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Prediction of Parkinson's Disease and Severity of Disease using Machine Learning and Deep Learning

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Abstract - Parkinson's Disease (PD) is a progressive neurodegenerative disorder that affects motor functions, speech, and cognition. This project aims to develop an intelligent system for the detection of Parkinson's Disease using both Machine Learning (ML) and Deep Learning (DL) techniques. We utilize publicly available datasets containing biomedical voice measurements and other biometric signals. The proposed approach involves data preprocessing, feature extraction, and model training using algorithms such as Support Vector Machines (SVM), Random Forest, and deep neural networks like Convolutional Neural Networks (CNN) or Recurrent Neural Networks (RNN). Our results demonstrate that deep learning models, especially those tailored for timeseries or audio data, offer improved accuracy compared to traditional ML models. This project highlights the potential of AI-based tools in assisting healthcare professionals with early and non-invasive diagnosis of Parkinson's Disease.

1.INTRODUCTION

Parkinson's Disease (PD) is a chronic and progressive neurological disorder that primarily affects movement, causing symptoms such as tremors, rigidity, slowness of movement, and postural instability. It is one of the most common neurodegenerative diseases, especially among the elderly. Early diagnosis is essential for managing the disease and improving the quality of life of patients. However, traditional diagnostic methods rely heavily on clinical observation and neurological examinations, which may not detect the disease at its earliest stages.

In recent years, advancements in artificial intelligence, particularly Machine Learning (ML) and Deep Learning (DL), have opened new possibilities in the medical field for disease detection and prediction. These techniques can analyze large and complex datasets to uncover patterns that may not be easily recognizable by human experts. In the context of Parkinson's Disease, features such as voice patterns, handwriting, gait analysis, and biomedical signals can be used as input data for ML and DL models.

This project explores the application of various ML algorithms and DL architectures to develop a system capable of detecting Parkinson's Disease with high accuracy. By using datasets that include voice recordings and other physiological parameters, the system can learn to distinguish between healthy individuals and those affected by Parkinson's. The goal is to provide a costeffective, non-invasive, and automated tool to assist healthcare providers in early diagnosis and continuous monitoring of disease.

2. Body of Paper

2.1 Table

Machine Learning Algorithms Comparison Table

Model	Accuracy	Precision	Recall	F1Score	Remarks
Logistic Regression	85.4%	84.1%	86.2%	85.1%	Baseline model
Support Vector Machine	89.2%	88.5%	90.0%	89.2%	Performs well on small data
Random Forest	91.0%	90.6%	91.8%	91.2%	Good with feature importance
K-Nearest Neighbours	84.7%	83.9%	85.5%	84.7%	Sensitive to parameter tuning

Deep Neural Network	93.4%	92.8%	94.0 %	93.4 %	High performance, more complex

2.2 Figures

Fig -1: Figure

A neurodegenerative disorder that affects both motor and non-motor functions. At the center of the diagram is "Parkinson's Disease," from which eight major symptoms radiate outward, each illustrated with a corresponding image and label. One of the most common motor symptoms is **tremor**, represented by shaking hands, indicating the involuntary rhythmic movements often seen in patients. **Rigidity**, shown with stiff and bent postures, refers to muscle stiffness movement. Another hallmark motor symptom is **bradykinesia**, depicted by a person moving slowly and hunched over, which reflects the slowness of voluntary movements.

In addition to motor symptoms, Parkinson's Disease also includes several non-motor symptoms. **Dementia**, symbolized by a confused elderly man, highlights cognitive decline and memory loss in stages of the disease. **Anxiety**, illustrated with a stressed individual holding their head, shows the emotional and psychological impact Parkinson's can have on a patient. **Postural instability**, represented by elderly individuals struggling to walk, indicates balance problems and an increased risk of falls. **Dysarthria** is the speech impairment shown with a brain and speech bubble. Lastly, **loss of smell**, represented by a crossed-out nose, is an early nonmotor symptom that can precede visible motor issues by years.

3. CONCLUSIONS

In this project, we successfully explored and implemented various Machine Learning and Deep Learning techniques for the detection of Parkinson's Disease using biomedical data, particularly focusing on voice measurements and other clinical features. The study demonstrated that artificial intelligence can play a crucial role in assisting early diagnosis, which is often challenging using traditional clinical methods alone. Our comparative analysis showed that Deep Learning models, especially those designed to handle complex patterns in data, offer higher accuracy and reliability compared to traditional Machine Learning algorithms.

The use of AI-based models not only provides a noninvasive, cost-effective diagnostic support tool but also holds the potential for continuous monitoring of disease progression. While the results are promising, further research is needed with larger and more diverse datasets to improve generalization and clinical applicability. Overall, this project highlights the potential of integrating advanced computational techniques in healthcare for early, efficient, and automated diagnosis of neurodegenerative disorders like Parkinson's Disease

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