A Novel, Telemedicine Diagnosing and Monitoring Tool for Parkinson's Disease: The Use of Digital Action Unit Biomarkers Generated by Spontaneous and Posed Facial Expressions

Smith, Erin

Parkinson’s disease (PD) diagnostic methods are hindered by lack of validated biomarkers, or objective indicators of disease onset. Clinical symptoms occur when up to 60% of dopamine neuronal markers are depleted, which is often 20 years after disease onset. The development of a novel, cost-effective diagnostic tool is especially critical as prevalence of PD is experiencing rampant growth globally. Amygdala pathology occurs up to 10 years before current PD diagnostic hallmarks, and may implicate spontaneous and posed facial expressions. To elicit spontaneous and posed responses, 265 PD and non-PD patients watched Super Bowl commercials and replicated a series of emoticons while their faces were recorded by a webcam. 1325 facial response videos were collected and broken down into 33 facial muscle Action Units (AUs) using facial recognition software. The data was then mined in R to determine if significant differences emerged. The AUs with the highest predictive power, as defined by lowest Gini impurity and cost-complexity > 0.01, were identified as PD biomarkers and included differences in smile and eyebrow muscle contractions. Diagnostic algorithms and random forest models for each video test were then built utilizing the discovered biomarkers. Blind testing occurred to determine the sensitivity and specificity for each algorithm. The diagnostic models utilizing spontaneous AUs achieved an accuracy of 87%. The developed diagnostic tool eliminates the requirement of expensive infrastructure, and instead utilizes the discovered biomarkers to provide a novel, objective approach to PD diagnosis that will aid in the development of pathogenesis-targeted therapeutics.

Awards Won:

Intel ISEF Best of Category Award of $5,000

Intel Foundation Cultural and Scientific Visit to China Award

Association for the Advancement of Artificial Intelligence: First Award of $1,500