ParkinAid: A Multimodal AI-Powered Diagnostic and Robot-Assisted Rehabilitation System for Parkinson's Patients

Han, Liyang (School: Brookfield Central High School)

Parkinson's disease (PD) is the second most prevalent neurodegenerative disease. Early diagnosis and efficient rehabilitation are critical, while current methods of in person clinical consultation and imaging scanning are time-consuming, expensive, and hardly accessible, and existing rehabilitation devices often fail to adapt to patient's condition. To address these limitations, we propose ParkinAid, an integrated system with AI-powered diagnostics and robot-assisted rehabilitation device that provides a multimodal platform for PD diagnosis and rehabilitation. ParkinAid diagnoses by utilizing machine learning models to evaluate a total of 18 PD features based on gait behaviors, hand tremor, speech patterns, and hand tremor sensor readings. Computer Vision and NLP models are deployed for feature extraction, and Neural Networks are deployed for data analysis. ParkinAid predicts PD index scores based on UPDRS criteria and performs binary diagnosis. The rehabilitation unit, constructed with EPM structures, assists finger movement training, addressing stiffness and tremors. It incorporates flex sensors, pressure sensors, and accelerometers to provide real-time feedback regarding the motor functions. Moreover, the rehab unit utilizes sensor data to optimize and personalize rehabilitation exercise and tracks the rehabilitation progress and effectiveness over time. ParkinAid demonstrates high accuracy and reliability. The AI-based diagnosis features are verified under both late and early-stage patients datasets and achieve an average of 92% accuracy; the rehabilitation module is tested under various scenarios and effectively assist with hand movement. ParkinAid provides an affordable, accessible, and portable solution for early diagnosis and rehabilitation for PD patients.

Awards Won: