IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 5, May 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 5, May 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1205031 |

Early Detection of Parkinson's Disease Using EEG Data

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ABSTRACT: It is important to accurately identify Parkinson's disease (PD) in its early stages to prevent its progression and provide patients with access to disease-modifying treatments. Disease An in-depth study is designed to determine early whether a person has Parkinson's disease (PD) based on early motor symptoms. This study specifically included dopaminergic imaging markers, cerebrospinal fluid data, several early signs of Parkinson's disease (PD), such as anosmia and eye velocity. Based on a small data set, a comparison of deep learning models consisting of 183 healthy people and 401 patients with early Parkinson's disease and 12 machine learning and learning method combinations showed that the most effective and accurate design was achieved, 96.45%.

I. INTRODUCTION

In recent years, health information has been widely used in monitoring and diagnosing important diseases. Knowledge-based studies are used to monitor Parkinson's disease (PD), a common disease in people aged 60 and over. Parkinson's disease (PD) is a neurological disease characterized by motor and non-motor symptoms. Because people with Parkinson's disease (PD) live longer when diagnosed early, accurate and reliable health screening tools are needed to detect people with Parkinson's disease. Another purpose of these systems is to reduce the workload of doctors. The goal of Parkinson's diagnosis is to evaluate the severity of symptoms using multiple scales.

One of the most common symptoms is hoarseness, and patients often develop voice deficits in the early stages of the disease. For this reason, voice problems, as well as health, are at the forefront of recent research on the diagnosis of Parkinson's disease. These studies used different types of speech signals to identify important clinical landmarks. These retrieved features are then fed into various machine learning algorithms to generate semi-output classification results. Artificial neural network (ANN) and support vector machine (SVM), as well as random forest (RF) and K-nearest neighbors (KNN), are suitable algorithms for PD classification because they are simple and straightforward. It is affected by the quality of the features selected from the data. Deep learning techniques can reveal hidden features of objects, but manually selecting the relevant features that best reflect the underlying objects can be difficult. Millions of adults worldwide suffer from Parkinson's disease (PD), a serious neurological disease that affects their quality of life. Because of the general nature of Parkinson's disease, each person's experience of Parkinson's symptoms is unique. One of the symptoms that people with Parkinson's disease may experience, especially while at rest, is tremors. Non-physical symptoms include depression, difficulty sleeping, loss of smell, and cognitive impairment. According to the Centers for Disease Control and Prevention (CDC), Parkinson's disease (PD) is the 14th most common disease in the United States. The main cause of Parkinson's disease (PD) is unknown. In the United States alone, the financial burden associated with Parkinson's disease (PD), including reimbursements, Social Security payments, and medical care, is estimated at more than $52 billion annually. Parkinson's disease affects up to 10 million people worldwide. As mentioned earlier, early diagnosis of Parkinson's disease (PD) allows rapid treatment and reduction of severe symptoms. Therefore, early diagnosis of Parkinson's disease (PD) is important to reduce the disease and may allow people to receive treatment changes when possible. Parkinson's disease (PD) has not yet been diagnosed. Instead, many symptoms and diagnostic criteria are confused. Researchers have studied various biomarkers to detect Parkinson's disease early and stop the spread of the disease. There is currently no treatment for Parkinson's disease that can stop or slow the progression of the disease. Instead, they just manage the symptoms.

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II. LITERATURE SURVEY

1)" **Deep learning-based Parkinson's disease classifier voice**", 2019.
Two distribution methods requested by CNN. These models differ in the way feature sets are sent to the input layer of the network. The features of these two frameworks are described in the following lines. We also compared the performance of the proposed models using the SVM model**.**

2)"**Automatic detection of Parkinson's disease based on multiple noises using genetically optimized neural networks and linear discriminant analysis**", 2019.
A hybrid intelligent recognition system that uses different types of voice data. The proposed method uses the LDA model for dimensionality reduction and neural classification. Experimental results show that based on all the data obtained, the artificial intelligence system can distinguish between Parkinson's patients and healthy people with accuracy as high as 95% of the study materials and 100% of the test materials. However, due to conflict between genders, the proposed process was simulated again by removing gender-related features. complicated. The results of the trial show that the proposed technology could help doctors diagnose more people with Parkinson's disease.

3) **Automated Detection of Parkinson's Disease Based on Multiple Types of Sustained Phonation Using Genetically Optimized Neural Network and Linear Discriminant Analysis, 2019.**
Language patterns where learners fail to perform many tasks, 2019. We show that the language models to perform these tasks are trained on a new database called Web Text, which contains millions of web pages. Based on the data and questions, the language response model achieved an F1 of 55 on the CoQA dataset, matching or exceeding the performance of three of the four baseline systems with access to more than 127,000 training samples. Language ability must increase for the accuracy of zero-throw job changeover. The result is a cross-linear increase in cross-sector performance.

4)**"Review of Machine Learning Techniques for Parkinson's Disease Severity Classification and Detection, 2021"**.
A research article on various machine learning methods for the diagnosis and severity assessment of Parkinson's disease. Feature selection, dataset characterization, and the pros and cons of various methods such as support vector machines, decision trees, and deep learning models are discussed.

5)"**Explore Parkinson's disease using machine learning and deep learning, research paper, 2019**."
being able to predict the disease. Specificity, sensitivity, and accuracy of models such as support vector machine (SVM), convolutional neural networks (CNN), and recurrent neural networks (RNN).

6)**" The use of machine learning for early detection of Parkinson's disease using speech and movement in 2021 patients."**
The performance of various machine learning (ML) methods such as nearest neighbor (KNN), decision trees, and neural networks is compared for early diagnosis based on this feature.

7)"**The progress of biomarkers and machine learning models for early diagnosis of Parkinson's disease in 2020.**"
It uses ML models such as support vector machines. It includes a variety of biomarkers, such as biochemical, neuroimaging, and clinical ones, and looks at how ML models, such support vector machines, are used.

III. METHODOLOGY AND DISCUSSION

The main goal is to generate reliable and reliable health data for early diagnosis of Parkinson's disease (PD) using machine learning (ML) algorithms and other applications. People over the age of 60 often develop a disease of the brain called Parkinson's disease (PD), which causes time to pass. Since the current treatment model for Parkinson's disease (PD) shows signs of disease change, early diagnosis, timely intervention, and good outcomes for the patient are important. Biomarker analysis of Parkinson's disease (PD) includes voice abnormalities, speech patterns, gait examination, and other measures that precede the onset of significant motor symptoms. Selection and model performance refer to the process of selecting the best clinical features from various information sources (such as speech symbols and graphic symbols) to improve the accuracy and reliability of machine learning (ML)-based PD diagnostic models. Parkinson's Disease Progression Marking Initiative (PPMI) data were used to highlight minor problems in the data. These data include characteristics of patients with early-stage Parkinson's disease (PD) and a small number of healthy individuals. Algorithm Selection and Comparative Analysis: Given the specificity and complexity of symptoms

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associated with Parkinson's disease, a comparative analysis will evaluate the performance of various machine learning (ML) algorithms, such as systems integration and deep learning, in healthcare. Implications and Implications: To translate research results into useful clinical tools to help clinicians diagnose Parkinson's disease (PD) earlier, thereby reducing physician work and improving patient care and quality of life. Documents such as the Parkinson's Disease Progression Marking Initiative (PPMI) The process of developing a machine learning model for early detection of Parkinson's disease (PD) includes preliminary design, architecture, and data collection. Once relevant features are extracted, appropriate machine learning algorithms (such as SVM, ANN, and RF) are trained and developed. Evaluate the model using performance indicators such as cross-validation and accuracy. Comparison of various algorithms and analysis of values led to the selection and interpretation of the model. The goal of using validated models in clinical settings is to improve patient outcomes and PD diagnosis.

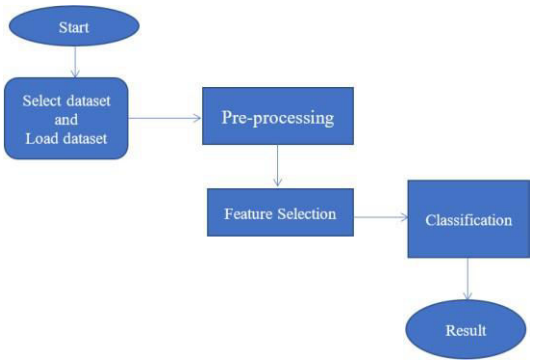


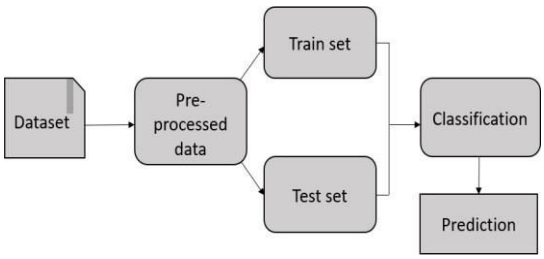
Fig1. Flowchart

- Step 1: Data selection and loading.
- Step 2: Data preprocessing.
- Step 3: Splitting dataset into train and test data.
- Step 4: Classification.
- Logistic Regression.
- XGBoost.
- Convolutional Neural Network.
- Recurrent Neural Network.
- Step 5: Prediction.
- Step 6: Result Generation.

Objectives

- Create and Assess ML-Based Models for PD Detection.
- Choose Features and Analyze Biomarkers.
- Comparative Analysis of Data Driven Methods.
- Improve Clinical Significance Generalization
- Enhance PD Detection with Health Informatics Systems.
- Contribute to Current, Upcoming Research.

This study aims to improve early diagnosis and treatment options for people with Parkinson's disease by achieving these goals and continuing to improve clinical data for Parkinson's disease diagnosis.



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Software Tools

a) Python:

Python is one of the few languages that can claim to be both simple and powerful. You will be surprised how easy it is to focus on problem solving rather than the syntax and structure of programming languages. As a practical guide, Python is a powerful programming language that is easy to learn. It uses a simple but effective project routing method and uses high-level data effectively. Python's dynamic typing, interpretive nature, and elegant syntax make it an ideal language for scripting and rapid platform-wide application development. The following sections will provide more information on many of these features. The TensorFlow, PyTorch, and scikit-learn Python libraries are just a few of the many that offer the tools and techniques needed to create machine learning models, specifically for the diagnosis of Parkinson's disease.

Preparing the data: Pandas and NumPy are two Python modules that enable managing missing data, normalizing data, and scaling features easy. These are essential steps in getting data ready for machine learning models. The use of Python's feature engineering and selection tools and modules allows researchers to extract new features from pre-existing data and determine which attributes are most crucial for the diagnosis of Parkinson's disease.

b) Anaconda:

The sturdy and adaptable Anaconda open-source system, intended for data research, machine learning, and scientific computing, includes the Python and R programming languages. It simplifies the configuration and management of complex settings by providing a large selection of pre- installed libraries, including popular ones like NumPy, Pandas, scikit-learn, TensorFlow, and PyTorch. With its intuitive package management system, conda, users can easily install, update, and manage dependencies, ensuring seamless compatibility across several operating systems. The integrated development environment (IDE) for managing packages, launching Jupyter Notebooks, and obtaining documentation, Anaconda Navigator, has a user- friendly interface. Because of its vast toolbox and scalability, Anaconda is widely used in research, industry, and education with the support of a vibrant community.

c)Spyder:

Spyder is an integrated development environment (IDE) designed specifically for scientific computing and data processing. Because of its many features and intuitive design, researchers and data scientists choose it. By giving users built-in capabilities for debugging, variable exploration, code autocompletion, and graphing, Spyder streamlines the development process. This makes it possible for users to create, test, and debug machine learning scripts and algorithms more rapidly.

Its simple integration with popular libraries likes as scikit-learn, PyTorch, and TensorFlow enhances its functionality and makes it a viable option for developing and deploying predictive models for a variety of applications, including early diagnosis of Parkinson's disease. All things considered, Spyder offers a comprehensive environment that facilitates academic collaboration on scientific projects, data analysis, and algorithm creation.

Code Autocompletion: By providing syntax highlighting and code autocompletion, Spyder makes it easier and faster to write machine learning algorithms and scripts.

Variable Explorer: Researchers may learn more about dataset properties connected to the diagnosis of Parkinson's disease by utilizing Spyder's variable explorer, which offers an easy-to-use interface for evaluating and displaying data variables.

The efficacy of the proposed methodology is evaluated by employing metrics like recall, sensitivity, specificity, accuracy, precision, and F1-measure.Recently, there has been a significant increase in the use of health informatics systems for the diagnosis and follow-up of severe illnesses, with a focus on Parkinson's disease (PD), which is frequently identified in those over 60.This project will successfully anticipate the dataset's overall prediction outcomes by optimizing the overall prediction results.

IV. RESULTS

Measurements such as sensitivity, specificity, recall, F1 measure, accuracy, and precision were used to evaluate the effectiveness of proposed machine learning algorithms for early prediction of Parkinson's disease. In recent years, health information has been widely used in diagnosing and monitoring serious diseases, especially Parkinson's disease (PD), which frequently occurs in people in their 60s. Diseases in the body with the following symptoms are divided into two: weak body and strong body. The system based on the difficulty level of the voice is an important part of the research because voice problems are in the early stages of the disease. After using speech signal technology to extract

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clinically important features, these systems classify Parkinson's disease using a variety of learning techniques such as random forest (RF), K nearest neighbor (KNN), artificial neural network (ANN), and support vector machine (SVM). The quality of the selected features is related to the accuracy of the algorithms. Deep learning is necessary for this purpose because they automatically reveal the properties of the material. Millions of people worldwide live with Parkinson's disease, and timely diagnosis is essential for effective treatment and relief of symptoms. It is currently undefined and can be diagnosed by a combination of symptoms and diagnostic criteria. Various biomarkers are being studied to detect Parkinson's disease early and stop its progression. Current treatments only relieve symptoms. Soft speech may herald prodromal neurodegeneration. Different studies have shown that multiple sclerosis (MSA), including PD, MSA-P, and MSA-C, can be distinguished by motor speech. Recent studies have revealed differences in the voice of Parkinson's disease. Machine learning techniques have an impact on heterogeneous classes. The researchers captured regular patterns in the patients' voices and varied the speech to create a balanced recording. Various selection strategies were used to improve the clarity of the display. Main results include 87.5% accuracy using the voice model and human characteristic cepstral coefficients (HFCC) and 82.5% accuracy using the SVM model and learning process hybrid. A recent study compared data-driven Parkinson's disease detection technologies to detect early signs of the disease using multiple markers. When Parkinson's patients were excluded from healthy controls, deep learning models outperformed traditional machine learning models. This study also investigated importance and frequency selection using the Boosting method and highlighted the role of measurement effects on brain regions in testing for Parkinson's disease. The main cause of Parkinson's disease is unknown. Financial stress results from the direct and indirect costs associated with Parkinson's disease, including medical care, Social Security benefits, and unpaid bills. This amount must exceed $52 billion annually in the United States alone. Parkinson's disease affects more than 10 million people worldwide.

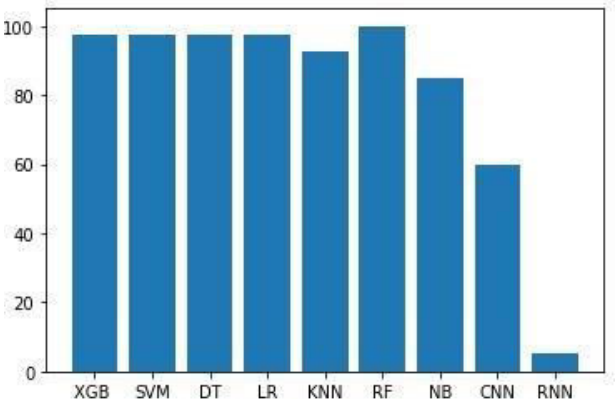

Fig3. Efficiency of algorithms

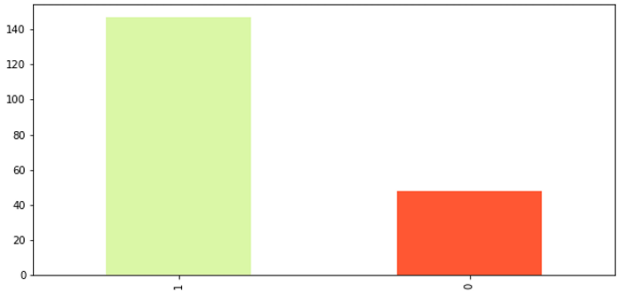

Fig4.Final result.

V. CONCLUSION

In this study, we propose a method to detect Parkinson's disease. A lot of machine learning and deep learning are used to predict a patient's likelihood. Preprocessing is the first step in processing the dataset. Clean the data before using the feature selection strategy in this process. For selection purposes, the dataset is divided into training data and testing data. The classification system was also evaluated for accuracy, specificity, sensitivity, confusion matrix, and true predictive value in predicting Parkinson's disease. path. Various machine learning and deep learning algorithms are

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used to assess whether patients are likely to be affected. First, a predefined method is used to process the data set. In this method, the feature selection method is used after the data set is cleaned. During the selection process, the data set is divided into training data and testing data. It estimates the accuracy, specificity, sensitivity, confusion matrix for the success of classification algorithms, and expected accuracy for patients with Parkinson's disease. In the future, the group will be able to benefit from the ability to add or modify its strategy and division strategy to make it more effective. to further improve performance. Apart from the combination of data mining techniques, other combinations such as artificial intelligence, software and different clustering algorithms can also be used to increase accuracy.

We provide a way to identify Parkinson's disease in this study. To estimate a patient's likelihood, a lot of deep learning and machine learning is employed. The initial stage of processing the dataset is called preprocessing. In this method, clean up the data before applying the feature selection approach. The dataset is split into training and testing data for selection purposes. In order to predict Parkinson's disease, the classification system's accuracy, specificity, sensitivity, confusion matrix, and true predictive value were also assessed. route. A range of machine learning and deep learning techniques are employed to evaluate the likelihood of patients being impacted.

The group will benefit from choosing to add or modify the distribution plan to improve future performance. more production. In addition to link data mining techniques, other links that can be used to improve accuracy include software, artificial intelligence, and other integration methods.

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