BaymaxGPT: Employing Speech for Early and Automated Diagnosis of Neurodegenerative Disorders (Parkinson's Disease) Using a ChatGPT-Based Deep Learning Architecture

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There is currently no definitive screening method or test for Parkinson’s Disease (PD), the second most prevalent neurodegenerative disorder with over 10 million cases worldwide and 1 million new diagnoses per year. Instead, diagnosticians rely on a holistic picture of multimodal data, including neuroimaging, physical and cognitive function testing, and years of longitudinal clinical assessments to make an informed prediction. This evaluation for PD is a lengthy, expensive, and still inaccurate process that is frequently only employed by patients after advanced symptoms have already presented. As a result, the current process results in a low diagnostic accuracy and missed opportunities for early diagnosis and pathophysiological treatment that stymie the progression of the disease. In order to establish a screening method for PD, I show that speech recorded on a cellphone can be used as a classifiable biomarker of the disease. I demonstrate two methods for the automated diagnosis of PD: the first method uses spontaneous speech to detect linguistic and semantic differences (aphasia and amnesia), and the second method uses read-out speech to detect acoustic differences (dysarthria) through a linguistic representation of acoustic features. Each approach employs a linguistic-based deep learning architecture leveraging the transformer encoder Wav2Vec for automatic speech recognition, and ChatGPT for contextualized vector representations (text embeddings), which capture lexical, syntactic, and semantic properties. This research presents the foundation of a low-cost, at-home, and widely accessible test for diagnosing PD. It also demonstrates pipelines that can be used to diagnose any disease with presentations of aphasia, dysarthria, or amnesia, including Alzheimer's and ALS.