PoDE - A Platform Leveraging Characteristic Time Series Patterns of Oculomotor Control Attributable to Cholinergic Neuron Destruction in the Parietal Lobe, Indicating Early Alzheimer's Disease Utilizing the PoDE Neural Network

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Late-stage diagnosis in over 90% Alzheimer's Disease (AD) patients worldwide often occurs at the 5th stage, significantly reducing life expectancy to an average of 5-6 years. Current screening methods are limited to urban hospitals, depending on human interventions by neurologists (1:37,000 at-risk population). Notably, AD primarily affects "Cholinergic Neurons" in the Parietal lobe, impairing oculomotor control which can serve as a potential early biomarker for AD. To improve accessibility and early-stage recognition, we developed a cutting-edge self-rapid AI platform, PoDE-NN, for screening early-stage AD. This platform uses an eye-tracking system to collect eye-characteristic time series data (position, height, gaze-position) during 5 eye assessments. It incorporates an Undetected Variance Minimizing algorithm to enhance self-collected data and PARNN for data augmentation, addressing imbalanced datasets. PoDE-NN's novel architecture combines Transformer Encoder, CNN for feature extraction, and ANN for data flattening and analysis, by integrating time series algorithmic components of each AI above to configure eye-characteristic data enhancing processing performance. This configuration achieved 95.33% accuracy and a 95.39% F1 score. Validated through a retrospective clinical trial, PoDE-NN demonstrated 93% accuracy, was nine times faster than existing method, and capable of detecting AD from its 3rd stage, potentially reducing progression by sevenfold. This system reduces costs and screening delays while increasing speed and capability, ensuring timely prevention for patients. PoDE-NN exemplifies a bench-to-bedside approach, offering remote access and serving as a pioneering prototype for diverse time series analysis in medical fields and far-reaching implications.