PROJECT REPORT

FERTILIZERS RECOMMENDATION SYSTEM FOR DISEASE PREDICTION

IBM-PROJECT-ID	**:**	IBM-Project-22221-1659835923
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1.INTRODUCTION

Agriculture Sector remained resilient even after the pandemic in India. It effectively met rising global food demands while maintaining a continuous supply chain of vital food goods across the country. India's agriculture sector employs a large number of people and is second after China in terms of producing fruits and vegetables. Traditional farming methods, on the other hand, are ineffective. It fails to make proper use of all available resources. Because the primary focus is on production, traditional methods frequently result in soil nutrient depletion and weariness. By producing only certain crops, the earth is depleted.

1.1 PROJECT OVERVIEW

The early identification of disease symptoms is made possible by the detection and recognition of plant diseases using machine learning. For the purpose of diagnosing plant diseases, plant pathologists can examine digital photographs utilising digital image processing. Simply said the use of computer vision and image processing techniques benefits farmers across all areas of agriculture. In most cases aberrant physiological functioning of plants is what causes plant diseases. Therefore, the difference between the plants' regular physiological capabilities and abnormal physiological functionalities leads to the generation of the specific symptoms. The pathogens that typically infect plant leaves are found on the stems of the plants. Different image processing techniques can forecast these various leaf signs and diseases. These many approaches make use of various core techniques like segmentation, feature extraction, and classification, among others. Most often, segmentation is used to distinguish between healthy and diseased tissues of leaves in order to forecast and diagnose leaf diseases.

1.2 PURPOSE

This project is used to test the fruits and vegetables samples and identify the different diseases. Also, this project recommends fertilizers for predicted diseases.

2.LITERATURE SURVEY

[1] The current work examines and describes image processing strategies for identifying plant diseases in numerous plant species. BPNN, SVM, K-means clustering, and SGDM are the most common approaches used to identify plant diseases. Disadvantages : Some of the issues in these approaches include the impact of background data on the final picture, optimization of the methodology for a specific plant leaf disease, and automation of the technique for continuous automated monitoring of plant leaf diseases in real-world field circumstances

[2] This method used datasets to find diseased and healthy plant leaves. we introduced a deep convolutional neural network to identify crop series and diseases that may not be present in the plant tissue. The model trained on the test set has an accuracy of 99.35%.

This process is enabled by deep learning, machine learning and digital epidemiologyA neural network associate's images of diseased plants and crops as a pair. A neural network node is a mathematical function that receives numerical inputs from input edges and provides numerical outputs as output edges. We analyze 54,306 images of plant leaves that have been assigned a variance of 38 class labels.

[3] The author proposes a method which helps us predict crop yield by suggesting the best crops. It also focuses on soil types in order to identify which crop should be planted in the field to increase productivity. In terms of crop yield, soil types are vital. By incorporating the weather details of the previous year into the equation, soil information can be obtained.

Advantages :

It allows us to predict which crops would be appropriate for a given climate. Using the weather and disease related data sets, the crop quality can also be improved. Prediction algorithms help us to classify the data based on the disease, and data extracted from the classifier is used to predict soil and crop

[4] The proposed method uses SVM to classify tree leaves, identify the disease and suggest the fertilizer. The proposed method is compared with the existing CNN based leaf disease prediction. The proposed SVM technique gives a better result when compared to existing CNN. For the same set of images, F-Measure for CNN is 0.7and

Advantages :

The prediction and diagnosing of leaf diseases are depending on the segmentation such as segmenting the healthy tissues from diseased tissues of leaves.

Disadvantages :

This further research is implementing the proposed algorithm with the existing public datasets. Also, various segmentation algorithms can be implemented to improve accuracy. The proposed algorithm can be modified further to identify the disease that affects the various plant organs such as stems and fruits.

[5] This proposed system explains about the water needs of plants vary from place to place due to changes in soil content, texture, climatic factors, and more. In addition to water requirements, plant diseases can also cause plants not to grow properly. In this article, we proposed a new intelligent irrigation system that can automatically control irrigation using an Android mobile application. In addition, photos of plant leaves are captured and sent to the cloud server. This is further processed and compared with images of diseased plant leaves in the cloud database. Based on the comparison, a list of suspected plant diseases is displayed to the user via an Android mobile application.

[6] In our country agriculture is the main occupation. Most of the people lead their life from the agriculture field, they are fully relying on agricultural products. If any plant is enduring disease, then it causes reduction in both quality and quantity of agriculture crops. Hence it is necessary to detect and analyze disease. Authentic exposure and recognition of crop disease plays an important role in adequately regulating and inhibiting disease for feasible agriculture and food preservation. Thus detection and diagnosis of disease at the right time is essential to the farmer. This proposed system offers a candid and computationally resourceful manner which is useful in the leaf disease detection and selection of fertilizers using artificial neural networks.

[7] Recent developments in machine learning approaches in the agriculture sector are up-and-coming. They have been receiving significant interest from academia, industries, and governments. This section reviews some of the existing work supporting the detection of crop diseases using different machine learning approaches.

[8] The proposed method makes use of soil and PH samples as input and helps predict plants that can be recommended for soil and fertilizer that can be suitable. Information on the ground is collected by sensors and the data is transmitted from the Arduino via Zigbee and WSN (Wireless Sensor Network) to MATLAB. Analysis and processing of soil data are performed using ANN (Artificial Neural Neural Networks) and crop recommendations are carried out using SVMs (SupportVectorMachines)

2.1 EXISTING PROBLEM

Agriculture is the main aspect of country development. Many people lead their life from agriculture field, which gives fully related to agricultural products. Plant disease, especially on leaves, is one of the major factors of reductions in both quality and quantity of the food crops. In agricultural aspects, if the plant is affected by leaf disease then it reduces the growth of the agricultural level. Finding the leaf disease is an important role of agriculture preservation. After pre-processing using a median filter, segmentation is done by Guided Active Contour method and finally, the leaf disease is identified by using Support Vector Machine. The disease-based similarity measure is used for fertilizer recommendation.

2.2 REFERENCES

[1] Reyes Angie .K, Juan C. Caicedo, and Jorge E. Camargo, "Fine-tuning Deep Convolutional Networks for Plant Recognition", In CLEF (Working Notes), 2015.

[2] Hamrouni .L, Aiadi .O, Khaldi .B and Kherfi .M.L, "Plants Species Identification using Computer Vision Techniques", Revue des Bioressources 7, no. 1, 2018.

[3] Dimitrovski, Ivica, GjorgjiMadjarov, DragiKocev, and PetreLameski, "Maestra at LifeCLEF 2014 Plant Task: Plant Identification using Visual Data", In CLEF (Working Notes), pp. 705-714, 2014.

[4] Naresh, Y. G., and H. S. Nagendraswamy, "Classification of medicinal plants: an approach using modified LBP with symbolic representation", Neurocomputing 173, pp: 1789-1797, 2016.

[5] Bindu Garg and Tanya Sah, "Prediction of Crop Yield Using Fuzzy-Neural System" , 19th October,2019. https://link.springer.com/chapter/10.1007/978- 3-030-19562-5_2119562-5_21

[6] Bindu Garg, B., Beg, M. M. S. & Ansari, A. Q. “Fuzzy time series model to forecast rice production, July-2013” https://www.researchgate.net/publication/258282994_Fuzzy_Time_Series_Model_to_Forecast_ Rice_Production

[7] Website DAVIS, L. E..25 1943. MEASUREMENTS OF pH WITH THE GLASS ELECTRODE AS AFFECTED BY SOLL MOISTURE Soll Sel. 56: 405-422, Illus.

[8] James. N. Mugo, Nancy N. Karanja, Charles K. Gachene, Klaus Dittert, Shadrack O. Nyawade,and Elmar Schulte-Geldermann - Assessment of soil fertility and potato crop nutrient status in central and eastern highlands of Kenya, 8th May, 2020. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7210878/

2.3 PROBLEM STATEMENT DEFINITION

The primary driver of national development is agriculture. Many individuals work in agriculture, which is directly tied to agricultural products. One of the main causes of decreases in the quality and quantity of food crops, particularly on leaves, is plant disease. The growth of the agricultural level is slowed down in agricultural elements if the plant has leaf disease. It is crucial for you to find the leaf illness. Preservation of agriculture After pre-processing with a median filter, guided active contour method segmentation is used to identify the leaf illness.

Example:

Problem Statement 1:

Problem Statement 2:

Problem Statement 3:

Problem Statement (PS)	I am (Customer)	I'm trying to	But	Because	Which makes me feel
PS 1	A Farmer	On my phone find the plant disease	Long time is required	Th webpage doesn't respond	Frustrated
PS 2	Student	Develop healthy plants	Disease always has an impact on it	I'm knowledgeable about it	Fear of fertiliser usage errors
PS 3	The Gardener	Determine the cause of the plant' s spots	Unable to specify which type	I require software that can identify plant diseases	Useful

3. IDEATION & PROPOSED SOLUTION

The proposed approach was organised in such a manner, that it is universal to all the users in the world.

3.3 PROPOSED SOLUTION

Problem Statement

- The various illnesses that impact plant growth are the main reason for production loss in agricultural products..
- Due to a lack of expertise and outdated methods, farmers are unable to identify crop diseases.
- The plant disease is one of the major problem in agricultural field. If the plant is affected by a leaf disease, it reduces the growth of Plant and productiveness.

Idea / Solution description

- Image processing helps in identification of the plants specification and disease detection that helps in classifying the plants based on disease.
- Predicts the plant disease and recommend suitable fertilizers for the Plant. By using CNN, the software analysis the plant image and detect the disease and recommend fertilizers.

Novelty / Uniqueness

The software advises both organic and inorganic fertilisers, and farmers can place online orders for the fertilisers that are readily accessible.

Social Impact / Customer Satisfaction

- Complete irrigation data provided via cloud computing.
- The quality and quantity of the produce are improved by recognizing diseases early and recommending fertilizer.

Business Model (Revenue Model)

- Helps farmers produce food goods in a good way and cuts down on production losses earlier.
- Crop yield, crop efficiency, and agricultural product output will all rise with the suggested approach.
- Agriculture output will expand significantly, and profit will be increased.

Scalability of the Solution

- The proposed structure for precision agriculture enables the application of a flexible methodology that may be modified for various types of crops.
- The software will predict accurate solution based on the trained data.

3.4 PROBLEM SOLUTION FIT

CUSTOMER SEGMENTS

Farmers are the customers who are going to use this application Farmers can interact with the portal build. Interacts with the user interface to upload images of diseased leaf. Our model-built analyses the Disease and suggests the farmer with fertilizers are to be used.

JOBS-TO-BE-DONE / PROBLEMS

A disease that affects plants could result in decreased crop production and a decline in the production of agricultural goods.

TRIGGERS

Adapt to climate change and operate in water scare environment and intensifying agriculture on existing land, reversing soil degradation.

EMOTIONS

Before:

Is there a way to get help?

After:

User-friendly, easy to browse, with available 24/7 support/help choices.

AVAILABLE SOLUTIONS

Non efficient image processing algorithms were used in earlier systems. This traditional approach gives lower accuracy and is time consuming. This drawback of the existing system propelled us towards the idea for developing a system that could ease this effort.

CUSTOMER CONSTRAINTS

Anxiety:

When the consumer was still unsure of how to utilise the fertiliser, they started to become nervous.

Mysteries:

They might have called it a mystery because they couldn't solve it.

BEHAVIOUR

Searches for the top disease prediction and fertilizer advise applications. A situation of this nature arises when the farmer is ignorant of the sickness.

PROBLEM ROOT CAUSE

The type of disease affecting the crops is unknown to the farmers. The farmer must consult an expert to produce.

YOUR SOLUTION

To determine what type of disease is affecting the plants and how to minimise its effect in deep learning algorithms are used. Its also suggests using fertiliser to treat those attributes.

4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

When the Farmer Don’t have the knowledge about disease this kind of situation occurs.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
1	User Registration	Utilizing a website or application to register
2	User Confirmation	Authenticating via OTP Authenticating via Gmail
3	User work	Take photo Upload from gallery
4	Image processing	Upload the photograph to help with leaf disease prediction.
5	Prediction result	The official name of the illness is fertiliser for that illness.
6	Final part	Type of Leaf disease is predicted

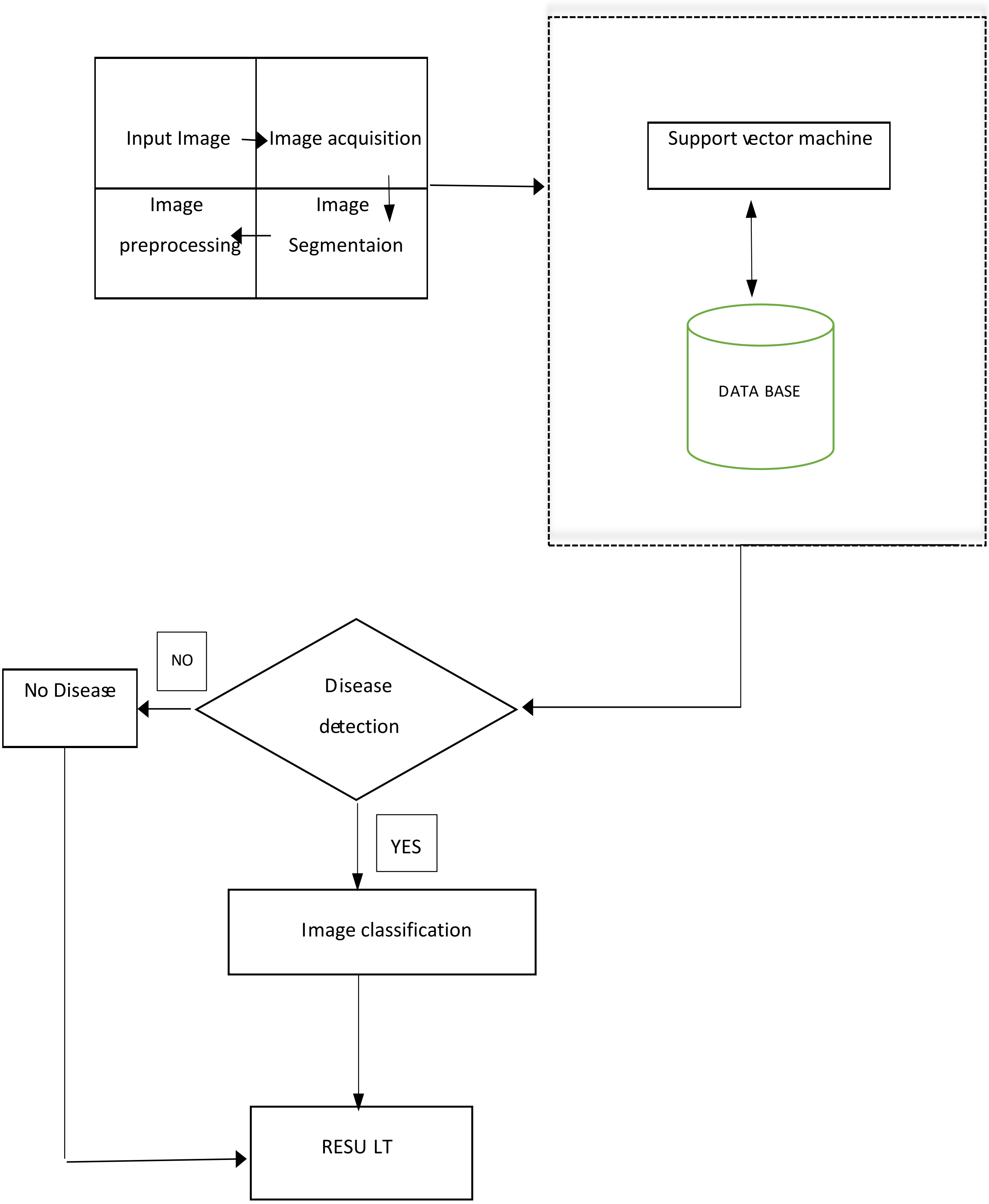
4.1 FUNCTIONAL REQUIREMENTS

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

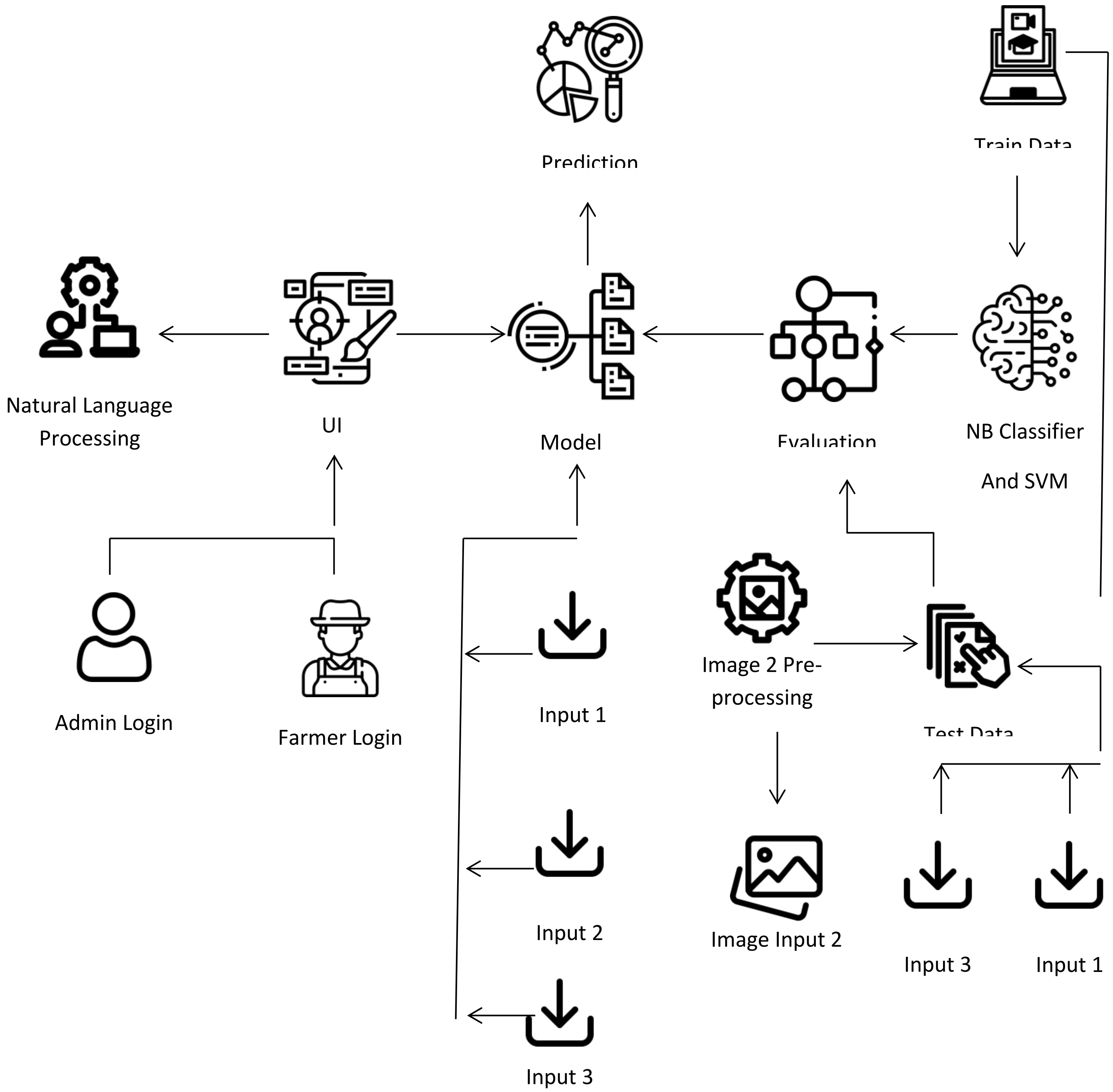
FR NO.	Non-functional requirement	Description
1	Usability	The expected level of system interaction from users.
2	Security	Software needs to be secured from malicious attacks and other hacking risks in order to continue working as intended.
3	Reliability	An algorithm for plant disease identification that never fails
4	Performance	The models' efficient deployment in the IBM cloud will result in good performance.
5	Availability	Everyone only has the access to the ability to predict plant disease.
6	Scalability	The system's capacity to modify its performance and cost in response to shifts in application and system processing demands.

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS



5.2 SOLUTION & TECHNICAL ARCHITECTURE



5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email as a user, password, and confirming my password.	I can access my profile / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	I can Access the Application via Gmail	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can use the Application for Disease Prediction	High	Sprint-1
Customer (Web user)	Registration	USN-6	As a Web user, I can register with a User ID on the System	I can able to access the app as a website	High	Sprint-1
Customer Care Executive	Customer Support	USN-7	As a Supporter, I can Understand exactly how customer use the product	I can create Guidelines and Practices for Customer	Low	Sprint-2
Administrator	Analyst	USN-8	As a Admin, I can Update many dataset about the Plant Diseases	I can able to store large Amount of Data	High	Sprint-1
Customer Purpose	Prediction	USN-9	It uses AI to identify the Plants Disease within the Captured photos and Live View of Prediction	I can Predict Disease of the Plant	High	Sprint-1

6. PROJECT PLANNING & SCHEDULING

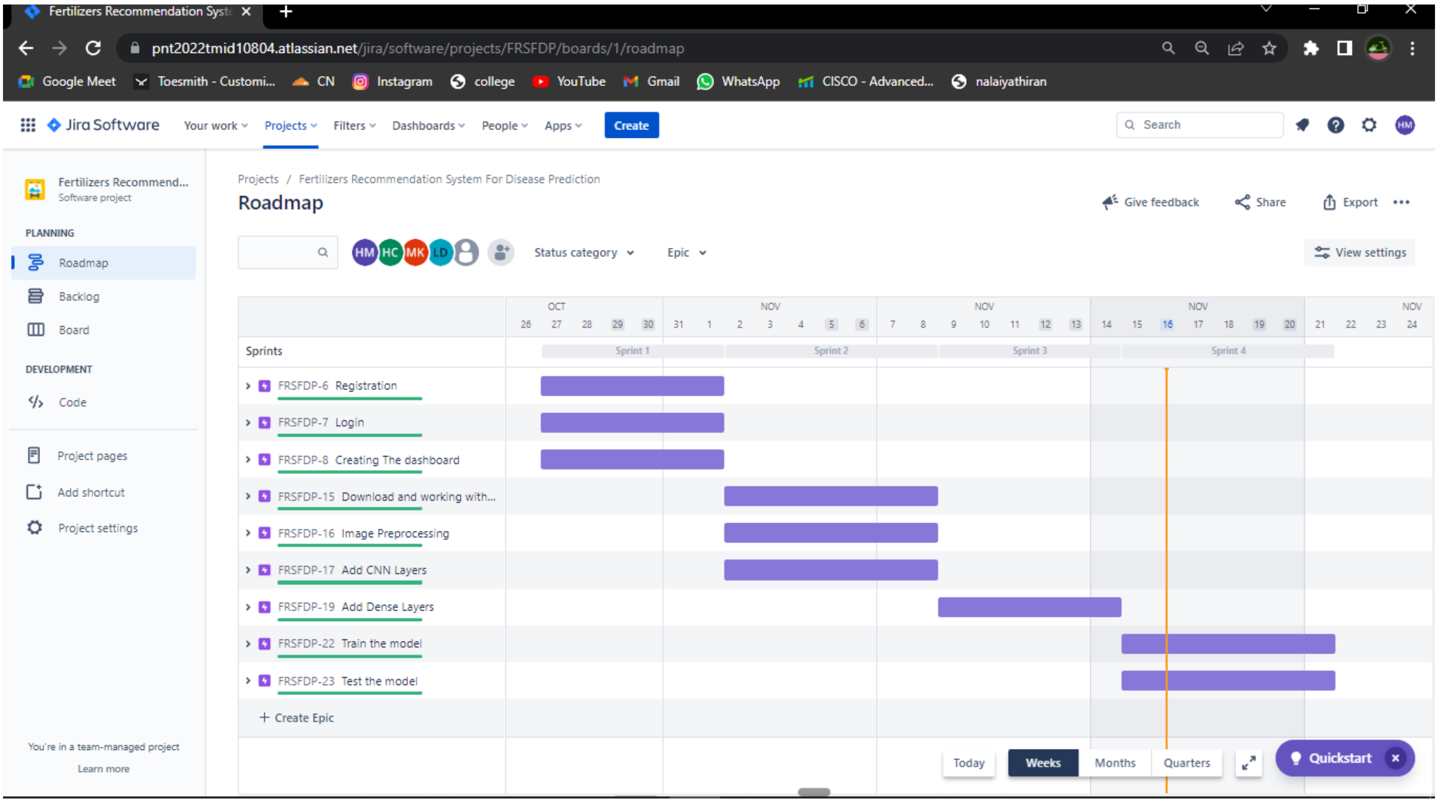
6.1 SPRINT PLANNING & ESTIMATION

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	27 Oct 2022	01 Nov 2022	20	01 Oct 2022
Sprint-2	20	6 Days	02 Nov 2022	8 Nov 2022	20	08 Nov 2022
Sprint-3	20	6 Days	9 Nov 2022	14 Nov 2022	20	14 Nov 2022
Sprint-4	20	6 Days	15 Nov 2022	21 Nov 2022	20	21 Nov 2022

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	Hariharan M Hemanath C
		USN-2	As a user, I will receive confirmation email once I have registered for the application	2	High	Hemanath C Mahan K Logesh D
		USN-3	As a user, I can register for the application through Gmail	2	Medium	Hemanath C Hariharan M Mahan K
	Login	USN-4	As a user, I can log into the application by entering email & password	4	High	Hariharan M Hemanath C
	Creating The dashboard	USN-5	Create the Dashboard to Interacts with the user interface to upload images	10	High	Hemanath C Mahan K Logesh D Hariharan M
Sprint-2	Download and working with the dataset	USN-6	To work on the given dataset, Download and Understand the Dataset.	2	Medium	Hemanath C
			Load the dataset	2	Medium	Hemanath C
	Image Preprocessing		Format images in the dataset before they are used by model training	4	Medium	Mahan K Hemanath C
			Import the Libraries	4	Medium	Hemanath C Hariharan M
			Initializing the model	4	Medium	Hemanath C
	Add CNN Layers	USN-7	Adding three layers for CNN • Convolution layer • Pooling layer • Flattening layer	4	High	Hemanath C Hariharan M Logesh D Mahan K
Sprint-3	Add Dense Layers	USN-8	Add a hidden layer and output layer	20	High	Hemanath C Mahan K
Sprint-4	Train the model	USN-9	Using the dataset, Train the model for disease prediction to recommend the fertilizer	10	Medium	Hemanath C Hariharan M Mahan K
	Test the model	USN-10	Test the model with different data	10	High	Hemanath C Mahan K

6.3 REPORTS FROM JIRA



7. CODING & SOLUTIONING

7.1 FEATURE 1

Image Enhancement - Image Histogram

Import required packages necessary for image processing.

InÂ [1]:

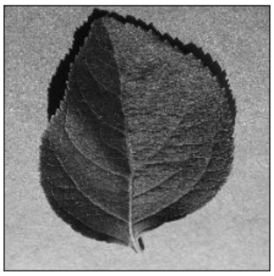
```
import cv2
import matplotlib.pyplot as plt
import numpy as np
%matplotlib inline
```

InÂ [2]:

```
img = cv2.imread('/content/0a285c8b-1c31-48d4-89f2-af8b9edc36f6___RS_HL 5759.JPG', 0)
plt.imshow(img, cmap='gray'), plt.grid(False)
plt.xticks([]), plt.yticks([])
```

Out[2]:

```
(([], <a list of 0 Text major ticklabel objects>),
 ([], <a list of 0 Text major ticklabel objects>))
```



1-Histogram of an image

cv2.calcHist(images, channels, mask, histSize, ranges[, hist[, accumulate]])

7.2 FEATURE 2

5380 lines (5380 sloc) | 662 KB

Raw | Blame

In [1]:
```
from keras.preprocessing.image import ImageDataGenerator
train_datagen = ImageDataGenerator (rescale = 1./255, shear_range= 0.2,zoom_range= 0.2, horizontal_flip = True)
test_datagen =ImageDataGenerator (rescale = 1)
```

In [2]:
```
from google.colab import files
```

In [3]:
```
uploaded = files.upload()
```

Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving fruit-dataset.zip to fruit-dataset.zip
```

In [4]:
```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

In [5]:
```
for fn in uploaded.keys():
  print('User uploaded file "{name}" with length {length} bytes'.format(
      name=fn, length=len(uploaded[fn])))
```

```
User uploaded file "fruit-dataset.zip" with length 98553840 bytes
```

In [6]:
```
!unzip drive/"My Drive"/images.zip
```

```
unzip:  cannot find or open drive/My Drive/images.zip, drive/My Drive/images.zip.zip or drive/My Drive/images.zip.ZIP.
```

In [7]:
```
!unzip /content/fruit-dataset.zip
```

```
Streaming output truncated to the last 5000 lines.
```

7.3 DATABASE SCHEMA

```
 flatten_1 (Flatten)         (None, 127008)            0

=================================================================
Total params: 896
Trainable params: 896
Non-trainable params: 0
_________________________________________________________________
```

In [81]:
```
model.add(Dense(300,activation='relu'))
model.add(Dense(150,activation='relu'))
```

In [82]:
```
model.add(Dense(9,activation='softmax'))
model.compile(loss='categorical_crossentropy',optimizer='adam',metrics=['accuracy'])
len(x_train)
```

Out[82]: 475

In [76]:
```
1238/24
```

Out[76]: 51.583333333333336

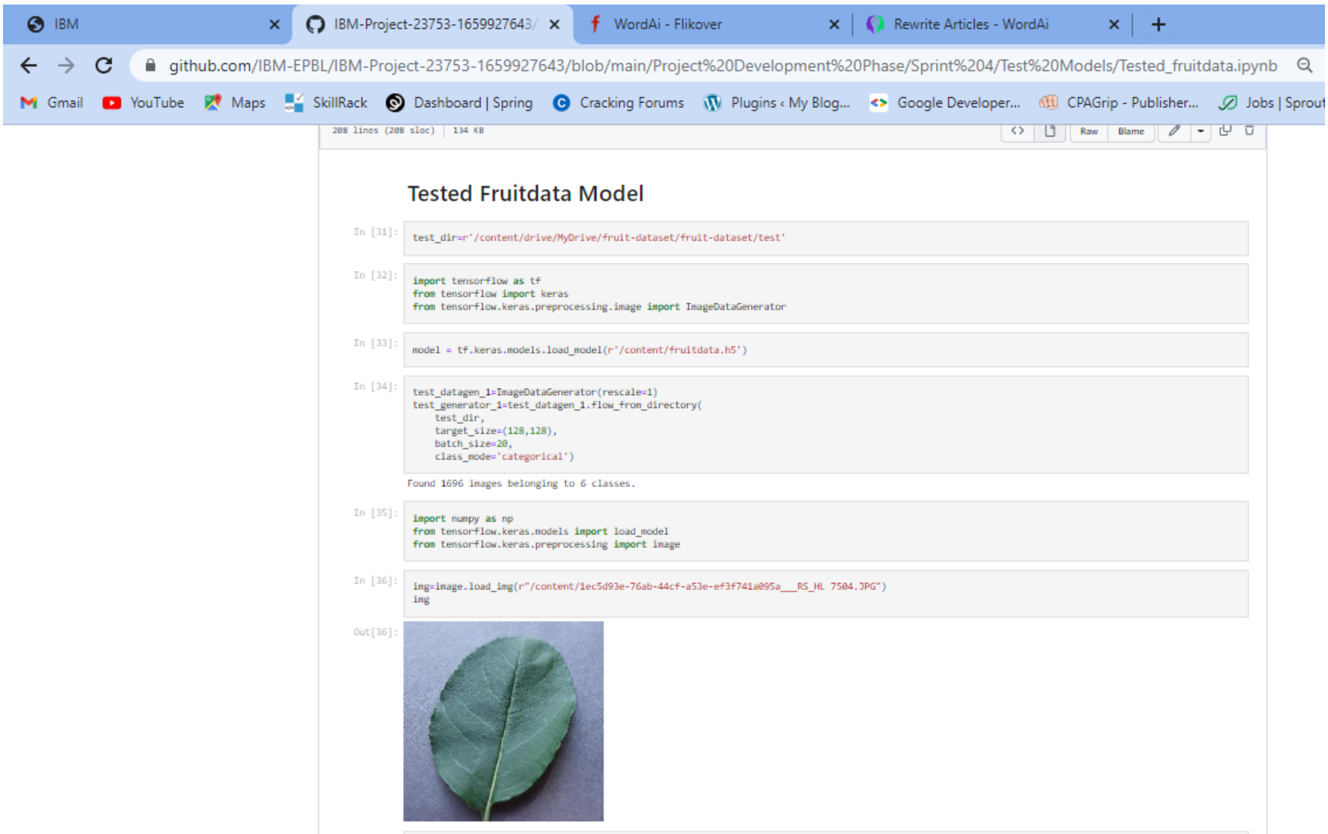
In [83]:
```
model.fit(x_train,steps_per_epoch=len(x_train),validation_data=x_test,validation_steps=len(x_test),epochs=10)
```

```
Epoch 1/10
475/475 [==============================] - 337s 707ms/step - loss: 2.0829 - accuracy: 0.1790 - val_loss: 2.0840 - val_accuracy: 0.1953
Epoch 2/10
475/475 [==============================] - 334s 703ms/step - loss: 2.0765 - accuracy: 0.1815 - val_loss: 2.0986 - val_accuracy: 0.1232
Epoch 3/10
475/475 [==============================] - 332s 699ms/step - loss: 2.0769 - accuracy: 0.1831 - val_loss: 2.0859 - val_accuracy: 0.1754
Epoch 4/10
475/475 [==============================] - 333s 701ms/step - loss: 2.0762 - accuracy: 0.1829 - val_loss: 2.0844 - val_accuracy: 0.1953
Epoch 5/10
475/475 [==============================] - 333s 701ms/step - loss: 2.0763 - accuracy: 0.1855 - val_loss: 2.0847 - val_accuracy: 0.1953
Epoch 6/10
475/475 [==============================] - 331s 697ms/step - loss: 2.0759 - accuracy: 0.1843 - val_loss: 2.0835 - val_accuracy: 0.1754
Epoch 7/10
475/475 [==============================] - 332s 699ms/step - loss: 2.0752 - accuracy: 0.1797 - val_loss: 2.0838 - val_accuracy: 0.1953
```

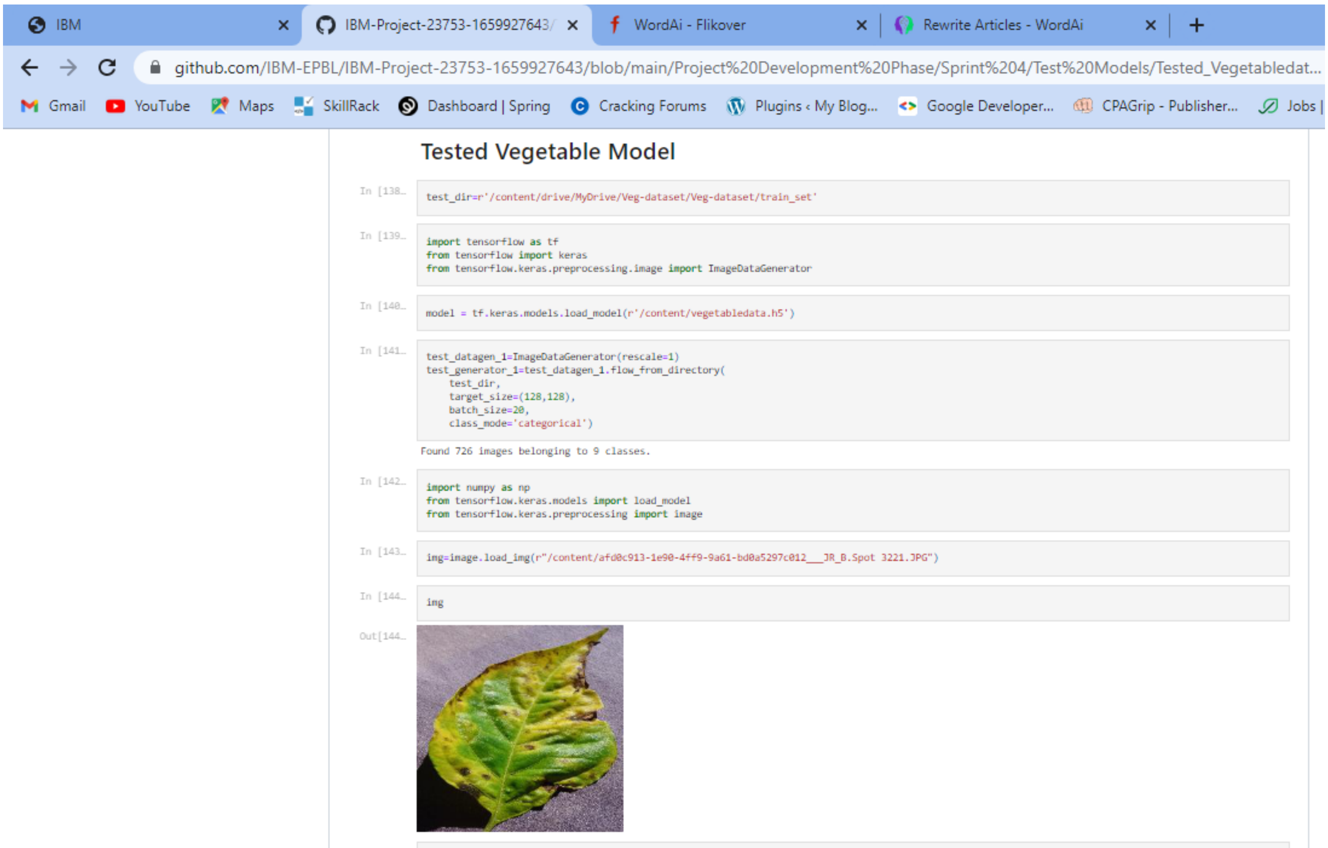
8. TESTING

8.1 TEST CASES

Fruit Case

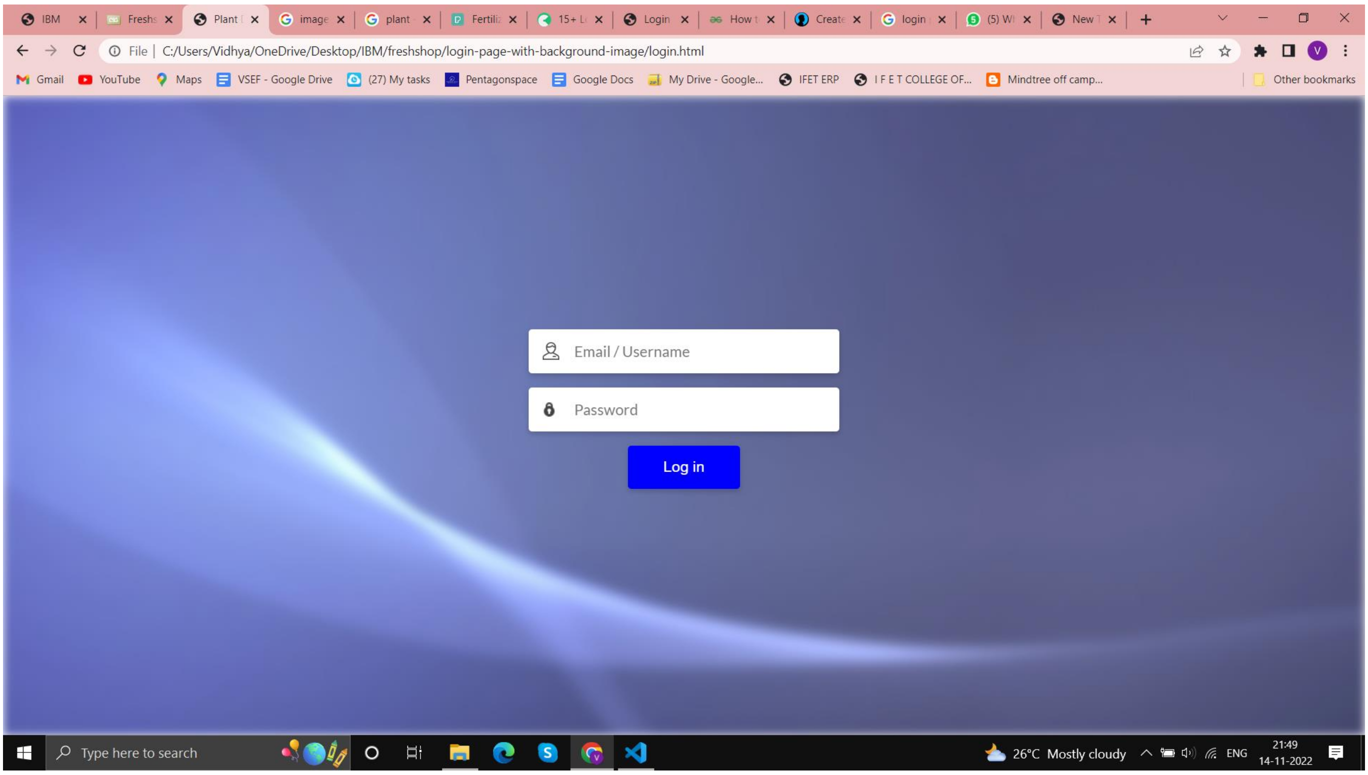


Vegetable Case

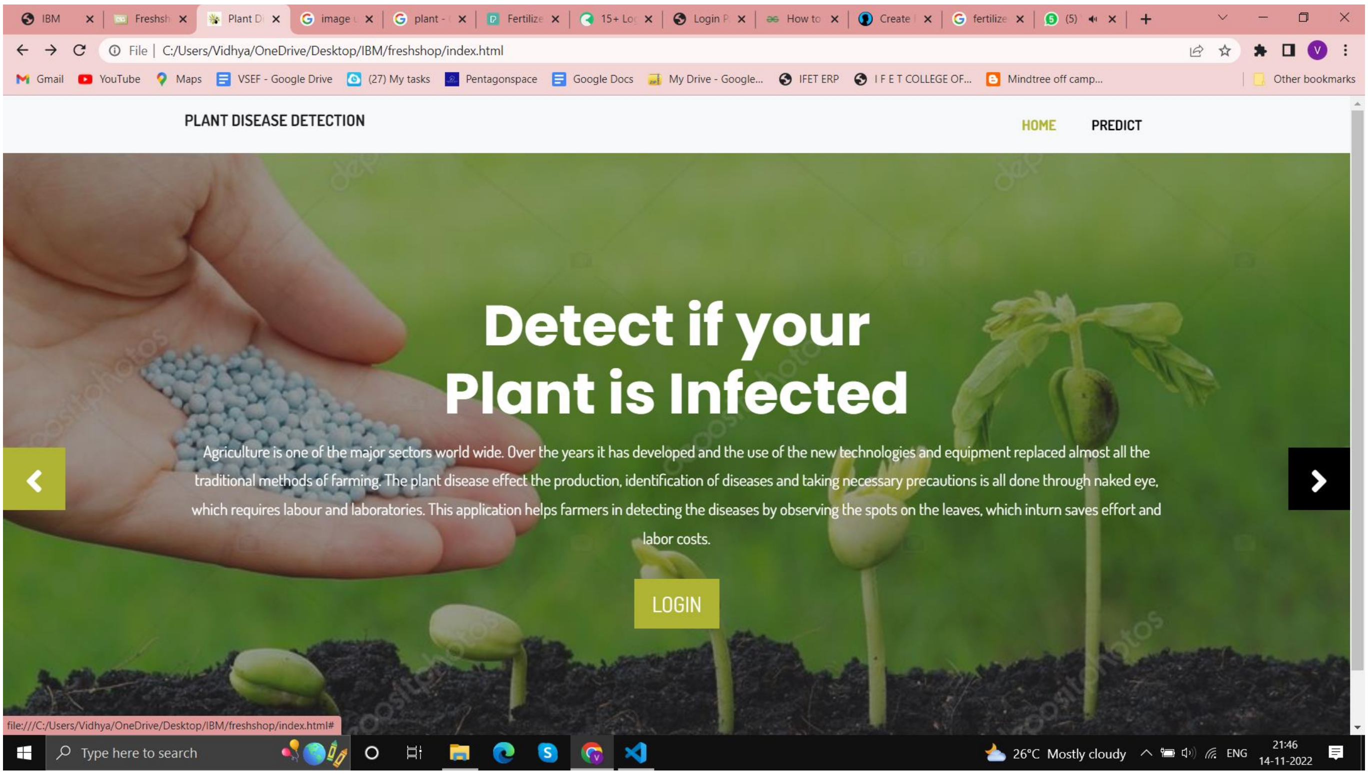


9. RESULTS

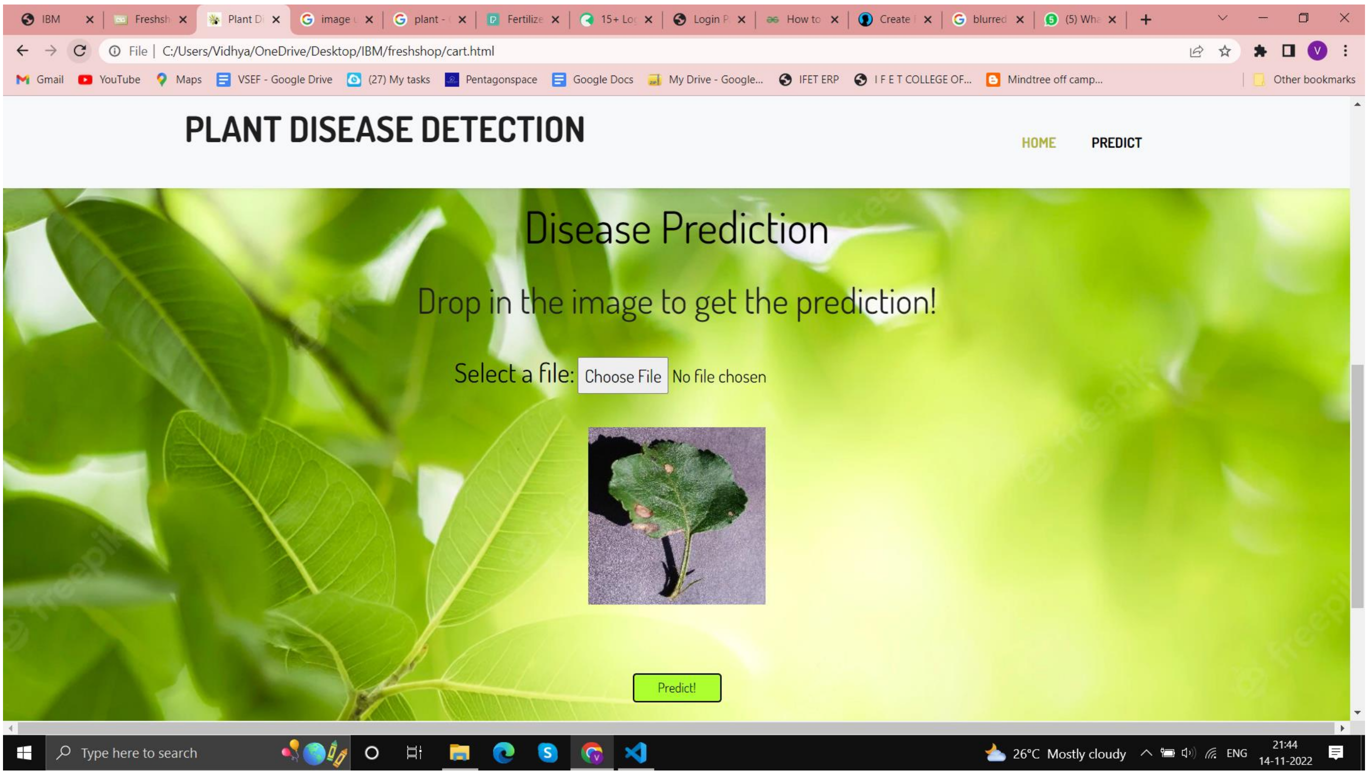
Login:



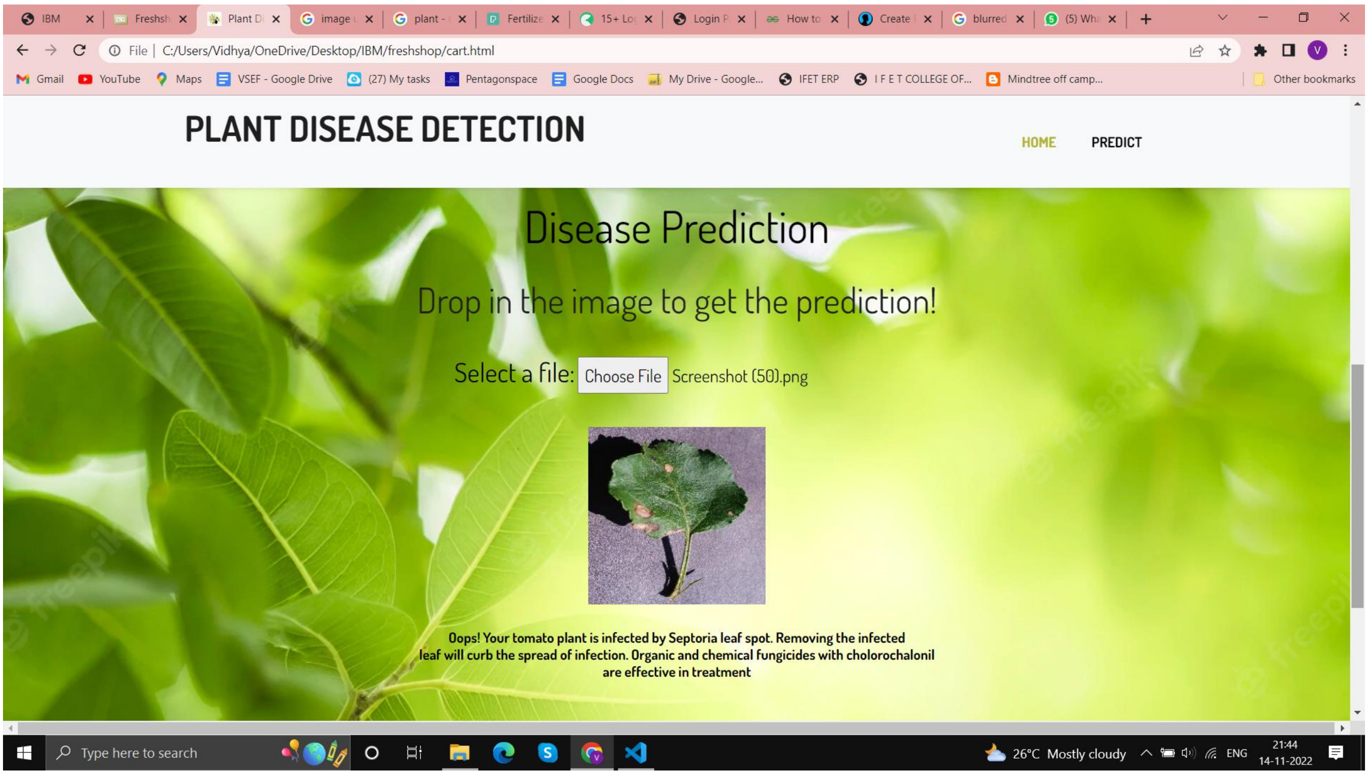
Description Login:



Disease Leaf:



Fertilizer:



10. ADVANTAGES & DISADVANTAGES

Advantages:

● The proposed model here produces very high accuracy of classification.

● Very large datasets can also be trained and tested.

● Images of very high can be resized within the proposed itself.

Disadvantages:

● For training and testing, the proposed model requires very high computational time.

● The neural network architecture used in this project work has high complexity.

11. CONCLUSION

This model involves image classification of vegetable datasets and fruit datasets. During model training and testing, the following observations were made: Classification accuracy increased with increasing the number of epochs. Different batch sizes yield different classification accuracy. By adding more convolution layers, the accuracy of classification can be increased. Variable density layers can also improve classification accuracy. Variation in the kernel size used to produce the convolution layer output can result in different accuracy levels. The size of the test and train datasets can have an impact on the accuracy.

12. FUTURE SCOPE

Image recognition can be applied to the model proposed in this project work. The whole model can be converted into application software with python-to-exe software. OpenCV python library allows for real-time image classification, recognition, and video processing. This project can be used for security applications like face recognition, iris recognition, and figure print recognition.

13. APPENDIX

SOURCE CODE

```
import requests

from tensorflow.keras.preprocessing import image

from tensorflow.keras.models import load_model

import numpy as np
```

```
import pandas as pd
import tensorflow as tf
from flask import Flask, request,render_template,redirect,url_for
import os
from werkzeug.utils import secure_filename
from tensorflow.python.keras.backend import set_session

app = Flask(__name__)
model=load_model("fruit.h5")
model1=load_model("veg.h5")

@app.route('/')
def home():
    return render_template('home.html')
@app.route('/prediction')
def prediction():
    return render_template('predict.html')
@app.route('/predict',methods=['POST'])
def predict():
    if( request.method=='POST'):
        f = request.files['image']
        basepath=os.path.dirname(__file__)
        file_path=os.path.join(basepath,'uploads',secure_filename(f.filename))
        f.save(file_path)
        img=image.load_img(file_path,target_size=(128,128))
        x=image.img_to_array(img)
        x=np.expand_dims(x,axis=0)
```

```
        plant=request.form['plant']
        print(plant)
        if(plant=='vegetable'):
            preds =model1.predict(x)
            classes=np.argmax(preds,axis=1)
            print(classes)
            df=pd.read_excel('precautions - veg.xlsx')
            print(df.iloc[classes[0]]['caution'])
        else:
            preds =model.predict(x)
            classes=np.argmax(preds,axis=1)
            df=pd.read_excel('precautions - fruits.xlsx')
            print(df.iloc[classes[0]]['caution'])
        return df.iloc[classes[0]]['caution']
if __name__=="__main__":
    app.run(debug=False
```

GITHUB & PROJECT DEMO LINK

Github Link:

https://github.com/IBM-EPBL/IBM-Project-22221-1659835923

Project Demo Link:

https://1drv.ms/v/s!AhqjGPy5BGCNhHcZfnGXyFGcR5yV?e=k EZgHe