FoGDTECT: A Novel Non-Invasive Freezing of Gait (FoG) Monitoring Solution Integrating Machine Learning and Mobile App Accelerometer Data

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This revolutionary solution uses multivariate machine-learning time-series models to detect freezing of gait (FoG) instances in individuals with Parkinson's disease (PD) based on accelerometer data from a smartphone. One of the most profound symptoms of PD, FoG manifests as abrupt episodes of walking hesitation or immobility and impairs a patient's balance, increases falls, and reduces overall quality of life. This study compares the performance of various machine learning models on a FoG-accelerometer dataset, and optimizes a model to accurately detect and plot instances of FoG in real individuals based on mobile-app-generated accelerometer data. Performance was evaluated using standard ML model metrics, and graphs of detected FoG instances were validated by Balance Disorder Lab Engineers at OHSU. Results highlight that the LSTM with Attention Mechanism had the best performance, with an accuracy of 0.875, precision of 0.602, recall of 0.495, and F1 score of 0.818. The uniqueness of this solution involves the ease of implementation of these models by fitting them to accelerometer data collected from a smartphone, achieving an average accuracy of 0.809. After optimizing the data collection and processing by creating an Android app, the model was able to successfully detect and graph FoG events corresponding to timestamps with an industry-grade average accuracy of 0.809. The efficacy of this model highlights the potential to become a non-invasive long-term monitoring solution for individuals with PD. This can lead to proactive management, personalized treatment plans, and enhanced safety through real-time feedback, to minimize the risk of falls associated with FoG.