Cepha: An End-to-End Self-Diagnostic Platform for Parkinson's Disease Utilizing Smartphone Sensor Data and Ensemble Machine Learning Methods

Ayyagari, Nitya (School: Amador Valley High School)

Although Parkinson’s Disease (PD) is the fastest-growing leading cause of disability, 25% of patients are either misdiagnosed or diagnosed after severe neurodegeneration has already occurred. Thus, the development of a fast, accurate, and cost-effective end-to-end diagnostic tool is critical. The only symptoms prevalent in onset PD and quantifiable using smartphone sensors are dysphonia and tremor, making them ideal biomarkers. To collect data for these biomarkers, 500 PD and non-PD patients rested their hands in their lap/maintained postures twice on each side of the body while holding their device. Likewise, 50 PD and non-PD patients recorded sustaining phonation of the short a (a) vowel. After introducing random perturbations to augment the sample size, 33 features were extracted from 1100 data points. An ensemble model comprising a CoreML classifier and a Decision Trees classifier was then built utilizing the discovered features. The algorithm achieved a mean accuracy of 98% and was implemented into a freely-accessible mobile application that tests for PD in under 5 minutes. Diagnoses are segmented into 5 classes; each class evaluates the severity of users’ symptoms and correlates with a value on the UPDRS. This gives users more insight than a binary diagnosis and allows for easy integration of the diagnostic tool into a clinical setting, a method never proposed before. This novel multimodal architecture is the first to couple testing for dysphonia with tremor, boosting prediction accuracy by providing the user with a holistic diagnosis, rather than testing for a single symptom (dysphonia).

Awards Won: