Title: Sequential graph convolutional network and DeepRNN based hybrid framework for epileptic seizure detection from EEG signal.

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Abstract: Automated epileptic seizure detection from ectroencephalogram (EEG) signals has attracted significant attention in the recent health informatics field. The serious brain condition known as epilepsy, which is characterized by recurrent seizures, is typically described as a sudden change in behavior caused by a momentary shift in the excessive electrical discharges in a group of brain cells, and EEG signal is primarily used in most cases to identify seizure to revitalize the close loop brain. The development of various deep learning (DL) algorithms for epileptic seizure diagnosis has been driven by the EEG's non-invasiveness and capacity to provide repetitive patterns of seizure-related electrophysiological information. Existing DL models, especially in clinical contexts where irregular and unordered structures of physiological recordings make it difficult to think of them as a matrix; this has been a key disadvantage to producing a consistent and appropriate diagnosis outcome due to EEG's low amplitude and nonstationary nature. Graph neural networks have drawn significant improvement by exploiting implicit information that is present in a brain anatomical system, whereas inter-acting nodes are connected by edges whose weights can be determined by either temporal associations or anatomical connections. Considering all these aspects, a novel hybrid framework is proposed for epileptic seizure detection by combined with a sequential graph convolutional network (SGCN) and deep recurrent neural network (DeepRNN). Here, DepRNN is developed by fusing a gated recurrent unit (GRU) with a traditional RNN; its key benefit is that it solves the vanishing gradient problem and achieve this hybrid framework greater sophistication. The line length feature, auto-covariance, auto-correlation, and periodogram are applied as a feature from the raw EEG signal and then grouped the resulting matrix into time-frequency domain as inputs for the SGCN to use for seizure classification. This model extracts both spatial and temporal information, resulting in improved accuracy, precision, and recall for seizure detection. Extensive experiments conducted on the CHB-MIT and TUH datasets showed that the SGCN-DeepRNN model outperforms other deep learning models for seizure detection, achieving an accuracy of 99.007%, with high sensitivity and specificity.

Keyword: Sequential Graph Convolutional Network (SGCN), Deep Recurrent Neural Network (Deeprnn), Periodogram, Seizure Detection, Electroencephalogram (EEG).

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