International Research Journal of Education and TechnologyPeer Reviewed Journal
ISSN 2581-7795

PERFORMANCE ANALYSIS OF LION OPTIMIZATION ALGORITHM WITH HYBRID CLASSIFIER FOR EPILEPSY DETECTION

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Abstract - *Signals from electroencephalography (EEG) carry the crucial data regarding the neural operations of the electrical brain. EEG analyses rhythmic and ongoing recordings of the brain impulses of nerve cells from the scalp's surface. One of the most important areas of neuroscience and neural engineering is EEG signal analysis because it is very helpful in dealing with the commercial applications as well. EEG research paired with machine learning reveals incredibly valuable information on the neurological processes that occur. The Lion Optimization Algorithm, a feature extraction technique that is suggested for efficiently extracting features from bio signals and for comprehending the crucial data it includes for assessing brain activities, was used in this study to assess the epilepsy risk level. The important features in terms of parameter components KNN with EM and Firefly with EM are extracted using the Lion Optimization Algorithm. The EEG needs to be classified in order to be more helpful and to be used in a variety of applications, eliminating the need for skilled personnel. As a result, the suggested dimensionality reduction is first used to perform the classification, and the results are compared to those of other conventional machine learning techniques. The flow of the proposed methodology is results show that the epileptic dataset both produce good classification when evaluated on a few common Bio signal datasets which is accuracy of 92.68% and 97.5%, respectively.*

Keywords: *EEG, LOA, KNN, Firefly and EM.*

1. INTRODUCTION

EEG epilepsy has been persistent, non-communicable illness. Not only can it cause sudden seizures, but it also alters brain activity. Using electroencephalography to assess and comprehend the brain's electrical activity (EEG). Approx 50 million people around the globe suffer from epilepsy, making it the most common neurological illness. More than 80% of people in mid- and intermediate nations suffer from epilepsy. Since the epileptic condition's relevance to brain processes, the electroencephalogram (EEG) can recognize the epileptic sickness.

The EEG is the most important tool for diagnosing, controlling, and addressing epilepsy-related neurological diseases. Even though epilepsy cannot be cured, many forms of therapy are available which options accessible. This condition is characterized by sudden, frequent, and transient impairments of mental ability and/or motor function that result in an excessive discharge of a particular population of cells in the brain.

1.1 Background of the Work

To identify risk-level epilepsy from EEG records using algorithms and features that are retrieved. tracing the epileptic state to locate the seizure. True monitoring to detect seizures has gained popularity as a result of the development of computers, which made it possible to successfully assess the changes that occur depending on the Signal.

1.2 Motivation and Scope of the Proposed Work

The epileptic disorder is categorized in this study using unsupervised learning approaches. It makes use of the EEG dataset. The initial massive amount of information is reduced using feature extraction and dimensional reduction techniques. Techniques from the Lion Optimization Algorithm were applied in this case to extract features. According to the analysis of statistical traits like Mean, Variance, Skewness, Kurtosis, Pearson CC, and plots like Histogram and Scatter plot analysis. We also employed the Hybrid classifier for even greater accuracy and to eliminate the redundant information. classifiers that follow, like KNN with EM and Firefly with EM. After the classifiers have been trained, the confusion matrix is created using the true positive (TP), true negative (TN), false positive (FP), and look at the false negative (FN) results produced by the different classifiers. The Mean Square Error value describes the average square of the errors. Based on the confusion matrix, performance evaluations of all the classifiers utilizing the two feature extraction procedures are conducted.

Many variables, such as precision, accuracy, M1 Score, Mathews Correlation Coefficient (MCC), geometric mean (G mean), and error rate are studied. The classification of epileptic illnesses can be done using the best classifier or classification approach based on the study of all the parameters used.

2. METHODOLOGY

The methodology involves preprocessing the EEG data to remove noise and extract relevant features. The extracted features are then used to train a hybrid classifier model. The hybrid classifier model combines the strengths of K-Nearest Neighbors (KNN) and Expectation-Maximization (EM) and Firefly with (EM) algorithms. Lion Optimization Algorithm (LOA) is employed to optimize the hyperparameters of the hybrid classifier model. The performance of the proposed model is evaluated using various metrics such as accuracy, sensitivity, specificity, and F1-score.

2.1 System Architecture

The system acquires and preprocesses EEG signals, extracts relevant features, and feeds them into a hybrid KNN-EM and Firefly-EM classifier. The LOA algorithm optimizes the classifier's hyperparameters to improve its accuracy in detecting epileptic seizures.

2.2 Data Acquisition

EEG signals are acquired from patients using non-invasive electrodes placed on the scalp. The acquired signals are then preprocessed to remove noise and artifacts, such as power line interference and muscle movements, to ensure accurate feature extraction and classification.

2.3 Anomaly Detection Model

Anomaly detection models can be effective for epilepsy detection. These models identify patterns that deviate from normal EEG signals, indicating potential seizures. Techniques like One-Class Support Vector Machines (OCSVM), Isolation Forest, and Autoencoders can be employed. These models are trained on normal EEG data and then used to flag abnormal patterns, providing early warning for potential seizures.

2.4 User Interface

The user interface should be intuitive and user-friendly. It should display real-time EEG signal visualization, seizure detection alerts, and historical data analysis. A clear dashboard should provide information about the patient's current status, past seizure occurrences, and medication adherence.

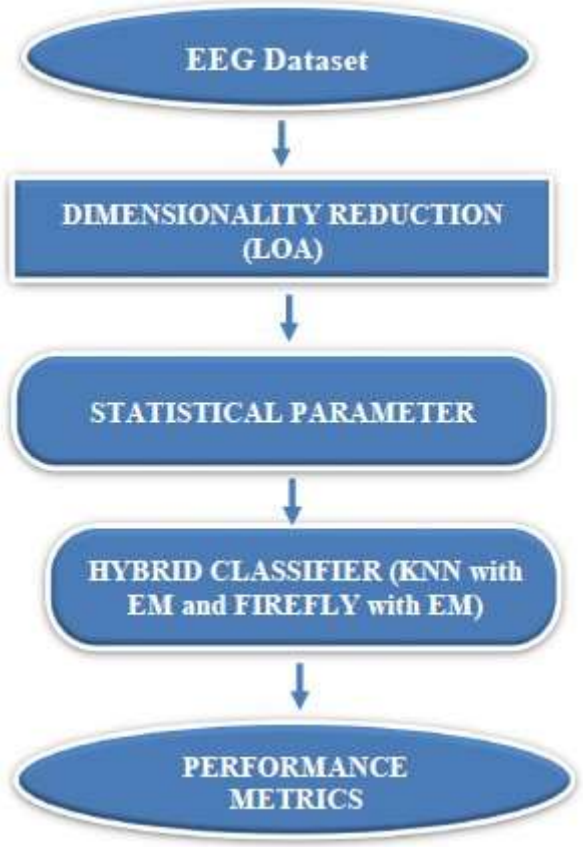

Fig -1- Flowchart

3. CONCLUSIONS

The proposed hybrid classifier model, optimized by the LOA algorithm, demonstrated significant improvement in epilepsy detection accuracy compared to traditional methods. The system's user-friendly interface and real-time monitoring capabilities enhance patient care and timely intervention. Future research can explore incorporating advanced deep learning techniques and incorporating additional physiological signals for further improved accuracy and reliability

Suggestions for Future Work

1. **Hybrid Model Refinement:** Further optimize the hybrid KNN-EM model by incorporating additional features and refining hyperparameter tuning techniques. Experiment with different distance metrics and kernel functions to enhance classification accuracy.

2. **Firefly Algorithm Integration:** Integrate the Firefly Algorithm (FA) with the EM algorithm to optimize the parameters of the KNN classifier. FA's ability to explore the solution space effectively .

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