ISSN 2320 - 2602
Volume 9 No.7, July 2020
International Journal of Advances in Computer Science and Technology
Available Online at http://www.warse.org/IJACST/static/pdf/file/ijacst18972020.pdf
https://doi.org/10.30534/ijacst/2020/18972020

An SVM Based Prediction of Parkinson's Disease Using MFCC, end to end ASR and Voice

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ABSTRACT

Application of machine learning (ML) can ameliorate healthcare sector on or mostly by its ability to process and reliability convert vast datasets beyond the scope of human capacity in to clinical insights that aid physicians in diagnosing and treatment planning to endeavor cast active cases and better patient satisfaction. Parkinson's disease (PD) is the second common neuro degenerative disorders affecting midbrain. Lack of precise diagnosis test and dismissal of easily symptoms as effect normal aging impediment the early analysis and treatment of PD, which signifies the development of ML application in prediction of PD. This work details an effective measure in diagnosis of PD through speech analysis of a subject consist mel frequency ceptral coefficient (MFCC) and end to end automatic speech recognition. Prior factors are consumed with the aid of a support vector machine and application of L-1 based algorithm to enhance feature selection has proven effectiveness in prediction of PD and NPD during the experiment with 99% accuracy in less than minutes which revoke existing diagnosis methods in accuracy and efficiency.

Key words: Parkinson's disease prediction, Speech extraction, Support vector machine, MFCC and end to end ASR, Machine Learning.

1. INTRODUCTION

Parkinson's disease is produced by the death of nerves in the midbrain and it is a disorder of central nerve system. That is caused by a progressive decline of dopamine producing nerve cells in the midbrain. It is an incurable disease. The medication of PD is self-care, physical exercise etc. Levodopa is the medicine commonly prescribed for Parkinson. When the patients are find in the exact time, which is help to physical restriction and medical facilities. The late prediction of PD causes an increase in the utilization of hospital resources and more expenses. Speech impairment is an early onset indicator of PD and it was estimated that up to 90% of the patients develop speech symptoms with the disease progression. The most observable speech symptoms are related to breathing, phonation, articulation and prosody. These symptoms are manifested in the speech quality of the patients in the form of distorted vowels and consonants, harsh and hoarse voice quality, reduced speaking rate, hypernasility, mono loudness and mono pitch. Previous studies has reported a continuous decline of these symptoms over the course of PD [1]. The current research is a promising initial step toward a long-term goal of providing a decision support algorithm for physicians in screening patients for PD. There is an absence of time-efficient, cost-effective, and biologically accurate diagnoses for Parkinson's disease in the world, especially since doctors confound PD with other Parkinsonian syndromes. Medical professionals depend completely on physical tests focusing on harmed movement and decrease hand-eye coordination for initial detection. DatSCANs1 and SPECT2 analyses are also used to determine if a patient has PD. However, these are relatively cost-inefficient and inaccurate. MRI3, CT4, and PET5 scans are used not to directly diagnose PD. Doctors never determine whether a patient has Parkinson's rather, they follow a process of elimination framework by eliminating the likelihood for other diseases, they conjecture that the individual has PD [2].

1.1 Machine learning in disease prediction

Machine learning (ML) algorithms are used for effective diagnosing of diseases. ML contributes in medical sector for disease prognosis, data scanning etc. The main role of learning in healthcare is to ease processes to save time, effort, and money. Here apply ML algorithms to maintain complete hospital data. Machine learning allows building models to quickly analyze data and deliver results, leveraging both past and real-time data. With machine learning techniques, doctors can make improved decisions on patient's diagnoses and treatment options, which lead to the improvement of healthcare services. The disease diagnosis process in the medical field was considered as a decision-making process. In

which the diagnosis of a new and unknown cases is made by medical practitioner from the information that is available from clinical data and from his/her experience in clinical field. In order to make this decision-these making process less costly, easy, faster, more accurate and efficient, the process can be automated.

2. RELATED WORK

Timothy J. Wroge, Yasin Ozkanca, Cenk Demiroglu, Dong Si, David C. Atkins and Reza Hosseini Ghomi proposed a Parkinson's disease Diagnosis Using Machine Learning and Voice. The opening step is to collect mPower voice dataset raw audio for training and testing, according to prognosis. Then performing preprocessing step for removing silence. After removing silence, AVEC features and GeMaps features for feature selection. Appling mRMR to these algorithms and taking some optimized features for machine learning processes. Using of support vector machine algorithm is to predict the patient result [3].

Sanjana Singh and Wenyao Xu, proposed Robust Detection of Parkinson's Disease Using Harvested Smartphone Voice Data: A Telemedicine Approach. Initially to download data from Synapse portal, then collect acoustic signal for each sample. To frame a single audio with 20-s. Each frame is done with MFCC feature extraction process and using some feature selection algorithm. Then apply machine learning algorithm for learning process. Which is help to predict PD OR NPD result [8].

3. METHODOLOGY

The proposed method is shown in Figure1. Initially to collect audio samples for the training and testing. To stockpile the PD audio and NPD audio for the development process, then pre-proposed that audios and get the noise free audio. After data preprocessing, the data to be passed to two sound recognition algorithms, MFCC and end to end ASR is used for optimized useful representation feature extraction. These two algorithm is automatic sound recognition algorithm. And getting the extracted sound features. Then the useful extracted features will be ranked using an L-1 Based algorithm. L-1 based algorithm for selection processes, it learns some important features present in the input data to minimize the error. And the optimized selected features will be provided as input into an RBF-SVM classifier which will be trained to classify the result. The test data's are given to the trained model and predict whether a patient has PD or NPD. This model also increases the prediction accuracy and also produces more stable result than any other methods.

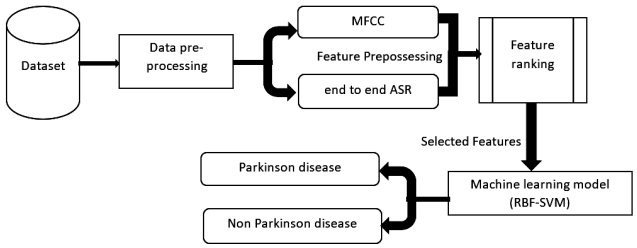

Figure 1: Architecture of prediction system.

3.1 Working of Proposed Model

A. Data Preprocessing

This is an among-st the major steps for the evolution of this model. Initially blackout the background noise from the audio samples. Then got a noise free sounds for the modeling of the system. This is help to make a data model. Data standardization is the critical process of bringing data into a common format. These sounds are help to the feature extraction step.

B. MFCC and end to end ASR for Extracting Features

Optimized useful features were extracted using MFCC and end to end ASR. Appropriately optimized feature extraction is the key to effective model construction of RBF-SVM. This method increases the accuracy of the model. These two feature extraction algorithm have been successfully used to efficiently extract meaningful features in disease diagnosis based on Parkinson's disease dataset. These two algorithm are using DFT and FFT based feature extraction. MFCC feature extracted process is done, this time also doing end to end ASR feature extraction. Then got PD features from the audio with some duplication, missing features, etc.

C. Feature Ranking

In this step doing a prepossessing process to the extracted features. Here is working with removing duplication, missing etc and making a feature ranking. Then taking only high ranked features using feature selection. In here an L-1 based algorithm is used to the selection of optimized featured. These optimized attributes are helping to prediction of Parkinson's disease. Good bit of features are getting from the features extraction processes, which is overfitting the model. L-1 based technique is used to selecting the most ranked features. A single attribute evaluator algorithm would suffice for feature ranking, multiple were implemented to ensure consistent.

D. Support Vector Machine

An L-1 based algorithm is able to represent to optimal representation which is then classified using RBF-SVM to derive the final result. Support Vector Machines are based on the decision planes that define decision boundaries. A decision plane is one that separates a set of objects having dissimilar class memberships. Classification involves identifying what type of data. It performs the classification by

constructing hyper planes in a multidimensional space that separates cases of different class labels, class labels are PD and NPD. This plan is the optimal hyper plane. The goal with the algorithm is to find the optimal level that can be controlled when the situation is exact. It is used to separate two different classes: PD and NPD. After that, test the data with this network and an output is obtained. Then obtained output and trained output is compared and choose the minimum distance and a class is obtained. That is whether a person has a Parkinson's disease or non-Parkinson's disease.

4. RESULT

This project is carried to detect whether a person is suffering from parkinsons disease or not. This system gives more accurate results and which are more stable. Other than classification algorithm of KNN, random forest, decision tree, NN Naïve bayes the feature selection techniques of Gemaps, Autoencoder, AVEC and nFrames. Parkinson prediction with MFCC, end to end ASR and RBF-SVM gives more precise outcomes. This model which is being proposed gives, 99% accuracy, CNN with 46% and autoencoder with 73%. The advantages of this model are low computational complexity, accurate result, cheap cost and it reduces our fitting problems.

Figure 2 is the screenshots of the Parkinson's and non-Parkinson's disease prediction system. In this method gives the accurate results of PD and NPD result. Python is used for Front-End and Back-End development. Different frameworks are used for all algorithms and GUI.

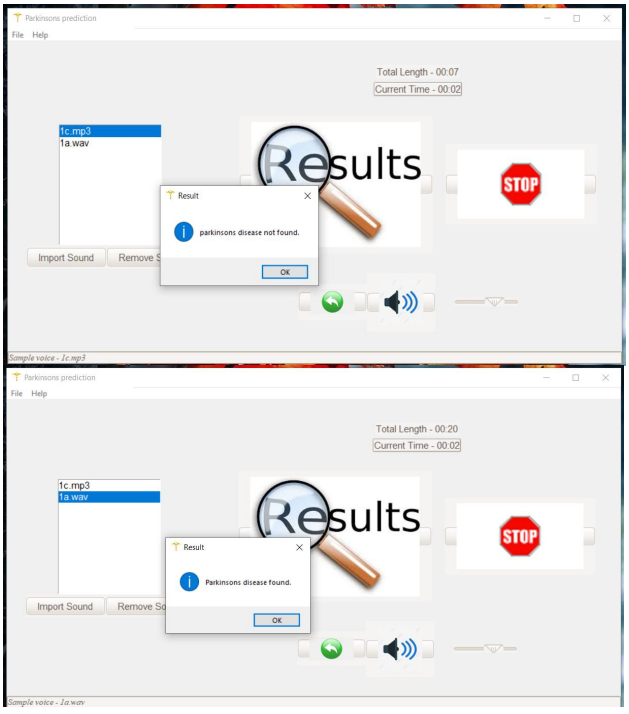

Figure 2 Screenshots of Parkinson's disease and non-Parkinson's disease found

Figure3 is the graphical representation of the prediction algorithms. In the below figure x-axis represents the algorithm used and the y-axis represents the accuracy in percentage. Test results can be predicted with 99% accuracy from the proposed mechanism for predicting Parkinson's disease.

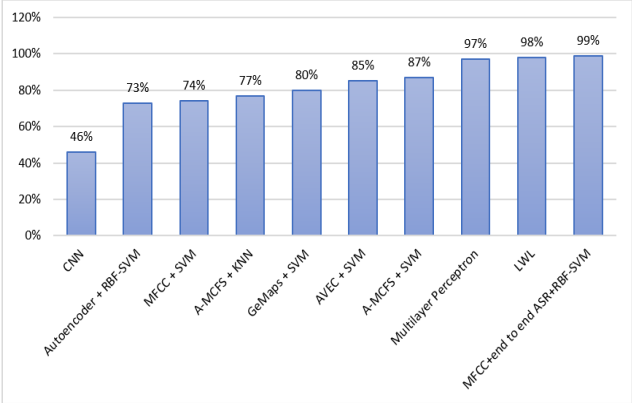

Figure 3: Graphical representations for accuracy comparison.

5. CONCLUSION

In this model an accurate method for the prognosis of Parkinson's disease is being discussed. Normally the signs and symptoms of this disease is very rare and also the diagnosis is very difficult task and it delays the proper treatment. So, to overcome that problem we have proposed system of data using RBF-SVM. This work is mostly about whether a person is diseased or not. This system helps determine whether a patient has Parkinson's disease or not.

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