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Variational Mode Decomposition Based Seizure Detection and Classification Using EEG Signals

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ABSTRACT

The seizure is an unexpected change in neurons, which leads to the second most common disease of the brain called epilepsy. An automatic seizure detection technique is essential for primary diagnosis and treatment because the traditional methods of seizure detection are time-consuming and inaccurate. In this regard, this proposal shows a novel seizure detection technique with the features of Variational mode decomposition (VMD). The features are computed from the levels of VMD. Further, the extracted features selections are optimized through Neighborhood components feature selections (NCFS), Filter method feature selection (FMFS). Finally the significant features are classified using different machine classification algorithms such as artificial neutral network (ANN), K-Nearest neighbor (KNN) and support vector machine (SVM).

1. INTRODUCTION

The seizure is an unexpected change in neurons, which leads to the second most common disease of the brain called epilepsy. An automatic seizure detection technique is essential for primary diagnosis and treatment because the traditional methods of seizure detection are time-consuming and inaccurate. In this regard, this proposal shows a novel seizure detection technique with the features of Variational mode decomposition (VMD). The features are computed from the levels of VMD. Further, the extracted features selections are optimized through Neighborhood components feature selections (NCFS), Filter method feature selection (FMFS).

2. LITERATURE REVIEW

Syed Anas Imatiaz work was supported in part by the European search Council (ERC),says epilepsy is a chronic and noncommunicable condition That affects the brain of those who suffers from the severe epilepsy condition More than 50 million people worldwide suffer from the epilepsy Authors presents the alterative sensing modalities to assist with the task of long- term monitoring to assist with the long-term management of disease For the first time the possibility of using physiological sounds sensed from the suprastemal notch to identify the presence of seizures Similar to the other non-EEG modalities used for detecting seizures, as a change in the cardio respiratory system rather than the electrical activities of the brain To quantify and characterize changes in cardio-respiratory system, including the evolution of such characteristics around seizure episodes.

3. RELATED WORK

As these autonomic changes boour in both focal and generalized epilepsy, they could have the potential to be used for detecting seizures and alleviate some of the issues in other modalities that onlywork well on specific seizure types Juozapavicius et al. expressed about the Centro temporal spikes and its characteristics to identify the irregularity in the EEG signals. Centro temporal Spikes are those which occur between the close by electrodes. The EEG signal deformed by 35Hz noise. The FIR filter removes this noise. The system identifies the spikes together with the noise, which gives a false depiction of seizure. It is challenging even to qualified doctors to detect epileptic spikes in noisy EEG signal. Raghunathan et al. investigated an implantable neural prosthesis, which delivers focal electrical stimulation on demand.

Detection of seizure algorithms facilitates feedback mechanisms to present particular intervention focally and temporally. The techniques presented in this work facilitated the development of seizure detection algorithms. 10 Cherian et al. recommended that in an independent dataset, the progression of discontinuity and the existence of sleep- wake cycles, EEG background categorized into eight positions based onneonatal seizure detection algorithm (Neo Guard). Victims additionally again divided into two groups; GPI: mild to moderate (categories 1–5) and GPII: severe (categories 6– 8) with EEG background abnormalities. Seizuresare regarded as definite and dubious. The comparison of seizure characteristics made between GPI and GPII. There was no selection on the topic of the quality of EEG or being there of artifacts.A method was described by Lewis et al. to affix power spectra and Deterministic Finite Automata (DFA) in a way to improve the identificationof spikes and seizures in epileptic form activity from Electroencephalogram (EEG). For the detection of seizure in the temporal lobe region, Cecchin et al. proposed a new semiautomatic technique using raw scalp EEG signal.

Hjorth parameters are used to find Quadratic mean and dominant frequency of the seizure signal. Then the mean values of the Hjorth parameters are calculated for either side of the brain and the computed values segmented for analysis. The seizure onset is lateralized using Physical characteristics like frequency, amplitude and correlation. It proved that 97.4% of correct lateralization attained from the experimental result with parameters like sliding windows, threshold level and the slope. Diabetes. examined a clarification for the loss of mobility in hands due to paralysis. EEG detection is used to bypass the separated connection between the brain and the hand using a system comprising of a dynamically controlled wrist orthosis, a commercial EEG headset and a computing interface. The raw EEG signal accepted by an artificial network from the movement trends and later classified real-time data into corresponding open/close movements in the orthosis via a linear actuator. The system performance calculated in terms of mobility, power efficiency, latency and accuracy.

4. PROPOSED SYSTEM

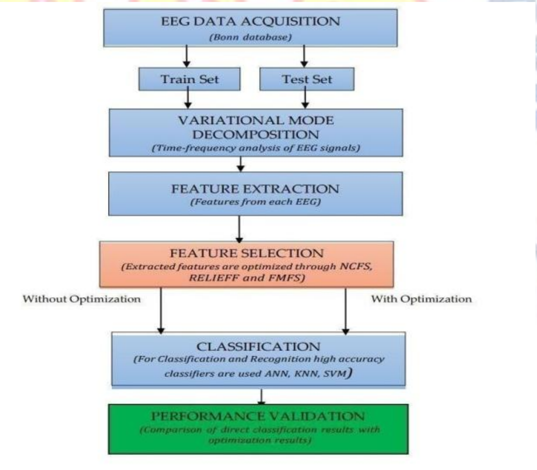

Fig 1: Identification system structure.

The identification system includes the stages of data acquisition, feature extraction, feature optimization and finally, classification and performance validation. The Identification system structure shows the sequence of essential stages involved in the data processing The occurrence of abnormal sensations and loss of consciousness are notable symptoms during a seizure. The nerve cells in the cerebral cortex act simultaneously and there are a sudden massive burst of electrical energy, which leads to epileptic seizures. As per the International League against Epilepsy. The detailed description of each stage in the identification system is as follows: Fig 1: Identification system structure. 32 healthy subjects with eyes closed and Set A was collected. From EEG records of five epileptic patients having a presurgical diagnosis, the Set E was created.

The EEG records during seizure activity of epileptic patients are recorded in set E. From each respective category, one of the signals is depicted in It can be visualized from the Figure when compared to the rest of the signals, the amplitude of EEG signals is the lowest in a normal condition. the representation of the amplitude of the signals in micro-volts is shown: The EEG signals were collected from the online database maintained at the department of Epileptology, University of Bonn, Germany website. Set A, Set E are the datasets consisting of two different sets. The normal state represented by the signals of Set A. The signals exhibit the ictal activity (epilepsy) in Set E. From healthy subjects with eyes closed and Set A was collected. From EEG records of epileptic patients having a presurgical diagnosis, the Set E was created. The retrieved data is in '.mat' format and analyzed in Matlab software for processing. Feature Extraction using VMD: EEG features play the vital role in the identification of epilepsy. Each EEG signal is fragmented into four segments for better examining. Variational mode decomposition technique is used to extract statistical and spectral features in the proposed research. The extracted features from each EEG signal are used to classify the normal and epilepsy signal. Optimized Feature Selection: The extensive feature set may consist of irrelevant, correlated and over-fitted features, these features misleading the classification technique. Those features should be sorted out from the dataset to enhance prediction accuracy. 33 Feature optimization techniques reduce the feature space depending on a feature selection criteria. It generates a smaller feature subset from a superset of original features to increase classification accuracy and computational efficiency.

Classification and Identification: Classifier classifies data based on the training set and the values in a classifying attribute and uses it in classifying new data. The epileptic seizure identification of the EEG signal can be done by feeding the data of EEG features to Machine Learning Classification algorithms. The obtained optimized feature set is trained with various classification algorithms to identify the epilepsy and normal signals. A comparative analysis is made with and without optimization and the results are generated by a confusion matrix which depicts the accuracy of correct classification of test data. The different performance parameters as accuracy, specificity, sensitivity, precision, F_measure and G_mean are determined for performance validation. Upper left: The filtered acoustic signals taken during the interictal period. Lower left: The features extracted for signals from the same interictal period. Upper right: The filtered acoustic signals taken during the ictal period. Lower right: The features extracted for signals from the same ictal period The postprocessing stage works as follow. It looks at the classification outputs, C, for the previous M acoustic segments and calculates the ratio according Then, the ratio, p, is compared to a predetermined threshold, thr. If the ratio is greater than the threshold, the algorithm then indicates that a seizure has occurred. Mathematically this is represented by (2), where a 0 at the output (H) indicates that no seizure is happening and 1 that a seizure is happening 34 A refractory period of 1 minute was also assumed and hence any subsequent seizure detected within this window was considered part of the same event.

5. RESULT

User Test Screen - I

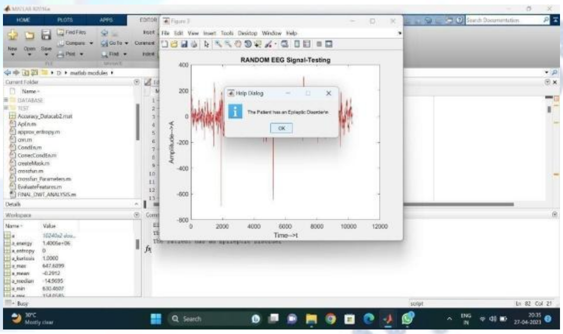

Fig 2 : Detection of Epileptic Signal

User Test Screen – II

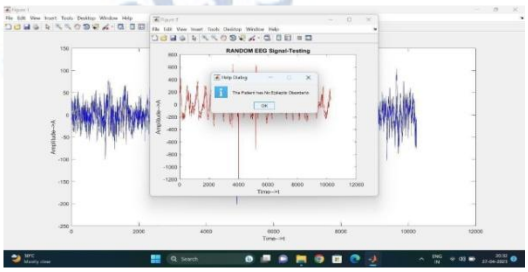

Fig 3 : Detection Of Non-Epileptic Signal

User Test Screen – III

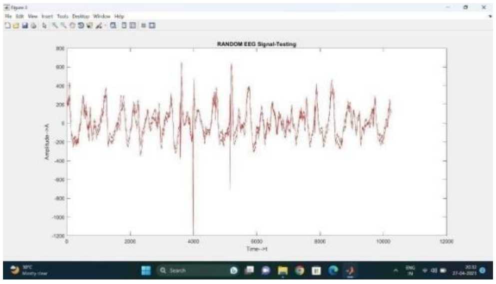

Fig 4: Epileptic Signal

User Test Screen – IV

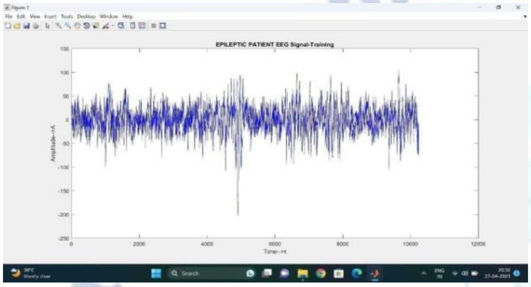

Fig 5: Non-Epileptic Signal

FUTURE ENHANCEMENTS

The future scope of the project is to build the dataset with more classes and to train the proposed model variational model decomposition method. The accuracy of the project is high compared to existing methods like x-ray and MRI scanning. So the future enhancement for this project is very high comparatively.

6. CONCLUSION

This paper represents an online and offline classification of healthy and abnormal subjects by using EEG signal based on variational mode decomposition. It is seen that the accuracy of the system abruptly increased by this VMD based technique. The extracted features are classified using SVM classifier. The performance of the classifier is also validated using tenfold cross validation method. The proposed work achieves the best accuracy of 97.5% in comparison with the other methods.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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