Improved Epileptic Seizure Detection Model

Aayesha†
Department of Computer Science
Shaheed Zulfikar Ali Bhutto Institute of Science and Technology
Islamabad, Pakistan
a2z.aayesha@gmail.com

ABSTRACT

Epilepsy is a severe neurological disorder that originates abnormality in brain cells caused by the occurrence of epileptic seizures. To detect epileptic seizures, the activities of brain cells are examined by clinical-based test of Electroencephalography (EEG). The dynamic characteristics of obtained EEG signals generate resemblance in seizure and seizure-free signals that make it challenging to detect epileptic seizures accurately. To address this issue, a machine learning-based model is proposed that captures the most discriminating features of seizure EEG recordings by introducing an effective feature extraction method and feature selection strategy. The evaluation of the proposed model presents tremendous performance accuracy of Random Forest and Fuzzy-Rough Nearest Neighbour classifiers for epileptic seizure detection.

1 Proposed Model

The proposed model for epileptic seizure detection classifies EEG signals into three classes; healthy, seizure-free, and seizure. It is comprised of four major phases: First, the acquainted EEG signals are preprocessed to remove artefacts and split into small signal segments for better interpretation. Second, feature extraction and selection is performed in two steps. The first step extracts multi-dimensional (temporal, spectral, non-linear, pattern) features from Discrete Wavelet Transformed [1] signal sub-bands to acquire complete morphological information. In the second step, apply Information gain-based strategy to select the most distinguishing features among the extracted ones. Third, the classification models are built by training traditional and fuzzy machine learning algorithms on the selected feature vector of annotated instances. Fourth, the classification performance of the built models are evaluated in terms of accuracy, sensitivity, and specificity measures while classifying test instances into normal, seizure-free, and seizure classes

2 Results and Discussion

The proposed model is evaluated on two epilepsy patients' datasets; Bonn dataset [2] and CHB-MIT dataset [3]. For Bonn dataset, Random Forest [4] provided a notable performance of 96.44% classification accuracy while in CHB-MIT dataset Fuzzy-Rough Nearest Neighbour was at the top with 97.32% accuracy. Furthermore, the empirical analysis of the proposed feature extraction method and feature selection strategy demonstrates the significance of the proposed model to extract distinguishing features of epileptic seizure EEG signals as depicted in Tables 1 and 2.

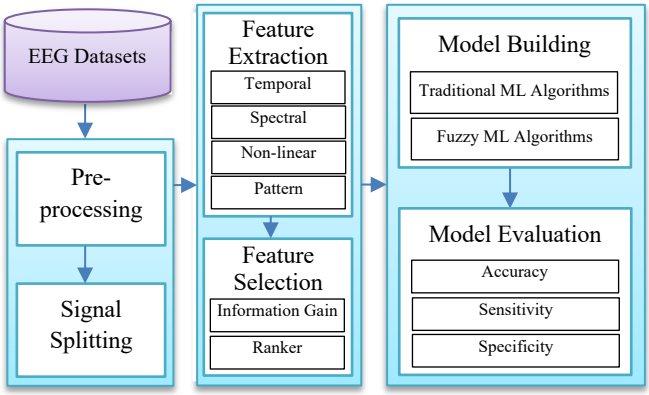

Figure 1: Improved Epileptic Seizure Detection Model

Extracted Features	Accuracy (%)	
	Bonn Dataset	**CHB-MIT Dataset**
Temporal	91.45	91.51
Spectral	92.65	93.43
Non-linear	91.43	77.50
Pattern	91.21	64.11
Proposed feature vector	**93.36**	**95.23**

Table 1: Empirical analysis of the feature extraction method.

	Accuracy (%)	
	Bonn Dataset	**CHB-MIT Dataset**
Without feature selection	93.36	95.23
With feature selection	**96.44**	**97.32**

Table 2: Comparative analysis of feature selection strategy.

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