DETECTION OF PARKINSON'S DISEASE USING MACHINE LEARNING

A PROJECT REPORT

Submitted by

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CHAPTER 1 – INTRODUCTION

1.1 Project Overview :

The recent report of the World Health Organization shows a visible increase in the number and health burden of Parkinson's disease patients increases rapidly. In China,this disease is spreading so fast and estimated that it reaches half of the population in the next 10 years. Classification algorithms are mainly used in the medical field for classifying data into different categories according to the number of characteristics. Parkinson's disease is the second most dangerous neurological disorder that can lead to shaking, shivering, stiffness, and difficulty walking and balance. It caused mainly due by the breaking down of cells in the nervous system. Parkinson's can have both motor and non-motor symptoms. The motor symptoms include slowness of movement,rigidity, balance problems, and tremors. If this disease continues, the patients may have difficulty walking and talking. The non-motor symptoms include anxiety, breathing problems, depression, loss of smell, and change in speech. If the above-mentioned symptoms are present in the person then the details are stored in the records. In this paper, the author considers the speech features of the patient, and this data is used for predicting whether the patient has Parkinson's disease or not.

1.2 Purpose :

The Parkinson's disease is progressive neuro degenerative disorder that affects a lot of people.. It mostly affect the motor functions of human. That is human's brain. 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 disease prediction system with Machine Learning. . This project showed 70% efficiency. In our model, a huge amount of data is collected from the normal person and also previously affected person by Parkinson's disease that will be compared though the algorithms.

CHAPTER 2 – LITERATURE SURVEY

2.1 Existing Problem :

Parkinson's disease (PD) is known to be one of the most common neurodegenerative diseases among older people aged more than 65. Since this diseaseis progressive in nature, negligence in the diagnosis of this disease in the early stage and monitoring at different stages would create a severe negative impact on the patients in terms of healthcare costs as well as the severe health-related disorders.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 . Toprevent the major negative impact on PD patient's it is necessary to detect the PD at theearly 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. The non-invasive measures such assketching of a shape such as spiral, waves, and other handwritten texts could be easilydistinguished from one person to another person as well as a person with PD and a person without PD.Previous researchers and clinicians already found some kind of association between the sketching of the spirals and handwriting in the early stages ofthe PD. However, the major drawback of these kinds of diagnoses needs proper interpretation of sketching and handwriting. Traditionally the sketching or handwritings

were performed in the papers and interpreted manually by the interpreters specialized inthose fields. With the availability of digital devices, it is easier to perform those tasks digitally as well as the assessments were done by the machine in a more precise and accurate manner compared to the traditional ways. 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 recentdays 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 and 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 healthygroup of patients as well as PD patients to assess the severity of the PD disease amongdifferent 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 onthe spiral sketches by extracting features from the images sketched by the healthy subjects and PD subjects.

Some of the studies related to the implementation of the machine learningtechniques for the development
of an automated system using different datasetsrelated to Parkinson's disease has been discussed here.

Zham et al. proposed a study that used two criteria such as speed, and pen-
pressure while performing the sketches to distinguish PD subjects at different stages.
They have extracted features from the sketches and proposed a method that can
provide a correlation factor between the features and severity level of the PD. Finally,
they performed the Mann-Whitney test to validate the study that these methods can beused to distinguish different stages of the PD. They observed that there was a significant difference in the correlation factor at different stages of PD .

Kotsavasiloglou et al., presented an investigation based on the trajectory of the

tip of the pen on the surface of the pad while drawing simple horizontal lines by the healthy subjects and PD subjects. They extracted features from the simple drawings and trained the machine learning algorithms using those features to distinguish the PDsubjects from the healthy subjects. They have used different classifiers such as Naïve Bayes, AdaBoost, Logistic Regression, J48, Support Vector Machine (SVM), and
Random Forest classifiers to train the features for developing an automated system.

The performance metrics used in that study were accuracy, Area under the curve (AUC),True positives (TP), and True negatives (TN). They achieved an accuracy of 91%, and TPof 0.88 and TN of 0.95.

Memedi et al. proposed a study based on the spiral data collected using

telemetry touch screen devices in the home environments to distinguish off episodesand peak dose dyskinesia using machine learning algorithms. Several features were
extracted from the data and used as input to the machine learning classifiers. They haveused Support Vector Machine, Logistic Regression, Random Forest, and Multi-Layer
Perceptron (MLP) to train the features for the development of automated systems andfound MLP performed well among all the classifiers with an accuracy of 84% .

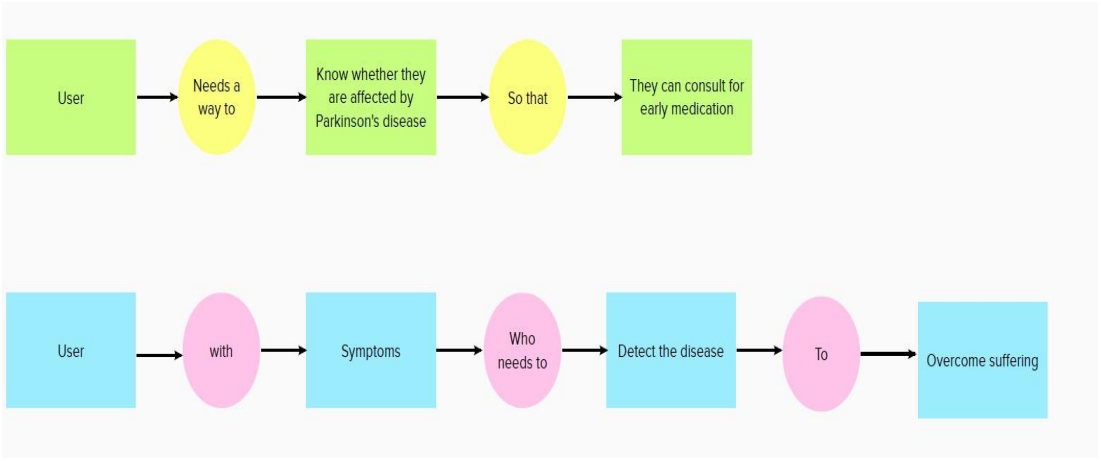
Aich et al. proposed a study that used a voice dataset to distinguish PD patientsfrom others. They have used different feature selection techniques to find the best
features that can be used to train different classifiers. The feature selection techniquesused for that study is principal component analysis. Finally, a performance comparisonstudy was performed using two groups of datasets such as original feature sets and
PCA based feature sets using nonlinear decision tree-based classifiers. It was foundthat the random forest classifier (RFC) was the best classifier among them and PCAbased feature set performance is better than the original feature sets. The best accuracy of 96.83% was found with RF classifier and PCA based feature sets .

2.2 References:

1) Zham, P., Arjunan, S.P., Raghav, S. and Kumar, D.K., 2017. Efficacy of guided spiraldrawing 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 mixedclassification approach for the prediction of Parkinson's disease

2.2Problem Statement Definition :

The main aim is to predict the prediction efficiency that would be beneficial for the patients who are suffering from Parkinson and the percentage of the disease will be reduced. Generally in the first stage, Parkinson's can be cured by the proper treatment. So it‘s important to identify the PD at the early stage for the betterment of the patients.The main purpose of this research work is to find the best prediction model i.e. the bestmachine learning technique which will distinguish the Parkinson's patient from the healthy person. The techniques used in this problem are Naive Bayes, and Logistic Regression. The experimental study is performed on the voice dataset of Parkinson's patients which is downloaded from the Kaggle. The prediction is evaluatedusing evaluation metrics like confusion matrix, precision, recall accuracy, and f1-score.The author used feature selection where the important features are taken into consideration to detect Parkinson's.


User
Needs a way to
Know whether they are affected by Parkinson's disease
So that
They can consult for early medication
User
with
Symptoms
Who needs to
Detect the disease
To
Overcome suffering


I am
senior-citizen
I'm trying to
analyze my parkinson diesease criticality
But
i donot have the correct tool
Because
no one recomended me
Which makes me feel
helpless

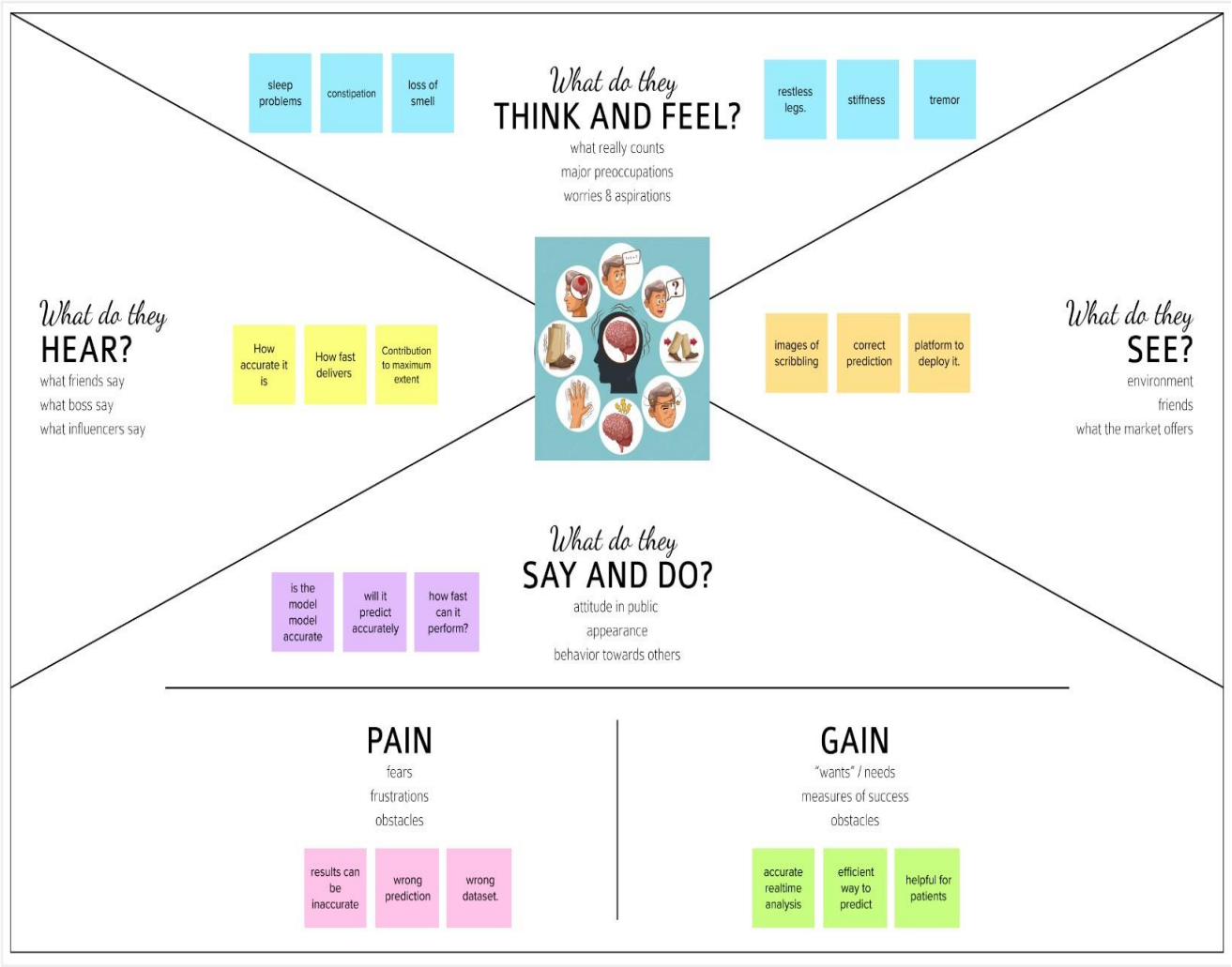

I am
parent
I'm trying to
keep track of my daughter's illness(parkinson's disease")
But
i donot have the correct tool
Because
no one recomended me
Which makes me feel
emotionally weak


I am
doctor
I'm trying to
maintain records of my patients very clearly for the research
But
i donot have the correct tool
Because
i have no idea of how to organize them
Which makes me feel
frustrated and clumsy

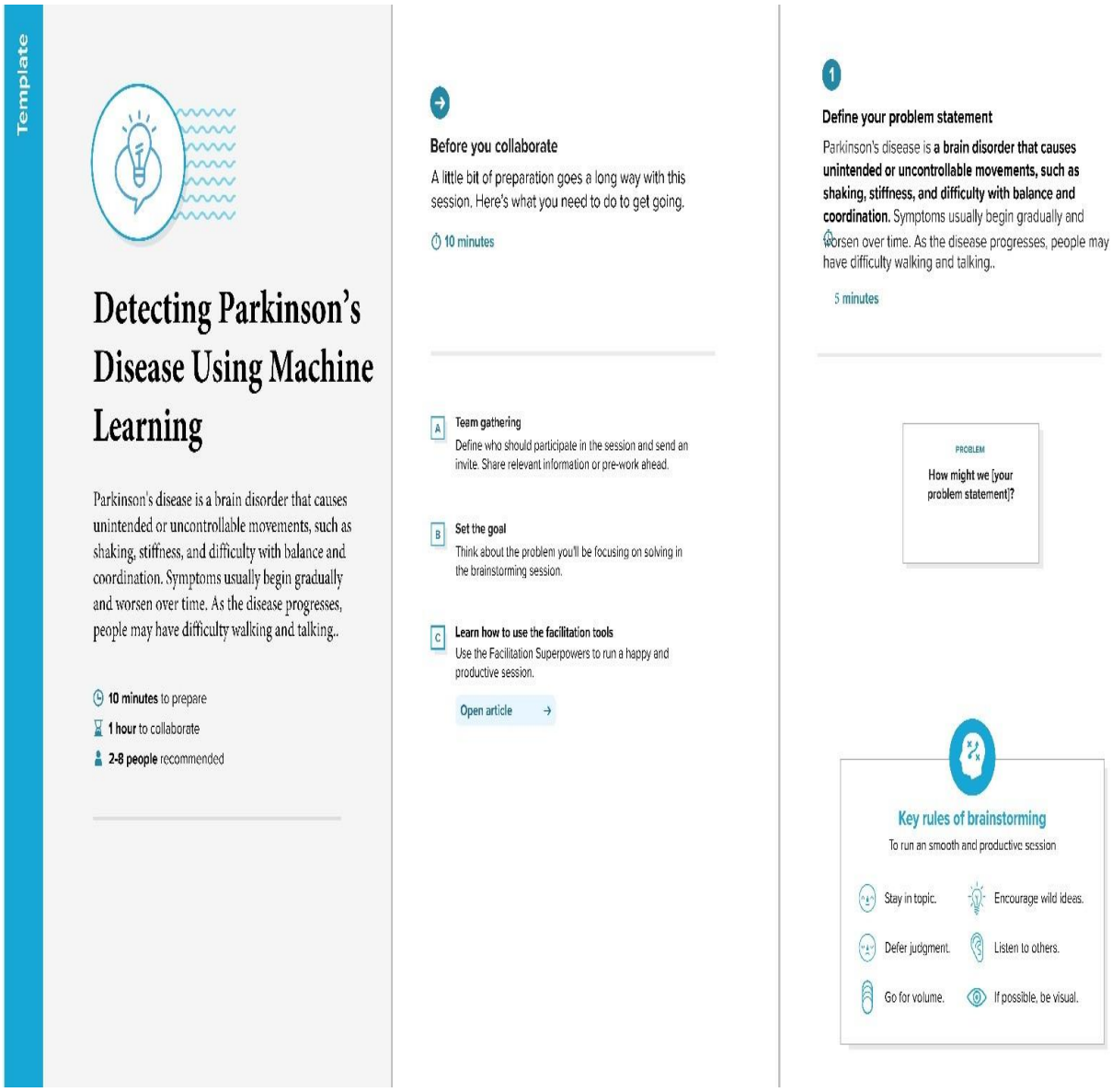

I am
Pharmacist
I'm trying to
analyze my parkinson diesease criticality and trying to find the best medicine
But
i donot have the correct tool for research and subjects
Because
no one recomended me
Which makes me feel
less informative
miro

CHAPTER 3 – IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas :



3.2 Ideation & Brainstorming :



2

Brainstorm

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

10 minutes

TIP

You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

Lalithaa Shree R

- Input as voice
- Data preprocessing
- Capture voice signal/ voice data
- Feature classification
- Train/Test data
- Use XGboost algorithm

Megha K

- Collect the dataset of parkinson's disease person
- Collecting dataset of normal person
- 60% training and 40% testing
- Input as datas
- Naive Bayes algorithm
- 0s and 1s as output

Kesavan S

- Make people draw spiral and wave images
- Input as hand-drawn spiral images
- Comparing images with datasets
- Deep learning algorithm
- Random forest algorithm
- Output says normal or in which stage of disease

Hariharan S

- Comparing overall datasets
- Remove the features that contributes less
- Select only those vectors that contribute more
- Scale under pre-processing
- K-nearest algorithm
- Output as yes or no

4

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

If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?

Feasibility

Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)

3.3 Proposed Solution :

Idea /Solution Description :

There are many ways to solve a single problem. One of those methods is those to detect the specific symptoms that are found uniquely for the Parkinson's patients. This includes the detection of Parkinson's disease using the drawings alone instead of measuring the speed and pressure of the pen on paper. We can try to quantify the visual appearance of these drawings and then train a machine learning model to classify them. We can use the 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. Another type of method is that the studies investigates signals from it sustained phonation and text dependent speech modalities for Parkinson's disease screening. Parkinson disease affect vocal chord so the motion of speech is detected and evaluated. This can also be a more appropriate method to detect Parkinson's.

Novelty/ Uniqueness :

According to a 2017 study by Zham et al., Parkinson's can be identifiedby having the patient draw a spiral and then tracking the drawings. A test that includes sketching a spiral on a piece of paper could be used to identify people who are at risk of gettingParkinson's disease, according to Australian researchers. A neuro-degenerative condition called Parkinson's disease results in trembling, tight muscles, and trouble walking. Theresearchers created a specialized automated electronic system that measured writing speeds, pen pressures, and produced the Composite Index of Speed and Pen-pressure (CISP) score in Parkinson's patients. All three measurements were used to determine whether a participant hadParkinson's disease or not. With this we can create a unique model specific to Parkinson.

SOCIAL IMPACT/CUSTOMER SATISFACTION:

Since it uses the machine learning model to identify these drawings based on their visual appearance (using the HOG approach), it is less prone to errors. In this research, we are utilizing a Random Forest classifier and the Histogram of Oriented Gradients (HOG) image descriptor to automatically identify Parkinson's disease in hand-drawn spirals and waveswhich can be easily implemented. It is convenient to use. It helps to detect without cost and helps to avoid travelling and the time taken.

BUSINESS MODEL(Financial benefit):

The EBC Value of Treatment Initiative combined different stakeholders to identify unmet needs in the patients' journey according to Rotterdam methodology. The economic evaluationfocused on three major topics identified as major gaps: start of treatment; best treatment for advanced disease; and adherence to treatment. Two separate healthcare systems (Germany and the UK) were chosen. Cost-effectiveness was determined by using decision-analytical modelling approaches. Effectiveness was expressed as quality-adjusted life-years (QALYs) gained and incremental cost-effectiveness ratio. Treatment intervention in PD was found to becost-effective regardless of the initial health state of the patient receiving the treatment. Cost savings were between -€1000 and −€5400 with 0.10 QALY gain and -€1800 and -€7600 with
0.10 QALY gain for Germany and the UK, respectively. Treatment remains cost-effectivewithin the National Institute for Health and Care Excellence thresholds. Availability of adequate treatment to more patients was also found to be cost-effective, with an ICER of
€15,000–€32,600 across country settings. Achieving the target adherence to treatment wouldgenerate cost-savings of €239,000–€576,000 (Germany) and €917,000–€2,980.000 (UK) forevery 1,000 patients treated adequately.

SCALABILITY OF SOLUTION:

UPDRS Subscale 1: Mentation, Behavior, and Mood

The examiner asks the patient about each of the following areas of cognitive function or moodand the rater scores the answers from 0 to 4, with 4 representing the greatest level of dysfunction, based upon the responses of the patient or a caregiver. The sum of these scores for this subscale can range from 0 (normal) to 16.

Proposed Solution :

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	Parkinson's disease disorder is a brain disorder that causesunintended or uncontrollable movements, such as shaking, stiffness, and difficulty with balance and coordination. Symptoms usually begin gradually and worsen over time. Asthe 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 phone or 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.

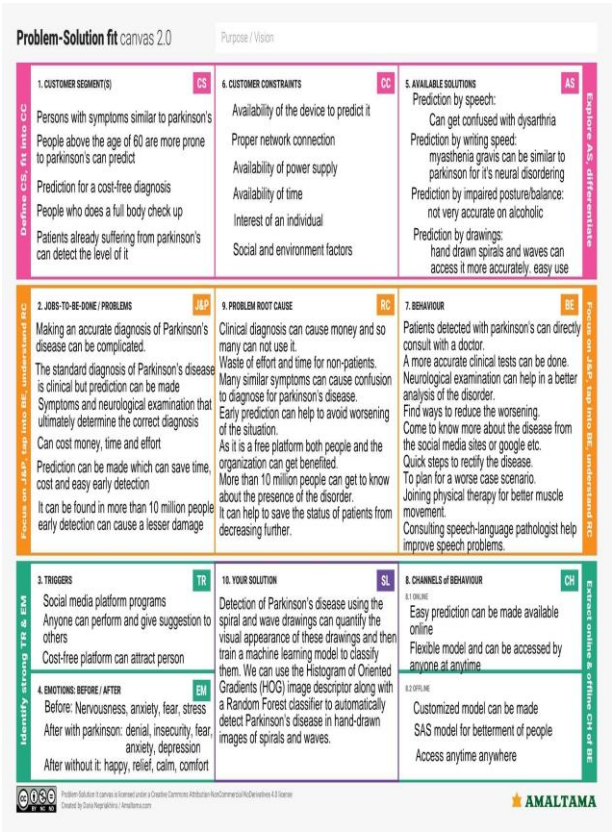
4.	Social Impact / Customer Satisfaction	Since it is based on the voice based detection it is very convenient to use. As it helps the people to detect theParkinson's disease in early stage, the loss of life is prevented. It detects without cost and helps to avoidtravelling and time.
5.	Business Model (Revenue Model)	A free platform with useful feature. Any adult and young people can use it and suggest it to others to increase the value
6.	Scalability of the Solution	Additional features can be added anytime anywhere. Anynumber of users can access it all at once.

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. Parkinson's disease disorder is a brain disorder that causes unintended or uncontrollable movements, such as shaking, stiffness, and difficulty with balance and coordination

PROBLEM SOLUTION FIT:

Problem-solution fit is a term used to describe the point validating that the base problem resulting in a business idea really exists and the proposed solution actually solves that problem.



CHAPTER 4 – REQUIREMENT ANALYSIS

4.1 Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)

FR-1	Analyzing Symptoms	➢ Stiffness in muscles ➢ Rigidity and slowness in body movements ➢ Breaking of voice and shivering in tone ➢ Difficulty with walking ➢ Emotional and behavioral changes ➢ Dementia and depression
FR-2	Collecting voice dataset	➢ Speech and voice recordings of the patient iscollected. ➢ Various voice parameters are measured.
FR-3	Working on dataset	➢ Voice recording is measured against theparameters. ➢ Data is preprocessed and dependent variablesare found. ➢ Data is split into train and test data. ➢ Training and testing is done and the model isevaluated.

FR-4	Applying SVM algorithm	➢ SVM finds a hyper-plane that creates a boundary between the types of data. ➢ We plot each data item in the dataset in an N-dimensional space. ➢ The algorithm tries to find the optimal hyperplane which can be used to classifydataset into healthy person or person suffering from Parkinson.
FR-5	Providing insights of dataset	➢ Raw data collection and sharing of dataand systems are essential factors in hospital management. ➢ According to these data appropriatemeasures can be taken. ➢ Providing data set without error. ➢ Providing treatment for the patients who aresuffering from Parkinson.

4.2 Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description

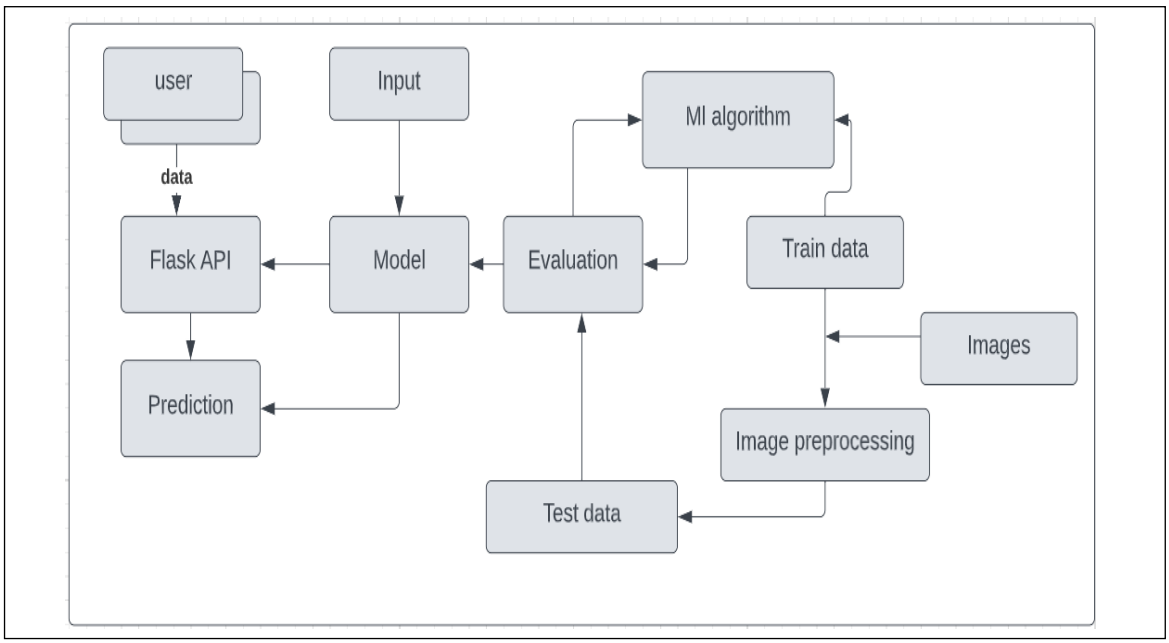
NFR-1	**Usability**	➢ Usable systems are straightforward to use by as many people as possible, both in caseof either end users or administrators to view the hospital records when needed.
NFR-2	**Security**	**Patient identification:** ➢ To recognize and analyze the patient perfectly.
NFR-3	**Reliability**	➢ Understanding the current trend and working on to it to solve the problem in anefficient manner. ➢ Being software as a service, HMS is highly resilient to any technology disruptions, downtime, or crashes experienced by othertechnology systems.
NFR-4	**Performance**	**Response time:** ➢ Providing acknowledgment in minimal time about the patient information. **Comfortability:** ➢ To ensure that the guidelines andaccessibilities are followed.
NFR-5	**Availability**	➢ Better coordination with the hospital management to provide all its resources accessible when needed. ➢ Accessibility of all medical facilities.

NFR-6	**Scalability**	➢ Make sure that the work is done in moreefficient way with the appropriate resources. ➢ Make complex decisions understandablewith proper data.

CHAPTER 5 – PROJECT DESIGN

5.1 Data Flow Diagrams :

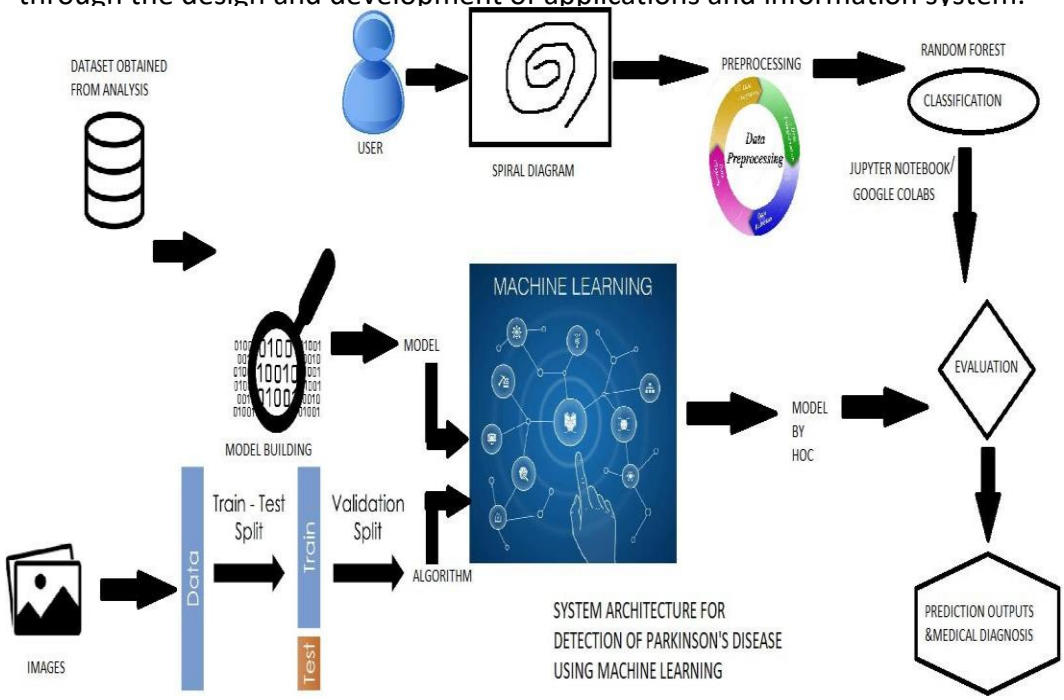
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the rightamount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.



5.2 Solution & Technical Architecture :

Solution Architecture :

Solution architecture is the process of developing solutions based on predefined processes, guidelines and best practices with the objective that the developed solution fits within the enterprise architecture in terms of information architecture, system portfolios, integration requirements and many more.It can then be viewed as a combination of roles, processes and documentation that are intended to address specific business needs, requirements or problems through the design and development of applications and information system.



Technical Architecture :

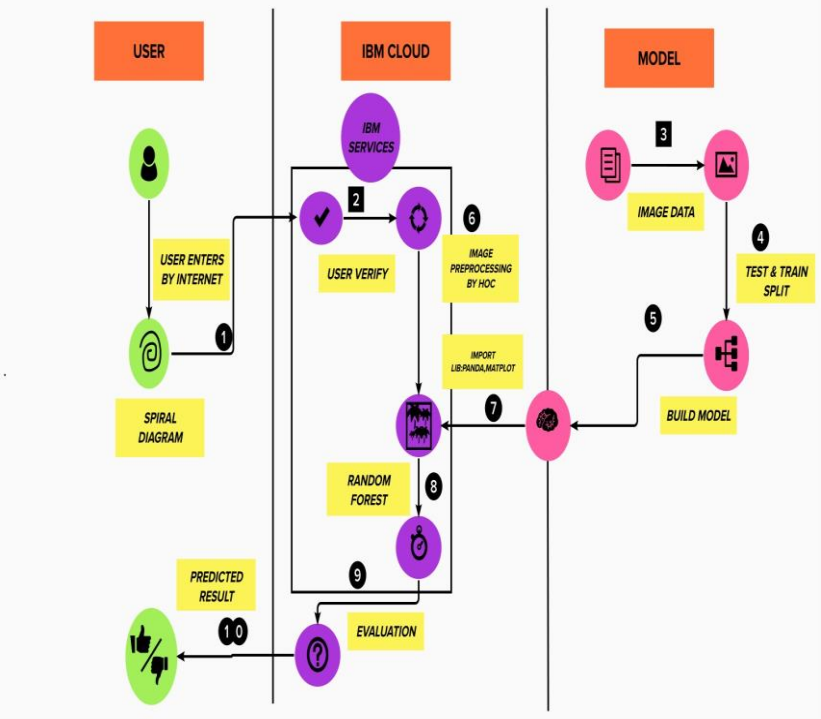
COMPONENTS AND TECHNOLOGIES:

S.NO.	COMPONENTS	DESCRIPTION	TECHNOLOGY
1.	User Interface	Web UI, mobile app	HTML, CSS, JavaScript, Flask
2.	Application Logic-1	User uploads drawings	Python image processor
3.	Application Logic-2	Prediction based on diagrams	Python IBM Watson STT service
4.	Application Logic-3	Predicted output	Random forest, hoc, IBM Watson assistant
5.	Database	Images	MySQL
6.	Cloud database	IBM cloud	IBM DB2
7.	File Storage	10-1000mb	IBM Block storage
8.	External API-1	User spiral drawings for prediction	Image processor
9.	External API-2	Data analysis for knowledge base	Train model in python
10.	Machine learning model	Prediction based on algorithm.Higher accuracy	HOC, Random Forest classifiers

11.	Infrastructure (Server/Cloud)	Cloud server con	IBM cloud

APPLICATION CHARACTERISTICS:

S.NO.	CHARACTERISTICS	DESCRIPTION	TECHNOLOGY
1.	Open-source frameworks	Frontiers, GitHub	Python
2.	Security implementations	Encryption are used to make itmore secure	Built-in encryption, BYOK
3.	Scalable architecture	3-tier architecture - horizontal	Python, css, js



5.3 User Stories :

Use the below template 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	Uploading the data	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-1
		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-2

CHAPTER 6 – PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning & Estimation :

TITLE	DESCRIPTION	DATE
Literature Survey & Information Gathering	Collect the relevant information on project use case, refer the existing solutions, technical papers, research publications etc.	16 October 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements	18 October 2022
Ideation	List the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance	19 October 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	20 October 2022

Problem Solution Fit	Prepare problem - solution fit document.	20 October 2022
Solution Architecture	Prepare solution architecture document.	20 October 2022

6.2 Sprint Delivery Schedule :

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	I need to collect data (Images of spirals and waves drawn by healthy people andParkinson's patients).	4	Medium	Mareeswaran M Arul pandi P Sankar S Rajaguru M
Sprint-1	Image Pre - Processing	USN-2	I need to clean my data and prepare it for model building by doing preprocessing activities such as resizing, converting from RGB to grayscale etc.	6	High	Mareeswaran M Arul pandi P Sankar S Rajaguru M
Sprint-2	Model Building 1	USN-3	I need to build the model using RandomForest Classifier for spiral images.	5	Medium	Mareeswaran M Arul pandi

						P Sankar S Rajaguru M
Sprint-2	Model Building 2	USN-4	I need to build the model using K –Nearest Neighbor for wave images.	5	Medium	Mareeswar an M Arul pandi P Sankar S Rajaguru M
Sprint-3	Model Deployment	USN-5	I need to deploy the ML model that wasbuilt	5	High	Mareeswar an M Arul pandi P Sankar S Rajaguru M
Sprint-4	Application Building	USN-6	I need to build the website for the application using HTML, CSS, Flask andlink it to the model.	1 0	High	Mareeswar an M Arul pandi P Sankar S Rajaguru M

Use the below template to create product backlog and sprint schedule

CHAPTER 7 – CODING AND SOLUTIONING

7.1 Feature 1 :

7.1.1 Detect Feasibility :

In our website , there is option to detect the parkinson's disease is affected a person or not. In this option you have to click the Detect button the it will redirect

to the basic information page about the users. You have to fill all of the information correctly.

Code:

```
<!doctype html>
<html lang="en">
  <head>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no">
  <link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/bootstrap@4.4.1/dist/css/bootstrap.min.css">
    <title>
      Page of Detection
    </title>

    <style>
      #bg
{
background-image: url('static/img/pict.jpg');
```

```
position: fixed;
left: 0;
top: 0;
width: 100%;
height: 100%;
background-size: cover;
filter: blur(0px);
}
    </style>
    <script>
        function clearFunc()
        {
        document.getElementById("name").value="";
        document.getElementById("dob").value="";
        document.getElementById("gender").value="";
        document.getElementById("address").value="";
        document.getElementById("spiral").value="";
        document.getElementById("wave").value="";
    }
```

```
    </script>
  </head>

  <body id="bg">
    <div class="container">
      <form method="post">
        <div class="form-group col-md-5">
          <h5> PATIENTS FORM </h5>
          <label>Enter Your Name</label>
          <input type="text" class="form-control" id="Name" name="name" placeholder="Enter Your Name" >
        </div>

        <div class="form-group col-md-5">
          <label>Enter Your Date of Birth</label>
          <input type="date" class="form-control" id="dob" name="dob" placeholder="Enter Your Date of Birth" >
        </div>

        <div class="form-group col-md-5">
```

```
<label for="gender">Gender</label>

<select class="form-control" id="gender" name="gender">

<option value="">-- Choose Your Gender --</option>

<option value="Male">Male</option>

<option value="Female">Female</option>

<option value="Transgender">Transgender</option>

</select>

</div>


<div class="form-group col-md-5">

<label>Enter Your Phone Number</label>

<input type="varchar" class="form-control" id="blood" name="phone" placeholder="+91 9361X XXXXX" >

</div>


<div class="form-row">

    <div class="form-group col-md-2">

<label>Enter Your Blood Group</label>

<input type="varchar" class="form-control" id="blood" name="blood" placeholder="Ex. B+ve" >
```

```
</div>         

        <div class="form-group col-md-1.5">
          <label>Age</label>
          <input type="varchar" class="form-control" id="age" name="age" placeholder="Enter Your Age" >
        </div></div>

        <div class="form-group col-md-5">
          <label>Enter Your Address</label>
          <input type="varchar" class="form-control" id="address" name="address" placeholder="Enter Your Address" >
        </div>

        <div class="form-row">    
        <div class="form-group col-md-3">
          <label>Upload The Spiral mage</label>
          <input type="file" class="form-control-file" id="spiral" name="spiral">
        </div>
```

```
            <div class="form-group col-md-3">
               <label>Upload The Wave Image</label>
               <input type="file" class="form-control-file" id="wave" name="wave"></div>
   </div>
            <div class="form-row">
                <div><button type="submit" class="btn btn-primary"
name="submit">Submit</button></div>    
               <div><button class="btn btn-primary" type="reset" onclick="clearFunc()">Reset</button></div>
            </div>
         </form>
      </div>
   </body>
</html>
```

7.2 What is Parkinson Feasibility :

Here is module for know about what is parkinson’s disease and about it all of the information.

Code :

```
<!DOCTYPE html>
```

```
<html lang="en">

<head>

    <meta charset="UTF-8">

    <meta http-equiv="X-UA-Compatible" content="IE=edge">

    <meta name="viewport" content="width=device-width, initial-scale=1.0">

    <title>what is Parkinson’s Disease?</title>


</head>

<body>


<section class="firstsection">

                                                    <div class="box-main">


                                                      <div class="firstHalf">


                                    <h3 class="text-big" id="web">Introduction</h3>
```

Parkinson’s disease (PD) is one of the most common neurodegenerative diseases with a prevalence rate of 1% in the population above 60 years old, affecting 1 - 2 per 1000 people.

The estimated global population affected by PD has more than doubled from 1990 to 2016 (from 2.5 million to 6.1 million), which is a result of increased number of elderly people and age-standardized prevalence rates.

PD is a progressive neurological disorder associated with motor and non-motor features which comprises multiple aspects of movements, including planning, initiation and execution. The diagnosis of PD is traditionally based on motor symptoms.

Despite the establishment of cardinal signs of PD in clinical assessments, most of the rating scales used in the evaluation of disease severity have not been fully evaluated and validated.

This section of the describes the theoretical background of this project, starting with an explanation of Parkinson’s disease, followed by overviews of machine learning, deep learning, related work and finally PD diagnosis problems.

The detection of PD is extremely important at the first stage. This entails the literature survey that was conducted for the purpose of better understanding the problem at hand and to explore possible solutions.

```
</section>

<section class="firstsection">

                                                    <div class="box-main">

                                                        <div class="firstHalf">

<h3 class="text-big" id="web">Detecting Parkinson’s Disease Using Machine Learning</h3>

                                                            <p class="text-small">

        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.

</p>

</section>

<h3 class="text-big" id="web">Empathize Map</h3>

<img src="static/img/img.jpg" alt="">

<h3 class="text-big" id="web">Technical Architecture</h3>

<img src="static/img/archi.png" alt="">

<section class="firstsection">

<h3 class="text-big" id="web">Advantages for Detecting Parkinson’s Disease</h3>

Accurately detecting Parkinson's disease (PD) at an early stage is certainly indispensable for slowing down its progress and providing patients the possibility of accessing to disease-modifying therapy.

</section>

```
</body>

</html>
```

CHAPTER 8 – TESTING

8.1 Testcases :

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.

Testing:

- Unit Testing

- Integration Testing
- Functional Testing

Unit Testing :

It is the level of software testing where individual units and the components are tested. In the proposed project the data of an individual person is taken and tested. The accuracy is high 100% when tested with a single person data.

Integration Testing :

It may be level of software testing where individual units are combined and it tested as a gaggle. In the proposed project all the data is combined and tested. The accuracy level is 94.87%. This testing will test whole project at a time.It reduces the time complexity in integration testing.

Functional Testing :

Functional testing may be a sort of software testing that validates the software against the functional requirements/specifications. This testing is detecting Parkinson's will based on machine learning algorithm.ML algorithm will boost up the speed.

Typically, functional testing involves the following steps:
• Identifying the functions of that the software is expected to perform.
•Create input-data based on the function's specifications.
•It Determines the output based up on the function's specifications.
•Execute the test case.

8.2 User Acceptance Testing :

Once Parkinson's disease Prediction model has been trained on the pre-processed dataset, then the model is tested using different data points. In this testing step, the model is checked for correctness and accuracy by providing a test dataset to it. All the training methods need to be verified for finding out the best model to be used. after fitting our model with training data, we used this model to predict values for

the test dataset. These predicted values on testing data are used for model comparison and accurate calculation.

CHAPTER 9 – RESULTS

9.1 Performance Metrics:

Coding for metrics :

```
import numpy as np
import pandas as pd
import os, sys
from sklearn.preprocessing import MinMaxScaler
from xgboost import XGBClassifier
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score #Modelmetrics
```

```
#We are going to import and use it for assessing the model using perfor
mance metrics from Classification process
from sklearn.metrics import confusion_matrix, accuracy_score, f1_score
List_metrics = []
List_accuracy = []
```

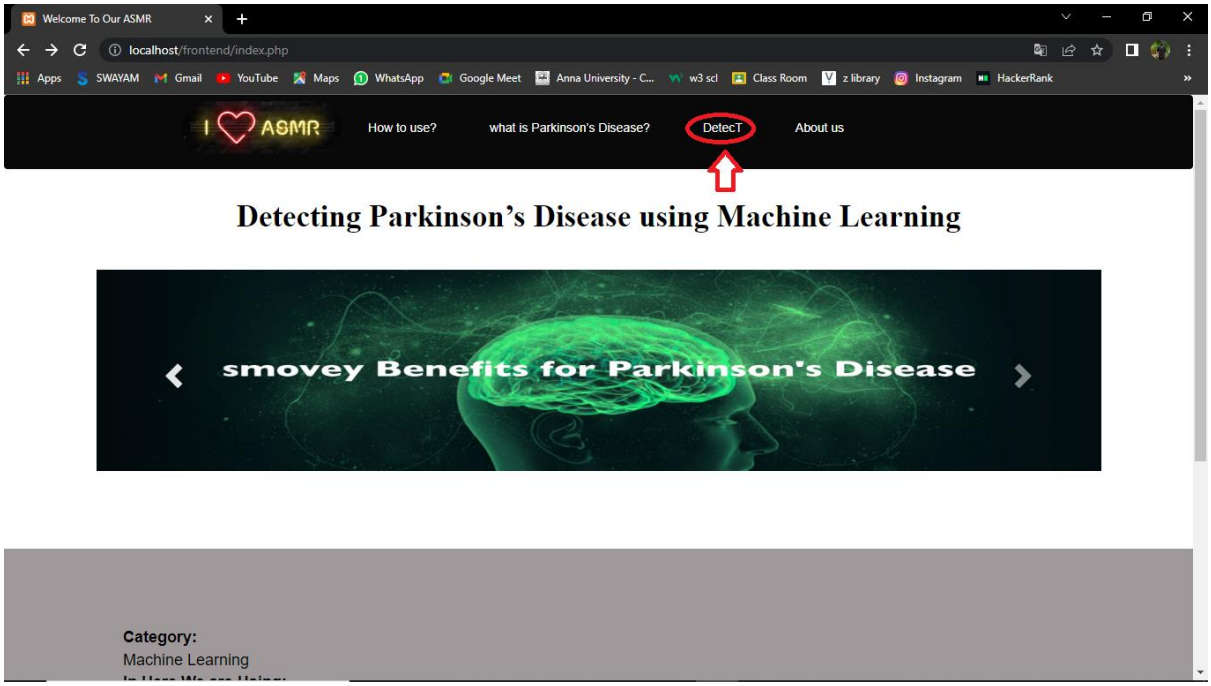
```
#Logistic Regression
from sklearn.linear_model import LogisticRegression
Classification_model = LogisticRegression(C=0.4,max_iter=1000,solver='l
iblinear')
Log_Regression = Classification_model.fit(x_train, y_train)
y_pred = Classification_model.predict(x_test)  #Prediction
Log_Regression_accuracy = accuracy_score(y_test, y_pred)  #Accuracy
print("The accuracy score with Logistic regression is:",Log_Regression_
accuracy)

#Decision Tree Classificaton using supervised machine learning for clas
sifiying the data with confident accuracy
from sklearn.tree import DecisionTreeClassifier
Classification_tree = DecisionTreeClassifier(random_state=14)
Decision_tree = Classification_tree.fit(x_train, y_train)
```

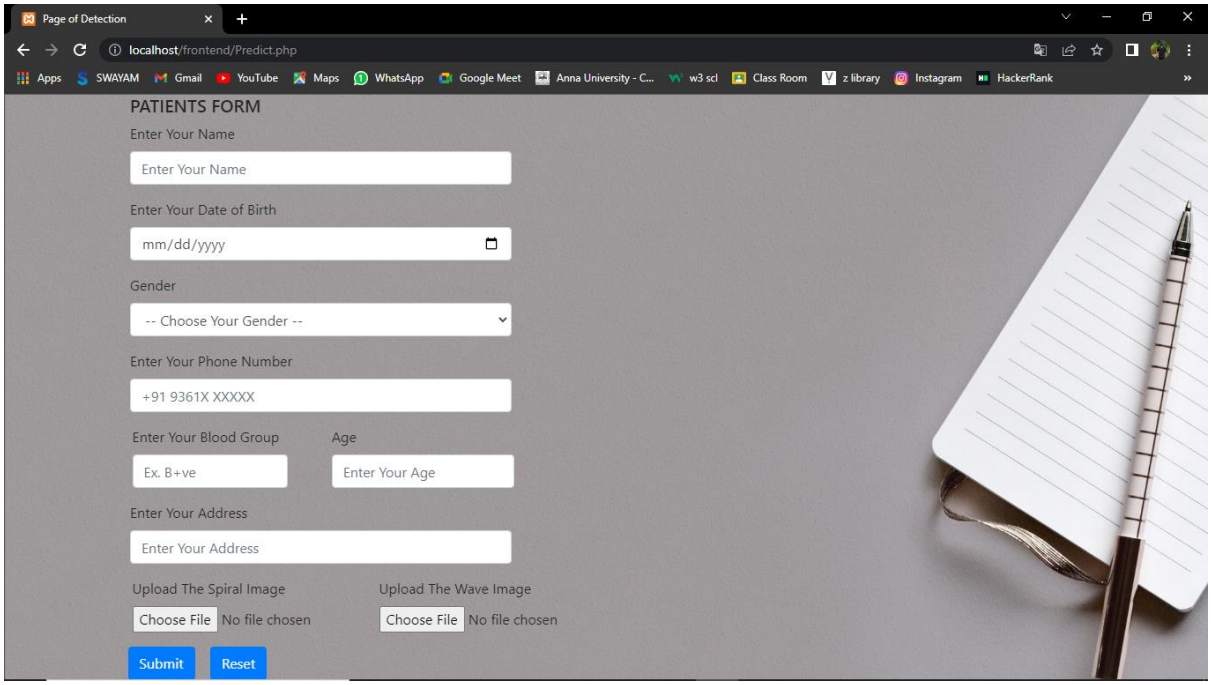
```
y_pred2 = Classification_tree.predict(x_test) #Prediction
Dec_tree_accuracy = accuracy_score(y_test, y_pred2) #Accuracy
print("The accuracy score with Decision Tree Classifier is:",Dec_tree_a
ccuracy)

#Random Forest Classifier is used for its high dimensionality and accur
acy capabilities, here information gain is priortized
from sklearn.ensemble import RandomForestClassifier
Classification_random = RandomForestClassifier(random_state=14)
RFE = Classification_random.fit(x_train, y_train)
y_pred3 = Classification_random.predict(x_test) #Prediction
Ran_For_accuracy = accuracy_score(y_test, y_pred3) #Accuracy
print("The accuracy score with Random Forest Classifier(Information gai
n) is:",Ran_For_accuracy)

#Random Forest Classifier with entropy condition
from sklearn.ensemble import RandomForestClassifier
Classification_entropy = RandomForestClassifier(criterion='entropy')
RFE = Classification_entropy.fit(x_train,y_train)
y_pred4 = Classification_entropy.predict(x_test)
Random = accuracy_score(y_test, y_pred4)
print("The accuracy score with Random Forest Classifier(Entropy) is:",R
andom)

#Using Support Vector Machine (SVM) for to enhance the similarity and t
o increase the scaling factor of the model
from sklearn.svm import SVC
Parkinson_model = SVC(cache_size=100)
Support_vector_machine = Parkinson_model.fit(x_train, y_train)
y_pred5 = Parkinson_model.predict(x_test)
Support_accuracy = accuracy_score(y_test, y_pred5)
print("The accuracy score with Support Vector Machine is:",Support_accu
racy)

#K Nearest Neighbor Classifier for better effectiveness
from sklearn.neighbors import KNeighborsClassifier
KNN_parkinson = KNeighborsClassifier(n_neighbors=3)
K_Nearest_Neighbor_Classifier = KNN_parkinson.fit(x_train, y_train)
KNN_predict = KNN_parkinson.predict(x_test)
```

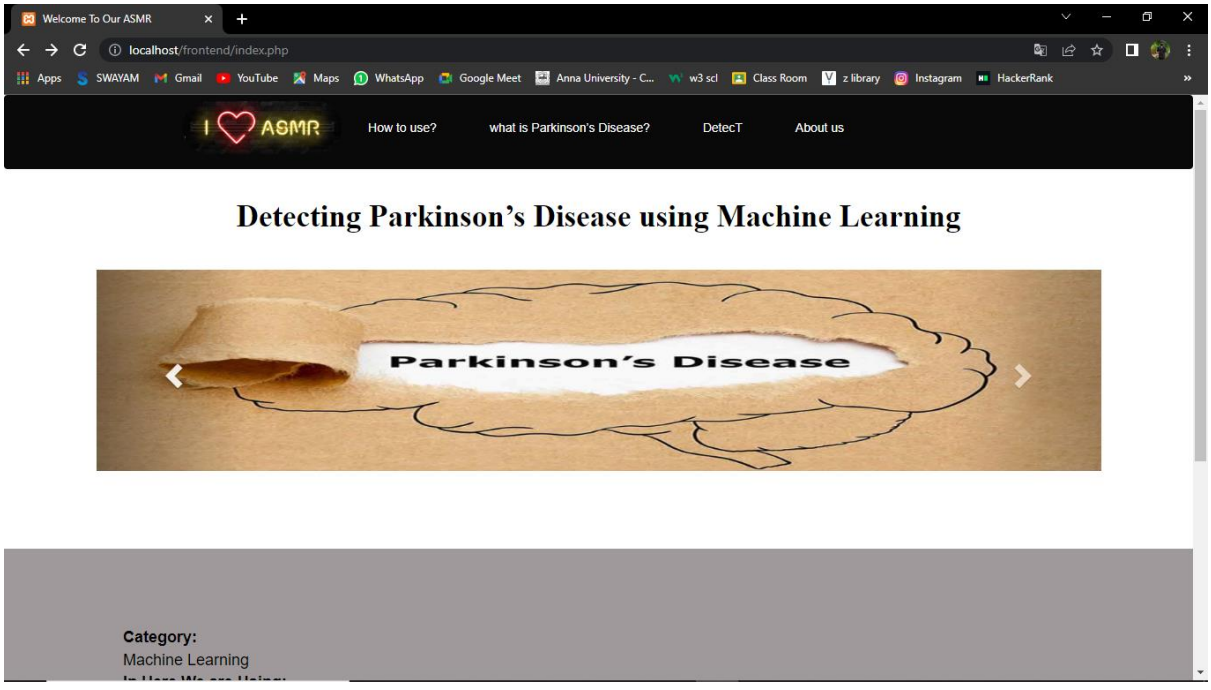
```
KNN_accuracy = accuracy_score(y_test, KNN_predict)
print("The accuracy score with K Nearest Neighbor Algorithm is:",KNN_ac
curacy)

#GaussianNB
from sklearn.naive_bayes import GaussianNB
GNB = GaussianNB()
Model_NB = GNB.fit(x_train,y_train)
pred_gnb = Model_NB.predict(x_test)
GNB_accuracy = accuracy_score(y_test, pred_gnb)
print("The accuracy score with Gaussian Naive Bayes is:",GNB_accuracy)

print("\nLet's see the overall accuracy of the built model that is been
 created below, view the overall accuracy score below!")
Overall_accuracy_percentage = Log_Regression_accuracy+Dec_tree_accuracy
+Ran_For_accuracy+Random+Support_accuracy+KNN_accuracy+GNB_accuracy
Average_accuracy = (Overall_accuracy_percentage)/7
print("The accuracy of all the combined metrics for the model is:",Aver
age_accuracy/0.01)
```

```
from sklearn.ensemble import VotingClassifier
VC = VotingClassifier(estimators=[('Classification_model',Classificatio
n_model),('Classification_tree',Classification_tree),('Classification_r
andom',Classification_random),('Classification_entropy',Classification_
entropy),('Support_vector_machine',Support_vector_machine),('K_Nearest_
Neighbor_Classifier',K_Nearest_Neighbor_Classifier),('Model_NB',Model_N
B)],voting='hard',flatten_transform=True)
Model_VC = VC.fit(x_train, y_train)
Model_prediction = VC.predict(x_test)
Model_accuracy = accuracy_score(y_test,pred_gnb)
print(Model_accuracy)
```

Output:


Welcome To Our ASMR
localhost/frontend/index.php
Apps
SWAYAM
Gmail
YouTube
Maps
WhatsApp
Google Meet
Anna University - C...
w3 scl
Class Room
z library
Instagram
HackerRank
I ASMR
How to use?
what is Parkinson's Disease?
DetecT
About us
Detecting Parkinson's Disease using Machine Learning
smovey Benefits for Parkinson's Disease
Category:
Machine Learning





Index.php

<!DOCTYPE html>

<html>

```
<head>
        <title>Welcome To Our ASMR</title>

        <link rel="stylesheet" href="./index.css">
   <link       rel="stylesheet"       href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/4.7.0/css/font-awesome.min.css">
</head>

<body>
        <nav class="navbar background">
                <ul class="nav-list">
                        <div class="logo">
                                <img src= "img/logo.jpg">
                        </div>
                        <li><a href="how_to_use.php">How to use?</a></li>
                        <li><a      href="parkinsin's.php">what      is      Parkinson’s
Disease?</a></li>
                        <li><a href="Predict.php">DetecT</a></li>
        <li><a href="about.php">About us</a></li>
                </ul>


        </nav>

        <section class="firstsection">
                <div class="box-main">
                        <div class="firstHalf">
                                <center><h2  class="text-big"  id="web">Detecting
Parkinson’s Disease using Machine Learning</h2></center> <br>
                                <p class="text-small">


<div id="aa">
```

```
<!DOCTYPE html>
<html>

<head>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">


  <link    href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/4.7.0/css/font-awesome.min.css" rel="stylesheet">
  <link                                                                rel="stylesheet" href="https://maxcdn.bootstrapcdn.com/bootstrap/3.3.7/css/bootstrap.min.css" integrity="sha384-BVYiiSIFeK1dGmJRAkycuHAHRg32OmUcww7on3RYdg4Va+PmSTsz/K68vbdEjh4u" crossorigin="anonymous">
  <link rel="stylesheet" href="css/style.css"/>
</head>

<body>
  <a id="banner" href="#"></a>
  <!-- Main body -->

  <header>
  </header>

  <section id="promo">
    <div class="container">
      <div class="row">
        <div class="col-lg-12">
          <div id="promo-carousel" class="carousel slide" data-ride="carousel">
            <div class="carousel-inner" role="listbox">
              <div class="item active">
                <img src="img/p1.jpg">
              </div>
```

```
          <div class="item">
            <img src="img/p2.jpg">
          </div>
          <div class="item">
            <img src="img/p3.jpg">
          </div>
          <div class="item">
            <img src="img/p4.png">
          </div>
        </div>

        <!-- Controls -->
        <a class="left carousel-control" href="#promo-carousel" role="button" data-slide="prev">
          <span class="glyphicon glyphicon-chevron-left" aria-hidden="true"></span>
          <span class="sr-only">Previous</span>
        </a>
        <a class="right carousel-control" href="#promo-carousel" role="button" data-slide="next">
          <span class="glyphicon glyphicon-chevron-right" aria-hidden="true"></span>
          <span class="sr-only">Next</span>
        </a>
      </div>
    </div>
  </div>
 </section>

 <section id="products">
  <div class="container">
   <div class="row">
    <div class="col-lg-12">
```

```
        </div>
      </div>
      <div class="col-lg-3">
        <div class="col" id="amazon-basics">


        </div>
      </div>
              </div>
      </div>
      <div class="col-lg-3">


        </div>
      </div>
    </div>
  </div>
</section>

<footer>


  <div class="middle">
    <div class="center">

    </div>


  </div>

  <div class="bottom">
    <div class="center">
          </div>
```

```
  </div>
 </footer>

 <script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.2.1/jquery.min.js"></script>
 <script
src="https://maxcdn.bootstrapcdn.com/bootstrap/3.3.7/js/bootstrap.min.js"
integrity="sha384-
Tc5IQib027qvyjSMfHjOMaLkfuWVxZxUPnCJA7l2mCWNIpG9mGCD8wGNI
cPD7Txa" crossorigin="anonymous"></script>
 <script src="js/app.js"></script>
</body>

</html>


</div>
                                    </p>


                            </div>
                        </div>
                </section>

                <section class="secondsection">
                        <div class="box-main">
                                <div class="firstHalf">
                                        <h1 class="text-big" id="program">

                                        </h1>
                                        <p class="text-small"><br><br>
        <b>Category:</b><br>Machine Learning<br>
        <b>In Here We are Using:</b><br>
        Python,Python Web Frame Works,Python For Data Visualization,Data
```

Preprocessing Techniques,

Machine Learning,IBM Cloud,IBM Watson Studio,Python-Flask

Project Description:

In Parkinson's disease, certain nerve cells (neurons) in the brain gradually break down or die.

Many of the symptoms are due to a loss of neurons that produce a chemical messenger in your brain called dopamine

```
                                </p>


                            </div>
                    </div>
            </section>


                    </div>


            </section>

            <footer class="background">

                    <p class="text-footer">
        <a href="https://www.facebook.com/ap.arul.75" class="fa fa-facebook"></a>    
        <a href="https://instagram.com/im_ap_arul?igshid=YmMyMTA2M2Y=" class="fa fa-instagram"></a>
                    </p>


            </footer>
</body>
```

```
</html>
```

Predict.php

```
<!doctype html>
<html lang="en">
   <head>
   <meta charset="utf-8">
   <meta name="viewport" content="width=device-width, initial-scale=1, shrink-to-fit=no">
   <link rel="stylesheet" href="https://cdn.jsdelivr.net/npm/bootstrap@4.4.1/dist/css/bootstrap.min.css">
      <title>
         Page of Detection
      </title>
      <link rel="stylesheet" href="./front.css">
      <script>
         function clearFunc()
         {
         document.getElementById("name").value="";
         document.getElementById("dob").value="";
         document.getElementById("gender").value="";
         document.getElementById("address").value="";
         document.getElementById("spiral").value="";
         document.getElementById("wave").value="";
      }
      </script>
   </head>

   <body id="bg">
      <div class="container">
         <form method="post">
            <div class="form-group col-md-5">
               <h5> PATIENTS FORM </h5>
               <label>Enter Your Name</label>
```

```
            <input type="text" class="form-control" id="Name" name="name" placeholder="Enter Your Name" >
        </div>

        <div class="form-group col-md-5">
            <label>Enter Your Date of Birth</label>
            <input type="date" class="form-control" id="dob" name="dob" placeholder="Enter Your Date of Birth" >
        </div>

        <div class="form-group col-md-5">
            <label for="gender">Gender</label>
            <select class="form-control" id="gender" name="gender">
            <option value="">-- Choose Your Gender --</option>
            <option value="Male">Male</option>
            <option value="Female">Female</option>
            <option value="Transgender">Transgender</option>
            </select>
        </div>

        <div class="form-group col-md-5">
            <label>Enter Your Phone Number</label>
            <input type="varchar" class="form-control" id="blood" name="phone" placeholder="+91 9361X XXXXX" >
        </div>

        <div class="form-row">
            <div class="form-group col-md-2">
            <label>Enter Your Blood Group</label>
            <input type="varchar" class="form-control" id="blood" name="blood" placeholder="Ex. B+ve" >

</div>         
```

```
<div class="form-group col-md-1.5">
  <label>Age</label>
  <input type="varchar" class="form-control" id="age" name="age" placeholder="Enter Your Age" >
</div></div>

<div class="form-group col-md-5">
  <label>Enter Your Address</label>
  <input type="varchar" class="form-control" id="address" name="address" placeholder="Enter Your Address" >
</div>

<div class="form-row">    
<div class="form-group col-md-3">
  <label>Upload The Spiral Image</label>
  <input type="file" class="form-control-file" id="spiral" name="spiral">
</div>

<div class="form-group col-md-3">
  <label>Upload The Wave Image</label>
  <input type="file" class="form-control-file" id="wave" name="wave">
</div>
</div>

<div class="form-row">
    <div><button type="submit" class="btn btn-primary" name="submit">Submit</button></div>    
  <div><button class="btn btn-primary" type="reset" onclick="clearFunc()">Reset</button></div>
</div>
</form>
```

```
        </div>
    </body>
</html>
```

CHAPTER 10 – ADVANTAGES & DISADVANTAGES

Advantages :

While Parkinson's cannot be cured, early detection along with proper medication can significantly improve symptoms and quality of life. Using this project we can find that disease earlier and easily.

Disadvantages :

We cannot cure the disease instead we can reduce the impacts of Parkinson disease.

CHAPTER 11 – CONCLUSION

Conclusion :

Parkinson's disease is the second most dangerous neurodegenerative disease which has no cure till now and to make it reduce prediction is important. In this project, we haveused three various prediction models to predict the Parkinson's disease which are Machine Learning Techniques i.e. KNN, Naïve Bayes and Logistic Regression. The dataset is trainedusing these models and we also compared these different models built using different methods and identifies the best model that

fits.

The aim is to use various evaluation metrics such as Accuracy, Precision, Recall, Specificity, F1-score, LR+, LR- and Youden score that produce the predicts the disease efficiently. We have used the Speech dataset that contains voice features of the patients which is available in the Kaggle website. The dataset consists of more than 700 features and 750 patient details. The models are built using the five best features which were identified by feature selection.

From this results, Naïve Bayes outstands from the other two machine learning algorithms with an accuracy of 81%. This system we designed can make the predictions of the Parkinson's disease.

CHAPTER 12 – FUTURE SCOPE

In future, these models can be trained with different datasets that have best features and can be predicted more accurately. If the accuracy rate increases, it can be used by the laboratories and hospitals so that it is easy to predict in early stages. This models can be also used with different medical and disease datasets. In future the work can be extended by building a hybrid model that can find more than one disease with an accurate dataset and that dataset has common features of two diseases. In future the work can extended to build a model that may extract more important features among all features in the dataset sothat it produce more accuracy.

Source code :

```
from flask import Flask, render_template

import pickle

import cv

from skimage import filters, feature

import os.path
```

```
app = Flask(__name__)


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


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


@app.route("/parkinson")
def parkinson():
    return render_template("parkinsin's.html")


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


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

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

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

        # Pre-process the image in the same manner we did earlier
```

```
image = cv.imread(filepath)

output = image.copy()


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

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

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

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

image = cv.threshold(image, 0, 255,

                cv.THRESH_BINARY_INV | cv.THRESH_OTSU)[1]


# Quantify the image and make predictions based on the extracted features using the last trained Random Forest

features = feature.hog(image, orientations=9,

                pixels_per_cell=(10, 10), cells_per_block=(2, 2),

                transform_sqrt=True, block_norm="L1")

preds = model.predict([features])

print(preds)

ls = ["healthy", "parkinson"]

result = ls[preds[0]]

'"color = (0, 255, 0) if result == "healthy" else (0, 0, 255)

cv2.putText(output, result, (3, 20),

        cv2.FONT_HERSHEY_SIMPLEX, 0.5, color, 2)
```

```
        cv2.imshow("Output", output)
        cv2.waitKey(0)"'
        return result
    return None



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

Output Links :

Git hub Link :

https://github.com/IBM-EPBL/IBM Project-14093-1659540451

Output Video Link :

https://youtu.be/wL8Q32bqdJs