FacePrint: A Novel, Differential Diagnostic and Monitoring Tool for Parkinson's Disease, Essential Tremor, and Atypical Parkinsonism Using Facial Behavioral Biomarkers and Dynamic Video Footage Tracking with Machine Learning

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A novel diagnostic tool was developed that identified and digitized facial changes that differentiate Essential Tremor (ET) and Parkinson's disease (PD) patients with 99.9% accuracy as compared to already diagnosed patients. 69 patients diagnosed with PD, ET, atypical parkinsonism, and healthy control subjects watched video clips and replicated emoticons. A webcam recorded their faces, collecting 621 facial response videos. The footage was broken down at 14 frames-per-second (fps) for 34 facial landmarks known as Action Units (AUs) using automated facial coding software. To identify AUs that are behavioral biomarkers between PD and ET patients, a three-layer feature selection framework was used, consisting of a Pearson's correlation redundancy filter layer, a Boruta algorithm wrapper layer, and a Regularized Random Forest algorithm embedded selection layer. The facial features were used to train decision tree and Random Forest models. Model performance was obtained using 3 metrics for out-of-sample datasets: classification accuracy, sensitivity, and specificity. The Doritos "Middle Seat" Spontaneous Facial Expression Test decision tree model and the Resting Face decision tree model achieved the highest accuracies of 99.9% compared to already diagnosed patients between PD versus non-PD, ET versus non-ET, and PD versus ET. Additionally, the developed models accurately captured early stages of PD and predicted that a prodromal patient has ET. The biomarker identification pipeline and machine learning diagnostic algorithms from facial observations provide clinicians with an objective artificial intelligence system for differential diagnosis and monitoring of PD and ET.

Awards Won:
First Award of $5,000
American Statistical Association: First Award of $1,500
Samvid Education Foundation: Agni Second Place Award of $500