Detecting Parkinsons Disease using Machine Learning

Applied Data Science

Team ID: PNT2022MID00774

by

PANIMALAR ENGINEERING COLLEGE

Project Report Format

1. **INTRODUCTION**
   - 1.1. Project Overview
   - 1.2. Purpose
2. **LITERATURE SURVEY**
   - 2.1. Existing problem
   - 2.2. References
   - 2.3. Problem Statement Definition
3. **IDEATION & PROPOSED SOLUTION**
   - 3.1. Empathy Map Canvas
   - 3.2. Ideation & Brainstorming
   - 3.3. Proposed Solution
   - 3.4. Problem Solution fit
4. **REQUIREMENT ANALYSIS**
   - 4.1. Functional requirement
   - 4.2. Non-Functional requirements
5. **PROJECT DESIGN**
   - 5.1. Data Flow Diagrams
   - 5.2. Solution & Technical Architecture
   - 5.3. User Stories
6. **PROJECT PLANNING & SCHEDULING**
   - 6.1. Sprint Planning & Estimation
   - 6.2. Sprint Delivery Schedule
   - 6.3. Reports from JIRA
7. **CODING & SOLUTIONING (Explain the features added in the project along with code)**
   - 7.1. Feature 1
   - 7.2. Feature 2
   - 7.3. Database Schema (if Applicable)
8. **TESTING**
   - 8.1. Test Cases
   - 8.2. User Acceptance Testing
9. **RESULTS**
   - 9.1. Performance Metrics
10. **ADVANTAGES & DISADVANTAGES**
11. **CONCLUSION**
12. **FUTURE SCOPE**
13. **APPENDIX**

    Source Code

    GitHub & Project Demo Link

1. INTRODUCTION

1.1 Project Overview

The Parkinson's disease is progressive neuro degenerative disorder that affects a lot only people significantly affecting their quality of life. It mostly affect the motor functions of human. The main motor symptoms are called "parkinsonism" or "parkinsonian syndrome". The symptoms of Parkinson's disease will occur slowly, the symptoms include shaking, rigidity, slowness of movement and difficulty with walking, Thinking and behavior change, Depression and anxiety are also common. There is a model for detecting Parkinson's using voice. The deflections in the voice will confirm the symptoms of Parkinson's disease. This project showed 73.8% efficiency. In our model, a huge amount of data is collected from the normal person and also previously affected person by Parkinson's disease. these data is trained using machine learning algorithms. From the whole data 60% is used for training and 40% is used for testing. The data of any person can be entered in db to check whether the person is affected by Parkinsons disease or not. There are 24 columns in the data set each column will indicate the symptom values of a patient except the status column. The status column has 0's and I's.those values will decide the person is effected with Parkinsons disease. I's indicate person is effected, 0's indicate normal conditions.

1.2 Purpose

By using machine learning techniques, the problem can be solved with minimal error rate. The voice dataset of Parkinson's disease from the UCI Machine learning library is used as input. Also our proposed system provides accurate results by integrating spiral drawing inputs of normal and Parkinson’s affected patients. We propose a hybrid and accurate results analyzing patient both voice and spiral drawing data’s. Thus combining both the results, the doctor can conclude normality or abnormality and prescribe the medicine based on the affected stage.

2. LITERATURE SURVEY

2.1 Existing problem

Jie Mei et al used all basic algorithms of deep learning techniques for the detection of PD. Like SVM, RF, Decision Tree, ANN, KNN, Radial Basis Function Networks (RBF) and Deep Belief Networks (DBN) etc. The early identification of Parkinson's disease is critical. The identification can be performed with the use of a data mining technique. The techniques for detecting PD, such as Naive Bayes, support vector machine, multilayer perceptron neural network, and decision tree, are theoretically explained in this study. This study uses speech input from acoustic devices to predict Parkinson's disease. People from various areas and speech factors are investigated in this article in order to predict Parkinson's disease among patients. The speech dataset was used to recognize Parkinson's illness using Multi - layer Perceptron and Logistic Regression (LR) frameworks.

Gabriel Solana-Lavalle et al. uses the algorithms such as Multilayer Perceptron (MLP), Random Forest (RF), K-Nearest Neighbour (KNN). For the prediction of Parkinson disease, three set of experiences were conducted to obtain the features with highest contribution to PD. This three sets are 1.a population with male and female subjects (balanced), 2.male subjects (balanced and unbalanced), and 3. Female subjects (balanced and unbalanced). In this study, the researchers used acoustic devices to collect speech parameters from 50 persons with Parkinson's disease and fifty healthy people. They employed the kfold cross validation method for testing and claim that it can deliver 85 percent accuracy.

Yi Xia et al. they have considered approaches, they include four DL-based models (DCNN, DALSTM, DCLSTM, and CNN-LSTM) and also used two traditional classifications for extraction. In the DL-based model DCNN gives less accuracy than other DL models. Parkinson's disease affects people all around the world. People and people with Parkinson's disease could be classified using machine learning approach. This paper provides a comprehensive overview of machine learning-based approaches for Parkinson disease prediction. A comprehensive overview of various computational system-based techniques for Parkinson disease

prediction is presented. This report also includes an overview of the results obtained by several scientists from publicly available data in order to forecast Parkinson's disease.

Kazi Amit Hasan et al. used different classification methods RF, KNN, Decision Tree, Logistic Regression (LR), SVM, and Naïve Bayes for detection of PD. The best result achieved by Decision Tree and Random Forest (RF) classification methods. The data mining techniques may be a more popular in many field of medical, business, railway, education etc. They are most commonly used for medical diagnosis and disease prediction at the early stage. The data mining is employed for healthcare sector in industrial societies.

Mosarrat Rumman et al. based on Image Processing and Artificial Neural Network (ANN) classification algorithm According to ANN prediction, if value closer to 1 then suggests PD and value closer to 0 then suggest normal. Parkinson disease is a global public health issue. Machine learning technique would be a best solution to classify individuals and individuals with Parkinson's sickness (PD). This paper gives an entire review for the forecast of Parkinson disease by utilizing the machine learning based methodologies. A concise presentation of varied computational system based methodologies utilized for the forecast of Parkinson disease is introduced. This paper likewise displays the outline of results acquired by different scientists from accessible information to predict the Parkinson disease.

Shail Raval et al. For the detection of PD they include all the aspects such as biological data, chemical data and genetic data. In this paper they mainly focused on the symptoms like rigidity, Tremor at rest, changing voice etc. The secure data transmission is proposed through authentication check, duplication check and faulty node detection. The proposed method is applicable to long ranges of transmission. It is also supporting a retransmission concept.

Zehra Karapinar Senturk et al. proposed the algorithms to detect PD like support vector machine (SVM), Classification and Regression Tree (CART). It provided about 13% performance improvement for SVM, about 11% for ANN, and about 5% improvement for CART. The result shows that Naive Bayes and decision tree

(j48) yield better accuracy when performed upon the discretized PD dataset with cross-validation test mode without applying any attributes selection algorithm.

Satyabrata Aich et al. According to this Random Forest (RF) gives more accuracy. This analysis will help the clinicians to differentiate the PD group from healthy group based on the voice data. CNN's, also referred to as ConvNets, contains multiple layers and are mainly used for image processing and object detection. Yann LeCun developed the primary CNN in 1988 when it had been called LeNet. It was used for recognizing characters like ZIP codes and digits.

Timothy J. Wroge et al. used Extra Tree and gradient boosted Decision tree classification algorithms are used to detect variations in voice. LSTMs are a kind of Recurrent Neural Network (RNN) which will learn and memorize longterm dependencies. Recalling past information for long periods is that the default behavior.

Rajalakshmi Shenbaga Moorthy et al. used to novel analytic system for Parkinson's disease Prediction mechanism using Improved Radial Basis Function Neural Network (IRBFNN). RNNs is during a one among the deep learning models that are used for modeling the arbitrary length sequences by applying a transition function to all or any it's hidden states during a recursive manner.

Rahul R. Chakre et al. According to the hybrid approach, which is a combination of supervised and unsupervised techniques, is also beneficial for classification and feature extraction. Support vector machine is employed as the supervised technique for classification, and ICA is used as unsupervised technique for the feature extraction in multiclass data set.

Rahul Ramesh Chakre et al.According to the field of medical diagnosis, bioinspired computing is also a novel technique. Swarm intelligence and immune computing algorithms, two major subsets of bio-inspired computation, are presented for a wide range of issues.

2.2 References

[1] J. Wroge, Yasin Ozkanca, Cenk Demiroglu et al. Parkinson's Disease Diagnosis Using Machine Learning and Voice Timothy

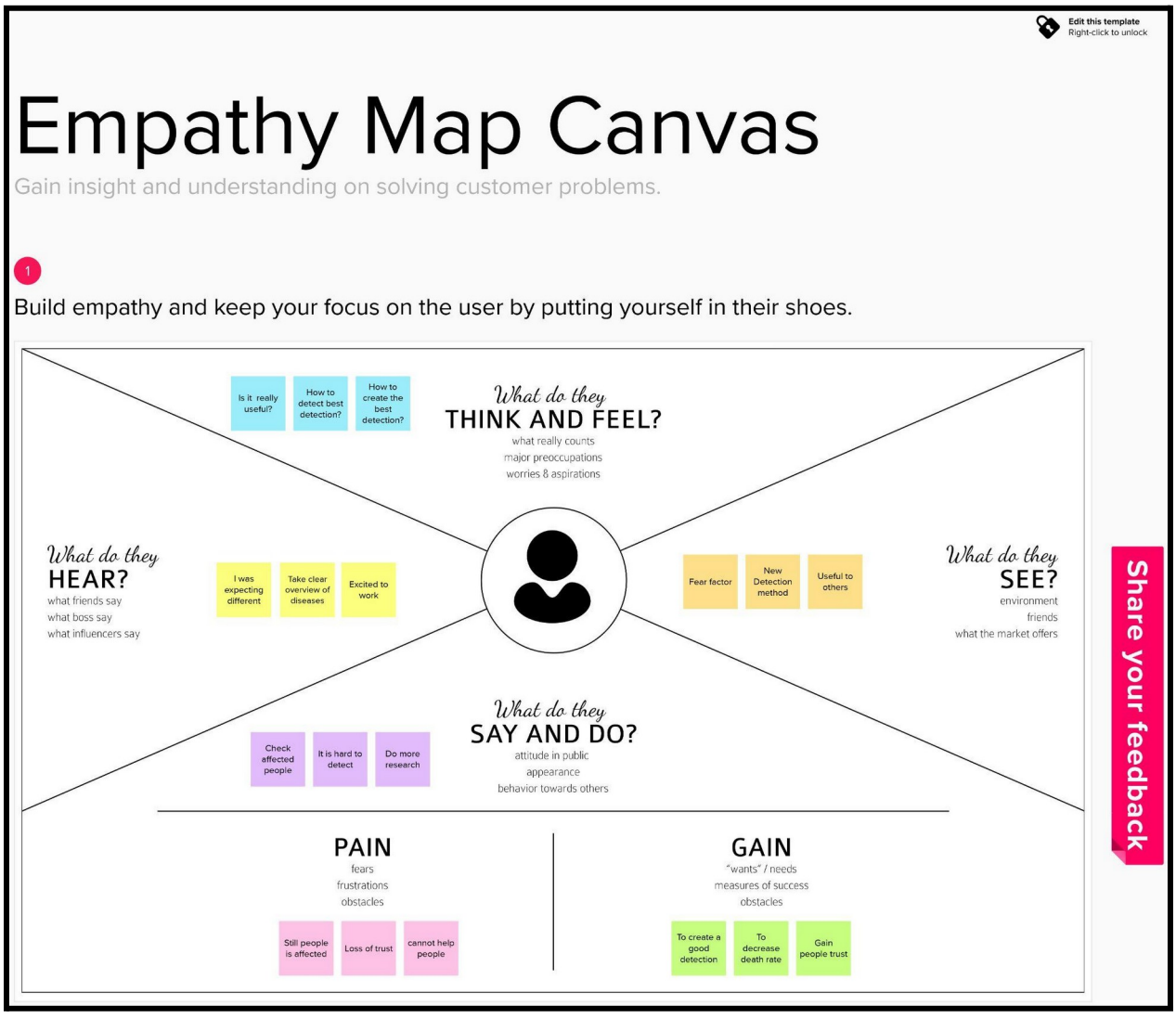
[2] Sakshi Jadhav, Seema Thorat, Sakshi Fokane et al. A Survey On Early Detection Of Parkinson Disease Using Deep Learning Technique

[3] Anitha R1, Nandhini T2, Sathish Raj S3 et al. Early Detection of Parkinson's Disease Using Machine Learning

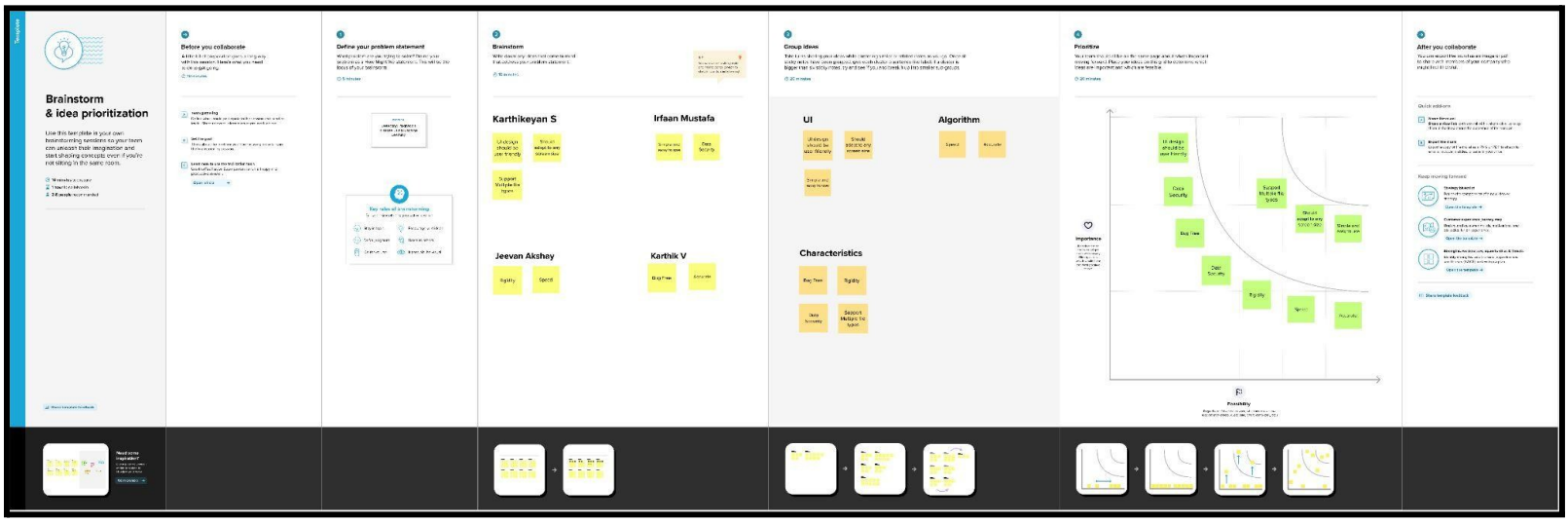
2.3 Problem Statement Definition

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming



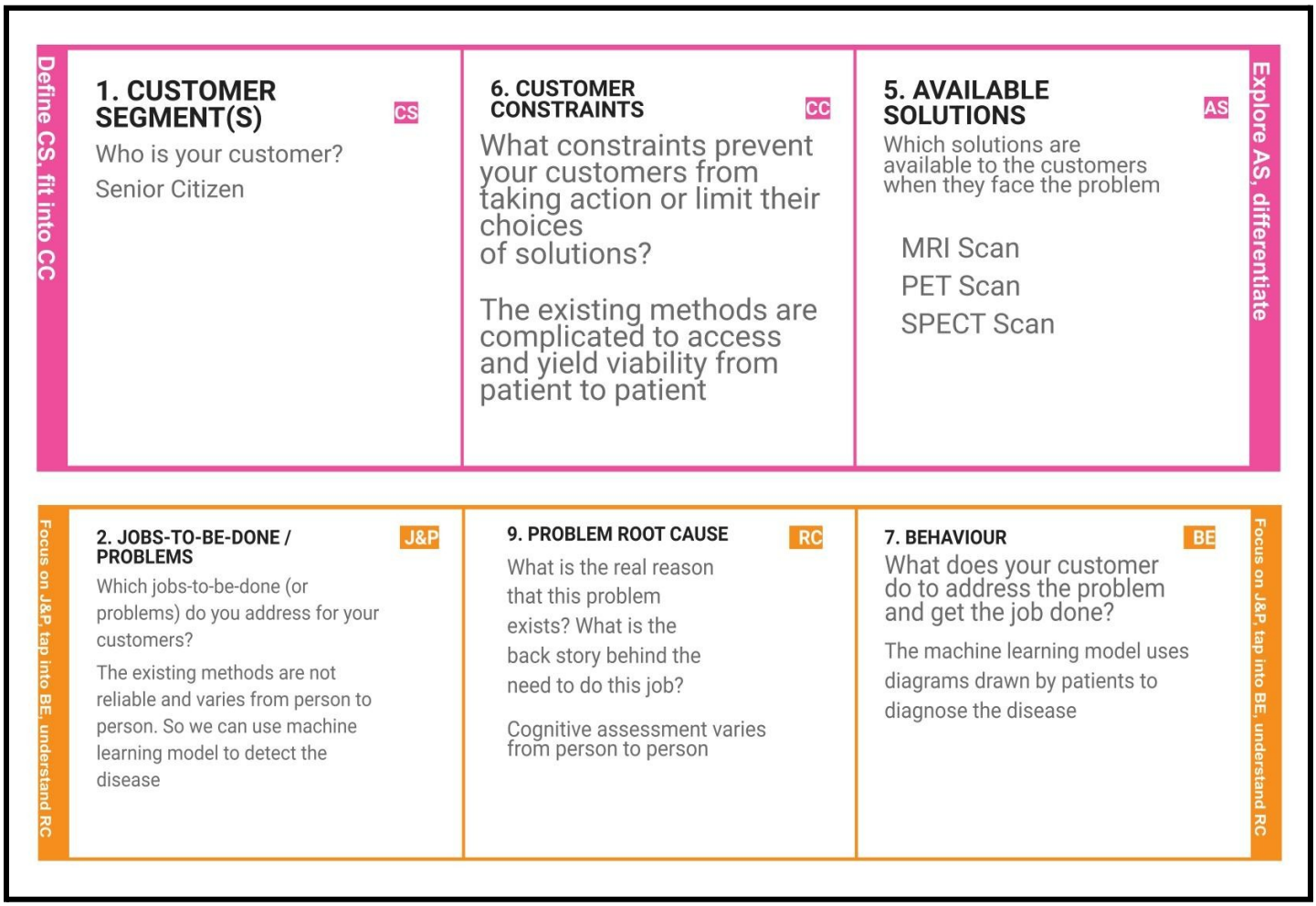
3.3 Proposed Solution

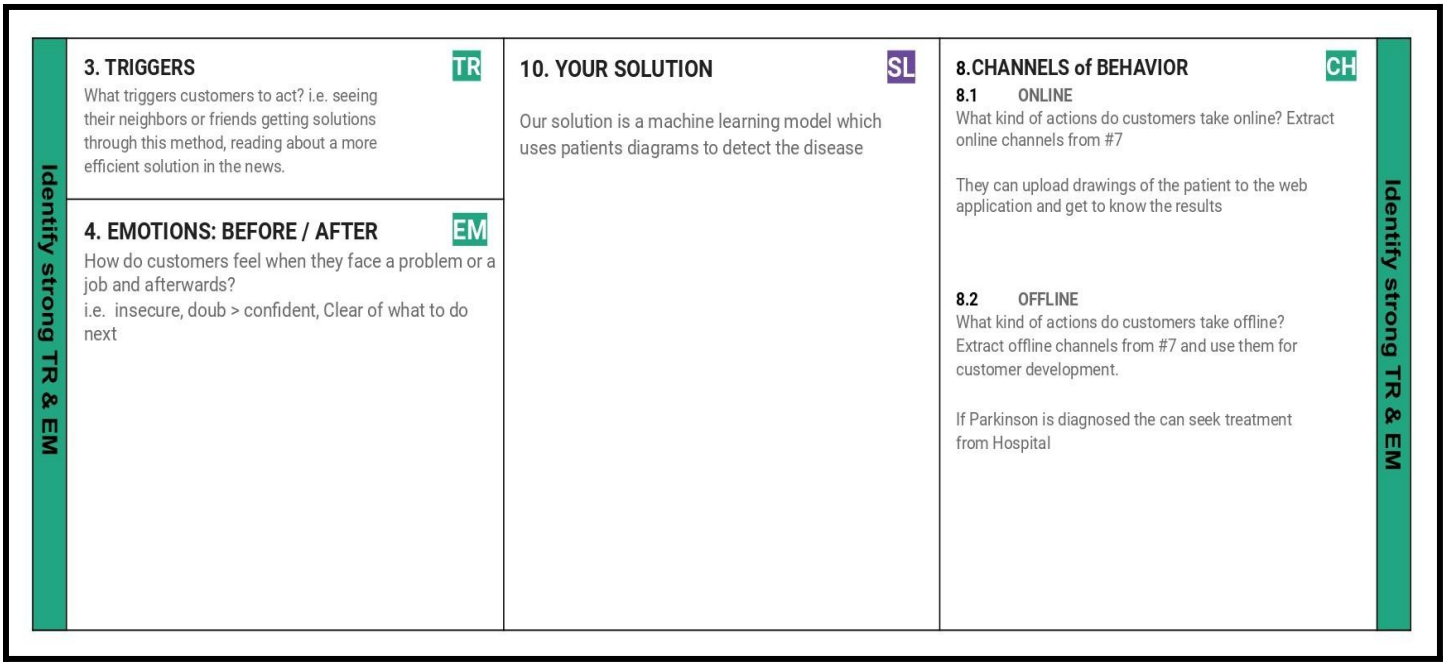
S. No.	Parameter	Description
1.	Problem Statement	More than 10 million people are living with Parkinson's disease worldwide, according to the Parkinson's Foundation. While Parkinson's cannot be cured, early detection along with proper medication can significantly improve symptoms and quality of life.
2.	Idea / Solution description	We came up with a solution that detects the disease by means of a Machine Learning Model
3.	Novelty / Uniqueness	The system uses the drawings of a person and analyses the pattern

4.	Social Impact / Customer Satisfaction	This enables easy and early detection of disease which can significantly improve symptoms and quality of life
5.	Business Model (Revenue Model)	Pay per use – each time a person needs the service he can avail it by paying for the use
6.	Scalability of the Solution	It can be implemented using any we framework and can be made available to everyone in need

3.4 Problem Solution fit

Project Title: Detecting Parkinson's Disease using Machine Learning **Project Design Phase-I - Solution Fit Template** **Team ID:** PNT2022TMID00774





		manipulation, business process, user interaction, or the other specific functionality which defines what function a system is **probably going to perform.**

FR-2	**Testing**	**Applying the algorithms on the test data**
FR-3	**Confirmation**	**Display the result with the description of having Parkinson's or not.**

4.2 Non - Functional requirement

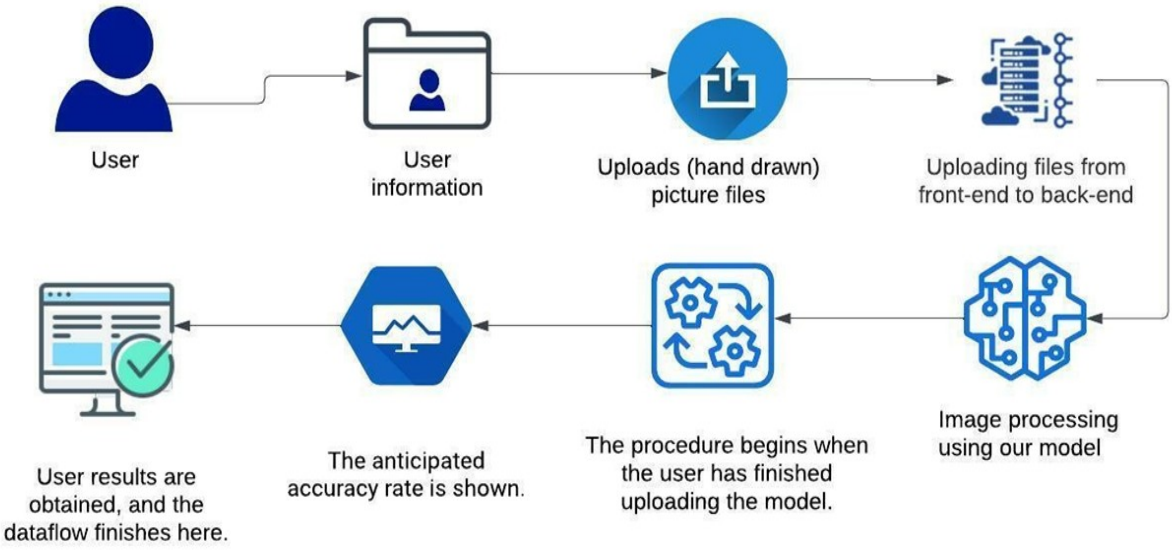
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	**The nervous system conditions (neurologist) will diagnose Parkinson's disease based on your medical history, a review of your signs and symptoms, and a neurological and physical examination.**
NFR-2	**Security**	**Parkinson symptoms make falls more likely. Safety improvements around the house can help. But if you start having frequent falls, talk**

		to your doctor. He or she may recommend physical therapy.
NFR-3	**Reliability**	**Low diagnostic accuracy is particularly relevant in the early stages of disease and presumably in older patients.**
NFR-4	**Performance**	**This enables easy and early detection of disease** **which can significantly improve symptoms and quality of life.**
NFR-5	**Availability**	**The system uses the drawing of a person and** **analyses the pattern.**
NFR-6	**Scalability**	**It can be implemented using any we framework and we framework and we can be made available to** **everyone in need.**

5. PROJECT DESIGN

5.1 Data Flow Diagrams

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 shows how data enters and leaves the system, what changes the information, and where data is stored.



5.2 Solution & Technical Architecture

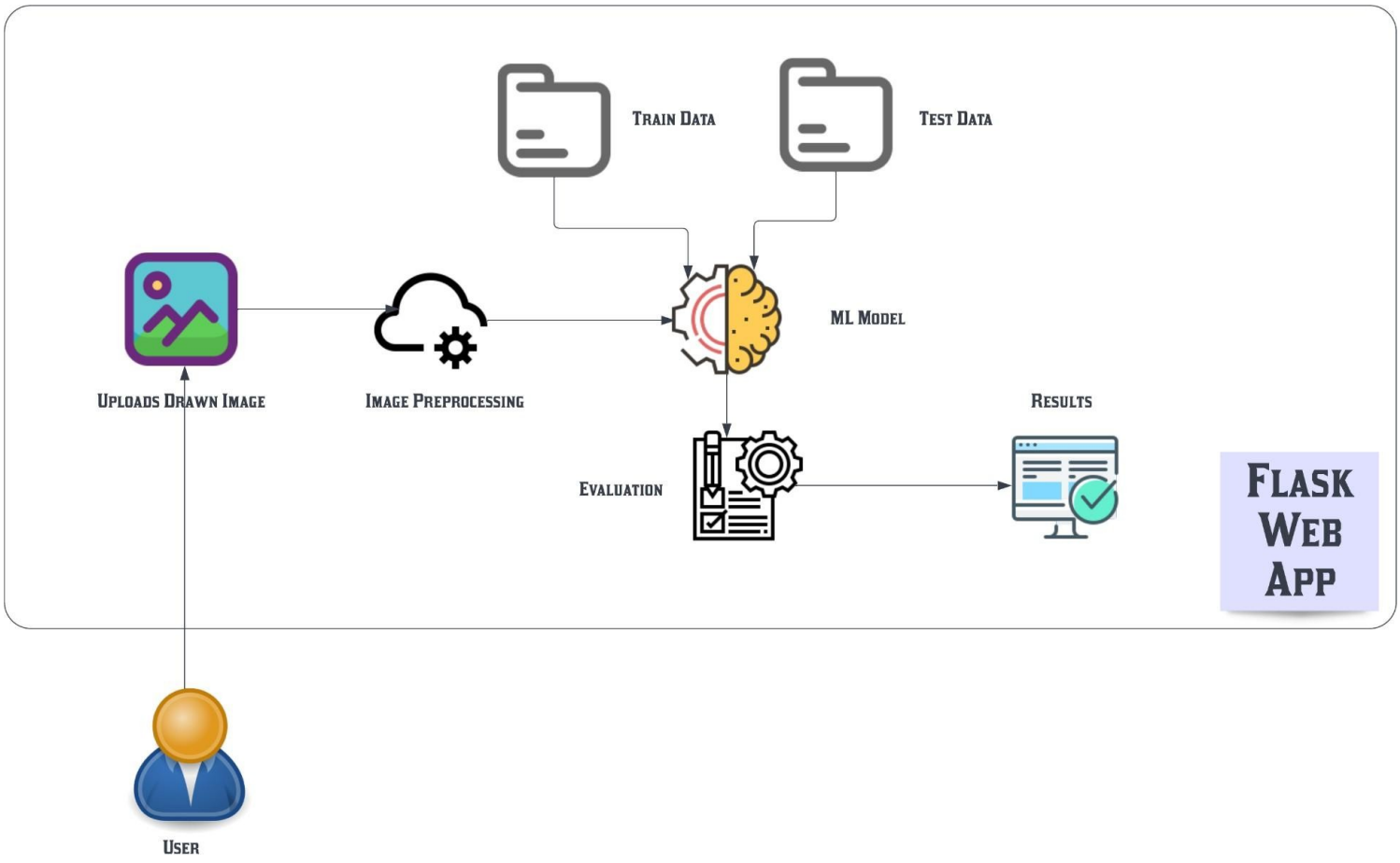
Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- When we used models pretrained on unrelated Image Net dataset for the construction of the ensemble architectures

● It significantly enhanced the performance on detecting PD compared to untrained models.

● Our finding suggests a promising direction, where unrelated training data can be considered when insufficient or no training data is available for a particular application.

Example - Solution Architecture Diagram :



5.3 User Stories

To list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
User (subject that submits the photograph)	Uploads image	USN-1	Users can upload pictures to the website to receive results for a Parkinson's Disease screening.	We can upload an image	High	Sprint-1
Examination	Image processing	USN-1	Users may examine the projections and outcomes with accuracy.	We can get results instantly.	High	Sprint-1

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

Product Backlog, Sprint Schedule, and Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Data Collection	USN-1	Collect the dataset or Create the dataset .	2	High	Irfaan Mustafa , Jeevan Akshay.B, Karthikeyan S Karthik.V
Sprint-2	Image Preprocessing	USN-2	Importing the required libraries and Loading Train data and Test data . Quantifying images with Label Encoding	1	High	Irfaan Mustafa ,Jeevan

						Akshay.B, **Karthikeyan S** **Karthik.V**
Sprint-3	**Model Building**	**USN-3**	**Training the model,Testing the model ,Model** **Evaluation, Saving the model**	**2**	**Low**	**Irfaan** **Mustafa ,** **Jeevan** **Akshay.B,** **Karthikeyan S** **Karthik.V**
Sprint-4	**Application Building**	**USN-4**	**Create an HTML file and and Build Python** **Code**	**2**	**Medium**	**Irfaan** **Mustafa ,** **Jeevan**

						Akshay.B, Karthikeyan S Karthik.V

7.1 INFORMATION CENTER

Provides an overview of parkinson disease in two tabs -

1.home

2.Info

Home-

Template -

```
<!-- Content Header (Page header) -->
<div class="content-header">
<div class="container">
<div class="row mb-2">
<div class="col-sm-6">
<h1 class="m-0">Detecting Parkinson Disease Using ML</h1>
</div>
<!-- /.col -->
<!-- /.col -->
</div>
```

```
<!-- /.row -->
</div>
<!-- /.container-fluid -->
</div>
<!-- /.content-header -->
<!-- Main content -->
<div class="content">
<div class="container">
<div class="row">
<div class="col-lg-6">
<div class="card card-primary card-outline">
<div class="card-header">
<h5 class="card-title m-0">Healthy</h5>
</div>
<div class="card-body">
<div class="col-sm-12">
<div class="position-relative">
<img
src="../static/dist/img/healthy.jpg"
alt="Photo 1"
class="img-fluid"
width="650"
height="400"/>
<div class="ribbon-wrapper ribbon-lg">
<div class="ribbon bg-success text-lg">Healthy</div>
</div>
</div>
```

```
</div>
</div>
</div>
<!-- /.card -->
</div>
<!-- /.col-md-6 -->
<div class="col-lg-6">
<div class="card card-primary card-outline">
<div class="card-header">
<h5 class="card-title m-0">Parkinson's Disease</h5>
</div>
<div class="card-body">
<div class="col-sm-12">
<div class="position-relative">
<img src="../static/dist/img/parkinson_affected.jpg"
alt="Photo 1"
class="img-fluid"
width="650"
height="300"/>
<div class="ribbon-wrapper ribbon-lg">
<div class="ribbon bg-danger text-lg">Parkinson</div>
</div>
</div>
</div>
</div>
</div>
</div>
```

<!-- /.col-md-6 -->

** **

** **

** **

** **

** **

**<h5 class="card-title m-0">About</h5> **

** **

** **

**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. 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. **

** **

** **

<!-- /.row -->

** **

<!-- /.container-fluid -->

** **

API DEclaration -

ZAPI Declaration-

@app.route("/info")

def information():

return render_template("info.html")

7.2 PREDICTOR

This is the part which enables file upload, process the image and determine whether parkinson is positive or negative.

Template-

<h5 class="card-title m-0">Parkinson Classifier</h5>

** **

** **

** **

** **

** **

** **

<h3 class="card-title">Dropzone</h3>

** **

** **

** **

** **

** **

```
<span
class="btn btn-success col fileinput-button"
>
<i class="fas fa-plus"></i>
<span>Add files</span>
</span>
<button type="submit"
class="btn btn-primary col start">
<i class="fas fa-upload"></i>
<span>Start upload</span>
</button>
<button type="reset"
class="btn btn-warning col cancel">
<i class="fas fa-times-circle"></i>
<span>Cancel upload</span>
</button>
</div>
</div>
<div class="col-lg-6 d-flex align-items-center">
<div class="fileupload-process w-100">
<div id="total-progress"
class="progress progress-striped active"
role="progressbar"
aria-valuemin="0" aria-valuemax="100"aria-valuenow="0">
<div class="progress-bar progress-bar-success" style="width: 0%"
data-dz-uploadprogress ></div>
</div>
```

```
</div>
</div>
</div>
<div
class="table table-striped files "id="previews">
<div id="template" class="row mt-2">
<div class="col-auto">
<span class="preview"><img src="data:," alt=""
data-dz-thumbnail/></span>
</div>
<div class="col d-flex align-items-center">
<p class="mb-0">
<span class="lead" data-dz-name></span>
(<span data-dz-size></span>)
</p>
<strong class="error text-danger" data-dz-errormessage >
</strong></div> <div class="col-4 d-flex align-items-center">
<div class="progress progress-striped active w-100"
role="progressbar" aria-valuemin="0" aria-valuemax="100"
aria-valuenow="0">
<div class="progress-bar progress-bar-success" style="width: 0%"
data-dz-uploadprogress
</div>
</div></div>
<div class="col-auto d-flex align-items-center">
<div class="btn-group">
<button class="btn btn-primary start">
```

```
<i class="fas fa-upload"></i>
<span>Start</span>
</button>
<button data-dz-remove
class="btn btn-warning cancel"
><i class="fas fa-times-circle"></i>
<span>Cancel</span>
</button>
<button data-dz-remove class="btn btn-danger delete">
<i class="fas fa-trash"></i>
<span>Delete</span>
</button>
</div>
</div>
</div>
</div>
</div>
<!-- /.card-body -->
<div class="card-footer">Drop your Image here</div>
</div>
<!-- /.card -->
</div>
</div>
</div>
</div>
</div>
</div>
```

```
<!-- /.row -->
<button type="button"
class="btn
btn-danger"data-toggle="modal"data-target="#modal-danger"id="danger
Model" hidden Launch danger Modal
</button>
<div class="modal fade" id="modal-danger">
<div class="modal-dialog">
<div class="modal-content bg-danger">
<div class="modal-header">
 <h4 class="modal-title">
<b>Parkinson Positive</b> </h4>
<button type="button" class="close" data-dismiss="modal"
aria-label="Close"
><span aria-hidden="true">&times;</span>
</button>
 </div>
<div class="modal-body">
<ion-icon name="alert-circle-outline"
size="large"
 ></ion-icon><p>
<b><i> Consult a doctor</i></b>
<br />
You’re going to beat this thing!</p>
</div>
<div class="modal-footer justify-content-between">
<button type="button"
```

```
class="btn btn-outline-light"
data-dismiss="modal"
>
Close</button></div>
</div>
<!-- /.modal-content -->
 </div>
<!-- /.modal-dialog -->
</div><button
type="button"
class="btn btn-success"
data-toggle="modal"
data-target="#modal-success"
id="successModel"
hidden
>
Launch Success Modal
</button>
<div class="modal fade" id="modal-success">
<div class="modal-dialog">
<div class="modal-content bg-success">
<div class="modal-header">
<h4 class="modal-title">
<b>Healthy</b> - Parkinson Negative
</h4>
<button
type="button"
```

```
class="close"
data-dismiss="modal"
aria-label="Close"
>
<span aria-hidden="true">&times;</span>
</button>
</div>
<div class="modal-body">
<ion-icon name="happy-outline" size="large"></ion-icon>
<p>
The image is drawn by a <b><i>HEALTHY PERSON</i></b>
</p>
</div>
<div class="modal-footer justify-content-between">
<butto
type="button"
class="btn btn-outline-light"
data-dismiss="modal">
Close
</button>
</div>
</div>
<!-- /.modal-content -->
</div>
<!-- /.modal-dialog -->
</div>
</div>
```

<!-- /.container-fluid -->

** **

<!-- /.content -->

Declaration -

@app.route('/predict', methods=['GET', 'POST'])

def upload():

if request.method == 'POST':

f=request.files['file'] #requesting the file

basepath=os.path.dirname(__file__)#storing the file directory

filepath=os.path.join(basepath, "uploads", f.filename) #storing the file in uploads folder

f.save(filepath) #saving the file

#Loading the saved model

print("[INFO] loading model...")

model = pickle.loads (open('parkinson.pkl', "rb").read())

 # pre-process the image in the same manner we did earlier

image = cv2.imread(filepath)

output = image.copy()

 # load the input image, convert it to grayscale, and resize

output = cv2.resize(output, (128, 128))

image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)

image = cv2.resize(image, (200, 200))

image = cv2.threshold(image, 0, 255, cv2.THRESH_BINARY_INV | cv2.THRESH_OTSU) [1]

 # quantify the image and make predictions based on the extracted

 # features using the last trained Random Forest

```
features = feature.hog(image, orientations=9, pixels_per_cell=(10, 10),
cells_per_block=(2, 2), transform_sqrt=True, block_norm="L1")
preds = model.predict([features]
ls=["healthy","parkinson"]
result = ls[preds[0]]
return result
return None
```

8. TESTING

8.1 Test case

Mrs. Tribianni is a 66-year-old female who has been diagnosed with late-onset stage 3 idiopathic PD. Mrs. Tribianni has an overall decrease in strength (3/5 MMT in UE/LE) and slight limitations in bilateral shoulder flexion and hip flexion. Upon observation, Mrs. Tribianni presents with facial masking, dysarthria, a right-sided dominant resting tremor, and moderate kyphosis. With gait, she is showing signs of freezing, difficulty turning, and a reduced arm swing. Outcome measures utilized in the assessment (TUG, BERG balance scale, Mini-BEST test, Dynamic gait index, and Activities-Specific Balance Conditions) indicate that she is at an increased risk of falling. All things considered, she is presenting with the cardinal signs of PD which are bradykinesia, rigidity, and postural instability.

8.2 User Acceptance Testing

Cancer, diabetes, and Alzheimer'sresearch can benefit from the study of phosphorylation and protein kinase activity. Because of their role in signal transduction, kinase activity detection and characterization is significant for drug discovery.

9.RESULT

Performance Metrics

The Parkinson's Disease Activities of Daily Living, Interference, and Dependence (PD-AID) is a new patient-reported outcome (PRO) instrument developed to assess the clinical benefit of PD treatment from the patient perspective. Specifically, it targets concepts that give meaning to PD motor symptoms in terms of their impact on everyday life. Details of its development and content validation have been published previously (4). The PD-AID was created to overcome the deficits of pre-existing instruments and developed in accordance with the United States (US) Food and Drug Administration's PRO guidance (5) with direct input from individuals with PD. The PD-AID focuses on those impacts that are direct and proximal consequences to day-to-day functioning resulting from PD motor fluctuation and areas of unmet priority related to treatment. Specifically, it assesses relevant activities of daily living (ADLs), dependence on others to perform ADLs, and life interference due to accommodating PD symptoms and treatment. The intended context of use for the PD-AID is as a clinical trial treatment benefit outcome for individuals with moderate-to-advanced PD experiencing motor fluctuations.

DISADVANTAGES

1. cognitive impairment or dementia,
2. depression and anxiety,
3. sleep dysfunction,

4. pain, apathy,
5. sexual dysfunction, and bowel incontinence.

11. CONCLUSION

By the time Parkinson's is diagnosed, most people have lost an estimated 60 to 80 percent of their dopamine-producing cells in the substantia nigra. While loss of dopamine accounts for the characteristic features of the disease, recent studies have revealed that a number of other brain systems are also damaged.

12.FUTURE SCOPE

While no cure currently exists, there is hope that there will be a cure in the future. Many researchers are looking to stem cell therapy as a possible cure for those who have Parkinson's disease. The hope is that stem cells can be used to replace damaged neurons that are no longer capable of making dopamine

13.APPENDIX

Source code

https://github.com/IBM-EPBL/IBM-Project-6713-1658834949

Demo Link

https://github.com/IBM-EPBL/IBM-Project-6713-1658834949/blob/main/Final%20Deliverables/Demo.mp4

GitHub Link

https://github.com/IBM-EPBL/IBM-Project-6713-1658834949