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ParkINN: An Integrated Neural Network Model for Parkinson Detection

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***Abstract*—One common neurological condition Parkinson is one of the diseases which might make it difficult for a patient to live a regular life like other people. It is a progressive neurodegenerative condition that is difficult to detect in the early stages. Traditional EEG-based PD diagnosis relies on arduous, time-consuming feature extraction that is done by hand. The ParkINN (Parkinson Identification Neural Network) has been proposed as a new EEG-based network for Parkinson's screening that can quickly identify patients suffering from Parkinson's or early stages of Parkinson's. The suggested approach uses windowing and long-short term memory (LSTM) architectures for sequence learning, as well as 3 Dimensional Convolutional Neural Networks (CNN) for temporal learning of the EEG signal. The accuracy rate of the proposed 3D CNN-LSTM model is 94.64 percent, which is higher than the findings of the majority of other work in this area.**

***Index Terms*—Parkinson, Neural Network, CNN, LSTM, EEG**

I. INTRODUCTION

The most prevalent type of Parkinson's, a collection of neurological conditions characterized by rigidity, sluggishness, and tremor in movement, is Parkinson's disease. Parkinson's disease affects more than 6 million people globally [1]. We assessed EEG signals [2] from the brain as prognostic biomarkers for dementia progression in Parkinson's disease (PD). To do so we have proposed a deep learning model [3].

II. RESEARCH AREA

In traditional ML, choosing the right feature extraction algorithms for PD diagnosis is a very difficult operation that necessitates an extensive understanding of the signal processing and AI fields. In order to get around this issue, DL-based approaches for PD diagnosis using EEG data have been developed recently [4], [5]. These algorithms perform feature extraction operations without the need for deep layer supervision [2], [6]. Deep learning has effectively advanced in recent years in identifying, classifying, and quantifying patterns in clinical data in numerous medical domains [7].

III. GOALS AND OBJECTIVES

The main objective of this project is to develop an optimized deep learning model using a neural network to classify Parkinson's patients and healthy controls. Useful feature selection plays a major role and the proposed model will focus on the automatic feature selection part [8]. To start the treatment it is very much important to diagnose the disease as early as possible. Also, the paper compared the proposed model with other neural networks and finds the best model for this work.

IV. DATASET

21 channel Nihon Kohden EEG machine [7] has been used to collect the data from 24 Parkinson's patients and 21 healthy controls. The subjects are asked to sit comfortably and while the EEG was being recorded, they were directed to fix their attention for 60 sec on a little circle that was shown on the computer screen. The local ethics commission gave its clearance for the conduct of our study. Every participant volunteered for this study. In accordance with the Helsinki declaration, they were told about the nature of the experiment and provided with a signed consent form. The findings of the mini-mental status evaluation (MMSE) [21.99 + 1.71 (range 25-30)] were found to be within the acceptable range. The exclusion criteria include the presence of other neurological problems like epilepsy or psychiatric disorders including acute mental illnesses like depression or alcohol use disorders or the use of dopamine-blocking medications.

V. METHODOLOGY

Figure 1 shows the overview of the method. The methodology includes data acquisition, pre-processing, feature extraction, feature selection, and classification. The validation part involves two-stage. Training stage and testing stage.

VI. PARKINN MODEL

This network (Fig. 2) is a combination of two very elegant and powerful neural networks convolutional neural network and a recurrent neural network. Here the convolutional neural network(CNN) selects relevant features from our EEG data and then these are fed to our long short-term memory(LSTM) whose output is then fed to a feed-forward network of three layers and its last layer will give us the probability of each emotion. This model has 3 Convolution layers, 2 Recurrent (LSTM) layers, and the feed-forward neural network layer. The input EEG signal is passed to the model. 3 CNN layers map the input EEG signal to a relevant feature sequence.

VII. RESULTS AND ANALYSIS

Experimental results (Table 1) showed that the ParkINN model is capable to recognize Parkinson's patients in a short

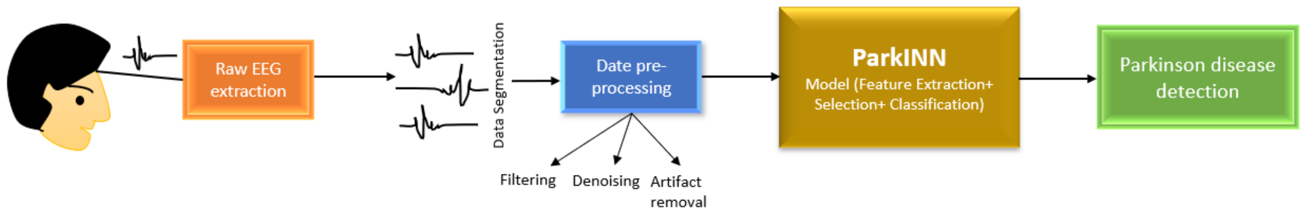

Fig. 1. Steps of the work

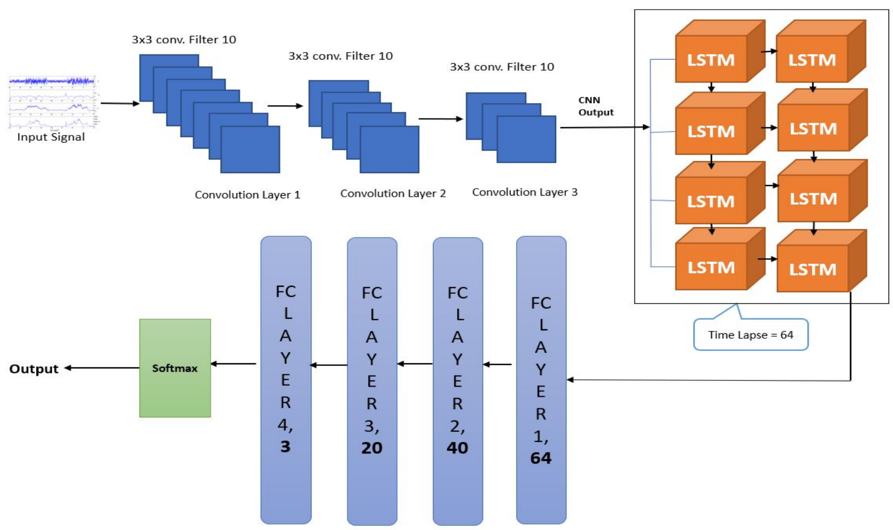

Fig. 2. Overview of the ParkINN model

TABLE I
COMPARISON OF THE ACCURACIES OF CNN, RNN, CNN-RNN, AND PARKINN MODEL

Classifier	**No of Fold**					
	1	2	3	4	5	Average Value
CNN	85.66%	84.56%	89.35%	82.45%	75.65%	81.65%
RNN	82.36%	81.65%	85.53%	81.36%	78.66%	83.45%
2D CNN-RNN	85.69%	89.35%	88.45%	86.65%	87.66%	88.26%
ParkINN	90.65%	89.96%	91.45%	94.66%	96.45%	94.64%

time. And it is also proved that CNN works better than a single model.

VIII. CONCLUSION

Moreover, the proposed ParkINN model provides better performance i.e. above 90 percent than 2D CNN or any combination of the Deep learning models.

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