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Study of Artificial Intelligence for Parkinson's Disease Prediction

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ABSTRACT: This comprehensive review explores the rapidly evolving landscape of Artificial Intelligence (AI) applications in predicting Parkinson's Disease (PD). With the increasing prevalence of PD and the critical importance of early diagnosis for effective management, AI-based prediction models hold great promise in revolutionizing the field. The review begins by providing an overview of Parkinson's Disease and the challenges associated with its timely detection. Subsequently, it delves into various AI techniques employed for PD prediction, encompassing machine learning algorithms, deep learning models, and hybrid approaches. Noteworthy advancements in feature selection, data pre-processing, and model optimization are discussed, highlighting the key considerations in building accurate and reliable prediction systems.

KEYWORDS: Parkinson's disease, Artificial Intelligence, Prediction.

I. INTRODUCTION

Parkinson's disease is characterized by a disruption in the brain cells that are accountable for the creation of the chemical dopamine. This disruption enables the illness to manifest. The ability of brain cells to communicate with one another is ensured by this particular chemical. In the brain, the cells that are responsible for producing dopamine are the ones that are accountable for providing us with control, suppleness, and fluidity in our movements. It is one of the most debilitating and degenerative conditions of the nervous system, and it has an effect on movement. Parkinson's disease is one of the most common neurological disorders. It is the second most common neurological condition, and despite the fact that it produces functional deficits and a shorter lifespan, it is now untreatable. Also, it is the second most common neurological disorder. More than ninety percent of persons who have this illness, known as bradykinesia, will have difficulty with speech, tremors, rhythmic shaking, and delayed movement. Alterations in speech are the most important thing to bear in mind when thinking about the phrase "Parkinson's disease." It is [1].

The fundamental cause of Parkinson's disease (PD), which is a neurodegenerative ailment that worsens with time, is the death of nerve cells in the brain. These nerve cells are crucial for the control of movement. This results in a loss of the ability to produce a vital neurotransmitter, which in turn leads to an inhibition of dopamine synthesis. This occurs as a consequence of the death of these nerve cells or the harm they sustain. As of right now, there is no medication that can be administered for this condition, and there is also no way to reverse the symptoms that are associated with the illness. It is of the highest significance to recognize the presence of a disease in its early stages as opposed to allowing it to evolve into a more hazardous threat. This is because of the reasons stated above. It is [2]. Because of a number of important factors, the prediction of Parkinson's disease (PD) is of great importance: The early recognition of Parkinson's disease symptoms enables prompt medical intervention and therapy to be administered. Even though Parkinson's disease (PD) is a neurological illness that worsens with time, early intervention may help patients control their symptoms, reduce the course of the disease, and improve their quality of life.

With the ability to predict Parkinson's disease, medical professionals are able to personalize treatment plans for each patient, therefore improving therapeutic approaches and reducing the risk of unwanted effects. There is a correlation between individualized treatment regimens and improved patient results and satisfaction. The identification of appropriate candidates for clinical trials and medication development may be facilitated by researchers and pharmaceutical corporations with the use of forecasting models that are accurate. In this way, the process of developing new treatments for Parkinson's disease may be streamlined. One way to contribute to the development of personalized medicine is to be able to predict the risk of Parkinson's disease (PD). Personalized medicine involves tailoring therapies to an individual's genetic composition, lifestyle, and risk factors. Assisting patients and their families in preparing for

the probable difficulties connected with Parkinson's disease (PD) is the use of predictive models. Patients and caregivers may see an improvement in their quality of life as they manage the development of the illness if they get early planning and assistance.

The use of artificial intelligence (AI) has shown significant potential in a variety of areas pertaining to Parkinson's disease (PD), such as diagnosis, prediction, monitoring, and therapy. AI is being applied in the following methods for the treatment of Parkinson's disease:

Through the analysis of medical imaging, such as brain scans or functional MRI, artificial intelligence algorithms may assist in the early diagnosis of Parkinson's disease (PD) by recognizing structural or functional abnormalities associated with the disease. Artificial intelligence has the ability to evaluate speech patterns and voice features in order to identify tiny alterations that may indicate the existence of Parkinson's disease. This provides a diagnostic tool that is both non-invasive and cost-effective. In order to determine the possibility of a patient getting Parkinson's disease (PD) based on risk factors, genetic markers, and other pertinent characteristics, artificial intelligence algorithms, which include machine learning and deep learning, may assess patient data.

II. RELATED WORK

N. Alapati et al., [1] discusses the analysis of both healthy volunteers and patients with Parkinson's disease for the purpose of PD prediction. Thirteen distinct prediction models, each tailored to a certain Machine Learning strategy, were built using data collected from the University of California, Irvine (UCI).

Using Alzheimer's, Parkinson's, and schizophrenia as case studies, A. Mathur et al. [2] evaluates and contrasts many ML-based diagnostic methods for neurological disorders. The purpose of this article is to provide a synopsis of the many computational intelligence methods already in use for the analysis and prediction of neurological disorders from a variety of data sources.

The work of B. Latha et al. [3] is based on a compilation of articles from various respected journals and books published by organizations like Science Direct, IEEEExplore, Science Direct, Hindawi, Springer Publishing Company, the Association for Computational Machinery (ACM), and the Multidisciplinary Digital Publishing Institute (MDPI). In addition to presenting considerable information and insight about the utilization of many research modalities, databases, and investigation configurations, each study has been thoroughly examined to identify its aims, methods, and outcomes.

S. S. S. et al., [4] goal is to create a reliable model that may aid in the early detection of Parkinson's disease, as well as its treatment and ultimate recovery, by comparing and contrasting different models. We plan to utilize the Parkinson's Telemonitoring data set that we obtained from the UCIML repository to achieve the aforementioned objective.

K. Barati et al., [5] aimed to improve classification performance by using ensemble techniques like Bagging and Adaboost and stratified cross-validation, a technique for sample balancing. Results show that a0, the most prevalent kind of smooth behavior in MFS, may be able to distinguish between faller PD patients when executed on a hard surface.

Dash, A. K. et al., [6] Out of all the classifiers used to forecast PD, the Gradient Tree Boosting technique stands out with its 98.31% accuracy and 98.66% area under the ROC curve. Our results show that the stated design outperforms the methods now employed in published research, and we also discovered a reduced case count compared to previous designs.

A study conducted by H. Kaur and et al., [7] The mental health of those with Parkinson's disease is being severely impacted by the COVID-19 epidemic, according to recent study. We provide a machine learning-based approach to early intervention in Parkinson's disease by predicting the severity of anxiety and depression using pre- and post-pandemic surveys.

Using the informative index from the UCI tool learning repository's dataset of PD patients' speech recordings, A. Papasani et al., [8] demonstrated its application. Testing the diagnostic version's efficacy involves using machine

learning classifiers in conjunction with common performance measures such as specificity rate, accuracy, and sensitivity.

The goal of this research is to enhance the dataset's correctness and optimize its characteristics, according to T. Wasif et al. [9]. Our optimization efforts were based on a hybrid feature selection strategy that combines the wrapper and filter technique. This technique is called "Recursive Feature Elimination." Out of all the classifiers tested, XGBoost had the best accuracy at 97.43% using only nine of the twenty-two attributes.

S. Swami et al., [10] Depending on the patient's community and geographic area, symptoms of Parkinson's disease might vary. A relatively emerging topic of research in medicine is the development of methods for the early and precise prediction of Parkinson's disease.

III. CHALLENGES

Here are some of the challenges of using AI for Parkinson's disease prediction:

- Data availability and quality: AI models need to be trained on large datasets of high-quality data. However, there is a lack of publicly available Parkinson's disease datasets, and the quality of existing datasets can vary widely.
- Model interpretability: It can be difficult to interpret how AI models make predictions. This can make it difficult to trust the predictions of AI models and to identify potential biases in the models.
- Ethical considerations: The use of AI for Parkinson's disease prediction raises a number of ethical concerns, such as the potential for discrimination and the importance of informed consent.

Here are some specific examples of these challenges:

- Data availability: Parkinson's disease is a relatively rare disease, so it can be difficult to collect large datasets of data from people with Parkinson's. Additionally, people with Parkinson's may be reluctant to participate in research studies, which can further limit the availability of data.
- Data quality: Parkinson's disease is a complex disease, and there is no single biomarker that can be used to diagnose or predict the disease with certainty. As a result, AI models for Parkinson's disease prediction need to be trained on a variety of different types of data, such as clinical data, imaging data, and genetic data. However, the quality of this data can vary widely. For example, imaging data may be acquired using different types of scanners, and clinical data may be collected using different methods.
- Model interpretability: AI models for Parkinson's disease prediction are often complex and difficult to understand. This can make it difficult for clinicians to trust the predictions of these models and to identify potential biases in the models. For example, an AI model may use certain features from the data to make predictions, but it may be difficult to understand why the model is using these features or how they are contributing to the predictions.

IV. CONCLUSION

Artificial intelligence (AI) has the potential to revolutionize the diagnosis and treatment of Parkinson's disease. AI-based predictive models can help to identify people at risk of developing Parkinson's earlier, so that they can receive treatment before their symptoms become severe. AI-based tools for monitoring the progression of Parkinson's disease can also help clinicians to better track the effectiveness of treatments and adjust them as needed

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