

# Chapter 14

## Early Parkinson's Disease Diagnosis Using Multi- Modal CASENet CNN-LSTM

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### **ABSTRACT**

*By analyzing the deviation of features earlier stages can be segmented with subtle patterns in patients' handwriting dynamics and voice recordings, this innovative method showcases deep learning's potential to revolutionize medical diagnostics. By applying Casenet convolutional neural network framework, a hybrid architecture incorporating CNNs and improved long short-term memory networks is implemented using Kaggle datasets, which excels in spatial feature extraction from handwriting features with individual cases. while LSTM captures temporal patterns from voice recordings. Demonstrating a robust 94.6% accuracy rate, the model proves its effectiveness in Parkinson's disease prediction in earlier stages that can support complete diagnosis. Model assessment includes precision, recall, and F1-score evaluations using Principal Component Analysis (PCA) by integrating the Casenet CNN framework to enhance the diagnosis system and reliable accuracy that can predict early detection of Parkinson's disease from multimodal data.*

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## **INTRODUCTION**

Utilizing handwriting and voice documents as potential indicators, deep learning aids in the diagnosis of Parkinson's disease. Pen pressure, pace, as well as stroke patterns are among the fine motor skill details that deep learning algorithms record for handwriting analysis. The models identify variations in pitch, rhythm, as well as other acoustic characteristics associated with Parkinson's symptoms in voice recordings (Mohaghegh et al. 2021). The accuracy of diagnosis is improved by combining all of these multimodal sources of data. Deep learning models that have been trained on a variety of datasets detect minute patterns that point to the illness, enabling early diagnosis and treatment. Generalizability is guaranteed by validation on different datasets. Applications for real-time monitoring enable people to capture and examine their speech and handwriting, enabling ongoing health evaluation. In order to handle privacy issues, ethical issues, and regulatory compliance, deep learning is potentially useful to improve accuracy of PD diagnosis as well as provide timely insights for efficient patient treatment. This can be achieved through collaboration with healthcare experts (Saravanan et al. 2022).

Followed by Alzheimer's disease, PD which stands for Parkinson's disease is the second most prevalent highly progressing neurological illness (Loh et al. 2021). Using voice recordings and handwriting, techniques from artificial intelligence are utilized for creating a system to perform diagnosis of this disease. DL stands for Deep learning is an artificial intelligence application that allows computers to learn without explicit programming. Intelligence of humans is imitated with the help of learning processes done from the history of data available. The applications of deep learning includes recognition of text, retrieval of information, analysis of market as well as healthcare and so on.

## **Parkinson's Disease**

Parkinson's disease remains a neurological condition which gets worsens as time passes by and affects an individual in case of motor function. The disorder, named for Dr. James Parkinson, was first reported in 1817. It is illustrated by an ongoing decrease of neurons that produce dopamine in the brain. One neurotransmitter that is essential for coordinating smooth muscular actions is dopamine. Patients have a variety of symptoms that are motor as well as non-motor as illness worsens. The symptoms for Parkinson's disease were described (Moises et al. 2021).

Resting tremors are important for identifying PD that typically affect hands, fingers, or other areas of the body when at rest. When moving with purpose, these tremors usually lessen or disappear. The term "bradykinesia" describes a slow pace of motion. The capacity to start and finish actions gradually declines for patients affected by this disease, which causes daily tasks to slow down overall. Muscle rigidity or stiffness is a common symptom of PD (Ayaz et al. 2023). It causes pain or discomfort in many places of patient's body. Such patients find it difficult to maintain their posture and balance, which increases their risk of falling.

Affected motor control and coordination makes it difficult to do jobs requiring precise motions, such as buttoning shirts or writing. Parkinson's disease impairs the muscles used for swallowing and speaking, which results in a lower voice, monotone speech, including severe swallowing issues. Memory loss, focus problems, as well as executive dysfunction constitute the cognitive impairments which certain patients encounter. Anxiety and depression are prevalent mental health problems among Parkinson's disease patients.

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