Detecting Parkinson’s Disease using Machine Learning

TEAM ID : PNT2022TMID15817

CHAPTER – 1

INTRODUCTION

1.1.PROJECT OVERVIEW:

Parkinson's disease is one of the most common neurodegenerative diseases with a prevalence rate of 1% in the population above 60 years old. The diagnosis of PD is traditionally based on motor symptoms. The symptoms of the disease will occur slowly, the symptoms include shaking, rigidity, slowness of movement and difficulty with walking, thinking and behavior change are common symptoms of this disease. This disease severely affects patients quality of life(QoL), social functions and family relationships, and places heavy economic burdens at individual and society levels. There is no defined test for early diagnosis of Parkinson's patient and medical decisions are provided based on the medical history of the patient and hence the possibility of misdiagnosis. Several researches were made to predict this disease in early stage.But they didn’t predict properly and cannot be able to give better results.

1.2 .PURPOSE:

The aim of the project is vocal dysphonia analysis of Parkinson's patient from voice dataset with different machine learning algorithms with a goal to achieve better performance with less number of attributes. For addressing 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 which can helpful to predict the disease earlier. Machine learning techniques are being increasingly applied in the healthcare sector. As its name implies, machine learning allows for a computer program to learn and extract meaningful representation from data.

CHAPTER – 2

LITERATURE SURVEY

2.1.EXISTING PROBLEM:

In existing system, the comparative study of various machine learning algorithms is carried out. For analysis and prediction of Parkinson's PPMI data sets and six different classification algorithms are used. The results show that the multiclass classifier and logistic regression better performed than the other algorithms for the data sets. In future, more number of biomarker features are to be included for the prediction of progression of P This study proposed regression, decision tree and neural network analysis to analyse the databank of Parkinson disease for error probability calculated. The result was logistic regression, classification and neural network analysis error probability by 5.15%, 8.47% and 23.73% respectively.

2.2.REFERENCES:

S.no	Year	Researcher	Title	Methodology	Remarks
01	2019	S. Kanagaraj, M.S. Hema, M. Nageswara Gupta	Machine Learning Techniques for Prediction of Parkinson's Disease using BigData	Progression Marker Initiative (PPMI)	Predicts Parkinson's disease at an early stagefrom the formerly available publicdatabase

02	2019	F.M. Javed Mehedi Shamrat, Md. Asaduzzaman, A.K.M. Sazzadur Rahman, Raja Tariqul Hasan Tusher, Zarrin Tasnim	A Comparative Analysis Of Parkinson Disease Prediction Using MachineLearning	machine learning techniques	Thus, different experiments to assess the three machine learning supervised algorithms for recognition of Parkinson's disease
03	2014	Ma, C. et al	Identifying Parkinson diseaseusing machine learning	SVM, KNN, and extreme learning machine (ELM)	discriminate healthy people from those with Parkinson's disease
04	2014	Ma, Ouyang, Chen, &Zhao	analysis of Parkinson disease	SCFW-KELM	Hybrid method is used to analysis Parkinson's disease
05	2014	YahiaA. et al	classification algorithm based on Naïve Bayes andK- Nearest Neighbours (KNN)	Parkinson speechdataset	Thus, Parkinson'sDisease is detected through voicesignal
06	2013	Chen et al.,	demonstrative precision for the identification of Parkinson Disease	fuzzy-based KNNmodel,a hybrid model	Identified the Parkinson's disease using thesemethods
07	2013	Sriram, Rao, Narayana, Kaladhar, Vital	detection of Parkinson diseases using machine learning algorithms	voice data	Thus, the analysis of voice data to understand the presence of Parkinson disease

08	2011	Rusz J	measurements to differentiate Parkinson diseasefrom healthy subjects	vector machine	Vector machine isused to differentiate Parkinson disease
09	2011	OzciftA. et al	detection of Parkinson diseases using machine learning algorithms	computer-aided diagnosis (CADx)systems	Thus, Parkinson’sDisease is detected
10	2011	Wu, S et al	Analysing the databank of Parkinson disease	regression, decision tree andneural network	Thus databank of Parkinson’s disease is analysed

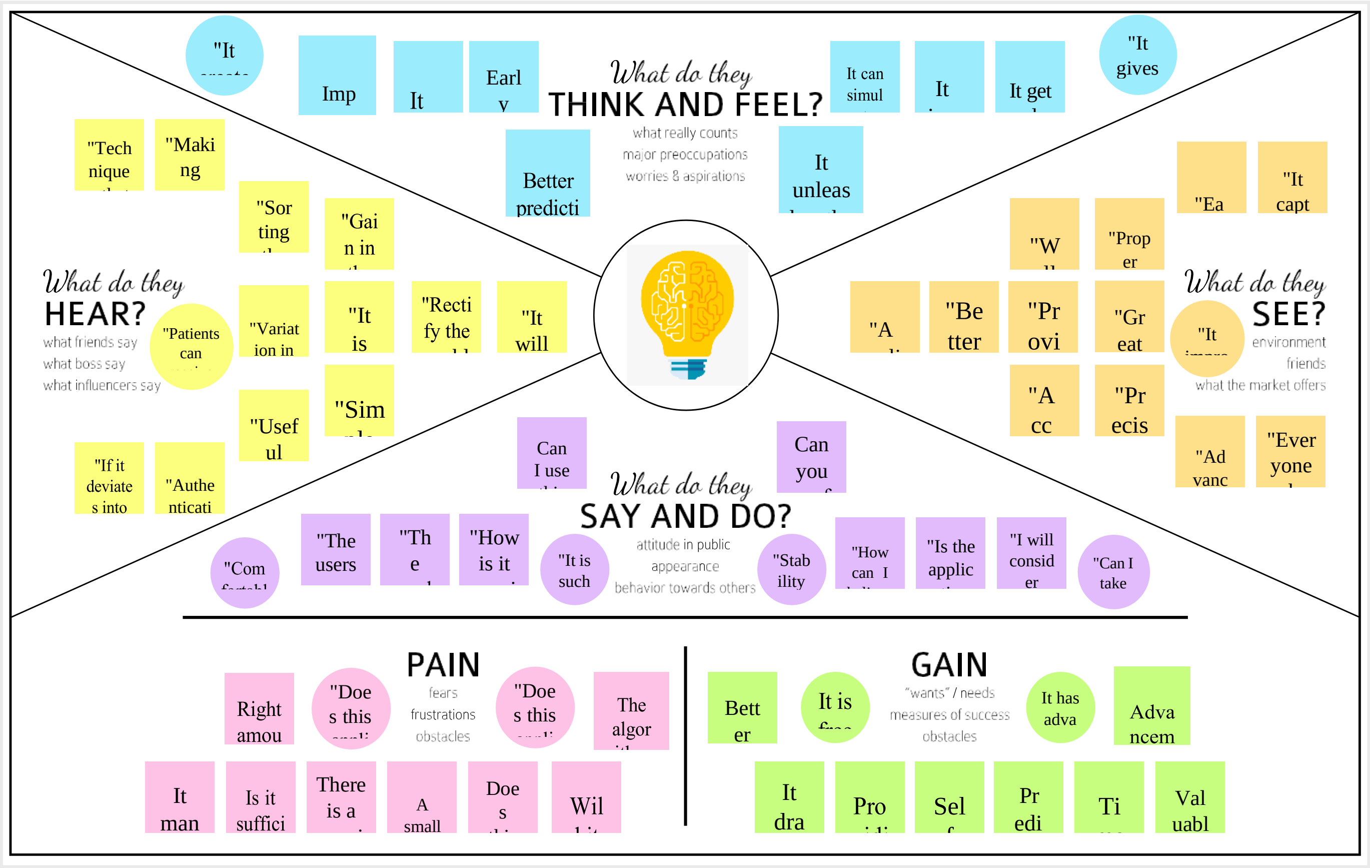
2.3.PROBLEM STATEMENT DEFINITION:

Who does the problem affect?	People who are men with minimization of nerve cells in primarily of village areas.
What are the boundaries of the problem?	People who are men with weak nerve cells and age over 50
What is the issue?	In real time life of human, if the person is affected by Parkinson disease then it produces the side effect problems like dry skin and dandruff which majorly affects the quality of the life. As the age gets progresses, it causes the people to face major problem with the nerve cells in the brain.
When does the issue occur?	During the age excess of over 50 as they will affect the people with loss of nerve cells in the brain.
Where is the issue coming?	It majorly occurs due to the age getting over 50 and as maximum in village areas.
What methodology usedto solvethe issue?	Supervised and Un-supervised machine learning, Data mining , Computer vision with OpenCV, Python web application interface – Flask , IBM Cloud.

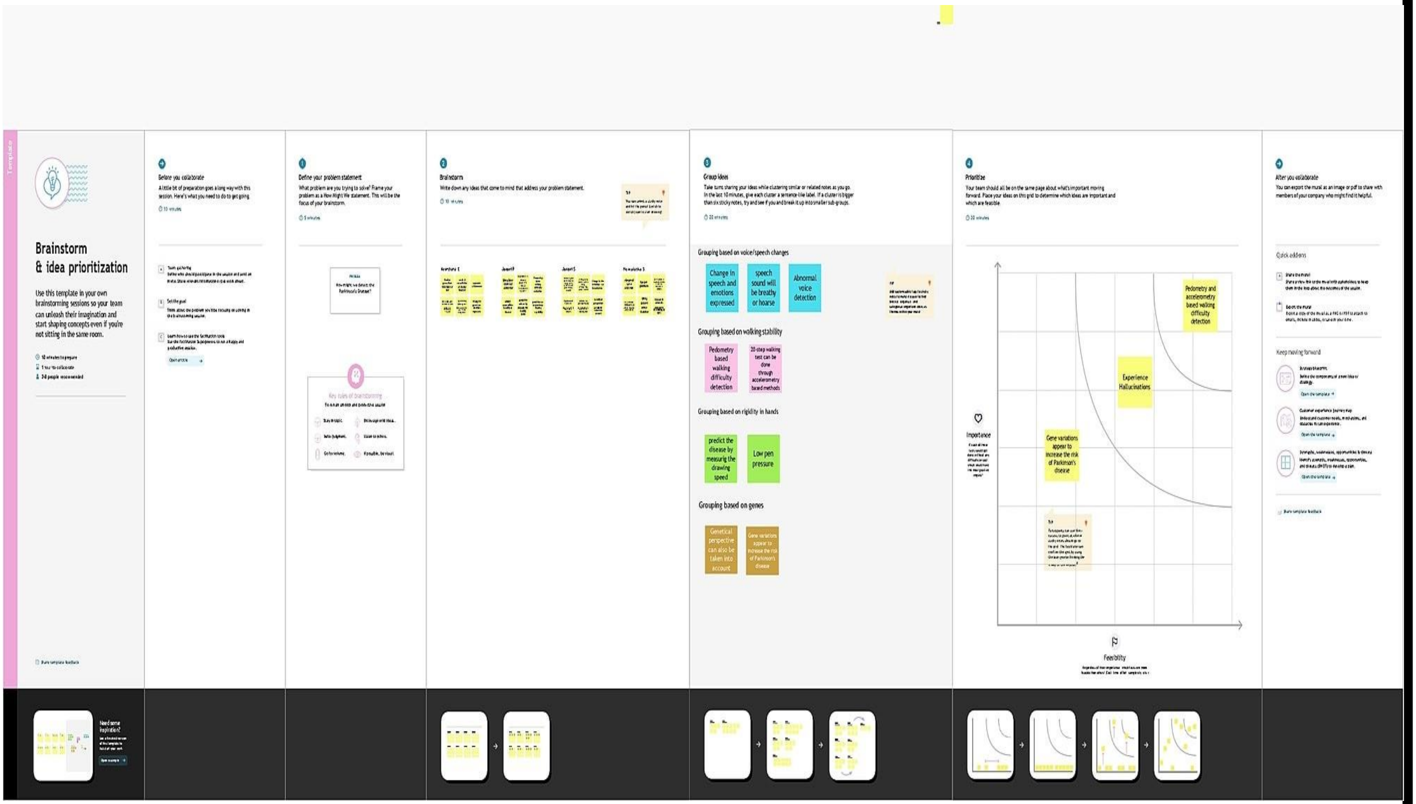
CHAPTER – 3

IDEATION & PROPOSED SOLUTION

3.1. EMPATHY MAP CANVAS:



3.2. IDEATION AND BRAINSTORMING:



Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare

1 hour to collaborate

3-8 people recommended

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

How might we detect the Parkinson's Disease?

Key rules of brainstorming

Stay in topic.

Encourage wild ideas.

Defer judgment.

Listen to others.

Go for volume.

If possible, be visual.

Brainstorm

Write down any ideas that come to mind that address your problem statement.

10 minutes

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, 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.

20 minutes

Grouping based on voice/speech changes

- Change in speech and emotions expressed
- speech sound will be breathy or hoarse
- Abnormal voice detection

Grouping based on walking stability

- Pedometry based walking difficulty detection
- 20-step walking test can be done through accelerometry based methods

Grouping based on rigidity in hands

- predict the disease by measurig the drawing speed
- Low pen pressure

Grouping based on genes

- Genetical perspective can also be taken into account
- Gene variations appear to increase the risk of Parkinson's disease

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

Importance
Feasibility
Pedometry and accelerometry based walking difficulty detection
Experience Hallucinations
Gene variations appear to increase the risk of Parkinson's disease

After you collaborate

You can export the mural as an image or pdf to share with members of your company who might find it helpful.

Quick add-ons

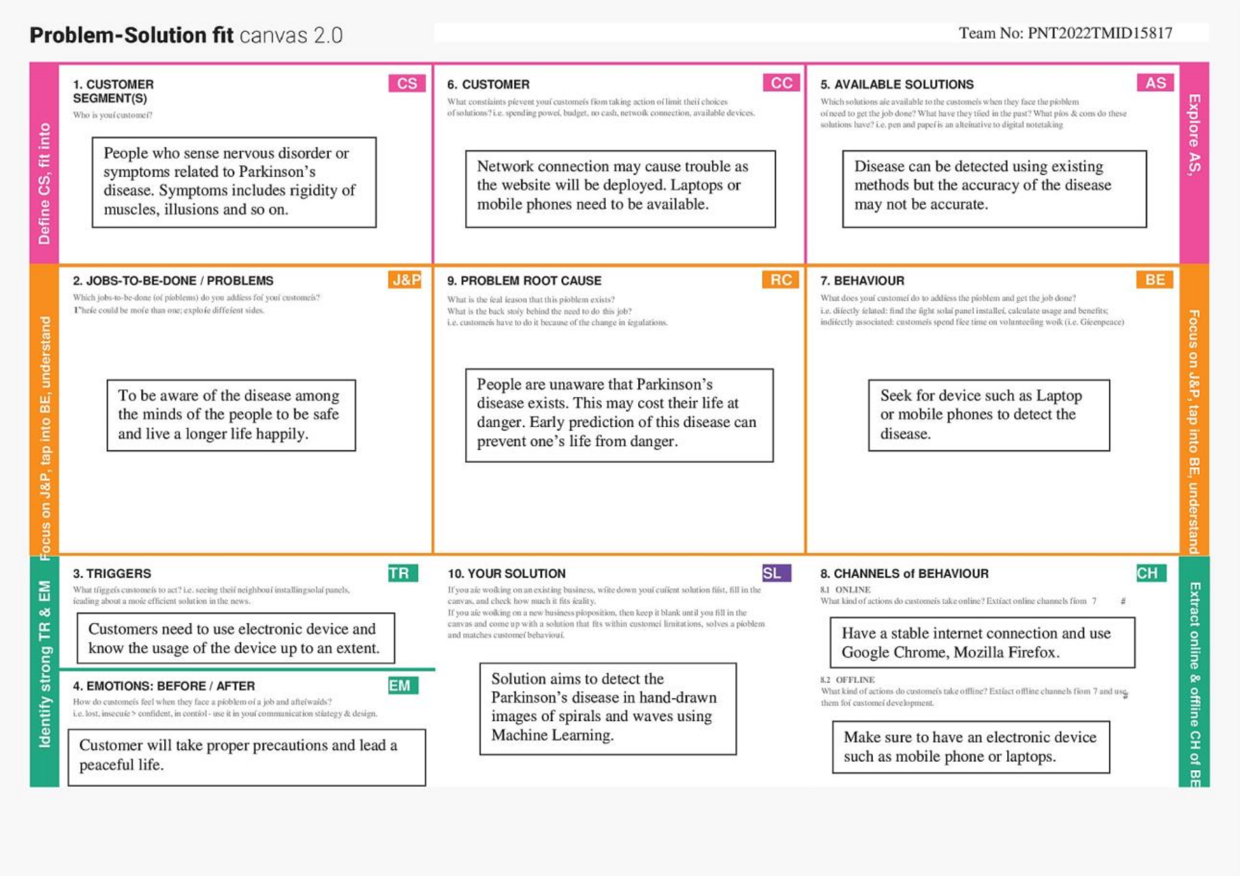
Keep moving forward

3.3. PROPOSED SOLUTION:

S.No	Parameter	Description
1.	Problem Statement (Problem to besolved)	Parkinson’s disease disorder 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.
2.	Idea / Solution description	Studies investigates signals from sustained phonation and text dependent speech modalities for Parkinson’s disease screening. Phonation corresponds to the vowel voicing task and speech to the pronunciation of a short sentence, signal will be recorded through channel simultaneously through mobile phoneor microphone. Parkinson disease affect vocal cord so the motion of speech is detected and evaluated.
3.	Novelty / Uniqueness	Testing 25 non impulsive patients with Parkinson's disease (PD) and 27 PD patients with impulsive compulsive behaviors (ICBs). Both patient groups were examined "on" and "off" dopaminergic medication in a counterbalanced order and their behavior was compared with 24 healthy controls. We found that PD patients with ICBs were significantly more prone to choose novel options than either non impulsive PD patients or controls, regardless of medication status. Our findings suggest that attraction to novelty is a personality trait in all PD patients with ICBs which is independent of medication status.
4.	Social Impact/ Customer Satisfaction	Since it is based on the voice based detection it is very convenient to use. As it helps the people to detect the Parkinson’s disease in early stage, the loss of life is prevented. It detects without cost and helps

		to avoidtravelling and time.
5.	BusinessModel (Revenue Model)	A free platform with useful feature. Any adult and young people can use it and suggest it to otherssto increase the value
6.	Scalability of the Solution	Additional features can be added anytime anywhere. Any number of users can accessit all at once.

3.4. PROBLEM SOLUTION FIT:



Problem-Solution fit canvas 2.0

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Define CS, fit into

1. CUSTOMER SEGMENT(S) CS

Who is youí customeí?

People who sense nervous disorder or symptoms related to Parkinson's disease. Symptoms includes rigidity of muscles, illusions and so on.

6. CUSTOMER CC

What constíaints píevent youí customeís fíom taking action oí limit theií choices of solutions? i.e. spending poweí, budget, no cash, netwoík connection, available devices.

Network connection may cause trouble as the website will be deployed. Laptops or mobile phones need to be available.

5. AVAILABLE SOLUTIONS AS

Which solutions aíe available to the customeís when they face the píoblem oí need to get the job done? What have they tíied in the past? What píos & cons do these solutions have? i.e. pen and papeí is an alteínative to digital notetaking

Disease can be detected using existing methods but the accuracy of the disease may not be accurate.

Explore AS,

Focus on J&P, tap into BE, understand

2. JOBS-TO-BE-DONE / PROBLEMS J&P

Which jobs-to-be-done (oí píoblems) do you addíess foí youí customeís? Theíe could be moíe than one; exploíe diffeíent sides.

To be aware of the disease among the minds of the people to be safe and live a longer life happily.

9. PROBLEM ROOT CAUSE RC

What is the íeal íeason that this píoblem exists?
What is the back stoíy behind the need to do this job?
i.e. customeís have to do it because of the change in íegulations.

People are unaware that Parkinson's disease exists. This may cost their life at danger. Early prediction of this disease can prevent one's life from danger.

7. BEHAVIOUR BE

What does youí customeí do to addíess the píoblem and get the job done?
i.e. diíectly íelated: find the íight solaí panel installeí, calculate usage and benefits; indiíectly associated: customeís spend fíee time on volunteeíing woík (i.e. Gíeenpeace)

Seek for device such as Laptop or mobile phones to detect the disease.

Focus on J&P, tap into BE, understand

Identify strong TR & EM

3. TRIGGERS TR

What tíiggeís customeís to act? i.e. seeing theií neighbouí installing solaí panels, íeading about a moíe efficient solution in the news.

Customers need to use electronic device and know the usage of the device up to an extent.

4. EMOTIONS: BEFORE / AFTER EM

How do customeís feel when they face a píoblem oí a job and afteíwaíds?
i.e. lost, insecuíe > confident, in contíol - use it in youí communication stíategy & design.

Customer will take proper precautions and lead a peaceful life.

10. YOUR SOLUTION SL

If you aíe woíking on an existing business, wíite down youí cuííent solution fiíst, fill in the canvas, and check how much it fits íeality.
If you aíe woíking on a new business píoposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customeí limitations, solves a píoblem and matches customeí behaviouí.

Solution aims to detect the Parkinson's disease in hand-drawn images of spirals and waves using Machine Learning.

8. CHANNELS of BEHAVIOUR CH

8.1 ONLINE
What kind of actions do customeís take online? Extíact online channels fíom 7 #

Have a stable internet connection and use Google Chrome, Mozilla Firefox.

8.2 OFFLINE
What kind of actions do customeís take offline? Extíact offline channels fíom 7 and use # them foí customeí development.

Make sure to have an electronic device such as mobile phone or laptops.

Extract online & offline CH of BE

CHAPTER-4

REQUIREMENT ANALYSIS

4.1. FUNCTIONAL REQUIREMENT:

FR NO:	FUNCTIONAL REQUIREMENT	SUB REQUIREMENT
FR-1	User Registration	Registration through Gmail Registration through Form Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Authentication	Verify the user.
FR-4	Provide hand drawn images	Give input to the application to check for the disease
FR-5	Detection of the disease	Accuracy of the figure is shown with future precautions

4.2. NON-FUNCTIONALREQUIREMENT:

FR.NO:	NON-FUNCTIONAL REQUIREMENT	DESCRIPTION
NFR-1	Usability	The application is user friendly.
NFR-2	Security	Data is secured and confidential.
NFR-3	Reliability	Prevent the model from moving into production
NFR-4	Performance	Detection of the disease is accurate
NFR-5	Availability	Deployed in cloud so it is accessible
NFR-6	Scalability	Application performs well under an increased workload

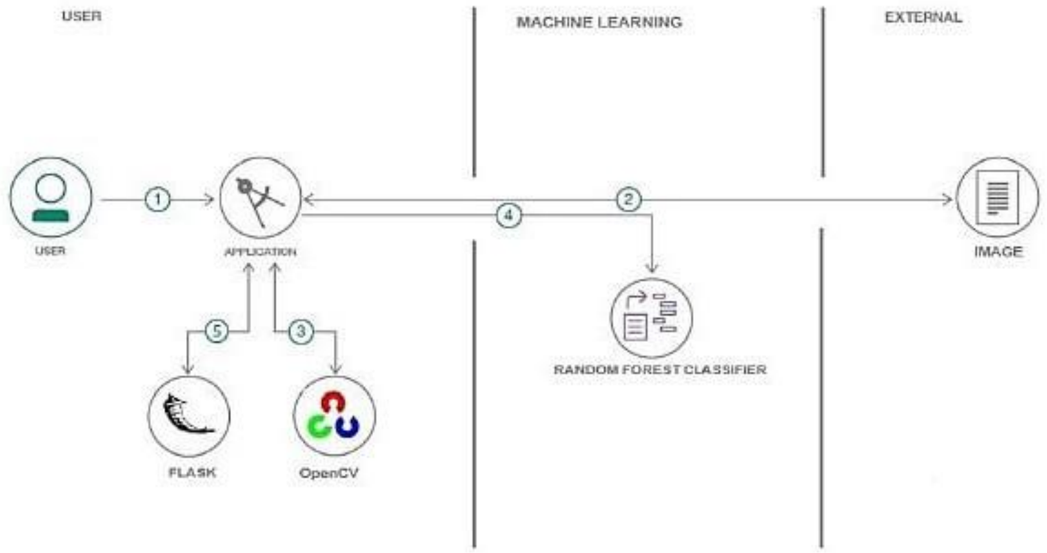
CHAPTER-5

PROJECT DESIGN

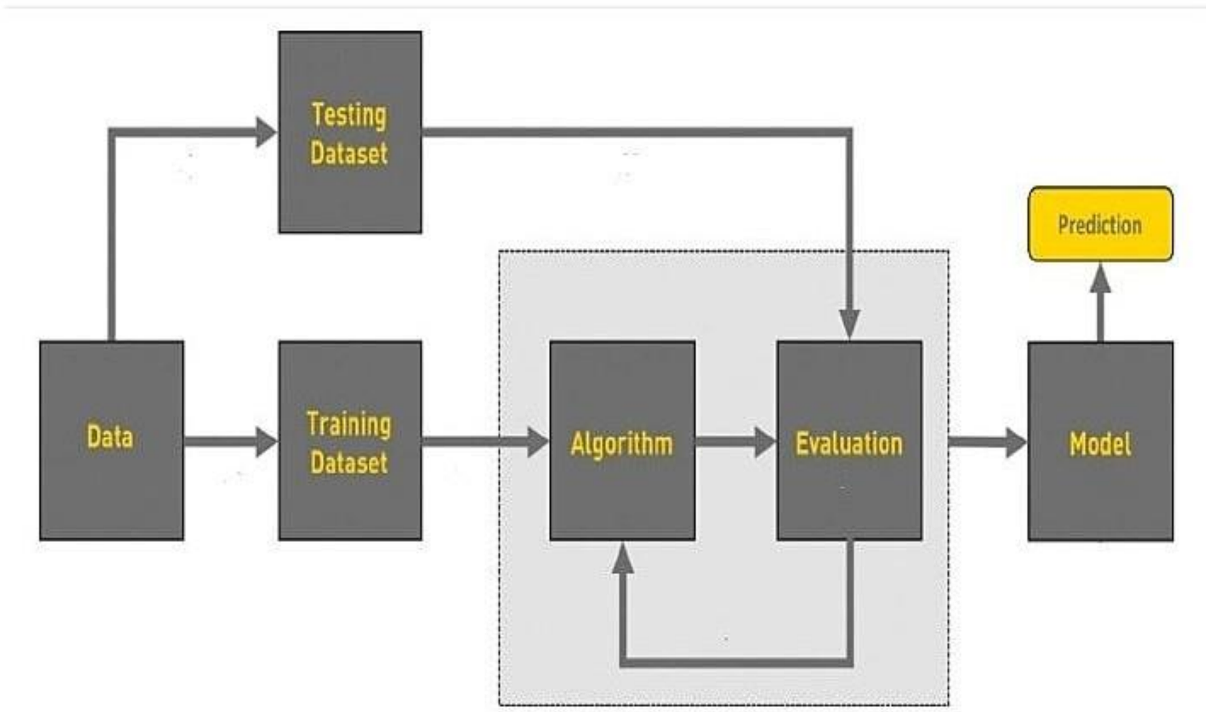
5.1. DATA FLOW DIAGRAM:

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It showshow data enters and leaves the system, what changes the information, and where data is stored.

Flow:



Data Flow Diagram:



1.User configures credentials and starts the app.

2.User selects hand drawn images to process and load.

3.OpenCV does the image pre-processing.

4.The processed image is sent to the Random Forest Classifier.

5.The predicted output is visualised using Flask.

5.2. SOLUTION AND TECHNICAL ARCHITECTURE:

1. Create and login to the IBM Credentials.

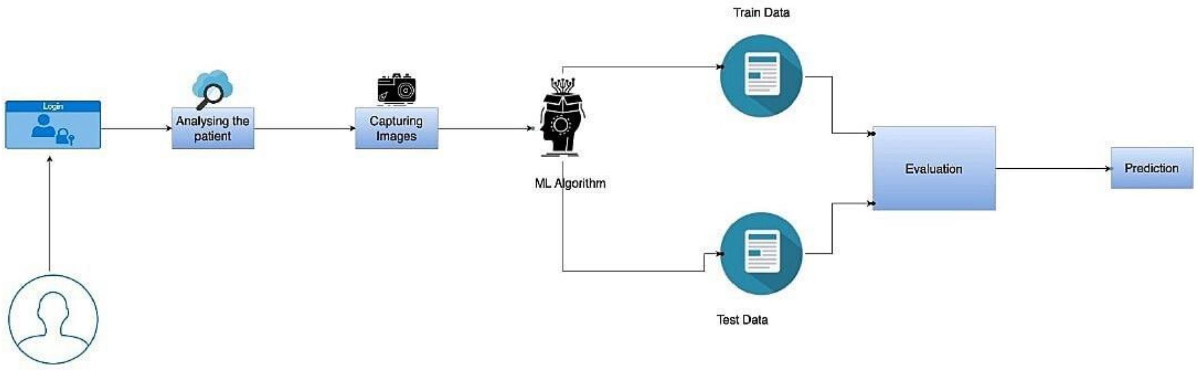
2. Link the GitHub accountwith the IBM.

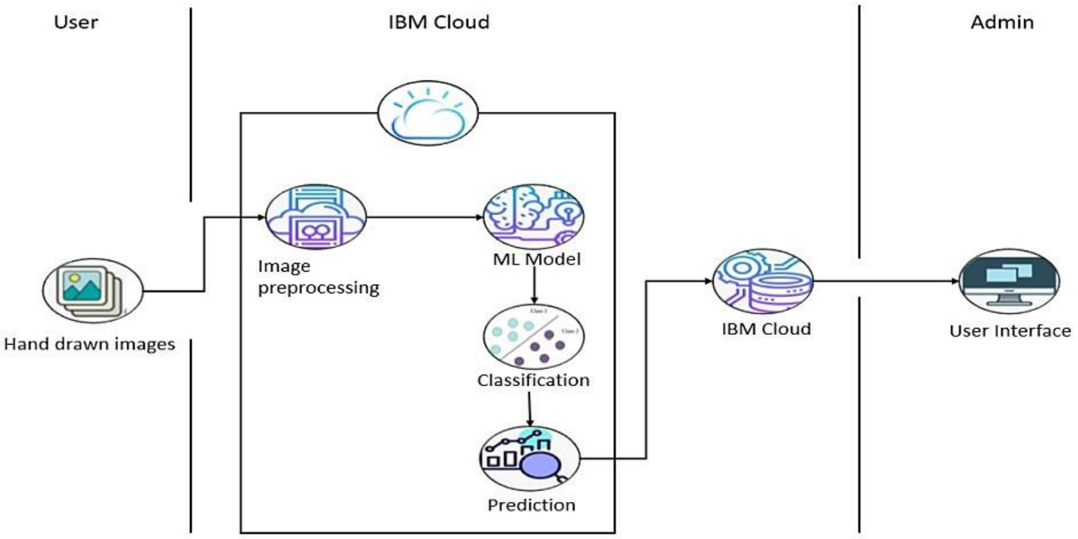
3. Notebook downloads from the dataset and imports data to analyses the patients.

4. After analyzing the affected patients we have to capture the images of them.

5. By using Machine Learning Algorithm, we have train and test the data for the further evaluation process.

6. After getting out the evaluation process we have to predict the given model by using Machine Learning.





5.3. USER STORIES:

User Type	Functional Requirement (Epic)	User Story Number	User Story/ Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email,password, and confirmingmy password.	I can access my account /dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation emailonce I haveregistered for the application	I can receive confirmationemail &click confirm	High	Sprint-1
		USN-3	As a user, I can register for the applicationthrough Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user,I can register for the applicationthrough Gmail	I can register & access the dashboard with Gmail Login	Medium	Sprint-1
	Login	USN-5	As a user, I can log intothe application byentering email & password	I can login & access my account with my registeredcredentials	High	Sprint-1
	Dashboard	USN-6	As a user, I can access the services and information provided in the dashboard	I can upload the hand drawnimages, I canviewthe result, I can edit my profile and I can view my history	High	Sprint-1
Customer (Webuser)	Login	USN-7	As a user,I can log into the web applicationand access the dashboard	I can login with the same registered credentials and accessmy account through web application	High	Sprint-1
Customer Care Executive	Help Desk	USN-8	As a user, I can get the guidance from the customer care	I can get help from the customer care for carrying out my tasks	High	Sprint-2

Administrator	Management	USN-9	As an administrator, I can collect new datasets and keep the model trained	I can collect and train the model with new dataset frequently	High	Sprint-2
		USN-10	As an administrator, I can update other features of the application	I can update and tune the features of application if needed	Medium	Sprint-1
		USN-11	As an administrator, I can maintain the information about the user	I can maintain information like user type and other such information	Medium	Sprint-1
		USN-12	As an administrator, I can maintain third-party services	I can support and maintain any third-party services	Low	Sprint-2

CHAPTER – 6

PROJECT PLANNING AND SCHEDULING

6.1. SPRINT DELIVERY SCHEDULE:

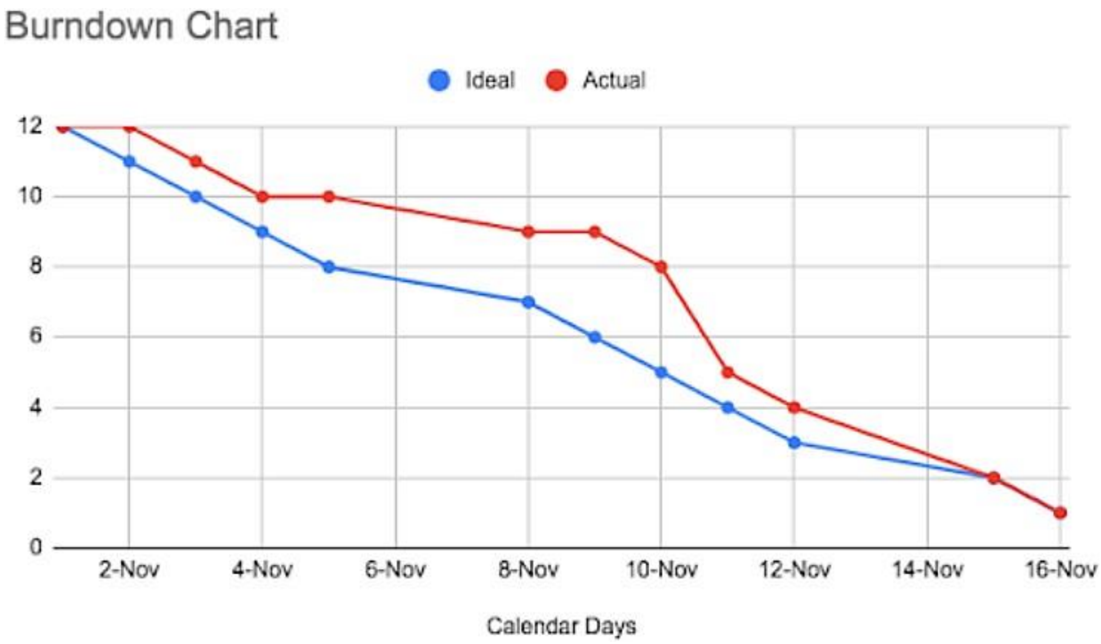
TITLE	DESCRIPTION	DATE
Ideation Phase	● Literature Survey ● Empathy Map ● Brainstorming ● Problem Statement	29 August 2022 – 17 September 2022
Project Design Phase1	● Problem Solution Fit ● Proposed Solution ● Solution Architecture	19 September 2022- 01 October 2022
Project Design Phase2	● Requirement Analysis ● Customer Journey ● Data Flow Diagrams ● Technical Architecture	03 October 2022- 15 October 2022
Project Planning Phase	● Sprint Delivery Plan ● JIRA files	17 October 2022- 22 October 2022
Project Development Phase	● Sprint 1 ● Sprint 2 ● Sprint 3 ● Sprint 4	24 October 2022- 19 November 2022

6.2. SPRINT PLANNINGAND ESTIMATION:

SPRINT	FUNCTIONAL REQUIREMENT	USER STORY NUMBER	USER STORY/TASK	STORY POINTS	PRIORITY	TEAM MEMBERS
Sprint-1	Pre-processing data	USN-1	Collect Dataset	5	High	Keerthana
Sprint-1		USN-2	Import therequired libraries, Read&Clean the datasets.	5	High	Hemalatha

Sprint-2	Building themodel	USN-1	Split the data intodependentand independent variables.	4	High	Janani P
Sprint-2		USN-2	Apply using regression model.	2	Medium	Janani S
Sprint-3	Application Building	USN-1	Build pythonflask application and HTML page.	5	High	Janani P
Sprint-3		USN-2	Execute and test the application.	2	Medium	Janani S
Sprint-4	Training the model	USN-1	Train machine learning model.	5	High	Hemalatha
		USN-2	Integrate flask.	5	High	Keerthana

6.3. REPORTS FROM JIRA:



CHAPTER – 7

CODING AND SOLUTION

7.1 FEATURE 1 (Decision Tree Classifier)

Decision Tree Classifier is used to train and test the model for detecting the phishing website with the help of collected and preprocessed dataset collections. NumPy is a library for the Python programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of high-level mathematical functions to operate on these arrays. Moreover, NumPy forms the foundation of the Machine Learning stack. Pandas is an open-source Python package that is most widely used for data science/data analysis and machine learning tasks. Sea born is a Python data visualization library based on matplotlib. It provides a high-level interface for drawing attractive and informative statistical graphics. For a brief introduction to the ideas behind the library, you can read the introductory notes or the paper.

Matplotlib is a comprehensive library for creating static, animated, and interactive visualizations in Python. Matplotlib makes easy things easy and hard things possible. Create publication quality plots. Make interactive figures that can zoom, pan, update.EDA is applied to investigate the data and summarize the key insights. It will give you the basic understanding of your data, it is distribution, null values and much more. You can either explore data using graphs or through some python functions. There will be two types of analysis. Descriptive statistics are brief informational coefficients that summarize a given data set, which can be either a representation of the entire population or a sample of a population. Descriptive statistics are broken down into measures of central tendency and measures of variability.

Label Encoding refers to converting the labels into a numeric form to convert them into the machine-readable form. Machine learning algorithms can then decide in a better way how those labels must be operated. It is an important pre-processing step for the structured dataset in supervised learning. “Pickling” is the process whereby a Python object hierarchy is converted into a byte stream, and “unpickling” is the inverse operation, whereby a byte stream is converted back into an object hierarchy.

XGBoost is an optimized distributed gradient boosting library designed to be highly efficient, flexible, and portable. It implements machine learning algorithms under the Gradient Boosting framework.

7.2 FEATURE 2 (Flask Connection)

The framework is the basis upon which software programs are built. It serves as a foundation for software developers, allowing them to create a variety of applications for certain platforms. It is a set of functions and predefined classes used to connect with the system software and handle inputs and outputs. It simplifies the life of a developer while giving them the ability to use certain extensions and makes the online applications scalable and maintainable. Flask is a web application framework written in Python. A Web Application Framework or a simply a Web Framework represents a collection of libraries and modules that enable web application developers to write applications without worrying about lowlevel details such as protocol, thread management, among other examples.

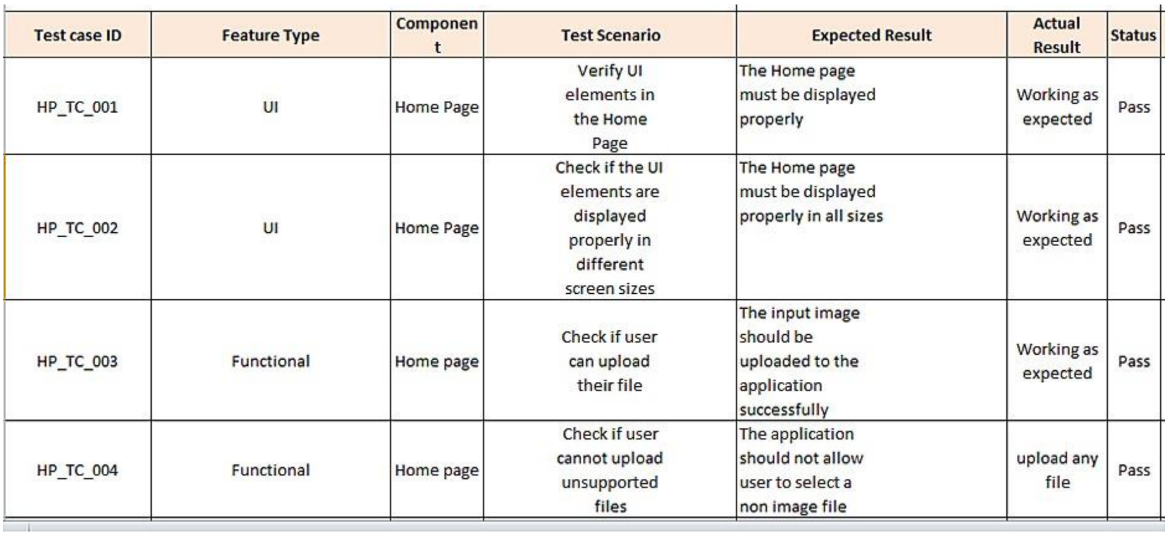
Flask is a web application framework written in Python. Flask is based on the Werkzeg WSGI toolkit and the Jinja2 template engine. Both are Pocco projects. The Web Server Gateway Interface (Web Server Gateway Interface, WSGI) has been used as a standard for Python web application development. WSGI is the specification of a common interface between web servers and web applications. Flask is often referred to as a micro-framework. It is designed to keep the core of the application simple and scalable. Instead of an abstraction layer for database support, Flask supports extensions to add such capabilities to the application. Unlike the Django framework, Flask is very Pythonic. It’s easy to get started with Flask, because it doesn’t have a huge learning curve.HTML stands for Hyper Text Markup Language. HTML is the standard markup language for creating Web pages. HTML describes the structure of a Web page. HTML consists of a series of elements. HTML elements tell the browser how to display the content. Flask is used for developing web applications using python, implemented on Werkzeug and Jinja2. Advantages of using Flask framework are: There is a built-in development server and a fast debugger provided. The model deployed using Flask is used to predict the Chronic Kidney Disease. Hypertext markup language (HTML) is the basic language used to create documents for the Web and, along with HTTP (hypertext transfer protocol) and URLs (universal resource locators), is one of the three main protocols of the Web. Hypertext is text that contains hyperlinks. A hyperlink is an automated cross-reference to another location on the same document or to another document which, when selected by a user, causes the computer to display the linked location or document within a concise period.

A markup language is a set of tags that can be embedded in digital text to provide additional information about it, including its content, structure and appearance. This information facilitates automated operations on the text, including formatting it for display, searching it and even modifying it. Some type of markup language is employed by every word processing program and by nearly every other program that displays text, although such languages and their tags are typically hidden from the user.HTML consists of a set of predefined tags that can be embedded in text by web site designers in order to indicate the details of how web pages are rendered (i.e., converted into a final, easily usable, form) by web browsers. These details include paragraphing, margins, fonts (including style and size), columns, colors (background and text), links, the location of images, text flow around images, tables, and user input form elements (such as spaces for adding text and submit buttons).

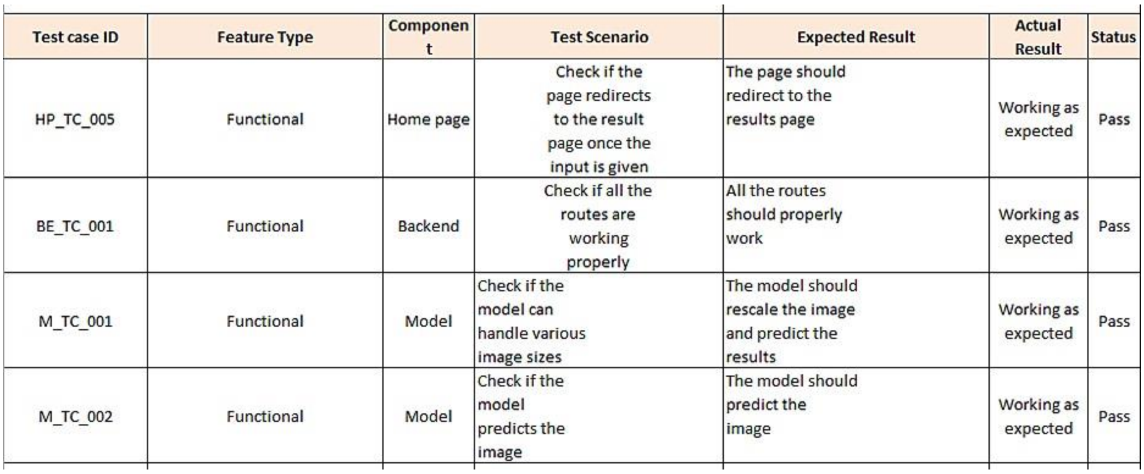
CHAPTER – 8

TESTING

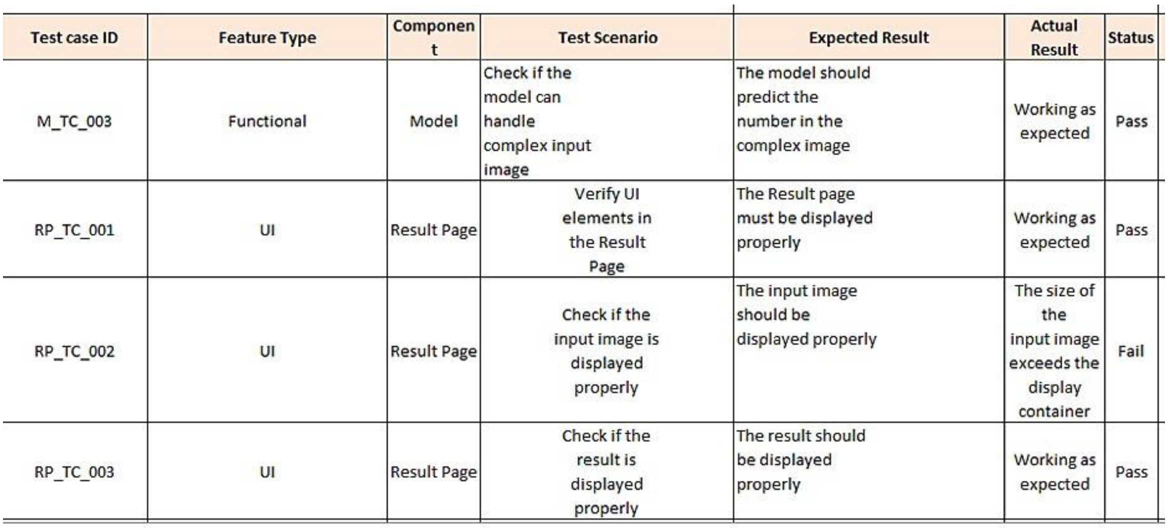
8.1. TEST CASES:



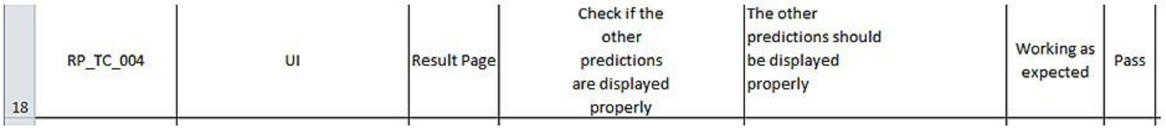
Test case ID	Feature Type	Component	Test Scenario	Expected Result	Actual Result	Status
HP_TC_001	UI	Home Page	Verify UI elements in the Home Page	The Home page must be displayed properly	Working as expected	Pass
HP_TC_002	UI	Home Page	Check if the UI elements are displayed properly in different screen sizes	The Home page must be displayed properly in all sizes	Working as expected	Pass
HP_TC_003	Functional	Home page	Check if user can upload their file	The input image should be uploaded to the application successfully	Working as expected	Pass
HP_TC_004	Functional	Home page	Check if user cannot upload unsupported files	The application should not allow user to select a non image file	upload any file	Pass



Test case ID	Feature Type	Component	Test Scenario	Expected Result	Actual Result	Status
HP_TC_005	Functional	Home page	Check if the page redirects to the result page once the input is given	The page should redirect to the results page	Working as expected	Pass
BE_TC_001	Functional	Backend	Check if all the routes are working properly	All the routes should properly work	Working as expected	Pass
M_TC_001	Functional	Model	Check if the model can handle various image sizes	The model should rescale the image and predict the results	Working as expected	Pass
M_TC_002	Functional	Model	Check if the model predicts the image	The model should predict the image	Working as expected	Pass



Test case ID	Feature Type	Component	Test Scenario	Expected Result	Actual Result	Status
M_TC_003	Functional	Model	Check if the model can handle complex input image	The model should predict the number in the complex image	Working as expected	Pass
RP_TC_001	UI	Result Page	Verify UI elements in the Result Page	The Result page must be displayed properly	Working as expected	Pass
RP_TC_002	UI	Result Page	Check if the input image is displayed properly	The input image should be displayed properly	The size of the input image exceeds the display container	Fail
RP_TC_003	UI	Result Page	Check if the result is displayed properly	The result should be displayed properly	Working as expected	Pass



RP_TC_004	UI	Result Page	Check if the other predictions are displayed properly	The other predictions should be displayed properly	Working as expected	Pass

8.2. USER ACCEPTANCE TESTING:

8.2.1. DEFECT ANALYSIS:

Resolution	**Severity 1**	**Severity 2**	**Severity 3**	**Severity 4**	**Severity 5**
By Design	1	0	1	0	2
Duplicate	0	0	0	0	0
External	0	0	2	0	2
Fixed	4	1	0	1	6
Not Reproduced	0	0	0	1	1
Skipped	0	0	0	1	1
Won’t Fix	1	0	1	0	2
Total	6	1	4	3	14

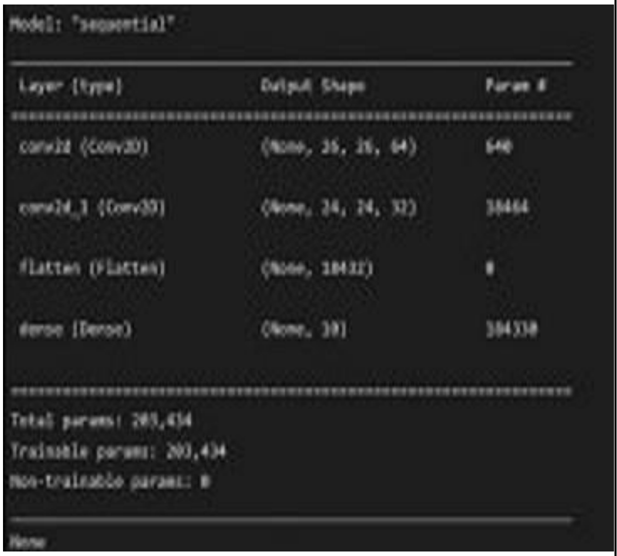
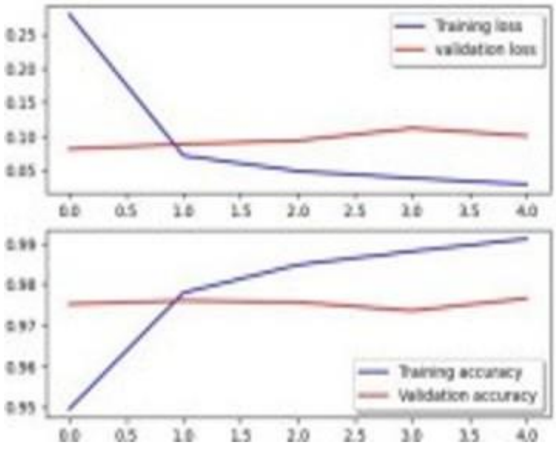
8.2.2. TEST CASE ANALYSIS:

SECTION	TOTAL CASES	NOT TESTED	FAIL	PASS
Client Application	10	0	3	7
Security	2	0	1	1
Performance	3	0	1	2
Exception Reporting	2	0	0	2

CHAPTER – 9

RESULT

9.1. PERFORMANCE METRICES:

S.NO	PARAMETER	VALUES	SCREENSHOT
1.	MODEL SUMMARY		
2.	ACCURACY	Training Accuracy-98% Validation Accuracy-97%	

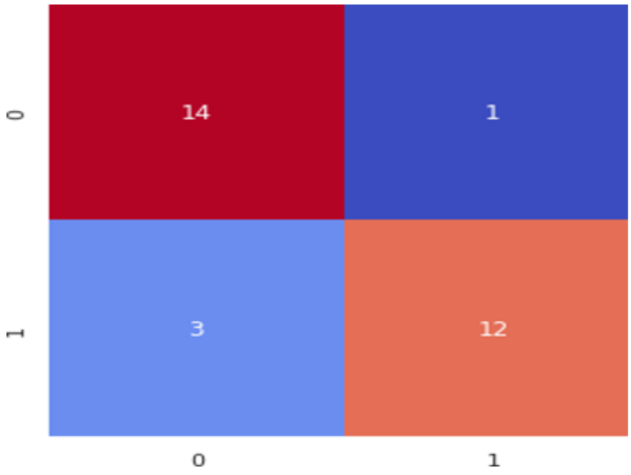
```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 26, 26, 64)        640

 conv2d_1 (Conv2D)           (None, 24, 24, 32)        18464

 flatten (Flatten)           (None, 18432)             0

 dense (Dense)               (None, 10)                184330

=================================================================
Total params: 203,434
Trainable params: 203,434
Non-trainable params: 0
_________________________________________________________________
None
```

3.	CONFUSION MATRIX		

CHAPTER – 10

ADVANTAGES AND DISADVANTAGES

ADVANTAGES:

- Reduces manual work
- More accurate than average human
- Capable of handling a lot of data
- Can be used anywhere from any device

DISADVANTAGES:

- Cannot handle complex data
- All the data must be in imageformat
- Requires a high performance server for fasterpredictions
- Prone to occasional errors

CHAPTER – 11

CONCLUSION

We have evaluated machine learning method for predicting Parkinson’s Disease using Classification Method likeLogistic Regression and Decision Tree Method which will be similar to Classification. In my project, I have exploited and evaluated the ability of motor functions of the person with the help of given measures who is healthier and affected. I collected 195 voice recording of an individual. I trained and tested the person’s body condition with the help of given measures. The model trained with Decision Tree gives better accuracy than other model for predicting the person who is affected with the disease or not. It can be useful in early stage detection of this disease and can easily able to give treatment for the persons.In the future, we will continue research to develop advanced techniques for predicting Parkinson’s Disease in large database.

CHAPTER – 12

FUTURE SCOPE

This project is far from complete and there is a lot of room for improvement. Some of the improvements that can be made to this project are as follows:

a. Add support to detectfrom multiple imagesand save the results

b. Add support to detect multiple images

c. Improve model to detect from compleximages

This project has endless potentialand can always be enhancedto become better.Implementing this concept in the real world will benefit several industries and reduce the workload on many workers, enhancing overall work efficiency.

CHAPTER-13

APPENDIX

SOURCE CODE:

Importing the Necessary Libraries

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import zipfile as zf
import os
import random
import cv2
import pickle
from imutils import build_montages
from imutils import paths
from sklearn.metrics import classification_report,confusion_matrix
from sklearn import metrics
from sklearn.preprocessing import LabelEncoder,LabelBinarizer from
sklearn.model_selection import train_test_split
from sklearn.ensemble import
RandomForestClassifier,GradientBoostingClassifier,ExtraTreesClassifier
from skimage import feature
from google.colab.patches importcv2_imshow
```

Loading the training and testing dataset

```
handle_spiral = zf.ZipFile(r&#39;dataset1.zip&#39;)
handle_spiral.extractall(&#39;dataset1&#39;)
handle_spiral.close()
spiral_train_healthy = os.listdir(&#39;dataset1/dataset/spiral/training/hea lthy/&#39;)
```

```
spiral_train_park = os.listdir(&#39;dataset1/dataset/spiral/training/parkin son/&#39;)

fp_spiral_train_healthy = &#39;dataset1/dataset/spiral/training/healthy/&#39;
fp_spiral_train_park = &#39;dataset1/dataset/spiral/training/parkinson/&#39;

spiral_test_healthy = os.listdir(&#39;dataset1/dataset/spiral/testing/healt hy/&#39;)

spiral_test_park = os.listdir(&#39;dataset1/dataset/spiral/testing/parkinso n/&#39;)

fp_spiral_test_healthy = &#39;dataset1/dataset/spiral/testing/healthy/&#39;

fp_spiral_test_park = &#39;dataset1/dataset/spiral/testing/parkinson/&#39;
```

Quantifying 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=&quot;L1&quot;) returnfeatures
```

Splitting up of training and testing data

```
trainX = []

testX = [] outputs = []

trainY = []

 testY = []

for i in spiral_train_healthy:
image = cv2.imread(fp_spiral_train_healthy+i)
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) trainX.append(features)

trainY.append(&#39;healthy&#39;) for i in spiral_train_park:

image = cv2.imread(fp_spiral_train_park+i)
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) trainX.append(features)
```

```
trainY.append(&#39;parkinson&#39;) for i in spiral_test_healthy:
image = cv2.imread(fp_spiral_test_healthy+i) outputs.append(image)
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) testX.append(features) testY.append(&#39;healthy&#39;)
for i in spiral_test_park:
image = cv2.imread(fp_spiral_test_park+i) outputs.append(image)
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) testX.append(features)
testY.append(&#39;parkinson&#39;) trainX= np.array(trainX)
testX = np.array(testX) trainY = np.array(trainY) testY = np.array(testY) trainX
trainY
```

Label Encoding

```
le = LabelEncoder()
trainY = le.fit_transform(trainY)testY = le.transform(testY) print(trainX.shape,trainY.shape)
trainY
testY
```

Model Building

```
Training the model print(&quot;Training model. &quot;)
model = RandomForestClassifier(n_estimators=100)model.fit(trainX,trainY)
preds = model.predict(testX)preds
```

Model Evaluation

```
cnf = confusion_matrix(testY,preds)cnf
array([[14,1], [ 3, 12]]) plt.figure(figsize=(5,5))
sns.heatmap(cnf , annot=True , cmap=&quot;coolwarm&quot; , cbar=False)plt.show()
```

```
acc = metrics.accuracy_score(testY,preds)acc
indexes = np.random.randint(0,30,25)indexes
```

Testing Model

```
testpath=list(paths.list_images(fp_spiral_train_healthy))idxs=np.arange(0,len(testpath))
idxs=np.random.choice(idxs,size=(25,),replace=False) images=[]
for i in idxs: image=cv2.imread(testpath[i]) output=image.copy()
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]
features= quantify_image(image) preds=model.predict([features])
label=le.inverse_transform(preds)[0]if  label==&quot;healthy&quot;:

color=(0,255,0)else:
(0,0,255)
cv2.putText(output,label, (3,20),cv2.FONT_HERSHEY_SIMPLEX,0.5,color
,2)
images.append(output)
&#39;&#39;&#39;montage = build_montages(images,(128,128),(5,5))[0]
cv2.imshow(montage)
cv2.waitKey(0)&#39;&#39;&#39; montage=build_montages(images,(128,128),(5,5))[0]
cv2_imshow(montage)
cv2.waitKey(0)
predictions = model.predict(testX)
cm = confusion_matrix(testY, predictions).flatten()print(cm)
(tn, fp, fn, tp) = cm
accuracy = (tp + tn) / float(cm.sum())print(accuracy)
```

Flask App

```
from flaskimport Flask, request,render_templateimport pickle
import cv2
from skimageimport featureimport os.path
#from werkzeug.utils importsecure_filename#from model import model


app = Flask(   name    )


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


@app.route("/home")

def home():
return render_template("home.html")


@app.route("/upload")def test():
return render_template("pred.html")


@app.route("/logout")def log():
return render_template("home.html")


@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# storingthe file in uploads folder
filepath = os.path.join(basepath, "uploads", f.filename)f.save(filepath)   # saving the file

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

# Pre-process the image in the same manner wedid earlierimage= cv2.imread(filepath)
output = image.copy()

# Load the input image, convert it to grayscale, and resizeoutput = 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]

# Quantifythe image and make predictions based on the extracted featuresusing the last
trained RandomForestfeatures = 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"]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 resultreturn None


if     name == ' main ':app.run()
```

HOME PAGE(HTML)

```
<!DOCTYPE
html>
<html lang="en">
<head>
<meta charset="UTF-8" />
<meta name="viewport" content="width=device-width, initial-scale=1.0"
/>
<meta http-equiv="X-UA-Compatible" content="ie=edge" />
<title>HomePage</title>
<style>
body {
background: linear-gradient(to right,#33ccff 0%, #99ffcc100%);
background-size: cover;
background-position:    relative;
background-repeat:   no-repeat;
height: 100%;
width: 100%;
}
h3 {
text-align: center;
color: white;
}
```

```
.main {
margin-top: 100px;
}
p {
color: black;
text-indent: 10px;
margin: 10px;
font-size: 20px;
}

          a{
          color: grey;
          float: right;
          text-decoration: none;
          font-style: normal;
          padding-right: 20px;
          }

          a:hover {
          background-color:
          black;
          color: white;
          font-size: 30px;
          padding-left: 10px;
          border-radius: 5px;
          }

          ul {
          align-items: center;
          display: flex;
          list-style-type: none;
          width: 100%;
          gap: 3rem;
          justify-content: center;
          font-size: 2rem;
          position: fixed;
          top: 0;
          margin: 0;
          padding: 1rem;
          background-color:
          white;
          }
```

```
  li {
  cursor: pointer;
  }
  li a {
  text-decoration: none;color:
  inherit;
  }
  li.active {
  font-weight: bold;
  color: orangered;
  }

img {
width: 450px;
height: 400px;
padding: 25px;
}
img:hover {
border-color: grey;
}
#im {
width:  1450px;
height:   700px;
padding: 25px;
}
</style>
</head>
<body>
<nav>
<ul>
<li class="active"><a href="/home">Home</a></li>
<li class="active"><a href="/upload">Predict-
Results</a></li>
</ul>
</nav>
<br /><br /><br />
<h1>
<center>
<b class="pd"
><font color="black" size="15" font-family="Comic Sans MS"
>Detection of Parkinson's Disease using ML</font
></b
>
```

```
</center>
</h1>
<div>
<center>
<p style="text-align: left">
Parkinson disease(PD) is a progressive neurodegenerative
disorder
that impacts more than 6 million people around the
world.Parkinson's
disease is non-communicable, early-stage detection of
Parkinson's can
prevent furtherdamages in humanssuffering from it.
However,Nonetheless, non-specialist physicians still do not
have a
definitive testfor PD, similarly in the earlystage of the
diseased
person wherethe signs maybe intermittent andbadly
characterized. It
    resulted in a high rate of misdiagnosis (up to 25% among
    non-specialists) and many years before treatment, patients can have
    the disorder. A more accurate, unbiased means of earlydetection is
    required, preferably one that individuals can use in their home
    setting.However, it has beenobserved that PD's presence in a humanis
    related to its hand-writing as well as hand-drawn subjects. From that
    perspective, several techniques have beenproposed by researchers to
    detect Parkinson's disease from hand-drawn images of suspected people.
    But the previous methods have their constraints.
  </p>
</center>
<h4>
  <center>
    <b class="pd"
      ><font color="black" size="12" font-family="Comic SansMS"
        >Causes andSymptoms of Parkinson's Disease</font
      >
    </b>
  </center>
</h4>
<span>
```

```
    <img
     src="https://www.narayanahealth.org/blog/wp-content/uploads/2015/04/parkinson.png"
     title="Disease"
    />
   </span>
   <span>
    <img
src="https://stanfordmedicine25.stanford.edu/the25/parkinsondisease/_jcr_content/main/panel_builder
_0/panel_0/panel_builder_0/pan el_0/panel_builder/panel_0/image.img.476.high.png/1.png"
     title="Symptoms"
   /></span>
   <span
    ><img
src="https://www.verywellhealth.com/thmb/Aaqo8oM3QDHSNHCt_DlKCNeWoUk=/1500x0/filter
s:no_upscale():max_bytes(15000 0):strip_icc()/zhansen-5200700_Finaledit2-
3e7eb00f1bdb4806adb3f67ca4404894.jpg"
     title="Stages"
   /></span>
   <span
```

```
><img
title="Effect"
 /></span>
 <span
 ><img
 src="https://i.pinimg.com/originals/02/16/e4/0216e4b8a5db4d6e2a3f7043eaf7dc32.jpg"
 title="Cause"
 /></span>
 <span
 ><img
 src="https://jnnp.bmj.com/content/jnnp/91/8/795/F4.large.jpg"
 title="diagnosis"
 /></span>
 <h3>
 <center>
 <font color="black" size="12" font-family="Comic Sans MS"
 >Treatment for parkinson disease</font
 >
 </center>
 </h3>
 <span
 ><img
src="https://www.mdpi.com/biomolecules/biomolecules-11-
00612/article_deploy/html/images/biomolecules-11-00612-
g001.png"
 title="diagnosis"
 /></span>
 <span
 ><img
 src="https://media.springernature.com/m685/springer-static/image/art%3A10.1038%2Fs41401-
020-0365-
y/MediaObjects/41401_2020_365_Fig1_HTML.png"
 title="diagnosis"
 /></span>
 <span
 ><img
```

```
src="https://www.verywellhealth.com/thmb/BgjmOKb2W7z0gqLZryKBd4FFHs=/1500x0/filters:no_upscale():max_bytes(150000):strip_icc()/advanced-parkinsons-disease5200544_color_text_v1-3bc74418259340ceaf5f6d407daeff73.jpg"
 title="diagnosis"
 /></span>
 <h3>
 <center>
 <font color="black" size="12" font-family="Comic Sans MS"
 >How brains looks during PD?</font

 >
 </center>
 </h3>
 <span
 ><img
 id="im"

src="https://ichef.bbci.co.uk/news/976/cpsprodpb/16161/production/_107456409_parkinsons.jpg"
 title="Stage"
 /></span>
 <span
 ><img
 id="im"
 src="https://img.parkinsonsinfoclub.com/wp-content/uploads/back-conditions-neck-conditions-london-back-pain-clinicscaled.jpeg"
 title="Stage"
 /></span>
 <br /><br />
 </div>
 </body>
</html>
```

BASE PAGE(HTML)

```
<html
```

```
lang="en"
>
 <head>
 <meta charset="UTF-8" />
 <meta name="viewport" content="width=device-width, initial-scale=1.0" />
 <meta http-equiv="X-UA-Compatible" content="ie=edge" />
 <title>Predict</title>
 <link
 href="https://cdn.bootcss.com/bootstrap/4.0.0/css/bootstrap.min.css"
 rel="stylesheet"
 />
 <script src="https://cdn.bootcss.com/popper.js/1.12.9/umd/popper.min.js"></script>
 <script src="https://cdn.bootcss.com/jquery/3.3.1/jquery.min.js"></script>
 <script src="https://cdn.bootcss.com/bootstrap/4.0.0/js/bootstrap.min.js"></script>
 <link
 href="{{ url_for('static', filename='css/main.css') }}"
 rel="stylesheet"
 />
 <style>
 body {
 background-image: url("https://img.freepik.com/free-vector/clean-medical-patterned-background-
vector_53876-
140867.jpg?w=1060&t=st=1667911964~exp=1667912564~hmac=4298568f384f42cfc60423d63a
c6a8c806e4fe025c1bed2f32ae68b3
f15b2139");
 background-position: center;
 background-repeat: no-repeat;
 background-size: cover;
 height: 100%;
 width: 100%;
 }
 h1 {
 font-size: 40px;
 text-align: center;
 color: black;
 font-style: italic;
```

```
font-weight: bolder;
}
h2 {
font-size: 35px;
text-align: center;
color: black;

font-style: italic;
font-weight: bolder;
}
h5 {
font-size: 25px;
text-align: center;
color: black;
font-weight: bolder;
}
a {
color: grey;
float: right;
text-decoration: none;
font-style: normal;
padding-right: 20px;
}
a:hover {
background-color: black;
color: white;
font-size: 30px;
padding-left: 10px;
border-radius: 5px;
}
ul {
align-items: center;
display: flex;
list-style-type: none;
width: 100%;
gap: 3rem;
```

```
justify-content: center;
font-size: 2rem;
position: fixed;
top: 0;
margin: 0;
padding: 1rem;
background-color: white;
}
li {
cursor: pointer;
}

li a {
text-decoration: none;
color: inherit;
}
li.active {
font-weight: bold;
color: orangered;
}
</style>
</head>
<body>
<nav>
<ul>
<li class="active"><a href="/home">Home</a></li>
<li class="active"><a href="/upload">Predict-Results</a></li>
</ul>
</nav>
<br />
<h1><b>Prevention is better than cure!</b></h1>
<br />
<h2>
<center>
❤Diagnosis is not the end, but the beginning of practice.
</center>
```

```
</h2>
<br />
<h2><center>❤Detect the disease and take measures wisely</center></h2>
<br />
<h5>
NOTE: Upload an spiral or wave page drawn by the patient/user in a white
sheet
</h5>
<div class="container">
<center>
<div id="content" style="margin-top: 2em">
{% block content %}{% endblock %}
</div>
</center>
</div>
</body>
<footer>
<script
src="{{ url_for('static', filename='js/main.js') }}"
```

PREDICTION PAGE(HTML)

```
{% extends
"base.html"
%} {%
block
content %}
<div>
 <form id="upload-file" method="post" enctype="multipart/form-data">
 <center>
 <label for="imageUpload" class="upload-label">
 Choose...
 </label>
 <input type="file" name="file" id="imageUpload" accept=".png, .jpg, .jpeg">
 </center>
 </form>
 <center> <div class="image-section" style="display:none;">
 <div class="img-preview">
 <div id="imagePreview">
 </div></center>
 </div>
 <center>
 <div>
 <button type="button" class="btn btn-primary btn-lg " id="btn-predict">Predict!</button>
 </div>
 </center>
 </div>
 <div class="loader" style="display:none;"></div>
 <h3 id="result">
 <span> </span>
 </h3>
</div>
 type="text/javascript"
 ></script>
 </footer>
</html>
47
{% endblock %}
```

HOME PAGE(CSS)

```
.imgpreview
{
 width: 256px;
 height: 256px;
 position: relative;
 border: 5px solid #F8F8F8;
 box-shadow: 0px 2px 4px 0px rgba(0, 0, 0, 0.1);
 margin-top: 1em;
 margin-bottom: 1em;
}
```

```
.img-preview>div {
 width: 100%;
 height: 100%;
 background-size: 256px 256px;
 background-repeat: no-repeat;
 background-position: center;
}
input[type="file"] {
 display: none;
}
.upload-label {
 display: inline-block;
 padding: 12px 30px;
 background: #fe2727;
 color: #fff;
 font-size: 1em;
 transition: all .4s;
 cursor: pointer;
}
.upload-label:hover {
 background: #34495E;
 color: #39D2B4;
}
```

```
.loader {
 border: 8px solid #f3f3f3;
 /* Light grey */
 border-top: 8px solid #3498db;
 /* Blue */
 border-radius: 50%;
 width:  50px;
 height: 50px;
 animation: spin 1s linear infinite;
}
@keyframes spin {
 0% {
```

```
 transform: rotate(0deg);
 }
 100% {
 transform: rotate(360deg);
 }
}
```

HOME PAGE(JS)

```
.imgpreview
{
 width: 256px;
 height: 256px;
 position: relative;
 border: 5px solid #F8F8F8;
 box-shadow: 0px 2px 4px 0px rgba(0, 0, 0, 0.1);
 margin-top: 1em;
 margin-bottom: 1em;
}
.img-preview>div {
 width: 100%;
 height: 100%;
 background-size: 256px 256px;
 background-repeat: no-repeat;
 background-position: center;
}
input[type="file"] {
49
 display: none;
}
.upload-label {
 display: inline-block;
 padding: 12px 30px;
 background: #fe2727;
 color: #fff;
 font-size: 1em;
 transition: all .4s;
 cursor: pointer;
}
.upload-label:hover {
 background: #34495E;
 color: #39D2B4;
}
.loader {
 border: 8px solid #f3f3f3;
 /* Light grey */
 border-top: 8px solid #3498db;
 /* Blue */
 border-radius: 50%;
 width:  50px;
 height: 50px;
 animation: spin 1s linear infinite;
}
@keyframes spin {
 0% {
 transform: rotate(0deg);
 }
 100% {
 transform: rotate(360deg);
 }
}
```

GITHUB

https://github.com/IBM-EPBL/IBM-Project-14972-1659592860

PROJECT DEMO LINK

https://drive.google.com/file/d/1Itoc0fK8vPaYUEtDLPlK3kGhI3RvxRU3/view?usp=sharing