Parkinson's Disease Detection Through Voice Pattern Analysis

A project proposal in CMSC 191: Machine Learning

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a. The Problem

The diagnosis of Parkinson's Disease (PD) is commonly based on traditional medical observations. This includes the characterization of a variety of motor symptoms. However, the traditional approach of diagnosis can be subject to misclassification as there are details that are sometimes too subtle for humans to notice[1][2]. Recent developments in the field of Neurology.and Machine Learning paved the way to a more accessible mode of PD detection through the analysis of voice patterns.

For our final project, we want to show how studies about Parkinson's Disease detection can be done through Machine Learning. Specifically, we want to replicate the algorithm that was used in the study Parkinson's Disease Diagnosis Using Machine Learning and Voice[3] and use it on a selected dataset. If given the time, we could also attempt to improve the algorithm in order to achieve better results. We also want to address the problem associated with how PD diagnosis through voice pattern recognition only works when an expert is able to listen and recognize patterns. By being able to replicate the study on another dataset, we can provide more evidence that the research is valid. This way, we can introduce the idea to the medical community in the Philippines and hopefully, open an area of research with Filipinos as participants.

b. Why is the problem interesting from the application perspective?

There are currently no laboratory tests to diagnose Parkinson's Disease. Existing techniques purely depend on a medical professional's subjective diagnosis on a patient which involves detection of symptoms such as muscle stiffness, resting tremor, slowness of movement, and balance issues. This traditional method can identify PD with 90% accuracy, but takes 2.9 years in average to diagnose[3]. This proves to be a persistent problem in the medical community as PD is a long-term degenerative disorder and hence, early detection is necessary. Furthermore, in low-income and developing countries like the Philippines, the process is even more difficult.

According to several studies, 60% to 80% of patients diagnosed with PD experience speech-related irregularities such as reduced vocal loudness, harsh or breathy vocal quality and abnormal speaking rates[4][5]. This is where technology, in the form of Machine Learning, comes in.

Recent studies have shown that detection of PD can be done through the analysis of voice patterns[5]. By detecting anomalies in voice recordings of patients, medical practitioners are able to classify whether a patient has PD or not. The problem also allows us to delve into the improvement of telemonitoring services for patients suspected of having Parkinson's Disease. This means that even when there is no direct and physical contact between the patient and the health care provider, diagnosis for the disease can still be done.

c. Why is the problem interesting from the point of view of applying machine learning techniques?

Teaching a machine to detect the presence of a disease means automation. It is interesting because, given sufficient training, the machine can be faster and more capable, in terms of accuracy, in identifying PD than a human expert since the machine can be trained to detect the most subtle signs in voice patterns.

d. What data do you plan to use?

We plan to use a range of biomedical voice measurements from people with Parkinson's disease. The data is stored in a .data file, and is in ASCII CSV format, with 195 rows (+ 1 header row) and 24 columns. The rows of the file contain an instance corresponding to one voice recording. The column entries, or the data attributes, include vocal fundamental frequencies, measures of variation in fundamental frequency, and measures of variation in amplitude. The file has a size of 40 kilobytes[6][7].

e. How do you plan to get or collect the data?

The dataset will be obtained from an online archive. Specifically, from the UC Irvine Machine Learning repository.

f. What are the expected outcomes of the study?

The study aims to produce a working network that will be able to identify whether or not a person is likely to have PD from voice data, thereby improving the use of machine learning in detection and classification of the disease. Furthermore, we aim to open this area of study in the Philippines where diagnosis of Parkinson's Disease proves to be more of a challenge than its treatment.

g. Who can possibly benefit from the outcomes of the study?

Institutions for research and the medical community would benefit from the outcomes of the study.

Sources:

[1] Mei, Jie & Desrosiers, Christian & Frasnelli, Johannes. (2020). Machine learning for the diagnosis of Parkinson's disease: A systematic review.

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[6] Little, M.A., McSharry, P.E., Hunter, E.J. Spielman, J. & Ramig, L.O. (2008). Suitability of dysphonia measurements for monitoring of Parkinson's disease.

[7] Little, M.A., McSharry, P.E., Roberts, S.J., Costello, D.A.E., & Moroz, I.M. (2007). Exploiting nonlinear recurrence and fractal scaling properties for voice disorder detection.