GaitGuardian: Real-Time Freezing of Gait Prediction and Progression Analysis for Parkinson's Disease

Bankapur, Viren (School: Independence High School)

Over 10 million people worldwide are diagnosed with Parkinson's Disease (PD), a neurodegenerative disorder significantly impacting daily life. Freezing of Gait (FoG), affecting around 80% of advanced PD patients, is a severely disabling symptom where individuals are temporarily unable to move, leading to an increased risk of balance loss and falling. In response to these challenges, especially in underdeveloped areas with minimal access to proper treatment, GaitGuardian, composed of FoG prediction, fall detection, and PD progression analysis, was deployed onto a Raspberry Pi, offering an accessible and low-cost solution for improved quality of life. First, for the FoG prediction component, a machine learning ensemble model, reaching 99.87% accuracy, was trained on angular features extracted from the Daphnet dataset consisting of real-time sensor data from 10 PD patients, to detect FoG periods 2 seconds before their occurrence and play an auditory cue to reduce the severity of FoG periods. Next, for fall detection, an XGBoost model, reaching 99.76% accuracy, was trained on features from the SisFall dataset containing sensor data from young and elderly individuals, and was paired with an emergency contact feature. Finally, for PD progression, two Random Forest Regressors, with R-squared values of 97.7% and 97.4%, were trained on vocal features from the Oxford Parkinson's Disease Telemonitoring Dataset to predict separately total and motor Unified Parkinson Disease Rating Scale (UPDRS) scores as PD progresses. Overall, GaitGuardian can predict FoG, detect falls, and analyze the progression of PD while outperforming state-of-the-art models, demonstrating its beneficial impact on PD patients.

Awards Won:
Fourth Award of $500
The University of Texas at Dallas: Scholarship awards of $5,000 per year, renewable for up to four years