

ROBUST EEG CLASSIFICATION USING ENHANCED ENSEMBLE METHOD FOR SEIZURE AND RHYTHMIC PATTERN DETECTION

*A Dissertation - Interim evaluation submitted in fulfilment of the requirement for
the degree*

Of

**Master of Technology
(Information Technology)**

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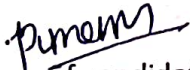
Guru Ghasidas Vishwavidyalaya (Central University)

Bilaspur, Chhattisgarh (2024 - 25)

CERTIFICATE

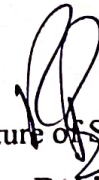
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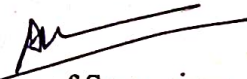
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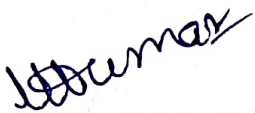
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ABSTRACT

Electroencephalography (EEG) is a commonly employed clinical neurophysiological technique to identify epileptic seizures and rhythmic brain activity. Nevertheless, visual analysis of EEG signals is labor-intensive and subjective, especially in the case of manual interpretation in the large- or real-time diagnostic applications. We propose a robust ensemble-based classification architecture implemented by coupling Convolutional Neural Networks (CNN) and Long Short Term Memory (LSTM) networks along with Random Forest (RF) classifiers to enhance the seizure detection performance and generalization. The methodology is based on the preprocessing of raw EEG signals by means of filtering, and artifact removal, and z-score normalization, and temporal segmentation of the recordings. A large number of features statistical measures, spectral band powers, entropy measures as well as discrete wavelet coefficients is extracted from each segment. On these engineered features we train individual classifiers and ensemble them through hard voting, soft voting and weighted averaging based on their validation performance. The models have been evaluated using accuracy, precision, recall, F1-score, AUC- ROC, confusion matrix, and generalization gap. Experiments on a multi-subject EEG dataset indicate that this ensemble is superior to single models in both the robustness and the sensitivity of seizure detection. Also, weighted soft voting contributes to balance precision and recall results. This work offers a scalable and explainable opportunity for real-time EEG classification, and a promising possibility for incorporation into clinical decision support systems.

Keywords- Electroencephalography (EEG), Seizure Detection, Machine Learning, Ensemble Methods, Convolutional Neural Networks (CNN), Long Short-Term Memory (LSTM), Feature Extraction.