Early Prediction of Parkinson Disease using Deep Learning

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Abstract - Parkinson's Disease (PD) is one of the most critical progressive neurological diseases mainly affect the motor system of the body. The accurate diagnosis of PD has been a challenge, mainly due to the close relevance of PD with other neurological diseases. This close relevance causes 25% inaccurate manual diagnosis of PD. Many researchers have suggested different algorithms and techniques for predicting Parkinson Disease. But after the overall analysis, Deep Learning Algorithm offers superior detection performance. Convolutional Neural Network (CNN) is used to classify PD and Healthy Control (HC) patients accurately. Parkinson Progression Markers Initiative (PPMI) provides publically available benchmarked Magnetic Resonance Images (MRI) images for both PD and Healthy Control (HC). These images are used to train the model. Proper tuning of parameters in CNN helps to reduce error rates, thus making the model more reliable.

Key Words: Parkinson Disease, Healthy Contol, Convolutional Neural Network, Magnetic Resonance Image, Deep Learning.

1.INTRODUCTION

Parkinson's Disease(PD) is a neurodegenerative disorder first described by James Parkinson. In Parkinson's Disease, several nerve cells(neurons) in the brain gradually break down or die. The gradual decrease in dopamine level causes abnormal brain activity, leading to impaired movement and other symptoms of PD.It has been reported by the Centers for Disease Control and Prevention (CDC) that PD complications rank as the 14th leading cause of death in the United States(US) . Till now , there is no way to cure PD permanently.Meditation and proper medical treatment decreases the progress of PD. Therefore, detection of PD at an earlier stage is certainly important to slow down its progression. The signs and symptoms can be different for everyone. Early signs may be mild and unnoticed. The signs and symptoms may include tremors, slow body movement,(bradykinesia),rigidmuscles,imbalance,lossofa utomaticmovements,speech changes, or writing changes. Thus, we have developed fast and efficient predictive model to detect PD. The main aim was to develop CNN model which efficiently classify PD affected MRI images and HC images.

2. METHODOLOGY

2.1 Data Collection

This paper uses PPMI dataset. MRI images of different patients are collected from PPMI repository. PPMI is a collaboration of researchers, study participants and funders working toward the goal of identifying progression biomarkers to improve PD therapeutics.

2.2 Data Pre-processing :

Data Preprocessing is an initial step. It involves transforming raw data into well format data. The MRI images extracted from PPMI repository were in DCM format.These DCM images were converted to JPG format and resized to 64×64. The data was then labeled to make them recognizable and understandable by the deep learning model. The training dataset was augmented to expand the size of dataset, which helped to train the model by variety of images.
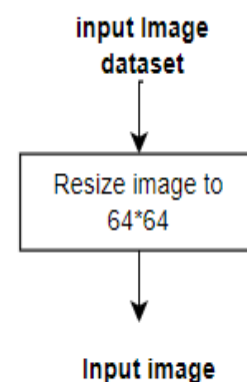

Fig 1.Data Pre-processing

2.3 Feature Extraction

Feature Extraction is the mathematical-statistical procedure that extracts the quantitative parameters of resolution changes/abnormalities from images. Features are extracted in initial layers of CNN architecture using convolutional operation.

2.4 Training model

The average model is created by merging ResNet-50andVGG-16algorithms.The model is trained by training dataset till the required accuracy is not achieved. Adam optimizer is used to change the attributes of neural network such as weights and learning rate in order to reduce the losses. The EarlyStopping function from Keras called as callbacks is used in order to stop the training exactly at the point where overfitting occurs. The trained model is saved, which is later used for prediction purpose.

2.5 Model Evaluation

Accuracy of the model is evaluated with the help of test dataset.

2.6 Retraining the model

2.6.1   Tuning : The model was tuned by changing it's parameter till stated accuracy was not achieved

2.6.2   Store the weights : The final model was saved so that it can be used for new data.

2.7 Convolution Neural Network (CNN)

Convolutional Neural Network (CNN), is a highly effective algorithm potentially used in a variety of applications like as handwritten digit recognition, visual recognition, and image classification. It is a multi-layer neural network that extracts important features from images with minimal preprocessing and uses them to classify images. The architecture of CNN has been designed in a way such that it utilizes spatial relationships to encode certain properties and reduce the number of hyperparameters and thus improves general feed-forward back propagation training. CNN models combine weights in to smaller kernel filters to simplify the learning model. To construct a CNN architecture, the convolutional layer is considered the basic building block. It also

consists of several other layers, some of which are described as below:

• Input Layer : It takes raw pixel values of image as an input.

• Convolution Layer : It extract features from the input image. To generate a feature map it takes two inputs such as an image matrix and a filter or kernel.

• Pooling Layer : It is used for dimensionality reduction.

• Flattening : The data is converted into a 1-D array for inputting to fully connected layer.

• Fully Connected Layer : It is dense neural network which combines the features together to create prediction model.

• Output Layer : It produces a single output based on the weighted sum of inputs.
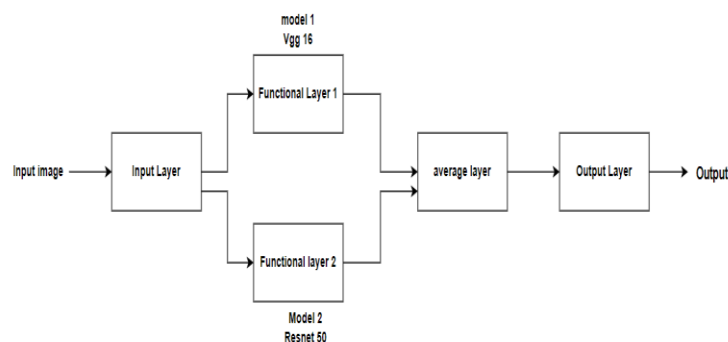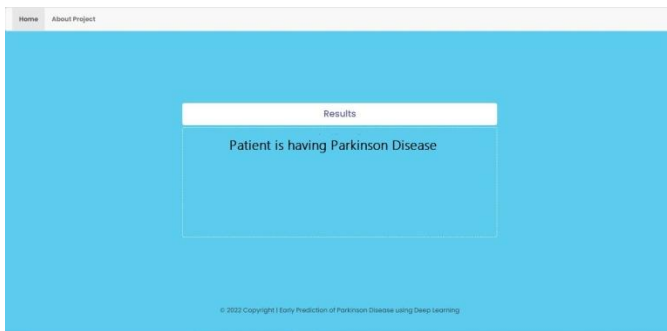

Fig 2.Block Diagram

3.RESULT

Input image uploading is possible on the system

System gives appropriate output about whether the person is having Parkinson or not.

4. CONCLUSIONS

The system is able to predict the Parkinson disease at early stage.We can adjust the parameters to optimize the model which will be developed, to decrease the bias and over-fitting problem by tweaking kernel size,number of layers, number of neurons in each layers and epochs. This Deep Learning based model will provide a good scope for medical image analysis and will enable researchers and medical teams to do feature selection and classification in order to potentially predict PD.

REFERENCES

1. Zeiler, Matthew D., and Rob Fergus,"Visualizing and understanding convolutional networks ",European conference on computer vision,Springer International Publishing, 2014

2. S. Marar, D. Swain, V. Hiwarkar, N. Motwani and A. Awari, "Predicting the occurrence of Parkinson's Disease using various Classification Models",IEEE, 2018

3. Pir Masoom Shah, Adnan zeb, Uferah Shafi, Syed Farhan Alam Zaidi, Munam Ali shah,"Detection of Parkinson Disease in Brain MRI using Convolutional Neural Network", International Conference on Automation and Computing,Newcastle University,UK,2018

4. G. Solana-Lavalle, J.-C. Galan-Hern ´andez, and R. Rosas-Romero," ´ Automatic Parkinson disease detection at early stages as a pre-diagnosis tool by using classifiers and a small set of vocal features", Biocybern. Biomed.Eng., vol.40, no. 1, pp. 505–516, Jan. 2020

5. Wang, Lee, F. Harrou and Y. S. Wu," Early Detection of Parkinson's Disease Using Deep Learning and Machine Learning",IEEE, 2021