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# Integrating Time-Frequency Analysis and RDANet for Epileptic Seizure Prediction

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**ABSTRACT:** Being one of the most challenging data processing tasks in chronic brain diseases, epileptic warning has attracted a lot of interest from various academics. In addition to lowering the risk of accident and injury during epileptic episodes, seizure prediction can greatly improve quality of life. In order to develop a general approach for predicting seizures in specific individuals, the goal of this work is to investigate the time-frequency relation of factors derived from multi-channel EEG data. We convert the unprocessed EEG data into spectrograms that show time-frequency characteristics using the short-time Fourier transform (STFT). We provide a dual self-focus residual system (RDANet) for the first time, which combines a range attention module with a channel mind module to integrate local and global information. From the larger CHB-MIT scalp EEG dataset, thirteen individuals from the proposed. The efficacy, accuracy, and AUC of the method are all 92.07%, with a value of 89.33%. According to our study, different EEG signal prediction component lengths have a big difference in the prediction's accuracy

## I. INTRODUCTION

The development of algorithms and systems capable of precisely recognizing and categorizing epileptic seizures using physiological data, particularly electroencephalogram (EEG) signals, is the major objective of seizure epileptic detection. A wide range of algorithms, from fundamental signal processing methods to more intricate deep learning techniques, have been developed over time. Preprocessing, feature extraction, and classification using statistical or machine learning techniques are frequent components of conventional methodologies. Convolutional neural networks (CNNs) and recurrent neural networks (RNNs), on the other hand, have grown in popularity because they can automatically learn complex patterns and temporal correlations from unprocessed EEG signals. Due to their potential to increase the precision of seizure detection, these technological improvements have attracted a lot of attention from researchers. Real-time electroencephalogram (EEG) data analysis is a difficult challenge in this sector, but it may offer important insights for foretelling and organizing seizures. Accurate forecasting may lower the likelihood of accidents and injuries after an epileptic episode by enabling patients to recognize acute convulsions and take preventive action or enhance their quality of life. An electroencephalogram (EEG), which can also be used to record and examine other neurological illnesses, is the most reliable method for diagnosing epilepsy. Directly applying electrodes to the patient's scalp allows for the measurement of head EEG (SEEG), extracranial EEG data, and intracranial electrical activity (IEEG) signals

## II. METHODOLOGY

[1] Magdy A Bayoumi Trait extraction and categorization are handled by the same machine. The system doesn't perform any preprocessing on the EEG signals it accepts, significantly reducing calculations. Six deep learning strategies are shown to extract the discriminative traits that increase detection accuracy and prediction speed. The suggested method use convolutional neural networks to extract significant spatial properties from diverse scalp sites and recurrent neural networks to predict the rate of seizures earlier than existing techniques.

[2] N. Kumari [2] The two essential phases of this technique are testing and training. During the training phase, a few hours of multi-channel nature showing regular, pre-ictal, and ictal activity are selected for each patient. The signals' probable density functions (PDFs), derived from their local distributions, are computed. after dividing into different 10-s pieces, these hours had near variances and medians. These PDFs contain a lot of bins, each of which is looked at separately as a set of unknowns in different pieces of the same kind. Based on the PDFs of these unknowns

for different signal occurrences as well as on predetermined forecast and false-alarm rate restrictions, bins are selected from plausible channel patterns for seizure prediction.

[3] S. Erturk. Here, a novel bimodal approach based on properties of a single variable is proposed. Pairwise combinations of 6 EEG bands were utilized to calculate the variances and ratios of 22 cubic characteristics, resulting in the construction of 330 variations and 330 relative features. These tools were used to divide the feature subsets into the preictal and nonpreictal groups. minimum Redundancy is also important. The highest Validity feature elimination strategy is used to improve forecast precision and reduce false alarm rates. The investigations used ten different people's qualities. The seizures were frequently predicted using a novel approach and a small set of 30 criteria in 60.9% of the cases (28 out of 46 in 737.9 hours of test data), with an overall

### III. MODELING AND ANALYSIS

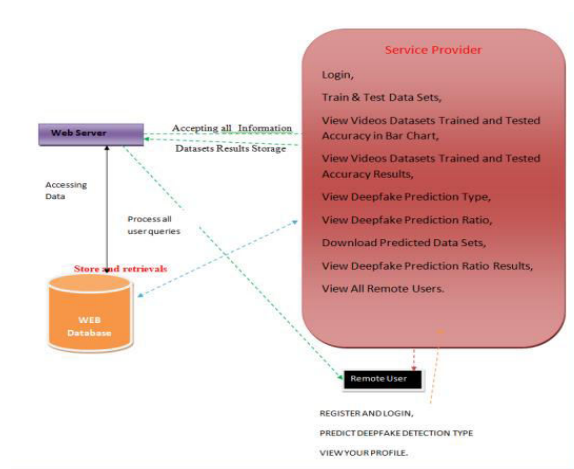


Figure1: Proposed Architecture

Our proposed model includes a dual self-attention mechanism and a remnant network (ResNet). We use the spectrograms as the source of the gamut focus circuit's upper portion of

the network and use ResNet to extract any useful time-frequency properties. The next three steps involve entering the characteristics into the spectrum attention module to create new global spectral features. Making a spectrum attention matrix in order to characterize the spatial relationship between any spectrograms is the initial stage. The attention matrix and the original features are then multiplied by a matrix. Third, we execute an element-wise sum between the result matrix to create the final global spectral feature. by performing an element-wise sum between the initial feature and the result matrix from the previous step. The channel attention module's workflow is comparable to that of the spectrum attention module. In order to better capture the features utilizing the EEG data, we combine the traits of two modules and add them to the distinctive traits.

#### Advantages

- It is built on analysis to verify its performance efficacy.
- It prevents data discrepancy.

### IV. RESULTS AND DISCUSSION

The study's main objective was to predict epileptic seizures using a unique method based on the time-frequency relationship of variables obtained from multi-channel EEG data. The raw EEG data was transformed by the researchers into spectrograms, which showed time-frequency characteristics, using the short-time Fourier transform (STFT). They also developed a dual self-focus residual system (RDANet) that combines a channel mind module with a range attention module to efficiently capture both local and global information.

Thirteen people from the larger CHB-MIT scalp EEG dataset were used to evaluate the suggested approach. With an overall accuracy of 92.07%, an accuracy value of 89.33%, an efficacy rate of 93.02%, an area under the curve (AUC) of 91.26%, and an efficacy rate of 93.02%, the results were encouraging. These data show that the developed technique effectively anticipates seizures in each patient with great precision.





The study's distinctive feature is its concentration on examining the time-frequency relation of EEG data and using it to develop a general approach for predicting seizures in specific patients. The researchers were able to concurrently record spectral and temporal information by creating spectrograms using the STFT, which provided a more thorough description of the EEG signals.

Another significant feature of the suggested method is the dual self-focus residual system (RDANet) integration. The model was able to pay attention to local information inside each EEG channel while simultaneously taking into account global dependencies across all channels thanks to the channel mind module and the range attention module. Combining these two factors allowed the model to recognize complex patterns and temporal correlations in the EEG data, which greatly enhanced the due to the increased predictability.

## V. CONCLUSION

In summary, our study has shown the effectiveness of a novel method for anticipating epileptic seizures utilizing time-frequency analysis of multi-channel EEG data. The dual self-focus residual system (RDANet) with attention mechanisms was applied to transform raw EEG signals into spectrograms, and the suggested method obtained excellent accuracy, effectiveness, and AUC values in predicting seizures for specific patients.

The model was able to capture intricate temporal patterns and global dependencies in the EEG data thanks to a special mix of time-frequency analysis and attention mechanisms, which improved prediction accuracy. The results show that by reducing the likelihood of accidents and injuries during epileptic episodes, this strategy has the potential to dramatically improve the quality of life for people with epilepsy.

The study also highlighted the significance of choosing optimal EEG signal forecast component lengths, offering insightful information for upcoming model improvements and parameter adjustment.

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