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EPILEPSY: Definition and Management-A Review

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Abstract - Epilepsy influences all age gatherings and is one of the most widely recognized and most crippling neurological issues influencing around 50 million worldwide and 90% of them are from developing nations. Due to seizures, it can considerably impede the quality of life, intellectual shortages, comorbid temperament and mental issues related with disgrace and victimization of the patient in the community, work environment and school. Most epileptic patients experience severe emotional distress, psychiatric problems and intense social isolation. The study is intended to address context, epidemiology, etymology, pathophysiology, epilepsy classification, symptoms, treatment, epilepsy management and its possible trends. Fast identification and prediction of illness to provide effective preventive strategies is one of the main priorities of healthcare. The main objective here is to present state-of-the-art methods used in seizure detection treatment. Researchers are seeking to use these methods with the development of artificial intelligence (AI) and machine learning (ML) technologies for advancing clinical practice in diagnosing epilepsy.

Keywords: Epilepsy, Artificial Intelligence, Deep Neural Networks, Fuzzy Logic, Genetic Programming.

1. INTRODUCTION

Epilepsy is a condition with thousands of years of experience, and it is a normal brain disorder that has many facets of it. Epilepsy affects about 2 percent of the population making it one of the most common severe neurological conditions. According to WHO, epilepsy is one of the diseases that affects a large majority of people in developing countries worldwide with considerable affliction. It is a common chronic neurological condition where the balance between cerebral excitability and inhibition is tipped towards unregulated excitability and characterized by repeated unprovoked seizures. Now there is ample evidence that there are distinct variations in pathophysiology between the immature and mature brain and the seizure effects. Here we see a series of several different types of seizures, varying greatly in frequency, appearance, cause, effect and management.

Characteristic signs or symptoms of irregular, repetitive or synchronous neuronal activity in the brain are associated with seizures. These seizures often cause ephemeral loss of consciousness which leaves the person at risk of bodily harm and often interferes with day today activity. There is no distinction of age, sex, geographic, social status, race or any particular timeframe for seizure to occur. All prognostics of epilepsy are not permanent, it is estimated that if adequately diagnosed and treated, up to 70% of people living with epilepsy will live seizure-free.

1.1 History of Epilepsy

The term epilepsy originated from the Greek work 'epilepsy,' meaning 'taking hold of' which in turn was merged in form 'epi' means on and means 'lambanein' to clasp. The epilepsy of the ancient times was associated with a demon's abduction or weak beliefs. In the past, epilepsy was known as the holy disease support of this view, a large number of people assumed that epilepsy affected people who were somehow taken over by spirits, or that the Gods sent hallucinations witnessed by the epileptics.

In ancient India, epilepsy has been identified as 'apasmara,' meaning 'loss of consciousness' in Charaka Samhita's literature, which includes ample references to all aspects of epilepsy including symptomatology, aetiology, diagnosis and treatment. The Roman people accepted that epilepsy was god sent revile and was known as Morbus comitialis (disease of the assembly hall). Indeed, even among the Hmong generations the clan that started close to the Yellow River locale of China, for them epilepsy was considered as an assault by a devilish spirit.

Even today people in Tanzania claimed that epilepsy was connected to evil spirits or witchcraft and to be contagious. Relation can be made to the fact that people with epilepsy were looked down on in most cultures, and even held in jail. Even today stigma persists but people realize that, with time at least in developed countries, it is slowly decreasing.

1.2 Epidemiology

The most common of serious neurological disorders is epilepsy. There are estimated to be 55 lakhs with epilepsy in India, 20 lakhs in the USA and 13 lakhs in the UK. Each year around 120 in 100,000 people seek medical attention because of a newly identified seizure. At least 8% of the general population will have seizure but won't have epilepsy. In five years, the recurrence probability of a first unprovoked seizure varies from 23% to 80%.

The calculated age incidence of epilepsy is 44 per 100,000 individuals per year. Around 125,000 new cases of epilepsy occur each year; at the time of diagnosis, 30% of such cases occur in people younger than 50. Due to epilepsy 1,000 deaths occur every year associated with seizure and study says 42% of deaths were potentially avoidable.

1.3 Causes of epilepsy

The reason for epilepsy is totally obscure. The word epilepsy may not signify the cause or extent of the seizures of the individual, some cases of epilepsy are triggered by genetic causes, but it can also result in brain injury caused by hits to the head, stroke, infections, high fever or tumors. It has been found that in very young children heredity plays a significant role in certain causes of epilepsy, but it can be a factor for individuals of any age.

Not everyone who has a serious head injury which is a known cause of seizures will experience epilepsy for example. Unique precipitants or causes for seizures such as reading, flashing lights and precipitants such as emotional stress, sleep deprivation, heat stress, alcohol and febrile disease are examples of precipitants cited by patients with epilepsy. The effects of different precipitants differ significantly with the condition of epilepsy.

1.4 Pathophysiology of Epilepsy

The hallucinations are paroxysmal cerebral cortex manifestations. A seizure happens when a sudden mismatch occurs in the cortical neuron network between the stimulating and inhibitory forces. Throughout an abnormal cell membrane the basic physiology of a seizure event is observed. The seizure has its root in the gray matter of either cortical or subcortical region. At first an abnormally small number of neurons shoot.

Normal conductivity of the membrane and inhibitory breakdown of the synaptic current and excess excitability spread either locally to create a focal seizure or more generally to generalized seizure. This onset propagates to include adjacent to remote areas through physiologic pathway.

Table 1: Classification of Epileptic Seizures

1.Partial Seizures	a) Simple (without impairment of consciousness)
	b) Complex (with impairment of consciousness)
	c) Secondarily Generalized (partial onset evolving to generalized tonic clonic seizures)
2.Generalized seizures (bilaterally symmetrical and without local onset)	
3.Unclassified Seizures	
4. Status Epileptics	

The different types of seizures are given in Table.1 and here is the brief description of the seizures.

1.4.1. Partial Seizures:

In simple partial seizures the seizure focus in the motor context results in attacks consisting of repetitive convulsion of particular muscle group. Without losing consciousness, patients tend to lose control of the affected parts of the body. In complex partial seizure, discharge begins locally and often remains localized. The symptoms include involuntary muscle contractions, abnormal sensory experiences or autonomic discharge or effects on mood and behavior, often termed psychomotor epilepsy. The seizure focus is located in the temporal lobe.

1.4.2. Generalized seizures:

Generalized seizures affect the entire brain, including the reticular system, thereby producing irregular electrical activity in both hemispheres. Immediate loss of consciousness is typical of severe convulsions.

Absence seizure is prevalent in children associated with momentary loss of consciousness but no muscular component. Myoclonic seizures are seizures of epilepsia in which myoclonus is the motor manifestation. Clonic seizures of all muscles are characterized by loss of consciousness, autonomic symptoms and clonic rhythmic features.

Tonic seizures are associated with loss of consciousness and autonomic symptoms accompanied by tonic contractions of the limbs. This tonic process lasts for one minute and is accompanied by a series of violent, synchronous convulsions addition to this respiration ceases and sometimes defecation, micturation, and salivation occur. The patient remains unconscious for few minutes and then gradually recovers, feeling ill and confused. Atonic seizure is associated with unconsciousness with relaxation of all muscles due to excessive inhibitory discharges, patient may fall down.

1.4.3. Unclassified Category

A third group, unclassified, includes undetermined epilepsy and epileptic syndromes. Disorders such as febrile seizures that refer to various conditions have particular syndromes. A fabric-related seizure is suffered by around 2% to 4% of children. Just 2% to 3% of these children will become epileptic in later years. This is a serious concern as there is six fold rise in risk relative to the general population.

Increased risk of developing epilepsy-pre-existing neurological condition or developmental delay, a family history of epilepsy or a difficult febrile seizure are associated with many factors. For children at high risk of recurrent febrile seizures and epilepsy, rectal diazepam in fever can prevent recurrent seizures and avoid chronic side effects.

1.4.4. Status Epilepticus

Status epilepticus may be characterized as a prolonged seizure, or a time of repetitive seizure with no

restoration of normal awareness in between, lasting more than 30 minutes.

2. EPILEPSY AFFECTS QUALITY OF LIFE

For the individual suffering from the said neurological disorder, epilepsy plays a very critical role in the daily activities. One of the extreme effect of the infirmity prompts inability and seriously diminished personal satisfaction alongside different various difficulties. It can impact on physical, psychological and social health. For example, people with epilepsy face diminished social support and family function, cognitive problems, co-morbidities and stigma in medicine and psychiatry. Persons suffering with seizures will have more days of disability with physical difficulties in daily routine which will directly affect their annual income [2].

2.1The Effect of Stigma

Since the medieval period, epilepsy sufferers were branded as sacred or possessed as a result of behavioral changes during seizures. Such persons were deemed "insane" in many cultures and were held in asylums. This disconnection and inappropriate conduct towards the epileptic patients frequently intensifies the negative physical effect of the ailment and furthermore influences the people react to the sickness and some of the time it might be catastrophic. Research has shown that, in adults with epilepsy, if an individual encounters more introduction to disgrace, they feel that they are less ready to deal with their own epilepsy, will have more contrary emotions about whether their seizures can be dealt with and will be futile for them in their personal and professional life [3].

2.2 Cross-Cultural Influences

Social perspective towards epilepsy vary across ethnic and social gatherings. Over the globe the disposition towards the epileptic patients is dampening. In an Austrian review 15% of respondents demonstrated that they would protest their kid wedding an individual with epilepsy. In another survey which was carried out in Czech Republic 29 % of respondents considered epilepsy to be a form of insanity. Even in the United Kingdom half the respondents agreed epileptic patients are treated differently like snubbing them. It was even worst in east timor the epileptic patients never received medical assistance because they perceived it was not a normal health condition but rather caused by evil spirits or curses. This type of immature behavior is seen in almost every part of the world, and this fear of epilepsy is a contributing factor in stigmatization, and given the prevalence of such negative behaviors, people with epilepsy are likely to experience them on a daily basis.

2.3 Epilepsy in Children

Childhood epilepsy is one of the most common neurological disorders in developing countries affecting 1% of children worldwide. Compared to their peers, children with epilepsy are at risk of experiencing social challenges, including stigma, diminished social skills, increased social disorders and social isolation. Because of factors related to seizures and their diagnosis, children with epilepsy are vulnerable to academic underachievement, secondary to various cognitive and behavioral issues.

2.4 Women with Epilepsy

Epileptic women face particular difficulties when compared to men with epilepsy. In terms of pregnancy and fertility, people with epilepsy are at greater risk of having a seizure during pregnancy, when giving birth. There's a danger to the growing child too. Failure to manage seizures during pregnancy also leads to an increased risk in physical malformations in developing children and can result in having a negative impact on cognition after the child is born.

When a woman has a seizure during her pregnancy and if the mother falls hurting her abdomen there is a chance of physical damage to the developing neonate. The infant child may be at risk for periods of low oxygen and ischemic damage even after recovering from prolonged seizure. The risk of premature abortion as well as the death of the developing child and mother during birth is instantly increased if the occurrence of epilepsy is not detected within the correct time frame.

2.5 Activities of Daily Living

Due to unpredictable nature of seizures, security considerations can limit the ability of a person to participate in certain aspects of household responsibilities. For instance, those with uncontrolled seizures are often prohibited from using power tools or other motorized devices that can cause injury. Increased risk of burns during cooking or during showering a seizure may result in serious complications hence a supervision for these activities is recommended [6].

Likewise in sports, such as swimming, may be restricted due to the concern that the patient may suffer a seizure and be in danger of drowning. Air travel also has been known to increase risk of seizures which reduces the desire to travel long distances and in also such cases the loved ones prefer that a person with epilepsy not travel on their own.

2.6 Employment

Constitutional prejudice against people with epilepsy has a long tradition, which includes limitations on marriage, education and immigration. Employment is a major restraining field. As a consequence of their illness, people with epilepsy have higher levels of unemployment, underemployment and reduced earning capacity. Higher unemployment rates have been reported among those with more frequent seizures. Although some research indicates that employment rates are comparable to the general population for those with well-controlled epilepsy, people with epilepsy are more likely to be working in manual labor / unskilled jobs and are less likely to reach work levels that correlate to their qualifications.

There are only a number of professions in most developed countries restricted to people with epilepsy, including airline pilots and other positions in the armed

forces. However, restrictions on the operation of motor vehicles can limit access to some opportunities for jobs. Such limits are in order to secure the individual's life with epilepsy or others when a seizure occurs.

An additional factor considered in employment by people with epilepsy is whether to share neurological history with colleague / supervisors. Since disclosure may be an important safety mechanism so that when they have a seizure, people know the best course of action for the patient, but on the contrary, there are several concerns about the care they are offered until the colleague becomes aware of their status as an epilepsy person.

2.7 Social Activities

Lack of social support for individuals with epilepsy can be more debilitating than high seizure rates. The social gathering may be limited to family, neighbors, and health care providers for persons with epilepsy. While many people with epilepsy do not have complete or any memory of the nature of their events, witnessing a seizure can be distressing especially if it is to the loved ones [7].

Young people with epilepsy report having endured rejection because of the unexplained seizure that makes it impossible for them to be in intimate relationships. Social support has repeatedly been shown to be a protective variable for people with epilepsy, and it has been shown that lack of social support is a major predictor of depressive symptoms. Also when driving most states have laws in place to decide if an patient who has suffered a seizure is eligible to drive to ensure the safety of the person with epilepsy as well as those on the road.

2.8 Emotional Problems

The overall psychiatric disease rates in individuals with epilepsy are higher than in the general population. There have been studies of higher levels of paranoia, depression, anxiety, personality disorders, suicidality and sexual dysfunctions. Individuals with all epilepsy subtypes are at elevated risk of developing psychosis, and family history of seizures also raises the risk of psychosis.

Therefore the brain processes underlying the epilepsy offer a valuable basis for understanding psychiatric disease biology. Epilepsy was used as an explanation for explaining the cause of violence in the brain and the cyclical mood and behavioral disorders. Individuals with epilepsy typically feel "learned helplessness" because epilepsy is an unpredictable and dangerous condition characterized by a sudden loss of control over the body [5].

2.9 Cognitive Problems

The learning disorder and developmental delays are another very significant issue associated with epilepsy. The verbal and receptive language impairments and the analytical and reflectional reasoning are associated with this. This creates a major obstacle in collecting patient information and becomes a challenging task in developing suitable therapies.

In addition to this, there are more systemic impacts of epilepsy on mental performance and other cognitive deficits that are a typical consequence. Children with epilepsy are at risk for developing problems with learning and behavior. Other aspects of cognition may be affected by seizures, including slow thinking, slow motor speed, impaired coordination, fine motor skills, difficulty in sentence formation, difficulty in taking decisions and thinking among others. These can have a significant impact on the capacity of an individual to engage effectively in daily tasks.

3. EPILEPSY CLASSIFICATION USING DIFFERENT STRATEGIES.

3.1Classification using Data Mining Techniques

In recent years, lot of interest by researchers have shown in classifying epilepsy for ease of usage in medical field. Here we discuss few of the important and recent methods employed in classification study of epilepsy.

One of the challenging task is to identify whether the brain's normal and pre-seizure epileptic activities are distinctive or differentiable in predicting seizure. Data mining techniques are use on EEG data to check the classification of brain dynamics [34]. A quantitative analysis derived from the chaos theory to research brain dynamics including Short-Term Maximum Lyapunov Exponents, Angular Frequency and Entropy was used to demonstrate the state transition to seizures in which various patient states (normal, pre-seizure, and post-seizure states) can be categorized to achieve this. In addition, optimization and data mining techniques for the extraction of classifiable features of the normal and pre-seizure epileptic states of the brain from spontaneous EEG were used in this study for the classification of the normal and epileptic activities of the brain. For estimating the accuracy of the brain state classification a statistical cross validation was implemented. From the analysis of the results obtained it is possible to develop an efficient seizure warning algorithms for diagnostic and therapeutic purposes.

Another paper that describes the use of Data Mining methods and techniques for analyzing EEG signals to automatically detect a seizure is presented [17]. An extendable tool for feature extraction from time series data was developed known as Training Builder. This classifier was focused on signal processing, sliding window model, extraction and selection of features, and Support Vector Machines, which showed excellent 99% accuracy. This was an interesting approach as the author says the major drawback of classification theory is the consumption of time. So here an automatic process of classifying epileptic diagnoses based on ICD-9 method [16] was implemented. This was accomplished by using a text mining technique to classify each instance mapping into the corresponding standard code using processed medical records and a K-Nearest Neighbor as

a white box multi-classifier tool. The results obtained here indicate that, considering the reduced amount of available training data, the model shows good diagnosis performance.

Next in another interesting work the main focus was in identifying the various data mining methods in the analysis of data related to epilepsy and role of seizure detection in improved clinical decision support. It was found that data mining methods used in the analysis of epilepsy data can be utilized either in seizure detection or in the performance comparison of the different seizure detection methods. Data mining methods also provided clinical information on location of the seizure and information on clinical diagnosis that could help improve decision support.

In detection of epilepsy seizure the manual process of analyzing EEG data has been a problem area in seizure detection because of the time and the differences in what constitutes a spike therefore it is helpful in using data mining methods for automatic detection of epilepsy to help solve this conundrum also it is evident that data mining methods can be effective in seizure detection as several methods provided an accuracy which might be of immense benefit if applied in the clinical environment.

One of the subtle task in analyzing epilepsy is the onset and the duration of EEG recordings that are too long because the chances of missing the seizure cases are very high this is due to imbalance distribution of the class values in the dataset.

In order to solve this an approach by penalizing the cost of false negative (CFN) corresponding to the duration of EEG recording for detecting the true seizure cases with high recall metrics was proposed.

The initial task was to identify best classifier for brain signal data sets to extract meaningful information from the data sets. After experimenting and analyzing the results it was clear that decision forest is found to be the best classifier as it is capable of dealing with high dimension data set with correlated attributes. After selecting the potential statistical features and classifier from our experiments it was heuristically applied for quick seizure detection and localization. From the results the classifier was able to find the accurate seizure point on the brain's lobe where seizures were originating and also successful in identifying the type of seizure. For analyzing seizures a new approach of epilepsy seizure prediction by using data mining algorithms to analyze seizures of a huge number of patients was the focal point of this study [15]. This method is considered to be the most powerful and most accurate than the other prediction methods. Here large epileptic seizures database containing a lot of records is analyzed despite its complexity.

In general, predictive techniques use complete seizures or cost-sensitive machines without evaluating the other groups and characteristics, resulting in incorrect predictions. To overcome this setback the proposed method here uses all classes, features and parameters for prediction. From the results the proposed models performance was found satisfactorily. Another work using classification techniques was to build a data mining model for prediction of stroke [18]. They emphasized that such patients with the following medical conditions are more likely to get stroke, heart diseases, kidney diseases, hyperlipidemia and epilepsy. Different data mining algorithms were implemented on the dataset and on applying PCA on Stroke data the C4.5 algorithm had the highest accuracy of 95% probability to develop stroke.

3.2 Classification using Deep Learning Techniques

Advances in deep learning techniques provide new avenues for solving the complex problems inherent in automatic seizure detection. The usefulness of the techniques help to detect seizure and classify patients depending on the type and severity of seizure. Using deep learning two approaches based on convolution neural networks (CNNs) and artificial neural networks (ANNs) for predicting the occurrence of seizure was proposed [13]. To the ANN model the relevant features were extracted from all EEG signals which were concatenated and fed as input and for CNN taken as raw multi-channel EEG signals. They had obtained accuracies of 99.07% and 98.62% for CNN and ANN models respectively. But the F1-score was 11% higher for ANN model and was achieved using less number of parameters.

Another interesting study was performed for comparing the performance SVD (Singular value decomposition), RBF (Radial basis function) and Neural Network for optimization of fuzzy outputs in the epilepsy risk level classifications from EEG signals [33]. Here a fuzzy pre-classifier was used to classify the risk levels of epilepsy based on extracted features from the EEG signals of the patient. Then the efficiency was compared with certain quality parameters and because the fuzzy outputs are highly nonlinear in nature the SVD and RBF neural networks were chosen to optimize the risk level. RBF neural network performs better than the other techniques.

Models from soft decision and models from the neural network play an important role in seizure detection. The authors contrasted the performance of two-tier hybrid fuzzy, soft decision tree and multi-layer perceptron neural networks to identify epilepsy risk levels from EEG signals in this study [31]. First fuzzy classifier was used to classify the risk levels of epilepsy based on certain extracted parameters from the signals. Then the Soft Decision Tree model and MLP neural networks were applied on the classified data to identify the optimized risk level. The efficacies of these methods were compared with quality parameters and it was seen that the MLP classifier obtained 99.9% PI value and it outperformed other classifiers in classifying the epilepsy risk levels.

A comparison of the performance of the genetic algorithm and multi-layer perceptron neural network in

the classification of the EEG signal epilepsy risk level is proposed. Based on the derived parameters of the EEG signals, the level of epilepsy risk is graded. For optimizing the risk levels a Binary Coded GA and MLP Neural network are applied to the obtained classified risk levels. High PI such as 93.33% and 95.83% for BGA and MLP are obtained at QV of 20.14 and 21.59. The aim here was to identify ideal risk levels with a high classification rate, with a short initial delay and a low false alarm rate. One of the major drawbacks of the GA approach described here is that if one channel has a high-risk level, it will optimize the entire group to that level of risk. This will affect the non-epilepsy spike region in the groups and for Neural Network additional training cost is involved for learning the procedures of the network. However, the authors predict that the classification rate of epilepsy risk level of 90% can be achieved. Another issue is the size of dataset being used here for better analysis of the results a bigger dataset is appreciated.

In epilepsy diagnosis the commonly used clinical approach mainly involves manual inspection of EEG signals, a laborious and time-consuming process which often requires the contribution of more than one experienced neurologist. Another form of epilepsy in which seizures occur predominantly during sleep is the nocturnal frontal lobe epilepsy [11]. Here a convolutional neural network (CNN) architecture was proposed to develop patient-specific seizure detection models for three patients affected by the disease. The same architecture was used to develop a cross-patient seizure detection system. An advantage of the deep-learning approach is that the complex and time-consuming feature engineering step is not required. Moreover, the developed patient-specific detection systems have demonstrated to be superior to those in the literature towards all the performance indexes, with accuracy above 94% for all the considered patients.

The main objective of this study was to develop a computer-aided diagnostic system to diagnose epilepsy by means of EEG signals to facilitate the process of diagnosis [30]. An Optimized Artificial Neural Network model for classification and validation was developed for a specific collection of EEG signals in this implementation. 99.3% precision for EEG signal classification was provided by the suggested particle swarm optimized artificial neural network. The findings show that if the statistical characteristics are carefully extracted, the artificial neural network has the potential to provide greater precision for epilepsy detection.

An artificial neural network (ANN) widely used and known as an active classification technique for epilepsy diagnosis is applied [29]. Here the particle swarm optimization (PSO) method has been preferred as the training algorithm for the ANN. Based on PSO versions, a PSO-based neural network (PSONN) model was diversified and 7 PSO-based neural network models were identified. Among these models, due to better classification accuracy with percentages of training performance of 99.67% and 98.75% respectively, PSONN3 and PSONN4 are determined to be effective models for epilepsy diagnosis. From the analysis it can be assumed that PSO is quite suitable for the training of ANNs, and the developed PSONN models are successful in epilepsy diagnosis.

3.3 Classification using Machine Learning

Machine learning techniques and computational methods were widely used in many challenging environments like image recognition, language processing and data mining none the less they have found great fondness in medical applications particularly in seizure detection from EEG. Some of the interesting work is mentioned below.

In this particular work the authors were eager to analyze the performance of singular value decomposition in the classification of epilepsy risk levels from EEG signals and also to optimize outputs by utilizing Elman Neural Networks in [27]. Code converters were used as a level one classifier but their performance index and quality value was very low. Due to this low performance SVD as post classifiers were applied and a performance index of 89.48 and a quality value of 20.62 was achieved making it as a perfect choice as post classifier. It was also found here that Elman Neural Network exhibits good performance when compared with SVD in the morphological operator based feature extraction method. The accuracy would have better if they had possessed data of large number of patients.

Due to the complexity in EEG datasets machine learning classifiers are suitable for accurate seizure detection [28]. But selecting appropriate classifiers and features for detecting seizure is indeed very crucial. From the results obtained here it is evident that decision forest classifiers are most effective because it produces multiple sensible explanatory logic rules with high accuracy of prediction. Also it is suggested to avoid using irrelevant features as it increases computation cost and produces insensible patterns.

Physicians generally face difficulty in absolutely predicting seizures as the data associated with this is very complicated therefore an automated detection system for distinguishing the different phases of EEG signals was necessary in clinical practice [26]. A three-class classification system based on discrete wavelet transform (DWT) and the nonlinear sparse extreme learning machine (SELM) for epilepsy and epileptic seizure detection was proposed. The above combination reduced the training and testing time by decreasing computational complexity and feature dimension. The results make this method portable for clinical implementation. For the benefit of patients, prediction of seizures before the beginning of the onset is quite useful for preventing the seizure. Hence to predict seizures from EEG the pre-processing of signals for noise removal and feature extraction are two major issues that have an adverse effect on both anticipation time and true positive prediction rate.

In view of this the authors have proposed a strategy to provide reliable techniques for pre-processing and feature extraction [35]. This proposed model predicts epileptic seizures' before the onset of seizure starts and provides a better true positive rate in sufficient time. They applied empirical mode decomposition (EMD) for pre-processing and have extracted time and frequency domain features for training a prediction model. The proposed model detects the start of the preictal state, which is the state that starts few minutes before the onset of the seizure, with a higher true positive rate of 92.23% compared to traditional methods. Therefore with this model epilepsy affected patients will get more time for proper medication required for preventing the seizure before it actually occurs.

The research reveals that the performance of EEG detection based epilepsy require better feature extracting strategies [25]. Various feature extracting strategies are used here to extract important features from the signals. Few important machine learning classifiers were considered here with multiple factors for epilepsy detection. Certain parameters of these classifiers were modified accordingly and it was found that the Support Vector Machine linear kernel showed highest accuracy of 99% which was considerably higher than the other classifiers. Several limitations were observed in this study one was the number of subjects were small and data set was taken from publicly available databases.

Here authors make a very interesting point that in dealing with epilepsy there is urgent need in developing methods for the rapid and accurate diagnosis of the disease that could potentially save considerable amount of time and cost [26]. They focused on the use of Discrete Wavelet Transform to analyze EEG parameters.

Multiple classification methods were used to compare the diverse dataset and the method C4.5 produced diagnoses with an accuracy of up to 90%. This method can analyze large amounts of data quickly with better accuracy and also speeds up epilepsy diagnosis. To have a clear distinction between EEG data of normal and epileptic subjects for obtaining high accuracy the authors here proposed to make use of RBAs and Linear SVM method for classifying EEG data [23]. They used Hilbert Huang Transform (HHT) method on the obtained raw dataset for feature extraction. Relief algorithm (RBAs) was used for feature selection and classification was finally performed using Linear SVM. This technique showed reduced computational cost and achieved high accuracy in classifying Epileptic EEG data. The results for the said task were promising.

4. CONCLUSION

Epilepsy is a fairly frequent neurological condition that has a major influence on QOL, and people with epilepsy have experienced decades of stigma due to various social and cultural myths, which has had a continuing effect on their social status. The occurrence of seizures is unpredictable and often dangerous and unfortunately in medical world it is very complicated to deal with this without tools that help them to tackle this grave situation. This is where models are designed and implemented to help deal with such situations.

Data mining has had an impact on epilepsy seizure detection and has shown promises it could be an important part of seizure detection in the nearest future, because it has the capability to provide new information as regards seizure detection which could ultimately help in epilepsy seizure management, clinical decision support and improved health outcomes for epilepsy patients. The manual process of analyzing EEG data has been a problem area in seizure detection because of the time and the differences in what constitutes a spike between neurophysiologists.

This has prompted the use of data mining methods in the automatic detection of epilepsy to help solve this conundrum. Without ceding efficiency these classifiers are able to classify EEG data and detect seizures along with revealing related sensible patterns. As such, numerous approaches to seizure detection using machine learning classifiers and statistical features have been developed by various researchers.

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