GaitNet: A Medically Interpretable Video-Based System for Assessing Parkinsonian Gait Impairment Severity Using 2-Stream Spatiotemporal Neural Network

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Parkinson's disease (PD) affects millions of people worldwide and causes gait impairments like tremors. Accurate motor impairment assessment is critical for efficient PD management. The MDS-UPDRS rating scale is the gold standard for evaluating PD motor disorders in clinics, but its manual evaluations are subjective and sometimes ineffective. Alternative methods like wearable sensors are expensive. This research presents a groundbreaking framework for PD gait impairment severity assessment that is accurate, quantitative, and accessible. First, I developed a novel neural network that, for the first time, extracts spatiotemporal features from 3D skeletons and silhouettes to evaluate gait disorders, achieving 91% sensitivity and outperforming state-of-the-art models. To build trust with physicians, I am the first to derive saliency values to pinpoint body regions and joint points that account for model decisions. The highlighted areas correspond to clinical observations of regions most affected by PD, helping physicians identify subtle gait changes in patients. Furthermore, I comprehensively evaluated 21 specific gait attributes defined by the MDS-UPDRS standard and identified parameters, including step length asymmetry, that are statistically correlated with PD gait impairment. Continually measuring these attributes supplements the discrete MDS-UPDRS ratings, significantly improving physicians' abilities to achieve precise diagnoses. Finally, I created a low-cost web application that utilizes videos to generate PD gait impairment diagnosis results at home. This system bridges the gaps between AI methods and PD care by enabling PD early detection, personalizing treatment plans, and monitoring disease progression. It can easily extend to other gait disorder diseases.