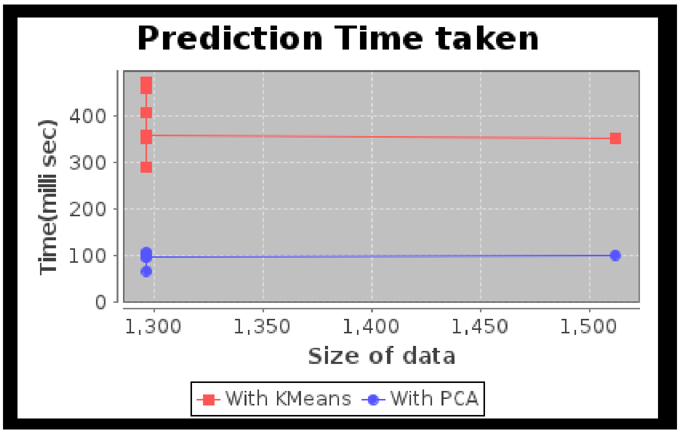
B. class diagram



C. Sequence diagram



VI. RESULTS



VII. CONCLUSION

The main goal of the paper lies in the risk level classification of epilepsy from EEG signals. The main aim is to get a high classification accuracy, good performance index, low time delay, high quality values with nil or low missed classification and false alarm. In this work, an average classification accuracy of 98.33% along with an average quality value of 22.43 is obtained. An average Performance Index of 96.46% along with an average time delay of 1.93 seconds is reported in this work. Future works aim to perform various other soft computing techniques to classify epilepsy in a better manner from EEG signals.

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