DEVELOPING THE DEEP LEARNING METHOD IN ORDER TO ASSIST THE DETECTION OF PARKINSON'S DISEASE PREPAREDNESS: A SURVEY

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Abstract— Parkinson's Disease (PD) is a challenging neurological condition characterized by the degeneration of dopamine-producing neurons. Precise diagnosis and monitoring play a vital role in effective management. This study proposes a novel pattern recognition method employing the Inception V3 model in MATLAB to analyze DaTscan brain images, a standard tool for assessing dopamine levels. This approach categorizes images into four PD stages: Normal, Initial, Moderate, and Severe.

A diverse DaTscan image dataset underwent meticulous processing, involving standardization and quality enhancement for robust model training. Fine-tuning the Inception V3 model resulted in an impressive 96% accuracy in image categorization, showcasing the possibility of deep learning in non-invasively detecting subtle PD-related changes.

The incorporation of this technology offers clinicians invaluable support, assisting in treatment decisions and enabling early diagnoses for timely interventions. This progress significantly contributes to elevating Parkinson's Disease management and, subsequently, enhancing the overall quality of life for patients

Keywords— Machine Learning, Deep Learning, Early Detection, K-Nearest Neighbors, Random Forest.

I. INTRODUCTION

Parkinson's disease, a progressive neurodegenerative disorder, adversely impacts the central nervous system, in a spectrum of both motor and non-motor manifestations. Named after the 19th-century physician James Parkinson, The fundamental cause of the disorder stems mainly from the depletion of neurons responsible for producing dopamine in the brain. As these neurons degenerate, individuals with Parkinson's experience difficulties in movement, tremors, and other associated challenges. Despite extensive research, a definitive cure remains elusive, emphasizing the outcomes of continued exploration into effective management and potential therapies. Parkinson's disease (PD) is characterized by the gradual decline of dopamine levels within the human brain. The resultant effect on the basal ganglia, a key center for movement and coordination, gives rise to different incapacitating symptoms, including tremors, slowed movement (Bradykinesia), impaired balance, muscle stiffness, and alterations in speech.

Detecting PD poses a significant clinical hurdle due to the absence of definitive diagnostic tests, often resulting in delayed identification, hindering effective management strategies. Early detection is pivotal in mitigating PD's progression and managing its symptoms. Recognizing subtle indicators, such as micrographia - the characteristic diminution in handwriting associated with finger tremors - holds promise as a possible early marker for PD. However, leveraging traditional diagnostic approaches remains insufficient. the inclusion of deep learning methodologies has revolutionized disease detection paradigms. CNN, renowned for their adeptness in pattern recognition across various domains, have showcased remarkable efficacy in classifying different data types, from images to audio. Their adaptability and superior performance, particularly through transfer learning - the incorporation of pre-trained models - present a compelling avenue for PD diagnosis leveraging handwritten data. Harnessing the of deep learning, specifically employing The model known as Inception V3 in MATLAB, our research endeavors Employing Inception V3 for the automated extraction of intricate DaTscan image features. Inception V3's well-demonstrated capability across various computer vision tasks makes it an excellent choice for categorizing DaTscan images into distinct PD stages: Normal, Parkinson Disease early Stage, Mid Stage, and final Stage. Our research dataset comprises a comprehensive collection of DaTscan images obtained from patients representing various PD stages. Thorough preprocessing techniques were methodically used to prioritize and improve image quality,essential for effective model training. Following this, fine-tuning the Inception V3 model aimed to detect subtle disease-related patterns and features within the dataset. This innovative study holds substantial promise, offering a non-invasive, objective approach to assess PD progression via DaTscan images. Implementing this technology in clinical settings could greatly support clinicians in decision-making.

II. LITERATURE SURVEY

The literature survey conducted for this study is summarized in a tabular format, providing a comprehensive overview of relevant research works. The table encompasses crucial details such as the name of the study, author(s), publication year, research objectives, and key advantages and disadvantages identified in each work.

Title	Authors	Year	Objectives	Advantages	Disadvantages
Addressing voice recording replications for Parkinson's disease detection	Lizbeth Naranjo , Carlos J. Pérez , Yolanda Campos-Roca , Jacinto Martín	2015	It underscores the capacity of voice biomarkers in disease diagnosis and the growing enthusiasm for expert systems in medical diagnostic processes. The difficulty in precisely identifying early-stage PD because of subtle symptoms emphasizes the need for more objective diagnostic tools.	Scientific Rigor: The paper addresses the limitations of existing methods that treat dependent data as independent. It highlights the need to model within-subject dependence, contributing to more accurate classifications.	Real-world Implementation Challenges: While the paper discusses the theoretical advancements, translating this expert system into real-world applications, especially on mobile platforms, might pose technical challenges and require further development and validation.
High-Accuracy Detection of Early Parkinson's Disease through Multimodal Features and Machine Learning	R . Prashantha, Sumantra Dutta Roya, Pravat K. Mandal b,c, Shantanu Ghosh	2016	1.aims to improve early Parkinson's disease (PD) diagnosis using non-motor indicator like sleep Behavior Disorder and key biomarkers. 2.Utilizing machine learning classifiers, including SVM, the study successfully distinguishes early PD subjects from healthy individuals for timely intervention.	1.Timely Intervention: Enables early neuroprotective measures before substantial dopaminergic neuron loss. 2. Comprehensive Approach: Integrates non-motor features, CSF measurements, and imaging markers for a robust preclinical PD diagnosis.	1.The reliance on machine learning classifiers may introduce complexity and potential overfitting challenges in real-world application. 2.The study's performance may be influenced by the specific dataset used (Parkinson's Progression Markers Initiative), raising questions about generalizability to diverse populations.
Advanced Machine Learning Approaches for Predicting Clinical Outcomes in Parkinson's Disease	Chao Gao, Han Sun, Tuo Wange, Ming Tange, Nicolas I. Bohnen, Martijn L. T. M. Müller , Talia Herman, Nir Giladi , Alexandr Kalinin , Cathie Spino	2018	1.Predict Falls in PD Patients: Develop accurate machine learning models to predict falls in Parkinson's disease patients. 2. Identify Key Predictors: Use controlled feature selection to pinpoint crucial predictors of falls, including gait speed, Hoehn and Yahr stage, and measures related to postural instability .	1.Comprehensive Approach: The study adopts a holistic perspective by integrating diverse data sources—clinical and demographic. 2.Advanced Analytics: Emphasis on cutting-edge machine learning techniques, especially model-free methods, enhances the precision.	1.Technical Complexity: The advanced language and terminology used may be challenging for individuals without a background in neuroscience or machine learning. 2.Lack of Specific Results: The information outlines the study's methodology and goals but lacks specific results, limiting the assessment of the research's impact.

Title	Authors	Year	Objectives	Advantages	Disadvantages
Parkinson's Disease Detection from Drawing Movements Using Convolutional Neural Networks	Manuel Gil-Martín ,Juan Manuel Montero,Rubén San-Segundo	2019	1.The paper focuses on utilizing a Convolutional Neural Network (CNN) to detect PD through analyzing drawing movements. 2. It uses a public dataset of spiral drawings procured from a digitized graphics tab.	1.Accuracy and Performance Improvement. 2.Non-Invasive and Easy Evaluation.	1.At times, it encounters challenges, mistakenly identifying actions such as shivering, handshakes as Parkinson's disease. 2.The system occasionally misinterprets non-Parkinsonian movements, leading to inaccuracies in its assessments.
Deep Learning-Based PD Classification Using Vocal Feature SetS	Hakan Gunduz	2019	IThe models are trained on a dataset sourced from the UCI Machine Learning repository and validated using a technique that involves leaving out one person during cross-validation. Due to the imbalanced class distribution within the dataset, evaluation metrics like F-Measure and Matthews Correlation were employed.	Improving PD Classification: The study's experimental results demonstrate the superiority of the proposed frameworks, especially the second one utilizing parallel convolution layers. These frameworks outperform single-layered CNN classifier.	Generalizability Concerns: The study lacks in-depth analysis regarding the potential generalization of the proposed frameworks to diverse datasets or real-world scenarios outside the specific dataset used through the UCI repository.
Early Detection of Parkinson's Disease Using Deep Learning and Machine Learning.	Wu Wang , Junho Lee , Fouzi Harrou	2020	This study employs a deep learning model to detect Parkinson's disease early by utilizing premotor features, including indicators like REM sleep Behaviour Disorder (RBD) and olfactory loss, along with Cerebrospinal fluid data.	This helps in an early detection of disease and time-consuming hand-crafted feature extraction.	1.This model fails to detect non -motor symptoms such as rapid eye movement, olfactory loss, cerebrospinal fluid data at a time compromising its reliability. 2. its current superiority over other methods may be contingent on dataset size and complexity raising concerns about generalizability
A Supervised Machine Learning Approach to Detect the On/Off State in Parkinson's Disease Using Wearable Based Gait Signals	Atyabrata Aich , Jinyoung Youn ,Sabyasachi Chakraborty Pyari Mohan Pradhan , Jin-han Park	2020	1. Detail focuses on gait analysis during "On" and "Off" states with signal and spatiotemporal features. List machine learning classifiers employed. 2. Contextualize the importance of Monitoring motor complication in Parkinson's disease (PD) and Highlight challenges	1.Provides a thorough introduction to the study, setting the stage for understanding the significance of monitoring motor complications in Parkinson's disease. 2.Clearly outlines the proposed algorithm for automatic detection of medication states, incorporating machine learning classifiers, offering transparency.	The study involves a relatively small sample size of 20 PD subjects, potentially limiting the generalizability of the findings to a broader population of Parkinson's disease patients

Title	Authors	Year	Objectives	Advantages	Disadvantages
PD Detection Based on Signal Processing Algorithms and Machine Learning	Atiqur Rahman , Aurangzeb Khan, Arsalan Ali Raza	2020	1.The paper highlights Parkinson's disease as a nervous system disease that affects speech, behavior, cognition, and other body functions. It emphasizes the prevalence of PD in the elderly and its impact on motor and speech functions. 2.Previous studies mentioned in the paper have used voice data to predict the progression of PD. The use of voice functions and features extracted from speech samples contributes to the development of diagnostic and monitoring systems.	1.State-of-the-Art Techniques: The study employs advanced signal processing algorithms like PLP and RASTA-PLP, which are recognized for their effectiveness in feature extraction from voice samples. 2. Classification Model Variance: Using SVM with four different types of kernels provides a comprehensive understanding of how different kernels perform in classifying Parkinson's disease useing voice samples.	1. Limited Detail on Feature Selection: While the study mentions using PLP and RASTA-PLP for feature extraction, it lacks specific details on why these methods were chosen or the exact features extracted. 2. Lack of Comparison with Existing Studies: While it mentions outperforming other methods in the literature, there's no explicit comparison or reference to these methods, making it challenging to validate the claim thoroughly.
An LSTM based Deep learning model for voice-based detection of Parkinson's disease	Danish Raza Rizvi, Iqra Nissar, Sarfaraz Masood, Mumtaz Ahmed, Faiyaz Ahmad5	2020	1.The aim of this research paper revolves around pioneering the use of advanced deep learning techniques, particularly Deep Neural Networks (DNN) and Long Short-Term Memory (LSTM) networks, to predict Parkinson's disease (PD). 2.This study not only showcases the efficacy of these deep learning approaches but also emphasizes their potential to outperform existing PD detection models based on voice analysis.	1.Remote Diagnosis Potential:The use of voice samples for diagnosis could enable remote monitoring and reduce the need for frequent physical visits to clinics, offering convenience for patients. 2.Comparison with Existing Methods:The paper compares the performance of deep learning models with conventional machine learning techniques, providing a benchmark for the effectiveness of these newer approaches.	1. Dataset Specificity:* The success of these models heavily relies on the quality, size, and representativeness of the datasets used. If the dataset doesn't reflect real-world diversity or is limited, it might affect the model's applicability. 2. Ethical and Privacy Concerns: Remote monitoring through voice samples might raise concerns about data privacy and consent, which need to be addressed appropriately.
A Deep Learning Based Method for Parkinson's Disease Detection Using Dynamic Features of Speech	Kangren,Changqin Quan, Zhiwei Luo	2021	1. Identify significant differences in articulation transition characteristics between HC speakers and PD patients. 2. Demonstrate substantial improvements in PD detection accuracy compared to traditional Machine Learning models using static features.	Innovative Dynamic Feature Capture Proposes Bidirectional Long Short-Term Memory (LSTM) models, introducing a novel approach to capture time-series dynamic features for enhanced PD detection precision.	Data Dependency and Generalization: The proposed approach's success may be heavily dependent on the quality and quantity of the available data. Achieving generalization to diverse populations or real-world scenarios might be challenging.

Title	Authors	Year	Objectives	Advantages	Disadvantages
Advances in Parkinson's Disease detection and assessment using voice and speech: A review of the articulatory and phonatory aspects	Laureano Moro-Velazquez , Jorge A. Gomez-Garcia , Julian D. Arias-Londoño , Najim Dehak , Juan I. Godino-Llorente	2021	This paper presents a comprehensive review of studies focused on using speech analysis, specifically examining phonatory and articulatory aspects, for the detection and assessment of Parkinson's Disease (PD).	The paper highlights the relevance of articulatory and phonatory aspects in automatic detection and severity assessment of PD, offering valuable insights into potential diagnostic tools.	Incomplete Assessment and Limited in capturing dynamic speech changes.
Machine Learning Approach to Support the Detection of PD in IMU-Based Gait Analysis	Dante Trabassi, Mariano Serrao ,Tiwana Varrecchia , Alberto Ranavolo , Gianluca Coppola, Roberto De Icco	2021	Optimal Feature Selection:Determine a minimum set of speed-independent through a comprehensive three-level feature selection process reducing computational load.	It Optimized Feature Selection: Rigorous three-level process selects relevant gait parameters, reducing computational load.	Limited Generalizability: Findings may not extend well to diverse populations or datasets beyond the study's specific context.
PD diagnosis using CNN and figure-copying tasks	Mohamad Alissa, Michael A. Lones, Jeremy Cosgrove, Jane E. Alty, Stuart Jamieson, Stephen L. Smith & Marta Vallejo	2022	This study employs a convolutional neural network (CNN) to assist in the Parkinson's disease (PD) diagnosis by analyzing drawing tasks, specifically wire cube and spiral pentagon, performed by individuals with and without PD.	Increasing efficiency focusing on single-drawing tasks ,Using a simple CNN helps in effective analysis and especially in primary care where multiple tasks might be burdensome for patients	Mistakenly identifying actions such as shivering, handshakes as Parkinson's disease. it can only detect only by using an one image.but that person can also have an other symptoms may become an positive.
Deep Transfer Learning Based PD Detection Using Optimized Feature Selection	Sura Mahdood Abdullah, Thekra Abbas,Munzir Hubiba Bashira,Mushee r Ahmad,Naglaa F. Soliman	2023	1.The paper discusses early detection and diagnosis of Parkinson disease (PD), symptoms overlapping with other diseases. 2.Utilizing handwritten records as a primary tool for PD detection, researchers have explored ML approaches dedicated to this objective.	1.Optimized Feature Selection and Transfer Learning Integration. 2.By using an Genetic algorithm procedure	It doesn't provide information about the stage of the disease if detected.

III. CONCLUSION

The utilization of DaTscan images in Parkinson's Disease detection has achieved remarkable accuracy, reaching an impressive 96%. This groundbreaking approach not only confirms the presence of the disease but also distinguishes between its distinct stages, delineating between initial, moderate, and severe phases. This level of precision stands as a testament to the efficacy and potential of leveraging advanced imaging technology in medical diagnostics. By offering such refined detection capabilities, clinicians can precisely pinpoint the progression of Parkinson's Disease, enabling tailored interventions at each stage.

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