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A Review Study on the Analysis of Epileptic Seizures Using EEG Signals

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Abstract: Epilepsy is an infirmity which affects the brain causing repeated seizures. An automatic novel method is used for analyzing the EEG signal and for detecting epileptic seizure activity. The proposed method is tested on a publicly available dataset and it uses time domain features.

Keywords: Epilepsy, epileptic seizure, EEG and time domain.

INTRODUCTION

Epilepsy (from the Ancient Greek meaning "to seize, possess, or afflict") is a group of long-term neurological disorders characterized by epileptic seizures. Epileptic seizures are neurological dysfunctions that are manifested in abnormal electrical activity of the brain. Behavioural correlates, such as convulsions, are sometimes associated with seizures. There are, however, seizures that do not have clear external manifestations. These non-convulsive seizures can be detected only by monitoring brain activity. One way to investigate the electrical activity of the brain is to record scalp potential resulting from brain activity. The recorded signal, i.e., potential difference between two positions, is called electroencephalogram. Long-term measurements generate a lot of data and manually reviewing all of it is an exhausting task. There is a clear need for an automatic seizure detection method. The term seizure detection generally refers to the use of an automated algorithm (a seizure detection algorithm or SDA) to recognize that a seizure is occurring (or has occurred) through analysis of biologic signals recorded from a patient with epilepsy. During seizure, there is abnormal electrical activity in the brain, that is reflected on scalp potentials and hence can be recorded with EEG. Essentially, the goal is to receive and analyze a set of signals and transform the information they contain into an output signal or indicator of whether or not the patient is in a state of seizure. Important objectives are to perform this transformation as quickly, efficiently and as accurately possible. Epilepsy is an important neurological disorder, characterized by recurrent seizures. In the world epilepsy affects an estimated 43 million people. Thirty percent of epilepsy patients between the ages of 5 and 25 develop seizures related to illness or accidents involving an injury to the head. As many as 50 percent of epilepsies continue into adulthood. Epilepsy is classified as the second most serious neurological condition known to man, after stroke. It affects nearly 50 million people around the world, which is approximately 1% of the world population.

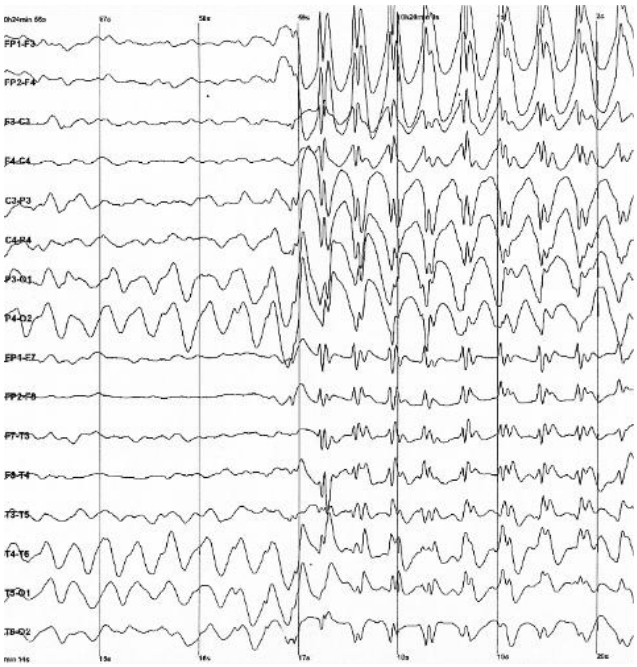

Fig 1 EPILEPTIC FIT[1]

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RELATED APPROACH

sThe most commonly used technique for diagnosing epilepsy is Electroencephalogram (EEG). The EEG utilizes metal electrodes to measure the electrical activity of the brain. The signals can be recorded in two ways, the first is by placing the electrodes on the scalp and the second is by placing the electrodes inside the scalp [1]-[3]. The EEG recordings contain tons of information and are analyzed by experts to detect epileptic activity [4]. However this traditional method of visual inspection is a time consuming and difficult process, hence developing an automatic epileptic seizure detection method is of great significance.

Researches on automatic detection of epileptic seizures began in the 1970's. Ling Guo et al. [1] proposed a new method for automatic epileptic seizure detection using wavelet based line length features and ANN for classifying the EEG signal. D. Gajic et al. [2] uses an automatic classification technique based on wavelet transform and statistical pattern recognition. Energy, entropy and standard deviation were the features extracted and quadratic classifier was used for classification.

M Shanir P.P et al. [3] proposed an automatic seizure detection method based on two statistical features in time domain. Mean and minimum values of energy were the features used and the method was tested on CHB pediatrics EEG datasets. This work obtained an accuracy of 99.81%, sensitivity 100%, and specificity 99.81%. V. Srinivasan et al. [4] uses a recurrent type of neural network known as Elman network (EN) for detection of epilepsy. Five different attributes comprising two time domain and three frequency domain features were used to evaluate the performance of neural network. Sharanreddy et al. [5] presented a hybrid technique for classification of EEG signals by combining multi-wavelet transform and ANN. K Najmah et al. [6] discussed a patient specific detection system using discrete wavelet transform on scalp EEG data. They used features namely mean and variance of ictal and interictal data and used linear classifier for classification. The work achieved 98.3 % specificity, 96.06 % sensitivity and 97.19 % accuracy.

CONCLUSION

In this paper a simple automatic seizure detection method based on time domain features is used. The classification algorithms used in this work is able to classify the EEG segments much efficiently and high classification accuracies are obtained for the two different classification problems. The results obtained show the success of the proposed method and makes it suitable for real time applications with less complexity, time and low cost. However, a drawback is that the EEG data used in this work is artifact free signals. This limits the assessment of the proposed method with noised EEG signals and thus extensive evaluation under real clinical settings is required.

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