International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

NEUROIMAGING USING MACHINE LEARNING FOR MENTAL DISORDER DIAGNOSIS

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Abstract - *Parkinson's malady (PD) is a dynamic neurodegenerative infection influencing more than 6 million individuals around the world. Still, there is at present no authoritative test for PD by clinicians, particularly in the early ailment stages where the side effects might be inconspicuous and inadequately described. There is a requirement for a progressively precise, target methods for early discovery, in a perfect world one which can be utilized by people in their home setting. In this project we are going to focus on misdiagnosis, detection in a home setting environment and real time execution of algorithms which are comprehensive earlier. Misdiagnosis and early detection is overcome using both the voice data and spiral image data of the individual. Both of the above inputs can be obtained easily and at desired intervals unlike MRI's which has a fixed constraints. On processing of these inputs, we execute algorithms like k-means clustering, decision tree, K-Nearest Neighbor(KNN), Support Vector Machine (SVM) in real time which are comprehensively described in the existing works.*

***Key Words*: PD(Parkinson disease),misdiagnosis, early detection,voice data,spiral image data.**

1. INTRODUCTION

Parkinson's disease is a movement disorder. It influences the sensory system, and side effects become more regrettable over time. There is no fix or counteraction for PD.Most of the manifestations result from a fall in dopamine levels in the cerebrum. Parkinson's sickness sufferers deteriorate after some time as the typical real capacities, including breathing, parity, development, and heart work intensify. Effect of Parkinson's increments with age, yet an expected four percent of individuals with PD are analyzed before the age of 50. Be that as it may, the malady can be controlled in beginning time.

Data mining is a computational procedure to discover shrouded designs in datasets by building prescient or grouping models that can be gained from past understanding and applied to future cases. There are numerous approaches to analyze and distinguish comprising of MRI filters, MMSE (Mini-Mental State Exams) both communicated as far as CDR principles. But these ways are complex and have specific constraints which makes diagnosis process lengthy.

The purpose of the project is to develop a machine learning based solution for Parkinson's disease, which suggests algorithms for diagnosing the disease based on their accuracy and by using two types of inputs it reduces the misdiagnosis rate. The scope of the project is, it eliminates manual error, reduces processing time based on increased accuracy. It overcomes two main challenges misdiagnosis and early detection at home setting environment.

The above challenges are achieved by taking two inputs both voice and spiral, where misdiagnosis fails. And both the inputs can be achieved at home setting at recurrent intervals, voice of the patient is a recording from which values are extracted and spiral images are drawings drawn by the individual.

1.1 RELATED WORKS

Parkinson's disease(PD) is a drawn out degenerative issue of the focal sensory system that influences the engine framework. There is no fix or precautoin for PD. These symptoms occurs as the disease develops stages, which worsens the individuals state. Appropriately early disclosure of the disease is significant.

And since the symptoms differs from person to person misdiagnosis may occur, therefore misdiagnosis also is important to be addressed.[2]Classifiers like Naïve Bayes, SVM, MLP neural network, and decision tree etc used to classify the PD dataset. The dataset comprises of voice signals.[10]With progressions in innovation and the sound gathering gadgets in day to day lives, dependable models that can make a transformation of this sound information into an indicative instrument for medical service experts would conceivably give analysis that are less expensive and increasingly precise.

[9]Patients suffering from PD typically exhibit impairments of previously learned motor skills, such as handwriting. In this manner, handwriting can be viewed as an amazing marker to create automatized demonstrative instruments. Dynamic features of the handwriting process can support PD diagnosis at earlier stages, this is tested by including those patients showing only early to mild degree of disease

severity. Built up an arrangement structure dependent on various classifiers and a ensemble scheme.

The above works led to our work of using both the inputs, voice dataset and spiral image dataset which has a high chance of eliminating misdiagonosis.And the inputs can be taken at home setting and can be taken recurrently, which helps, in early detection.

1.2 BASIC DEFINITIONS

Degenerative: It is defined or characterized by degeneration of the nervous system, especially the neurons in the brain.

Misdiagnosis: an incorrect identification of the nature of an illness or other problem by examination of the symptoms.

Classification: It is the issue of distinguishing to which of a lot of classes belong, based on a preparation set of information containing perceptions whose classification participation is known.

Early detection: Methods to decide in patients, the idea of an ailment or confusion at its beginning time of progression. Generally, early determination improves treatment result.

Accuracy: the condition or nature of being valid, right, or definite; free from blunder or deformity.

2. METHODOLOGY

The main aim of this paper is to relate to the two main challenges of this paper, misdiagnosis and early detection of PD by executing and suggesting algorithms based on accuracy, that are comprehensive so far. The system architecture is shown in figure 1.

In the voice part we process the voice data set, which consists of voice parameters such as PPE (Pitch Period Entropy), Shimmer etc. This part contains of two main operations clustering and classification which is done using R-programming in Studio platform. These operations involve algorithms like k-means and decision tree. Whereas, the spiral part processes the spiral dataset which contains values extracted from spiral images. It extricates highlights, for example, speed, velocity and so forth then the process extends with classification using algorithms like K-Nearest Neighbor(KNN) and Support Vector Machine(SVM).This part is done in Jupyter utilizing python.

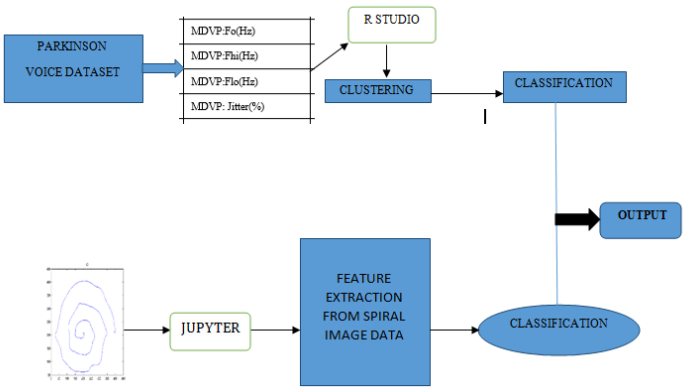

Fig 1-System Architecture

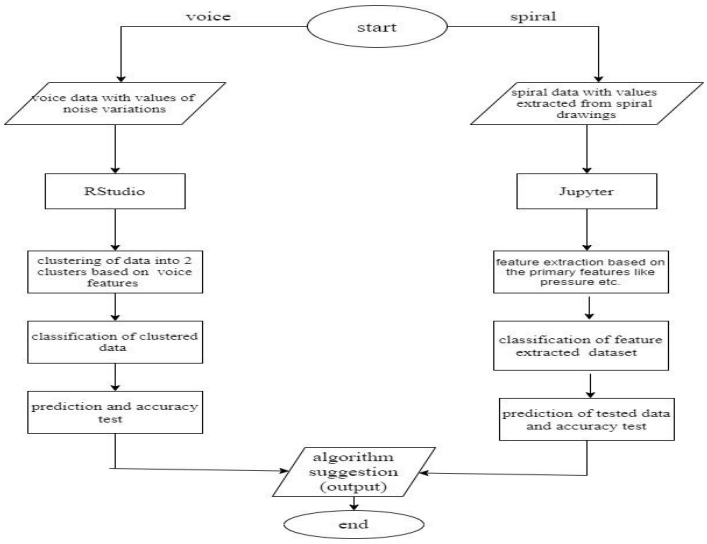

Chart -1: Flow diagram of the system

2.1 VOICE MODULE

This module briefs about one of the stems(voice stem) of the flowchart above in Chart -1.We utilized RStudio for information analysis. The proposed prescient examination structure is a blend of K-means clustering and Decision Tree classification algorithm which is utilized to pick up bits of knowledge from patients. These algorithms clusters the inputs to two groups and further the groups are characterized and a model is constructed. Utilizing a set of test information we test the mode land precision is tried and the algorithms that can be utilized are recommended.

2.2 SPIRAL MODULE

This module briefs about one of the stems(spiral stem) of the flowchart above in Chart-1.For processing the spiral images, we have used Jupyter. Our system takes inputs by integrating spiral drawing inputs of normal and Parkinson's affected patients. Pressure; Grip Angle; Timestamp; Test ID esteems are utilized as a dataset to be prepared. Having these as the

base values features like speed, velocity etc are calculated and extracted. Those values are classified using algorithms like k-nearest neighbor and SVM(Support Vector Machine) are used to train models and accuracy is tested and algorithms are suggested for output.

2.3 RESULTS AND DISCUSSION

The outcomes accomplished in the proposed framework depend on the proficiency of algorithms. Utilizing this we finish up by proposing effective algorithms for Parkinson's disease diagnosis. Here we have suggested Decision Tree for processing voice data and Support Vector Machine for handling winding information, to upgrade the determination execution and accomplish early analysis of the disease, we also have addressed misdiagnosis by using both voice and spiral image values.

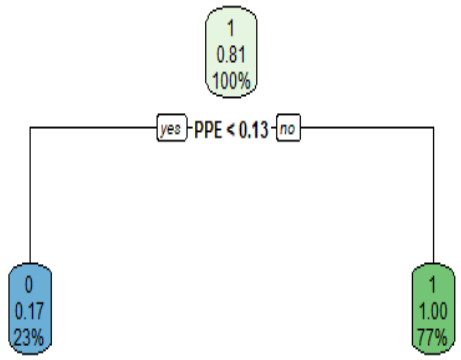

Fig- 2: Classification output of voice module

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[1. 1. 1. 1. 1. 0. 0. 0. 0. 0.]
57    1.0
58    1.0
59    1.0
60    1.0
61    1.0
72    0.0
73    0.0
74    0.0
75    0.0
76    0.0
Name: target, dtype: float64
accuracy: 100.0 %
{'Precision': 0.5, 'Recall': 1.0, 'F1': 0.6666666666666666}
```

Fig 3 -Classification output of spiral module

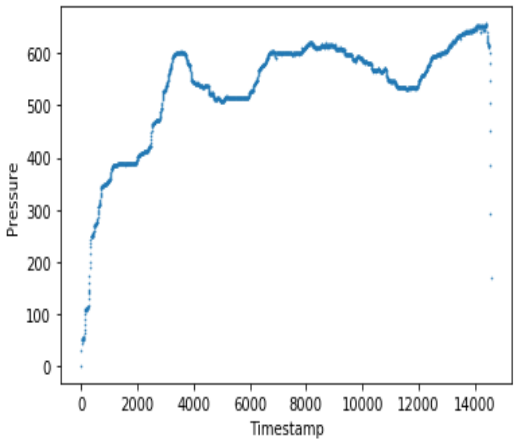

Chart -2 Plots between pressure and time of diseased indiviguals

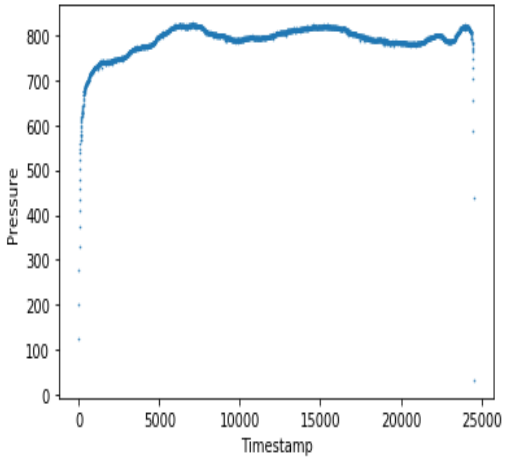

Chart -3 Plots between pressure and time of healthy indiviguals

The plot below in Charts 2&3 shows the difference between healthy and diseased individuals based on timestamp and pressure values of the spiral drawing. This plot acts as a valid example and as a reference where spiral drawing can be taken as a deciding factor in the in the determination of the disease.

3. CONCLUSIONS

This project aimed to cover a broader space of imaging and machine learning technologies for mental illness diagnostics such that researchers in the field could use them in the process of diagnosis. We attempted on a real time execution of processes and algorithms from the comprehensive work done from existing frameworks, added to that we planned for recommending the algorithms that gives higher and précised accuracy which can be used in systems designed for early diagnostic purposes. On using two different inputs we have addressed misdiagnosis.

Future works can be focused on developing a wholesome system which is ready for diagnosis and can readily assist the doctors. It can also involve different techniques to predict the Parkinson disease by using different datasets like processing real time datasets directly from the patients and process them to provide medical prescriptions as this disease involves unique symptoms which differs from person to person.

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