Chapter 6
Early Detection of Parkinson's Disease for Developing a Predictive Model Using Biomedical Voice Data

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ABSTRACT

The quality of life of every patient suffering from Parkinson's disease is significantly hindered by tremors, muscle rigidity, and other symptoms of general backed-up stages of the disorder. Early detection in some instances has improved treatment, leading to higher quality of living. This study aims to devise a predictive model utilizing biomedical voice data to allow for early diagnosis of Parkinson's disease. By studying voice signals and extracting crucial features from them, the model will seek to discover factors that can be traced to the disease. Findings from this study would aid in initiating early and necessary interventions towards furthering treatment and provide insights into the role of voice-based biomarkers for the diagnosis of other neurological diseases.

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1. INTRODUCTION

PD is a neurodegenerative disorder characterized by progressive impairment due to motor symptoms like tremor, rigidity, and bradykinesia, among others, and also non-motor symptoms such as speech impairments. The early diagnosis of PD is an important stage toward timely interventions that can decelerate disease progression and improve quality of life for patients.

Recent breakthroughs in machine learning have enabled the development of predictive models that can analyze biomedical voice data for early signs of PD. Voice impairments are among the early signs of PD, and hence, voice analysis is a non-invasive, cost-effective tool for early diagnosis. Several studies have demonstrated that ML algorithms can classify PD patients from voice recordings with high accuracy. For instance, one of the studies, which applied voice samples pre-processed by ML methods, reported very good results in distinguishing PD patients from healthy controls. Furthermore, deep learning approaches integrated with voice analysis have also shown great promise for improving early detection of PD. Several studies using multimodal deep learning approaches have reported increased accuracy in the identification of prodromal stages of PD by combining multiple data modalities including voice . In another work, the authors presented a deep learning-based system for the prediction and monitoring of PD by using voice data, underlining the potential of such technologies in non-invasive diagnostics (Garcia and Hertel, 2023).

Other than the fact that predictive models using biomedical voice data enable early detection, they also offer a scalable solution for wide screening. With the growing prevalence of PD worldwide, leveraging ML and voice analysis is an exciting avenue for early diagnosis and better patient outcomes. This research, therefore, has the aim of identifying a predictive model, utilizing biomedical voice data, that will be able to diagnose the presence of Parkinson's disease. We will try to discover distinctive vocal biomarkers linked to the onset of PD through advanced machine learning analysis of voice recordings. We wish to contribute to the development of non-invasive diagnostic means for early intervention and management of PD.

This study will focus on developing a predictive model that will make early detection of the disease possible using biomedical voice data. This project makes use of a Parkinson's Disease Dataset found in Kaggle, consisting of 1,195 samples and 24 features, mostly voice-related measures. The dataset is cleaned; EDA and preprocessing are done to make further analysis appropriate and reliable (Hazan et.al, 2019).

It includes feature analysis to identify relevant voice biomarkers, construction of predictive models using machine learning techniques, and validation of the models to optimize their accuracy. Feature importance ranking and predictive modeling

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