

# Voice Signal Processing and Machine Learning for Parkinson's Disease Detection

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**Abstract:** Early vocal deficits manifest quite insidiously as a rather debilitating side effect of Parkinson's disease a chronic neurodegenerative illness affecting motor activities largely. Voice pattern analysis provides a useful opportunity for early non-invasive diagnosis since changes in voice often occur before overt symptoms appear. Recent advancements in artificial intelligence and machine learning have made automated PD identification using vocal biomarkers a tantalizing prospect suddenly. Machine learning techniques utilized in voice-based Parkinson's disease detection are thoroughly analyzed here with significant findings presented in this work. Voice recordings are leveraged for data collection then preprocessing techniques are employed heavily to standardize and clean input data thoroughly. Feature extraction methods including jitter shimmer pitch and Mel-Frequency Cepstral Coefficients highlight pertinent voice traits pretty effectively under certain conditions. Accuracy of classification models such as Support Vector Machines and k-Nearest Neighbors and Deep Neural Networks in recognizing PD patterns gets assessed rigorously. Current issues like data variability small datasets and real-world implementation problems are also thoroughly covered in this particular review. It concludes by outlining potential future options such as incorporation of deep learning models and bigger voice datasets alongside mobile-based health applications..

**Keywords:** Parkinson's Disease, Voice Analysis, Machine Learning, Feature Extraction, Neural Networks, Support Vector Machine, Early Diagnosis, Biomedical Signal Processing, Healthcare AI

