Project Report
Detection of Parkinson's Disease using Machine Learning

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Team Members	Nallajonnala Ramanaidu Ilakkiya Janani Keerthivasan
Project Name	Detecting Parkinson's Disease using Machine Learning

Parkinson's disease

- Parkinson's disease is a brain disorder that causes unintended or uncontrollable movements, such as shaking, stiffness, and difficulty with balance and coordination.
- Symptoms usually begin gradually and worsen over time. As the disease progresses, people may have difficulty walking and talking. They may also have mental and behavioral changes, sleep problems, depression, memory difficulties, and fatigue.
- While virtually anyone could be at risk for developing Parkinson's, some research studies suggest this disease affects more men than women. It's unclear why, but studies are underway to understand factors that may increase a person's risk.

Project objective

- To understand the problem for to classify if it is a regression or a classification kind of problem.
- To pre-process the image by using different data pre-processing techniques.
- To implement the algorithm by using OpenCV framework and machine learning to automatically detect Parkinson's disease in hand-drawn images of spirals and waves.
- To know how to find the accuracy of the model.

- To build web application using the Flask framework that features the detection of Parkinson's Disease.

Problem Statement

Parkinson's disease is a brain disorder that causes unintended or uncontrollable movements, such as shaking, stiffness, and difficulty with balance and coordination. Symptoms usually begin gradually and worsen over time. As the disease progresses, people may have difficulty walking and talking.

Literature Survey

1. Jie Mei, Christian Desrosiers, Johannes Frasnelli, "Machine Learning for the Diagnosis of Parkinson's Disease," 2021.

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

2. C K Gomathy, "The Parkinson's Disease Detection using Machine Learning Techniques." 2021.

The Parkinson's disease is progressive neuro degenerative disorder that affects a lot only people significantly affecting their quality of life. It mostly affects the motor functions of human. The main motor symptoms are called "parkinsonism" or "parkinsonian syndrome". 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 this model, a huge amount of data is collected from the normal person and previously affected person by Parkinson's disease. these data are

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 database to check whether the person is affected by Parkinson's disease or not.

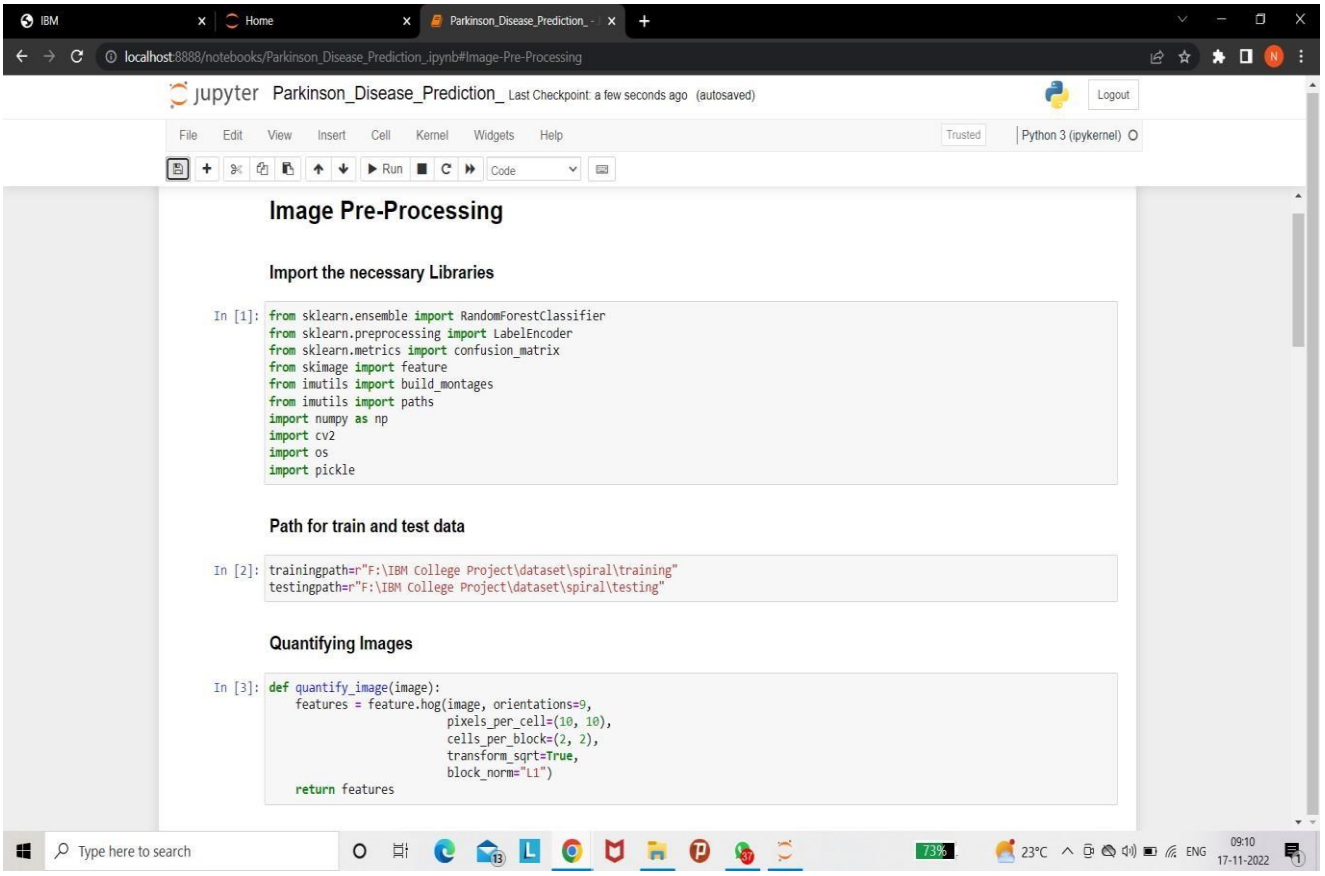
3. Iqra Nissar, Waseem Ahmad Mir, Izharuddin, Tawseef Ayoub Shaikh, "Machine Learning Approaches for Detection and Diagnosis of Parkinson's Disease," 2021.

Parkinson's disease (PD) is disabling disease that affects the quality of life. It happens due to the death of cells that produce dopamine's in the substantia nigra part of the central nervous system (CNS) which affects the human body. People who have Parkinson's disease feel difficulty in doing activities like speaking, writing, and walking. However, speech analysis is the most considered technique to be used.

Deployment of ML Model

The Machine Learning model which is developed using Random Forest Classifier Algorithm generates accuracy of 0.8666 approximately is deployed using IBM Watson which enhances scalability, reliability, security and performance of the ML model.

Codes: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Parkinson_Disease_Prediction_
localhost:8888/notebooks/Parkinson_Disease_Prediction_.ipynb#Image-Pre-Processing
jupyter Parkinson_Disease_Prediction_ Last Checkpoint: a few seconds ago (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3 (ipykernel)
Run
Code
Image Pre-Processing
Import the necessary Libraries
In [1]:
from sklearn.ensemble import RandomForestClassifier
from sklearn.preprocessing import LabelEncoder
from sklearn.metrics import confusion_matrix
from skimage import feature
from imutils import build_montages
from imutils import paths
import numpy as np
import cv2
import os
import pickle
Path for train and test data
In [2]:
trainingpath=r"F:\IBM College Project\dataset\spiral\training"
testingpath=r"F:\IBM College Project\dataset\spiral\testing"
Quantifying Images
In [3]:
def quantify_image(image):
features = feature.hog(image, orientations=9,
pixels_per_cell=(10, 10),
cells_per_block=(2, 2),
transform_sqrt=True,
block_norm="L1")
return features
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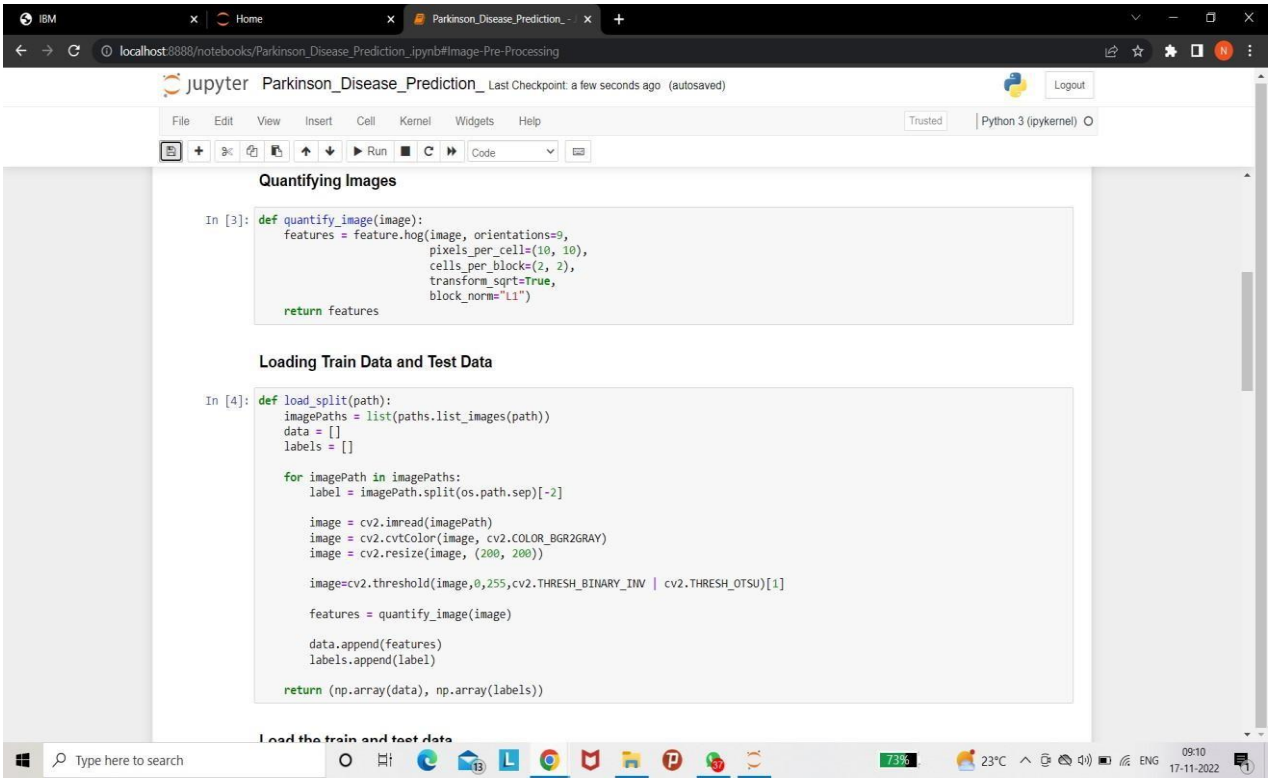
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Logout
File Edit View Insert Cell Kernel Widgets Help
Trusted
Python 3 (ipykernel)
Run
Code
Quantifying Images
In [3]:
def quantify_image(image):
features = feature.hog(image, orientations=9,
pixels_per_cell=(10, 10),
cells_per_block=(2, 2),
transform_sqrt=True,
block_norm="L1")
return features
Loading Train Data and Test Data
In [4]:
def load_split(path):
imagePaths = list(paths.list_images(path))
data = []
labels = []
for imagePath in imagePaths:
label = imagePath.split(os.path.sep)[-2]
image = cv2.imread(imagePath)
image = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
image = cv2.resize(image, (200, 200))
image=cv2.threshold(image,0,255,cv2.THRESH_BINARY_INV | cv2.THRESH_OTSU)[1]
features = quantify_image(image)
data.append(features)
labels.append(label)
return (np.array(data), np.array(labels))
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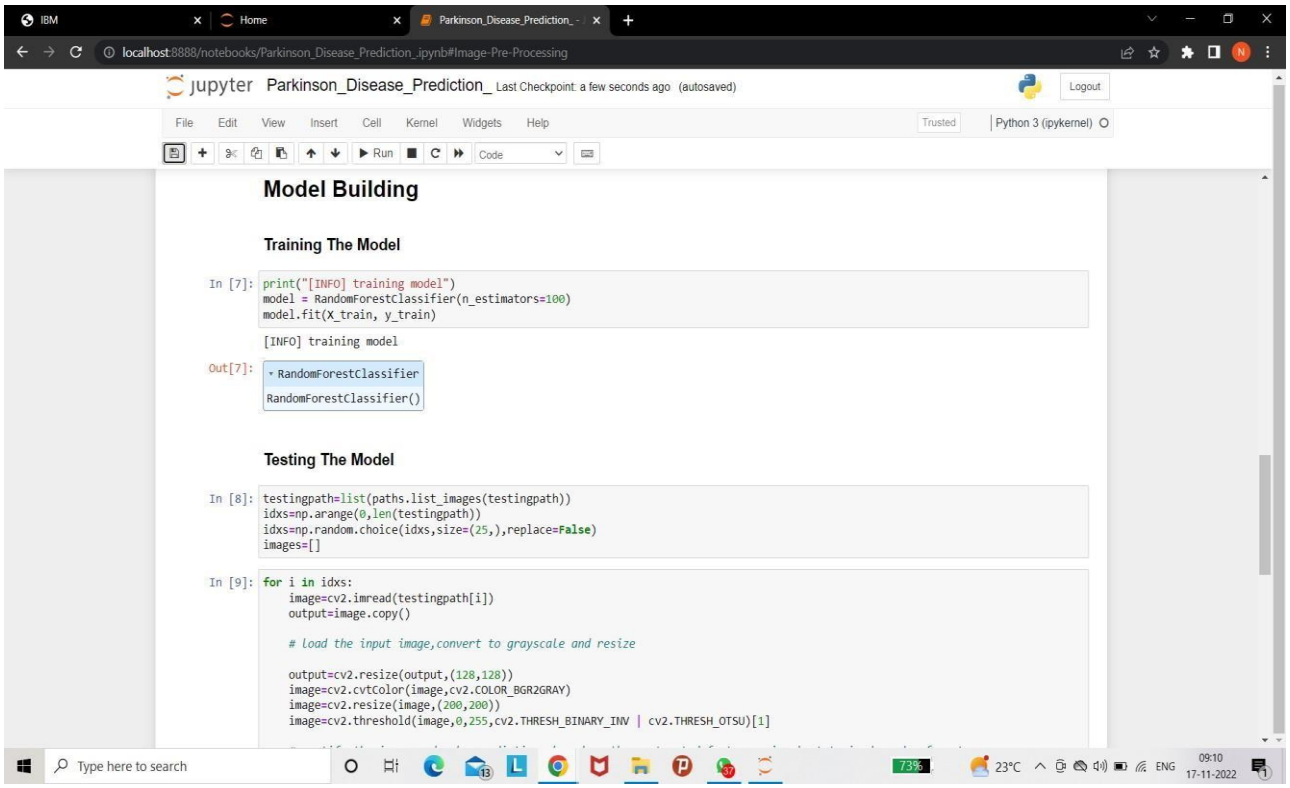
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jupyter Parkinson_Disease_Prediction_ Last Checkpoint: a few seconds ago (autosaved)
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Trusted
Python 3 (ipykernel)
Run
Code
Model Building
Training The Model
In [7]:
print("[INFO] training model")
model = RandomForestClassifier(n_estimators=100)
model.fit(X_train, y_train)
[INFO] training model
Out[7]:
RandomForestClassifier
RandomForestClassifier()
Testing The Model
In [8]:
testingpath=list(paths.list_images(testingpath))
idxs=np.arange(0,len(testingpath))
idxs=np.random.choice(idxs,size=(25,),replace=False)
images=[]
In [9]:
for i in idxs:
image=cv2.imread(testingpath[i])
output=image.copy()
# load the input image,convert to grayscale and resize
output=cv2.resize(output,(128,128))
image=cv2.cvtColor(image,cv2.COLOR_BGR2GRAY)
image=cv2.resize(image,(200,200))
image=cv2.threshold(image,0,255,cv2.THRESH_BINARY_INV | cv2.THRESH_OTSU)[1]
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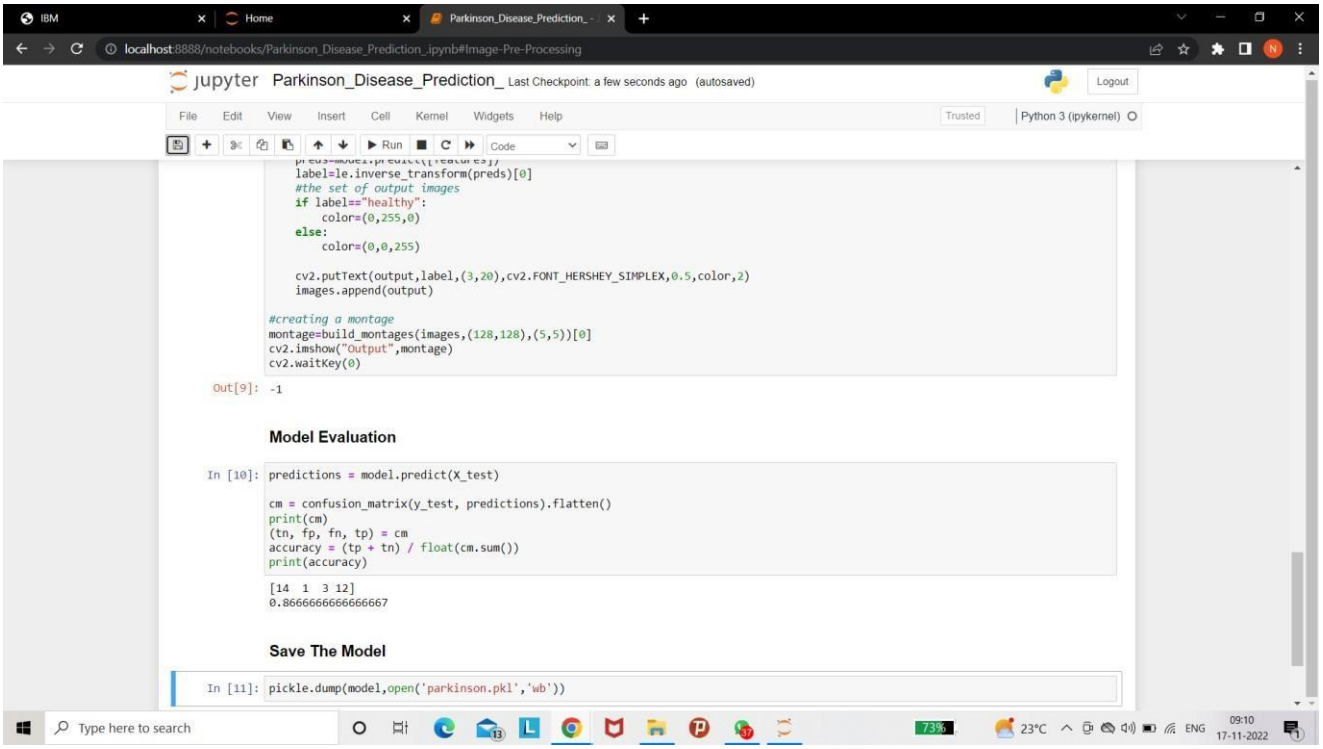
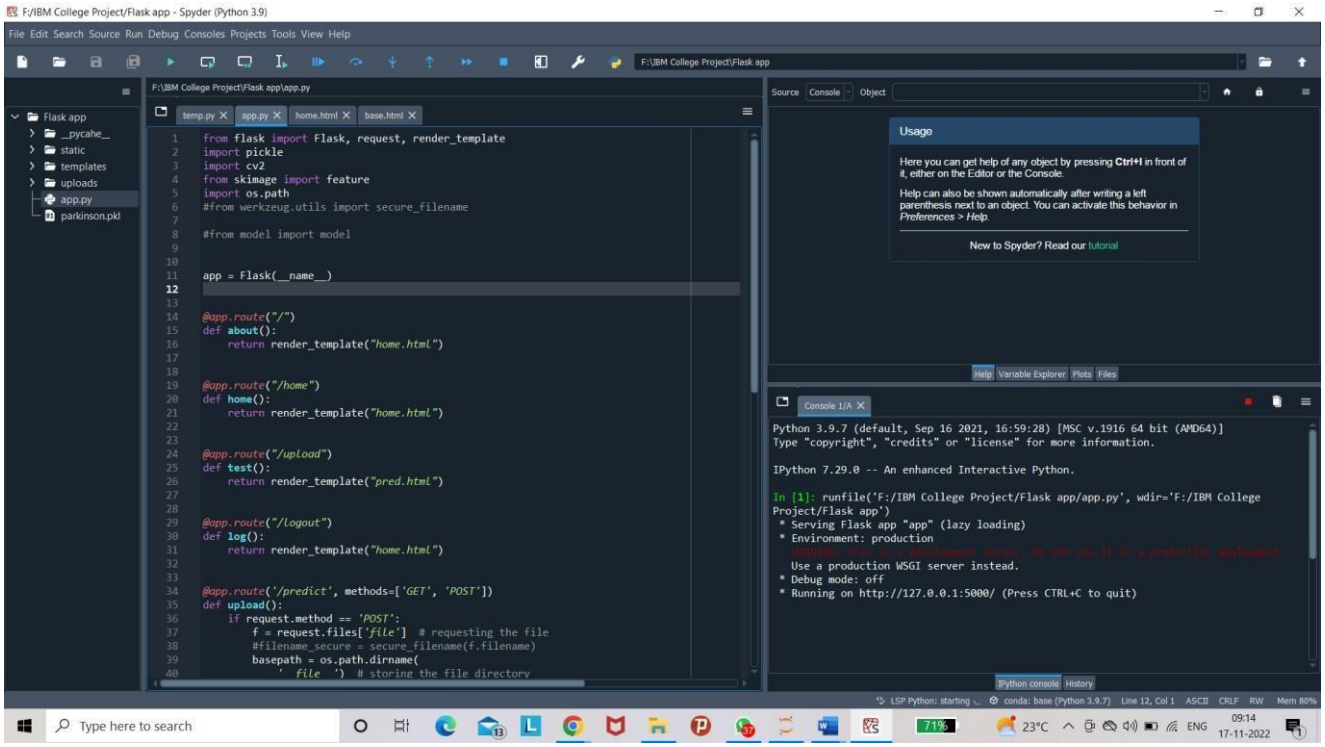
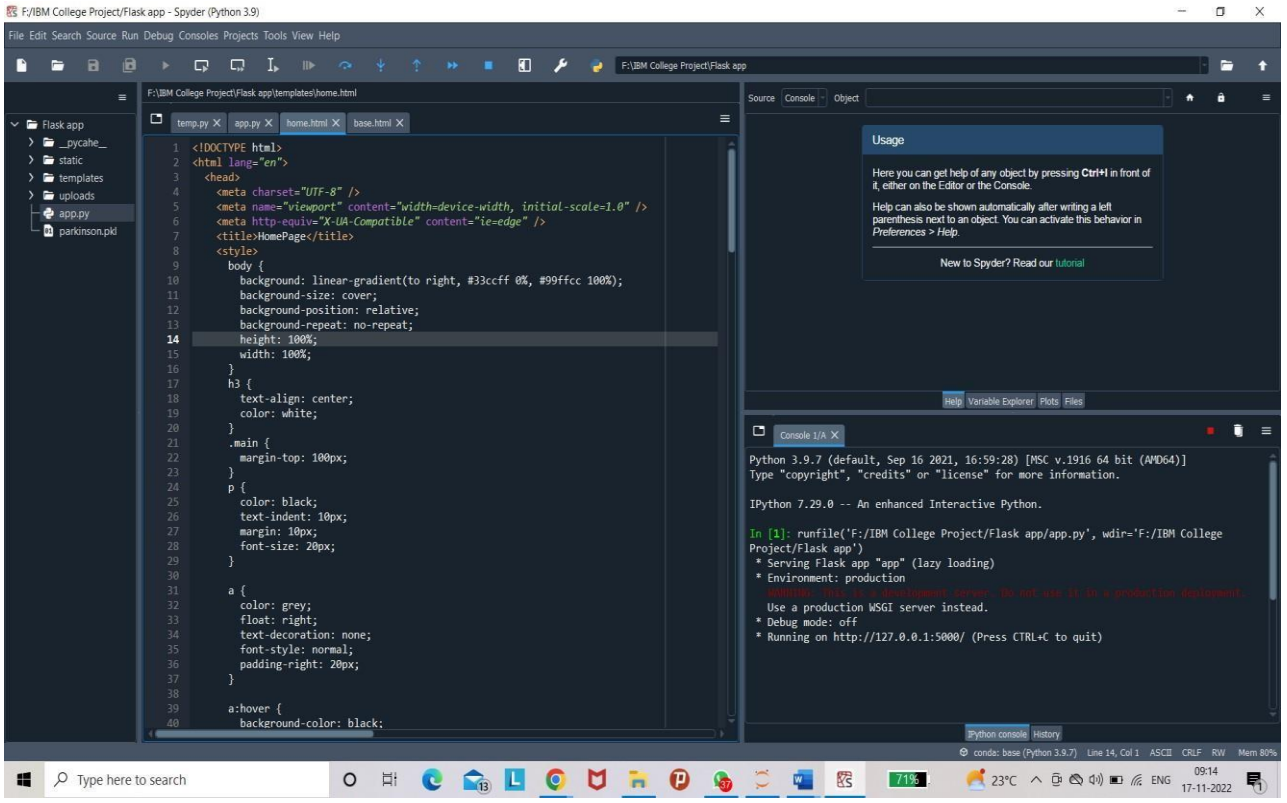


Flask Application Codes




F:/IBM College Project/Flask app - Spyder (Python 3.9)
File Edit Search Source Run Debug Consoles Projects Tools View Help
F:\IBM College Project\Flask app
F:\IBM College Project\Flask app\templates\home.html
temp.py
app.py
home.html
base.html
Flask app
__pycahe__
static
templates
uploads
app.py
parkinson.pkl
<!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%, #99ffcc 100%);
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;
Usage
Here you can get help of any object by pressing Ctrl+I in front of it, either on the Editor or the Console.
Help can also be shown automatically after writing a left parenthesis next to an object. You can activate this behavior in Preferences > Help.
New to Spyder? Read our tutorial
Help
Variable Explorer
Plots
Files
Console 1/A
Python 3.9.7 (default, Sep 16 2021, 16:59:28) [MSC v.1916 64 bit (AMD64)]
Type "copyright", "credits" or "license" for more information.
IPython 7.29.0 -- An enhanced Interactive Python.
In [1]: runfile('F:/IBM College Project/Flask app/app.py', wdir='F:/IBM College Project/Flask app')
* Serving Flask app "app" (lazy loading)
* Environment: production
WARNING: This is a development server. Do not use it in a production deployment.
Use a production WSGI server instead.
* Debug mode: off
* Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
IPython console
History
Type here to search
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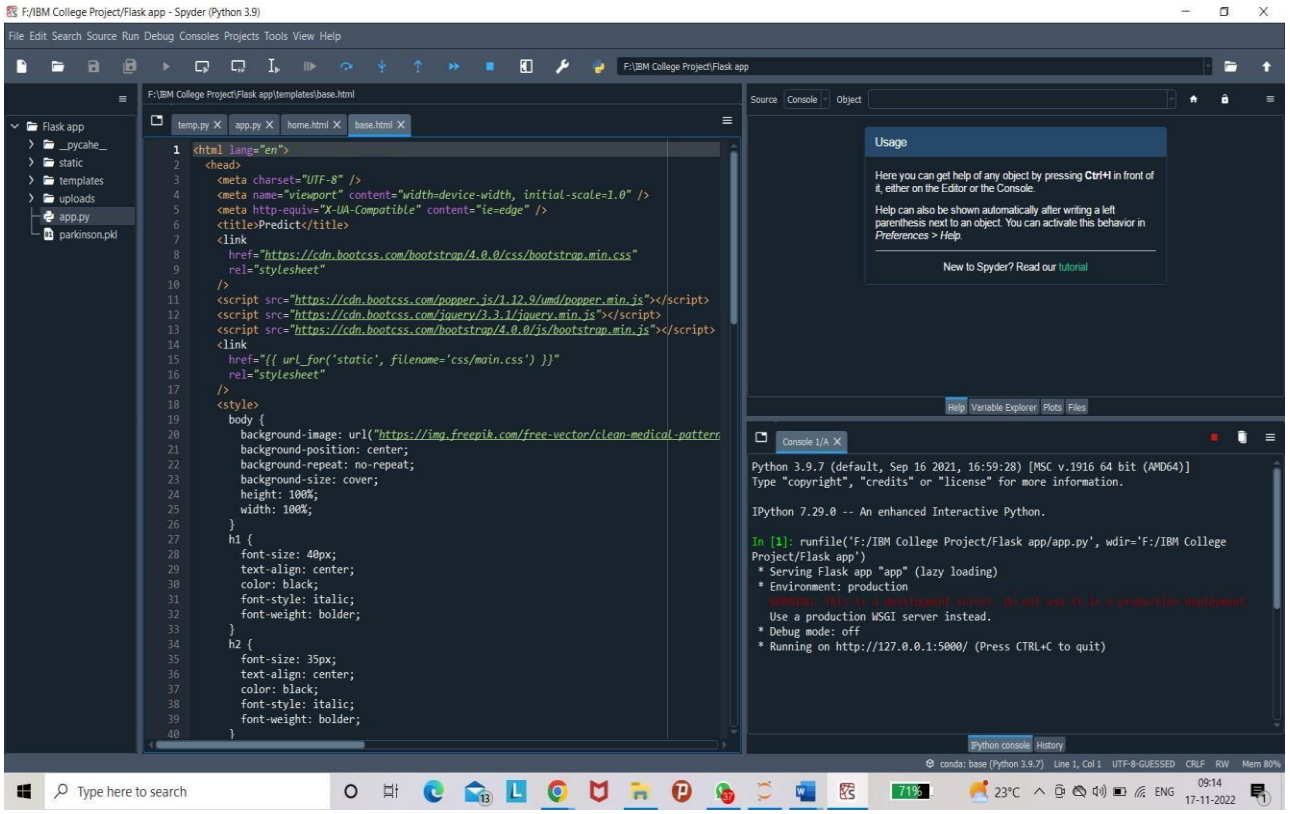
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F:\IBM College Project\Flask app\templates\base.html
temp.py
app.py
home.html
base.html
Flask app
__pycahe__
static
templates
uploads
app.py
parkinson.pkl
<html lang="en">
<head>
<meta charset="UTF-8" />
<meta name="viewport" content="width=device-width, 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-pattern
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;
}
Usage
Here you can get help of any object by pressing Ctrl+I in front of it, either on the Editor or the Console.
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* Debug mode: off
* Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
IPython console
History
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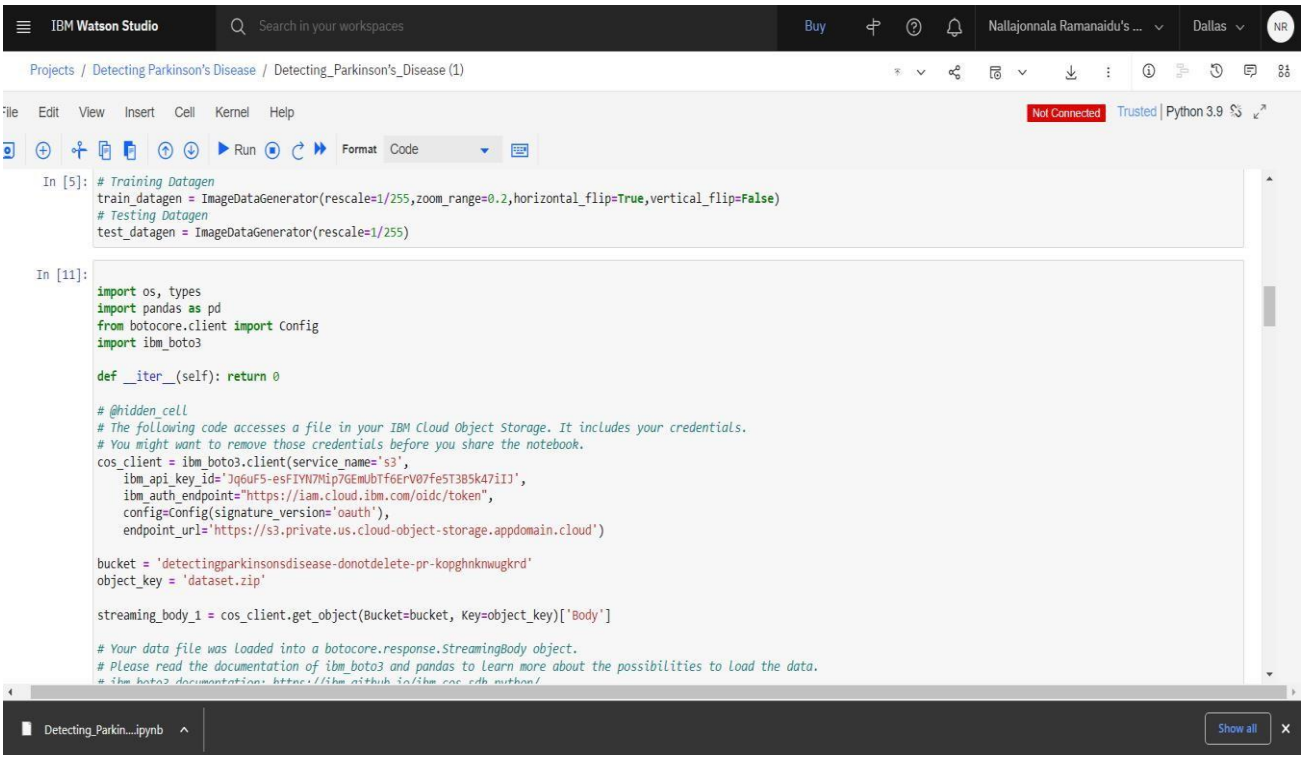
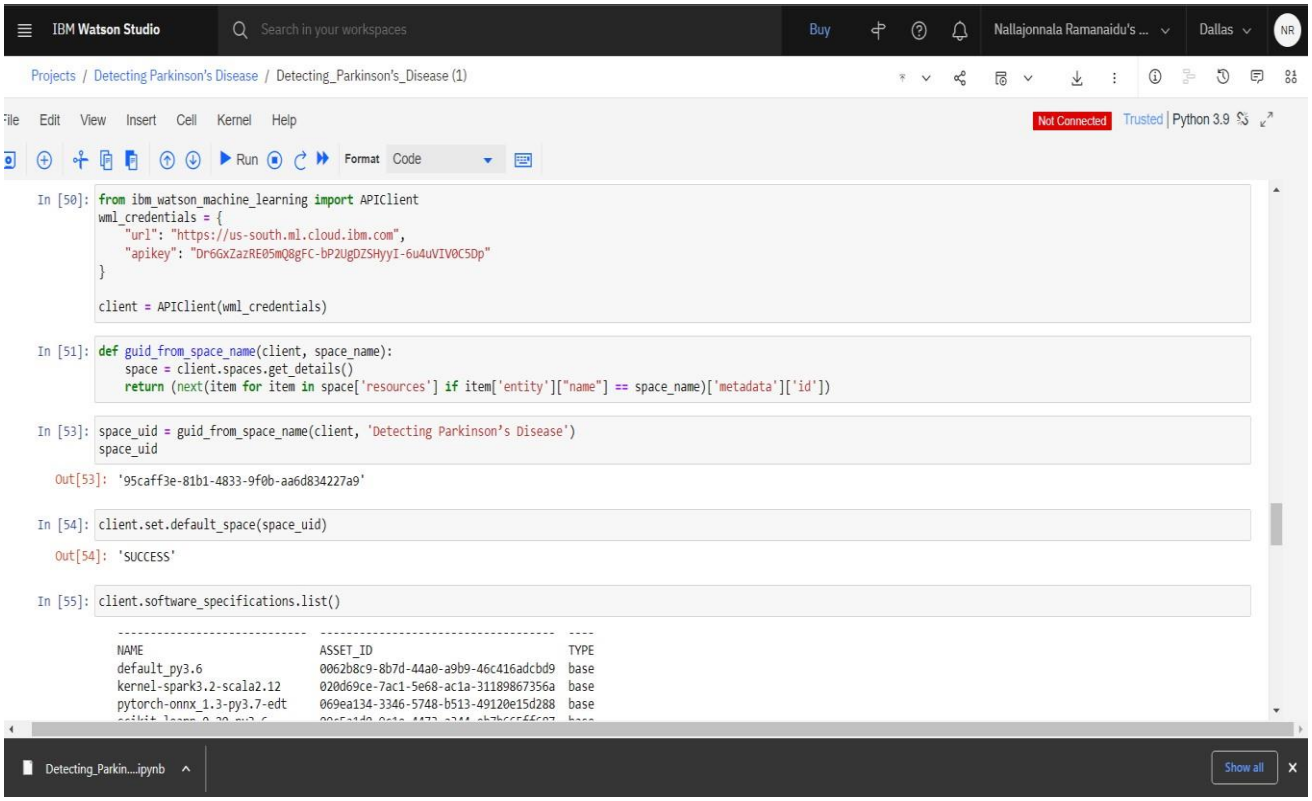
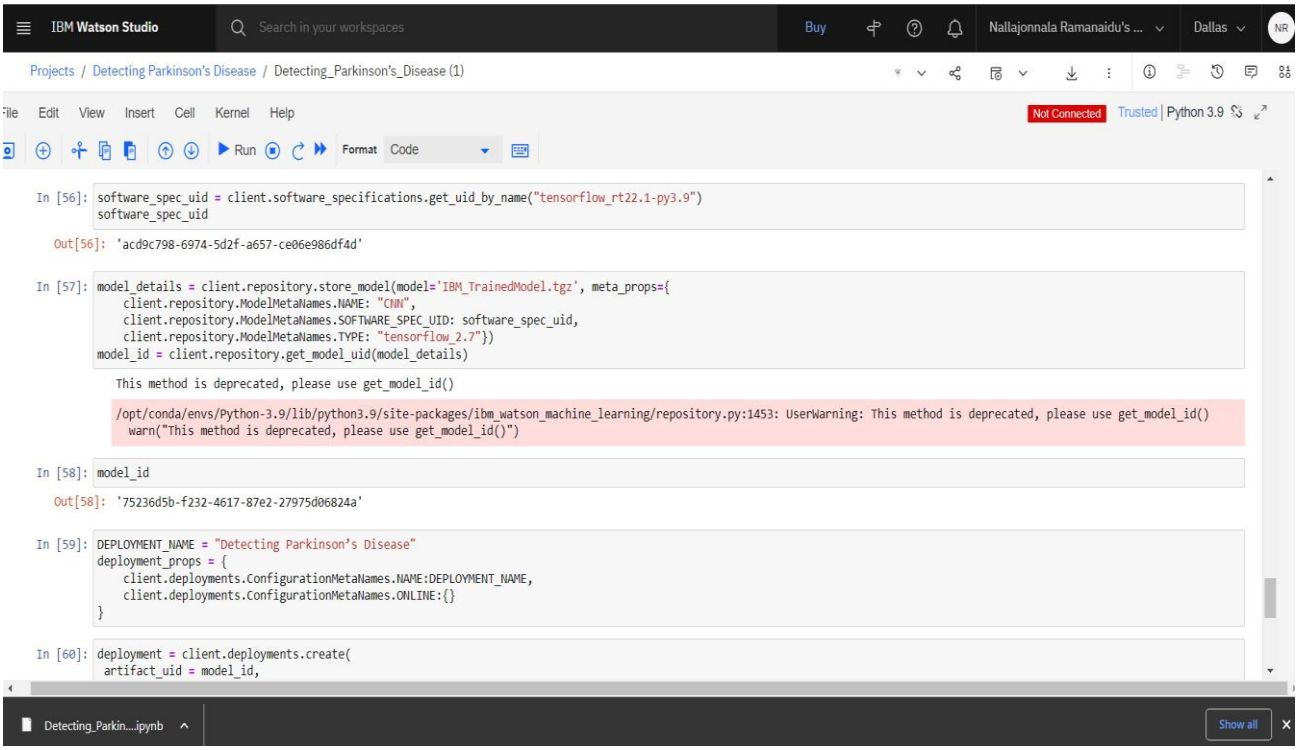
IBM Deployment Code



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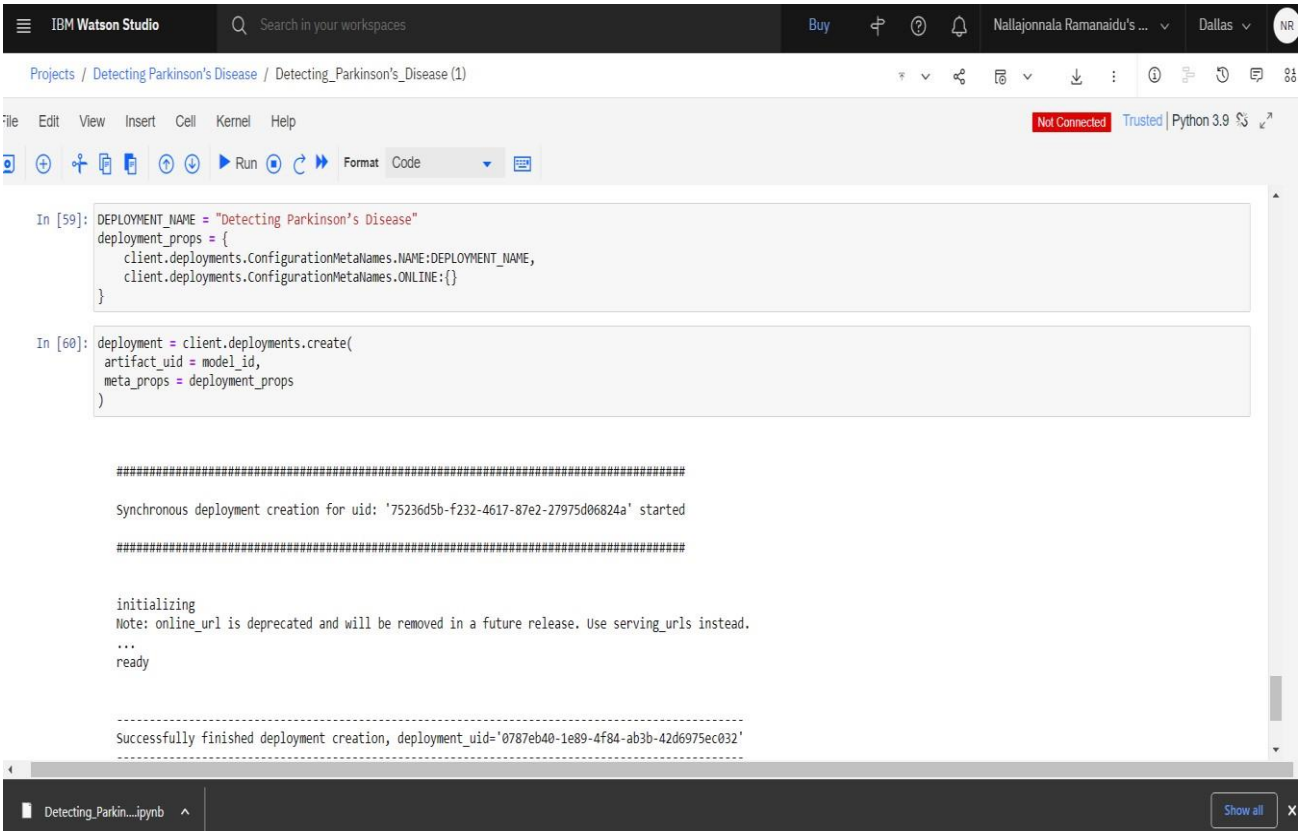
Projects / Detecting Parkinson's Disease / Detecting_Parkinson's_Disease (1)
File Edit View Insert Cell Kernel Help
Not Connected
Trusted | Python 3.9
Run
Format Code
In [56]:
software_spec_uid = client.software_specifications.get_uid_by_name("tensorflow_rt22.1-py3.9")
software_spec_uid
Out[56]: 'acd9c798-6974-5d2f-a657-ce06e986df4d'
In [57]:
model_details = client.repository.store_model(model='IBM_TrainedModel.tgz', meta_props={
client.repository.ModelMetaNames.NAME: "CNN",
client.repository.ModelMetaNames.SOFTWARE_SPEC_UID: software_spec_uid,
client.repository.ModelMetaNames.TYPE: "tensorflow_2.7"})
model_id = client.repository.get_model_uid(model_details)
This method is deprecated, please use get_model_id()
/opt/conda/envs/Python-3.9/lib/python3.9/site-packages/ibm_watson_machine_learning/repository.py:1453: UserWarning: This method is deprecated, please use get_model_id()
warn("This method is deprecated, please use get_model_id()")
In [58]:
model_id
Out[58]: '75236d5b-f232-4617-87e2-27975d06824a'
In [59]:
DEPLOYMENT_NAME = "Detecting Parkinson's Disease"
deployment_props = {
client.deployments.ConfigurationMetaNames.NAME:DEPLOYMENT_NAME,
client.deployments.ConfigurationMetaNames.ONLINE:{}
}
In [60]:
deployment = client.deployments.create(
artifact_uid = model_id,
Detecting_Parkin....ipynb
Show all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Format Code
In [59]:
DEPLOYMENT_NAME = "Detecting Parkinson's Disease"
deployment_props = {
client.deployments.ConfigurationMetaNames.NAME:DEPLOYMENT_NAME,
client.deployments.ConfigurationMetaNames.ONLINE:{}
}
In [60]:
deployment = client.deployments.create(
artifact_uid = model_id,
meta_props = deployment_props
)
###
Synchronous deployment creation for uid: '75236d5b-f232-4617-87e2-27975d06824a' started
###
initializing
Note: online_url is deprecated and will be removed in a future release. Use serving_urls instead.
...
ready

Successfully finished deployment creation, deployment_uid='0787eb40-1e89-4f84-ab3b-42d6975ec032'

Detecting_Parkin....ipynb
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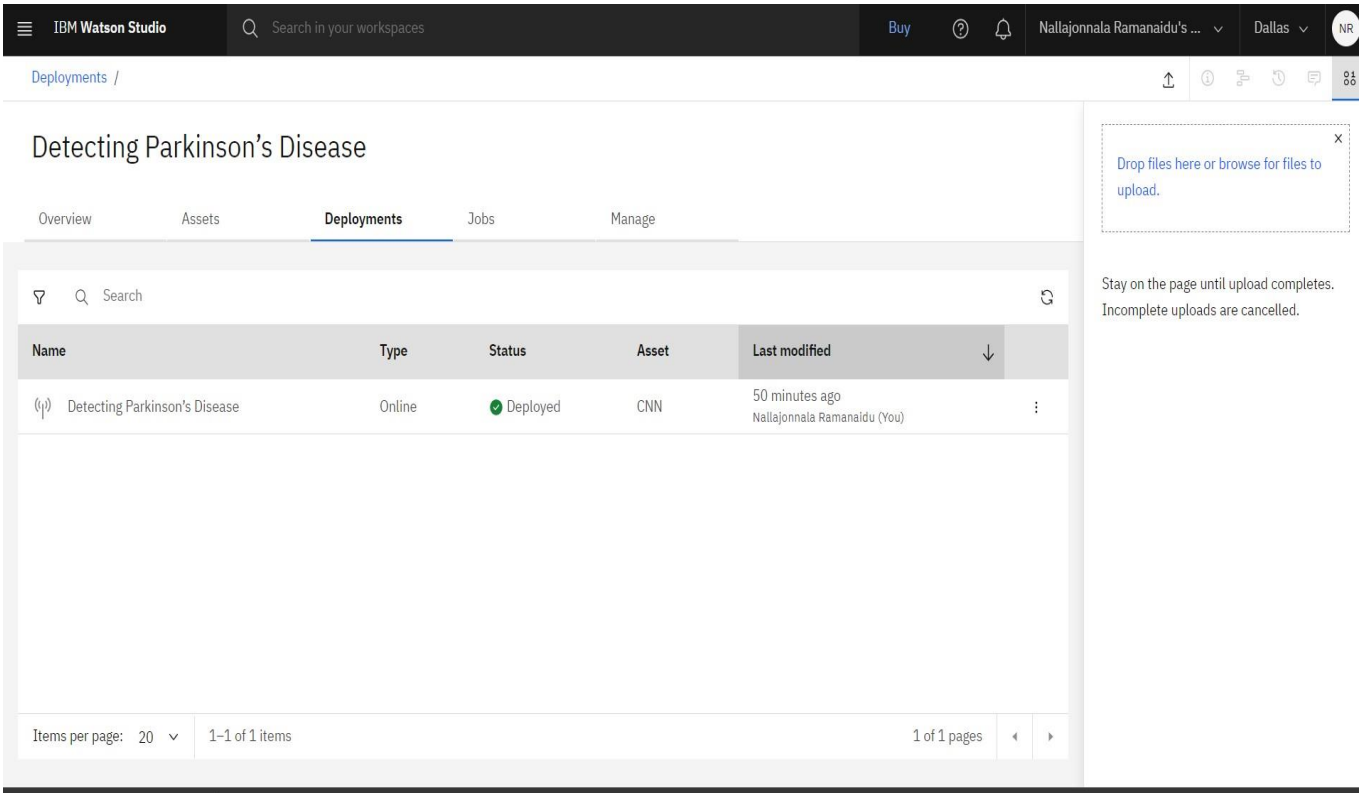
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Type
Status
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Online
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1–1 of 1 items
1 of 1 pages
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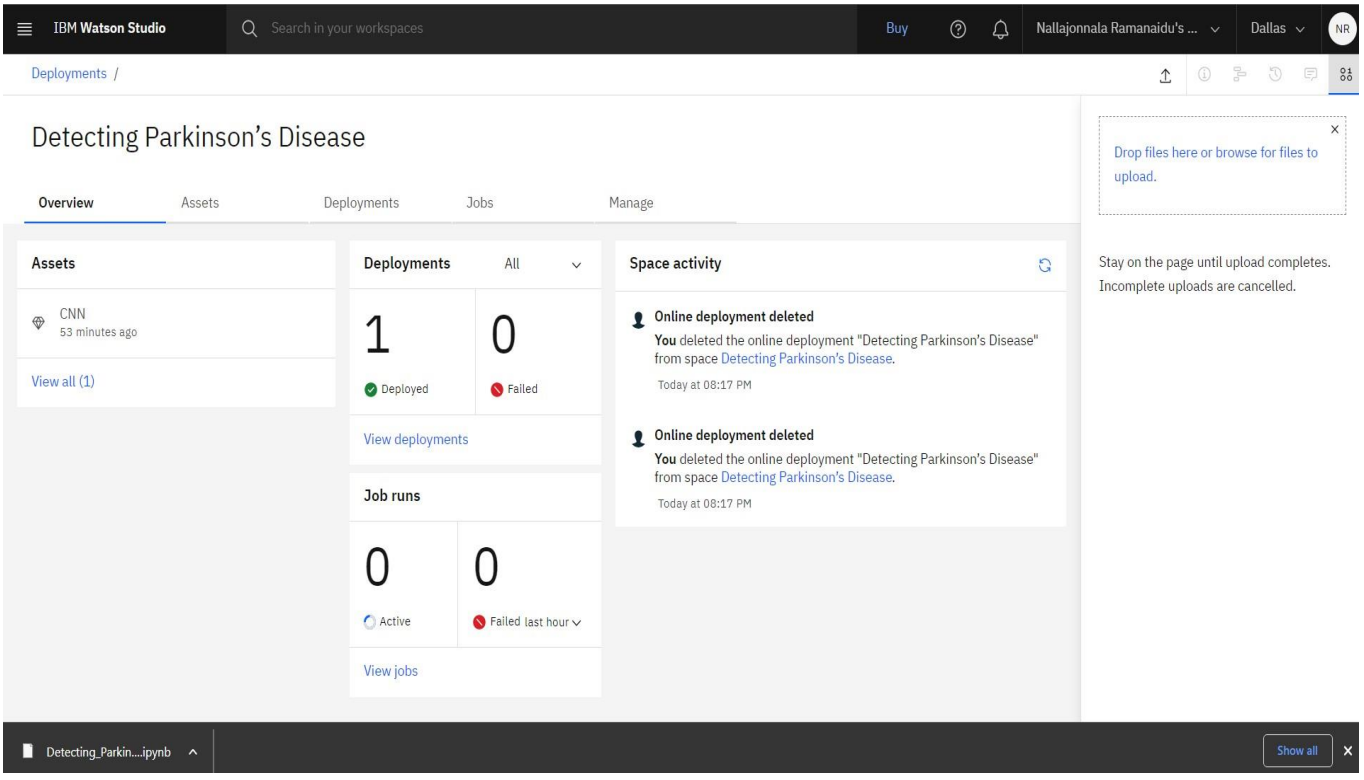
Stay on the page until upload completes. Incomplete uploads are cancelled.
Detecting_Parkin....ipynb
Show all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Overview
Assets
Deployments
Jobs
Manage
Assets
CNN
53 minutes ago
View all (1)
Deployments
All
1
Deployed
0
Failed
View deployments
Job runs
0
Active
0
Failed last hour
View jobs
Space activity
Online deployment deleted
You deleted the online deployment "Detecting Parkinson's Disease" from space Detecting Parkinson's Disease.
Today at 08:17 PM
Online deployment deleted
You deleted the online deployment "Detecting Parkinson's Disease" from space Detecting Parkinson's Disease.
Today at 08:17 PM
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Stay on the page until upload completes. Incomplete uploads are cancelled.
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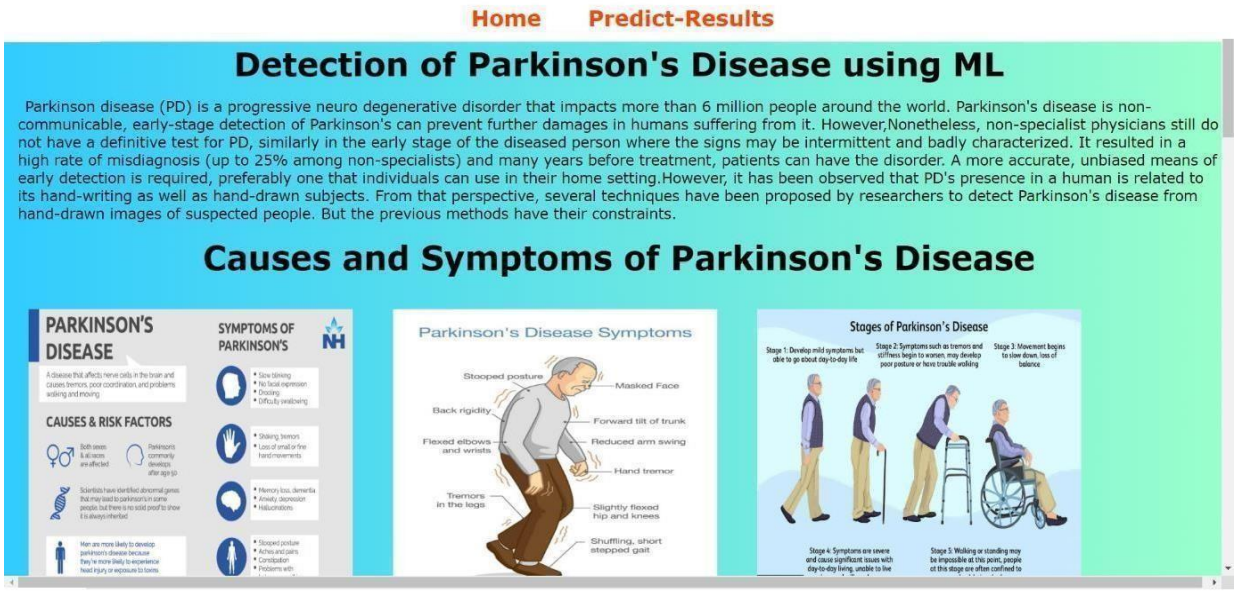
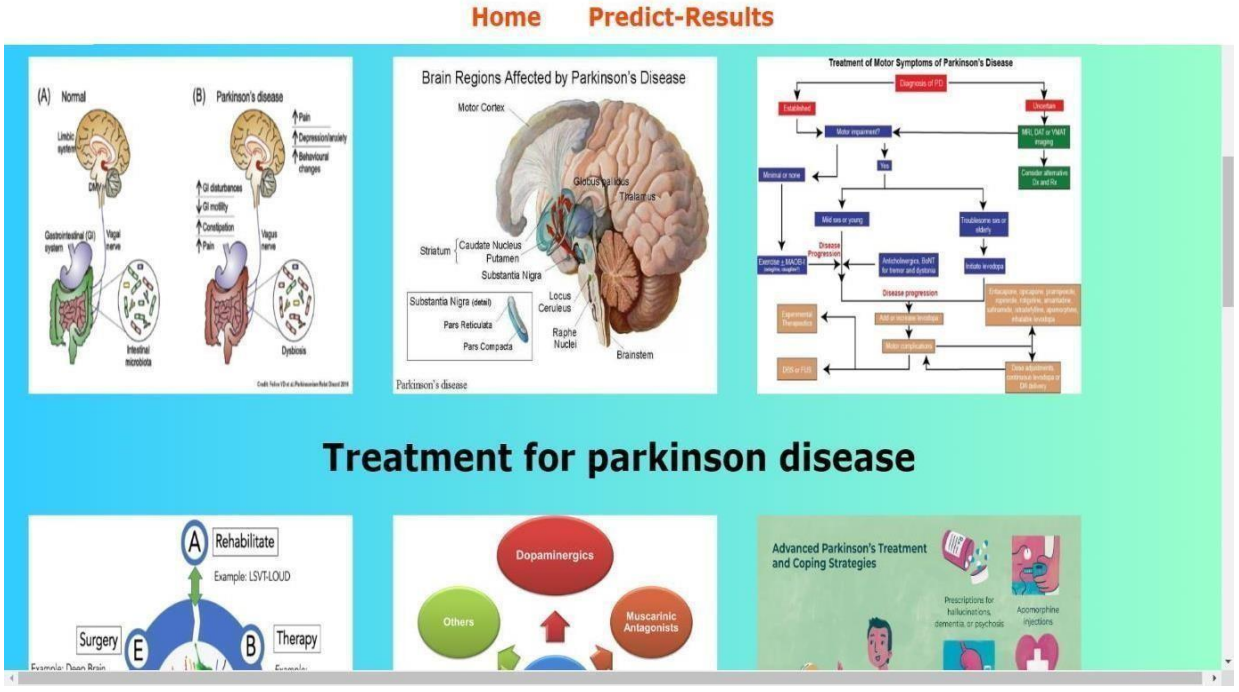
Home Page


Home
Predict-Results
Detection of Parkinson's Disease using ML
Parkinson disease (PD) is a progressive neuro degenerative 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 further damages in humans suffering from it. However,Nonetheless, non-specialist physicians still do not have a definitive test for PD, similarly in the early stage of the diseased person where the signs may be intermittent and badly 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 early detection is required, preferably one that individuals can use in their home setting.However, it has been observed that PD's presence in a human is related to its hand-writing as well as hand-drawn subjects. From that perspective, several techniques have been proposed by researchers to detect Parkinson's disease from hand-drawn images of suspected people. But the previous methods have their constraints.
Causes and Symptoms of Parkinson's Disease
PARKINSON'S DISEASE
SYMPTOMS OF PARKINSON'S
CAUSES & RISK FACTORS
Parkinson's Disease Symptoms
Stooped posture
Masked Face
Back rigidity
Forward tilt of trunk
Flexed elbows and wrists
Reduced arm swing
Hand tremor
Tremors in the legs
Slightly flexed hip and knees
Shuffling, short stepped gait
Stages of Parkinson's Disease


Home
Predict-Results
(A) Normal
(B) Parkinson's disease
Brain Regions Affected by Parkinson's Disease
Motor Cortex
Striatum
Caudate Nucleus
Putamen
Substantia Nigra
Locus Ceruleus
Raphe Nuclei
Brainstem
Parkinson's disease
Treatment of Motor Symptoms of Parkinson's Disease
Treatment for parkinson disease
Rehabilitate
Example: LSVT-LOUD
Surgery
Therapy
Dopaminergics
Others
Muscarinic Antagonists
Advanced Parkinson's Treatment and Coping Strategies

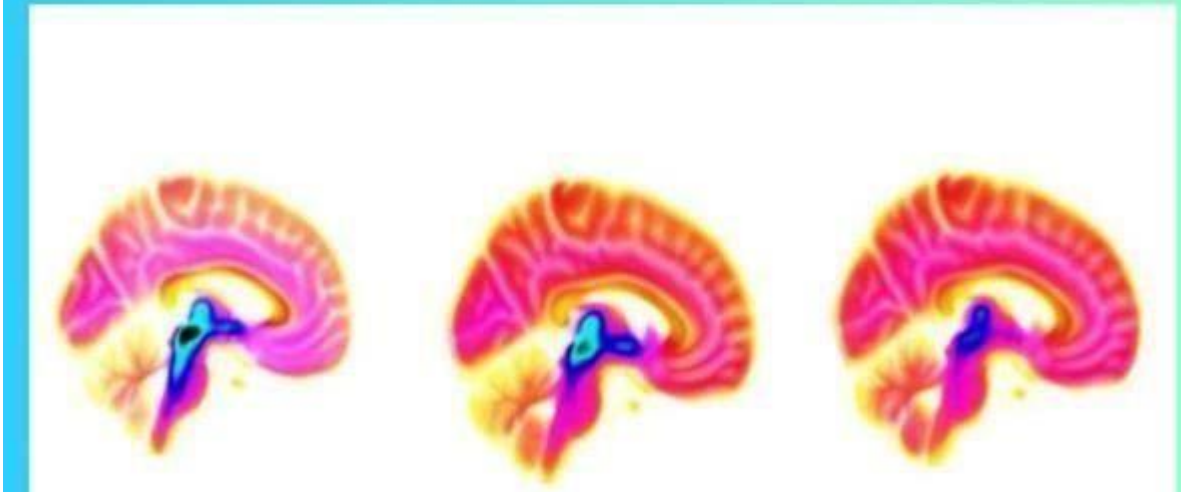
Home Predict-Results

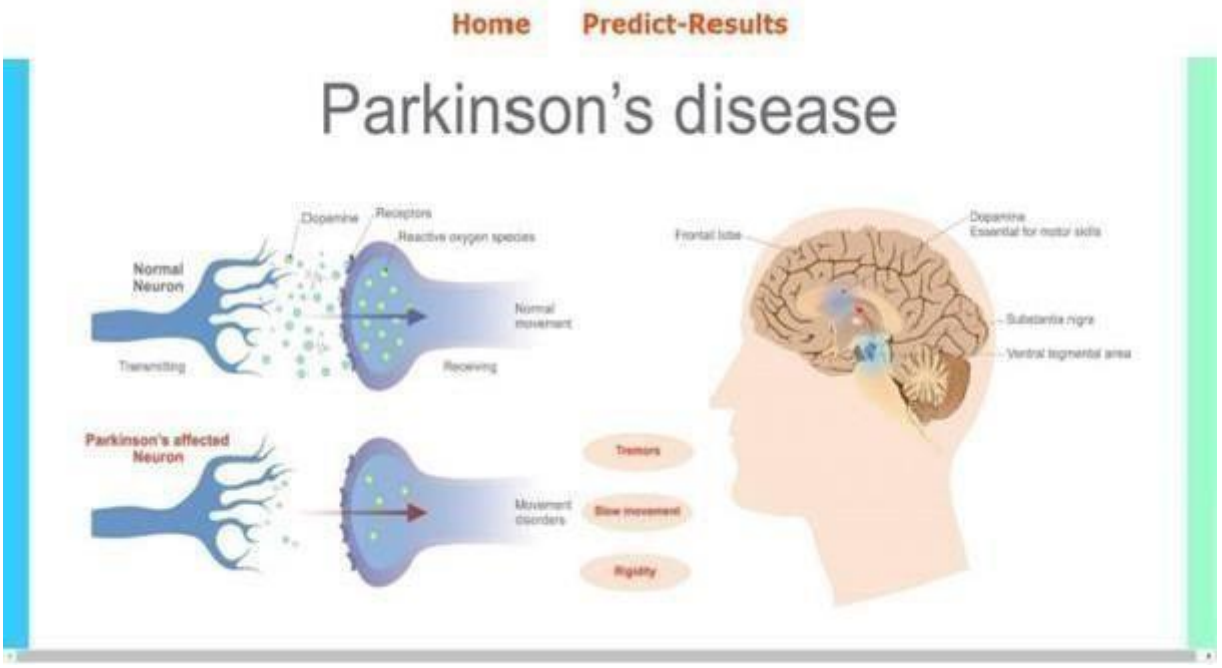
Treatment for parkinson disease

How brains looks during PD?

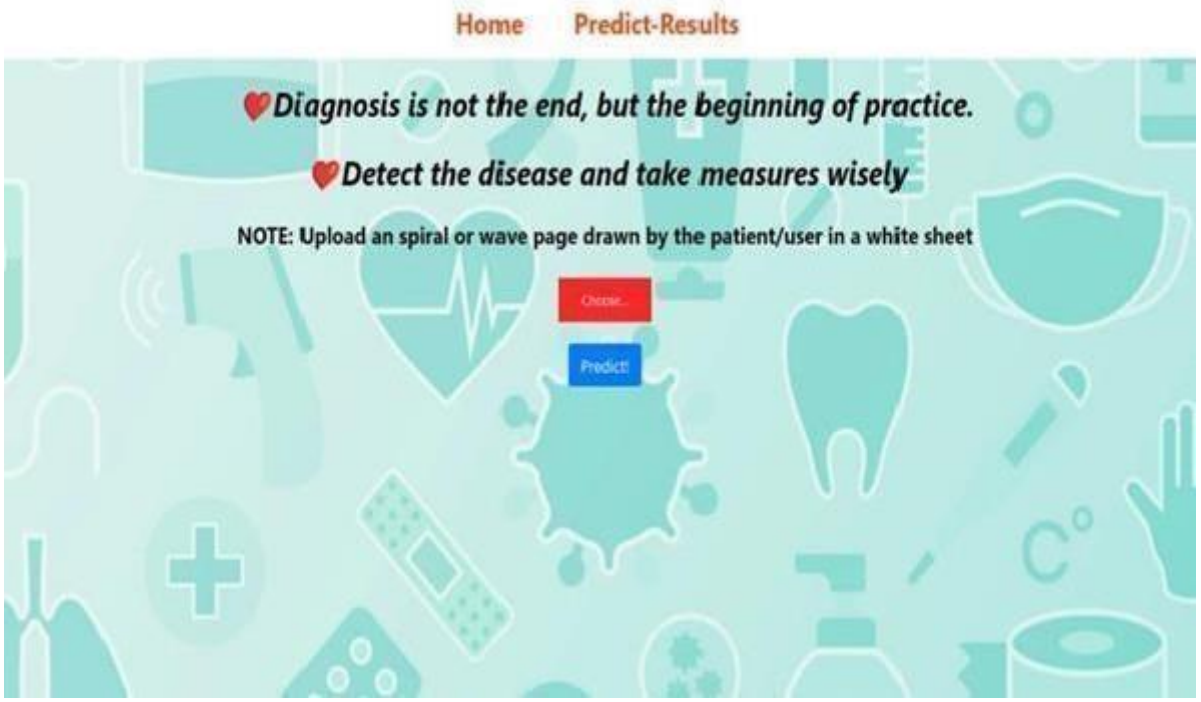
Home Predict-Results

How brains looks during PD?

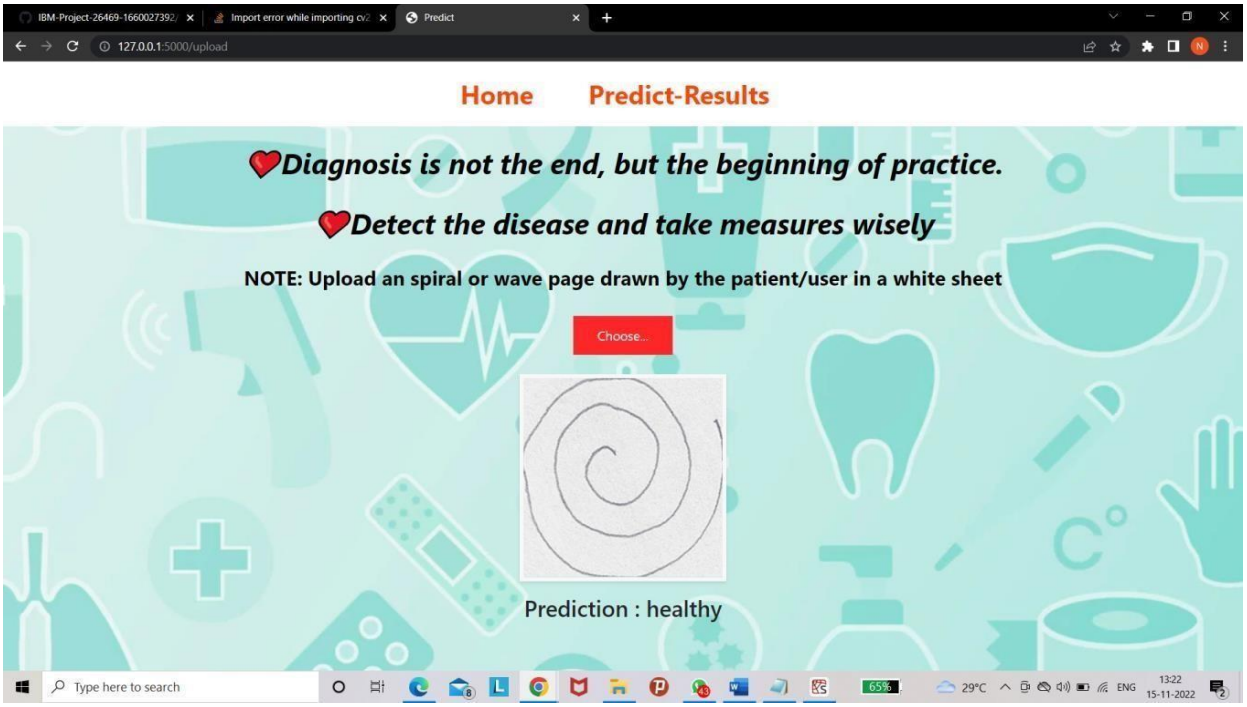


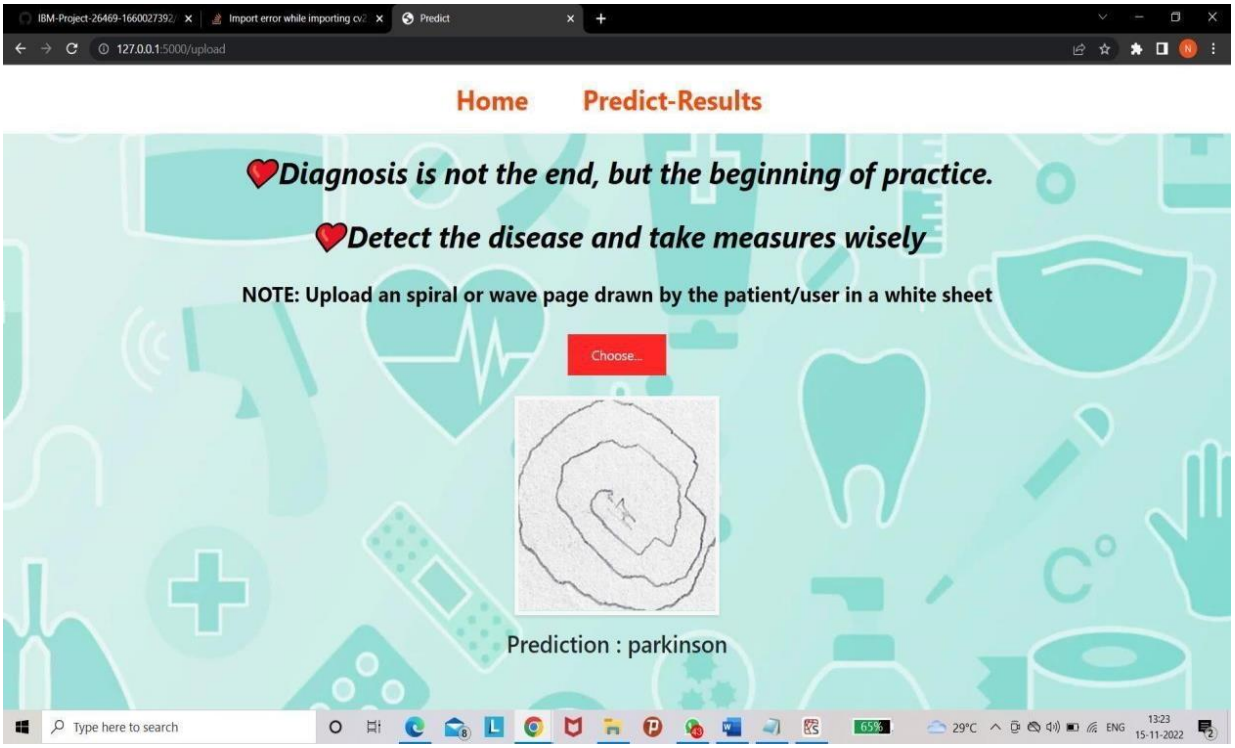


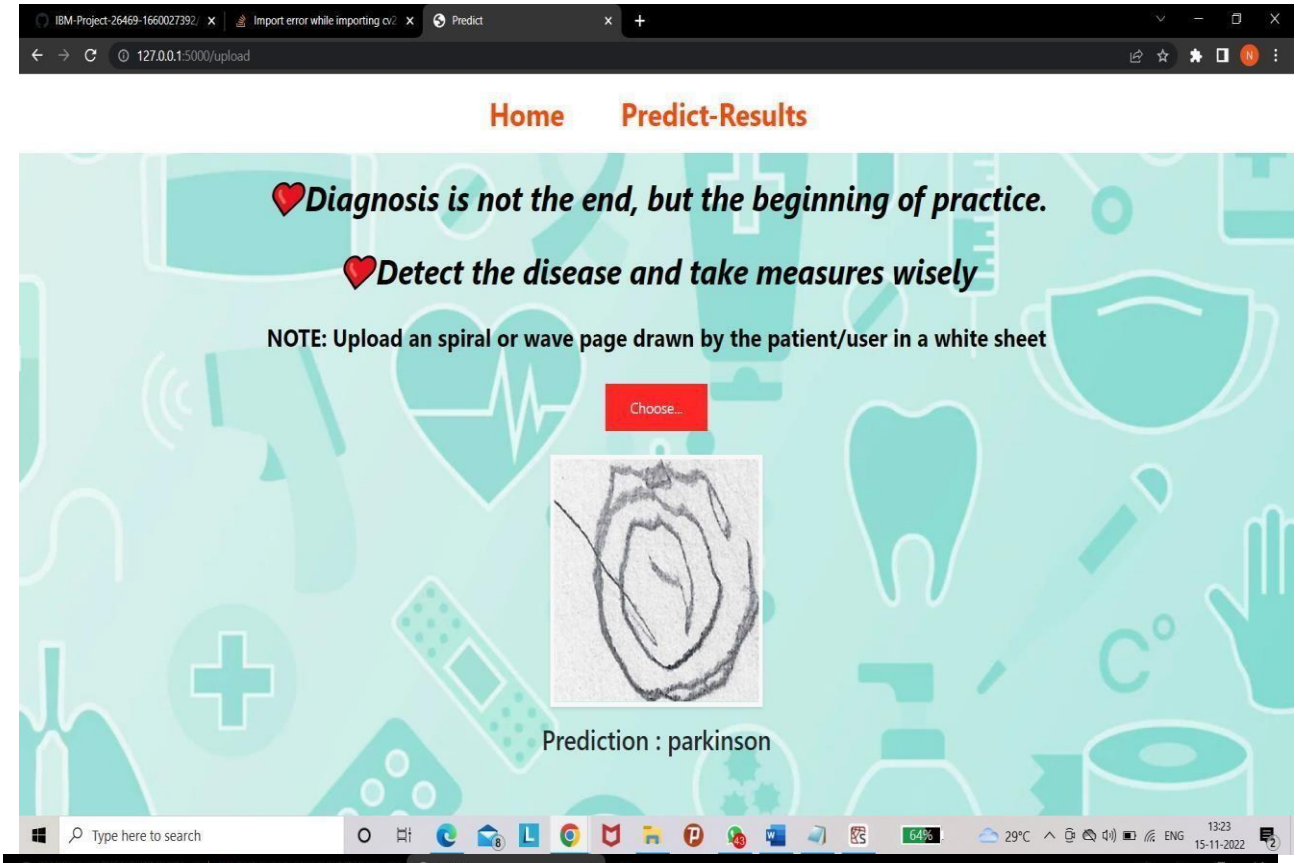
Test-Vital Page

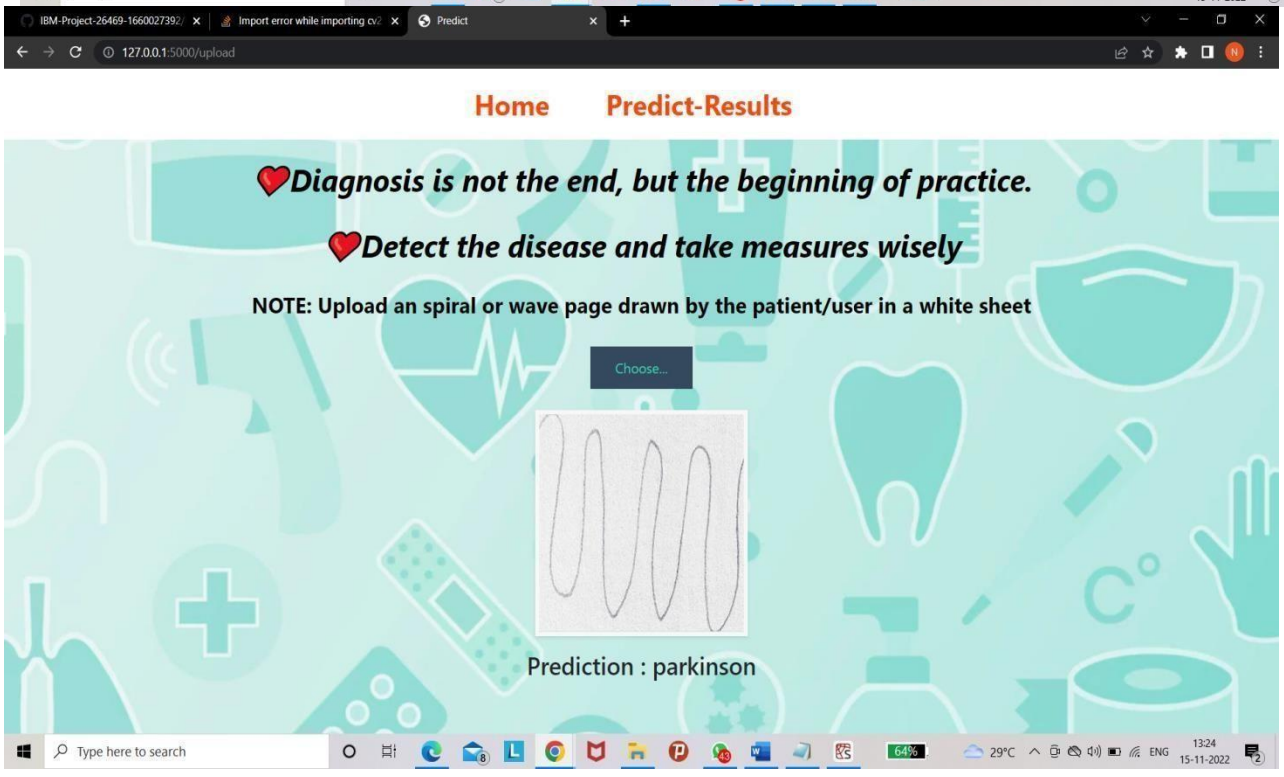


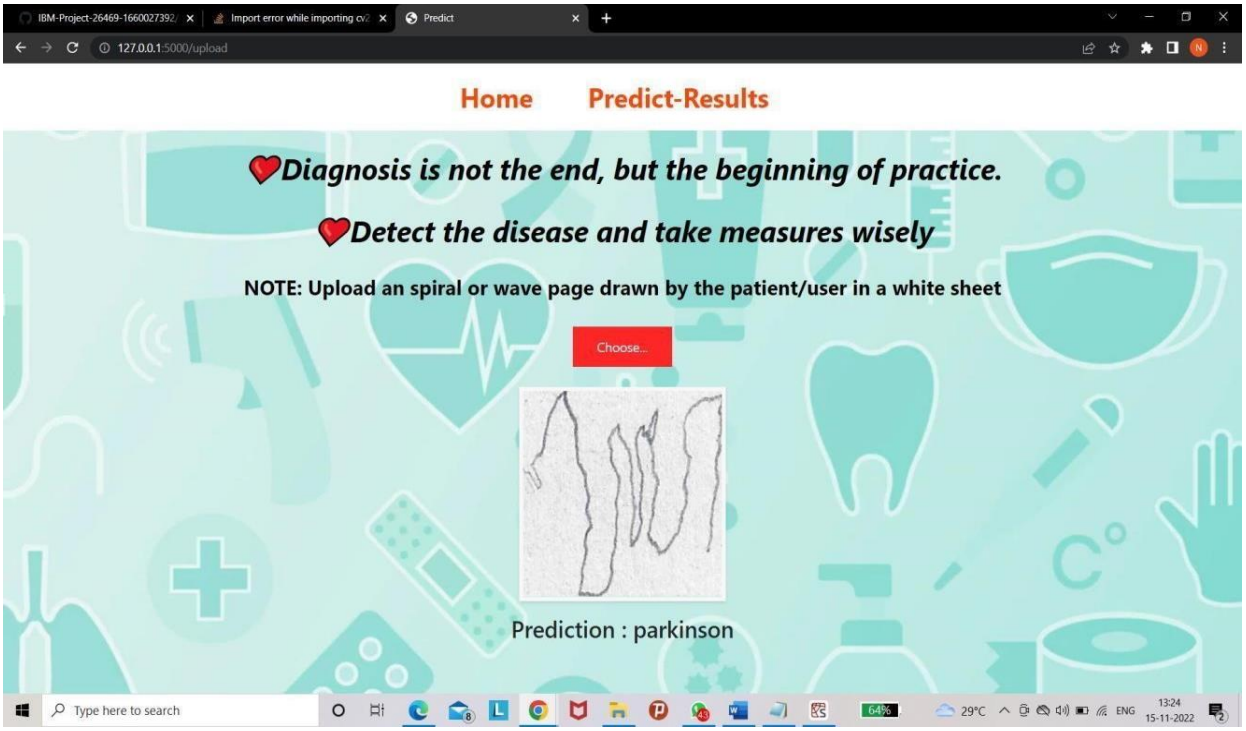
Predicted Result of Spiral/Wave Images


IBM-Project-26469-1660027392
Import error while importing cv2
Predict
127.0.0.1:5000/upload
Home
Predict-Results
Diagnosis is not the end, but the beginning of practice.
Detect the disease and take measures wisely
NOTE: Upload an spiral or wave page drawn by the patient/user in a white sheet
Choose...
Prediction : healthy
Type here to search
29°C
ENG
13:22
15-11-2022


IBM-Project-26469-1660027392
Import error while importing cv2
Predict
127.0.0.1:5000/upload
Home
Predict-Results
Diagnosis is not the end, but the beginning of practice.
Detect the disease and take measures wisely
NOTE: Upload an spiral or wave page drawn by the patient/user in a white sheet
Choose...
Prediction : parkinson
Type here to search
29°C
ENG
13:23
15-11-2022


IBM-Project-26469-1660027392
Import error while importing cv2
Predict
127.0.0.1:5000/upload
Home
Predict-Results
Diagnosis is not the end, but the beginning of practice.
Detect the disease and take measures wisely
NOTE: Upload an spiral or wave page drawn by the patient/user in a white sheet
Choose...
Prediction : parkinson
Type here to search
64%
29°C
ENG
13:23
15-11-2022


IBM-Project-26469-1660027392
Import error while importing cv2
Predict
127.0.0.1:5000/upload
Home
Predict-Results
Diagnosis is not the end, but the beginning of practice.
Detect the disease and take measures wisely
NOTE: Upload an spiral or wave page drawn by the patient/user in a white sheet
Choose...
Prediction : parkinson
Type here to search
64%
29°C
ENG
13:24
15-11-2022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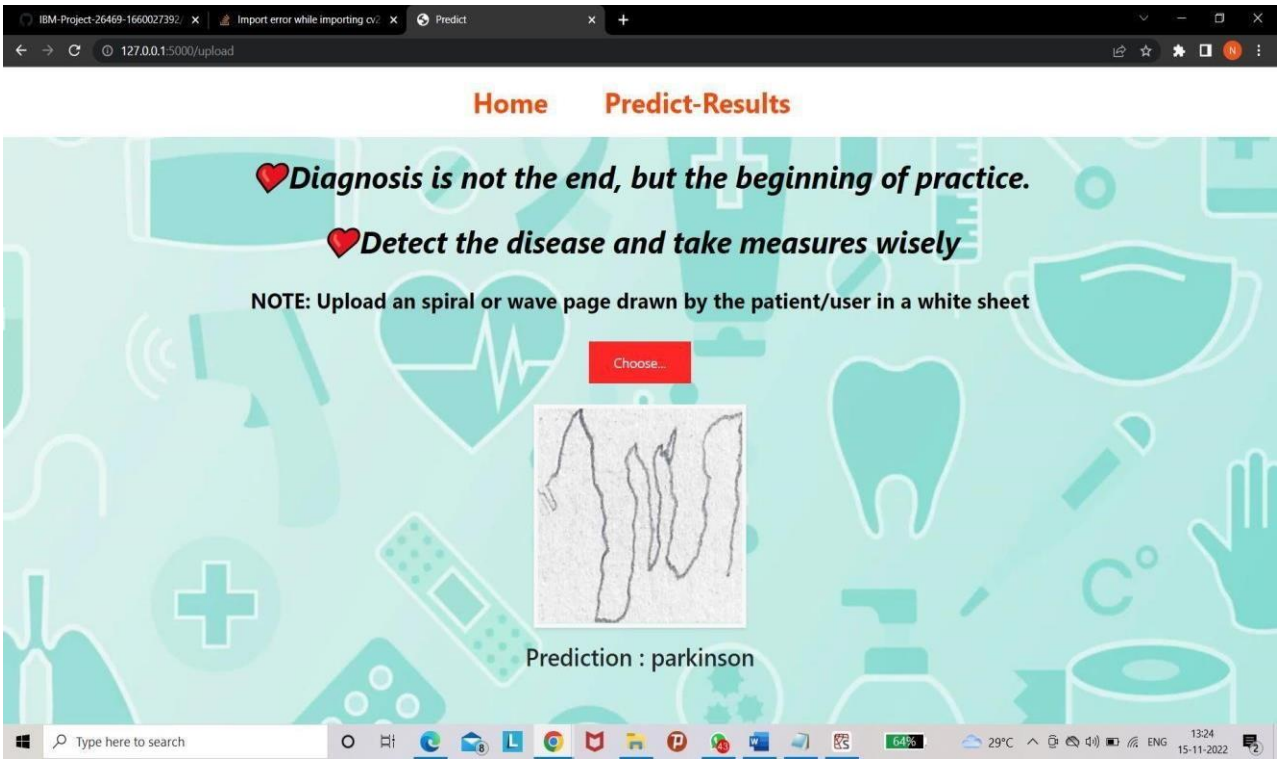
Prediction : parkinson
Type here to search
64%
29°C
ENG
13:24
15-11-2022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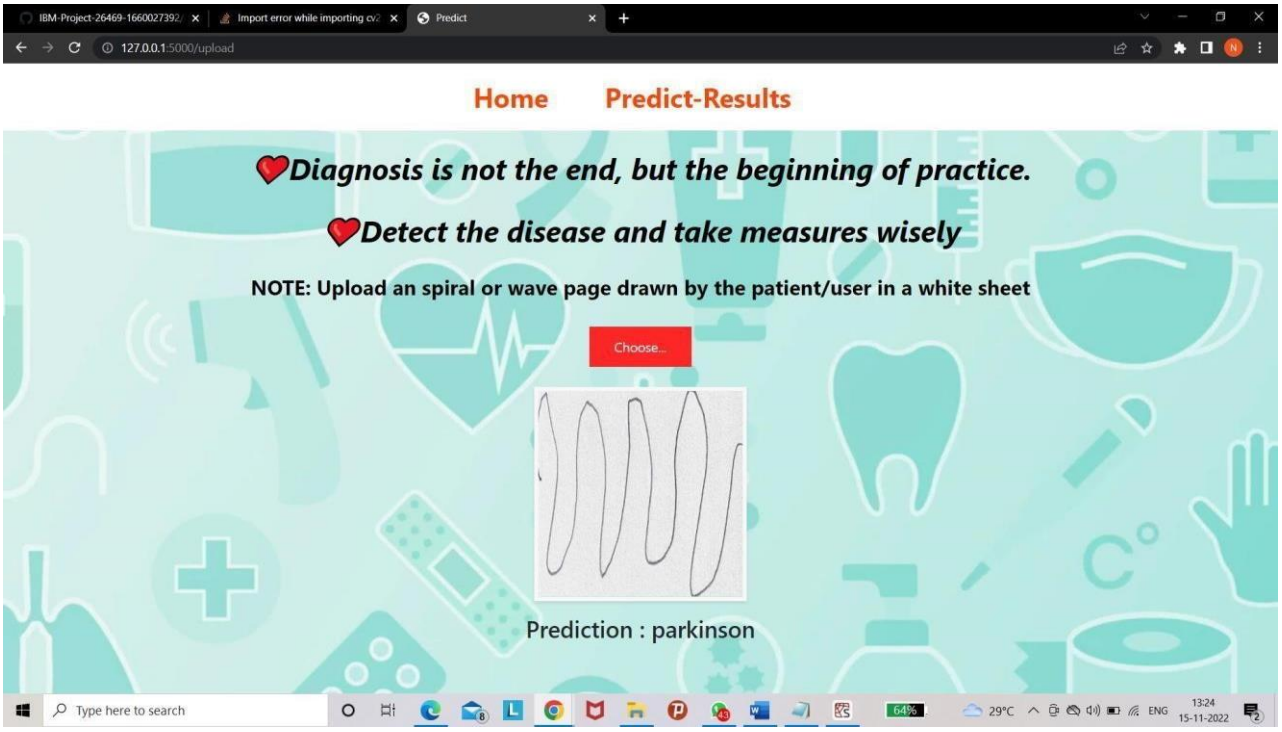
Prediction : parkinson
Type here to search
64%
29°C
ENG
13:24
15-11-2022


IBM-Project-26469-1660027392
Import error while importing cv2
Predict
127.0.0.1:5000/upload
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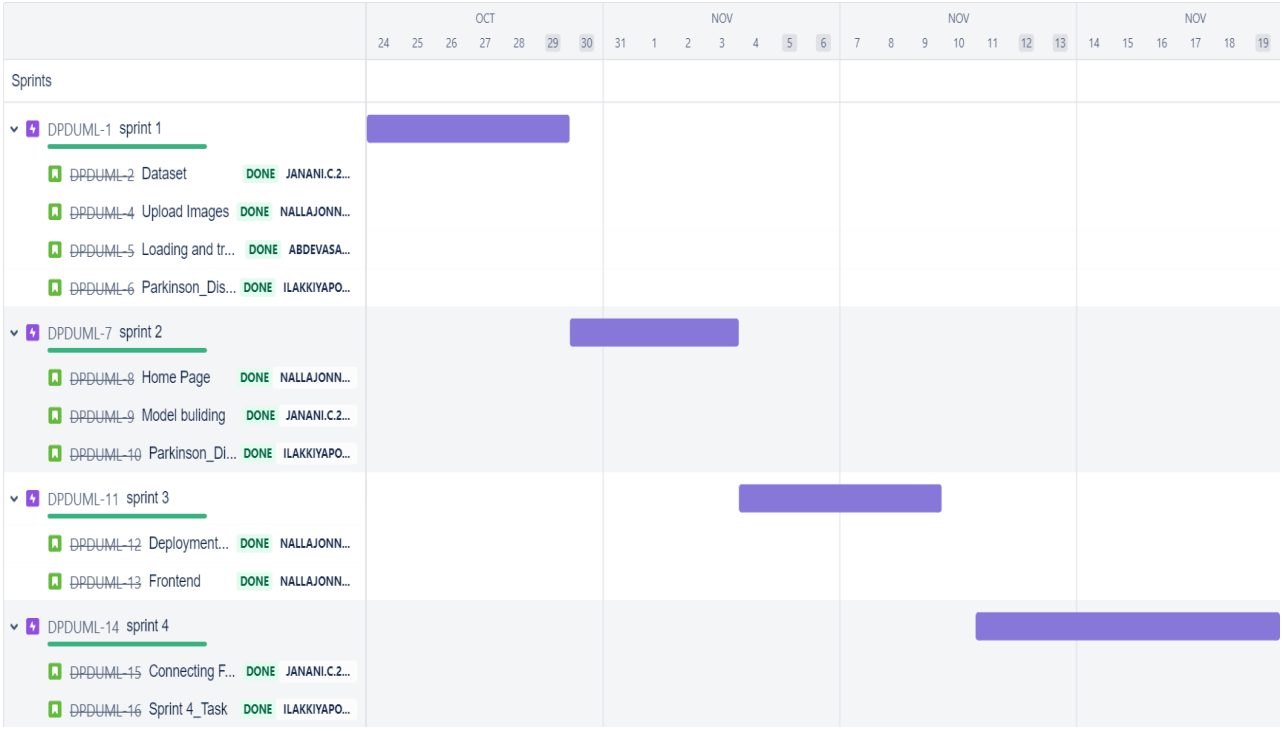
Choose...
Prediction : parkinson
Type here to search
29°C
ENG
13:24
15-11-2022

Jira File


OCT
NOV
NOV
NOV
24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
Sprints
DPDUML-1 sprint 1
DPDUML-2 Dataset DONE JANANI.C.2...
DPDUML-4 Upload Images DONE NALLAJONN...
DPDUML-5 Loading and tr... DONE ABDEVASA...
DPDUML-6 Parkinson_Dis... DONE ILAKKIYAPO...
DPDUML-7 sprint 2
DPDUML-8 Home Page DONE NALLAJONN...
DPDUML-9 Model buliding DONE JANANI.C.2...
DPDUML-10 Parkinson_Di... DONE ILAKKIYAPO...
DPDUML-11 sprint 3
DPDUML-12 Deployment... DONE NALLAJONN...
DPDUML-13 Frontend DONE NALLAJONN...
DPDUML-14 sprint 4
DPDUML-15 Connecting F... DONE JANANI.C.2...
DPDUML-16 Sprint 4_Task DONE ILAKKIYAPO...

Conclusion

Parkinson's disease affects the CNS of the brain and has yet no treatment unless it's detected early. Late detection leads to no treatment and loss of life. Thus, its early detection is significant. Machine Learning techniques is used to improve the accuracy of early diagnosis significantly. So, our Machine Learning model can help doctors and assist them in detecting Parkinson's disease at an earlier stage and increase the chances of survival.

Demo Link:
https://drive.google.com/file/d/1k1QOBDGBajSNktwF7nL5gpWd6_GbqogF/view?usp=drivesdk

GITHUB:

https://github.com/IBM-EPBL/IBM-Project-26469-1660027392