TDI Capstone Project 2 - XEED Parkinson's Disease Resting Study

Our primary objective is to passively monitor and identify "ON", "OFF", and dyskinetic (DYS) states of patients in their work and home environments. Current methods of assessing patient performance outside the clinic includes recounts from memory, patient diaries, and projections based on clinical performance. The states can be deduced by a trained physician based on the severity of parkinson's symptoms such as tremors, dyskinesia, and bradykinesia therefore it is our hypothesis that a strategically placed sensor is able to track them as well. ON is characterized by fluid, controlled movements, OFF by tremors and jerky movements, and DYS by "dance-like" or wandering movements.

Current methods of assessment involve having patients perform key activities in a controlled environment under the supervision of physicians. This however gives inaccurate results as parkinsonian symptoms can be controlled when thinking consciously about the movements resulting in an inaccurate evaluation of the patient's current state. XEED has partnered with physicians at Penn Medicine to develop passive wearable studies that can be used to evaluate new therapies and drugs for pharmaceutical companies and research groups.

There will be an XEED device on each wrist and each ankle that will collect unix time accurate to the second with real world time, acceleration in the X,Y, and Z directions with +/- 1 mg resolution, and orientation with accuracy of +/- 3 degrees in Roll and Pitch, and +/- 5 degrees in Yaw. The orientation is self correcting and referenced to the earth's magnetic field and gravity. The device itself performs calculations at 1024 samples/second however the data collected is at intervals of 32 samples/second. This ensures that the 32 samples/second contain the accuracy of the 1024 samples/second without draining the battery.

The resting study consists of two phases: (1) resting recognition phase and (2) state determination phase. Resting, defined as near zero acceleration, was chosen as a key activity in determining patient states because it is an easily identifiable activity that is performed multiple times throughout the day subconsciously. Even though only 70% of PD patient's experience resting tremors during the onset of the disease, it is a key symptom used in evaluating the severity of the disease. The first goal of the capstone project is to take streams of data from the XEED devices and create a method to reliably identify the times during which resting occurred. This must be done for both healthy and PD subjects. There is no requirement towards analysis type (eg. statistical) or tools used (eg. python). Once resting is identified, Phase 1 will be complete.

Phase 2 will require differentiating resting features between healthy subjects and PD subjects if any. These features should be instrumental in determining the patient's ON, OFF, or DYS state. A wide range of PD resting data and control resting data will be provided to account for variability across people, gender, body sizes, and time of day. Medication data and United Parkinson's Disease Rating Scale (UPDRS) data will be provided when available for intra-person comparisons and to avoid false positives. If an accurate state determination can be reached within the scope of the project, the next step will be identifying the UPDRS score that corresponds to the resting pattern.