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CHAPTER 1
INTRODUCTION

1.1 PROJECT OVERVIEW

The Parkinson's disease is progressive neuro-degenerative disorder that affects a lot of people significantly affecting their quality of life. It mostly affects the motor functions of human. The symptoms of Parkinson's disease will occur slowly, the symptoms include shaking, rigidity, slowness of movement and difficulty with walking, Thinking and behavior change, Depression and anxiety are also common. It has been observed that impairment in the handwriting is directly proportional to the severity of the disease. Also, the speed and pressure applied to the pen while sketching or writing something are also much lower in patients suffering from Parkinson's disease. Therefore, correctly identifying such biomarkers accurately and precisely at the onset of the disease will lead to a better clinical diagnosis. Therefore, in this project, a system design is proposed for Analyzing Spiral drawing patterns in patients suffering from Parkinson's disease.

1.2 PURPOSE

Parkinson Disease is a brain neurological disorder. It leads to shaking of the body, hands and provides stiffness to the body. No proper cure or treatment is available yet at the advanced stage. Treatment is possible only when done at the early or onset of the disease. These will not only reduce the cost of the disease but will also possibly save a life. Most methods available can detect Parkinson in an advanced stage; which means loss of approx. 60% dopamine in basal ganglia and is responsible for controlling the movement of the body with a small amount of dopamine.

CHAPTER 2

LITERATURE SURVEY

2.1 EXISTING PROBLEM

Diagnosis of Parkinson's disease is commonly based on medical observations and assessment of clinical signs, including the characterization of a variety of motor symptoms. However, traditional diagnostic approaches may suffer from subjectivity as they rely on the evaluation of movements that are sometimes subtle to human eyes and therefore difficult to classify, leading to possible misclassification. In the meantime, early non-motor symptoms of Parkinson Disease may be mild and can be caused by many other conditions. Therefore, these symptoms are often overlooked, making diagnosis of Parkinson Disease at an early stage challenging. To address these difficulties and to refine the diagnosis and assessment procedures of Parkinson Disease, machine learning methods have been implemented for the classification of Parkinson Disease.

2.2REFERENCES

- **https://www.researchgate.net/publication/357448942_THE_PARKINSON'S_DISEASE_DETECTION_USING_MACHINE_LEARNING_TECHNIQUES#:~:text=There%20is%20a%20model%20for,affected%20person%20by%20Parkinson%27s%20disease.**
- **https://www.analyticsvidhya.com/blog/2021/07/parkinson-disease-onset-detection-using-machine-learning/.**
- **https://www.frontiersin.org/articles/10.3389/fnagi.2021.633752/full.**

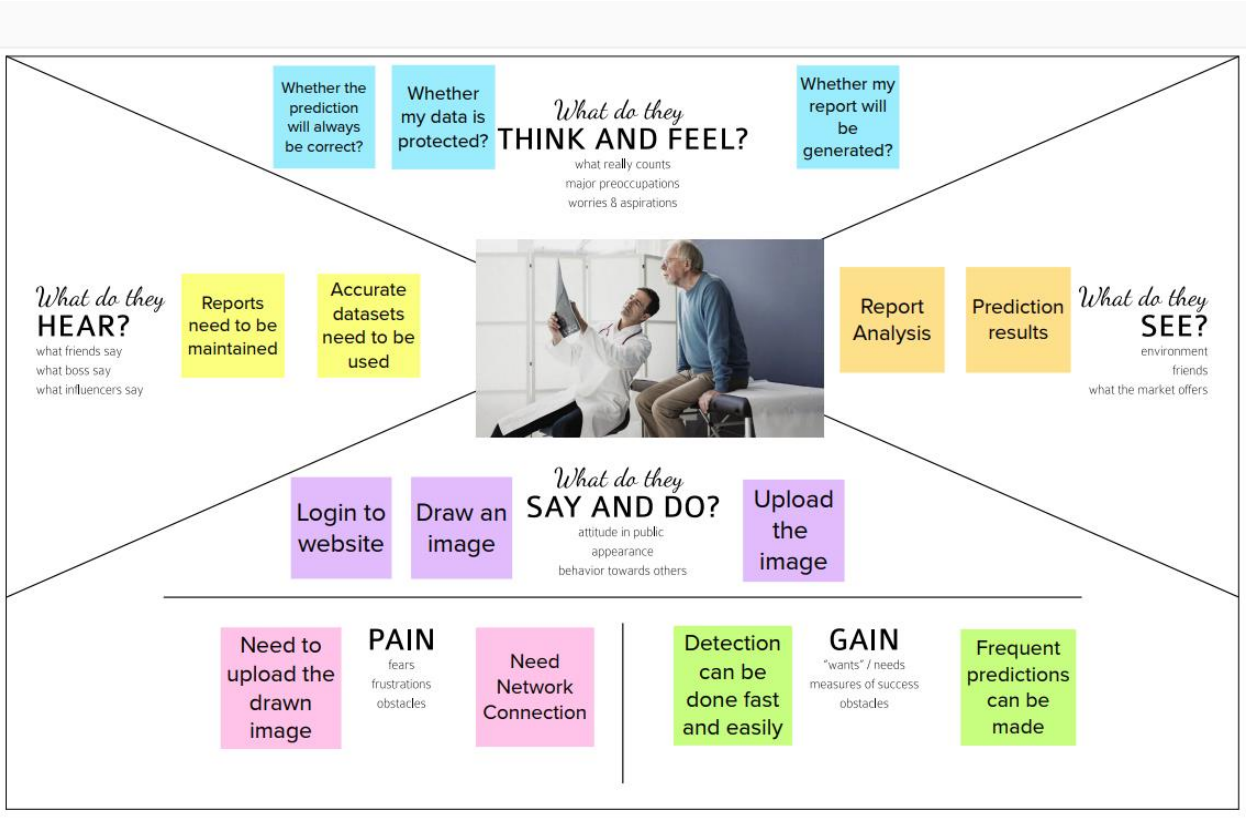
2.3 PROBLEM STATEMENT DEFINITION

One of the indications of Parkinson’s is tremors and rigidity in the muscles, making it difficult to draw smooth spirals and waves. It is possible to detect Parkinson’s disease using the drawings alone instead of measuring the speed and pressure of the pen on paper. Our goal is to quantify the visual appearance (using HOG method) of these drawings and then train a machine learning model to classify them. In this project, we are using, Histogram of Oriented Gradients (HOG) image descriptor along with a Random Forest classifier to automatically detect Parkinson’s disease in hand-drawn images of spirals and waves.

CHAPTER 3

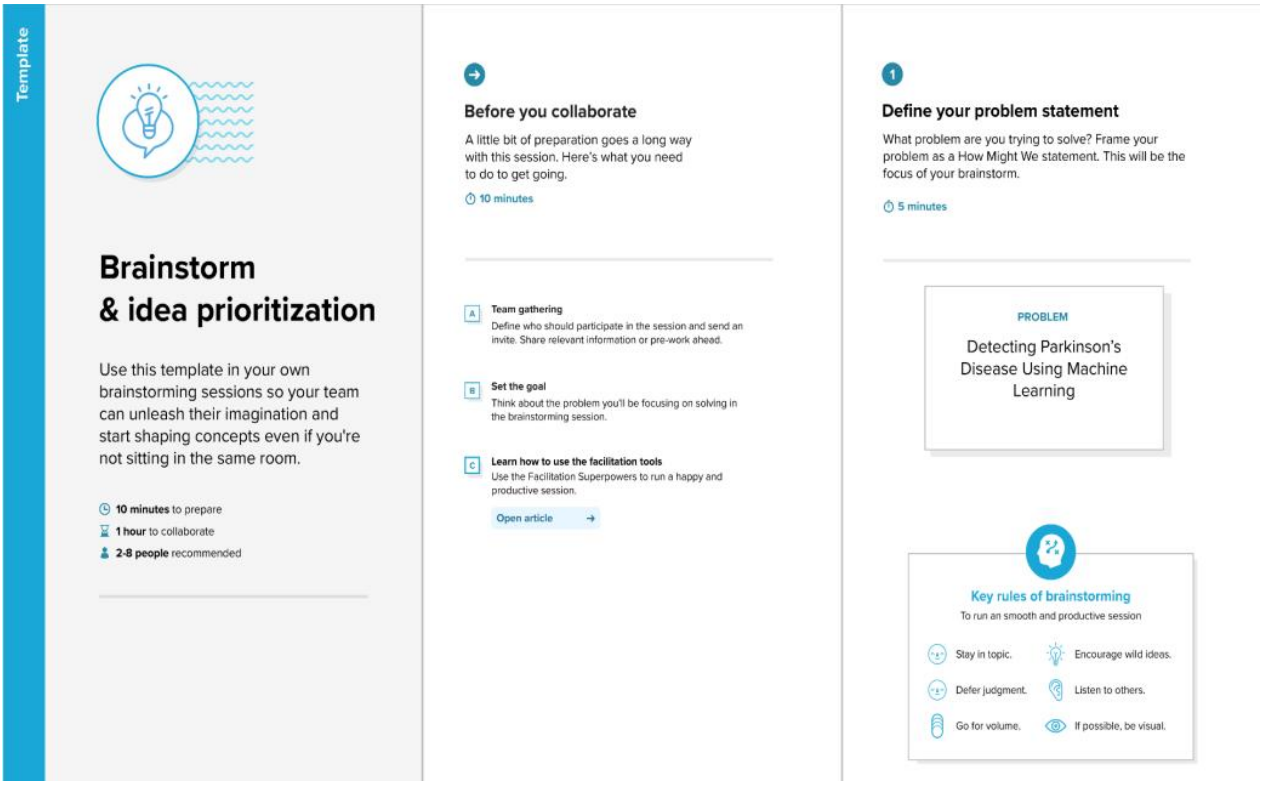
IDEATION AND PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

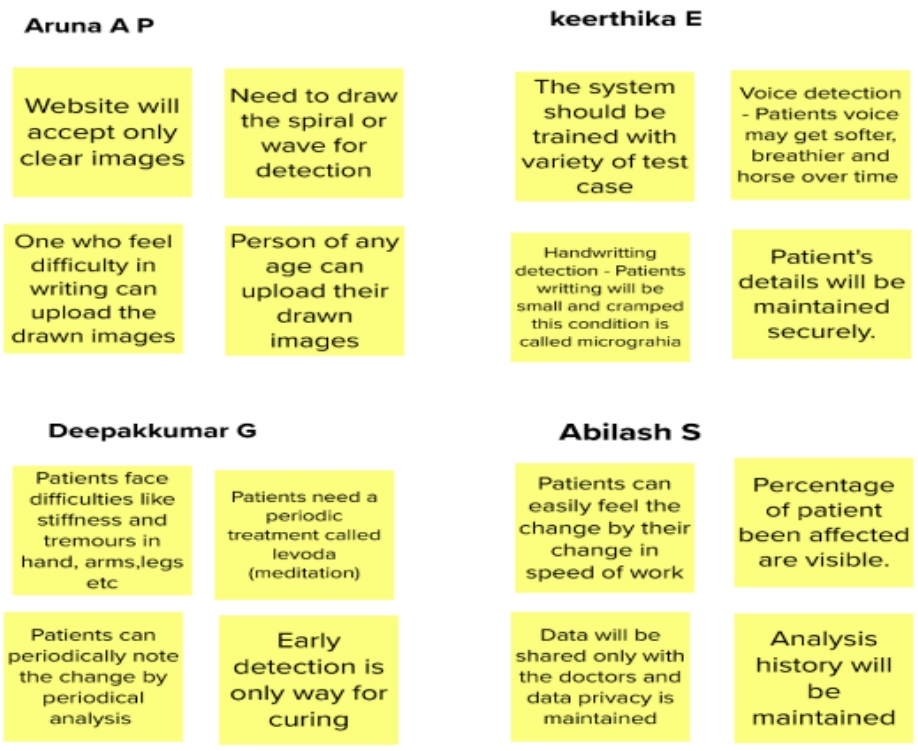


3.2 IDEATION AND BRAINSTORMING

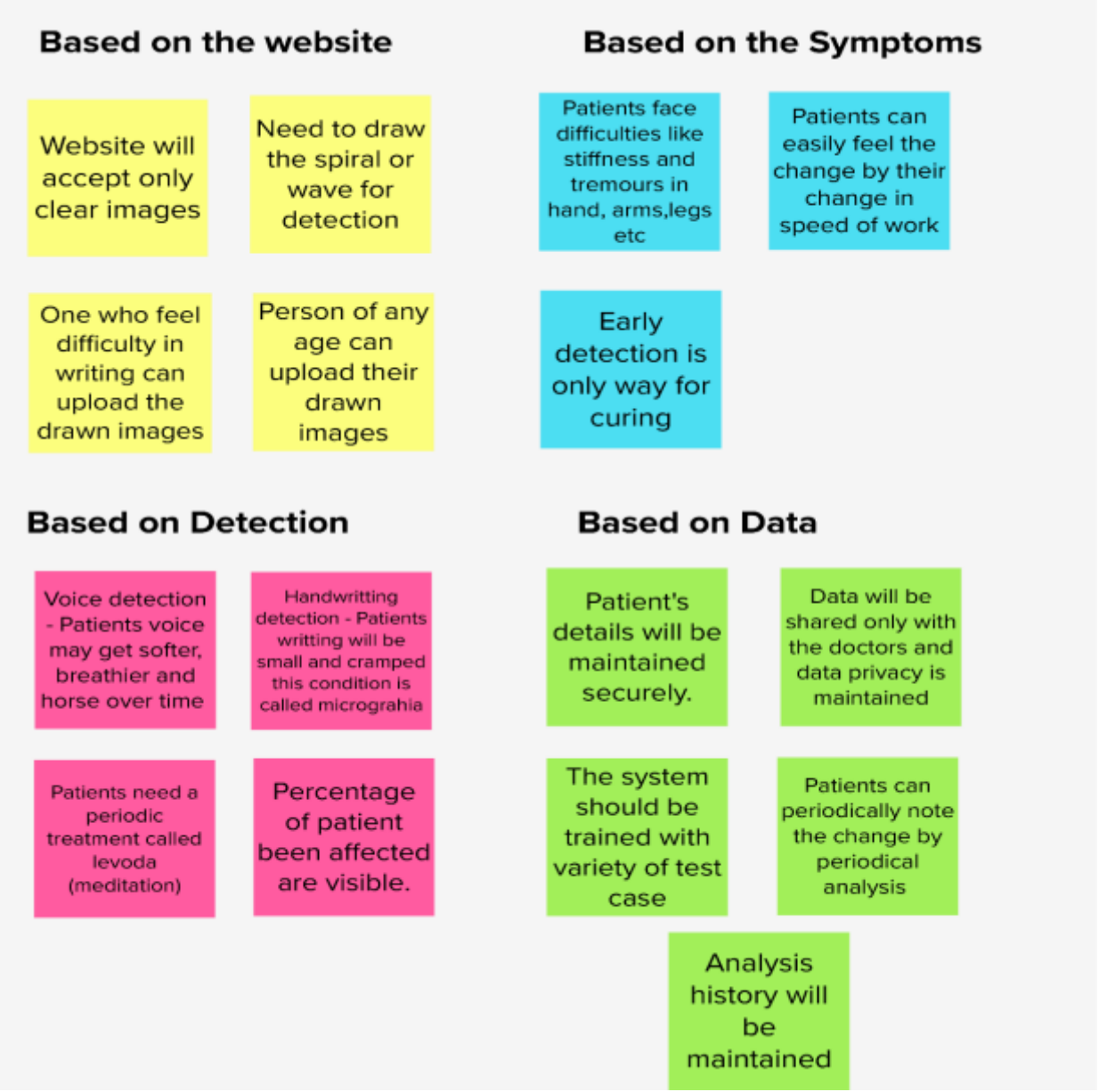
STEP 1: TEAM GATHERING, COLLABORATION AND SELECT THE PROBLEM STATEMENT



STEP 2: BRAINSTORM, IDEA LISTING AND GROUPING



STEP 3: GROUP IDEAS



STEP 4: IDEA PRIORITIZATION

3.3 PROPOSED SOLUTION

S.No	Parameter	Description
1.	Problem Statement	The main aim of this project is to detect Parkinson's Disease. More than 10 million people are living with Parkinson's Disease worldwide.
2.	Idea/Solution description	Machine Learning is used to identifythe affected people by their uploaded images. Where they need to upload their drawn spiral or wave images.
3.	Novelty/Uniqueness	By using more datasets for training. We need to train the model by spiral and wave images to detect the disease. And need to differentiate the healthy and unhealthy people.
4.	Social Impact/Customer Satisfaction	This model will find the person who is affected by Parkinson's and also the percentage of the impact of the disease. The results provided by the project will be more accurate.
5.	Business Model(Revenue Model)	This project is free of cost. And can be easily accessed by all the users. Doesn't need any technical knowledge to use.
6.	Scalability of the solution	This model can able to handle many number of inputs and provide the respective outputs.

3.4 PROBLEM SOLUTION FIT

Problem-Solution fit canvas 2.0

Parkinson's Disease Detection using machine learning

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail.
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Login	User needs to log in to the website using the registered email.
FR-4	Upload the Image	User need to draw spiral or wave pictures and upload them to the website for prediction
FR-5	Predicting	Prediction will be done based on the drawn images.
FR-6	Result after prediction	The result will be provided immediately after the prediction of whether the user is having Parkinson's disease or not.
FR-7	Suggestion and Report generation	Suggestions of doctors and the report of the user can be downloaded.

4.2 NON-FUNCTIONAL REQUIREMENT

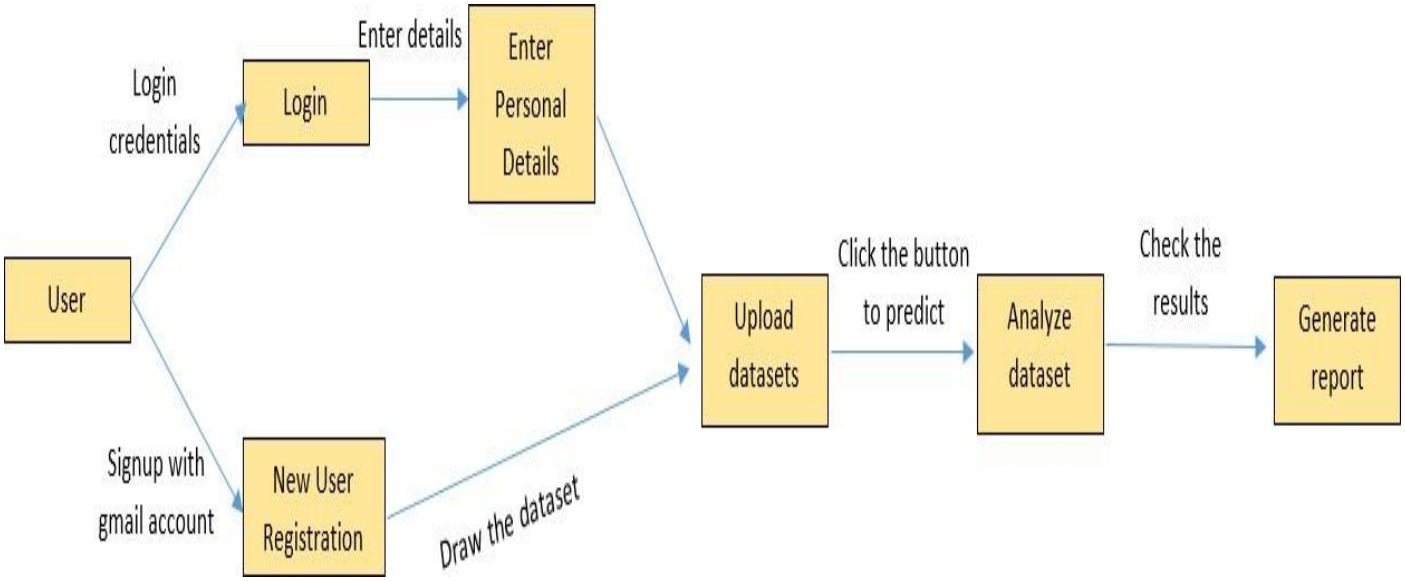
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Our Website can be easily accessed by everyone, irrespective of any technical knowledge.
NFR-2	**Security**	The details provided by the user are securely maintained.
NFR-3	**Reliability**	The prediction provided by this system will be accurate.
NFR-4	**Performance**	This model can give results for a large number ofinputs with a high rate of accuracy and high performance.
NFR-5	**Availability**	This Website is freely(Open Source) available for all users.
NFR-6	**Scalability**	This Website can handle a large number of users and work efficiently.

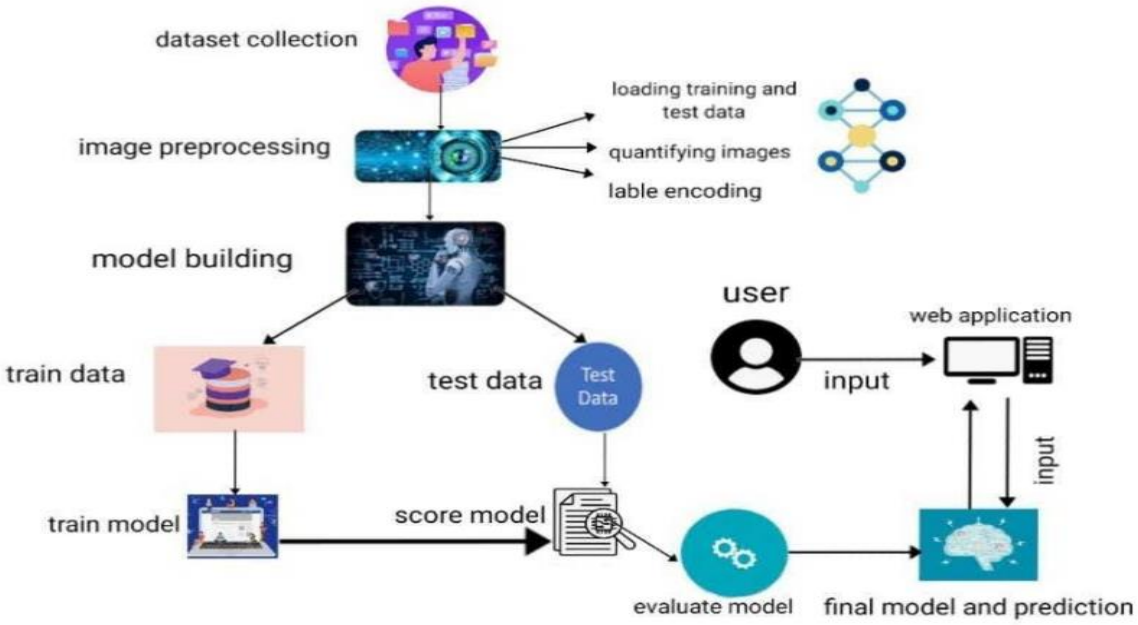
CHAPTER 5

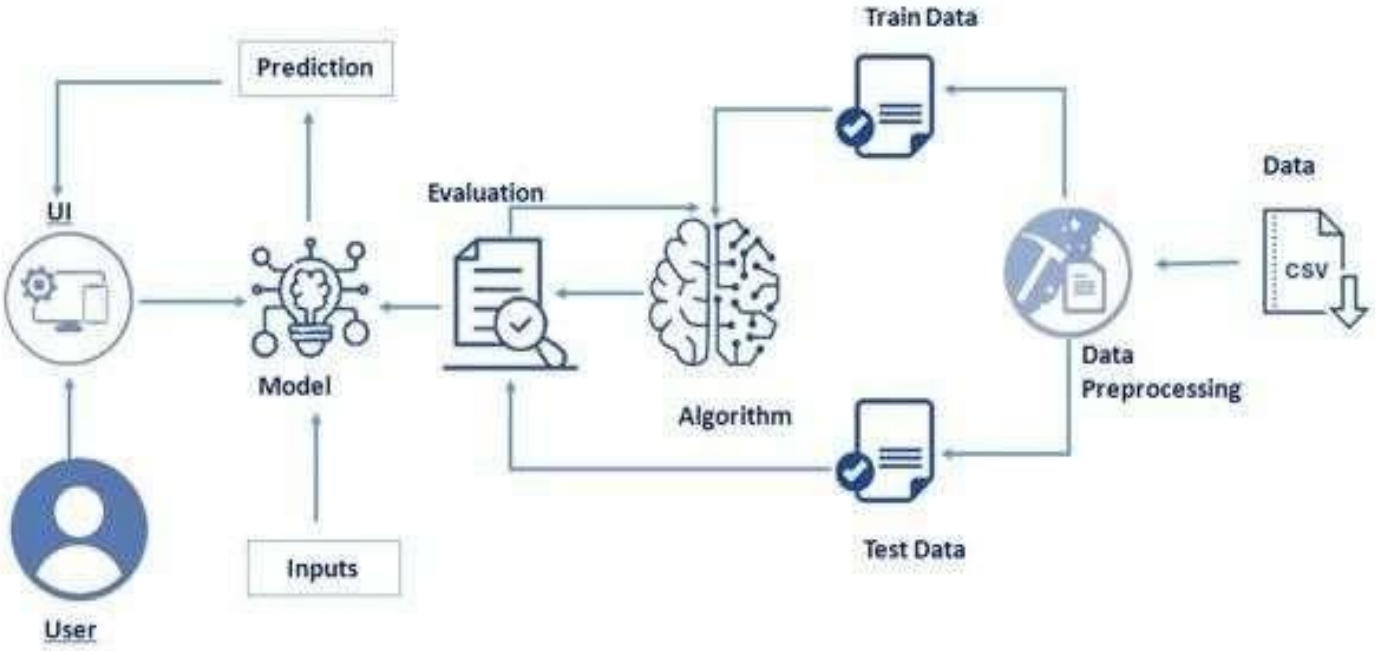
PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



5.2 SOLUTION AND TECHNICAL ARCHITECTURE





5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer(user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the through Gmail	I can register through gmail	Medium	Sprint-1
	Login	USN-4	As a user, I can log into the application by entering email & password	I can login and verify my account	High	Sprint-1
	Personal Details	USN-5	As a user, I can complete my profile.	I can fill my details in the profile section	Low	Sprint-2
		USN-6	As a User, I have to draw datasets	I can draw and make it available for uploading	Medium	Sprint-3
	Upload the Datasets	USN-7	As a User, I have to upload the datasets for prediction.	I can upload the datasets drawn	High	Sprint-3
	Analyse the Dataset	USN-8	As a User, I can analyse the result of the dataset uploaded	I can visualize the result of prediction	High	Sprint-4
	Generate Report	USN-9	As a User, I can collect my reports	I can get my reports for further process	Low	Sprint-4

CHAPTER 6

PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

USER:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Landing Page	USN-1	As a user, I can view the homepage and instructions to use the website.	4	Medium	Abilash S Aruna A P Deepakkumar G Keerthika E
Sprint-1	Registration	USN-2	As a user, I can register for the application through Gmail.	4	High	Abilash S Aruna A P Deepakkumar G Keerthika E
Sprint-1	Authorization	USN-3	As a user, I will receive a confirmation email once I have registered for the application.	4	High	Abilash S Aruna A P Deepakkumar G Keerthika E
Sprint-1	Login	USN-4	As a user, I can log into the application by entering email & password.	4	Medium	Abilash S Aruna A P Deepakkumar G Keerthika E

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Personal Details	USN-5	As a user, I can complete my profile.	4	Low	Abilash S Aruna A P Deepakkumar G Keerthika E
Sprint-2	Drawing the dataset	USN-6	As a User, I have to draw datasets.	6	Medium	Abilash S Aruna A P Deepakkumar G Keerthika E
Sprint-2	Upload the Datasets	USN-7	As a User, I have to upload the datasets for prediction.	8	High	Abilash S Aruna A P Deepakkumar G Keerthika E
Sprint-3	Analyse the Dataset	USN-8	As a User, I can analyse the result of the dataset uploaded.	10	High	Abilash S Aruna A P Deepakkumar G Keerthika E
Sprint-4	Generate Report	USN-9	As a User, I can collect my reports.	10	Medium	Abilash S Aruna A P Deepakkumar G Keerthika E

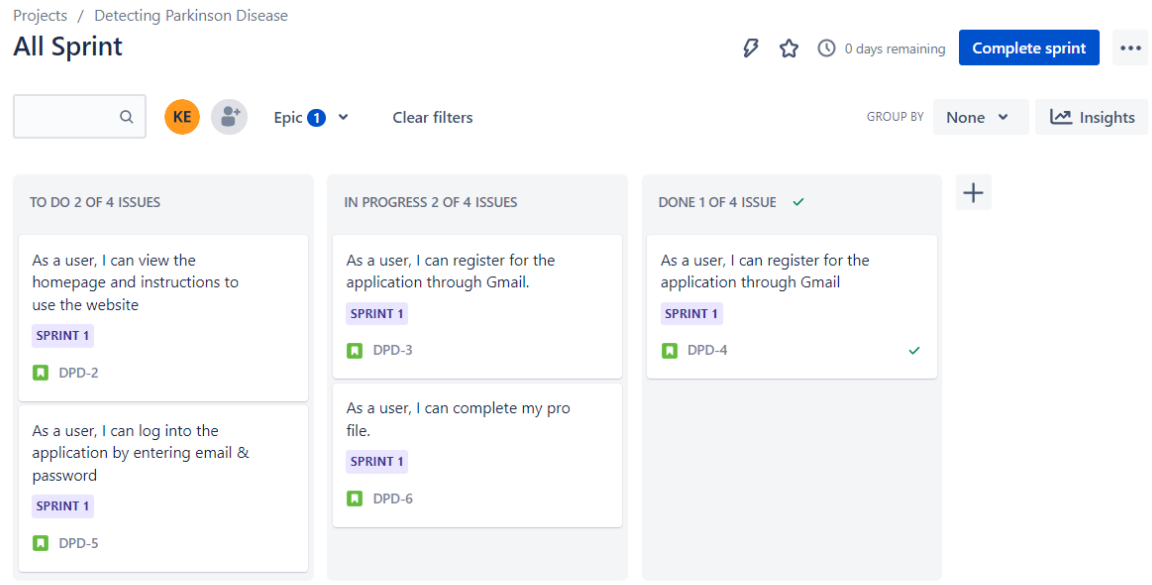
DEVELOPER:

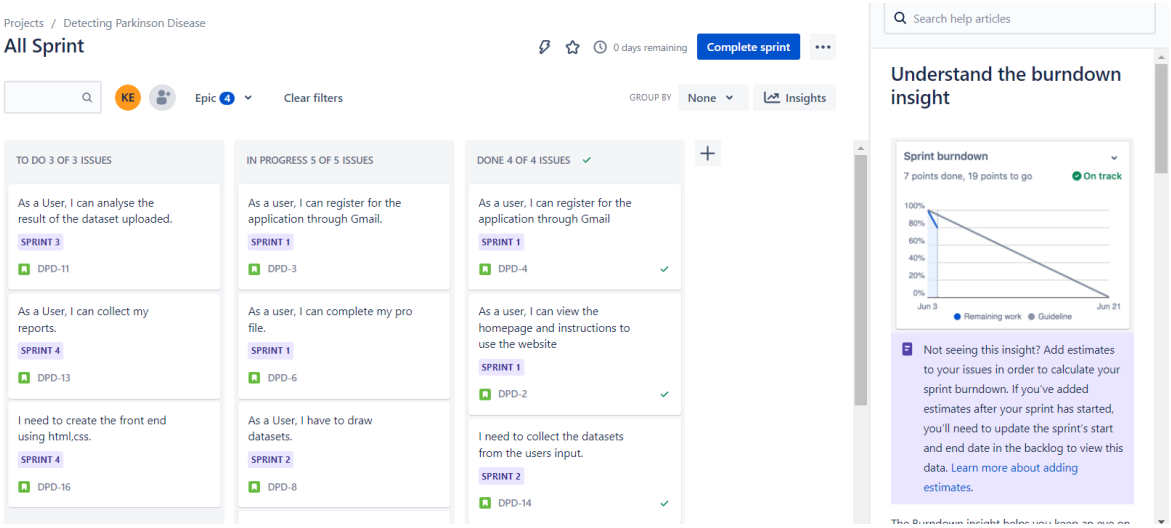
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Collecting Datasets	USN-10	I need to collect the datasets from the users input.	6	High	Abilash S Aruna A P Deepakkumar G Keerthika E
Sprint-3	Logic building	USN-11	I need to use machine learning algorithms like random forest classifiers to analyse thedatasets.	10	High	Abilash S Aruna A P Deepakkumar G Keerthika E
Sprint-4	Front End	USN-12	I need to create the front end using html,css.	10	Medium	Abilash S Aruna A P Deepakkumar G Keerthika E

6.2 SPRINT DELIVERY SCHEDULE:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

6.3 REPORTS FROM JIRA

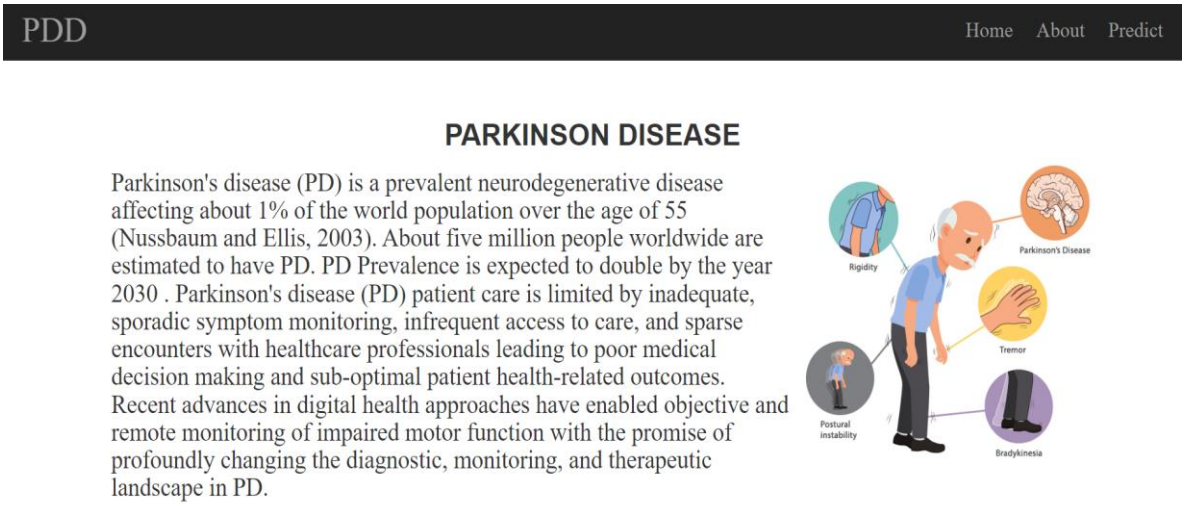




CHAPTER 7
CODING & SOLUTIONING

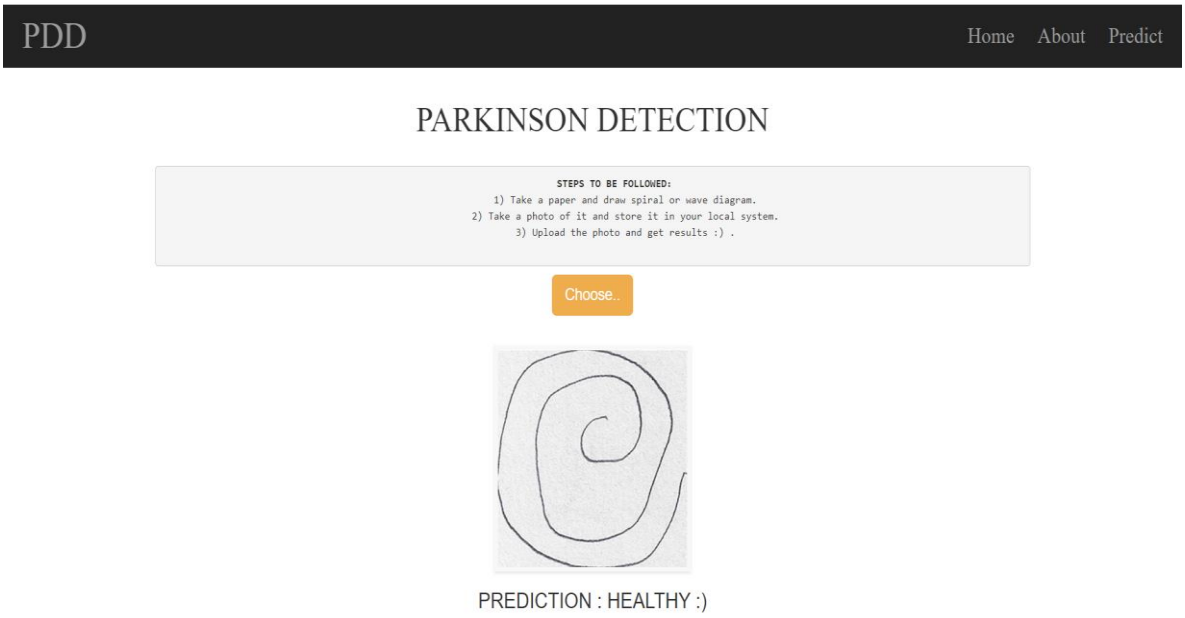
7.1. FEATURE 1

Using our website everyone can easily access and upload their drawn images. In the UI we have complete information about Parkinsons Disease. They can easily understand all the details about the disease. The one who has no knowledge about Parkinson's disease can grab the causes and symptoms and its recovery. And we also attached the images for easy understanding.



7.2. FEATURE 2

Using Machine learning we have created a prediction website. The users can upload their images and they need to simply click the Predict button.
The user can refer to the note mentioned there for the steps to upload their images. Then the result will be displayed as either Parkinson or Healthy. And we used Random Forest Classifier for the prediction. And the one who is affected needs to reach out to the doctor immediately.



CHAPTER 8

TESTING

8.1 TEST CASE

Test case ID	Feature Type	Component	Test Scenario	Steps To Execute	Expected Result	Actual Result	Status	Comments	Executed By
Home Page_ TC_OO1	Functional	Home Page	To Verify if the user is able to see the Home page when they click on the link	1. Enter URL 2. Click Direct and check if the Home page is displayed or not	The Home page should be displayed to the user or who clicks the url	Working as expected	P	The Home Page can be seen	Aruna AP
Homepage_TC_OO2	UI	Home Page	To Verify the UI elements in Homepage 1.Home icon 2. Information icon 3.Predict Icon	1. Enter the URL 2. Verify the UI elements in homepage: a. Home icon b. Information icon c. Predict Icon	Application should show below UI elements: a. Home b. Information c. Predict	Working as expected	P	Can to view all the icons	Keerthika E
Information Page_ TC_OO3	Functional	Information page	To Verify if the Information and the predict icons functions properly	1.Enter URL and click Direct 2. Click on Information icon on homepage 3. Click on Predict Icon on the homepage	1. The user should be navigated to the Information page 2. The user should be navigated to the Predict page that asks for the upload of files	Working as expected	P	Both Information page and the prediction page is displayed	Abilash S
Predict Page_ TC_OO4	Functional	Predict page	To Verify user is able to view the upload file option and its function	1.Enter URL and click Direct 2.Click on Upload file option 3. It should navigate to the local file system	Application should navigate the user to the local file system to upload the files	Working as expected	P	Navigated to the local file system	Deepak kumar G
Predict Page_ TC_OO5	Functional	Predict Page	To Verify if the user is able to choose the file from the local file system and click on predict to find the predicted result	1.Enter URL and click Direct 2. Click on the choose option 3. Choose a File 4. It should be on a Valid Format 5.Click on Predict	Choose the file popup screen must be displayed and the user should be able to click on the predict button and the result must be displayed	Working as expected	P	Result got Displayed as "The Person has parkinson's"	Abilash S
Predict Page_ TC_OO6	Functional	Predict page	To Verify whether the user is able to select the invalid file formats	1.Enter URL and click Direct 2. Click on the choose option 3. Choose a file 4. It should be on a Invalid format 5.Click on Predict	The Application won't allow to attach the files in the formats other than ".png, .,jpg"	Working as expected	Pass	The app shows error message while uploading unsupported file formats	Aruna AP

8.2 USER ACCEPTANCE TESTING

1.Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Detection of Parkinson's Disease project at the time of the release to User Acceptance Testing (UAT).

2.Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and howthey were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	5	2	1	3	11
Duplicate	1	0	0	1	2
External	3	4	1	0	8
Fixed	9	3	2	13	27
Not Reproduced	0	1	0	0	1
Skipped	1	1	0	0	2
Won't Fix	0	1	2	1	4
Totals	19	12	6	18	55

3.Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Login	5	0	1	4
Image Upload	2	0	0	2
Prediction	2	0	0	2

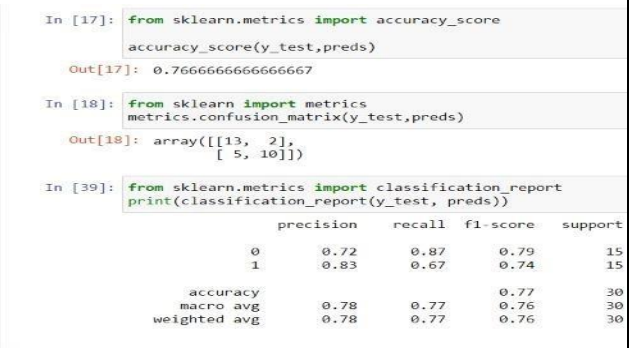
CHAPTER 9

RESULTS

9.1 PERFORMANCE METRICS

Model Performance Testing:

Project team shall fill the following information in model performance testing template

S.No.	Parameter	Values	Screenshot
1.	Metrics	**Classification Model:** Confusion Matrix Accuracy Score Classification Report	
2.	Tune the Model	Hyper parameter Tuning Validation Method	

CHAPTER 10

ADVANTAGES AND DISADVANTAGES

10.1 ADVANTAGES

1. Traditional diagnostic approaches may suffer from subjectivity as they rely on the evaluation of movements that are sometimes subtle to human eyes and therefore difficult to classify, leading to possible misclassification. To address these difficulties and to refine the diagnosis and assessment procedures of PD, machine learning methods have been implemented for the classification of PD and healthy controls or patients with similar clinical presentations.
2. It is Cost effective and user-friendly model and easy to use.
3. It requires only few steps to identify whether a person has Parkinson's disease or not.

10.2 DISADVANTAGES

1. It requires more number of dataset to train the model so that the percentage of accuracy while be near to the actual diagnosis of the disease
2. Training the model will be little more complex with huge number of datasets.
3. It can only predict whether a patient is having Parkinson's disease or not. But it cannot able to predict the Severity of the disease.

CHAPTER 11

CONCLUSION

Managing Parkinson's disease in day-to-day life is very challenging for an individual. Limited care due to inadequate, infrequent symptom monitoring, infrequent access to care, and sparse encounters with healthcare professionals leading to poor medical decision making and sub-optimal patient health-related outcomes. Therefore we use ML-based research algorithm (Random Forest Algorithm) to diagnose Parkinson's disease in terms of handwritten spiral and wave patterns in order to predict whether a particular person is undergoing Parkinson's disease or not. The improvements that can be made in the current methodology is that the number of data samples can be increased significantly.

CHAPTER 12

FUTURE SCOPE

1. The model will be even more accurate as the number of datasets trained increases.
   The more the datasets acquired and trained higher the accuracy of the model.

2. We can add additional features to the already existing model which will be able to predict the intensity of the disease.

3. According to the intensity of the disease we can recommend the specialists doctor to treat the patient by including features such as chat room, video calling, etc.

CHAPTER 13

APPENDIX

13.1 SOURCE CODE:

Home.html:

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Parkinson Disease Detection</title>
    <link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css"
>
    <script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.5.1/jquery.min.js"></scr
ipt>
    <script
src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></
script>
    <link rel="stylesheet" href="style.css">
    <link rel="stylesheet"
href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/4.7.0/css/font-
awesome.min.css">
</head>
<style>

</style>
<body>
    <section id="home">
        <!--navbar-->
     <nav class="navbar navbar-inverse navbar-fixed-top" style="padding:
10px;">
        <div class="container-fluid">
            <div class="navbar-header">
                <button type="button" class="navbar-toggle" data-
toggle="collapse" data-target="#menu">
                    <span class="icon-bar"></span>
                    <span class="icon-bar"></span>
                    <span class="icon-bar"></span>
                </button>
                <!--action="/action_page.php"-->
                <a href="/home" class="navbar-brand" style="font-family:
Roboto; font-size: 300%;"> PDD</a>
            </div>
```

```
            <div class="collapse navbar-collapse" id="menu" style="font-
size: 25px;">

              <ul class="nav navbar-nav navbar-right" style="font-family:
roboto;">
                <li><a href="/home"> Home</a></li>
                    <li> <a href="/info"> About</a></li>
                    <li> <a href="/upload">Predict</a></li>

              </ul>
            </div>
        </div>
      </nav>
      <div class="container-fluid">
        <div class="col-md-12 " style=" position: absolute; margin-right:
80px; right: 10px; top: 150px; margin-left: 100px; color: white;" class="nav
navbar-nav navbar-right">
          <h1 style="font-size:50px;  font-family: Roboto; color: black;"
class="nav navbar-nav navbar-right">PARKINSON DISEASE DETECTION</h1>
          <br><br><br><br>
          <h2 style="font-size:40px; position:absolute; right: 150px; font-
family: Roboto; color: black;" class="nav navbar-nav navbar-right">EASIEST
WAY TO DETECT</h2>
          <br><br><br>
          <H2 style="font-size:35px; position:absolute; right:200px; font-
family: Roboto; color: black;" class="nav navbar-nav navbar-right">Get
results with just 3 steps</H2>
          <br><br><br>
          <p style="font-size:30px; position:absolute; right:260px; font-
family: Roboto; color: black;" class="nav navbar-nav navbar-right">Step 1:
Draw diagram</p>
          <br><br><br>
          <p style="font-size:30px; position:absolute; right:285px; font-
family: Roboto; color: black;" class="nav navbar-nav navbar-right">Step 2:
Take photos</p>
          <br><br><br>
          <p style="font-size:30px; position:absolute; right:340px; font-
family: Roboto; color: black;" class="nav navbar-nav navbar-right">Step 3:
Upload</p>
          <img style="margin-left: 3%;" src="https://pyimagesearch.com/wp-
content/uploads/2019/04/detect_parkinsons_opencv_patient.jpg"
alt=""  width="40%" height="570px"/>
        </div>
          <br>
      </div>
    </section>
</body>
</html>
```

App.py:

```
import pickle
import cv2
from skimage import feature
from flask import Flask,request, render_template
import os.path
app=Flask(__name__)#our flask app

@app.route("/") #default route
def about():
    return render_template("home.html")#rendering html page

@app.route("/home") #route about page
def home():
    return render_template("home.html")#rendering html page

@app.route("/info") # route for info page
def information():
    return render_template("info.html")#rendering html page

@app.route("/upload") # route for uploads
def test():
    return render_template("index6.html")#rendering html page

@app.route('/predict', methods=['GET', 'POST'])
def upload():
    if request.method == 'POST':
        f = request.files['file']  # requesting the file
        #filename_secure = secure_filename(f.filename)
        basepath = os.path.dirname(
            '__file__')  # storing the file directory
        # storing the file in uploads folder
        filepath = os.path.join(basepath, "uploads", f.filename)
        f.save(filepath)  # saving the file

        # Loading the saved model
        print("[INFO] loading model...")
        model = pickle.loads(open('parkinson.pkl', "rb").read())
        '''local_filename = "./uploads/"
        local_filename += filename_secure
        print(local_filename)'''

        # Pre-process the image in the same manner we did earlier
        image = cv2.imread(filepath)
        output = image.copy()

        # Load the input image, convert it to grayscale, and resize
        output = cv2.resize(output, (128, 128))
```

```
        image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
        image = cv2.resize(image, (200, 200))
        image = cv2.threshold(image, 0, 255,
                              cv2.THRESH_BINARY_INV | cv2.THRESH_OTSU)[1]

        # Quantify the image and make predictions based on the extracted
features using the last trained Random Forest
        features = feature.hog(image, orientations=9,pixels_per_cell=(10,
10), cells_per_block=(2, 2),transform_sqrt=True, block_norm="L1")
        preds = model.predict([features])
        print(preds)
        ls = ["HEALTHY :)", "PARKINSON \n :( You are affected by Parkinson
please Consult a Doctor."]
        result = ls[preds[0]]

        color = (0, 255, 0) if result == "HEALTHY :)" else (0, 0, 255)
        cv2.putText(output, result, (3, 20), cv2.FONT_HERSHEY_SIMPLEX, 0.5,
color, 2)
        cv2.imshow("Output", output)
        cv2.waitKey(0)
        return result

    return None


if __name__ == '__main__':
    app.run()
```

13.2 GITHUB AND DEMO LINK:

Github link: https://github.com/IBM-EPBL/IBM-Project-16839-1659623741

Demo link: https://www.kapwing.com/videos/6378f37bfb7ee1002508b383