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` PARKINSON DISEASE DETECTION USING DEEP NEURAL NETWORKS

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ABSTRACT

Parkinson Disease is a brain neurological disorder. It leads to shaking of the body, hands and provides stiffness to the body. No proper cure or treatment is available yet at the advanced stage. Treatment is possible only when done at the early or onset of the disease. These will not only reduce the cost of the disease but will also possibly save a life. Most methods available can detect Parkinson in an advanced stage; which means loss of approx... 60% dopamine in basal ganglia and is responsible for controlling the movement of the body with a small amount of dopamine. More than 145,000 people have been found alone suffering in the U.K and in India, almost one million populations suffers from this disease and it's spreading fast in the entire world.

Parkinson's disease symptoms can be different for everyone. Early signs are mild that goes unnoticed. Symptoms usually begin on one side of your body and gets worsen on that side, afterwards it affects both the sides.

Parkinson's symptoms may include

- Tremor
- Slowed movement
- Rigid muscles.
- Impaired posture and balance.
- Loss of automatic movements
- Speech changes
- Writing changes
- Depression
- Anxiety
- Sleeping, and memory-related issues
- Loss of sense of smell along with balance problems.
- What causes Parkinson's disease is still unclear, but researchers have research that several factors are responsible for triggering the disease.
- As a result people suffer from this disease for many years before diagnosis. The estimated results have shown that there are 7-10 million people are affected by parkinson's disease worldwide. People with age above 50 are the one's who has the higher possibility of getting parkinson's disease but still an estimated 4 percentage of people who are under the age 50 are diagnosed with parkinson's disease

Keywords: Deep Neural Networks,Deep Learning,CNN,RNN

INTRODUCTION

The brain is the main controller of our body. Therefore, any damage to this sensitive part of the human body will affect badly on the other organs. One of these negative effects is Parkinson's disease. As Pereira et al. (2017) note, Parkinson's disease (PD) is a chronic, progressive, neurodegenerative disorder which begins when a certain area of the brain has been damaged. PD symptoms overlap with other diseases like normal ageing and essential tremor, especially in the early stages of these diseases (Samii et al.,2004). Thus, it is important to differentiate between PD and other diseases in order to give the right treatment to the patient.

Mathematical models such as Deep Learning (DL) provide a suitable technique to detect disease symptoms These modelling approaches include topologies specialized for some kind of datasets such as imaging datasets and time-series datasets(i.e. a dataset comprised of a set of sequences, where each sequence contains data points that are indexed in time order). Therefore, it is worthy to investigate the deep learning techniques on the PD, especially after the recent success of deep learning in different fields.

METHODOLOGY

XG Boost is an implementation of gradient boosted decision trees designed for speed and performance that is dominative competitive machine learning. XGBoost provides a wrapper class to allow models to be treated like classifiers or regressors in the scikit-learn framework. This means we can use the full scikit-learn library with XGBoost models.

Machine Learning

Machine learning (ML) is an important area in computer science. ML, called sometimes automated learning, is a collection of algorithms which aim to make computers learn from available input (called training data or representing experience) and give us the output as expertise (Shalev-Shwartz et al., 2014). Generally, We use machine learning in automating several tasks such as tasks performed by humans and tasks are over human capabilities.

DEEP LEARNING (DL)

Overview

Deep learning is a relatively new approach within the field of neural networks. It is a branch of machine learning which deals with unstructured data (hierarchy data) like audio, image and text (Wang et al., 2017). DL represents the data in several layers with several levels of abstraction (Lin et al., 2017).

Why Deep learning?

The limitation of the shallow neural network (a standard NN with two hidden layers as maximum) leads to the necessity of depth. For example, in shallow NN, the number of neurons in the hidden layers grows exponentially with task complexity. So the shallow would need more neurons than the deep one (Goodfellow et al., 2016). Also, the human nervous system is a deep system (Wang et al., 2017).

Deep learning applications

Several prominent applications recently used DL, such as voice recognition, face recognition, prediction and machine translation. DL has been applied successfully in the medical field such as cancer detection and PD diagnosis.

DL architectures can be divided into several topologies including convolution neural network (CNN) and recursive neural network (RNN).

MODELING AND ANALYSIS

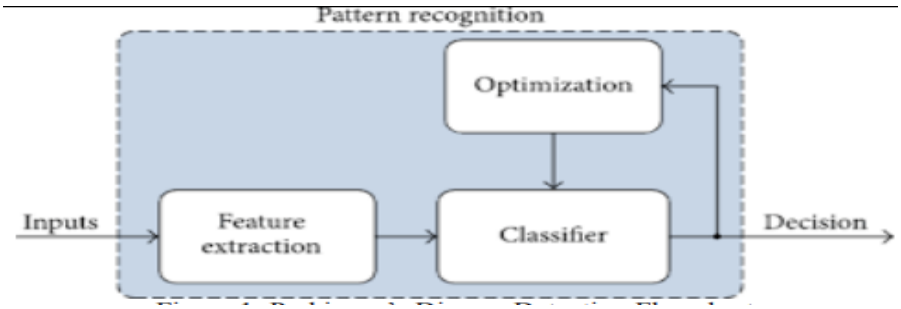

Fig.1: Parkinson 's disease Detection Flowchart

Table 1: showing attribute information of dataset

Attribute	Description
MDVP:Fo(Hz)	Average vocal fundamental frequency
MDVP:Fhi(Hz)	Maximum vocal fundamental frequency
MDVP:Flo(Hz)	Minimum vocal fundamental frequency
MDVP:Jitter(%),MDVP Jitter(Abs),MDVP:RAP,MDVP:PPQ,Jitter:DDP	Several measures of variation in fundamental frequency
MDVP:Shimmer,MDVP:Shimmer(dB),Shimmer:APQ3,Shimmer:APQ5,MDVP:APQ,Shimmer:DDA	Several measures of variation in amplitude
NHR,HNR	Two measures of ratio of noise to tonal components in the voice
Status	Health status of the subject (one) - Parkinson's, (zero) – healthy
RPDE,D2	Two nonlinear dynamical complexity measures
DFA	Signal fractal scaling exponent spread1,spread2
PPE	Three nonlinear measures of fundamental frequency variation

RESULTS AND DISCUSSION

The statistical functions namely Minimum, Maximum, Mean, Median, Standard Deviation, Skewness, and Kurtosis have been used to compress over 3 million tuples into 310 tuples. Finally, various Machine Learning techniques have been applied to the transformed dataset to perform detection of Parkinson 's disease. The classification has been performed using Logistic Regression, Decision Trees, Random Forest, SVM (Linear Kernel), SVM (RBF Kernel), SVM (Poly Kernel) and k-Nearest Neighbours and XG Boost .Experiments with Principal Component Analysis for data compression have also been performed and their incompetence (with reasons) has been stated.

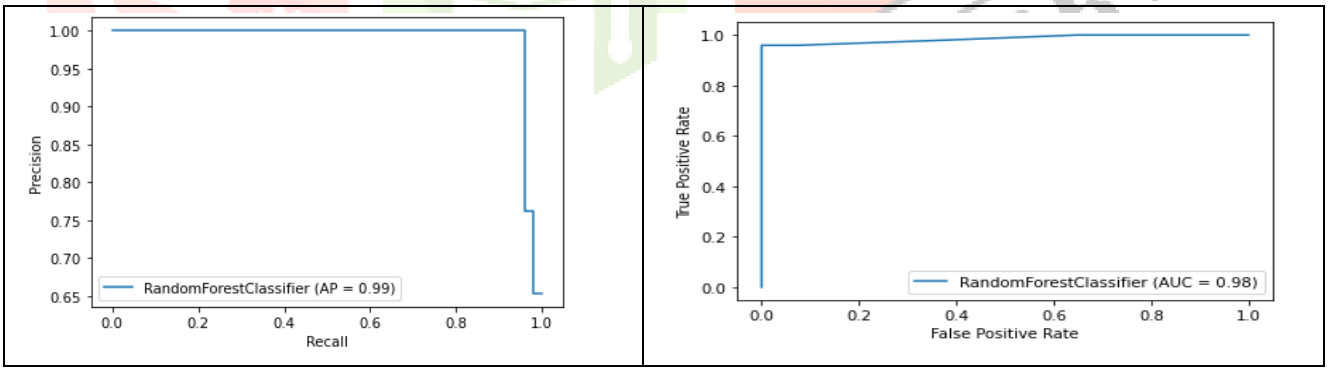

Fig – 2 Precession Recall Curve

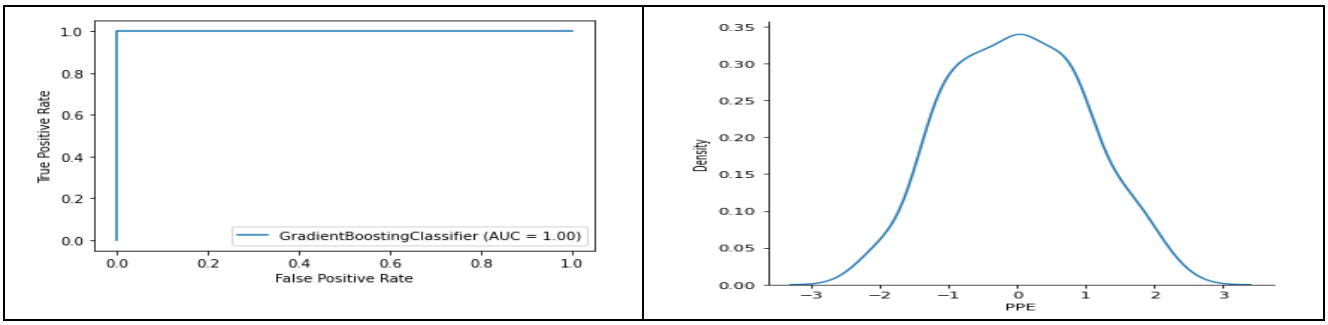

Fig – 3 Receiver Operating Characteristic Curve (ROC) & Performance Analysis on Fundamental Frequency of PPE

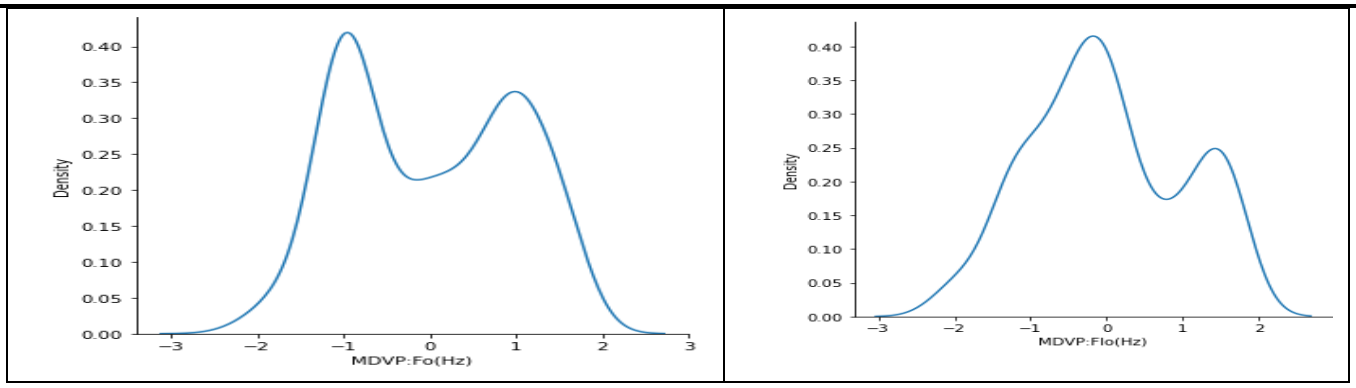

Fig – 4 Performance Analysis on Fundamental Frequency of MDVP. FIo

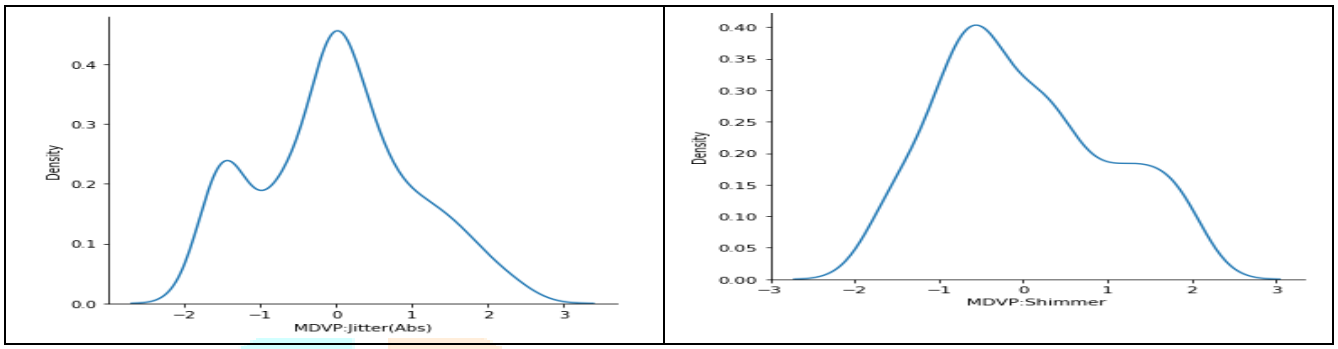

Fig – 5 : Performance Analysis on Fundamental Frequency of Jitter

Table 2: The Comparison tables of different models

Models	Samples	ML Classifier	Sensi tivity	Speci-ficity	Test Accuracy
Existing Method	50	Random Forest	0.95	1.0	0.95
Proposed Method	50	XG Boost Classifier	0.98	0.98	97.5
	50	Gradient Boost With MHD	1.0	0.937	98.2

CONCLUSION

The analyze of which algorithm provide the high accuracy of prediction for the Parkinson's disease dataset, here the classification accuracy was studied and compared, with good performance and fast implementation XGBoost with multiple fold data achieved a high accuracy with 98.2%. This system provides the comparison between machine learning classifiers of LR and XGBoost in PD disease diagnosis with high dimensional data.

SCOPE FOR FUTURE

In future work, we can focus on different techniques to predict the Parkinson disease using different datasets. In this research, we using binary attribute (1- diseased patients, 0-non-diseased patients) for patient's

classification. In the future we will use different types of attributes for the classification of patients and also identify the different stages of Parkinson's disease

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