Detecting Parkinson’s disease using Machine Learning

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Abstract

More than 10 million people are living with Parkinson's disease worldwide, according to the Parkinson's Foundation. While Parkinson's cannot be cured, early detection along with proper medication can significantly improve symptoms and quality of life.

The researchers found that the drawing speed was slower and the pen pressure is lower among Parkinson's patients. One of the indications of Parkinson's is tremors and rigidity in the muscles, making it difficult to draw smooth spirals and waves. It is possible to detect Parkinson's disease using the drawings alone instead of measuring the speed and pressure of the pen on paper. Our goal is to quantify the visual appearance (using HOG method) of these drawings and then train a machine learning model to classify them. In this project, We are using, Histogram of Oriented Gradients (HOG) image descriptor along with a Random Forest classifier to automatically detect Parkinson's disease in hand-drawn images of spirals and waves.[1]

Background

Biomarkers derived from human voice can offer insight into neurological disorders, such as Parkinson's disease (PD), because of their underlying cognitive and neuromuscular function. PD is a progressive neurodegenerative disorder that affects about one million people in the United States, with approximately sixty thousand new clinical diagnoses made each year. Historically, PD has been difficult to quantify and doctors have tended to focus on some symptoms while ignoring others, relying primarily on subjective rating scales. Due to the decrease in motor control that is the hallmark of the disease, voice can be used as a means to detect and diagnose PD. With advancements in technology and the prevalence of audio collecting devices in daily lives, reliable models that can translate this audio data into a diagnostic tool for healthcare professionals would potentially provide diagnoses that are cheaper and more accurate. We provide evidence to validate this concept here using a voice dataset collected from people with and without PD. This paper explores the effectiveness of using supervised classification algorithms, such as deep neural networks, to accurately diagnose individuals with the disease. Our peak accuracy of 85% provided by the machine learning models exceed the average clinical diagnosis accuracy of non-experts (73.8%) and average accuracy of movement disorder specialists (79.6% without follow-up, 83.9% after follow-up) with pathological post-mortem examination as ground truth.[1]

Literature Review

Jie Mei et al used all basic algorithms of deep learning techniques for the detection of PD. Like SVM, RF, Decision Tree, ANN, KNN, Radial Basis Function Networks (RBF) and Deep Belief Networks (DBN) etc. The early identification of Parkinson's disease is critical. The identification can be performed with the use of a data mining technique. The techniques for detecting PD, such as Naive Bayes, support vector machine, multilayer perceptron neural network, and decision tree, are theoretically explained in this study. This study uses speech input from acoustic devices to predict Parkinson's disease. People from various areas and speech factors are investigated in this article in order to predict Parkinson's disease among patients. The speech dataset was used to recognize Parkinson's illness using Multi - layer Perceptron and Logistic Regression (LR) frameworks.

Gabriel Solana-Lavalle et al. uses the algorithms such as Multilayer Perceptron (MLP), Random Forest (RF), K-Nearest Neighbour (KNN). For the prediction of Parkinson disease, three set of experiences were conducted to obtain the features with highest contribution to PD. This three sets are 1.a population with male and female subjects (balanced), 2.male subjects (balanced and unbalanced), and 3. Female subjects (balanced and unbalanced). In this study, the researchers used acoustic devices to collect speech parameters from 50 persons with Parkinson's disease and fifty healthy people. They employed the k-fold cross validation method for testing and claim that it can deliver 85 percent accuracy.

Yi Xia et al. they have considered approaches, they include four DL-based models (DCNN, DALSTM, DCLSTM, and CNN-LSTM) and also used two traditional classifications for extraction. In the DL-based model DCNN gives less accuracy than other DL models. Parkinson's disease affects people all

around the world. People and people with Parkinson's disease could be classified using machine learning approach. This paper provides a comprehensive overview of machine learning-based approaches for Parkinson disease prediction. A comprehensive overview of various computational system-based techniques for Parkinson disease prediction is presented. This report also includes an overview of the results obtained by several scientists from publicly available data in order to forecast Parkinson's disease.

Kazi Amit Hasan et al. used different classification methods RF, KNN, Decision Tree, Logistic Regression (LR), SVM, and Naïve Bayes for detection of PD. The best result achieved by Decision Tree and Random Forest (RF) classification methods. The data mining techniques may be a more popular in many field of medical, business, railway, education etc. They are most commonly used for medical diagnosis and disease prediction at the early stage. The data mining is employed for healthcare sector in industrial societies.

Mosarrat Rumman et al. based on Image Processing and Artificial Neural Network (ANN) classification algorithm According to ANN prediction, if value closer to 1 then suggests PD and value closer to 0 then suggest normal. Parkinson disease is a global public health issue. Machine learning technique would be a best solution to classify individuals and individuals with Parkinson's sickness (PD). This paper gives an entire review for the forecast of Parkinson disease by utilizing the machine learning based methodologies. A concise presentation of varied computational system based methodologies utilized for the forecast of Parkinson disease is introduced. This paper likewise displays the outline of results acquired by different scientists from accessible information to predict the Parkinson disease.

Shail Raval et al. For the detection of PD they include all the aspects such as biological data, chemical data and genetic data. In this paper they mainly focused on the symptoms like rigidity, Tremor at rest, changing voice etc. The

secure data transmission is proposed through authentication check, duplication check and faulty node detection. The proposed method is applicable to long ranges of transmission. It is also supporting a retransmission concept.

Zehra Karapinar Senturk et al. proposed the algorithms to detect PD like support vector machine (SVM), Classification and Regression Tree (CART). It provided about 13% performance improvement for SVM, about 11% for ANN, and about 5% improvement for CART. The result shows that Naive Bayes and decision tree (j48) yield better accuracy when performed upon the discretized PD dataset with cross-validation test mode without applying any attributes selection algorithm.

Satyabrata Aich et al. According to this Random Forest (RF) gives more accuracy. This analysis will help the clinicians to differentiate the PD group from healthy group based on the voice data. CNN's, also referred to as ConvNets, contains multiple layers and are mainly used for image processing and object detection. Yann LeCun developed the primary CNN in 1988 when it had been called LeNet. It was used for recognizing characters like ZIP codes and digits.

Timothy J. Wroge et al. used Extra Tree and gradient boosted Decision tree classification algorithms are used to detect variations in voice. LSTMs are a kind of Recurrent Neural Network (RNN) which will learn and memorize long-term dependencies. Recalling past information for long periods is that the default behavior.

Rajalakshmi Shenbaga Moorthy et al. used to novel analytic system for Parkinson's disease Prediction mechanism using Improved Radial Basis Function Neural Network (IRBFNN). RNNs is during a one among the deep learning models that are used for modeling the arbitrary length sequences by

applying a transition function to all or any it's hidden states during a recursive manner.

Rahul R. Chakre et al. According to the hybrid approach, which is a combination of supervised and unsupervised techniques, is also beneficial for classification and feature extraction. Support vector machine is employed as the supervised technique for classification, and ICA is used as unsupervised technique for the feature extraction in multiclass data set.

Rahul Ramesh Chakre et al.According to the field of medical diagnosis, bio-inspired computing is also a novel technique. Swarm intelligence and immune computing algorithms, two major subsets of bio-inspired computation, are presented for a wide range of issues. [2]

Existing System

In existing system, PD is detected at the secondary stage only (Dopamine deficiency) which leads to medical challenges. Also doctor has to manually examine and suggest medical diagnosis in which the symptoms might vary from person to person so suggesting medicine is also a challenge. Thus the mental disorders are been poorly characterized and have many health complications. PD is generally diagnosed with the following clinical methods as,

- MRI or CT scan - Conventional MRI cannot detect early signs of Parkinson's disease
- PET scan - is used to assess activity and function of brain regions involved in movement
- SPECT scan - can reveal changes in brain chemistry, such as a decrease in dopamine

This results in a high misdiagnosis rate (up to 25% by non-specialists) and many years before diagnosis, people can have the disease. Thus existing system is not effective in early prediction and accurate medicinal diagnosis to the affected people, and immune computing techniques are proposed for the classification. [3]

Reference

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[3] Anitha R1, Nandhini T2, Sathish Raj S3 et al. Early Detection of Parkinson's Disease Using Machine Learning