International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 8, Issue 1 [January 2019] PP: 11-14

A Survey on Detection of Seizure and Non-Seizure EEG Signal Using Machine Learning Technique

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ABSTRACT: *Approximately 1%–2% of the world's population has epilepsy, a neurological seizure that occurs when several nerve cells in the brain generate excessive and repetitive electric impulses over a short period of time. Electroencephalography (EEG) enlighten about the state of the brain i.e. about the electrical bustle going on in the brain. A seizure is an event that causes an abrupt surge of electrical activity in the brain, where epilepsy is the disease involving recurrent unfair seizures. The proposed methodology in signal modelling which gives us automatic seizure detection in EEG signals. Diagnosis of epilepsy requires long term electroencephalography (EEG) monitoring. The interpretation of long-term EEG monitoring takes a lot of time and requires the assistance of experienced experts. To optimize the seizure detection we used feature extraction concept. In order to overcome these limitations we apply machine learning technique.*

Date of Submission: 20-02-2019 Date of acceptance:08-03-2019

I. INTRODUCTION

Your brain is alive. Your brain shapes how you see your environment, highlights objects and information most relevant to you. It creates its own stories based on your thoughts, emotions, desires and experiences. Electroencephalography (encephalon = brain), or EEG, is the physiological method of choice to record all of the electrical activity generated by the brain from electrodes placed on the scalp surface. For faster application, electrodes are mounted in elastic caps similar to bathing caps, ensuring that the data can be collected from identical scalp positions across all respondents. The diagnosis of epilepsy relies on the clinical history of the patient, computed tomography (CT), magnetic resonance imaging (MRI),video-recording and electroencephalography (EEG). EEG measures electrical activity generated by the synchronized activity of thousands of neurons (in voltage). It also provides excellent time resolution, allowing you to analyze which brain areas are active at a certain time, even at sub-second timescales. EEG is one of the fastest imaging techniques available as it can take thousands of snapshots per second (256 Hz or higher). 100 years ago the EEG time course was a plot on paper

The difference between epileptic seizures and other seizures is that epileptic seizures are caused by a disruption in the way the brain is working. When someone had seizures, and it is thought that they might have epilepsy, there are various tests that their specialist might ask for.

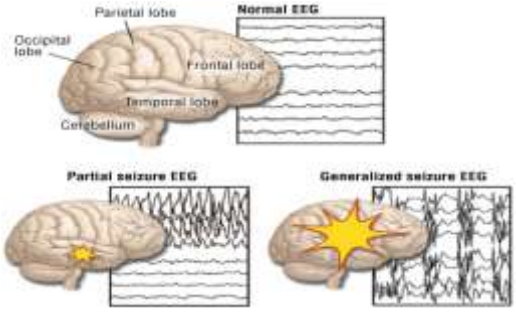


Fig. Seizure and Non Seizure Condition in brain

A neurologist (someone who specializes in nervous system disorders) interprets the recordings from the EEG and then sends the results to your doctor. Moreover, the analysis of continuous EEG monitoring takes a lot of time and requires experienced epileptologist. Therefore, it is difficult to use long-term EEG monitoring as the universal procedure in many hospitals. To solve this problem we apply the machine learning techniques for both seizure and non seizure EEG signals.

II. RELATED WORK

Seizure detection is performed in three stages: preprocessing, feature extraction, and classification. We used feature extraction which is nothing but the process of calculating the feature vectors of the EEG signals.

Miran Lee, Inchan Youn, Jaehwan Ryu, Deok-Hwan Kim[1] was proposed the technique of a novel feature extraction method, a slope of counting wavelet coefficients over various thresholds (SCOT) method based hidden markov model (HMM) for seizure detection. The purpose of that proposed method is to aid in the diagnosis of epilepsy, which requires long term electroencephalography (EEG) monitoring. The interpretation of long-term EEG monitoring takes a lot of time and requires the assistance of experienced experts. In order to overcome these limitations, it is important to apply the optimized feature extraction algorithm to the seizure detection system. The proposed SCOT method based HMM has a robust detection accuracy, and a short feature extraction time.

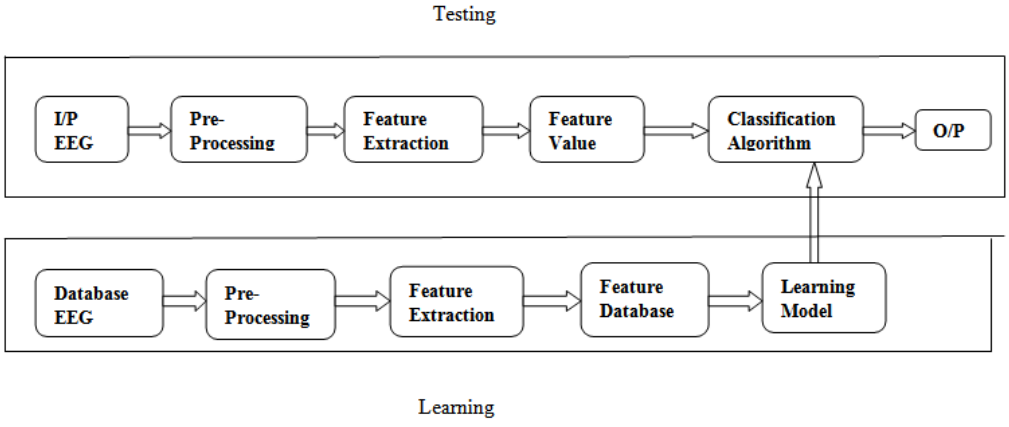
Anubha Gupta, Pushpendra Singh, et al [2] was presented the technique consists of three stages. First, a multirate filterbank structure is proposed that is constructed using the basis vectors of discrete cosine transform (DCT). The proposed filterbank decomposes EEG signals into its respective brain rhythms: delta, theta, alpha, beta, and gamma. Second, these brain rhythms are statistically modeled with the class of selfsimilar Gaussian random processes, namely, fractional Brownian motion (fBm) and fractional Gaussian noises (fGn). The statistics of these processes are modeled using a single parameter called the Hurst exponent. In the last stage, the value of Hurst exponent and autoregressive moving average (ARMA) parameters are used as features to design a binary SVM classifier to classify pre-ictal, inter-ictal (epileptic with seizure free interval), and ictal (seizure) EEG segments.

Jasjeet Kaur , Amanpreet Kaur [4] was presented the statistical approaches to analyze EEG data are conversed. The EEG signals have gained a lot of importance in the field of biomedical science in the past few decades. The advancement in technology and its ever increasing demands have encouraged the engineers to ascertain new methods for analyzing these signals. Some of the most widely used methods have been discussed in this paper. These methods can be further modified or combined with some other methods to get more appropriate results. Also, in the later stages, the support vector machines or the neural networks can be used for the classification of signal.

A machine learning algorithm (SVM) is used as a classifier to discriminate between the seizure and non seizure EEG signals.

III. PROPOSED WORK

A seizure is an event that causes an abrupt surge of electrical activity in the brain, where epilepsy is the disease involving recurrent unprovoked seizures. An epileptic seizure is a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain. Epilepsy is the 4th most common neurological disease in the world. Electroencephalography (EEG) is the most reliable and commonly used tool for the prediction of epilepsy. It requires long time monitoring and experts. Also it is time consuming and required high cost. Here we demonstrate the used of machine learning techniques which helps to improves the signals of EEG. The detection of seizure and non- seizure conditions using this technique gives more accuracy and efficient results of the signal.



The database which we are using is collected at the Children's Hospital Boston, consists of EEG recordings from pediatric subjects with intractable seizures. All signals were sampled at 256 samples per second with 16-bit resolution. An EEG tracks and records brain wave patterns. Small flat metal discs called electrodes

are attached to the scalp with wires. The electrodes analyze the electrical impulses in the brain and send signals to a computer that records the results. The electrical impulses in an EEG recording look like wavy lines with peaks and valleys. These lines allow doctors to quickly assess whether there are abnormal patterns. Any irregularities may be a sign of seizures or other brain disorders. Feature extraction is one of the method for signal processing to analyse the signal. Wavelet transformation is most popular in time-frequency transformations. The parameters use are as follows:

$$\mathbf{F(a,b)} = \int_{-\infty}^{\infty} \mathbf{f(x)\psi^{*}_{(a,b)}(x)dx}$$

Mean : $\boldsymbol{\mu = \frac{1}{n}\sum_{i=1}^{n} f\,i\,xi = \sum_{i=1}^{n} pi\,xi}$

Variance: $\textbf{Variance} = \boldsymbol{\sigma^2 = \frac{1}{n}\sum_{i=1}^{n} fi(xi - \mu)}$

Standard Deviation:

$$\mathbf{STD} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} fi(xi - \mu)}$$

$$\textbf{Kurtosis :} \quad \mathbf{k = \frac{E(x-\mu)^4}{\sigma^4}}$$

$$\textbf{Skew ness} : \mathbf{s = \frac{E(x-\mu)^3}{\sigma^3}}$$

Learning model is used to first learn all the values in database once it is done it goes to classification algorithm in the testing phase. First the system will learn in the learning phase and in testing we used binary classifier algorithm i.e. SVM (Support Vector Machine). Support Vector Machine (SVM) is primarily a classier method that performs classification tasks by constructing hyperplanes in a multidimensional space that separates cases of different class labels. SVMs are effective when the number of features is quite large. As with any supervised learning model, you first train a support vector machine, and then cross validate the classifier. Use the trained machine to classify (predict) new data.

IV. CONCLUSION

The rapid advancement in biomedical technology for analysing bio medical signals are an important research area. One such technology is EEG, which is to measure the brain potentially in order to help the disable people and obtain accurate diagnosis of disease. EEG records brain waves with respect to specific frequency by placing metal electrodes on the scalp. The EEG signals have gained a lot of importance in the field of biomedical science in the past few decades. The advancement in technology and its ever increasing demands have encouraged the engineers to ascertain new methods for analyzing these signals. Here we take support vector machines or the neural networks can be used for the classification of signal. EEG provides important information for epilepsy detection. Feature extraction, selection, and optimization methods exert significant influence in EEG classification. Our proposed system is to predict the seizure and non seizure EEG signal.

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