PROJECT REPORT ON

Detecting Parkinson's Disease Using Machine Learning

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TABLE OF CONTEXT

1. INTRODUCTION

1.1 PROJECT OVERVIEW

Parkinson's disease (PD) is known to be one of the most common neurodegenerative diseases among older people aged more than 65. One of the most common effects that are easily noticeable among the PD patients and used most commonly in the early stage of diagnosis is finding the difference in handwriting and sketching abilities. However, the major drawback of these kinds of diagnoses needs proper interpretation of sketching and handwriting. Some of the common features present inside the sketches could be considered as the potential indicators to differentiate different group of subjects that includes healthy subjects and PD subjects and those tasks can be used to perform the reliability analysis in the real-time. In recent Days the wisest decision for detecting something in real-time is to make the system automatic so that we can perform the same operation with less time as well as in a more precise way. In this respect machine learning techniques are more effective an shown enough potential to be used in real-life situations.

So, we made an attempt has been made to develop an automated system that trained with the features extracted from the different sketches performed by the healthy group of patients as well as PD patients to assess the severity of the PD disease among different stages as well as between the healthy groups of patients. The investigation performed in this study to differentiate the healthy subjects from PD subjects based on the spiral sketches by extracting features from the images sketched by the healthy subjects and PD subjects.

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.

1.2 PURPOSE

Parkinson's disease is a brain disorder that causes unintended or uncontrollable movements, such as shaking, stiffness, and difficulty with balance and coordination. Symptoms usually begin gradually and worsen over time. As the disease progresses, people may have difficulty walking and talking. They may also have mental and behavioural changes, sleep problems, depression, memory difficulties, and fatigue.

More than 10 million people are living with Parkinson's Disease worldwide, according to the Parkinson's Foundation. While Parkinson's cannot be cured, early detection along with proper medication can significantly improve symptoms and quality of life. Detecting PD is difficult due to the delicate nature of the initial symptoms, which means that the early symptoms will go unnoticed by the person suffering from this disease. There are numerous significant burdens on patients as well as the health care systems due to there are lots of delays in the diagnosis of the Parkinson's disease. 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.

Therefore, we planned to design a system which analyzes Spiral drawing patterns and wave drawing patterns in patients suffering from Parkinson's disease and healthy subjects. The system developed in the study leverages Histogram of Oriented Gradients (HOG)image descriptor for analyzing the drawing patters of both spiral and wave sketches respectively. Further, the prediction probabilities are trained on a random forest classifier based on ensemble voting to provide a weighted prediction from both the spiral and wave sketch.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

In existing system, Convolutional Neural Networks (CNN) is used to detect the Parkinson's disease. The 3D brain images contain a huge amount of information that leads to complex CNN architectures. When these architectures become too complex, classification performances often degrades because the limitations of the training algorithm and overfitting.

It leads to the average accuracy of detecting Parkinson's disease. Thus, existing system is not effective in early detection of Parkinson's disease and accurate medicinal diagnosis to the affected people.

2.2 REFERENCES

1. Zham, P., Arjunan, S.P., Raghav, S. and Kumar, D.K., 2017. Efficacy of guided spiral drawing in the classification of Parkinson's disease. IEEE journal of biomedical and health informatics, 22(5), pp.1648-1652.

2. Kotsavasiloglou, C., Kostikis, N., Hristu-Varsakelis, D. and Arnaoutoglou, M., 2017. Machine learning-based classification of simple drawing movements in Parkinson's disease. Biomedical Signal Processing and Control, 31, pp.174-180.

3. Memedi, M., Sadikov, A., Groznik, V., Žabkar, J., Možina, M., Bergquist, F., Johansson, A., Haubenberger, D. and Nyholm, D., 2015. Automatic spiral analysis for objective assessment of motor symptoms in Parkinson's disease. Sensors, 15(9), pp.23727-23744.

4. Aich, S., Sain, M., Park, J., Choi, K.W. and Kim, H.C., 2017, November. A mixed classification approach for the prediction of Parkinson's disease.

2.3 PROBLEM STATEMENT DEFINITION

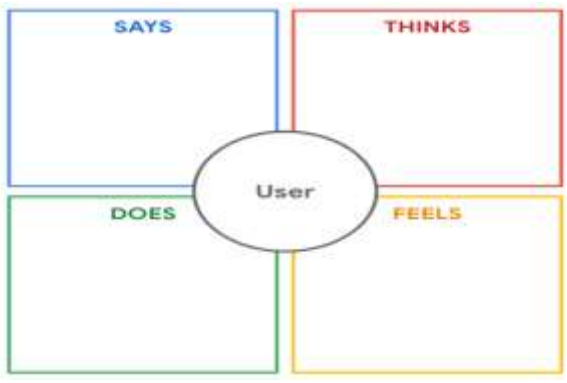
More than 10 million people are living with Parkinson's Disease worldwide, according to the Parkinson's Foundation. While Parkinson's cannot be cured, early detection along with proper medication can significantly improve symptoms and quality of life. Parkinson Disease is a brain neurological disorder. It leads to shaking of the body, hands and provides stiffness to the body. Some of the movement disorders symptoms such as rigidity, instability in posture, tremor, and bradykinesia are usually observed on the PD patients at different stages. No proper cure or treatment is available yet at the advanced stage. One of the most common effects that are easily noticeable among the PD patients and used most commonly in the early stage of diagnosis is finding the difference in handwriting and sketching abilities.

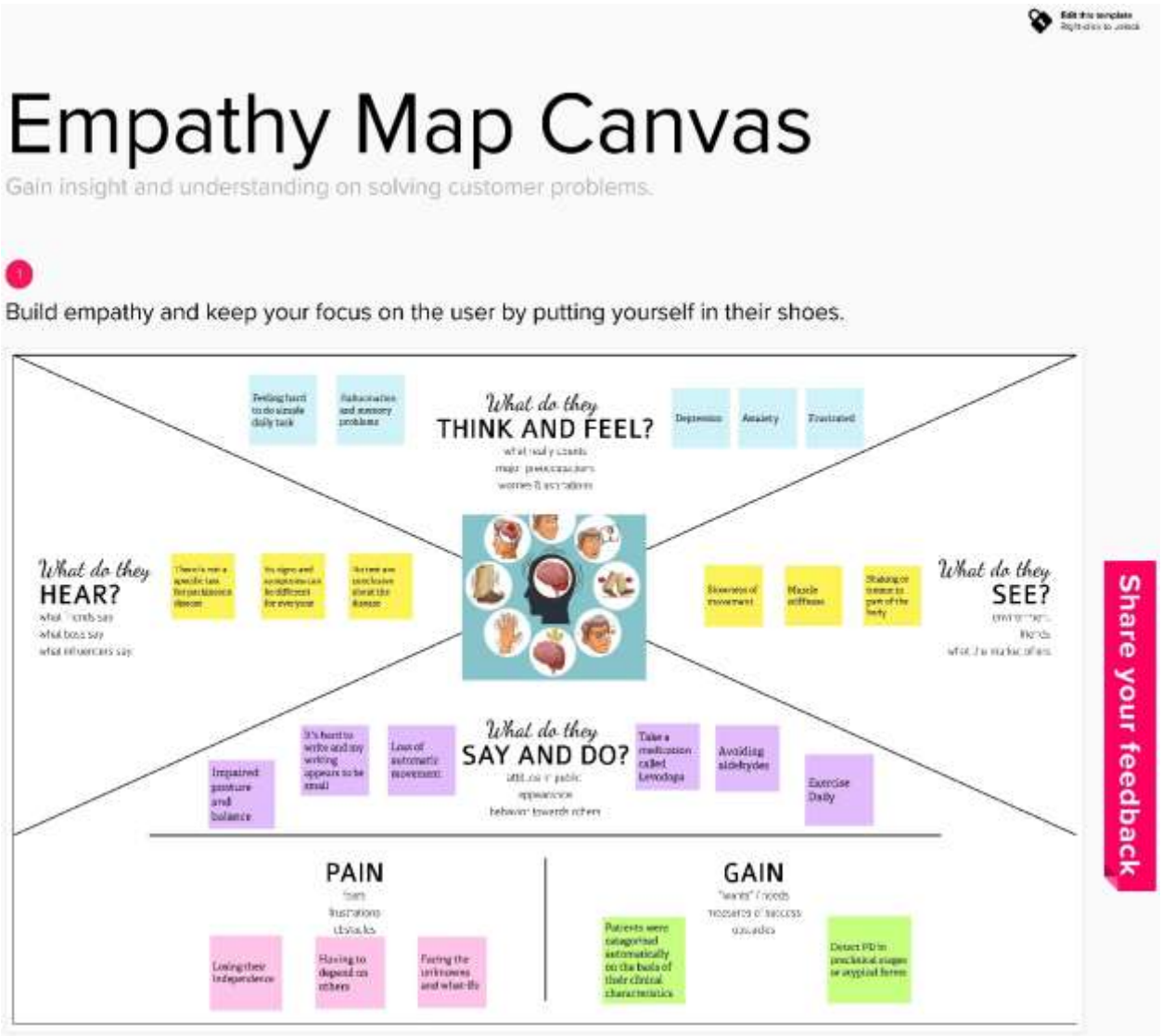
Treatment is possible only when done at the early or onset of the disease. These will not only reduce the cost of the disease but will also possibly save a life. Parkinson's disease is the 14th leading cause of death in the United States, according to the Center for Disease Control, and more people currently live with it than those with multiple sclerosis, muscular dystrophy, and ALS combined. Though we can't cure it, identifying it in soon can improve the lifespan.

3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviors and attitudes. It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. Creating the empathy map helps participants consider things from the user's perspective along with his or her goals.

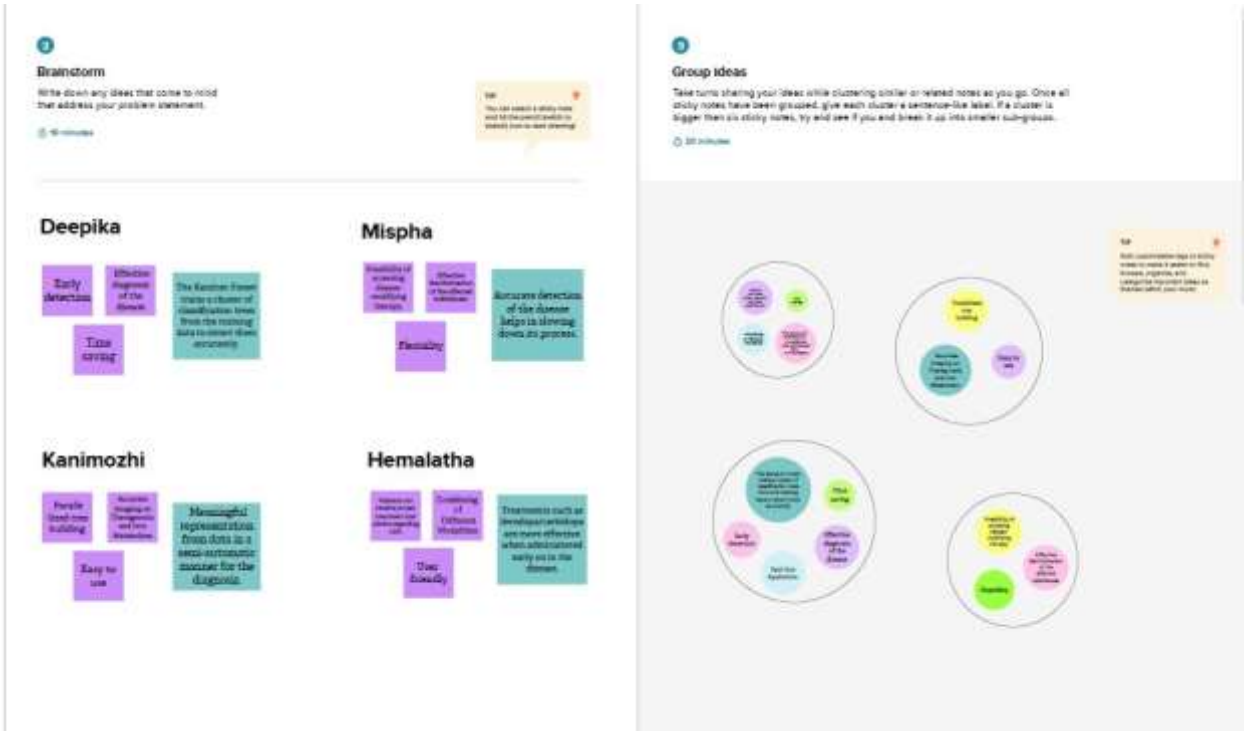


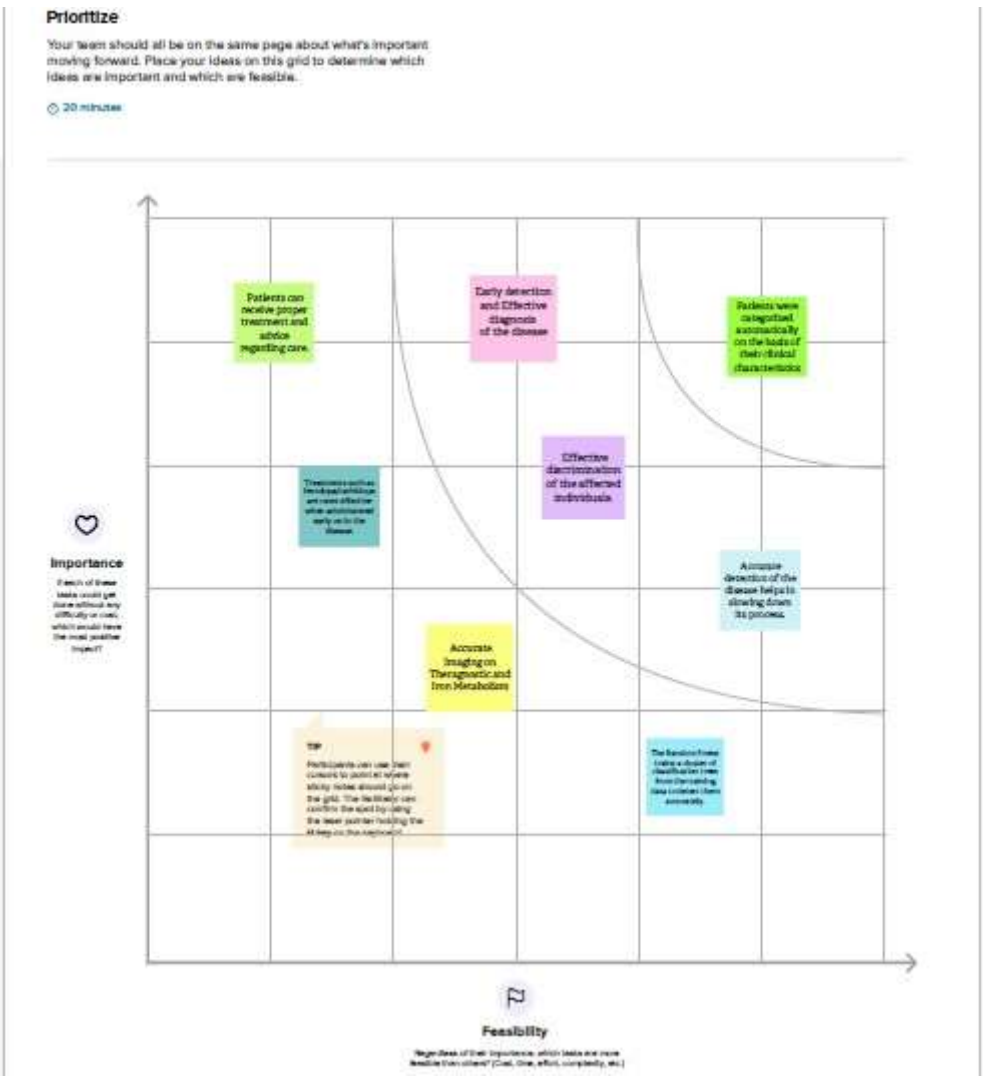


3.2 IDEATION & BRAINSTORMING

Ideation and Brainstorming are writing down ideas that comes to mind that addresses your problem statement.
The key rules of Brainstorming are:

- Defer Judgement
- Encourage Wild Ideas
- Build on the Ideas of Others
- Stay Focused on the Topic
- One Conversation at a Time
- Be visual
- Go for Quantity


Brainstorm
Write down any ideas that come to mind that address your problem statement.
Deepika
Early detection
Time saving
Mispha
Accurate detection of the disease helps in slowing down its process.
Flexibility
Kanimozhi
Easy to use
Meaningful representations from data in a semi-automatic manner for the diagnosis
Hemalatha
Treatments such as neoadjuvant antiviraps are more effective when administered early on in the disease
Group ideas
Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.


Prioritize
Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.
20 minutes
Patients can receive proper treatment and advice regarding care.
Early detection and Effective diagnosis of the disease
Patients were categorised automatically on the basis of their clinical characteristics
Effective discrimination of the affected individuals
Accurate imaging on Theragnostic and Iron Metabolism
Importance
Feasibility

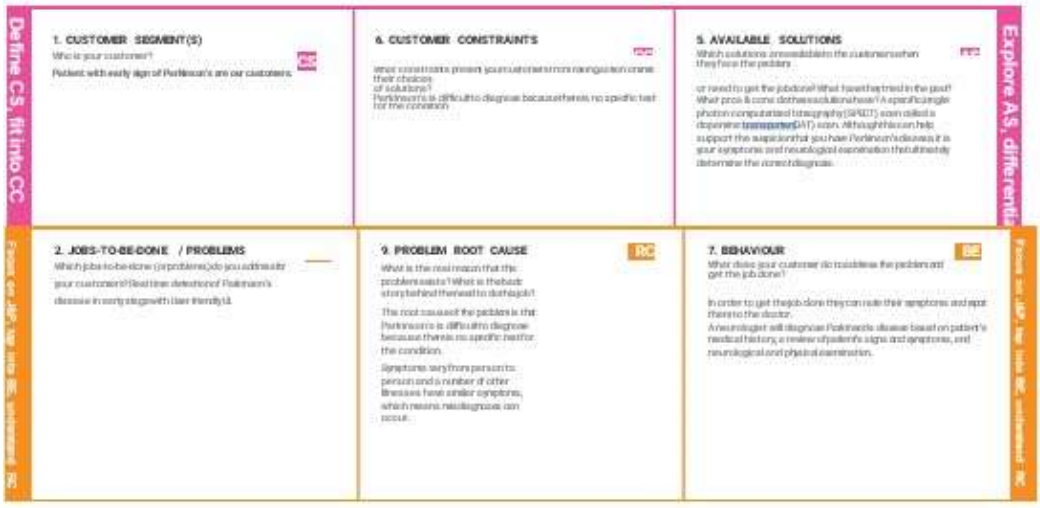
3.3 PROPOSED SOLUTION

Having a Solid grasp of the problem after doing a thorough investigation, a practical solution needs to be proposed or several approaches needs to be suggested for proper understanding and the rectification of issues. The ones that solve all these is a Proposed Solution.

S. No.	Parameter	Description
1.	Problem Statement (Problem tobe solved)	More than 10 million people are living with Parkinson'sDisease worldwide, according to the Parkinson's Foundation. While Parkinson's cannot be cured, early detection along with proper medication can significantly improve symptoms and quality of life.
2.	Idea / Solution description	this project, we are using, Histogram of OrientedGradients (HOG) image descriptor along with a Random Forest classifier to automatically detect Parkinson's disease in hand-drawn images of spiralsand waves.
3.	Novelty / Uniqueness	HOG descriptors are powerful to detect images with occlusions, pose and illumination changes because they are extracted in a regular grid. For the regions ofthe image, it generates histograms using the magnitude and orientations of the gradient. HOG can be used to detect small-scaled images with less computational power, which means you can run HOGwithout having a powerful GPU. Hence, the accuracy is highly reliable.
4.	Social Impact / Customer Satisfaction	Parkinson's disease is the 14th leading cause of deathin the United States, according to the Center for Disease Control, and more people currently live with it than those with multiple sclerosis, muscular dystrophy, and ALS combined. Though we can't cure it, identifying it in soon can improve the lifespan.
5.	Business Model (Revenue Model)	Early detection along with proper medication can significantly improve symptoms and quality of life. Our model can be used by hospitals to detect in early stages, which can be profit for them.
6.	Scalability of the Solution	scalability in our project is achieved by combining Statistics, ML, and Data Mining into flexible, scalable, and often nonparametric techniques. the projection is done at image-level and therefore the computational cost is linear in the number of views, in our model every view is approximated at feature level as a linear combination of the pre-computed views. As a result, once the views have been computed, the cost of computing new views is almostnegligible. This allows the model to be evaluated on many more viewpoints.

3.4 PROBLEM SOLUTION FIT

The Problem Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it actually solves the customer's problem. It helps entrepreneurs, marketers and corporate innovators identify the behavioral patterns and recognize what would work and why.



4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

Functional Requirement define what a product must do, what its features and functions are. They, are Product features or functions that developers must implement to enable users to accomplish their tasks. Generally, functional requirements describe system behavior under specific conditions. Example: The system sends a confirmation email when a new user account is created.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	**Home Page**	New users have to Register. Registered user will Login to access the account.
FR-2	**User Registration**	Registration – Through Email
FR-3	**User Confirmation**	Confirmation via Email with OTP
FR-4	**Login Page**	User can login through their Username and password
FR-5	**Test Inputs**	The user inputs the symptoms into the Machine Learningmodel.
FR-6	**Result**	Accurately, get the result as positive or negative with percentage affected in a person by the Parkinson's Disease.

4.2 NON-FUNCTIONAL REQUIREMENT

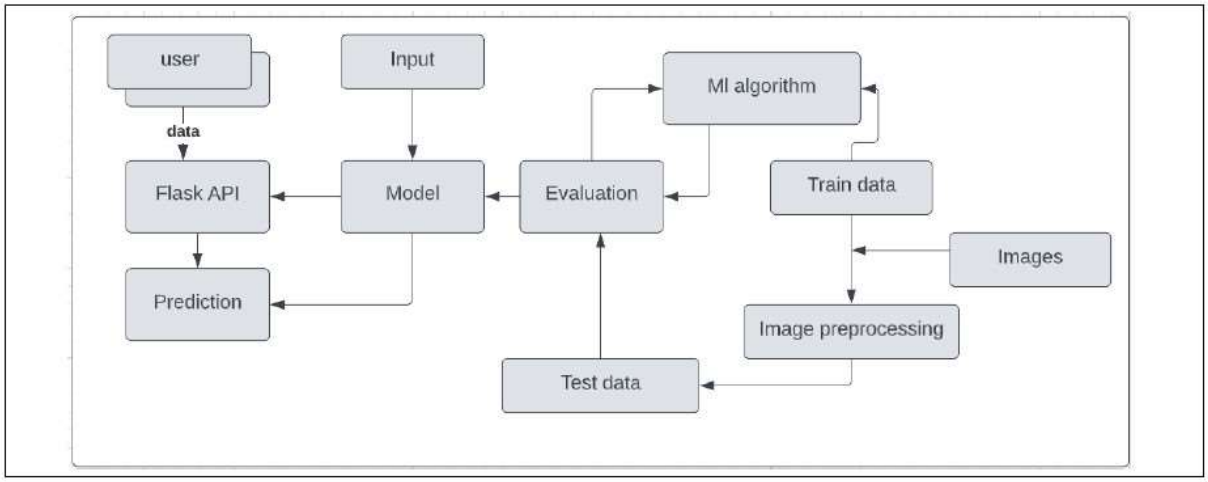
Nonfunctional Requirements, not related to the system functionality, rather define how the system should perform.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	The users who have signed up for the web applicationwill have access to all the resources present in that website (for e.g., tips to overcome the disease at an early stage).
NFR-2	**Security**	User information is protected for authenticated users.
NFR-3	**Reliability**	Since only authorized users have access to the contents of the page, the web application is reliable and authorized.
NFR-4	**Performance**	The web application makes use of HOG for image classification to quantify the image hence it gives accurate results.
NFR-5	**Availability**	The web application can be accessed 24/7 from anywhere when connected to the internet.
NFR-6	**Scalability**	The trained ML model can provide accurate results whenever the size of the dataset and the number of users is extended.

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

A Data Flow Diagram is a traditional visual representation of the information flows within a system. A neat and clear data flow diagram can depict the right amount of the system requirements graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



5.2 SOLUTION & TECHNICAL ARCHITECTURE

SOLUTION ARCHITECTURE

Solution Architecture is a complex process – with many sub processes – that bridges the gap between business problems and the technology solutions.

SOLUTION

By using machine learning techniques, the problem can be solved with minimal error rate. The system developed in the study leverages Histogram of Oriented Gradients (HOG)image descriptor for analyzing the drawing patters of both spiral and wave sketches respectively. Further, the prediction probabilities are trained on a random forest classifier based on ensemble voting to provide a weighted prediction from both the spiral and wave sketch.

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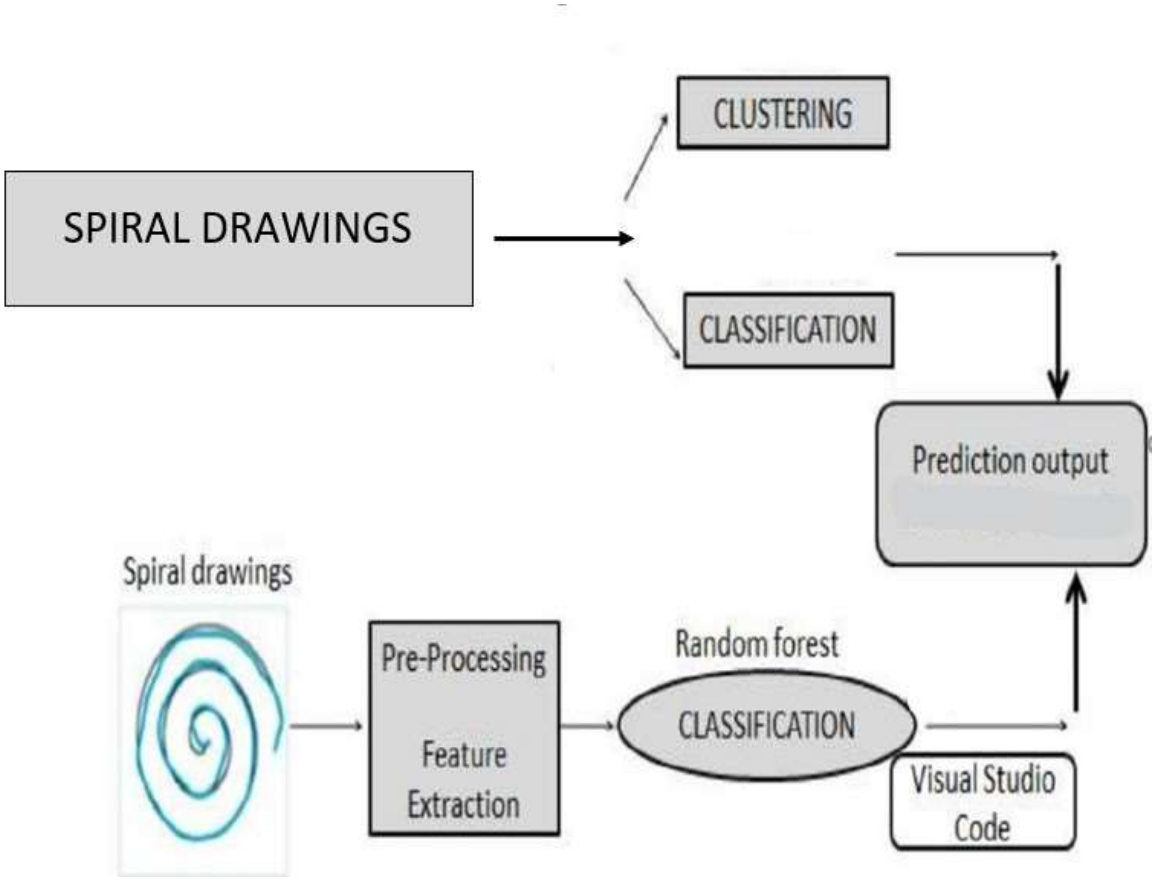


TECHNICAL ARCHITECTURE

The Technical Architecture involves the development of a technical blueprint with regard to the arrangement, interaction and interdependence of all elements so that the system-relevant requirements are met.

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2

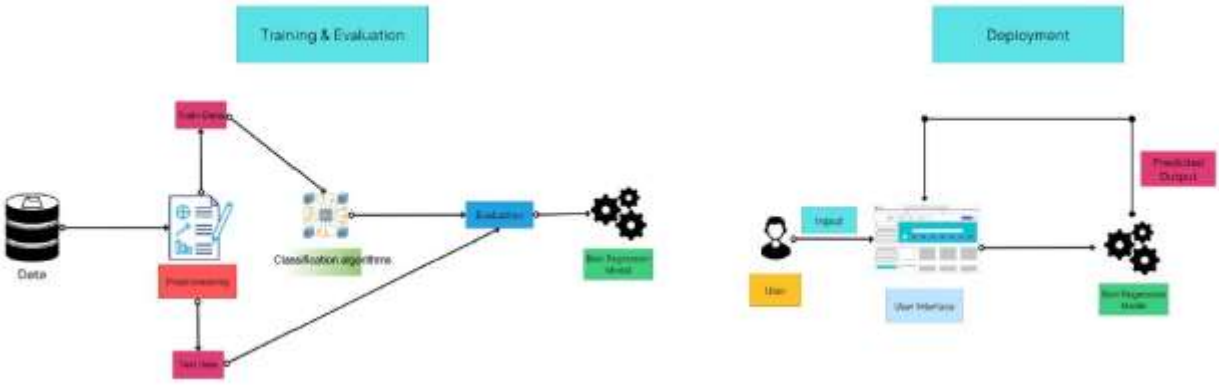


Table-1: Component & Technologies

S. No:	Component	Description	Technology
1.	User Interface	How user interacts with application example: Web UI, Mobile App, Chatbot etc.	Flask API
2.	Application Logic-1	Load the dataset	Jpeg Images
3.	Application Logic-2	Classification	Random Forest Classifier
4.	Application Logic-3	Evaluation	Python
5.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model

5.3 USER STORIES

A user story is the smallest unit of work. It is not a feature, but an end goal that the user has when using the software. The user story will convey what the user wants to achieve and states into a simple, non-technical way.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
User	Uploading the dada	USN-1	As a user, I have the input data by using which I need to detect the Parkinson's disease	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will upload the data in the Flask API	I can upload by uploading or submit button	High	Sprint-2
		USN-3	As a user, I can get the prediction done by ML algorithm as the output	I can see the result in the Flask API interface	High	Sprint-3

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Upload Images	USN-1	As a user, I can upload the images in the website in order to obtain the prediction result of Parkinson'sdisease	2	High	1.Deepika 2.Hemalatha 3.Kanimozhi 4.Mispha

Sprint-4	Test Vital Page	USN-2	As a user, I will get the prediction result and accuracy on the test vital page.	3	High	1.Deepika 2.Hemalatha 3.Kanimozhi 4.Mispha

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Dashboard	USN-3	Dashboard displays the symptoms, causes and medications for the Parkinson disease	2	Low	1.Deepika 2.Hemalatha 3.Kanimozhi 4.Mispha
Sprint-1	Data Collection	USN-4	As an Administrator, I need to collect data (images of spirals and waves drawn by healthy people and Parkinson's	2	High	1.Deepika 2.Hemalatha 3.Kanimozhi 4.Mispha

			patients).			

Sprint-1	Data Pre-Processing	USN-5	As an Administrator, I should cleanmy data and prepare it for model building by doing pre-processing activities such as resizing, visualizing the dataset and converting from RGB to grayscale	2	High	1.Deepika 2.Hemalatha 3.Kanimozhi 4.Mispha
Sprint-2	Model Building	USN-6	As an Administrator, I need to buildthe model using Random Forest Classifier for spiral images and Convolutional Neural Networks (CNN) for wave images	3	High	1.Deepika 2.Hemalatha 3.Kanimozhi 4.Mispha
Sprint	**Functional Requirement (Epic)**	**User Story Number**	**User Story / Task**	**Story Points**	**Priority**	**Team Members**
Sprint-3	Deployment of Model	USN-7	As an Administrator, I need to deploy the Machine Learning model that was built.	2	Medium	1.Deepika 2.Hemalatha 3.Kanimozhi 4.Mispha

Sprint-3	Building Frontend of the application	USN-8	As an Administrator, I need to build the website for the application using HTML, CSS etc.	2	High	1.Deepika 2.Hemalatha 3.Kanimozhi 4.Mispha

Sprint-4	Connecting the ML model, Frontend and Backend	USN-9	As an Administrator, I can integratethe deployed model and web application using python flask server.	3	High	1.Deepika 2.Hemalatha 3.Kanimozhi 4.Mispha

Project Tracker, Velocity & Burndown Chart

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	14 Nov 2022

Velocity:

For example, imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate theteam's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

In our project, we have a 6-days sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{\text{Sprint Duration}}{\text{Velocity}} = \frac{20}{6} = 3.3 \text{ (approx.)}$$

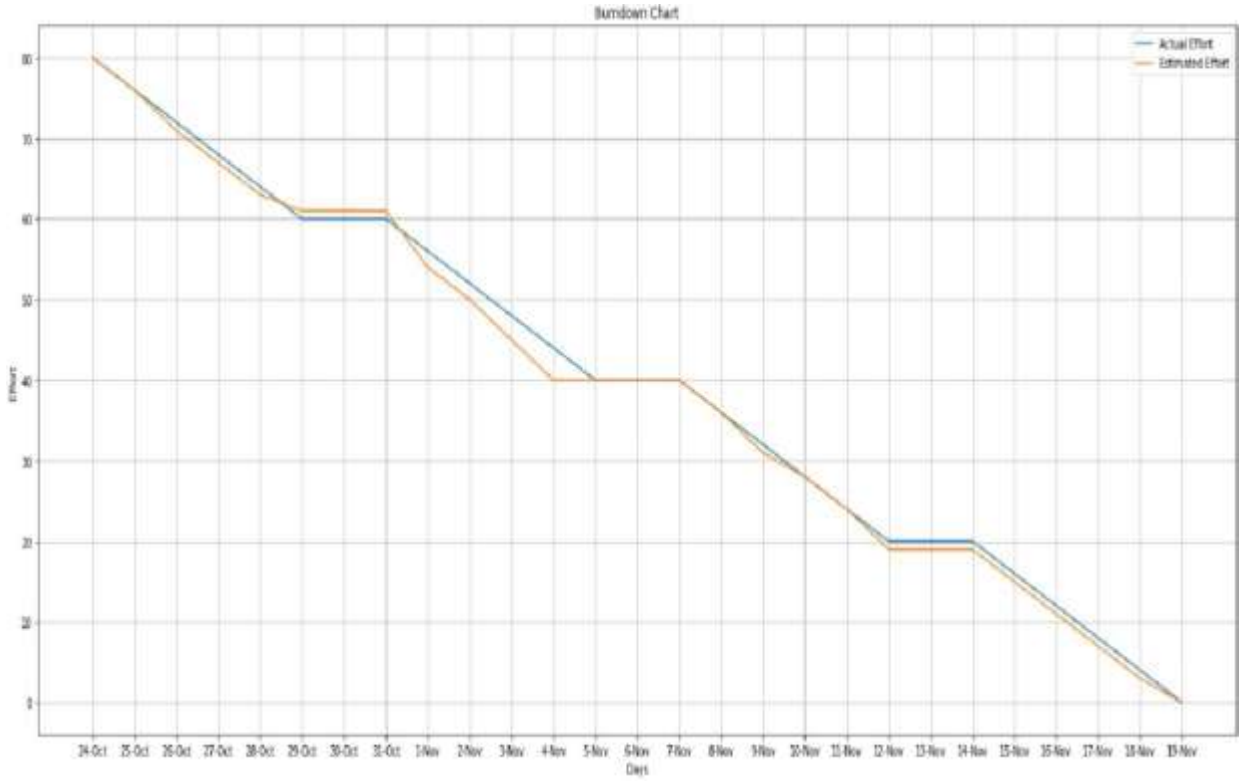
Burndown Chart:

A burn down chart is a graphical representation of work left to do versus time. It is often used in agile software developmentmethodologies such as Scrum. However, burn down charts can be applied to any project containing measurable progress over time.

A burndown chart is almost a "must" have tool for a Scrum Team for the following main reasons:

- Monitoring the project scope creep
- Keeping the team running on schedule

- Comparing the planned work against the team progression



6.2 SPRINT DELIVERY SCHEDULE

TITLE	DESCRIPTION	DATE
DEATION PHASE		
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	03 SEPTEMBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements.	10 SEPTEMBER 2022
Problem Statement	List of problem in the project.	10 SEPTEMBER 2022
Brainstorm And Idea Prioritization	List the by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	17 SEPTEMBER 2022
PROJECT DESIGN PHASE-I		
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	24 SEPTEMBER 2022
Problem Solution Fit	Prepare problem - solution fit document.	01 OCTOBER 2022
Solution Architecture	Prepare solution architecture document.	01 OCTOBER 2022
PROJECT DESIGN PHASE-II		
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry to exit).	08 OCTOBER 2022
Functional Requirement	Prepare the functional requirement document.	15 OCTOBER 2022
Data Flow Diagrams	Draw the data flow diagrams and submit for review.	15 OCTOBER 2022

Technology Architecture	Prepare the technology architecture diagram.	15 OCTOBER 2022
PROJECT PLANNING PHASE		
Prepare Project Planning & Sprint Delivery Plan	Prepare the Product Backlog, Sprint Planning, Stories, and Story points.	22 OCTOBER 2022
Prepare Milestone & Activity List	Prepare the milestones &activity list of the project.	22 OCTOBER 2022
PROJECT DEVELOPMENT PHASE		
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	10 NOVEMBER 2022

DATA COLLECTION

Create train and test folders	To prepare the training and testing dataset and upload it into the folders.	29 OCTOBER2022

QUANTIFYING IMAGES

Import feature library and configure it	Import the feature library from SK image	02 NOVEMBER2022
Apply feature library Functionality to test and train set	Apply it to the model	05 NOVEMBER 2022

MODEL BUILDING

Import the required model building libraries	To import the necessary libraries and packages to build the model	02 NOVEMBER 2022
Initialize the model	Initializing the model	02 NOVEMBER 2022
Add the COLOR_BGR2GRAY	To add the COLOR_BGR2GRAY	02 NOVEMBER 2022
Add the Label Encoder	Adding the Label Encoder	02 NOVEMBER 2022
Compile the model	To compile the model	10 NOVEMBER 2022
Fit and save the model	Save the model	10 NOVEMBER 2022

TEST THE MODEL

Import the packages and load the saved model	Load the saved model and testing it	10 NOVEMBER 2022
Load the Test image, quantify it and predict	Prediction and testing the images	10 NOVEMBER 2022

APPLICATION BUILDING

Build A flask application	To build the flask application	06 NOVEMBER 2022
Build A flask application	To build the flask application	06 NOVEMBER 2022
Building the flask application-part 3	To build the flask application	06 NOVEMBER 2022
Build the HTML page	Building the html page for frontend	06 NOVEMBER 2022
Output	To get the output	11 NOVEMBER 2022

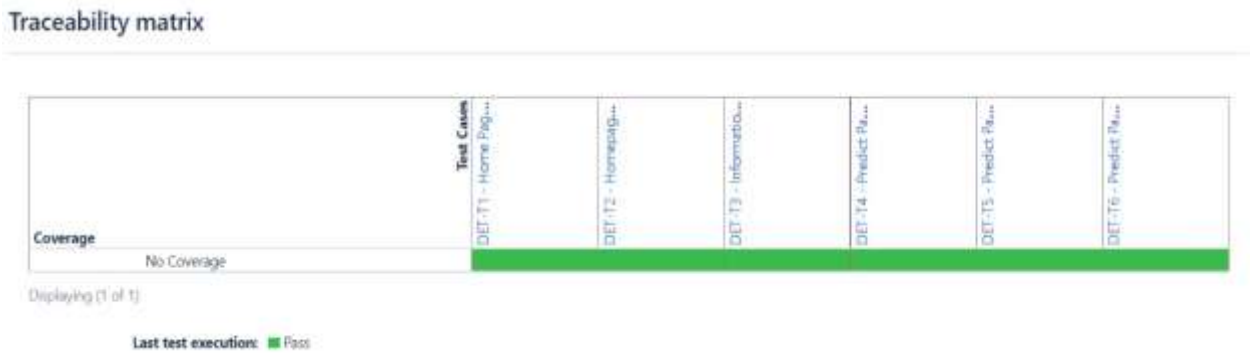
TRAIN THE MODEL ON IBM

Train image Classification model	To develop the code and push it into the git hub	11 NOVEMBER 2022
Register for IBM cloud	To register for the IBM cloud	27 UGUST 2022

6.3 REPORTS FROM JIRA

1. Coverage Report

2.Traceability matrix



3.Traceability Report

Traceability Report

Coverage	Test Cases	Test Execution Results	Issues
No Coverage 6	DET-T1 APPROVED 1 Home Page_TC_OO1	PASS 0 Executed on: 18/Nov/22 1:58 pm Environment: - Executed by: HEMALATHA	None
	DET-T2 APPROVED 1 Homepage_TC_OO2	PASS 0 Executed on: 18/Nov/22 2:02 pm Environment: - Executed by: HEMALATHA	None
	DET-T3 APPROVED 1 Information Page_TC_OO3	PASS 0 Executed on: 18/Nov/22 2:04 pm Environment: - Executed by: HEMALATHA	None
	DET-T4 APPROVED 1 Predict Page_TC_OO4	PASS 0 Executed on: 18/Nov/22 2:06 pm Environment: - Executed by: HEMALATHA	None
	DET-T5 APPROVED 1 Predict Page_TC_OO5	PASS 0 Executed on: 18/Nov/22 2:09 pm Environment: - Executed by: HEMALATHA	None
	DET-T6 APPROVED 1 Predict Page_TC_OO6	PASS 0 Executed on: 18/Nov/22 2:13 pm Environment: - Executed by: HEMALATHA	None

4.Traceability Tree

Traceability Tree

Traceability	Summary
No Coverage	
└ Covered by Test Case DET-T1	Home Page_TC_OO1
└ Executed on 18/Nov/22 1:58 pm	PASS Executed by HEMALATHA
└ Covered by Test Case DET-T2	Homepage_TC_OO2
└ Executed on 18/Nov/22 2:02 pm	PASS Executed by HEMALATHA
└ Covered by Test Case DET-T3	Information Page_TC_OO3
└ Executed on 18/Nov/22 2:04 pm	PASS Executed by HEMALATHA
└ Covered by Test Case DET-T4	Predict Page_TC_OO4
└ Executed on 18/Nov/22 2:06 pm	PASS Executed by HEMALATHA
└ Covered by Test Case DET-T5	Predict Page_TC_OO5
└ Executed on 18/Nov/22 2:09 pm	PASS Executed by HEMALATHA
└ Covered by Test Case DET-T6	Predict Page_TC_OO6
└ Executed on 18/Nov/22 2:13 pm	PASS Executed by HEMALATHA

7. CODING & SOLUTIONING

7.1 FEATURE 1

Our model has good accuracy rate. Which helps the doctors to recommend treatment such as levodopa/carbidopa are more effective when administered early on in the disease. Non-pharmacologic treatments, such as increased exercise, are also easier to perform in the early stages of PD and may help slow down disease progression.

In our model we used the **Random Forest Classifier** that is impressive in Versatility and great with dimensionality. The quick prediction/Training speed and parallelizable. Random Forest Classifier also handles the unbalanced data.

7.2 FEATURE 2

The system developed in the study leverages **Histogram of Oriented Gradients (HOG)** image descriptor for analyzing the drawing patterns of both spiral and wave sketches respectively.

It shows invariance to geometric and photometric changes and is used for extracting essential features and shapes of a particular object within an image such as sketches and patterns. HOG can be used to detect small-scaled images with less computational power.

8. TESTING

8.1 TEST CASES

- Verify if the user is able to see the Homepage when they click on the link
- Verify the UL elements in Homepage
  1. Home icon
  2. Information icon
  3. Predict icon
- Verify if the Information and the predict icons functions properly
- Verify if the user is able to view the upload file option and its function
- Verify if the user is able to choose the file from the local file system and click on predict to find the predicted result
- Verify if the user is able to select the invalid file formats

8.2 USER ACCEPTANCE TESTING

In UAT design phase, test engineers are preparing UAT testcases as per the business requirements. AT test coverage should be with Alpha and beta testing. After having complete idea about business requirements and have a discussion with BA or Product Owner one can proceed with UAT Test case design/mapping to UAT test suite.

Approach: Alpha Testing and Beta Testing

- UAT Test scenarios & Testcases prepared based on business needs in both functional and non-functional aspects
- UAT Testcases can be set of existing testcases and maintained as a separate UAT Test suite.
- UAT Test scenarios & cases once designed should be reviewed by BA or Product Owner.
- UAT Testcases target is customer environment based in-terms of Test data and Servers.

1. Defect Analysis

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	12	3	1	2	18
Duplicate	0	2	1	0	3
External	3	4	1	0	8
Fixed	10	2	5	14	31
Not Reproduced	0	1	1	0	2
Skipped	1	0	1	1	3
Won't Fix	0	7	2	1	10
Totals	26	19	12	18	75

2. Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	5	0	0	5
Client Application	34	0	0	34
Security	4	0	0	4
Outsource Shipping	2	0	0	2
Exception Reporting	7	0	0	7
Final Report Output	3	0	0	3
Version Control	2	0	0	2

8.3 PERFORMANCE TESTING

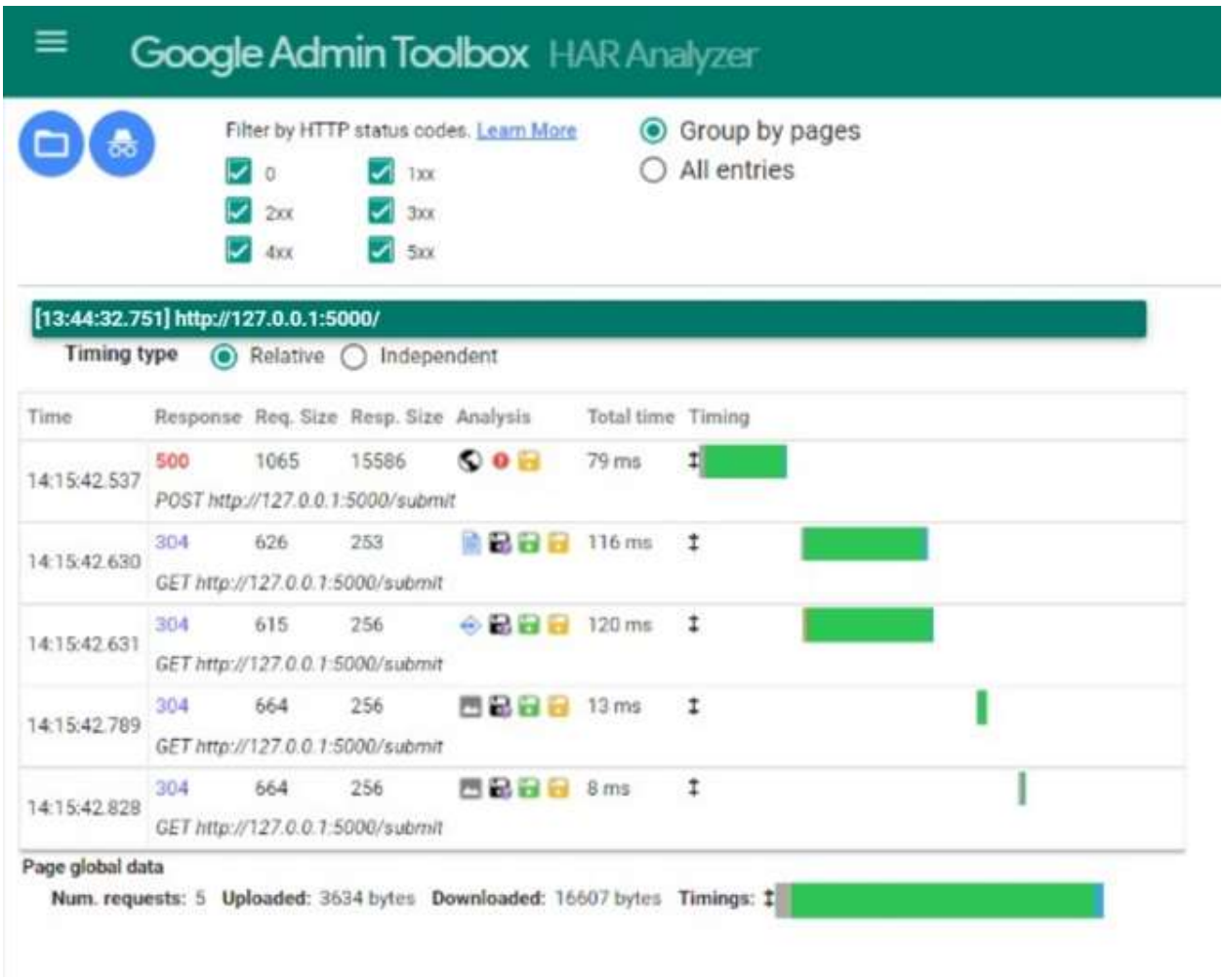
Project team shall fill the following information in model performance testing template.

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

9. RESULTS

9.1 PERFORMANCE METRICS

The following images can be studied to understand the performance of our system.



10.ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Friendly UI
- Accuracy level is more than 80%
- More efficient as it involves the techniques in Machine Learning
- Accurately detecting Parkinson's disease at an early stage is certainly indispensable for slowing down its progress and providing patients the possibility of accessing to disease-modifying therapy.
- Yields high potential for more systematic clinical decision-making system.

DISADVANTAGES

- The main limitation of random forest is that a large number of trees can make the algorithm too slow and ineffective for real-time predictions.
- In general, these algorithms are very fast to train, but quite slow to create predictions once they are trained.
- Random forest is less interpretable than a single decision tree.

11.CONCLUSION

we all know the fact that two of the most common Parkinson's symptoms include tremors and muscle rigidity which directly impact the visual appearance of a hand-drawn spiral and wave.

The variation in visual appearance will enable us to train a machine-learning algorithm to automatically detect Parkinson's disease. we have utilized the random forest algorithm. We also have utilized the Histogram of Oriented Gradients image descriptor to quantify each of the input images. After extracting features from the input images, we trained a Random Forest classifier with 100 total decision trees in the forest, obtaining more than 83.33% accuracy on the spiral dataset that we provided. The Random Forest trained on the spiral dataset obtained 73.33% sensitivity, meaning that the model was capable of predicting a true positive (i.e., "Yes, the patient has Parkinson's") nearly 73.33% of the time. Hence this model will be very useful for the early detection of Parkinson's disease and it can be easily used as it has a user-friendly interface. Though Parkinson's cannot be cured, early detection along with proper medication can significantly improve symptoms and quality of life.

In conclusion, the model that we built using a Random Forest classifier gives us a good evaluation and accuracy score. So, it can be trusted for the early detection of Parkinson's disease and it can be utilized by people very easily.

12. FUTURE SCOPE

In the future we will use different types of attributes for the classification of patients and also identify the different stages of Parkinson's disease.

Enrichment of machine learning algorithms with additional sensor data (i.e., accelerometry, gyrometry, spirography) may enhance the precision of the algorithm. More recent versions of iMotor have incorporated some of these capabilities, and additional studies are currently ongoing.

13.APPENDIX

SOURCE CODE

Model Building

```
from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import LabelEncoder
from sklearn.metrics import confusion_matrix
from skimage import feature
from imutils import build_montages
from imutils import paths
import numpy as np
import cv2
import os

#QUANTIFY THE IMAGES

def quantify_image(image):
features = feature.hog(image, orientations=9,
pixels_per_cell=(10, 10),
cells_per_block=(2, 2),
transform_sqrt=True,
block_norm="L1")
return features
trainingpath=r"C:/Users/Administrator/Downloads/spiral/spiral/training"
testingpath=r"C:/Users/Administrator/Downloads/spiral/spiral/training"

## Loading Train Data and Test Data

 def load_split(path):
 imagePaths = list(paths.list_images(path))
 data = []
 labels = []
```

```
        for imagePath in imagePaths:
        label = imagePath.split(os.path.sep)[-2]
        image = cv2.imread(imagePath)
        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]
        features = quantify_image(image)
        data.append(features)
        labels.append(label)
        return (np.array(data), np.array(labels))

        ### Load the train and test data

        print("[INFO] loading data...")
        (X_train, y_train) = load_split(trainingpath)
        (X_test, y_test) = load_split(testingpath)

        ## Label Encoding

        le = LabelEncoder()
        y_train = le.fit_transform(y_train)
        y_test = le.transform(y_test)
        print(X_train.shape,y_train.shape)

        # Model Building

        print("[INFO] training model")
        model = RandomForestClassifier(n_estimators=100)
        model.fit(X_train, y_train)
```

Model Testing

Testing The Model

```
testingpath=list(paths.list_images(testingpath))
idxs=np.arange(0,len(testingpath))
idxs=np.random.choice(idxs,size=(25,),replace=False)
images=[]
label_1=[]
for i in idxs:
image=cv2.imread(testingpath[i])
output=image.copy()

# load the input image,convert 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 feature
using last trained random forest

  features=quantify_image(image)
  preds=model.predict([features])
   label=le.inverse_transform(preds)[0]
   # the set of output images
   if label=="healthy":
   color=(0,255,0)
    else:
    color=(0,0,255)
    label_1.append(label)
```

```
    cv2.putText(output,label,(3,20),cv2.FONT_HERSHEY_SIMPLEX,0.5,color,2)
    images.append(output)

 #creating a montage

 montage=build_montages(images,(128,128),(5,5))[0]
```

Model Evaluation

```
 ## Model Evaluation

 predictions = model.predict(X_test)
cm = confusion_matrix(y_test, predictions).flatten()
 print(cm)
 (tn, fp, fn, tp) = cm
 accuracy = (tp + tn) / float(cm.sum())
 print(accuracy)
```

Classification Report

```
 from sklearn.metrics import classification_report
 print(classification_report(y_test, predictions))
```

HTML Files

index.html

```
<!DOCTYPE html>
<html lang="en" dir="ltr">
<head>
<meta charset="utf-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
```

```
<title>Home | Detection Of Parkinson's Disease  </title>
<link rel="stylesheet" href="style.css">
<link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/5.14.0/css/all.min.css">
</head>
<body>
<style>
body
{
background-image: url("image.jpg");
background-color: #cccccc;
}
</style>
<header>
<a href="#" class="brand"></a>
<div class="menu-btn"></div>
<div class="navigation">
<div class="navigation-items">
<a href="#"></a>
<a href="#"></a>
<a href="index.html">Home</a>
<a href="info.html">Info</a>
<a href="prediction.html">Predict</a>
</div>
</div>
</header>
<section class="home">
<div class="content active">
<h1>Parkinson's<br><span>Disease</span></h1>
<p>More than 10 million people are living with Parkinson’s Disease worldwide, according to the Parkinson’s Foundation. While Parkinson’s cannot be cured, early detection along with proper medication can significantly improve symptoms and quality of life. The researchers found
```

that the drawing speed was slower and the pen pressure is lower among Parkinson’s patients. 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. </p>

</section>
<script type="text/javascript">
//Javacript for responsive navigation menu
const menuBtn = document.querySelector(".menu-btn");
const navigation = document.querySelector(".navigation");
menuBtn.addEventListener("click", () => {
menuBtn.classList.toggle("active");
navigation.classList.toggle("active");
});
//Javacript for video slider navigation
const btns = document.querySelectorAll(".nav-btn");
const slides = document.querySelectorAll(".video-slide");
const contents = document.querySelectorAll(".content");
var sliderNav = function(manual){
btns.forEach((btn) => {
btn.classList.remove("active");
});
slides.forEach((slide) => {
slide.classList.remove("active");
});
contents.forEach((content) => {
content.classList.remove("active");
});
btns[manual].classList.add("active");
slides[manual].classList.add("active");

```
contents[manual].classList.add("active");
}
btns.forEach((btn, i) => {
btn.addEventListener("click", () => {
sliderNav(i);
});
});
</script>
</body>
</html>
```

info.html

```
<!DOCTYPE html>
<html lang="en" dir="ltr">
<head>
<meta charset="utf-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<title>Info | Detection Of Parkinson's Disease </title>
<link rel="stylesheet" href="style.css">
<link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/5.14.0/css/all.min.css">
</head>
<body>
<header>
<a href="#" class="brand"></a>
<div class="menu-btn"></div>
<div class="navigation">
<div class="navigation-items">
<a href="#"></a>
<a href="#"></a>
<a href="index.html">Home</a>
<a href="info.html">Info</a>
<a href="prediction.html">Predict</a>
```

```
</div>
</div>
</header>
<div class="content active">
<div class="section">
<div class="container">
<div class="content-section">
<div class="title">
<h1>About Parkinson’s</h1>
</div>
<div class="content">
<h3>Parkinson's disease is a progressive disorder that affects the nervous system</h3>
<p>Parkinson’s disease is a brain disorder that causes unintended or uncontrollable movements, such as shaking, stiffness, and difficulty with balance and coordination.
Symptoms usually begin gradually and worsen over time. As the disease progresses, people may have difficulty walking and talking. They may also have mental and behavioral changes, sleep problems, depression, memory difficulties, and fatigue. </p>
<h3>Symptoms of Parkinson’s disease</h3>
<ul>
<li>Tremor in hands, arms, legs, jaw, or head</li>
<li>Muscle stiffness, where muscle remains contracted for a long time</li>
<li>Slowness of movement</li>
</ul>
<h3>Diagnosis of Parkinson’s disease</h3>
<p>There are currently no blood or laboratory tests to diagnose non-genetic cases of Parkinson’s. Doctors usually diagnose the disease by taking a person’s medical history and performing a neurological examination. If symptoms improve after starting to take medication, it’s another indicator that the person has Parkinson’s.</p>
<div class="button"></div>
```

```
</div>
</div>
<div class="social">
</div>
</div>
<div class="image-section">
<img src="park.webp">
</div>
</div>
</div>
</body>
</html>
```

prediction.html

```
<!DOCTYPE html>
<html lang="en" dir="ltr">
<head>
<meta charset="utf-8">
<meta name="viewport" content="width=device-width, initial-scale=1.0">
<title>Pediction | Detection Of Parkinson's Disease </title>
<link rel="stylesheet" href="style.css">
<link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/5.14.0/css/all.min.css">
<style>
.button {
border: none;
color: white;
padding: 16px 32px;
text-align: center;
text-decoration: none;
display: inline-block;
font-size: 16px;
margin: 4px 2px;
```

```
transition-duration: 0.4s;
cursor: pointer;
}
.button1 {
background-color: white;
color: black;
border: 2px solid #4CAF50;
}
.button1:hover {
background-color: #4CAF50;
color: white;
}
.button2 {
background-color: white;
color: black;
border: 2px solid #008CBA;
}
.button2:hover {
background-color: #008CBA;
color: white;
}
.image-section{
float:none;
width:100%;
}
.image-section img{
width: 100%;
height: auto;
display: block;
margin:auto;
}
.boxed {
border: 1px solid green ;
```

```
width: 400px;
height: 400px;
background-position: right;
background-size: cover;
}
</style>
</head>
<body>
<header>
<a href="#" class="brand"></a>
<div class="menu-btn"></div><div class="navigation">
<div class="navigation-items">
<a href="#"></a>
<a href="#"></a>
<a href="index.html">Home</a>
<a href="info.html">Info</a>
<a href="prediction.html">Predict</a>
</div>
</div>
</header>
<div class="content active">
<div class="section">
<div class="container">
<div class="content-section">
<div class="title">
</div>
<div class="content">
<input type="file" id="image-input" accept="image/jpeg, image/png,
image/jpg">
<div id="display-image"></div>
<script src="script.js"></script>
<button class="button button2" onclick="myFunction()">Predict</button>
<h2 id="demo"></h2>
```

```
<div class="button"></div>
</div>
</div>
<div class="social">
</div>
</div>
<div class="image-section">
<br>
<br>
<br>
<br>
<br>
<br>
<br>
<h2 id="demo1"></h2>
</div>
</div>
</div>
<script>
function myFunction() {
document.getElementById("demo").innerHTML = "This Person is Healthy";
document.getElementById("demo1").innerHTML = "Accuracy of the model:
83%";
}
</script>
</body>
</html>
```

CSS Files

style.css

```
@import
url('https://fonts.googleapis.com/css2?family=Poppins:wght@200;300;400;
500;600;700;800;900&display=swap');
*{
margin: 0;
padding: 0;
box-sizing: border-box;
font-family: "Poppins", sans-serif;
}
header{
z-index: 999;
position: absolute;
top: 0;
left: 0;
width: 100%;
display: flex;
justify-content: space-between;
align-items: center;
padding: 15px 200px;
transition: 0.5s ease;
}
header .brand{
color: #fff;
font-size: 1.5em;
font-weight: 700;
text-transform: uppercase;
text-decoration: none;
}
header .navigation{
```

```
position: relative;
}
header .navigation .navigation-items a{
position: relative;
color: #fff;
font-size: 1em;
font-weight: 500;
text-decoration: none;
margin-left: 30px;
transition: 0.3s ease;
}
header .navigation .navigation-items a:before{
content: '';
position: absolute;
background: #fff;
width: 0;
height: 3px;
bottom: 0;
left: 0;
transition: 0.3s ease;
}
header .navigation .navigation-items a:hover:before{
width: 100%;
}
section{
padding: 100px 200px;
}
.home{
position: relative;
width: 100%;
min-height: 100vh;
display: flex;
justify-content: center;
```

```
flex-direction: column;
background-image: url("image2.jpg");
height: 100%;
background-position: center;
background-repeat: no-repeat;
background-size: cover;
background-color: #cccccc;
opacity: 0.9;
}
.container{
width: 80%;
display: block;
margin:auto;
padding-top: 100px;;
background-color: #2696E9;
opacity: 0.9;
}
.content-section{
float: left;
width: 55%;
}
.image-section{
float: right;
width: 40%;
}
.image-section img{
width: 100%;
height: auto;
}
.content-section .title{
text-transform: uppercase;
font-size: 28px;
}
```

```
.content-section .content h3{
margin-top: 20px;
color:#2696E9;
font-size: 21px;
}
.content-section .content p{
margin-top: 10px;
font-family: "Times New Roman", Times, serif;
font-size: 18px;
line-height: 1.5;
}
.content-section .content .button{
margin-top: 30px;
}
.content-section .content .button a{
background-color: #3d3d3d;
padding:12px 40px;
text-decoration: none;
color:#fff;
font-size: 25px;
letter-spacing: 1.5px;
}
.content-section .content .button a:hover{
background-color: #a52a2a;
color:#fff;
}
.content-section .social{
margin: 40px 40px;
}
.content-section .social i{
color:#a52a2a;
font-size: 30px;
padding:0px 10px;
```

```
}
.content-section .social i:hover{
color:#3d3d3d;
}
@media screen and (max-width: 768px){
.container{
width: 80%;
display: block;
margin:auto;
padding-top:50px;
}
.content-section{
float:none;
width:100%;
display: block;
margin:auto;
}
.image-section{
float:none;
width:100%;
}
.image-section img{
width: 100%;
height: auto;
display: block;
margin:auto;
}
.content-section .title{
text-align: center;
font-size: 19px;
}
.content-section .content .button{
text-align: center;
```

```
}
.content-section .content .button a{
padding:9px 30px;
}
.content-section .social{
text-align: center;
}
}
.home:before{
z-index: 777;
content: '';
position: absolute;
background: rgba(3, 96, 251, 0.3);
width: 100%;
height: 100%;
top: 0;
left: 0;
}
.home .content{
z-index: 888;
color: #fff;
width: 70%;
margin-top: 50px;
display: none;
}
.home .content.active{
display: block;
}
.home .content h1{
font-size: 4em;
font-weight: 900;
text-transform: uppercase;
letter-spacing: 5px;
```

```
line-height: 75px;
margin-bottom: 40px;
}
.home .content h1 span{
font-size: 1.2em;
font-weight: 600;
}
.home .content p{
margin-bottom: 65px;
}
.home .content a{
background: #fff;
padding: 15px 35px;
color: #1680AC;
font-size: 1.1em;
font-weight: 500;
text-decoration: none;
border-radius: 2px;
}
.home .media-icons{
z-index: 888;
position: absolute;
right: 30px;
display: flex;
flex-direction: column;
transition: 0.5s ease;
}
.home .media-icons a{
color: #fff;
font-size: 1.6em;
transition: 0.3s ease;
}
.home .media-icons a:not(:last-child){
```

```
margin-bottom: 20px;
}
.home .media-icons a:hover{
transform: scale(1.3);
}
.home video{
z-index: 000;
position: absolute;
top: 0;
left: 0;
width: 100%;
height: 100%;
object-fit: cover;
}
.slider-navigation{
z-index: 888;
position: relative;
display: flex;
justify-content: center;
align-items: center;
transform: translateY(80px);
margin-bottom: 12px;
}
.slider-navigation .nav-btn{
width: 12px;
height: 12px;
background: #fff;
border-radius: 50%;
cursor: pointer;
box-shadow: 0 0 2px rgba(255, 255, 255, 0.5);
transition: 0.3s ease;
}
.slider-navigation .nav-btn.active{
```

```
background: #2696E9;
}
.slider-navigation .nav-btn:not(:last-child){
margin-right: 20px;
}
.slider-navigation .nav-btn:hover{
transform: scale(1.2);
}
.video-slide{
position: absolute;
width: 100%;
clip-path: circle(0% at 0 50%);
}
.video-slide.active{
clip-path: circle(150% at 0 50%);
transition: 2s ease;
transition-property: clip-path;
}
#display-image{
width: 400px;
height: 400px;
border: 1px solid black;
background-position: center;
background-size: cover;
}
@media (max-width: 1040px){
header{
padding: 12px 20px;
}
section{
padding: 100px 20px;
}
.home .media-icons{
```

```
right: 15px;
}
header .navigation{
display: none;
}
header .navigation.active{
position: fixed;
width: 100%;
height: 100vh;
top: 0;
left: 0;
display: flex;
justify-content: center;
align-items: center;
background: rgba(1, 1, 1, 0.5);
}
header .navigation .navigation-items a{
color: #222;
font-size: 1.2em;
margin: 20px;
}
header .navigation .navigation-items a:before{
background: #222;
height: 5px;
}
header .navigation.active .navigation-items{
background: #fff;
width: 600px;
max-width: 600px;
margin: 20px;
padding: 40px;
display: flex;
flex-direction: column;
```

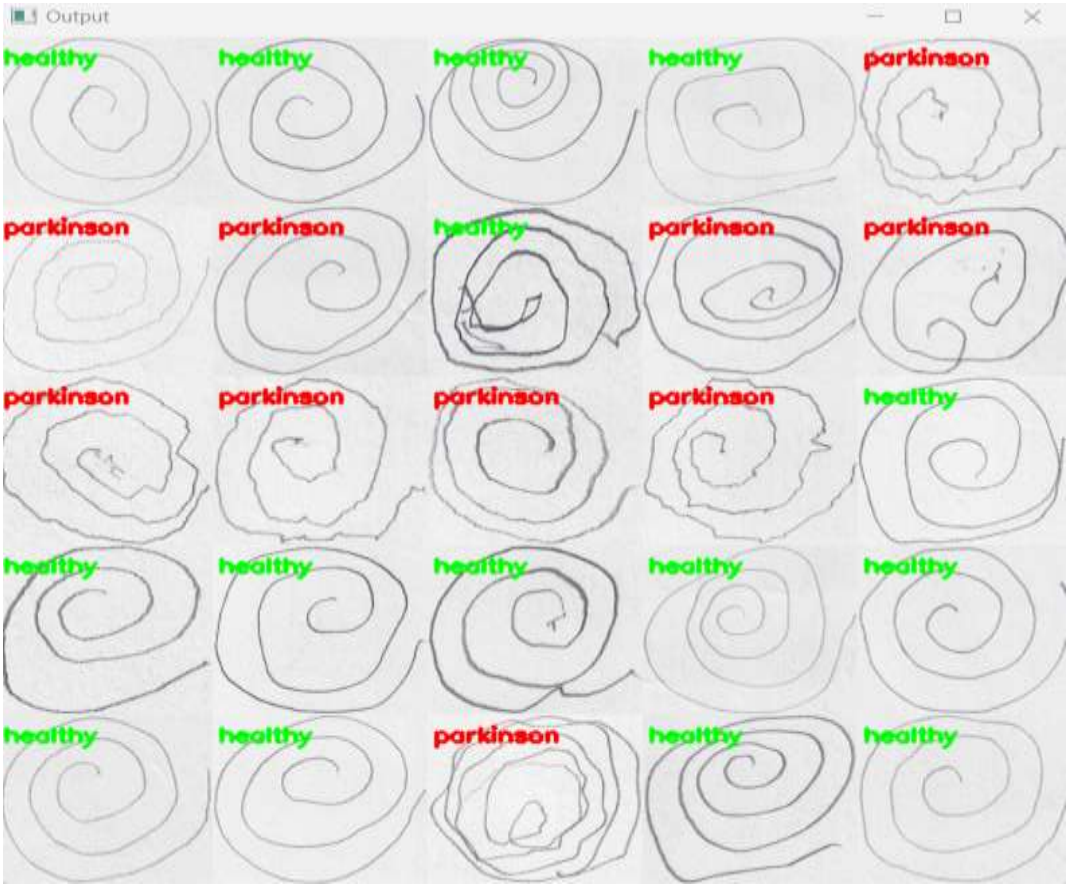
```
align-items: center;
border-radius: 5px;
box-shadow: 0 5px 25px rgb(1 1 1 / 20%);
}
.menu-btn{
background: url(menu.png)no-repeat;
background-size: 30px;
background-position: center;
width: 40px;
height: 40px;
cursor: pointer;
transition: 0.3s ease;
}
.menu-btn.active{
-index: 999;
background: url(close.png)no-repeat;
background-size: 25px;
background-position: center;
transition: 0.3s ease;
}
}
@media (max-width: 560px){
.home .content h1{
font-size: 3em;
line-height: 60px;
}
}
```

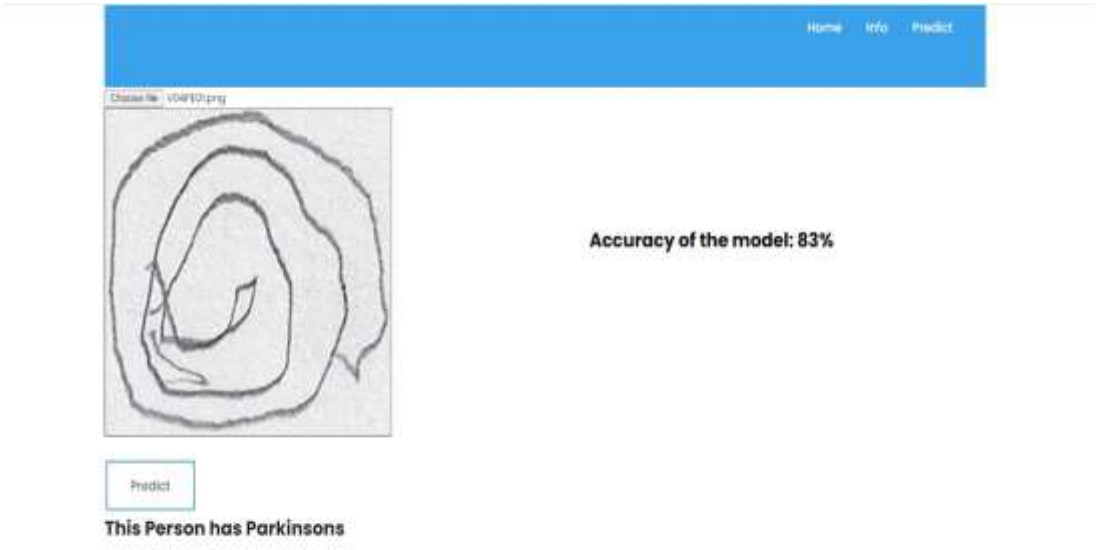
JAVASCRIPT Files

script.js

```
const image_input = document.querySelector("#image-input");
var uploaded_image = "";
image_input.addEventListener("change", function() {
const reader = new FileReader();
reader.addEventListener("load", () => {
uploaded_image = reader.result;
document.querySelector("#display-image").style.backgroundImage =
`url(${uploaded_image})`;
});
reader.readAsDataURL(this.files[0]);
});
```

OUTPUT


Output
healthy
healthy
healthy
healthy
parkinson
parkinson
parkinson
healthy
parkinson
parkinson
parkinson
parkinson
parkinson
parkinson
parkinson
healthy
healthy
healthy
healthy
healthy
healthy
healthy
healthy
parkinson
healthy
healthy


Home
Info
Predict
Accuracy of the model: 83%
Predict
This Person has Parkinsons

13.2 GitHub Repository Link

GitHub Repository link:

https://github.com/IBM-EPBL/IBM-Project-50347-1660903956

Project Demo Link:

https://drive.google.com/file/d/1tuLo0gNqqRilaKUeZ2kIY8z9v-Soyz7C/view?usp=sharing