

PROJECT REPORT

Fertilizers Recommendation for Disease Prediction



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INTRODUCTION :

- Agriculture is the most important sector in today's life. Most plants are affected by a wide variety of bacterial and fungal diseases. Diseases on plants placed a major constraint on the production and a major threat to food security. Hence, early and accurate identification of plant diseases is essential to ensure high quantity and best quality. In recent years, the number of diseases on plants and the degree of harm caused has increased due to the variation in pathogen varieties, changes in cultivation methods, and inadequate plant protection techniques.

Project Overview

- An Automated system is introduced to identify different diseases on plants by checking the symptoms shown on the leaves of the plant. Deep learning techniques are used to identify the diseases and suggest the precautions that can be taken for those diseases changes in cultivation method and inadequate plant protection techniques and suggest all the precautions that can be taken for those diseases.

Purpose

- To Detect and recognize the plant diseases and to recommend fertilizer, it is necessary to identify the diseases and to recommend to get different and useful features needed for the purpose of analyzing later.
- To provide symptoms in identifying the disease at its earliest. Hence the authors proposed and implemented new fertilizers Recommendation System for Crop Disease Prediction.

LITREATURE SURVEY

Literature Review

[1] 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 0.7 and 0.8 for SVM, the accuracy of identification of leaf disease of CNN is 0.6 and SVM is 0.8.

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.

[2] Detection of Leaf Diseases and Classification using Digital Image Processing International Conference on Innovations in Information, Embedded and Communication Systems(ICIECS), IEEE, 2017.

Advantages: The system detects the diseases on citrus leaves with 90% accuracy.

Disadvantages: System only able to detect the disease from citrus leave.

The main objective of this paper is image analysis & classification techniques for detection of leaf diseases and classification. The leaf image is firstly preprocessed and then does the further work. K-Means Clustering used for image segmentation and then system extract the GLCM features from disease detected images. The disease classification done through the SVM classifier.

Algorithm used: Gray-Level Co-Occurrence Matrix (GLCM) features, SVM, K-Means Clustering .

[3] Semi-automatic leaf disease detection and classification system for soybean culture IET Image Processing, 2018

Advantages: The system helps to compute the disease severity.

Disadvantages: The system uses leaf images taken from an online dataset, so cannot implement in real time.

This paper mainly focuses on the detecting and classifying the leaf disease of soybean plant. Using SVM the proposed system classifies the leaf disease in 3 classes like i.e. downy mildew, frog eye, and septoria leaf blight etc. The proposed system gives maximum average classification accuracy reported is ~90% using a big dataset of 4775 images.

Algorithm used: SVM.

[4] Cloud Based Automated Irrigation And Plant Leaf Disease Detection System Using An Android Application. International Conference on Electronics, Communication and Aerospace Technology, ICECA 2017.

Advantages:It is simple and cost effective system for plant leaf disease detection.

Disadvantages:Any H/w failures may affect the system performance.

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The current paper proposes an android application for irrigation and plant leaf disease detection with cloud and IoT. For monitoring irrigation system they use soil moisture and temperature sensor and sensor data send to the cloud. The user can also detect the plant leaf disease. K-means clustering used for feature extraction.

Algorithm used: K-means clustering,

Other than this there are some other levels which can be used for sentimental analysis these are- document level, sentence level, entity and aspect level to study positive and negative, interrogative, sarcastic, good and bad functionality, sentiment without sentiment, conditional sentence and author and reader understanding points.

[5] 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.

Disadvantages : Due to the changing climatic conditions, accurate results cannot be predicted by this system.

[6] 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.

[7] 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 0.7 and 0.8 for SVM, the accuracy of identification of leaf disease of CNN is 0.6 and SVM is 0.8.

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.

[8] In this paper, we propose a user-friendly web applications system based on machine learning and web-scraping called the 'Farmer's Assistant'. With our system, we are successfully able to provide several features - crop recommendation using Random Forest algorithm, fertilizer recommendation using rule based classification system, and crop disease detection using

EfficientNet model on leaf images. The user can provide the input using forms on our user interface and quickly get their results. In addition, we also use the LIME interpretability method

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to explain our predictions on the disease detection image, which can potentially help understand why our model predicts what it predicts, and improve the datasets and models using this information.

Advantages : For crop recommendation and fertilizer recommendation, we can provide the availability of the same on the popular shopping websites, and possibly allow users to buy the crops and fertilizers directly from our application.

Disadvantages : To provide fine-grained segmentations of the diseased portion of the dataset, this is not possible due to lack of such data. However, in our application, we can integrate a segmentation annotation tool where the users might be able to help us with the lack. Also, we can use some unsupervised algorithms to pin-point the diseased areas in the image. We intend to add these features and fix these gaps in our upcoming work.

Existing Problem

- Adequate mineral nutrition is central to crop production. However, it can also exert considerable influence on disease development. Fertilizer application can increase or decrease development of diseases caused by different pathogens, and the mechanisms responsible are complex, including effects of nutrients on plant growth, plant resistance mechanisms and direct effects on the pathogen. The effects of mineral nutrition on plant disease and the mechanisms responsible for those effects have been dealt with comprehensively elsewhere. In India, around 40% of land is kept and grown using reliable irrigation technologies, while the rest relies on the monsoon environment for water. Irrigation decreases reliance on the monsoon, increases food security, and boosts agricultural production.
- Most research articles use humidity, moisture, and temperature sensors near the plant's root, with an external device handling all of the data provided by the sensors and transmitting it directly to an Android application. It was created to measure the approximate values of temperature, humidity and moisture sensors that were programmed into a microcontroller to manage the amount of water.

References :

- [1] Semi-automatic leaf disease detection and classification system for soybean culture IET Image Processing, 2018
- [2] Cloud Based Automated Irrigation And Plant Leaf Disease Detection System Using An Android Application. International Conference on Electronics, Communication and Aerospace Technology, ICECA 2017.
- [3] Ms. Kiran R. Gavhale, Ujwalla Gawande, Plant Leaves Disease detection using Image Processing Techniques, January 2014.
- https://www.researchgate.net/profile/UjwallaGawande/publication/314436486_An_Overview_of_the_Research_on_Plant_Leaves_Disease_detection_using_Image_Processing_Techniques/links/5d3710664585153e591a3d20/An-Overviewof-the-Research-on-Plant-Leaves-Disease-detection-using-Image-ProcessingTechniques.pdf
- [4] Duan Yan-e, Design of Intelligent Agriculture Management Information System Based on IOT, IEEE, 4th, Fourth International reference on Intelligent Computation Technology and Automation, 2011
- <https://ieeexplore.ieee.org/document/5750779>
- [5] R. Neela, P. Fertilizers Recommendation System For Disease Prediction In Tree Leave International journal of scientific & technology research volume 8, issue 11, november 2019
- <http://www.ijstr.org/final-print/nov2019/Fertilizers-Recommendation-System-For-Disease-Prediction-In-Tree-Leave.pdf> .
- [6] Swapnil Jori¹, Rutuja Bhalshankar², Dipali Dhamale³, Sulochana Sonkamble , Healthy Farm: Leaf Disease Estimation and Fertilizer Recommendation System using Machine Learning, International Journal of All Research Education and Scientific Methods (IJARESM), ISSN: 2455-6211
- [7] Detection of Leaf Diseases and Classification using Digital Image Processing International Conference on Innovations in Information, Embedded and Communication Systems (ICIIECS), IEEE, 2017.
- [8] Shloka Gupta ,Nishit Jain ,Akshay Chopade, Farmer's Assistant: A Machine Learning Based Application for Agricultural Solutions.

Problem Statement Definition:

Mr.Narasimma Rao is a 65 years old man. He had a own farming land and do Agriculture for past 30 Years , In this 30 Years he Faced a problem in Choosing Fertilizers and Controlling of Plant Disease.

- Narasimma Rao wants to know the better recommendation for fertilizers for plants with the disease.
- He has faced huge losses for a long time.
- This problem is usually faced by most farmers.
- Mr. Narasimma Rao needs to know the result immediately.

Who does the problem affect?	Persons who do Agriculture
What are the boundaries of the problem?	People who Grow Crops and facing Issues of Plant Disease
What is the issue?	In agricultural aspects, if the plant is affected by leaf disease, then it reduces the growth and productiveness. Generally, the plant diseases are caused by the abnormal physiological functionalities of plants.
When does the issue occur?	During the development of the crops as they will be affected by various diseases.

Where does the issue occur?	The issue occurs in agriculture practicing areas, particularly in rural regions.
Why is it important that we fix the problem?	It is required for the growth of better quality food products. It is important to maximise the crop yield.
What solution to solve this issue?	An automated system is introduced to identify different diseases on plants by checking the symptoms shown on the leaves of the plant.
What methodology used to solve the issue?	Deep learning techniques are used to identify the diseases and suggest the precautions that can be taken for those diseases.

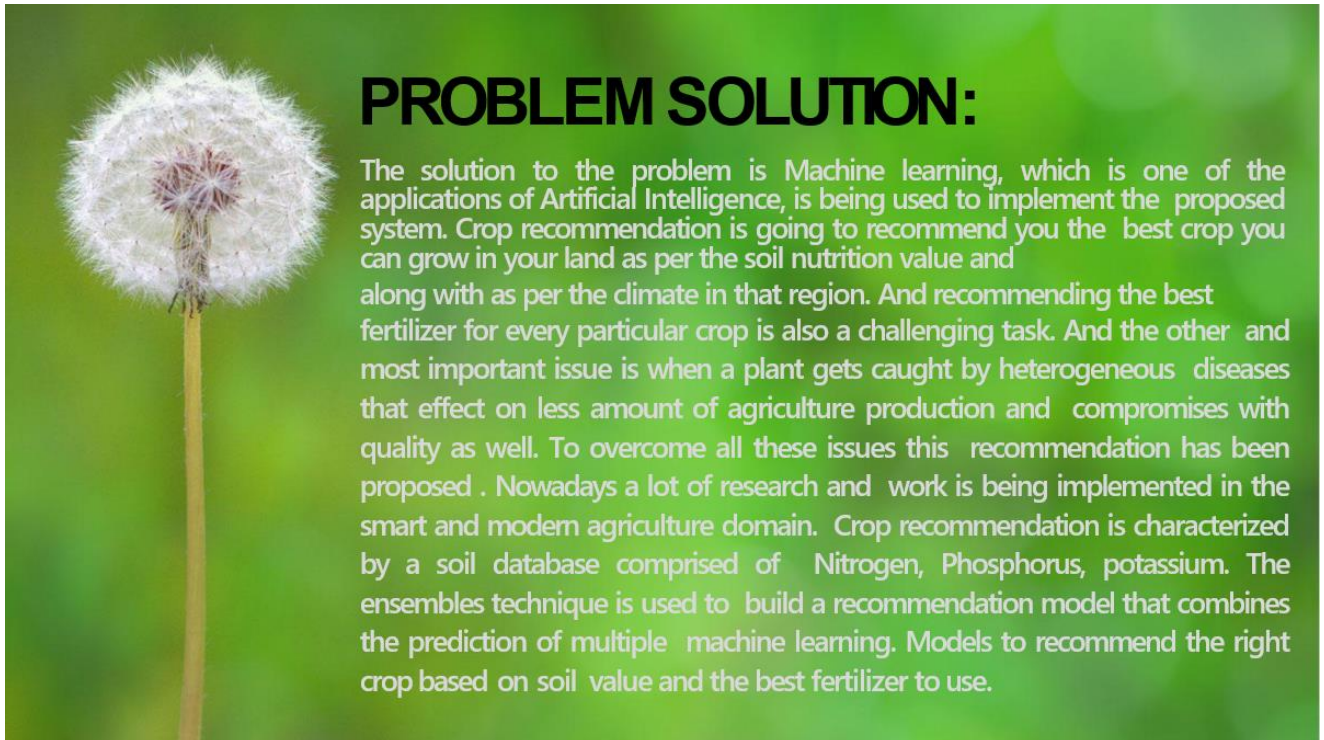
Ideation & Brainstorming :

Fertilizers Recommendation System For Disease Prediction

Agriculture is the main aspect of the economic development of a country. Agriculture is the heart and life of most Indians. By understanding their feelings and problems, we can create a better product and contribute to their lives. For our project, we are getting surveys from farmers to understand what they truly require and desire.



ProposedSolution:



- The idea of the proposed solution uses Deep learning and Machine algorithm to classify leaves and identify the diseases and suggest the fertilizers. The deep learning process includes the MobileNetV2 and VGG19 training Models.
- Based on the leaf disease detected , the model recommendation for fertilizers for the prevention. The farmers and researchers are the end users get benefited by the system.
- More accurate in others. The system is more robust incorporating more image data sets with wider variations. This system also estimates the probability of infected plant.
- Plant growth can be enhanced. Ensure plants are getting supplied with every nutrient they need also and multiple cross in grow in every yields for every season. It also helps people's nutritional needs.

Problem Solution Fit





OUR SOLUTION:

- By Building a AI , ML based web application make their issues resolved in seconds .
- Make their expensive process affordable .
- Minimize the Time for analyze their problem and provide results in seconds .
- Easy Graphical representation makes a better understanding by everyone .

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REQUIREMENT ANALYSIS :

Functional Requirements

Functional Requirements:

Following are the functional requirements of the proposed solution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Specific characteristics	It identifies the diseases especially rice bran diseases
FR-4	Functions	The proposed methods uses the SVM to classify tree leaves, identify the diseases and suggest the fertilizer.
FR-5	Fault tolerance	This study enables a possible prediction of crop yield from the historic data collected and offers a suggestion to farmers.
FR-6	Analyze	It helps us to classify the data based on the diseases, and data extracted from the classifier is used to predict soil and crop.

Non Functional Requirements

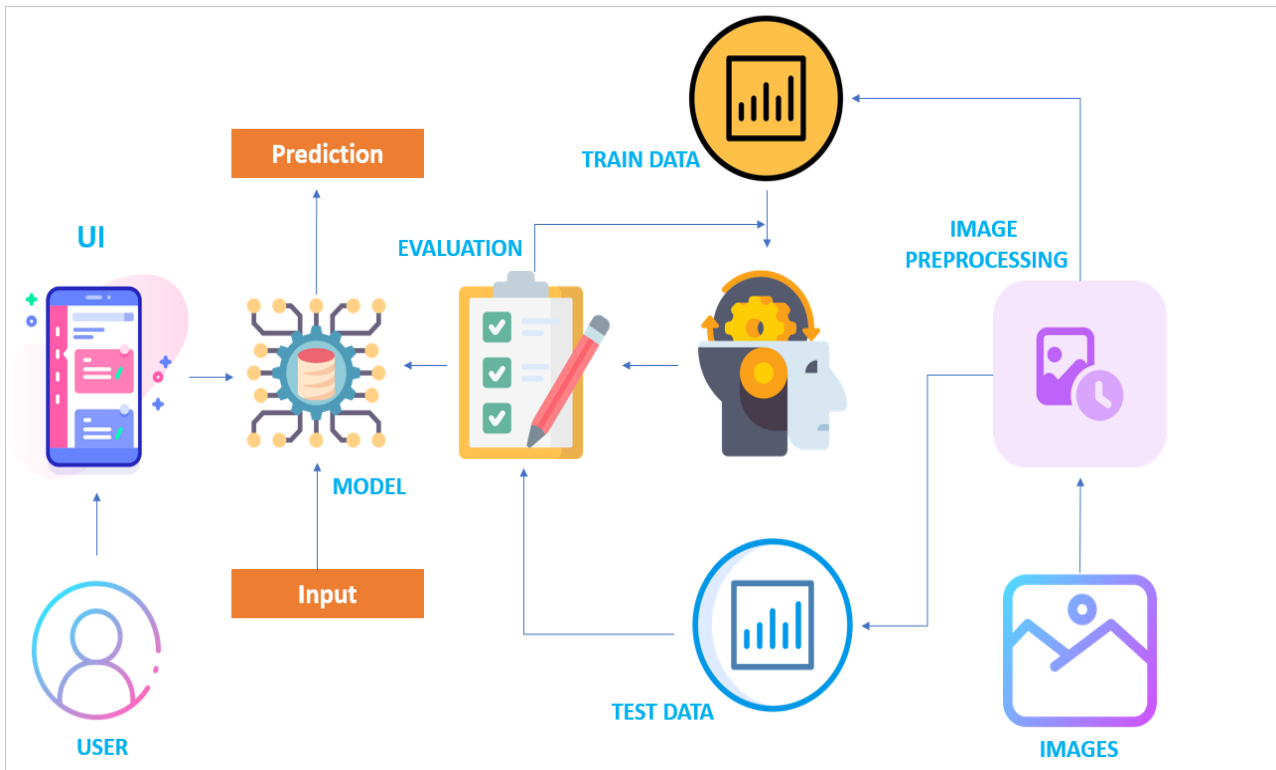
Non-functional Requirements:

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

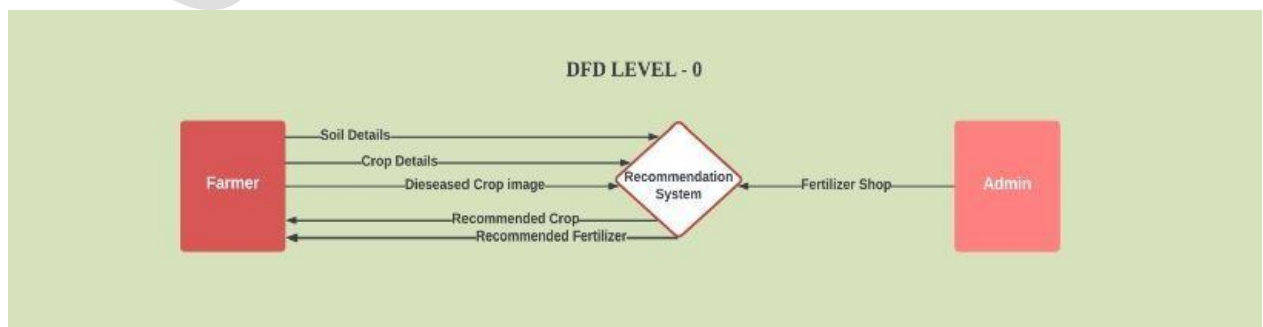
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Crop and fertilizer recommendation system help the farmer to identify the diseases.
NFR-2	Security	The proposed method combines two major aspects in farming , pest identification and insecticide recommendation.
NFR-3	Reliability	It is easy use so that health issues can be avoided.
NFR-4	Performance	Precision fertilizer and precision crops is mostly used. They used to predict the crop in artificial intelligence.
NFR-5	Availability	reduces the losses as ammonia , nitrate leaching, apply the right rate, apply accurately.
NFR-6	Scalability	If the soil is not replenished with nutrients through fertilizing ,crop yields will deteriorate over time.

PROJECT DESIGN :

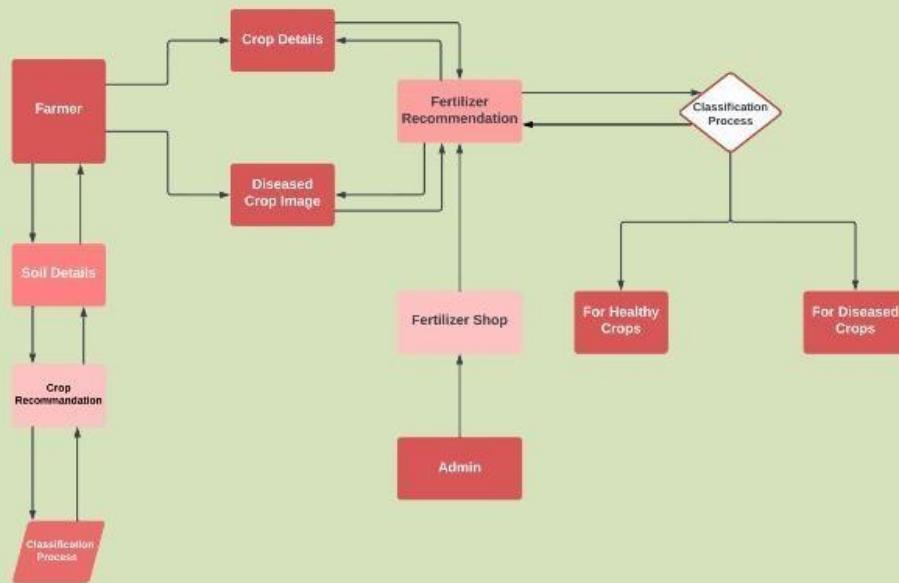
Solution & Technical Architecture



Data Flow Diagrams



DFD LEVEL - 1



User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
	Login	USN-2	As a user, I can log into the application by entering email & password	I can login using my E-mail ID accounts or user credentials	High	Sprint-1
	Dashboard	USN-3	As a user, I can view the page of the application where i can upload my images and the fertilizer should be recommended	I can access my account/ dashboard	High	Sprint-2
Customer (Webuser)	Registration	USN-4	As a user, I can login to web dashboard just Like website dashboard	I can register using my username and password	High	Sprint-3
	Login	USN-5	As a user, I can login to my web dashboard with the login credentials	I can login using my User credentials	High	Sprint-3
	Dashboard	USN-6	As a user, I can view the web application where i can upload my images and thefertilizer should be recommended	I can access my account/ dashboard	High	Sprint-4
		USN-7	As a user, the fertilizer recommended to me should be of higher accuracy	I can access my account/ dashboard	High	Sprint-4
Administrator	Login	USN-8	As a admin, I can login to the website using my login credentials	I can login to the website using my login credentials	High	Sprint-5
	Dashboard	USN-9	As a admin, I can view the dashboard of the application	I can access my dashboard	High	Sprint-5

PROJECT PLANNING & SCHEDULING:

Sprint Planning and Estimation:

Project Planning Phase

Project Planning Template (Product Backlog, Sprint Planning, Stories, Story points)

Date	24 October 2022
Team ID	PNT2022TMID38633
Project Name	Fertilizer Recommendation System for Disease Prediction
Maximum Marks	8 Marks

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points (Total)	Priority	Team Members
Sprint-1	Model Building	USN-1	Building the model and selecting best ML model based on accuracy for accurate prediction.	4	High	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
Sprint-1	Model Creation and Training (Fruits)		Create a model which can classify diseased fruit plants from given images. I also need to test the model and deploy it on IBM Cloud	8	High	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
	Model Creation and Training (Vegetables)		Create a model which can classify diseased vegetable plants from given images	2	High	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points (Total)	Priority	Team Members
Sprint-2	Model Creation and Training (Vegetables)		Create a model which can classify diseased vegetable plants from given images and train on IBM Cloud	6	High	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
	Registration	USN-1	As a user, I can register by entering my email, password, and confirming my password or via OAuth API	3	Medium	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
	Upload page	USN-2	As a user, I will be redirected to a page where I can upload my pictures of crops	4	High	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
	Suggestion results	USN-3	As a user, I can view the results and then obtain the suggestions provided by the ML model	4	High	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
	Base Flask App		A base Flask web app must be created as an interface for the ML model	2	High	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
Sprint-3	Login	USN-4	As a user/admin/shopkeeper, I can log into the application by entering email & password	2	High	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
	User Dashboard	USN-5	As a user, I can view the previous results and history	3	Medium	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
	Integration		Integrate Flask, CNN model with Cloudant DB	5	Medium	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
	Containerization		Containerize Flask app using Docker	2	Low	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL

Sprint-4	Dashboard (Admin)	USN-6	As an admin, I can view other user details and uploads for other purposes	4	Medium	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
	Dashboard (User)		As a User, they can upload the leaf image in the portal and get the suggestion for the fertilizers to be used	6	High	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL
	Containerization		Create and deploy Helm charts using Docker Image made before	2	Medium	SATHISHKUMAR K, SHAIK RIYAZ AHMED, PRAKASH, RAAGHUL

Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart: (4 Marks)

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	14	6 Days	24 Oct 2022	29 Oct 2022	14	30 Oct 2022
Sprint-2	19	6 Days	31 Oct 2022	05 Nov 2022	19	06 Nov 2022
Sprint-3	12	6 Days	07 Nov 2022	12 Nov 2022	12	13 Nov 2022
Sprint-4	12	6 Days	14 Nov 2022	19 Nov 2022	12	20 Nov 2022

Feature 1[Model Building]:

1. Import The Libraries

Import the libraries that are required to initialize the neural network layer, and create and add different layers to the neural network model.

```
from keras.models import Sequential
from keras.layers import Dense
from keras.layers import Convolution2D
from keras.layers import MaxPooling2D
from keras.layers import Flatten
```

2. Initializing The Model

Keras has 2 ways to define a neural network:

- Sequential
- Function API

The Sequential class is used to define linear initializations of network layers which then, collectively, constitute a model. In our example below, we will use the Sequential constructor to create a model, which will then have layers added to it using the add () method.

Now, will initialize our model.

Initialize the neural network layer by creating a reference/object to the Sequential class.

```
model=Sequential()
```

3. ADD CNNLayers

We will be adding three layers for CNN

- Convolution layer
- Pooling layer
- Flattening layer

Add Convolution Layer

The first layer of the neural network model, the convolution layer will be added. To create a convolution layer, Convolution2D class is used. It takes a number of feature detectors, feature

detector size, expected input shape of the image, and activation function as arguments. This

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layer applies feature detectors on the input image and returns a feature map (features from the image).

Activation Function: These are the functions that help us to decide if we need to activate the node or not. These functions introduce non-linearity in the networks.

```
model.add(Convolution2D(32,(3,3),input_shape = (128,128,3),activation = 'relu'))
```

Add the pooling layer

Max Pooling selects the maximum element from the region of the feature map covered by the filter. Thus, the output after the max-pooling layer would be a feature map containing the most prominent features of the previous feature map.

After the convolution layer, a pooling layer is added. Max pooling layer can be added using MaxPooling2D class. It takes the pool size as a parameter. Efficient size of the pooling matrix is (2,2). It returns the pooled feature maps. (Note: Any number of convolution layers, pooling and dropout layers can be added)

```
model.add(MaxPooling2D(pool_size = (2,2)))
```

Add the flatten layer

The flatten layer is used to convert n-dimensional arrays to 1-dimensional arrays. This 1D array will be given as input to ANN layers.

```
model.add(Flatten())
```

4. Add Dense Layers

Now, let's add Dense Layers to know more about dense layers click below

Dense layers

The name suggests that layers are fully connected (dense) by the neurons in a network layer. Each neuron in a layer receives input from all the neurons present in the previous layer. Dense is used to add the layers.

Adding Hidden layers

This step is to add a dense layer (hidden layer). We flatten the feature map and convert it into a vector or single dimensional array in the Flatten layer. This vector array is fed it as an input to the neural network and applies an activation function, such as sigmoid or other, and returns the output.

- `init` is the weight initialization; function which sets all the weights and biases of a network to values suitable as a starting point for training.
- `units/ output_dim`, which denote is the number of neurons in the hidden layer.
- The activation function basically decides to deactivate neurons or activate them to get the desired output. It also performs a nonlinear transformation on the input to get better results on a complex neural network.
- You can add many hidden layers, in our project we are added two hidden layers. The 1st hidden layer with 40 neurons and 2nd hidden layer with 20neurons.

Adding the output layer

This step is to add a dense layer (output layer) where you will be specifying the number of classes your dependent variable has, activation function, and weight initializer as the arguments. We use the `add ()` method to add dense layers. the output dimensions here is 6

```
model.add(Dense(output_dim = 40 ,init = 'uniform',activation = 'relu'))
model.add(Dense(output_dim = 20 ,init = 'random_uniform',activation = 'relu'))
model.add(Dense(output_dim = 6,activation = 'softmax',init = 'random_uniform'))
```

5. Train And Save The Model

Compile the model

After adding all the required layers, the model is to be compiled. For this step, loss function, optimizer and metrics for evaluation can be passed as arguments.

```
model.compile(loss = 'categorical_crossentropy',optimizer = "adam",metrics = ["accuracy"])
```

Fit and save the model

Fit the neural network model with the train and test set, number of epochs and validation steps. Steps per epoch is determined by number of training images/ batch size, for validation steps number of validation images/ batch size.

```
model.fit_generator(x_train, steps_per_epoch = 168,epochs = 3,validation_data = x_test,validation_steps = 52)
```

Accuracy, Loss: Loss value implies how poorly or well a model behaves after each iteration of optimization. An accuracy metric is used to measure the algorithm's performance in an

interpretable way. The accuracy of a model is usually determined after the model parameters and is calculated in the form of a percentage.

The weights are to be saved for future use. The weights are saved in as .h5 file using save().

```
model.save("fruit.h5")
```

model.summary() can be used to see all parameters and shapes in each layer in our models.

6. Test The Model

The model is to be tested with different images to know if it is working correctly.

Import the packages and load the saved model

Import the required libraries

```
from keras.preprocessing import image
from tensorflow.keras.preprocessing.image import img_to_array
from tensorflow.keras.models import load_model
import numpy as np
```

Initially, we will be loading the fruit model. You can test it with the vegetable model in a similar way.

```
model = load_model("fruit.h5")
```

Load the test image, pre-process it and predict

Pre-processing the image includes converting the image to array and resizing according to the model. Give the pre-processed image to the model to know to which class your model belongs to.

```
img = image.load_img('apple_healthy.JPG',target_size = (128,128))
```

```
x = image.img_to_array(img)
x = np.expand_dims(x,axis = 0)
```

```
pred = model.predict_classes(x)
```

```
pred
```

The predicted class is 1.

Feature 2[Python Code]:

Build Python Code:

After the model is built, we will be integrating it into a web application so that normal users can also use it. The user needs to browse the images to detect the disease.

Activity 1: Build a flask application

Step 1: Load the required packages

```
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
```

Step 2: Initialize the flask app and load the model

An instance of Flask is created and the model is loaded using load_model from Keras.

```
app = Flask(__name__)

#load both the vegetable and fruit models
model = load_model("vegetable.h5")
model1=load_model("fruit.h5")
```

Step 3: Configure the home page

```

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

```

Step 4: Pre-process the frame and run

Pre-process the captured frame and give it to the model for prediction. Based on the prediction the output text is generated and sent to the HTML to display. We will be loading the precautions for fruits and vegetables excel file to get the precautions based on the output and return it to the HTML Page.

```

#prediction page
@app.route('/prediction')
def prediction():
    return render_template('predict.html')

@app.route('/predict', methods=['POST'])
def predict():
    if request.method == 'POST':
        # Get the file from post request
        f = request.files['image']
        # Save the file to ./uploads
        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 = model.predict_classes(x)
            print(preds)
            df=pd.read_excel('precautions - veg.xlsx')
            print(df.iloc[preds[0]]['caution'])
        else:
            preds = model1.predict_classes(x)
            df=pd.read_excel('precautions - fruits.xlsx')
            print(df.iloc[preds[0]]['caution'])
        return df.iloc[preds[0]]['caution']

```

Run the flask application using the run method. By default, the flask runs on 5000 port. If the port is to be changed, an argument can be passed and the port can be modified.

```
if __name__ == "__main__":  
    app.run(debug=False)
```

User Acceptance Testing:

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Fertilizers Recommendation System for Disease Prediction project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	0	0	1	0	1
Duplicate	1	3	2	2	8
External	2	3	0	0	5
Fixed	4	4	4	4	16
Not Reproduced	0	0	0	1	1
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	7	10	7	7	31

3. Test Case Analysis



This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	1	0	0	1
Client Application	1	0	0	1
Security	1	0	0	1
Outsource Shipping	1	0	0	1
Exception Reporting	1	0	0	1
Final Report Output	1	0	0	1
Version Control	1	0	0	1



RESULT:

Model Summary:

```
model.summary()
```

Model: "sequential"

Layer (type)	Output Shape	Param #
conv2d (Conv2D)	(None, 126, 126, 32)	896
max_pooling2d (MaxPooling2D)	(None, 63, 63, 32)	0
flatten (Flatten)	(None, 127008)	0

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

```

Epoch 1/10
225/225 [=====] - 96s 425ms/step - loss: 1.1095 - accuracy: 0.7829 - val_loss: 0.3157 - val_accuracy: 0.8861
Epoch 2/10
225/225 [=====] - 88s 393ms/step - loss: 0.2825 - accuracy: 0.9042 - val_loss: 0.3015 - val_accuracy: 0.9075
Epoch 3/10
225/225 [=====] - 85s 375ms/step - loss: 0.2032 - accuracy: 0.9303 - val_loss: 0.2203 - val_accuracy: 0.9288
Epoch 4/10
225/225 [=====] - 84s 374ms/step - loss: 0.1576 - accuracy: 0.9463 - val_loss: 0.2424 - val_accuracy: 0.9164
Epoch 5/10
225/225 [=====] - 84s 372ms/step - loss: 0.1719 - accuracy: 0.9389 - val_loss: 0.1330 - val_accuracy: 0.9632
Epoch 6/10
225/225 [=====] - 85s 376ms/step - loss: 0.1240 - accuracy: 0.9580 - val_loss: 0.1340 - val_accuracy: 0.9573
Epoch 7/10
225/225 [=====] - 87s 388ms/step - loss: 0.1235 - accuracy: 0.9591 - val_loss: 0.1638 - val_accuracy: 0.9478
Epoch 8/10
225/225 [=====] - 83s 371ms/step - loss: 0.1012 - accuracy: 0.9643 - val_loss: 0.1468 - val_accuracy: 0.9561
Epoch 9/10
225/225 [=====] - 83s 367ms/step - loss: 0.0967 - accuracy: 0.9655 - val_loss: 0.1412 - val_accuracy: 0.9531
Epoch 10/10
225/225 [=====] - 83s 369ms/step - loss: 0.0954 - accuracy: 0.9655 - val_loss: 0.0905 - val_accuracy: 0.9745

```

ADVANTAGES & DISADVANTAGES:

ADVANTAGES:

- The proposed model could predict the disease just from the image of a part icular plant.
- Easy to use UI.
- Model has some good accuracy in detecting the plant just by taking the **input(leaf)**.
- These kind of web applications can be used in the agricultural sector as well as for small house hold plants as well.

Disadvantages:

- Prediction is limited to few plants as we havent trained all the plants.

Conclusion :

- The core strategy of this project is to predict the crop based on the soil nutrient content and the location where the crop is growing. This system will help he farmers to choose the right crop for their land and to give the suitable

amount of fertilizer to produce the maximum yield. The Support Vector Machine algorithm helps to predict the crop precisely based on the pre-processed crop data. This system will also help the new comers to choose the crop which will grow in their area and produce them a good profit. A decent amount of profit will attract more people towards the agriculture.

Future Scope :

- As of now we have just built the web application which apparently takes the input as an image and then predict the out in the near future we can develop an application which computer vision and AI techniques to predict the infection once you keep the camera near the plant or leaf this could make our project even more usable
- 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 vegetables and fruits.

Appendix :

App.py

```
import os
import numpy as np
import pandas as pd
import requests
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
from tensorflow.python.keras.backend import set_session
from werkzeug.utils import secure_filename

from flask import Flask, redirect, render_template, request, url_for

app=Flask(__name__)
model=load_model("vegetable.h5")
model1=load_model("fruit.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=model.predict_classes(x)
            print(preds)
            df=pd.read_excel('precautions - veg.xlsx')
            print(df.iloc
            [preds[0]]['caution'])
        else:
            preds=model1.predict_classes(x)
            df=pd.read_excel('precautions - fruits.xlsx')
            print(df.iloc[preds[0]]['caution'])
        return df.iloc[preds[0]]['caution']

if __name__=="__main__":
    app.run(debug=False)

```

TEMPLATES:

HOME.HTML:

```

<!DOCTYPE html>
<html>
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <link rel="stylesheet" href="{{url_for('static', filename='fc.css')}}">
    <link rel="preconnect" href="https://fonts.googleapis.com">
    <link rel="preconnect" href="https://fonts.gstatic.com" crossorigin>

```

```

<link href="https://fonts.googleapis.com/css2?family=Abril+Fatface&display=swap"
rel="stylesheet">
<title>FERTICT</title>
</head>
<body>

<nav>
  <div class='heading'>
    <h4>Plant Disease Prediction</h4>
  </div>
  <ul class='nav-links'>
    <li><a class="links" href="home.html">Home</a></li>
    <li><a class="links" href="https://www.amazon.in/Fertilizers-Plant-
Food/s?rh=n%3A3639097031&page=3">Store</a></li>

  </ul>
</div>
</nav>

<h2><u>Detect if your plant is infected!</u></h2>
<a class="sub" href="{{ url_for('prediction') }}">Check!</a>
<div class="para">
  <p> Agriculture is one of the major sectors world wide. Over the years<br>
  it has developed and the use of new technologies and equipment replaced<br>
  almost all the traditional methods offarming. The plant diseases affect<br>
  the production. Identificationof diseases and taking necessary precaution<br>
  is all done through naked eye, which requires labour and laboratries. <br>
  This application helps farmers in detecting the diseases by observing <br>
  the spots on the leaves, which inturn saves effort and labour costs.<br>
  </p>
</div>
</body>
</html>

```

PREDICT.HTML :

```

<!DOCTYPE html>
<html>

<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <link rel="stylesheet" href="{{url_for('static', filename='fc.css')}}">
  <link rel="preconnect" href="https://fonts.googleapis.com">

```

```

<link rel="preconnect" href="https://fonts.gstatic.com" crossorigin>
<link href="https://fonts.googleapis.com/css2?family=Abril+Fatface&display=swap"
rel="stylesheet">
<title>FERTICT</title>
<script>
    var loadFile = function (event) {
        var image = document.getElementById('output');
        image.src = URL.createObjectURL(event.target.files[0]);
    };
</script>
</head>

<body>
    <nav>
        <div class='heading'>
            <h4>Plant Disease Prediction</h4>
        </div>
        <ul class='nav-links'>
            <li><a class="links" href="home.html">Home</a></li>
        </ul>
    </div>
</nav>
<h2><u>Upload your image to check:</u></h2>
<div class="drop">
    <label class="choose" for="pet-select">Choose:</label>
    <select name="pets" id="pet-select">
        <option value="">--Please choose an option--</option>
        <option value="Fruit">Fruit</option>
        <option value="Vegetable">Vegetable</option>
    </select>
</div>
<form action="{{ url_for('predict') }}" method="post">
    <p><input type="file" accept="image/*" name="image" onchange="loadFile(event)"></p>
    <p><img id="output" width="400" /></p>
    <input type="submit" value="Submit">
</form>
</body>
</html>

```

MODEL TRAINING:

FRIUT_TRAINING:

```
import numpy as np
```

```
import tensorflow as tf
from tensorflow import keras
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Convolution2D
from tensorflow.keras.layers import MaxPooling2D
from tensorflow.keras.layers import Flatten
import matplotlib.pyplot as plt
```

```
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)
```

```
x_train = train_datagen.flow_from_directory('fruit-dataset/fruit-dataset/train', target_size =
(128,128), batch_size = 32, class_mode = 'categorical')
x_test = test_datagen.flow_from_directory('fruit-dataset/fruit-dataset/test', target_size =
(128,128), batch_size = 32, class_mode = 'categorical')
```

```
model=Sequential()
```

```
model.add(Convolution2D(32,(3,3),input_shape = (128,128,3),activation = 'relu'))
```

```
model.add(MaxPooling2D(pool_size = (2,2)))
```

```
model.add(Flatten())
```

```
model.add(Dense(units = 40 ,kernel_initializer = 'uniform',activation = 'relu'))
model.add(Dense(units = 20 ,kernel_initializer = 'random_uniform',activation = 'relu'))
model.add(Dense(units = 6 ,activation = 'softmax',kernel_initializer = 'random_uniform'))
```

```
model.compile(loss = 'categorical_crossentropy',optimizer = "adam",metrics = ["accuracy"])
```

```
model.fit_generator(x_train, steps_per_epoch = 168, epochs = 3, validation_data = x_test,
validation_steps = 52)
```

```
model.save("fruit.h5")
```

VEGETABLE_TRAINING:

```
import numpy as np
import tensorflow as tf
```

```

from tensorflow import keras
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.layers import Convolution2D
from tensorflow.keras.layers import MaxPooling2D
from tensorflow.keras.layers import Flatten
import matplotlib.pyplot as plt

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)

x_train = train_datagen.flow_from_directory('Veg-dataset/Veg-dataset/train_set', target_size =
(128,128), batch_size = 32, class_mode = 'categorical')
x_test = test_datagen.flow_from_directory('Veg-dataset/Veg-dataset/test_set', target_size =
(128,128), batch_size = 32, class_mode = 'categorical')

model=Sequential()
model.add(Convolution2D(32,(3,3),input_shape = (128,128,3),activation = 'relu'))
model.add(MaxPooling2D(pool_size = (2,2)))
model.add(Flatten())

model.add(Dense(units = 300 ,kernel_initializer = 'uniform',activation = 'relu'))

model.add(Dense(units = 150 ,kernel_initializer = 'uniform',activation = 'relu'))

model.add(Dense(units = 75 ,activation = 'relu',kernel_initializer = 'uniform'))

model.add(Dense(units = 9 ,activation = 'softmax',kernel_initializer = 'uniform'))

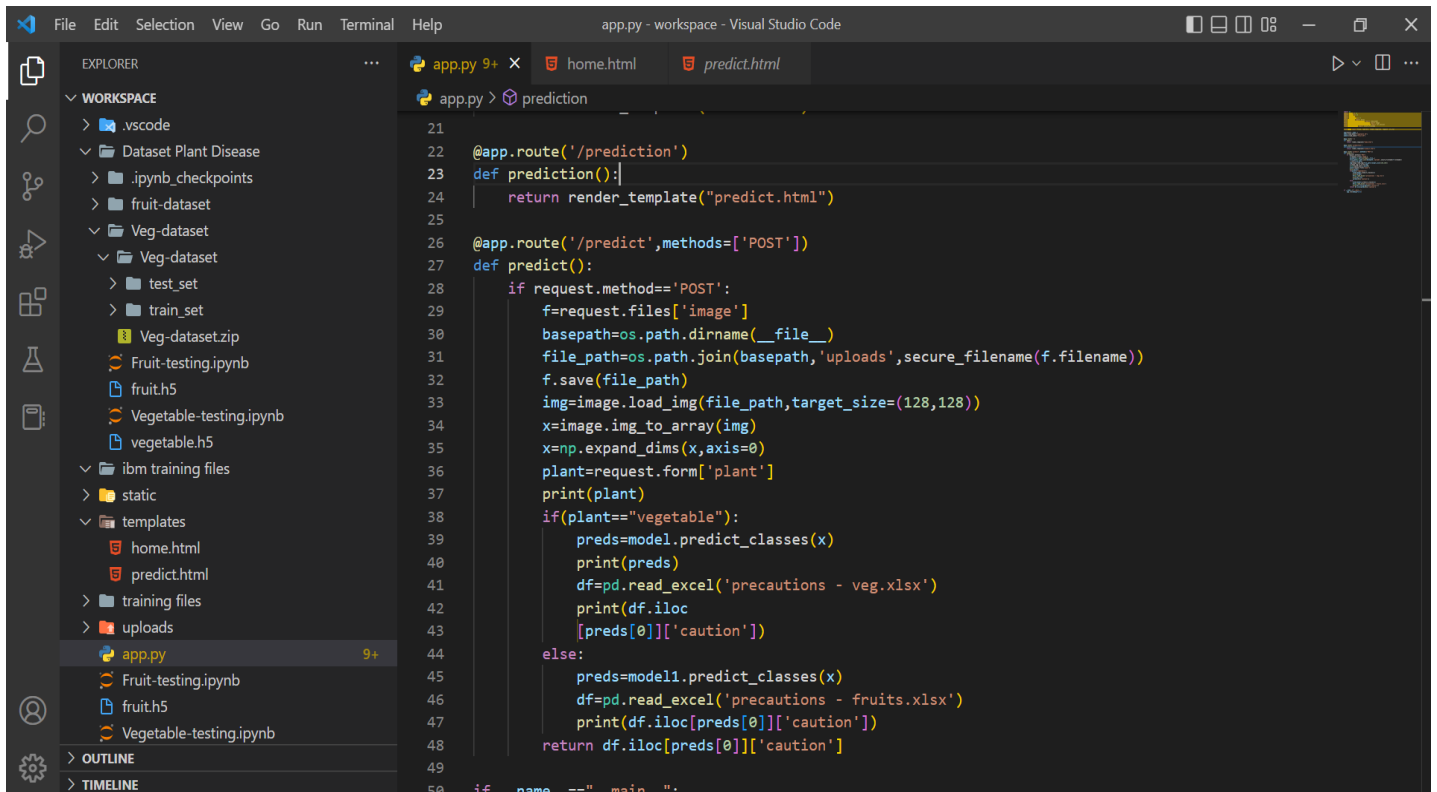
model.compile(loss = 'categorical_crossentropy',optimizer = "adam",metrics = ["accuracy"])

model.fit_generator(x_train, steps_per_epoch = 89, epochs = 20, validation_data = x_test,
validation_steps = 27)

model.save("vegetable.h5")

```

Project Structure :



The screenshot shows a Visual Studio Code workspace named 'app.py - workspace'. The Explorer panel on the left displays the project structure, which includes a '.vscode' folder, a 'Dataset Plant Disease' folder, and several data files like 'fruit-dataset', 'Veg-dataset', 'train_set', 'test_set', 'Veg-dataset.zip', 'Fruit-testing.ipynb', 'fruit.h5', 'Vegetable-testing.ipynb', and 'vegetable.h5'. There are also 'ibm training files', a 'static' folder, and a 'templates' folder containing 'home.html' and 'predict.html'. The main editor area shows the 'app.py' file, which contains a Flask application. The code defines two routes: a GET route for '/prediction' that renders 'predict.html', and a POST route for '/predict' that processes an uploaded image, predicts the plant class, and prints the result. The code also includes a main block at the bottom.

```
21
22 @app.route('/prediction')
23 def prediction():
24     return render_template("predict.html")
25
26 @app.route('/predict', methods=['POST'])
27 def predict():
28     if request.method == 'POST':
29         f = request.files['image']
30         basepath = os.path.dirname(__file__)
31         file_path = os.path.join(basepath, 'uploads', secure_filename(f.filename))
32         f.save(file_path)
33         img = image.load_img(file_path, target_size=(128, 128))
34         x = image.img_to_array(img)
35         x = np.expand_dims(x, axis=0)
36         plant = request.form['plant']
37         print(plant)
38         if plant == "vegetable":
39             preds = model.predict_classes(x)
40             print(preds)
41             df = pd.read_excel('precautions - veg.xlsx')
42             print(df.iloc[preds[0]]['caution'])
43         else:
44             preds = model1.predict_classes(x)
45             df = pd.read_excel('precautions - fruits.xlsx')
46             print(df.iloc[preds[0]]['caution'])
47         return df.iloc[preds[0]]['caution']
48
49
50 if __name__ == '__main__':
```

Github Link : <https://github.com/IBM-EPBL/IBM-Project-5618-1658811945>

Project Demonstration Video Link :

https://drive.google.com/file/d/13SiLmiFTxNLtzx5gEww2IygzCmgtz9Ix/view?usp=share_link