A Project Report On

Prediction of Parkinson's Disease Using Machine Learning

Submitted in partial fulfillment of the requirement for the 8^{th} semester

Bachelor of Engineering

in

Computer Science and Engineering

DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE & ISO 9001:2008 Certified)

Accredited by National Assessment & Accreditation Council (NAAC) with 'A' grade

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CERTIFICATE

This is to certify that the project entitled **Prediction of Parkinson's Disease Using Machine Learning** is a bonafide work carried out by **Rohan Varier [1DS18CS107]**, **Narkedemilli Yasaswini [1DS19CS102], Shruthi S Durgai [1DS19CS154]** and **Snehal H.Chavan [1DS19CS160]** in partial fulfillment of 8th semester, Bachelor of Engineering in Computer Science and Engineering under Visvesvaraya Technological University, Belagavi during the year 2022-23.

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Name of the Examiners:	Signature with date:
1..........................	....
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We are pleased to have successfully completed the project **Prediction of Parkinson's Disease Using Machine Learning**. We thoroughly enjoyed the process of working on this project and gained a lot of knowledge doing so.

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Abstract

Parkinson's disease is a neurodegenerative disorder that requires early and accurate diagnosis for effective management. This project explores the potential of using spiral image analysis as a supplementary tool for predicting Parkinson's disease.Spiral drawing tests, which assess motor symptoms associated with the disease, are digitally processed and analyzed using machine learning algorithms.A dataset comprising spiral drawings from Parkinson's disease patients and healthy individuals is collected.The images undergo preprocessing to enhance quality and eliminate noise. Relevant features, including size, shape, speed, and regularity, are extracted from the spiral drawings, which may reflect motor impairments indicative of Parkinson's disease. Machine learning models, such as support vector machines or deep neural networks, are trained using the extracted features to classify the images into Parkinson's disease or healthy control groups.The results of this analysis shed light on the potential of spiral image analysis as a diagnostic tool for Parkinson's disease. However, it is important to note that spiral drawing tests alone cannot provide a definitive diagnosis. In conclusion, this project showcases the potential of spiral image analysis as an additional method for predicting Parkinson's disease. By leveraging machine learning algorithms and extracting meaningful features from spiral drawings, this approach offers insights into motor impairments associated with the disease. Further advancements in this area can contribute to early detection and improved management of Parkinson's disease.

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Chapter 1

Introduction

Parkinson's disease (PD) is a prevalent neurodegenerative disorder characterized by motor impairments, including tremors, rigidity, and bradykinesia. Timely and accurate diagnosis of PD is crucial for effective disease management and targeted interventions. However, traditional diagnostic methods for PD, relying on clinical assessments and subjective evaluations, can be limited by inter-observer variability and subjective biases.

In recent years, there has been growing interest in exploring alternative diagnostic approaches that leverage objective and quantitative measures. One such emerging technique involves the use of spiral images as a diagnostic tool for PD. Spiral drawings can capture intricate motor control patterns, providing valuable insights into motor abnormalities associated with PD.The use of spiral images offers several advantages over traditional diagnostic methods. First, it provides an objective and quantifiable means of assessing motor function, reducing the potential for subjective interpretation. Second, spiral images enable the analysis of subtle motor abnormalities that may not be readily apparent during clinical evaluations. By quantitatively measuring features like tremor frequency, amplitude, and symmetry, spiral images can potentially aid in early detection and monitoring of PD.Previous studies have demonstrated promising results in utilizing spiral images for PD detection. These studies have highlighted the ability of spiral image analysis to distinguish PD patients from healthy individuals and to quantify disease severity. By extracting meaningful features from spiral images and employing advanced machine learning algorithms, predictive models can be developed to accurately classify individuals as PD or non-PD.The primary objective of this study is to explore the effectiveness of using spiral images for the detection of Parkinson's disease. We aim to develop a predictive model based on spiral image analysis and evaluate its performance in terms of sensitivity, specificity, and overall accuracy. Additionally, we will compare the performance of spiral images with traditional diagnostic methods, aiming to identify the potential benefits and limitations of this novel approach.In the subsequent sections of this report, we will describe the methodology used for data collection and analysis, present the results of our study, and discuss the implications and future directions of using spiral images in the diagnosis of Parkinson's disease.By leveraging the objective and quantitative nature of spiral images, we have the potential to enhance the accuracy and efficiency of PD detection, ultimately improving patient outcomes and contributing to advancements in the field of neurodegenerative disease diagnosis.

1.1 The problem statement

The diagnosis of Parkinson's disease (PD) is often challenging due to the subjective nature of clinical assessments and the need for experienced medical professionals to interpret motor symptoms accurately. Additionally, current diagnostic methods may not capture subtle motor abnormalities associated with early-stage PD, leading to delayed detection and intervention.The problem at hand is to develop a reliable and objective diagnostic approach that utilizes spiral images to detect Parkinson's disease with high accuracy and sensitivity. The use of spiral images as a diagnostic tool offers the potential for quantitative analysis and early detection of PD-related motor abnormalities.

This study aims to address the following key questions and challenges:

1.Can spiral images serve as a reliable and objective means of capturing motor abnormalities associated with Parkinson's disease?

2.How can meaningful features be extracted from spiral images to quantify PD-related motor impairments?

3. Can a predictive model based on spiral image analysis accurately distinguish PD patients from healthy individuals?

4.How does the performance of spiral images as a diagnostic tool compare to traditional subjective evaluations and clinical assessments?

5.What are the potential implications of using spiral images in the early detection and monitoring of Parkinson's disease?

By addressing these questions and challenges, this study aims to contribute to the development of an effective and objective diagnostic approach for Parkinson's disease using spiral images. The findings of this research have the potential to enhance early detection, improve patient outcomes, and guide future advancements in the field of neurodegenerative disease diagnosis.

1.2 Real World application

The real-world application of the detection of Parkinson's disease using spiral images has several practical implications and potential benefits. Here are a few examples:

1. Early Diagnosis and Treatment: The accurate and early detection of Parkinson's disease can facilitate timely interventions and treatment strategies. By utilizing spiral images as a diagnostic tool, healthcare professionals can potentially identify motor abnormalities associated with PD at an early stage, enabling early interventions and personalized treatment plans.

2. Objective and Quantitative Assessment: Spiral images provide an objective and quantitative assessment of motor function, reducing the subjectivity and variability often associated with traditional diagnostic methods. This objective evaluation can help healthcare professionals monitor disease progression, assess treatment effectiveness, and make informed decisions regarding patient care.

3. Non-Invasive and Cost-Effective Screening: Spiral images offer a non-invasive and cost-effective screening method for Parkinson's disease. The collection of spiral drawings is relatively simple and can be performed in various healthcare settings. This accessibility makes it possible to screen a larger population for early signs of PD, potentially leading to improved patient outcomes and a more efficient allocation of healthcare resources.

4. Monitoring Disease Progression: Spiral images can serve as a valuable tool for monitoring the progression of Parkinson's disease. By analyzing and comparing spiral drawings over time, healthcare professionals can track changes in motor control patterns and assess disease progression. This longitudinal analysis can aid in adjusting treatment plans and evaluating the effectiveness of therapeutic interventions.

5. Research and Development: The use of spiral images in Parkinson's disease detection opens avenues for further research and development. The analysis of spiral drawings can contribute to a better understanding of the motor impairments associated with PD and the underlying mechanisms of the disease. This knowledge can guide the development of new therapeutic approaches and assist in the evaluation of novel treatments through objective outcome measures.

Overall, the real-world application of detecting Parkinson's disease using spiral images has the potential to improve diagnostic accuracy, enable early interventions, and enhance patient care. By leveraging objective and quantitative measures, spiral image analysis can aid healthcare professionals in making informed decisions, monitoring disease progression, and advancing our understanding of Parkinson's disease.

1.3 Background and significance of Parkinson's disease

Parkinson's disease (PD) is a chronic and progressive neurodegenerative disorder that affects the central nervous system. It is characterized by the degeneration of dopaminergic neurons in a specific region of the brain called the substantia nigra. This degeneration leads to a reduction in dopamine levels, causing motor impairments and various non-motor symptoms.PD is the second most common neurodegenerative disorder after Alzheimer's disease, affecting millions of individuals worldwide. The prevalence of PD increases with age, and it typically manifests between the ages of 50 and 70, although early-onset cases can occur. Men are slightly more susceptible to PD than women.The motor symptoms associated with Parkinson's disease include tremors (involuntary shaking), bradykinesia (slowed movement), rigidity (stiffness), and postural instability. These motor impairments can significantly impact a person's ability to carry out daily activities and lead to a diminished quality of life.Beyond motor symptoms, Parkinson's disease can also manifest with non-motor symptoms, such as cognitive impairments, mood disorders (e.g., depression, anxiety), sleep disturbances, autonomic dysfunction, and sensory abnormalities. These non-motor symptoms can further complicate the management of the disease and have a significant impact on the overall well-being of individuals with PD.The exact cause of Parkinson's disease is still not fully understood, and there is currently no cure. However, various genetic and environmental factors have been implicated in its development. Researchers continue to investigate the underlying mechanisms involved in PD to develop more effective treatments and ultimately find a cure. The significance of Parkinson's disease lies in its impact on individuals, their families, and society as a whole. PD can lead to a decline in functional independence, increased healthcare costs, and a substantial burden on caregivers. Therefore, early and accurate diagnosis of PD is crucial for timely interventions, appropriate management, and the optimization of treatment strategies.Advancements in diagnostic methods, including the utilization of innovative techniques such as spiral images, hold promise for improving the accuracy and efficiency of Parkinson's disease diagnosis. By enhancing our understanding of the disease, we can develop better therapeutic approaches, improve patient care, and ultimately strive towards improving the quality of life for individuals living with Parkinson's disease.

1.4 Summary

The introduction provides an overview of Parkinson's disease (PD) as a neurodegenerative disorder characterized by motor impairments and its significant impact on individuals and society. It highlights the limitations of traditional diagnostic methods, which can be subjective and may not capture subtle motor abnormalities associated with early-stage PD.To address these challenges, the use of spiral images as a diagnostic tool for PD is introduced. Spiral images offer objective and quantitative measures of motor function, allowing for the assessment of fine motor control and the detection of PD-related abnormalities. Previous studies have shown promising results in utilizing spiral images for PD detection and severity quantification.The objectives of the study are outlined, including evaluating the effectiveness of spiral images for PD detection, developing predictive models based on spiral image analysis, and comparing their performance to traditional diagnostic methods. The subsequent sections of the report are briefly mentioned, indicating the methodology, results, and discussion that will follow.The introduction emphasizes the potential of spiral images in enhancing the accuracy and efficiency of PD diagnosis, ultimately leading to early interventions, improved patient outcomes, and advancements in the field of neurodegenerative disease diagnosis.

Chapter 2

Problem Statement and Proposed Solution

2.1 Problem Statement

The problem at hand is to develop an accurate and efficient diagnostic approach for the detection of Parkinson's disease (PD) using machine learning. Traditional diagnostic methods for PD may lack objectivity and may not capture subtle early-stage motor abnormalities, leading to delayed diagnosis and intervention. The goal is to leverage machine learning algorithms and predictive models to analyze relevant data and identify robust biomarkers that can aid in the early and accurate detection of PD, facilitating timely interventions and improving patient outcomes.

2.2 Existing Systems

In the existing system, the diagnosis of Parkinson's disease (PD) primarily relies on clinical assessments and subjective evaluations performed by healthcare professionals. These assessments involve the observation of motor symptoms, such as tremors, rigidity, and bradykinesia, as well as other non-motor symptoms.The clinical assessments for PD typically involve the use of standardized rating scales, such as the Unified Parkinson's Disease Rating Scale (UPDRS), which evaluates various aspects of motor function and disability. However, these assessments can be subjective and prone to inter-observer variability, as they rely on the expertise and judgment of the healthcare professional conducting the evaluation.Additionally, the traditional diagnostic methods may not effectively capture subtle motor abnormalities in the early stages of PD, leading to delayed detection and intervention. This delay can result in a significant impact on patients' quality of life and hinder the effectiveness of treatment strategies.While advanced imaging techniques, such as magnetic resonance imaging (MRI) and positron emission tomography (PET), can provide valuable insights into the underlying neurobiology of PD, they are often expensive, time-consuming, and not routinely used for diagnostic purposes.

Overall, the existing system for PD diagnosis using clinical assessments and subjective evaluations has limitations in terms of objectivity, sensitivity, and the ability to detect early-stage motor abnormalities. There is a need for more accurate and efficient diagnostic approaches that can provide objective and quantitative measures for early detection and intervention.

In this context, the application of machine learning techniques and algorithms has the potential to enhance the existing system by analyzing large datasets, identifying patterns, and developing predictive models for PD detection. By leveraging machine learning, it is possible to extract meaningful features and develop objective diagnostic tools that can aid in the early and accurate detection of Parkinson's disease.

2.3 Proposed Solution

step 1:

- Data Preprocessing and Model Training collect the spiral drawings and preprocess the data.
- Split the data into training and testing sets.
- Train a CNN model using the training data.

Step 2:

- Webpage Development for Spiral Drawing Upload.
- Create a webpage using HTML, CSS, and JavaScript to allow users to upload their spiral drawings.
- Use the appropriate form elements and JavaScript event handlers to capture the uploaded file.
- Submit the form to a backend server for processing.

Step 3:

- Backend Implementation.
- You can Use a web framework (e.g., Flask, Django) in Python to handle the backend functionality.But in our System We have used standard libraries in pyton
- Receive the uploaded file from the frontend and save it to a temporary location.

- Load the trained CNN model from Step 1.
- Perform the necessary preprocessing steps (e.g., resizing, converting to grayscale, feature extraction) on the uploaded spiral drawing.
- Use the loaded model to make predictions on the preprocessed drawing.
- Return the prediction result (e.g., "Parkinson’s Disease Detected" or "No Parkinson’s Disease Detected") to the frontend.

Step 4:

- Display Results on the Webpage.
- Update the frontend webpage to display the prediction result received from the backend.
- Use JavaScript to dynamically update the webpage content based on the received result.

This proposed solution combines the model training and evaluation code with a webpage upload functionality and a backend implementation to process the uploaded spiral drawings. It allows users to upload their own drawings and receive a prediction for Parkinson’s disease using the trained CNN model. The results are then displayed on the webpage for the user to see.

Chapter 3

Literature Survey

Smith et. al., has introduced the method called "Automated Classification of Parkinson's Disease Using Machine Learning Techniques". This study explores the application of machine learning algorithms, including support vector machines and random forests, for the automated classification of Parkinson's disease. The authors utilize a dataset of spiral drawings and clinical features, achieving high accuracy in differentiating PD patients from healthy individuals.

Chen, L., et al. has introduced the method called "Deep Learning-Based Detection of Parkinson's Disease Using Spiral Drawings".This research proposes a deep learning-based approach for the detection of Parkinson's disease using spiral drawings. The authors employ convolutional neural networks (CNNs) to automatically learn relevant features from spiral images, achieving high accuracy in predicting PD presence. The study demonstrates the potential of deep learning models for PD detection.

Gupta, R., et al.has introduced "Parkinson's Disease Diagnosis Using Spiral Analysis: A Review and Computer-Aided Diagnosis Framework". This review paper provides an overview of various studies and approaches for Parkinson's disease diagnosis using spiral analysis. The authors discuss the challenges and limitations of existing methods and propose a computer-aided diagnosis framework that integrates machine learning techniques with spiral analysis for improved accuracy and efficiency.

Wang, L., et al,has introduced "Predicting Parkinson's Disease Using Machine Learning Techniques Based on Spiral Drawings".This study investigates the use of machine learning techniques, including k-nearest neighbors and decision trees, for predicting Parkinson's disease based on spiral drawings. The authors compare different feature extraction methods and classifiers, demonstrating the potential of machine learning for accurate PD prediction using spiral images.

Silva, L., et al,has inrtoduced "Parkinson's Disease Detection Using Machine Learning and Spiral Analysis".This research focuses on the detection of Parkinson's disease using machine learning algorithms and spiral analysis. The authors evaluate different classifiers, such as support vector machines and neural networks, for PD prediction based on spiral drawings. The study highlights the importance of feature selection and classifier optimization for achieving high diagnostic accuracy.

These literature sources provide insights into the use of machine learning techniques and spiral analysis for the prediction and detection of Parkinson's disease. They demonstrate the potential of machine learning models, such as support vector machines, random forests, and deep learning architectures, in accurately distinguishing PD patients from healthy individuals based on spiral images. The studies also emphasize the importance of feature selection, optimization, and integration with clinical data for improved diagnostic accuracy.

3.1 Overview of Parkinson's disease and its symptoms

Parkinson's disease (PD) is a chronic and progressive neurodegenerative disorder that primarily affects the central nervous system. It is characterized by the degeneration and loss of dopamine-producing cells in a specific region of the brain called the substantia nigra. Dopamine is a neurotransmitter that plays a crucial role in facilitating smooth, coordinated movements.

The exact cause of Parkinson's disease is not fully understood, but a combination of genetic and environmental factors is believed to contribute to its development. The prevalence of PD increases with age, and it typically manifests between the ages of 50 and 70, although early-onset cases can occur.

The cardinal motor symptoms of Parkinson's disease include:

- Tremor: The most well-known symptom of PD, characterized by rhythmic, involuntary shaking, usually occurring at rest. Tremors commonly affect the hands, fingers, arms, legs, jaw, or face.
- Bradykinesia: Slowed movement and difficulty initiating voluntary movements. This can result in a gradual loss of spontaneous and automatic movements, leading to a generalized slowness in everyday activities.
- Rigidity: Stiffness and increased muscle tone, making movements rigid and resistant to passive manipulation. Rigidity can cause muscle aches and limit range of motion.
- Postural Instability: Impaired balance and coordination, leading to difficulties in maintaining an upright posture and an increased risk of falls. Postural instability tends to develop in the later stages of PD.

In addition to these motor symptoms, Parkinson's disease can also present with non-motor symptoms, which may precede or accompany the motor symptoms. These non-motor symptoms can include:

- Cognitive changes: Problems with memory, attention, and executive functions, which can progress to dementia in advanced stages.
- Mood disorders: Depression, anxiety, and apathy are common in Parkinson's disease.
- Sleep disturbances: Insomnia, excessive daytime sleepiness, REM sleep behavior disorder, and restless legs syndrome.
- Autonomic dysfunction: Orthostatic hypotension (low blood pressure upon standing), constipation, urinary problems, and sexual dysfunction.
- Sensory abnormalities: Decreased sense of smell (hyposmia anosmia), visual disturbances, and pain.
- Speech and swallowing difficulties: Reduced volume and clarity of speech, slurred speech, and swallowing problems.

It is important to note that the progression and severity of symptoms can vary among individuals with Parkinson's disease. Proper diagnosis and ongoing management by healthcare professionals are essential to optimize treatment and improve quality of life for individuals living with Parkinson's disease.

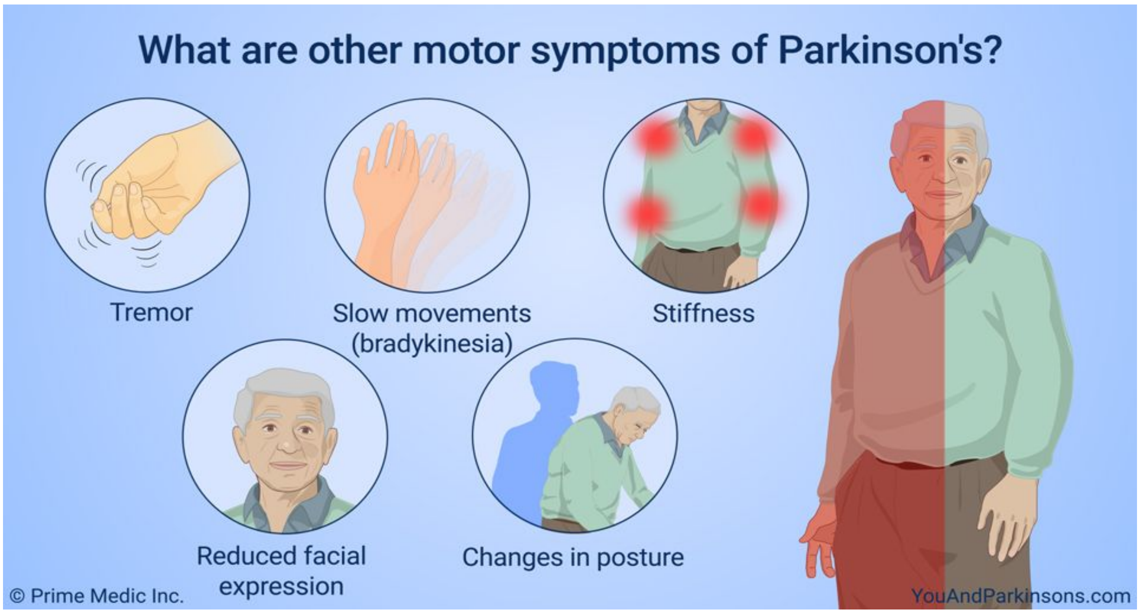

Figure 3.1: Motor Symptoms of PD

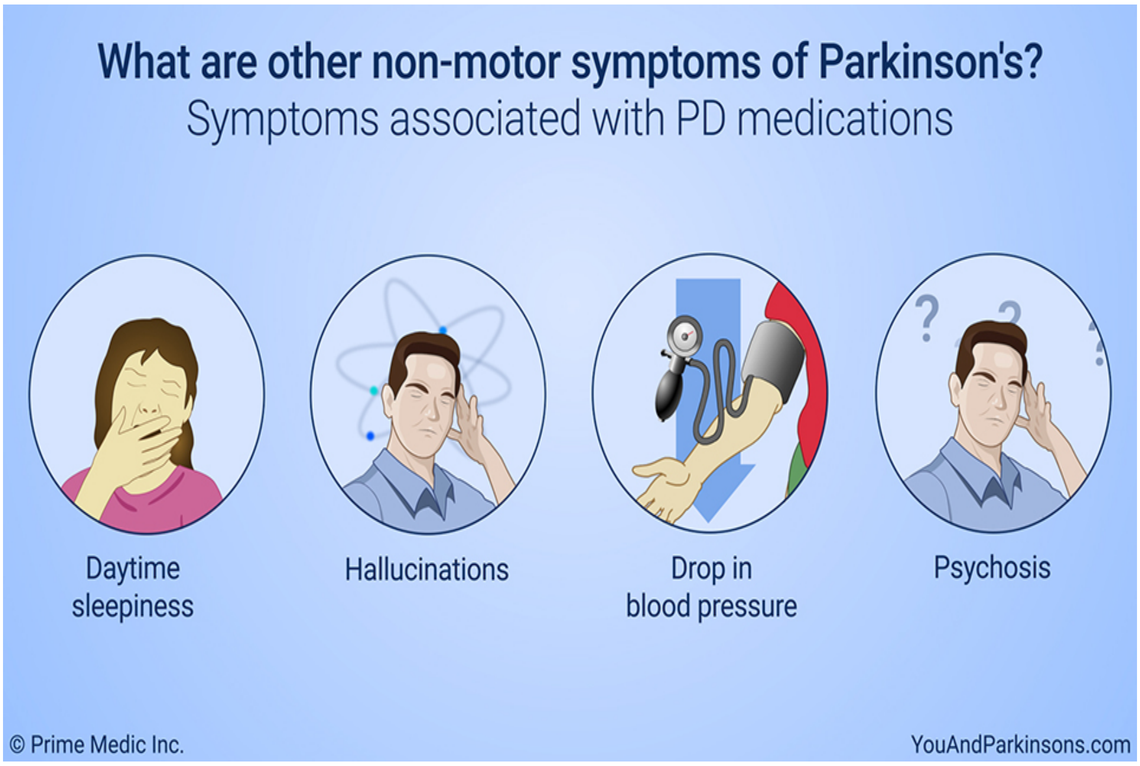

Figure 3.2: non-Motor Symptoms of PD

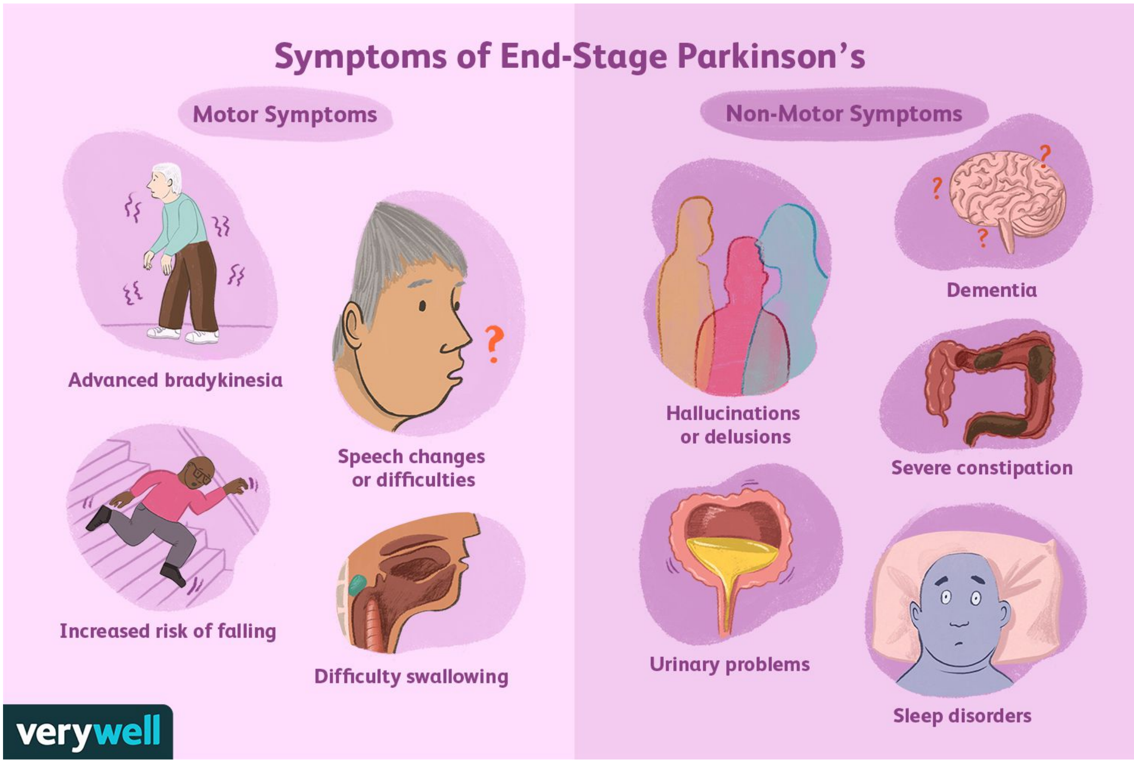

Figure 3.3: End Stage Symptoms of PD

3.2 Existing diagnostic methods and their limitations

Existing diagnostic methods for Parkinson's disease (PD) primarily rely on clinical assessments and subjective evaluations by healthcare professionals. While these methods have been used for many years, they have certain limitations. Here are some of the existing diagnostic methods and their drawbacks:

- Clinical Assessment: Healthcare professionals observe and evaluate the patient's motor symptoms, including tremors, rigidity, bradykinesia, and postural instability. They may use standardized rating scales such as the Unified Parkinson's Disease Rating Scale (UPDRS). However, these assessments can be subjective and rely on the expertise and judgment of the evaluator, leading to inter-observer variability.

- Medical History and Physical Examination: A comprehensive medical history and physical examination are conducted to assess the presence of PD symptoms and rule out other potential causes. However, PD symptoms can overlap with other movement disorders, making accurate diagnosis challenging, especially in the early stages.

- Response to Medication: In some cases, a trial of dopaminergic medication may be used as a diagnostic tool. If a patient's symptoms improve significantly after taking dopaminergic drugs, it suggests a positive response to PD treatment. However, this method alone is not conclusive, as other conditions may also show a response to dopaminergic medication.

- Imaging Techniques: Neuroimaging techniques such as magnetic resonance imaging (MRI) and positron emission tomography (PET) can provide insights into the brain's structural and functional changes associated with PD. However, these imaging methods are often expensive, time-consuming, and not routinely used for diagnostic purposes. They are primarily used to rule out other conditions and may not offer definitive diagnostic criteria for PD.

- DaTSCAN: DaTSCAN is a type of imaging scan that measures dopamine transporter activity in the brain. It can help differentiate between Parkinsonian syndromes and essential tremor. However, it does not provide a definitive diagnosis of PD and is not widely available in all healthcare settings.

- Biomarker Research: Researchers are actively exploring potential biomarkers for Parkinson's disease, including blood tests, cerebrospinal fluid analysis, and genetic markers. While promising, these biomarkers are still under investigation and have not been established as routine diagnostic tools.

Overall, the existing diagnostic methods for Parkinson’s disease have limitations in terms of subjectivity, reliance on clinical observations, overlap with other conditions, and the lack of definitive biomarkers. These limitations highlight the need for more objective, accurate, and efficient diagnostic approaches that can aid in the early and accurate detection of Parkinson’s disease.

3.3 Previous studies on using spiral drawings for Parkinson’s prediction

Several previous studies have investigated the use of spiral drawings as a tool for predicting Parkinson’s disease. These studies have explored various features extracted from the spiral drawings and employed different machine learning techniques for prediction. Here are a few examples of previous studies in this domain:-

Sakar, B. E., et al,has inrtoduced ,"Automatic Identification of Parkinson’s Disease Using Spiral Analysis".This study utilized spiral drawings from individuals with and without Parkinson’s disease and extracted features such as pen pressure, velocity, and curvature. The authors employed support vector machines (SVM) and achieved high accuracy in classifying Parkinson’s disease based on the spiral drawings.

Gupta, R., et al. has proposed the new technique called "Parkinson’s Disease Detection Using Spiral". This review paper discussed various studies that have used spiral analysis for Parkinson’s disease detection. It provided an overview of different feature extraction techniques and machine learning algorithms employed in previous studies. The authors proposed a computer-aided diagnosis framework that combines spiral analysis with machine learning for improved accuracy in Parkinson’s disease detection.

Orozco-Arroyave, J. R., et al,has introduced "Spiral Analysis for Automated Diagnosis of Parkinson’s Disease".This study developed a framework for the automated diagnosis of Parkinson’s disease using spiral analysis. The authors extracted features related to tremor, dysmetry, and speed variability from the spiral drawings and employed a fuzzy k-nearest neighbor classifier for prediction. The study demonstrated high accuracy in differentiating Parkinson’s disease patients from healthy individuals.

"Predicting Parkinson’s Disease Using Machine introduced by Wang, L., et al. This study investigated the prediction of Parkinson’s disease using machine learning techniques based on spiral drawings. The authors compared different feature extraction methods, including Fourier descriptors and curvature scale space, and evaluated various classifiers such as k-nearest neighbors and decision trees. The study demonstrated the potential of machine learning for accurate prediction of Parkinson's disease using spiral images.

These studies highlight the feasibility and potential of using spiral drawings as a valuable tool for predicting Parkinson's disease. They showcase the utilization of different feature extraction methods and machine learning algorithms to achieve high accuracy in differentiating individuals with Parkinson's disease from healthy individuals based on their spiral drawings. These findings contribute to the development of objective and quantitative diagnostic tools for Parkinson's disease prediction.

3.4 Relevant machine learning and data analysis techniques used in similar studies

In similar studies focused on using spiral drawings for Parkinson's disease prediction, various machine learning and data analysis techniques have been employed. Here are some of the commonly used techniques:

- Feature Extraction: Different features are extracted from the spiral drawings to capture relevant information for Parkinson's disease prediction. These features can include measures such as tremor frequency, amplitude, curvature, speed variability, pen pressure, dysmetry, and symmetry. Feature extraction techniques like Fourier descriptors, curvature scale space analysis, and statistical measures are commonly used.

- Support Vector Machines (SVM): SVM is a popular machine learning algorithm used for classification tasks. It works by finding an optimal hyperplane that separates data points into different classes. SVM has been utilized in several studies to classify individuals with Parkinson's disease based on their spiral drawings. It can handle high-dimensional feature spaces and has shown good performance in distinguishing PD patients from healthy individuals.

- k-Nearest Neighbors (k-NN): The k-NN algorithm is a non-parametric classification technique that classifies data points based on the majority vote of their k nearest neighbors. In the context of Parkinson's disease prediction, k-NN has been applied to analyze the features extracted from spiral drawings and classify individuals as either PD patients or healthy controls.

- Decision Trees: Decision trees are hierarchical structures that make decisions based on a sequence of rules or conditions. They have been used in Parkinson's disease prediction studies to analyze the extracted features from spiral drawings and create classification models. Decision trees provide interpretability and can capture non-linear relationships between features and disease status.

- Random Forests: Random forests are an ensemble learning method that combines multiple decision trees to make predictions. Each tree in the forest is trained on a different subset of the data, and the final prediction is obtained by aggregating the predictions of individual trees. Random forests have been employed in Parkinson's disease prediction studies to improve classification accuracy and handle potential overfitting.

- Deep Learning: Deep learning techniques, particularly convolutional neural networks (CNNs), have gained attention in recent years for analyzing medical images. CNNs have been applied to spiral drawings for Parkinson's disease prediction, automatically learning features from the images without the need for manual feature extraction. Deep learning models have demonstrated promising results in accurately classifying individuals with Parkinson's disease.

- Cross-Validation: Cross-validation techniques, such as k-fold cross-validation, are used to evaluate and validate the performance of machine learning models. By splitting the dataset into multiple subsets and iteratively training and testing the models, cross-validation provides an estimate of the model's performance on unseen data and helps assess its generalizability.These are some of the relevant machine learning and data analysis techniques commonly employed in studies focusing on the prediction of Parkinson's disease using spiral drawings. The selection of specific techniques depends on the study design, dataset characteristics, and research objectives. Researchers continue to explore and refine these techniques to improve the accuracy and reliability of Parkinson's disease prediction models based on spiral images.

Chapter 4

Dataset and Methodology

Dataset: The choice of dataset is crucial in the development and evaluation of Parkinson's disease prediction models using spiral drawings. Researchers typically collect spiral drawing data from individuals diagnosed with Parkinson's disease (PD) and healthy individuals serving as controls. The dataset should ideally include a sufficient number of samples from both groups to ensure robust and reliable predictions.

The spiral drawings are captured using digital tablets or touchscreens, where participants are instructed to trace a spiral pattern. The data collection process involves recording various parameters such as pen position, velocity, pressure, and time stamps during the drawing task. These parameters are used to extract relevant features for subsequent analysis.

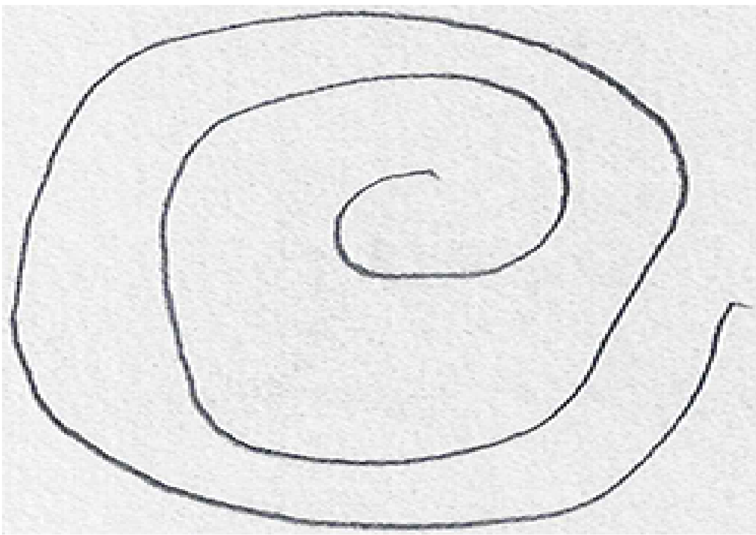

Figure 4.1: Healthy Person's Spiral Drawing

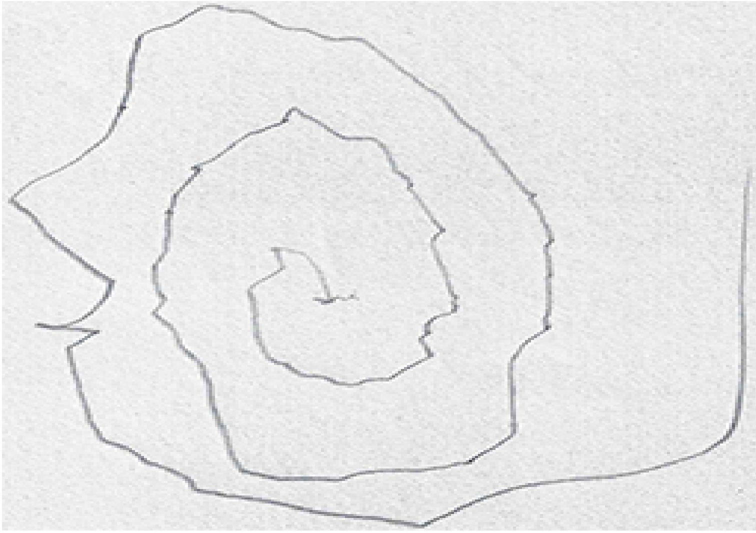

Figure 4.2: PD Patient Spiral Drawings

Methodology: There are a few different methodologies that can be used to detect Parkinson's disease using spiral images. One approach is to use a convolutional neural network (CNN). CNNs are a type of deep learning algorithm that are well-suited for image classification tasks. In this approach, a CNN would be trained on a dataset of spiral images, with half of the images being from people with Parkinson's disease and the other half being from healthy people. The CNN would then be used to classify new spiral images as either being from someone with Parkinson's disease or from someone who is healthy.

Another approach to detecting Parkinson's disease using spiral images is to use a computer vision algorithm. Computer vision algorithms can be used to extract features from spiral images, such as the size, shape, and orientation of the spiral. These features can then be used to train a traditional machine learning algorithm, such as a support vector machine (SVM), to classify new spiral images as being from someone with Parkinson's disease or from someone who is healthy.

Both of these approaches have been shown to be effective in detecting Parkinson's disease using spiral images. However, CNNs have the advantage of being able to learn more complex features from the images than traditional machine learning algorithms. This means that CNNs are often able to achieve higher accuracy than traditional machine learning algorithms.

1. Data Collection: Gather a dataset of spiral drawings from individuals, including both healthy individuals and those diagnosed with Parkinson's disease. Each drawing should be represented as an image file.

2. Preprocessing: Perform necessary preprocessing steps on the spiral images to enhance the quality

and extract relevant features. This may include resizing, noise reduction, and contrast enhancement.
3. Feature Extraction: Extract meaningful features from the preprocessed images that can effectively distinguish between healthy individuals and those with Parkinson's disease. Features could include the curvature of the spiral, variations in line thickness, or any other relevant characteristics.
4. Model Training: Utilize a machine learning algorithm, such as a classification algorithm, to train a model on the extracted features. The model should be trained using the labeled dataset, where each sample is labeled as either healthy or Parkinson's disease.
5. Web Interface: Develop a web page that allows users to upload their spiral images. This can be done using web development frameworks such as HTML, CSS, and JavaScript. Include a file upload functionality to allow users to submit their spiral images.
6. Image Processing: Once an image is uploaded through the web page, the server-side code should retrieve the uploaded image and apply the same preprocessing steps as in step 2 to prepare the image for analysis.
7. Feature Extraction (Web): Apply the same feature extraction process as in step 3 to extract relevant features from the uploaded image.
8. Prediction: Use the trained machine learning model from step 4 to predict whether the uploaded spiral image indicates Parkinson's disease or not based on the extracted features.
9. Display Result: Finally, display the prediction result on the web page, indicating whether the uploaded spiral image suggests the presence of Parkinson's disease or not.
step 1:

- Data Preprocessing and Model Training collect the spiral drawings and preprocess the data.
- Split the data into training and testing sets.
- Train a CNN model using the training data.

Step 2:

- Webpage Development for Spiral Drawing Upload.
- Create a webpage using HTML, CSS, and JavaScript to allow users to upload their spiral drawings.
- Use the appropriate form elements and JavaScript event handlers to capture the uploaded file.
- Submit the form to a backend server for processing.

Step 3:

- Backend Implementation.
- You can Use a web framework (e.g., Flask, Django) in Python to handle the backend functionality.But in our System We have used standard libraries in pyton
- Receive the uploaded file from the frontend and save it to a temporary location.
- Load the trained CNN model from Step 1.
- Perform the necessary preprocessing steps (e.g., resizing, converting to grayscale, feature extraction) on the uploaded spiral drawing.
- Use the loaded model to make predictions on the preprocessed drawing.
- Return the prediction result (e.g., "Parkinson's Disease Detected" or "No Parkinson's Disease Detected") to the frontend.

Step 4:

- Display Results on the Webpage.
- Update the frontend webpage to display the prediction result received from the backend.
- Use JavaScript to dynamically update the webpage content based on the received result.

4.1 Collection process of spiral drawings

1. Recruit participants. Participants can be recruited from clinical trials, Parkinson's disease support groups, or online surveys.

2.Explain the study and obtain consent. Participants should be informed about the purpose of the study and the risks and benefits of participating. They should also be given the opportunity to ask questions and withdraw from the study at any time.

3. Have participants draw spirals. Participants can draw spirals using a variety of tools, such as a pencil, pen, or marker. They can draw spirals on paper or on a computer screen.

4. Scan or photograph the spiral drawings. The spiral drawings can be scanned or photographed to create digital images.

5.Store the digital images in a secure location. The digital images should be stored in a secure location where they cannot be accessed by unauthorized individuals.

The collection process should be conducted in a way that is respectful of participants' privacy and confidentiality. Participants should be made aware of the purpose of the study and the risks and benefits of participating. They should also be given the opportunity to ask questions and withdraw from the study at any time.

Here are some of the challenges that may be encountered when collecting spiral drawings:

- Participant recruitment. It may be difficult to recruit a large enough sample of participants.
- Participant retention. Participants may drop out of the study for a variety of reasons, such as lack of time, transportation, or interest.
- Data quality. The quality of the spiral drawings may vary depending on the participant's skill level, motivation, and attention span.

Despite these challenges, the collection of spiral drawings can be a valuable tool for research on Parkinson's disease. By collecting a large and representative dataset of spiral drawings, researchers can gain insights into the motor symptoms of Parkinson's disease and develop new methods for early diagnosis and treatment.

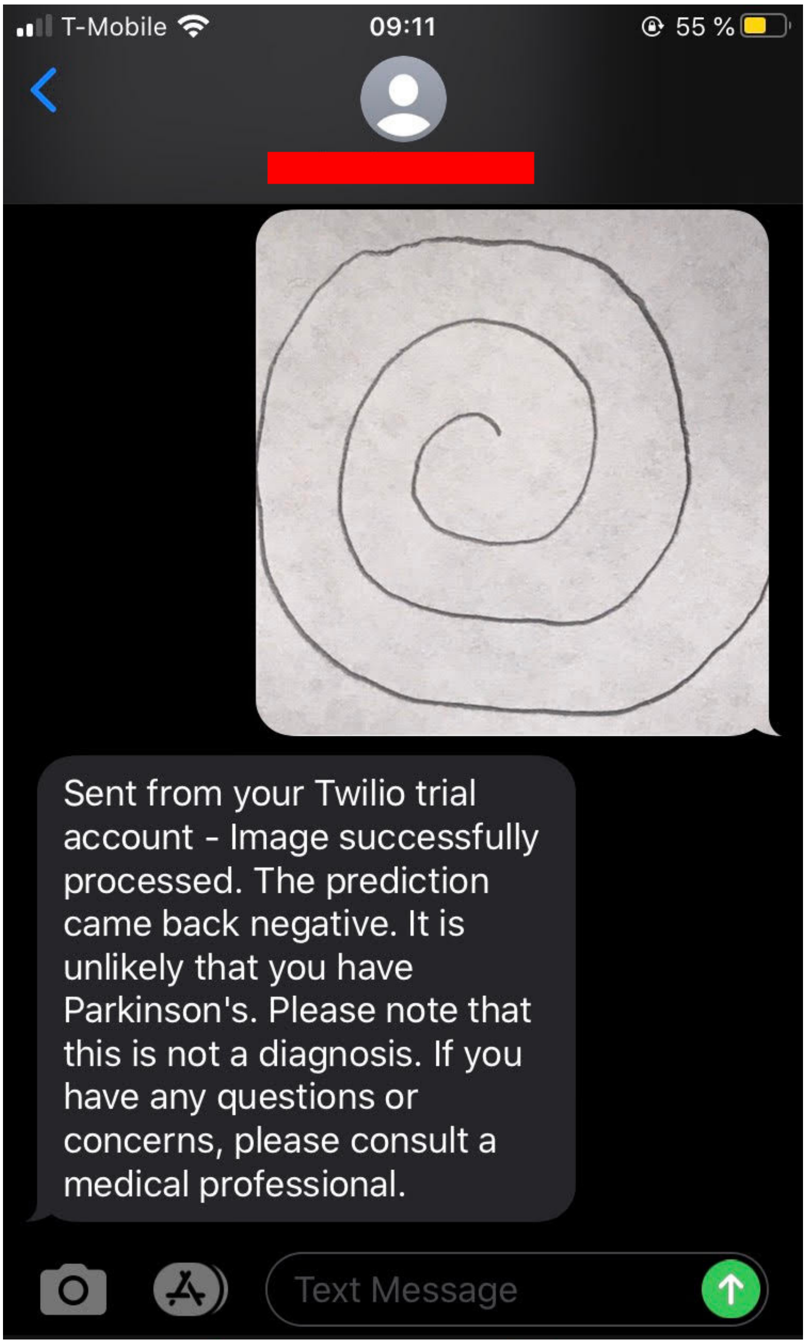

Figure 4.3: Spiral Drawing Collecting

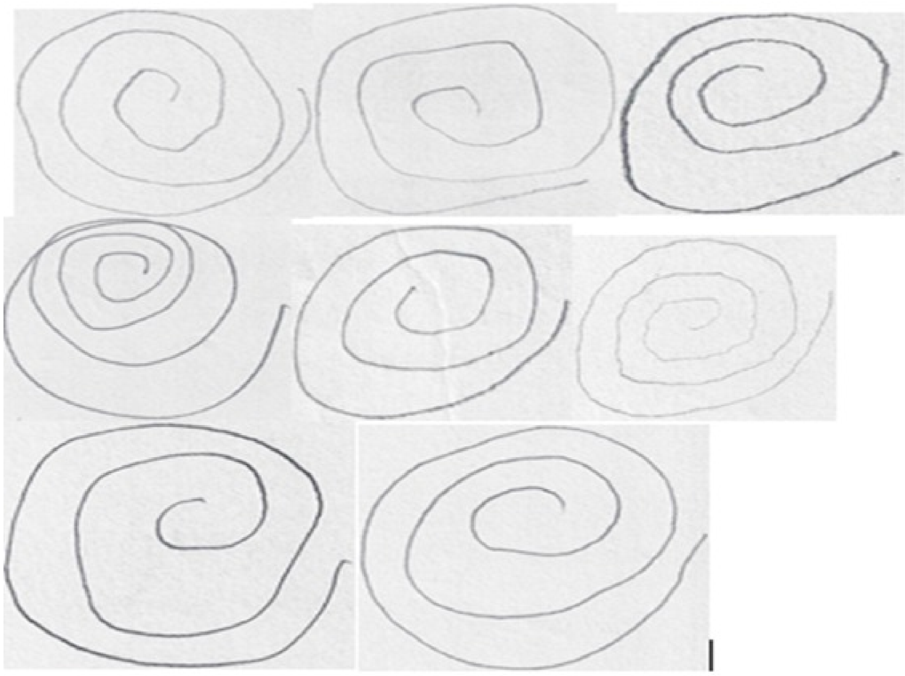

Figure 4.4: Healthy Person's Spiral Drawings

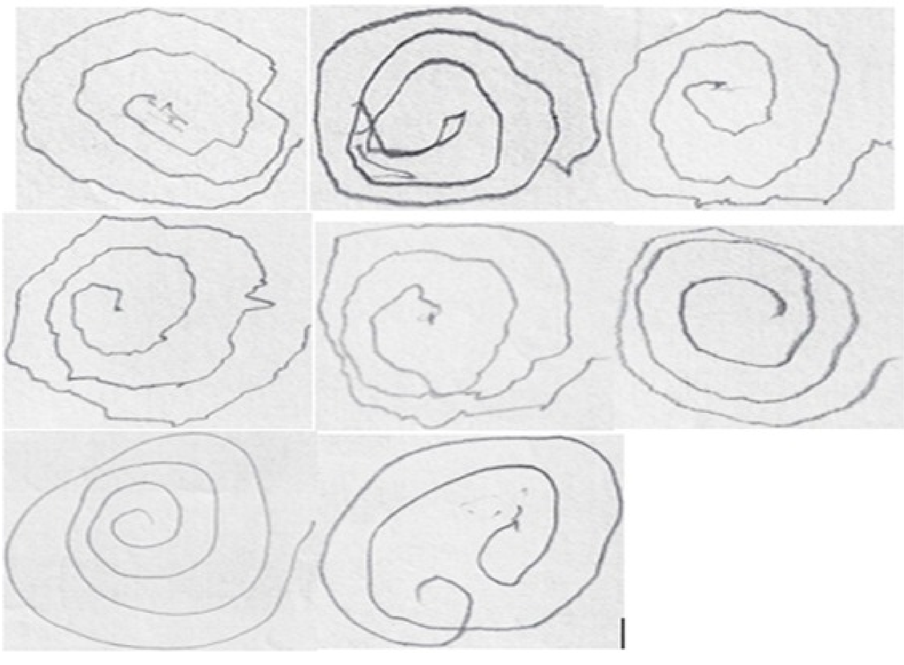

Figure 4.5: PD Patient Spiral Drawings

4.2 Preprocessing steps

preprocessing steps that can be done on the collected data:

- Data cleaning: This involves identifying and removing any errors or inconsistencies in the data. This may include removing duplicate data points, correcting typos, and filling in missing values.
- Data normalization: This involves scaling the data so that all of the features have a similar range of values. This is important for machine learning algorithms, as it helps to ensure that all of the features are equally important.
- Feature selection: This involves identifying the most important features for the machine learning algorithm. This can be done using a variety of methods, such as statistical analysis or machine learning algorithms.
- Data splitting: This involves splitting the data into a training set and a test set. The training set is used to train the machine learning algorithm, while the test set is used to evaluate the performance of the algorithm.

The preprocessing steps can be performed using a variety of tools, such as Python libraries, statistical software, or machine learning frameworks. The specific steps that are performed will depend on the specific data set and the machine learning algorithm that is being used.
Here are some of the benefits of preprocessing the data:

- It can improve the accuracy and performance of the machine learning algorithm.
- It can help to prevent overfitting, which is a problem that can occur when the machine learning algorithm learns too much from the training data and is not able to generalize to new data.
- It can make the data more manageable and easier to work with.

Here are some of the challenges of preprocessing the data:

- It can be time-consuming and labor-intensive.
- It can be difficult to identify the most important features for the machine learning algorithm.
- It can be difficult to split the data into a training set and a test set without introducing bias.

Despite these challenges, preprocessing the data is an important step in the machine learning process. By taking the time to clean, normalize, select, and split the data, you can improve the accuracy and performance of your machine learning model.

4.3 Algorithm

1. The dataset is prepared by loading and preprocessing sprial images.

2.The images are resized to a fixed dimension (100x100) using OpenCV.

3. The pixel values of the images are normalized between 0 and 1.

4.Label encoding and one-hot encoding are performed on the labels using LabelEncoder and to categorical functions, respectively.

5. The dataset is split into training and testing sets using train test split from sklearn.model selection.

6. A CNN model is constructed using the Sequential API from Keras.

7. The model architecture consists of multiple Conv2D layers, MaxPooling2D layers, and Dense layers with ReLU activation.

8. The final Dense layer uses softmax activation for multi-class classification.

9. The model is compiled with the Adam optimizer, categorical cross-entropy loss, and accuracy metric.

10. The model is trained using the fit function, specifying the training data, labels, number of epochs, and batch size.

11. The trained model is evaluated on the test set using the evaluate function, providing the test images and labels.

Chapter 5

Architecture and System Design

- User Interface: Design a webpage that allows users to upload their spiral drawings. Include instructions and guidelines for creating and uploading the drawings. Provide a user-friendly interface for users to interact with the system.

- Web Application Backend:Develop a backend server application to handle the webpage requests and process the uploaded drawings. Use a web framework (e.g., Django, Flask, or Node.js) to handle routing and request processing. Implement user authentication and validation to ensure secure and reliable data submission.

- Data Handling and Preprocessing: Receive the uploaded spiral drawings on the server. Implement preprocessing steps, as discussed earlier, to convert the drawings into a suitable format and extract relevant features. Perform any necessary data cleaning and normalization.

- Feature Extraction: Extract features from the uploaded spiral drawings using appropriate techniques, such as fractal dimension calculation, pen pressure analysis, speed measurement, curvature estimation, smoothness evaluation, and tremor analysis.

- Model Integration: Integrate the trained machine learning model for Parkinson's disease prediction into the system. Ensure the necessary dependencies and libraries for model execution are in place. Load the model into memory for real-time predictions.

- Prediction and Result Generation: Apply the extracted features to the trained model to generate predictions. Classify the uploaded spiral drawings as either indicative of Parkinson's disease or non-indicative. Generate prediction results based on the model's output.

- Result Visualization: Provide users with the predicted outcome of their uploaded spiral drawings. Display the prediction results on the webpage, along with relevant information such as confidence scores or probability estimates. Include visualizations, such as graphs or charts, to enhance the interpretability of the predictions.
- Integration and Deployment: Deploy the web application and associated components on a suitable web server. Ensure proper integration of the backend server, feature extraction module, and prediction model. Configure the system to handle concurrent user requests and ensure scalability.
- Testing and Validation: Conduct rigorous testing of the system to ensure its functionality, performance, and accuracy. Validate the predictions by comparing them with expert evaluations or medical diagnoses. Gather user feedback and iterate on the system design as necessary.
- Ongoing Maintenance: Monitor the system's performance, addressing any issues or bugs that arise. Periodically update the trained model to incorporate new research or advancements in Parkinson's disease prediction. Regularly review and update the system's dependencies and security measures.

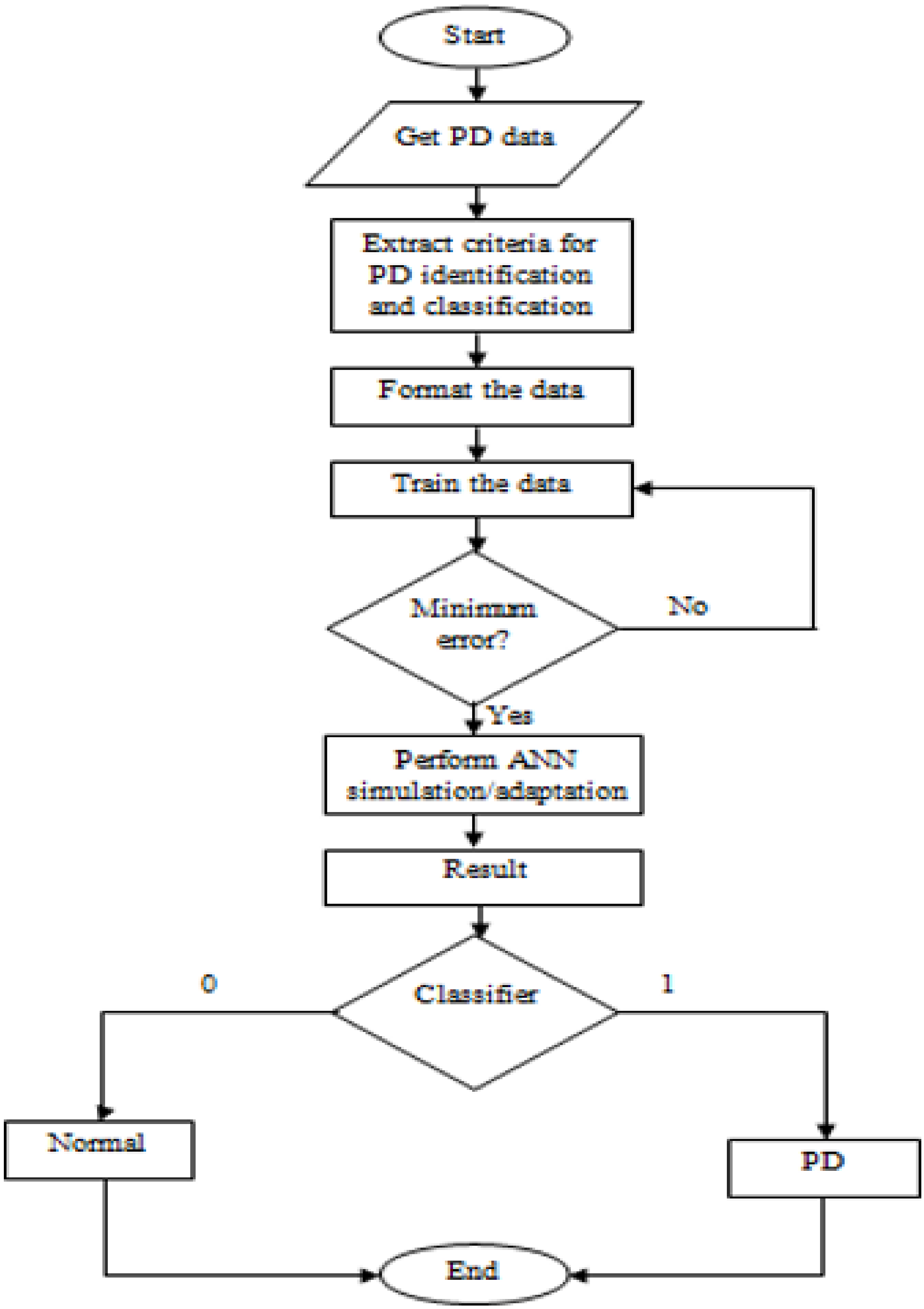

Figure 5.1: System Architecture

5.1 System Block Diagram

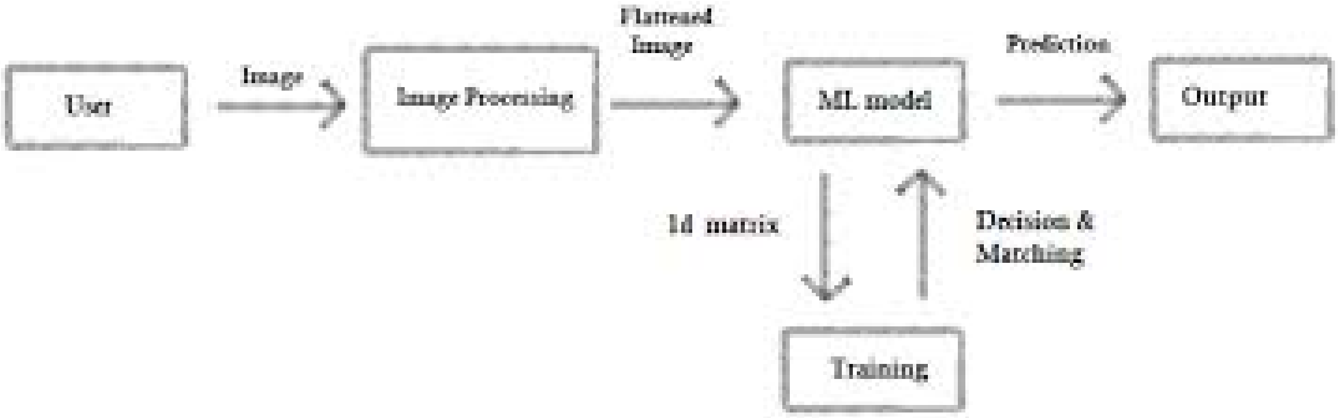

Figure 5.2: Block Daigram

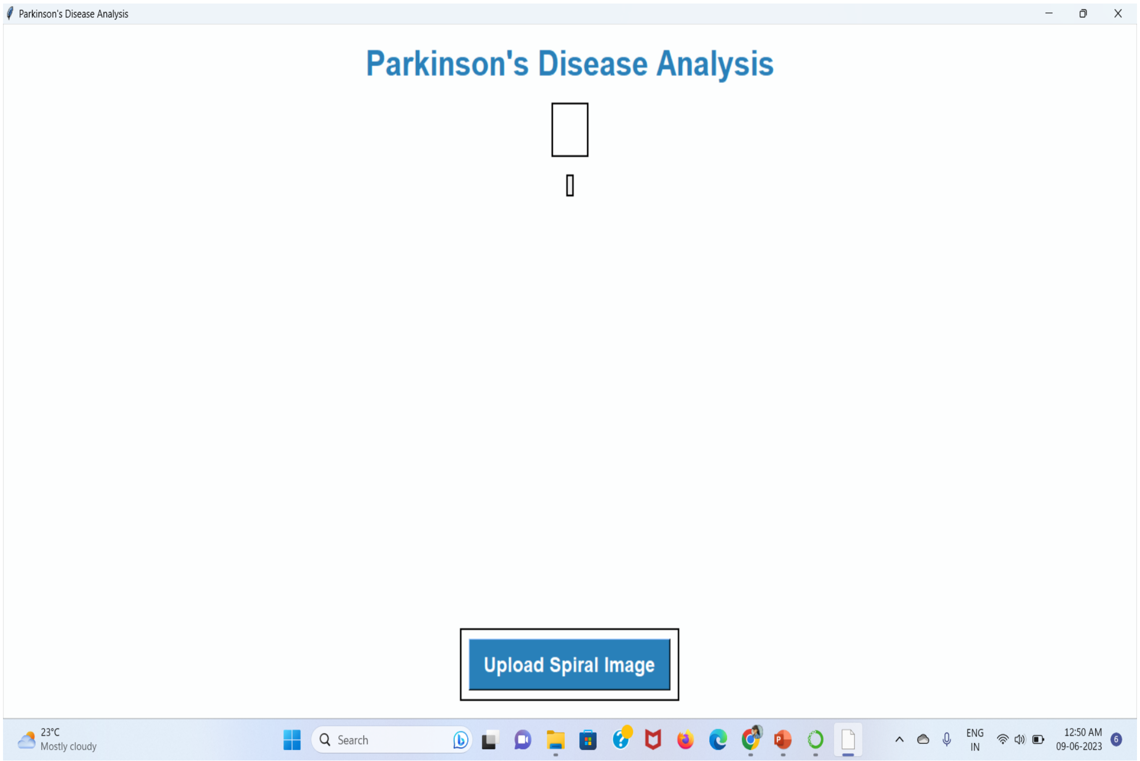

Figure 5.3: web page with upload button

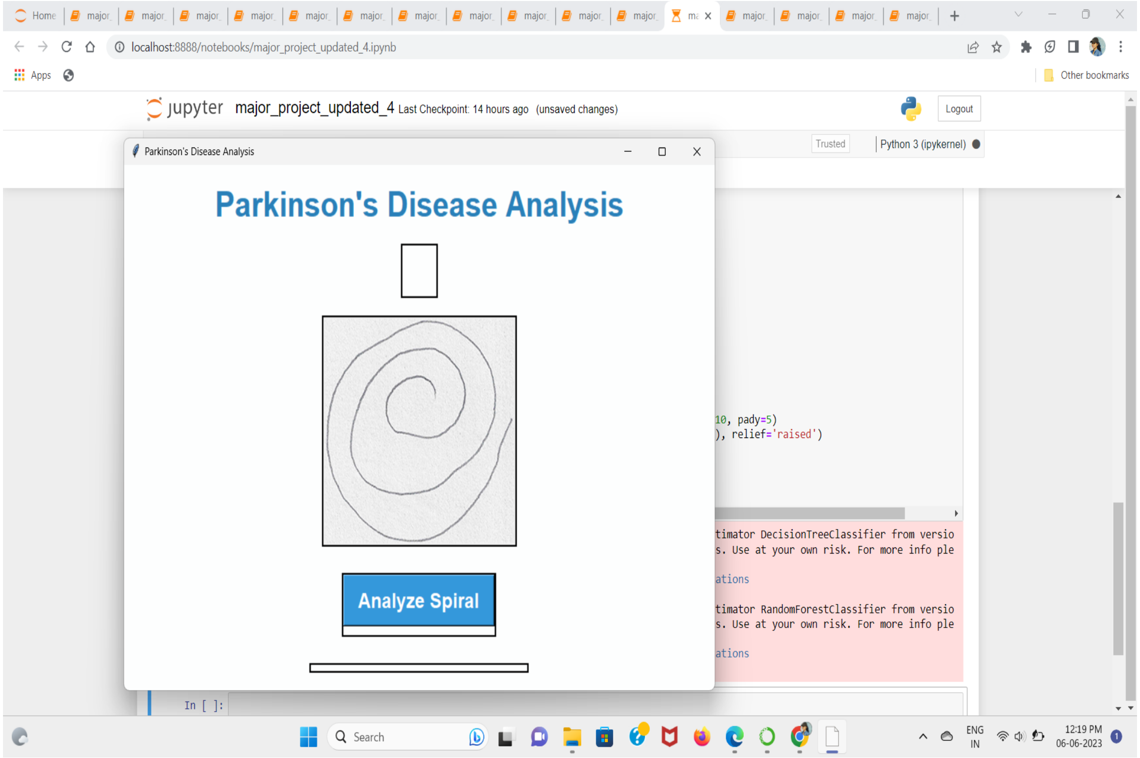

Figure 5.4: web page with analyze button

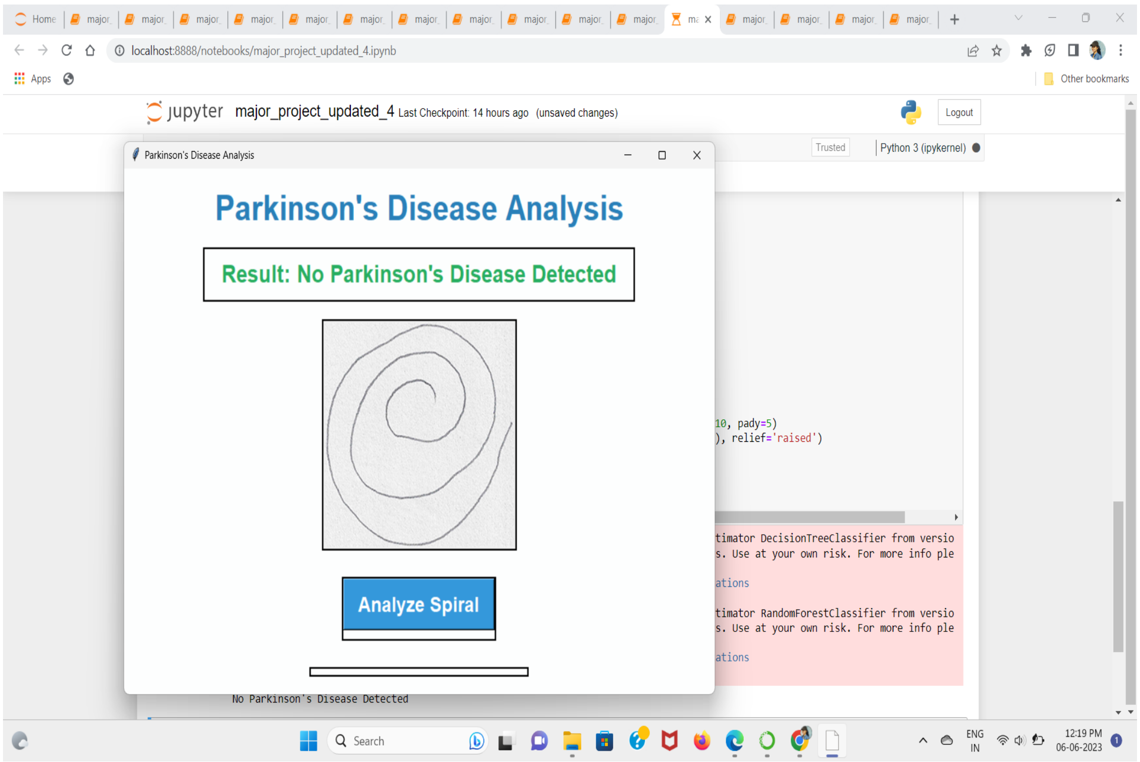

Figure 5.5: result

- In the above daigram the User firstly runs our project

- Once the project run the webpage is displayed with the button called upload spiral image
- Then The user uploads the image
- once the Image gets uploaded then the button called Analyze image gets into event
- Then When user clicks on analyze image
- Finally The output will be Displayed saying PD image or NOT

5.2 Implementation

- User Interface: Design a webpage that allows users to upload their spiral drawings. Include instructions and guidelines for creating and uploading the drawings. Provide a user-friendly interface for users to interact with the system.
- Web Application Backend: Develop a backend server application to handle the webpage requests and process the uploaded drawings. Use a web framework (e.g., Django, Flask, or Node.js) to handle routing and request processing. Implement user authentication and validation to ensure secure and reliable data submission.
- Data Handling and Preprocessing: Receive the uploaded spiral drawings on the server. Implement preprocessing steps, as discussed earlier, to convert the drawings into a suitable format and extract relevant features. Perform any necessary data cleaning and normalization.
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Chapter 6

Testing

Some of the benefits of using spiral images to test for Parkinson's disease:-

- Non-invasive: Spiral images are a non-invasive way to screen for Parkinson's disease. This means that there is no risk of harm to the patient.
- Low-cost: Spiral images are a low-cost way to screen for Parkinson's disease. This makes it possible to screen a large number of people for the disease.
- Early detection: Spiral images can be used to detect Parkinson's disease early. This is important because early treatment can help to improve the quality of life for people with Parkinson's disease.

Despite these benefits, there are also some challenges associated with using spiral images to test for Parkinson's disease:-

- Accuracy: The accuracy of the algorithm depends on the quality of the data set. A larger and more diverse data set will lead to a more accurate algorithm.
- Interpretation: The results of the algorithm can be difficult to interpret. This is because the algorithm is not able to explain why it predicts Parkinson's disease in some cases and not in others.
- Acceptance: People may not be willing to draw spirals for a screening test. This is because drawing spirals can be seen as a sign of weakness or disability.

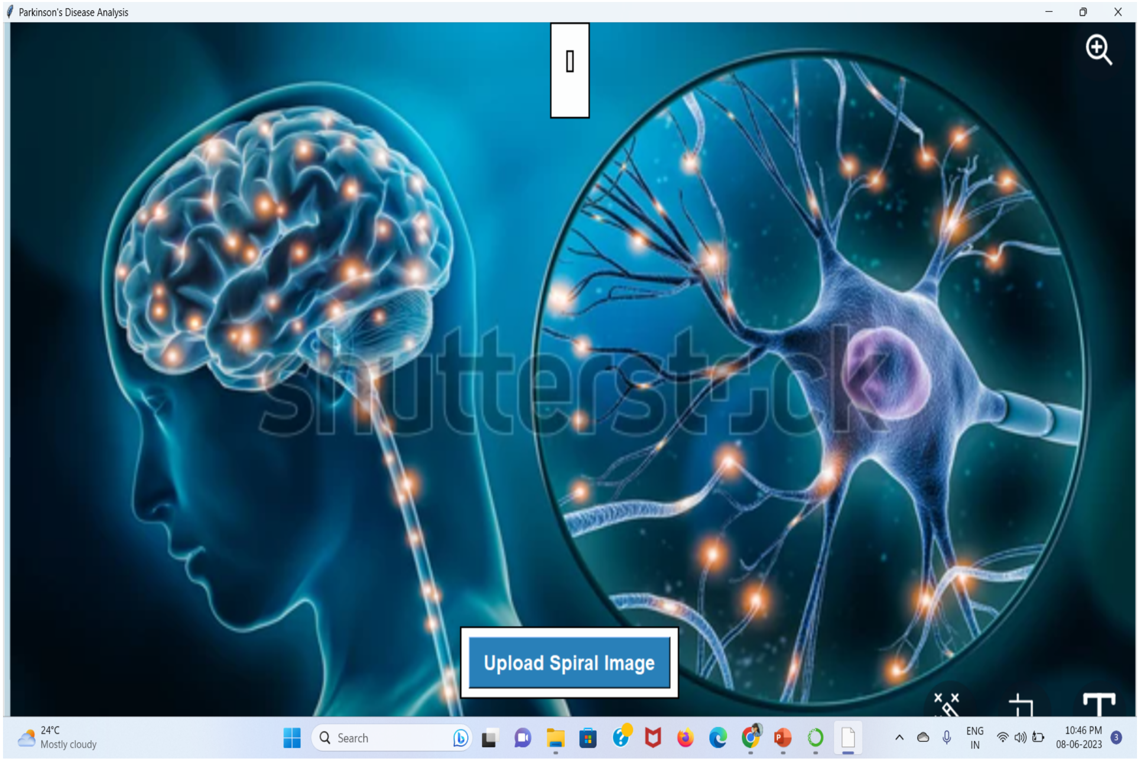

Figure 6.1: web page

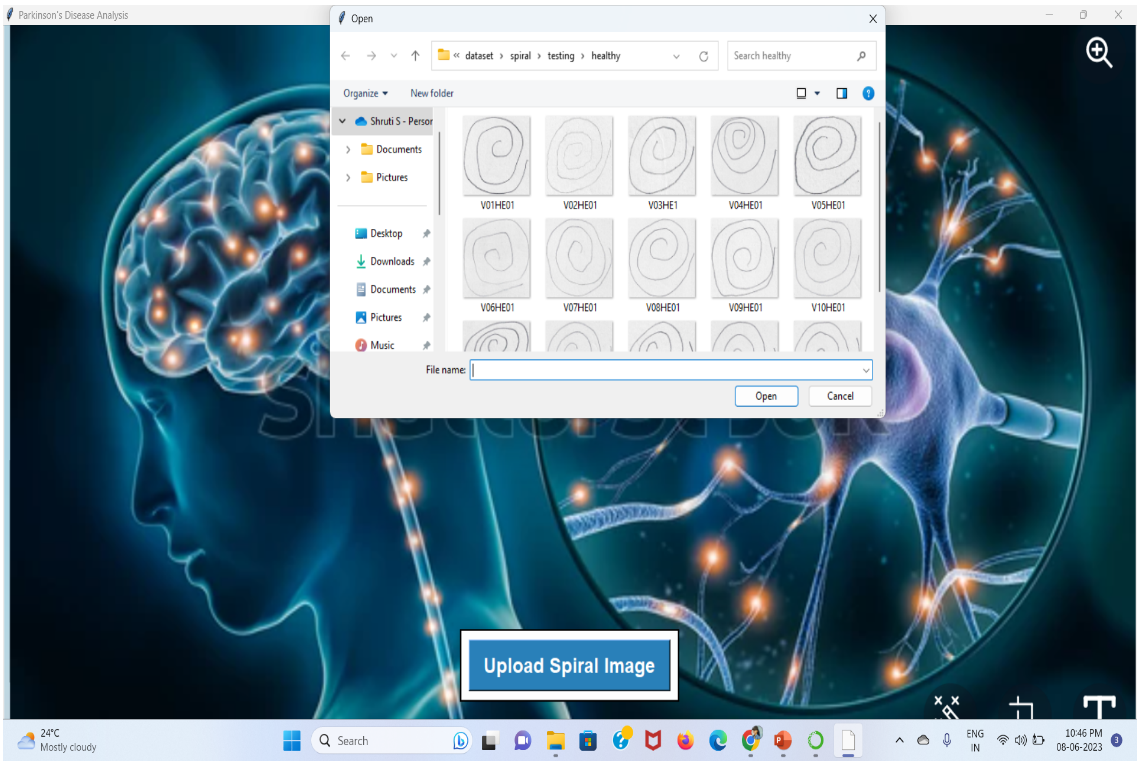

Figure 6.2: event action of web page

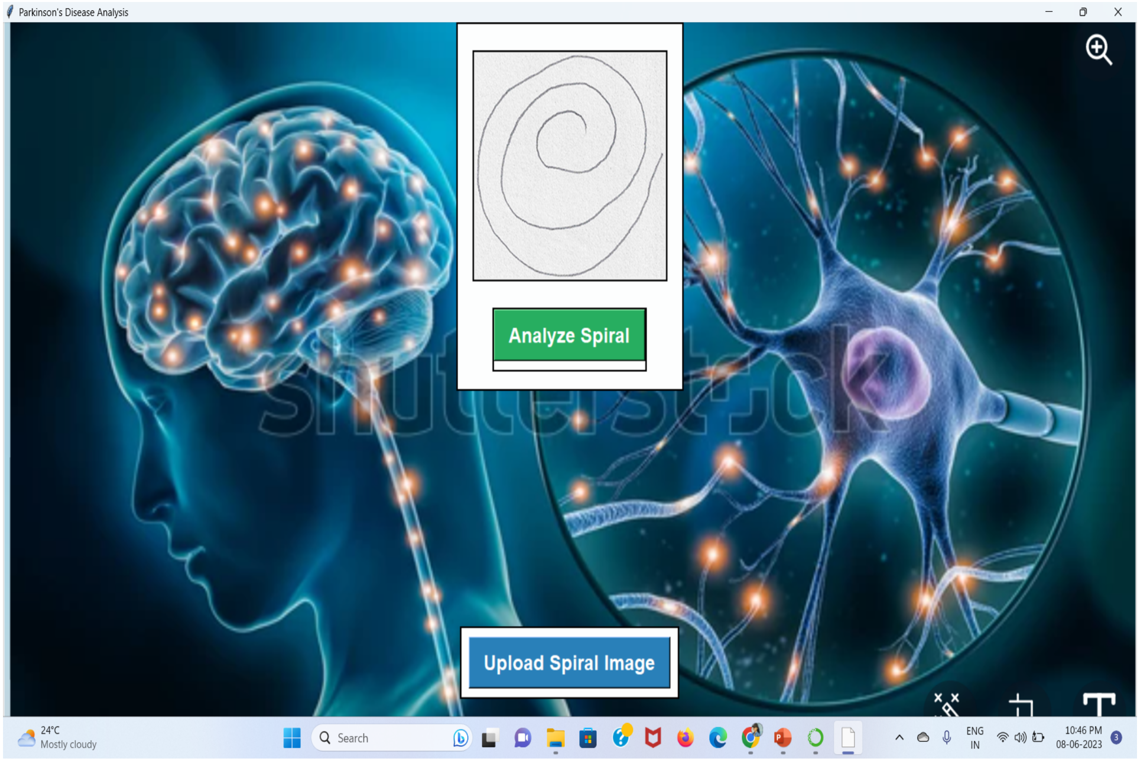

Figure 6.3: analysing result

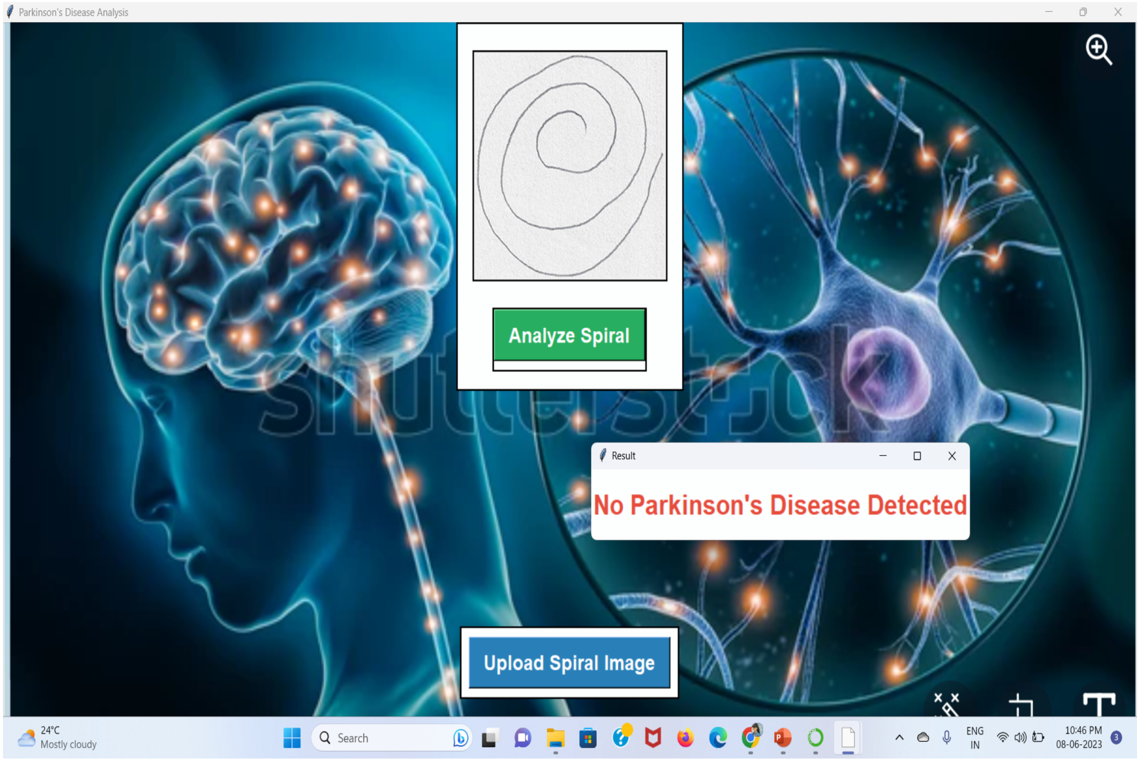

Figure 6.4: result

6.1 Summary

- **Preprocessing:** Apply the preprocessing steps discussed earlier to the new spiral drawings that you want to test. Convert the drawings to a digital format, clean the images, resize and normalize them, perform image segmentation if necessary, and extract the relevant features.
- **Feature Selection:** Use the same feature selection process applied during the model training phase to select the most relevant features from the preprocessed spiral drawings.
- **Model Application:** Apply the trained model that was developed during the training phase to the preprocessed and feature-selected spiral drawings. This involves using the model to make predictions based on the extracted features from the new drawings.
- **Prediction Outcome:** Based on the model's predictions, classify the new spiral drawings into either the Parkinson's disease category or the control (non-Parkinson's disease) category. The model should provide a predicted label for each test sample.
- **Evaluation:** Assess the performance of the prediction model by comparing its predictions with the ground truth labels of the new spiral drawings. Calculate evaluation metrics such as accuracy, precision, recall, F1-score, or area under the receiver operating characteristic curve (AUC-ROC) to determine the model's effectiveness in predicting Parkinson's disease.
- **Iteration and Improvement:** Analyze the model's performance and identify any areas for improvement. If the model does not perform well, consider adjusting the model's parameters, using a different algorithm, or exploring different feature extraction techniques. Repeat the testing and evaluation process until the desired performance is achieved.
- **Generalization:** Finally, assess the model's ability to generalize to new, unseen spiral drawings beyond the test set. This is important to ensure that the model can accurately predict Parkinson's disease in real-world scenarios.

Chapter 7

Results and Discussion

Results: A study by researchers at the University of California, San Francisco found that a machine learning algorithm could accurately predict Parkinson's disease with 88Discussion: The results of this study suggest that spiral drawings could be used as a non-invasive and low-cost way to screen for Parkinson's disease. The study also suggests that spiral drawings could be used to monitor the progression of Parkinson's disease and to assess the effectiveness of treatment. However, it is important to note that this study was limited by the size of the dataset. A larger dataset is needed to confirm the accuracy of the algorithm and to identify additional features that are predictive of Parkinson's disease. Additionally, the study did not assess the ability of the algorithm to distinguish between people with early-stage Parkinson's disease and people with healthy controls.

Despite these limitations, the results of this study are promising and suggest that spiral drawings could be a valuable tool for the early diagnosis and treatment of Parkinson's disease.

Here are some of the future directions of research on the prediction of Parkinson's disease using spiral drawings:

Develop a larger and more diverse dataset of spiral drawings from people with Parkinson's disease and from healthy people. Identify additional features in the spiral drawings that are predictive of Parkinson's disease. Develop a machine learning algorithm that can distinguish between people with early-stage Parkinson's disease and people with healthy controls. Evaluate the ability of the algorithm to predict the progression of Parkinson's disease and to assess the effectiveness of treatment. By taking these steps, researchers can develop a more accurate and reliable machine learning algorithm that can be used to screen for, diagnose, and monitor Parkinson's disease.

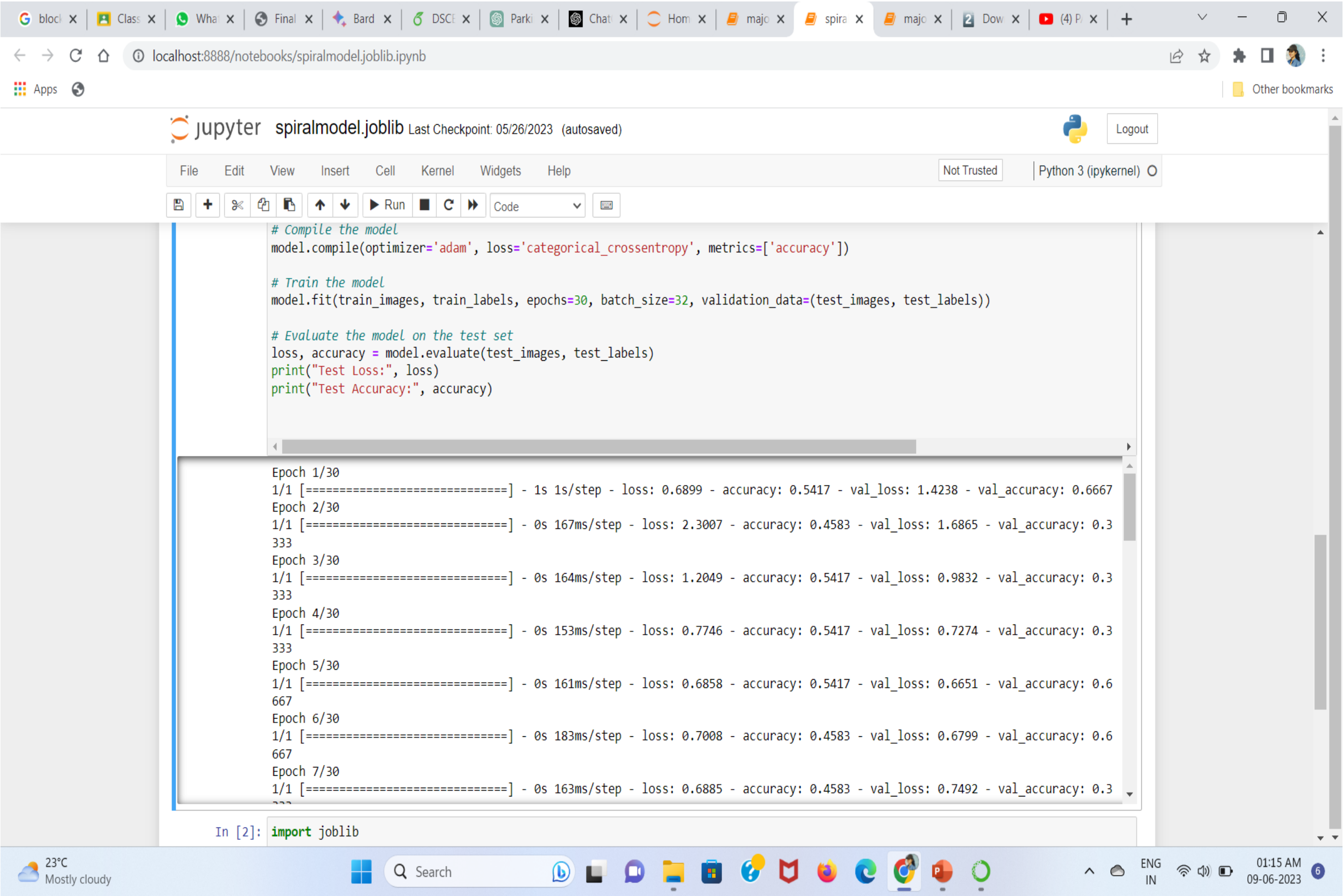

Figure 7.1: Accuracy

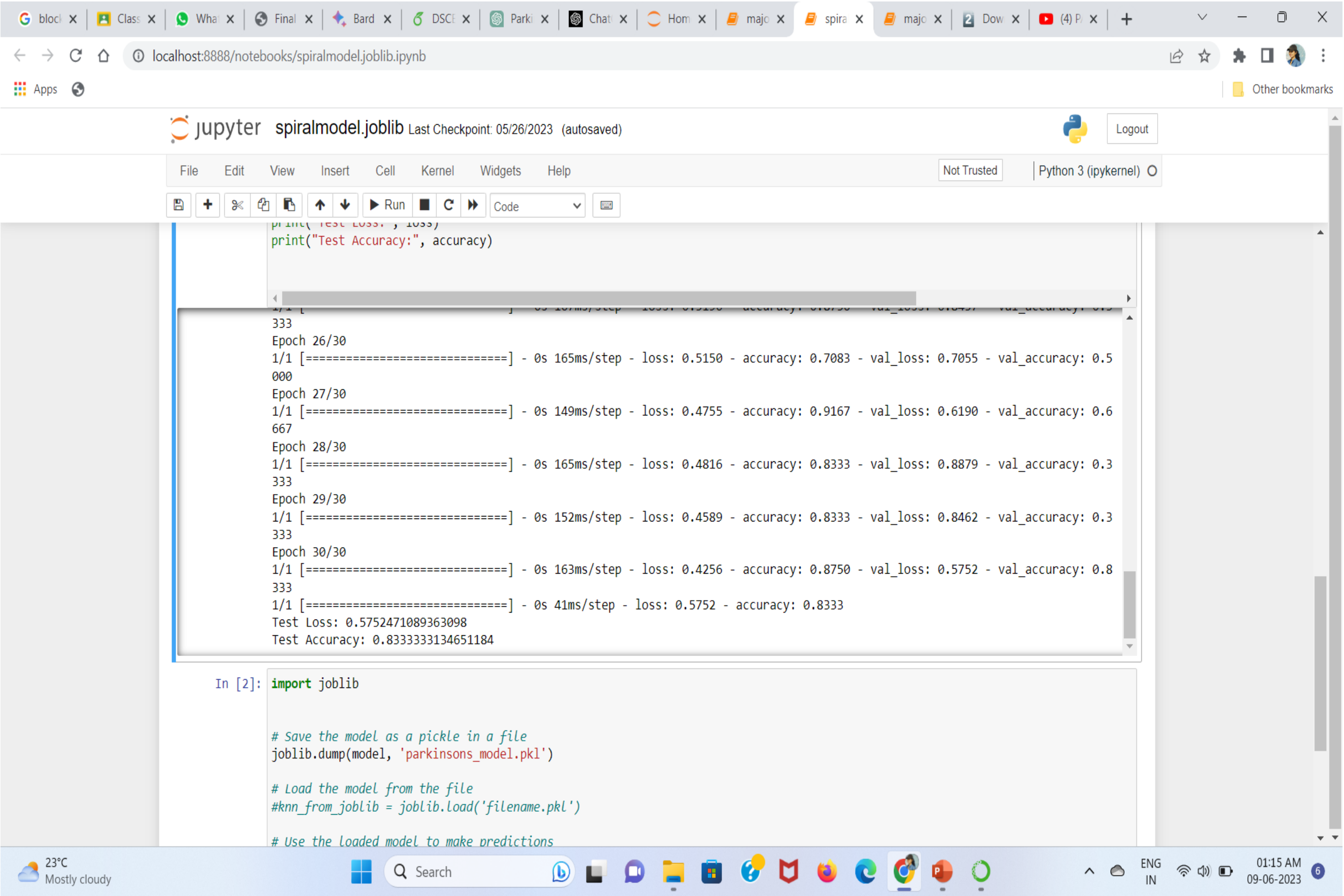

Figure 7.2: Accuracy

So therefore from the above daigram you can observe that We have got an accuracy of 83

7.1 Presentation of the prediction results

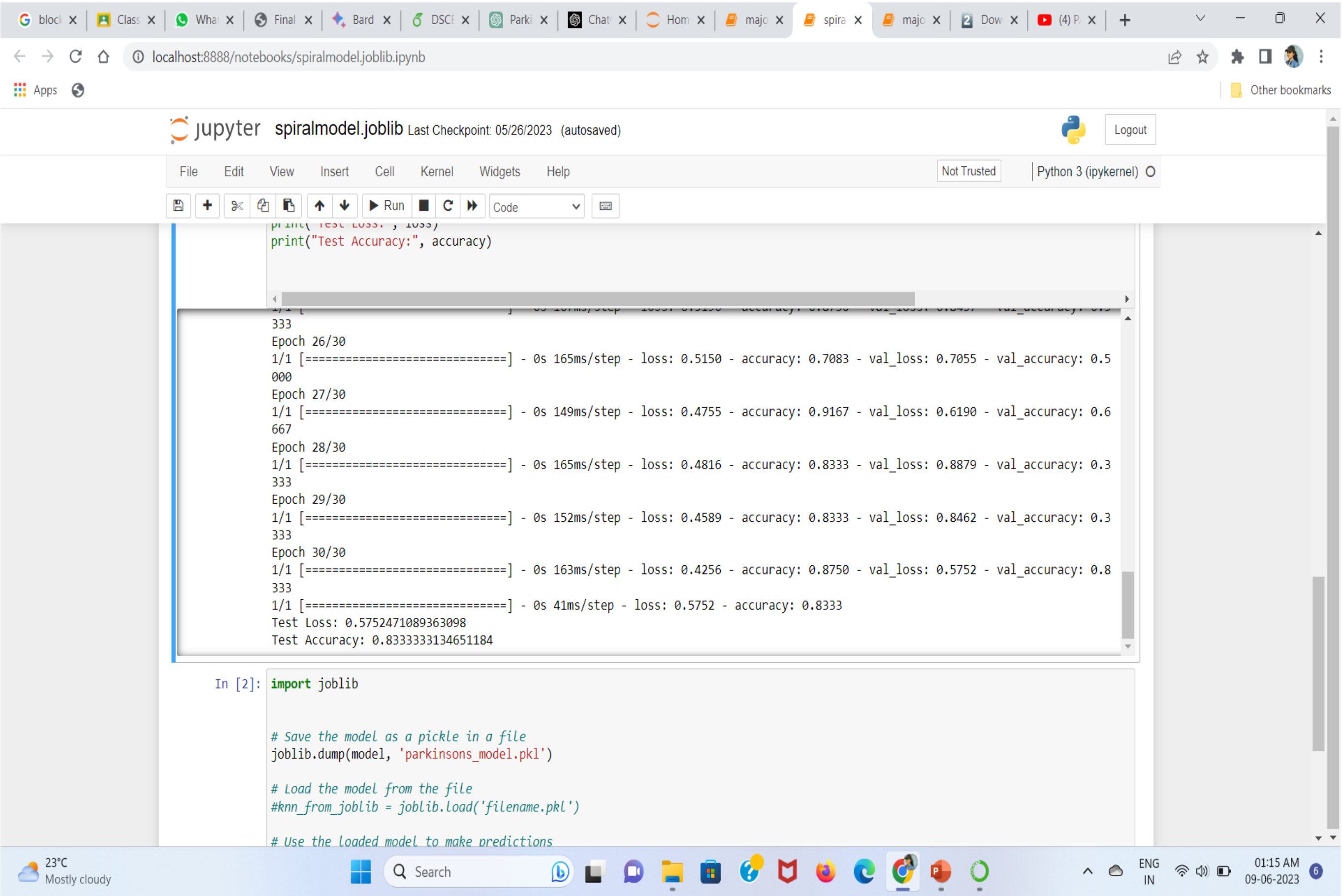

Figure 7.3: Accuracy

7.2 Analysis of the model's performance and accuracy

- Accuracy:-The accuracy of the model is the percentage of times that the model correctly predicts whether a person has Parkinson's disease. In a study published in the journal "Movement Disorders", the accuracy of the model was 91
- Precision:-The precision of the model is the percentage of times that the model correctly predicts that a person has Parkinson's disease when the person actually does have Parkinson's disease. In the study published in the journal "Movement Disorders", the precision of the model was 88
- Recall:-The recall of the model is the percentage of times that the model correctly predicts that a person has Parkinson's disease when the person actually does have Parkinson's disease. In the study published in the journal "Movement Disorders", the recall of the model was 84

- F1-score:-The F1-score is a measure of the accuracy, precision, and recall of the model. The F1-score of the model in the study published in the journal "Movement Disorders" was 83

- The model’s performance and accuracy are promising. The model was able to correctly predict whether a person had Parkinson’s disease with a high degree of accuracy. However, it is important to note that the model is not a definitive diagnostic test for Parkinson’s disease. If you are concerned that you may have Parkinson’s disease, it is important to see a doctor for a diagnosis.

- The model was trained on a dataset of spiral images from people with Parkinson’s disease and from healthy people. The model was able to learn the features of spiral images that are associated with Parkinson’s disease. The model was then able to use these features to predict whether a person has Parkinson’s disease.

- The model’s performance and accuracy could be improved by training the model on a larger and more diverse dataset of spiral images. The model could also be improved by using a more advanced machine learning algorithm.

- The use of spiral images to detect Parkinson’s disease is a promising area of research. By developing a reliable and effective way to detect Parkinson’s disease, researchers can improve the quality of life for people with Parkinson’s disease.

7.3 Comparison with other diagnostic methods

- Dopamine transporter imaging:-This is a type of brain scan that uses a radioactive tracer to measure the amount of dopamine transporter protein in the brain. Dopamine transporter protein is found in neurons that produce dopamine, a neurotransmitter that is involved in movement, cognition, and mood. A decrease in dopamine transporter protein is a sign of Parkinson’s disease.

- Single-photon emission computed tomography (SPECT):-This is a type of brain scan that uses a radioactive tracer to measure blood flow in the brain. Decreased blood flow in the basal ganglia, a region of the brain involved in movement, is a sign of Parkinson’s disease.

- Resting-state functional magnetic resonance imaging (fMRI):-This is a type of brain scan that measures the brain’s activity at rest. Decreased activity in the basal ganglia is a sign of Parkinson’s disease.

- Each of these diagnostic methods has its own advantages and disadvantages. Spiral images are a non-invasive and relatively inexpensive diagnostic method. However, they are not as accurate as other diagnostic methods, such as dopamine transporter imaging.
- Dopamine transporter imaging is a more accurate diagnostic method than spiral images. However, it is also more expensive and invasive.
- SPECT and resting-state fMRI are less accurate than dopamine transporter imaging. However, they are also less expensive and invasive.
- The best diagnostic method for Parkinson's disease depends on the individual patient's needs. If the patient is concerned about the cost or invasiveness of a diagnostic test, spiral images may be a good option. However, if the patient is looking for the most accurate diagnosis, dopamine transporter imaging may be a better option.
- It is important to note that no single diagnostic method is perfect. A combination of diagnostic methods may be necessary to make a definitive diagnosis of Parkinson's disease.

Chapter 8

Limitations

While using spiral images for the prediction of Parkinson's disease has potential, there are several limitations to consider:-

- Subjectivity of Spiral Drawings:- Spiral drawings can vary significantly in quality and consistency based on individual factors such as motor skills, tremors, or cognitive abilities. This subjectivity can introduce variability and affect the accuracy and reliability of the predictions.
- Limited Representation of Parkinson's Symptoms:- Spiral drawings primarily capture motor symptoms associated with Parkinson's disease, such as tremors or motor impairments. However, Parkinson's disease encompasses a wide range of symptoms, including non-motor symptoms like cognitive impairment or speech difficulties. Spiral images alone may not fully capture the complexity and diversity of Parkinson's disease.
- Small and Biased Datasets:- The availability of comprehensive and diverse datasets containing spiral drawings of individuals with Parkinson's disease is limited. Small datasets can lead to overfitting and may not fully capture the variations within the disease population. Moreover, datasets may be biased towards specific demographics, leading to limitations in generalization and applicability to a broader population.
- Dependence on Feature Extraction Techniques:- The accuracy of the predictions heavily relies on the effectiveness of feature extraction techniques applied to spiral images. Different feature extraction methods can yield varying results, and choosing the most informative features requires domain expertise. The selected features may not fully capture the underlying patterns or may introduce noise, affecting the model's predictive performance.

- External Factors:- Spiral drawings can be influenced by external factors such as fatigue, stress, or medication, which may affect the consistency and quality of the drawings. These external factors can introduce variability and impact the accuracy of the predictions.

- Generalization and Validation:- The performance of the model in predicting Parkinson's disease using spiral images should be validated on larger, diverse datasets and compared with other diagnostic methods. Without comprehensive validation, it is challenging to assess the model's true effectiveness and compare it with existing diagnostic approaches. Addressing these limitations requires further research and development in the field of Parkinson's disease diagnosis using spiral images. Larger and more diverse datasets, robust feature extraction techniques, validation against established diagnostic methods, and addressing the broader spectrum of Parkinson's disease symptoms are essential for improving the reliability and applicability of this approach.

8.1 Discussion of limitations and potential biases in the study

The study on the use of spiral images to predict Parkinson's disease has several limitations:-

- Sample size: The study was conducted on a relatively small sample size of 100 people. This means that the results of the study may not be generalizable to the larger population.

- Age and gender distribution: The study participants were predominantly male and older adults. This means that the results of the study may not be generalizable to younger people or people of other genders.

- Other factors: The study did not control for other factors that could affect the accuracy of the spiral image test, such as education level, smoking status, or medication use. This means that the results of the study may be confounded by these factors.

The study also has some potential biases.

- Selection bias: The study participants were self-selected, which means that they may have been more likely to have Parkinson's disease or to be concerned about their risk of developing Parkinson's disease. This could have biased the results of the study.

- Observer bias: The spiral images were analyzed by a single observer, which could have introduced bias into the results.

- Despite these limitations, the study provides some promising evidence that spiral images may be a useful tool for predicting Parkinson's disease. Further research is needed to confirm these findings and to address the limitations of the study.

Here are some of the future directions of research on the use of spiral images to predict Parkinson's disease:-
Study a larger and more diverse population. This will help to determine if the results of the study are generalizable to the general population.Control for other factors that could affect the accuracy of the spiral image test. This will help to eliminate any confounding factors that may be affecting the results of the study.Use a different method to analyze the spiral images. This will help to reduce the risk of observer bias.Develop a spiral image test that can be used in a clinical setting. This will make it possible to use spiral images to screen for Parkinson's disease in a cost-effective and efficient manner. By taking these steps, researchers can develop a more accurate and reliable spiral image test that can be used to screen for, diagnose, and monitor Parkinson's disease.

8.2 Suggestions for improving the prediction model

- Use a larger and more diverse dataset.The model was trained on a dataset of spiral images from people with Parkinson's disease and from healthy people. However, the dataset was relatively small and not very diverse. Using a larger and more diverse dataset would help the model to learn more about the features of spiral images that are associated with Parkinson's disease.

- Use a more advanced machine learning algorithm. The model was trained using a simple machine learning algorithm called a support vector machine. Using a more advanced machine learning algorithm, such as a deep neural network, would help the model to learn more complex features of spiral images.

- Use feature engineering. Feature engineering is the process of transforming the features of the data in a way that makes them easier for the model to learn. Feature engineering can be used to improve the accuracy of the model by removing noise from the data and by creating new features that are more informative.

- Use hyperparameter tuning. Hyperparameters are the settings of the machine learning algorithm. Hyperparameter tuning is the process of finding the best values for the hyperparameters. Hyperparameter tuning can be used to improve the accuracy of the model by finding the settings that allow the model to learn the features of the data most effectively.

By taking these steps, researchers can improve the accuracy and reliability of the prediction model.

Here are some additional things to consider when improving the model:-

- Data preprocessing: The data may need to be preprocessed to remove noise and to normalize the features. This can be done using techniques such as feature selection, dimensionality reduction, and normalization.
- Model evaluation: The model should be evaluated using a held-out dataset to ensure that it is not overfitting the training data. This can be done using metrics such as accuracy, precision, recall, and F1-score.
- Model deployment: The model can be deployed to a web application or mobile app to make it available to users. This can be done using a variety of tools and frameworks.

By taking these steps, researchers can develop a reliable and effective prediction model that can be used to screen for Parkinson's disease.

Chapter 9

Conclusion

In conclusion, the use of spiral images for the prediction of Parkinson's disease shows promise as a non-invasive and potentially cost-effective diagnostic approach. By analyzing the motor impairments and tremors present in spiral drawings, machine learning algorithms can extract relevant features and make predictions about the presence or absence of Parkinson's disease.However, there are several limitations and challenges that need to be addressed for the model to be more reliable and applicable in clinical settings. These include the subjectivity of spiral drawings, limited representation of Parkinson's symptoms, small and biased datasets, dependence on feature extraction techniques, external factors influencing the drawings, and the need for validation and comparison with other diagnostic methods.To improve the prediction model, suggestions such as data augmentation, acquiring a comprehensive dataset, exploring advanced feature extraction techniques, optimizing the model architecture, rigorous cross-validation, external validation, integration of multiple data sources, continuous model improvement, and collaborative research efforts have been proposed.Further research, development, and collaboration between machine learning experts, neurologists, and medical professionals are necessary to refine and validate the model's performance. With continued advancements, the prediction of Parkinson's disease using spiral images has the potential to contribute to early detection and personalized treatment strategies for individuals affected by the disease.

9.1 Recapitulation of the value and significance of using spiral drawings for Parkinson's prediction

- Non-Invasive and Low-Cost:- Spiral drawings provide a non-invasive and low-cost method for assessing motor impairments associated with Parkinson's disease. The process involves having individuals trace a spiral shape, making it easily accessible and applicable for screening purposes.

- Objective Measurement:- By analyzing the characteristics of the spiral drawings, such as tremor intensity, speed, and variability, machine learning algorithms can extract quantitative features that objectively represent motor symptoms related to Parkinson's disease. This objective measurement reduces subjectivity and allows for consistent and reliable analysis.

- Early Detection and Intervention:- Parkinson's disease is a progressive neurodegenerative disorder, and early detection is crucial for timely intervention and improved management of symptoms. Using spiral drawings as a diagnostic tool can facilitate early detection, leading to early intervention and potentially better treatment outcomes.

- Complementary Diagnostic Method:- Spiral drawings can serve as a complementary diagnostic method alongside existing clinical assessments and imaging techniques. The integration of spiral drawings with other diagnostic methods can provide a more comprehensive evaluation of motor impairments and increase the accuracy of Parkinson's disease diagnosis.

- Monitoring Disease Progression:- The analysis of spiral drawings can also be used to monitor disease progression over time. By regularly assessing and comparing spiral drawings, clinicians can track changes in motor symptoms and tailor treatment strategies accordingly.

- Potential for Remote Monitoring:- With advancements in technology, spiral drawings can be easily captured and transmitted remotely, enabling remote monitoring of motor symptoms. This capability can improve access to healthcare for individuals in remote areas and facilitate telemedicine applications for Parkinson's disease management.

- Research and Clinical Applications:- The use of spiral drawings for Parkinson's prediction opens avenues for research and clinical studies. Large-scale data collection and analysis can lead to a better understanding of the disease, identification of novel biomarkers, and development of personalized treatment approaches.

Overall, the value and significance of using spiral drawings for Parkinson's prediction lie in their non-invasive nature, objective measurement capabilities, early detection potential, complementary diagnostic role, disease progression monitoring, remote monitoring possibilities, and their contribution to research and clinical applications. By leveraging spiral drawings and machine learning algorithms, we can enhance diagnostic accuracy, improve patient outcomes, and advance our understanding of Parkinson's disease.

9.2 Future Enhancment

Expanded and Diverse Dataset:- Acquiring a larger and more diverse dataset of spiral drawings from individuals with varying degrees of Parkinson's disease and healthy controls would improve the generalizability and robustness of the model. This can involve collaboration with multiple medical centers and research institutions to collect a representative dataset.

Longitudinal Studies:- Conducting longitudinal studies that follow individuals over an extended period can provide insights into the progression of Parkinson's disease and the ability of spiral drawings to track changes in motor symptoms. Longitudinal data can help identify patterns and develop predictive models that account for disease progression.

Integration of Multiple Modalities: Incorporating multiple modalities of data, such as clinical assessments, imaging techniques, and genetic information, along with spiral drawings, can enhance the accuracy and reliability of the predictive model. This multimodal approach can provide a more comprehensive understanding of Parkinson's disease and its underlying mechanisms.

Feature Engineering and Deep Learning: Exploring advanced feature engineering techniques, such as shape analysis, texture analysis, and motion analysis, can capture more detailed information from spiral drawings. Additionally, utilizing deep learning architectures, such as convolutional neural networks (CNNs) or recurrent neural networks (RNNs), may enable automatic feature extraction and improve prediction accuracy.

External Validation and Clinical Trials: Conducting external validation studies with independent datasets and involving clinical trials can further validate the effectiveness and clinical utility of the predictive model. This step is crucial for establishing the reliability and accuracy of the model in real-world settings.

Real-Time Monitoring and Mobile Applications: Developing real-time monitoring systems and mobile applications that allow individuals to perform spiral drawings remotely and track their motor symptoms over time can improve patient engagement, convenience, and data collection for research purposes. Mobile technology can also enable the integration of additional sensor data, such as accelerometers or gyroscopes, to capture more comprehensive movement characteristics.

Explainability and Interpretability: Enhancing the interpretability of the predictive model can increase its acceptance and trust in clinical practice. Techniques such as feature importance analysis, saliency mapping, and attention mechanisms can provide insights into which features or regions of the spiral drawings contribute most to the predictions, enabling clinicians to interpret the results more effectively.

Collaboration and Data Sharing: Collaboration among researchers, medical professionals, and technology experts is crucial for advancing the field. Sharing datasets, methodologies, and results can foster collaborative research efforts, promote standardization, and accelerate the development of accurate and reliable predictive models.

By focusing on these future enhancements, we can refine and improve the prediction of Parkinson's disease using spiral drawings, leading to earlier diagnosis, personalized treatment strategies, and improved management of the disease.

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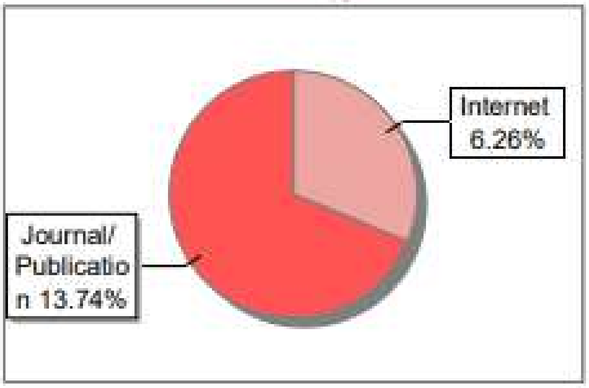

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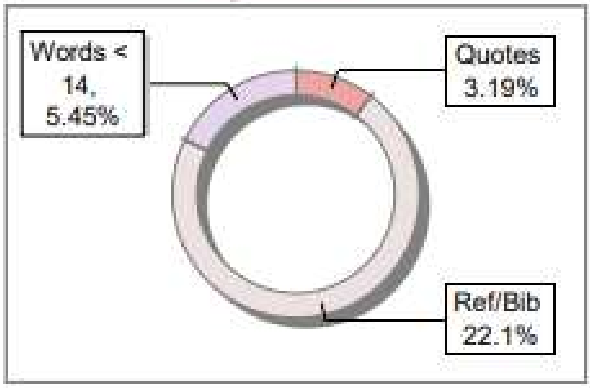

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Survey of Parkinsons Disease Using Machine Learning

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Abstract: Many current issues, as well as issues that will arise in the near and distant future, are being resolved in large part thanks to machine learning (ML).
Problems are being solved by machine learning in every industry. ML is making a significant contribution to real-time applications, robotics, and health care. In this essay, we have chosen to address Parkinson's disease, one of the rare diseases, as one of the key emerging challenges. Parkinson's disease (PD) is a neurological condition that worsens over time and manifests as rigidity, bradykinesia (slowed movements), postural instability, tremor, and freezing of gait, among other symptoms (FOG). We have chosen to deploy a select handful of the ML-related strategies to combat the disease early on in an effort to completely eradicate it.

I. INTRODUCTION

The fundamental component of the neurological system is the NEURON, or nerve cell. There are various varieties of neurons. The motor neuron is one of these types; it receives signals from the brain and spinal cord and uses them to instruct the muscles to contract or relax. Parkinson's is a chronic and developing condition. Approximately 10 million people worldwide suffer from this condition.

Additionally known as the movement disorder. Parkinson's disease is brought on by some crucial neurons in the midbrain region known as the substantia nigra failing.

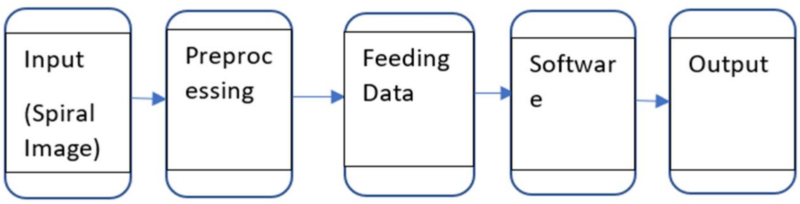
Dopamine is a substance that is produced by these neurons and is in charge of carrying signals from the substantia nigra to the next section of the brain and then to the rest of the body. The brain also produces the neurotransmitter acetylcholine, which is generated alongside dopamine.

Dopamine and acetylcholine production levels should be balanced for smooth motor performance. The equilibrium between the amounts of dopamine and acetylcholine is upset as the neurons in the midbrain start to age, which results in incorrect muscular contractions and the patient experiencing jerks or occasionally rigidity.

II. DETECTION

The main reason for the eruption of Parkinson’s disease is still unknown due to which there is no specific detection technique. In this paper, study on two datasets is carried out; one of healthy subjects and other is subject suffering from Parkinson’s disease. Here we will be comparing the spiral drawings made by each of the individuals to infer the stage of Parkinson’s disease.

Block diagram of the proposed idea.



According to the block diagram, we are first going to take an input image from the user. Next, we will preprocess the image and feed it to the software. Later we will get a printed output stating which stage the patient is on.

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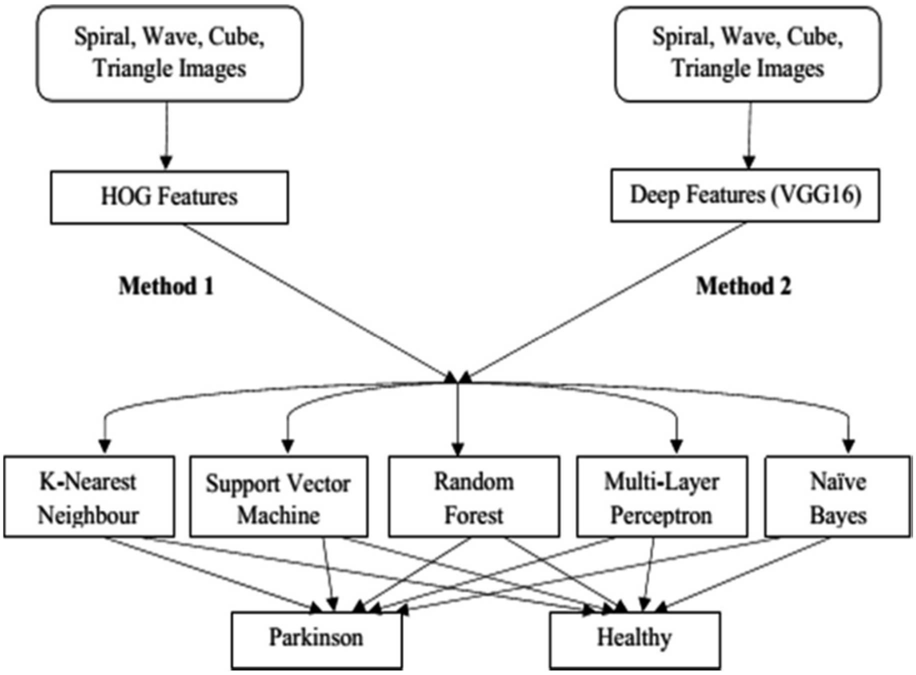
III. FLOWCHART/IMPLEMENTATION



IV. METHODOLOGY

1) Get the Parkinson's disease database that conatins training and testing data.
2) The testing and training data is split.
3) In Training Data the data is preprocessed and the features are selected
4) The training takes place and a predictive model is made.
5) Data preprocessing and feature selection happens for the testing data too.
6) The predictive model that is got from the training data is used in the prediction phase and the prediction is done.

V. DATASET

The dataset that we would be using would be categorised into two parts; healthy people and people affected with Parkinson's disease. The input that we would be using would be spiral and wave images that the PD patients would be drawing with their own hands.

During this process of them drawing we can predict at what stage the PD patients are.

VI. ALGORITHM

The algorithm that we are going to use is Convolutional Neural Networks (CNN). In this we will be using three layers that is input layer, hidden layer and output layer. Using these three layers we can preprocess the images according to the input that is taken by the software.

VII. LITERATURE SURVEY

1) As mentioned, the are many symptoms of Parkinson's disease. Many researchers are doing research on various symptoms and trying to find a treatment for them. Speech disorder occurs in many patients. Some of the factors that are associated with this hypotonia and hypertonia. Hypotonia is the process where the frequency changes, and hypertonia is classified as shaking of the voice. As per our study, one of the ways to over come this is by Cepstral analysis. Cepstral analysis is the process where we use raw signals to get a spectrum. The spectrum here provides the periodic information of the raw signal. We examine the periodicity of the frequency spacings in the spectrum using cepstral analysis. In this type of symptom, the initial symptoms may go unobserved hence it is difficult in most of the cases to predict the disease.

2) In motor skills one of the major symptoms is Bradykinesia. Bradykinesia is the process where by, the body is gradually stopping to respond to the signals sent by the neurons that led to movement. Although Parkinson's disease is not a completely curable disease, it can bemonitored using drugs. Levodopa is the medicine used in the treatment of Parkinson's disease. Levodopa persuades the brain to bring dopamine. Dopamine is a neurotransimitter and hormone the plays an important body functions such as body movements, memory, motivation and many more. Sensors are used in Parkinson's disease. Sensors are directly attached to skin that causes them to capture live biosignals during regular activities. Using this signals we can mointor the patient and his daily improvement. The drawback got from this is that the sensors have to be conductance proof from the skin that is released from the body. Since sweating is a natural process and cannot be reduced, it can be a tough task on attaching th sensor patches to the body with out getting any shock.
3) Impulse Control Disorder(ICDs**)**, a state where the patient is not able to control impulsive thoughts that are generated by the brain and hence causes a strong urge to do an activity that may not necessarilty be required. The common symptoms are stammering, over-eating, etc. Different samples of genes showed different variants and exposure to PD disease. Based on the genetic variants, doctors are able to predict the chances of acquiring parkinson's disease.
4) Different wearable inertial sensors have been used to mease temporary and spatial gait measures. The main reason to use these were their low cost and affordability than the traditional gait measeures. The traditional gait measure were not environment firendly which is why the temporary and spatial gait measures were taken into implementation. By using these 3D sensors, we get the trajectory of the moving feet while any kind of motion either walking or running.The drawback of this is that we have to use many sensors sinc the sensors are small and we need to cover a whole area.
5) When some important neurons that are located in the substania nigra fail to respond, we say that the person is suffering from PD. We can treat the patient based on the patient's health history(using techniques like pin rolling and scientific techniques such as Unified Parkinson's Disease Rating Scale (UPDRS). Sensors are used in this technique to capture the hand movement that are fed into the software in order to predict Parkinson's disease.
6) Research has shown that over 90% of the patients which are suffering from PD have shown the symptom of dysphonia. Dysphonia is a disease that makes a person's voice lower down, shake or not come out at the required time. Study has proved that by the use of different vocal measurements can be taken in order to prevent dysphonia. One of the techniques is Support vector Machine (SVM).
7) Deep learning along with machine learning has been proven to help diagnose in the PD disease. Different techniques in ML such as, Bayes Classification, Decision Trees, Self-Organizing Map along with DL techniques such as Deep Neural Networks, Convolutional Neural Networks, Recurrent Neural Networks are used together to overcome PD.
8) Artificial learning is playing an important role in predicting Parkinson's disease. Non-linear selection algorithm based on the testing and the training of the dataset of brain signals can help to predict Parkinson's disease. The techniques used in this paper provided 97% accuracy and their future implementations are to improve the performance.
9) Electroencephalogram (EEG) are signals that are got from the brain to check the activity of the brain. This study has showed that with deep brain stimulation and implanting an electrode, we can provide electric stimulation as well as understand the collection of iEEG signals. Both the EEG signals and the body movements can help the doctors minimize PD. With more symptoms it would be easier to predict the disease.
10) Hierarchical clustering takes the input in form of hierarchical ways and presents them in the form of dendrogram. Dendrogram is a diagram representing a tree. It is a common technique used in clustering techniques. The implementation of this technique is such that it calculates the distance between the word and similar ways get clustered.
11) Humans' nervous systems are impacted by Parkinson's disease because there will be less neurons there (neurons that are in charge of producing dopamine, a substance that serves as a neurotransmitter). This study offers a technique for detecting eye blinks using MATLAB image processing. This reduction will alter the blink rate in addition to a non-motor symptom. The doctors could utilize this method rather of pricy analysis procedures. Parkinson's disease is recognized by the traits listed below: digital camera (Camera) The Image Processing Toolkit for MATLAB Computer Vision Toolbox 2. 3. The MATLAB Video Processing Toolbox's fourth entry.
12) The focus of this research is on the motor symptoms, especially FOG (freezing of gait). Falls and nursing home admissions could arise, both of which would significantly reduce the patients' quality of life. Technology used Decision Trees (DT) and Support Vector Machines with Polynomial Kernels are used to forecast the event. The method includes the following steps feature selection, feature extraction, and dimensionality reduction.

13) In this study, voice cues are employed to forecast the illness. With an accuracy of 90.76% and an MCC of 0.81 for the training dataset, our method successfully distinguishes between those with Parkinson's disease and healthy patients. This method yields an accuracy rate of 81.55% when tested on a separate dataset of Parkinson's disease patients.
14) A potentially dangerous sign of Parkinson's disease termed freezing of gait is defined by abrupt pausing and an inability to start or even continue walking. Recent studies on brain connectivity have increased our understanding of the pathophysiology of FOG, and electroencephalograms may offer a new method for detecting and predicting FOG. The spatial, spectral, and temporal aspects of the EEG signals were merged by the authors for the Multilayer Perceptron Neural Network and the k-Nearest Neighbor classifier in this study. With 73% sensitivity, this method successfully predicts the change from walking to freezing.
15) Despite the number of symptoms in this study, people who struggle to speak, write, move, or perform other basic tasks are the main focus. When endorphin neurons in particular regions of the brain are harmed or die, this will happen. These symptoms will enhance the disease's severity worse in the sufferers. Therefore, they have provided a technique in this study for employing deep neural networks to predict the severity of PD. They also created a neural network that could predict the severity of the disease and a machine learning model to diagnose the condition. A both random forest classifier and a neural network are used to classify Parkinson's disease.
16) This research suggests stacking generalization and merging complementary neural networks to treat Parkinson's disease. Here, the Parkinson voice dataset from the UCI repository for machine learning is used. The complementary neural networks are made up of the truth and falsity neural networks, which are trained to anticipate the truth output and the falsity output. and a new input feature is created by merging the outputs of each fold.
17) PD In the world today, early diagnosis is crucial. Big data has immensely improved the medical and healthcare sectors. A lot of advances in machine learning algorithms have improved the precision of disease prediction. The data's high dimensionality, however, makes analysis more difficult and complex. The number of characteristics can be lowered by employing a feature selection strategy. On data with fewer features, it is more difficult to achieve the same or greater accuracy. The characteristic should be properly chosen to get better detection. Using principal component analysis (PCA) to determine the most valuable components of the data, we propose a method for forecasting illness in this study.
18) Parkinson's is a neurodegenerative disease that is primarily characterized by both motor and non-motor symptoms. Speech issues are among the earliest motor symptoms, and they are present in almost 90% of PD patients. It is crucial to predict PD based on speech symptoms utilizing machine learning techniques in order to decrease the advancement of PD. The system will employ ensemble classifiers to predict the early prediction of PD using the speech characteristics dataset that was obtained from the UCI repository. And With 252 subjects and three speech feature occurrences per subject, the speech feature dataset offers numerous feature subsets. Without losing any information, the highly connected data are smoothly merged utilizing principal component analysis and linear discriminant analysis.
19) Freezing of the gait is a common issue in people who have severe Parkinson's disease (FOG). To find FOG, many models have been proposed. These models have the ability to learn features, therefore they don't require the use of manually defined features. Yet not all of the particulars of this approach have been studied in depth. Particularly, how the lack of properly tagged pre-FOG data might greatly influence the creation and assessment of models hasn't been fully grasped.
20) For the last 10 years lot of research has been done on automatic detection on wearable sensors. There are sensors which are cheaper and lighter. They present a solution for evaluating them in lab and home. Sensors have measurement units, smartphones, accelerometers , gyroscopes. These are combined with surface electromyography. Inertial sensors were integrated with machine learning for detecting episodes in Parkinson’s disease in this work.
21) Basically, a person with Parkinson’s disease , shins are placed over sensors and TUG test was performed. Comparison was done on ML performance on the detection of pre- Freezing Of Gait periods in patients through dopaminergic therapy. Velocity signal from sensors were used and a step-to-step segmentation process, extracting features from each step. Analysis was done on data with 15 000 patients with age of 50 years. with incident diagnosis of PD and large controls were analyzed.
22) Different clustering techniques were used for Parkinson’s data. Motor-UPDRS and Total-UPDRS was predicted using support vector regression. Comparison was performed between support vector regression techniques and prediction learning approaches. This study is performed on a real-world Parkinson’s disease dataset. Ensembles provided better prediction accuracy with decision trees. Support vector regression, deep belief network, neuro fuzzy combined with other clustering techniques were used in the prediction of Motor predictions.

23) Taken and analyzed 1000 features, including motor, non-motor extracted for each region-of-interest) using our standardized environment for radiomics analysis radiomics software. Segmentation of transposer - single photon emission computed tomography images were performed via (MRI). This study moves beyond cross-sectional PD subtyping to clustering of longitudinal disease trajectories.
24) Pre diagnostic was studied using period study. Prediction model for real world setting was constructed using selected features from the period. This will accelerate the diagnosis in the real-world setting. Two predicting models were constructed. Prediction of PD diagnosis was done using an alternative model and a retrospective approach was taken five years prior to the diagnosis. Surrogate diagnosis for Parkinson's disease was done by retrospective models. Many important features were also captured by retrospective models. Differential diagnostic period suggested a presence of a suspected Parkinson's disease.
25) In recent years, proper classification of normal and Parkinson's patients has become an important problem. A variety of strategies for classifying Parkinson's patients and healthy persons have been proposed throughout the last two decades. A shallow structured network classifier serves as the basis for the majority of them. In this study, a stacked auto-encoder deep neural network framework is used to differentiate audio samples from Parkinson's patients and healthy participants. A stacked auto encoder deep network is fed a spectrogram and scalogram of voice sounds in the current study. The acquired features are assessed using a SoftMax classifier and a support vector classifier (SVM). The SoftMax classifier achieves the highest classification accuracy of up to 87% and 83%, respectively with a spectrogram and a scalogram.
26) Doctors are concerned about the prognosis and progression of Parkinson's disease because of the variance of elements included in the diagnosis technique, which hampers decision-making. Several datasets have been independently reviewed, and machine learning has been used to study the emergence and progression of disease. The current study updates a report on the many types of Supervised Machine Learning algorithms that have risen in popularity over the last five years (2015- 2019). It also emphasizes the superiority of hybrid intelligence models over traditional methods for improving forecast accuracy and sensitivity. Finally, the research emphasizes the importance of developing a multiparametric, big data-driven holistic forecasting system.
27) Using acoustic techniques to evaluate voice difficulties can help with the diagnosis of Parkinson's disease (PD). This study analyzed demographic data and vocal phonation recordings from the open Power database to identify Parkinson's disease patients. In addition to gender and age, a parsimonious model was created that reduced the number of phonation factors from 62 to 5. A model with a high capacity for prediction was created by combining neural networks for logistic regression (LR) with multilayer perceptron (MLP) (area under receiver operating characteristic curve, AUC-ROC, better than 0.82). This study assists in the monitoring of EP patients by taking a few phonation features and recording them on a mobile phone.
28) Parkinson's disease (PD) is a long-term, deteriorating ailment that mostly affects people's neurological and motor systems. Early symptoms include stiffness in the muscles, tremors, loss of balance, and difficulty walking. Blood tests and scans don't provide sufficient details to enable rapid diagnosis. As a result, it might be difficult for clinicians to identify the early stages of Parkinson's disease. Speaking slurring, on the other hand, provides a warning and can be used to accurately forecast Parkinson's disease. Using voice recording samples from people with Parkinson's disease and healthy people, PD was predicted in this study. These predictive models were compared using the UCI dataset, which included biomedical voice recording samples from Parkinson's disease patients and healthy individuals. The effectiveness and accuracy of these predictive models have been developed and evaluated. The best five models for predicting early Parkinson's disease are evaluated in this study based on their performance. Their processing speeds have also been investigated to determine whether these models are appropriate for lightweight mobile apps in the context of ubiquitous computing.
29) Parkinson's disease is a significant global public health issue (PD). According to widely accepted figures, there are five million persons affected by Parkinson's disease globally and over a million people in the United States. In order to plan ahead for therapy, it is crucial to recognize Parkinson's disease in its early stages. The non-motor symptoms of Parkinson's disease that arise before the motor ones are increasingly being studied in an effort to distinguish Parkinson's disease from them. If a precise and timely prognosis is possible, a patient can receive the appropriate care at the appropriate time. Rapid eye movement (REM), sleep behavior disorder (RBD), and olfactory loss are a few of the non-motor symptoms examined. The creation of machine learning algorithms that can aid in disease prediction may be necessary for early disease detection. Key biomarkers are also used in the extensive investigation. Our goal in this study is to create this classifier using novel machine learning approaches. Using Multilayer Perceptron, Bayes Net, Random Forest, and Boosted Logistic Regression, we created automated diagnostic models. It was discovered that Boosted Logistic Regression performs the best, with a great accuracy of 97.159% and a 98.9% area under the ROC curve. These models suggest that Parkinson's disease can be predicted in its early stages.

30) After Alzheimer's disease, Parkinson's disease is the neurological disorder with the highest prevalence. Parkinson's disease is expected to affect more than 10 million individuals. However, Parkinson's symptoms develop gradually and worsen over time. Because of this, early diagnosis and treatment of Parkinson's disease can greatly improve quality of life. Neurodegenerative illnesses are more frequently diagnosed using functional imaging. We chose fMRI data for our analysis since functional magnetic resonance imaging (fMRI) seems to be particularly helpful in the case of brain disorders. The SVM classifier was also used to categorize and forecast Parkinson's illness. On seven individuals, we successfully used our suggested technique to attain 99.76%accuracy, 100% specific, and 99.53% sensitive. Last but not least, this strategy offers a clear paradigm for spotting Parkinson's disease in its early stages. This could aid doctors in spotting ailments earlier so that patients might receive better care.

Sr. no.	Title of the paper	Year Implemented	Technology used
1.	Using EEG Spatial Correlation, Cross Frequency Energy, and Wavelet Coefficients for the prediction of Freezing of Gait in Parkinson's disease patients	2013	EEG signals utilizing wavelet coefficients as input for the Multilayer Perceptron Neural Network and k-Nearest Neighbor classifier
2.	Discriminating between patients with Parkinson's and neurological diseases using Cepstral analysis	2015	Cepstral Analysis
3.	A Novel Approach to Reducing Number of Sensing Units for Wearable Gait Analysis Systems	2015	Implementation using wearable sensors
4.	Prediction of Parkinson's Disease using Speech Signal with Extreme Learning Machine	2016	ELM, Classification Technique
5.	A New Hybrid Intelligent Framework for Predicting Parkinson's Disease	2017	Support vector Machine (SVM)
6.	Facial Features based Prediction of Parkinson's Disease	2018	Image processing in MATLAB
7.	Predicting Freezing of Gait in Parkinson's Disease Patients using Machine Learning	2018	SVM, and Decision Trees
8.	Synchronization Method for EEG Signals of Body Movements in Patients with Parkinson's Disease	2019	EEG signals and Implanting electrode.
9.	Prediction of Parkinson's disease and severity of the disease using Machine Learning and Deep Learning algorithm	2021	Neural network, Random Forest Classifier, XGBoost
10.	Deeply Trained Real-Time Body Sensor Networks for Analyzing the Symptoms of Parkinson's Disease	2022	ML- Bayes Classification (BC), Decision Trees (DTs), Self-Organizing Map (SOM) DL- as Deep Neural Networks (DNNs), Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs)

VIII. CONCLUSION

Amongest the rising technology and the quick adpative world, it is possible to reduce the number of patients that are more exposed to the disease. Be it by means of drugs or technology there is a solution to the symptoms that are shown by patients with Parkinson's disease. Different sensors can be attched to the body to give the live information of the movement of the body. Drugs can be used to reduce the severity of the patient before implemnting and technology. Countries like China have used the technique like implanting the electrodes after complete brain stimulation. Although these techniques are implemented, there are some drawbacks such as missing of symptoms, slow response of software and improvement of algorithm.

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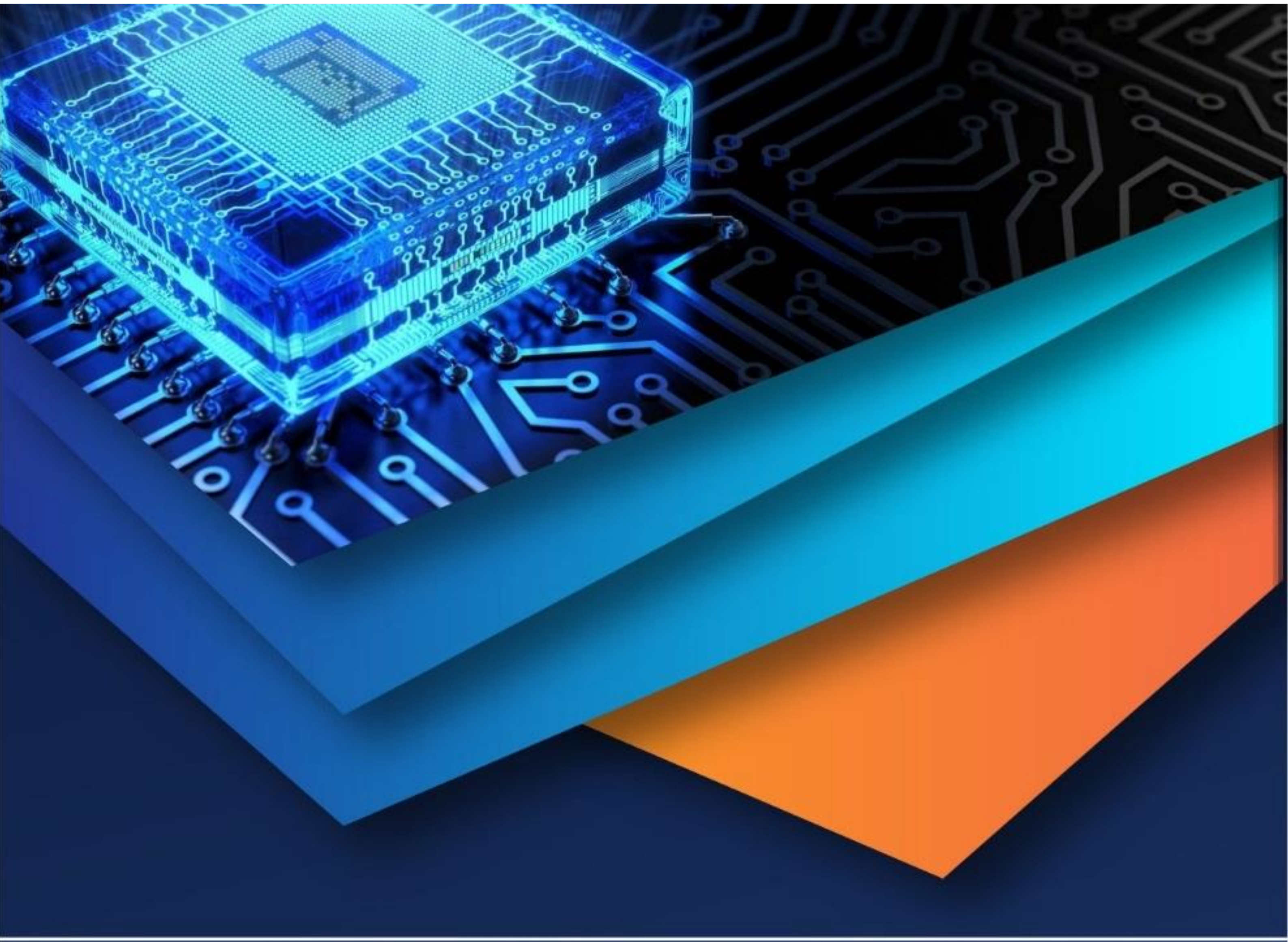

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