STRiDE: A Real-Time Gait Tracking System for Early Parkinson's Disease Assessment Using Spatiotemporal Analysis of Ground Reaction Forces

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Parkinson's disease (PD) is a chronic neurodegenerative disorder affecting over 10 million people worldwide. Gait impairments are a key indicator of brain-body dysfunction in PD. However, early motor symptoms, such as stride length asymmetry, often go undetected. Current clinical methods, such as the Hoehn & Yahr scale, are costly, time-consuming, and subjective. As a result, early diagnoses are frequently missed, leading to increased disability and delayed intervention. To address these challenges, we developed STRiDE, an interpretable, accurate, affordable, and scalable framework for assessing PD severity through motor behavior. Using ground reaction force (GRF) data, we extracted spatiotemporal gait features and analyzed their correlation with PD. We found that the center of pressure reliably reflects PD motor symptoms and is not sensitive to individual variability. To enhance classification accuracy, we created a novel spatiotemporal Generative Adversarial Network (ST-GAN) using Gramian Angular Field images derived from gait features. The model achieved 98% accuracy, outperforming state-of-the-art models. We then developed a low-cost wearable system utilizing force sensitive resistors and Arduino hardware to collect real-time GRF data. We integrated the ST-GAN model with sensor-based gait data into a comprehensive web application that provides gait visualizations and evaluates PD severity, enabling continuous monitoring and early diagnosis beyond clinical settings. By translating early neurological decline into measurable motor behavior, STRiDE enables proactive and personalized PD care. STRiDE sets a new standard for gait assessment in neurodegenerative and movement disorders, with broad applicability in physical therapy and neurological conditions such as autism.

Awards Won: