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1. 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.

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 disease

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1.1. Project Overview:

The project overview of Fertilizer Recommendation System For Disease Prediction is to detect the disease in the plant using machine learning and recommendate the fertilizer.

1.2 Purpose:

To Detect and recognize the plant diseases and to recommend fertilizer, it is necessary to provide symptoms in identifying the disease at its earliest. Hence the authors proposed and implemented new fertilizers Recommendation System for crop disease prediction.

2. LITERATURE SURVEY:

2.1Existing 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 external display or an Android application. The application 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.

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2.2.References:

TITLE	AUTHOR	YEAR	METHODOLOGY
Sampling and nutrient recommandation.	E.panten,K.haneklaus	1998	Is the recommendation it was able to analyse the soil nutrient type efficiently.
fertilizer suggestionfor corn .	A.dobermann,GW.hergert	2008	Kind of leaf dieses present in the crop and predict the fertilizer
A machine learning based for application for agriculture.	Akshaya chopade Aparna bhonde	2002	A user friendly web application based on machine learning and web scraping.
Soil based fertilizer recomandation system for crop diease	P.pandi selvi, P.selvi	2021	The proposed system was able to analyse

2.3.Problem Statement

Mr.sanjay is a 60 years old man. He had a own farming land and he is doing Agriculture for past 30 Years , In this 30 Years he Faced a problem in Choosing Fertilizers and Controlling of Plant Disease for improving the production.

- Sanjay wants to know the better recommendation forfertilizers for plants withthe disease.
- He has faced huge losses since past 5 years.
- This problem is usually faced by most of the farmers in India.
- Mr. Sanjay needs to know the result immediately to enhance his cultivation in field.

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Who does the problem affect?	Persons who do Agriculture in there own field.
What are the boundaries of theproblem?	People who Grow Crops are facingIssues of Plant Disease due to improper use of fertilizer
What is the issue?	In agricultural aspects, if the plantis affected by leaf disease, then itreduces thegrowth and productiveness. Generally, the plant diseases are caused by the abnormal physiological functionalities ofplants with get affected due to climatic condition ,soil erosion etc.

When does the issue occur?	During the development of thecrops asthey will be affected by various diseases.

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Where does the issue occur?	The issue occurs in agriculture practicing areas, particularly inrural regions due to improper knowledge incultivation.
Why is it important that we fix theproblem?	It is required for the growth ofbetterquality food products.
What solution to solve thisissue?	An automated system is introducedto identifydifferent diseases on plants by checking the symptoms shown on the leaves of the plant.
What methodology used to solve theissue?	Deep learning techniques are usedto identify the diseases and suggest the precautions that can be taken for the diseases.

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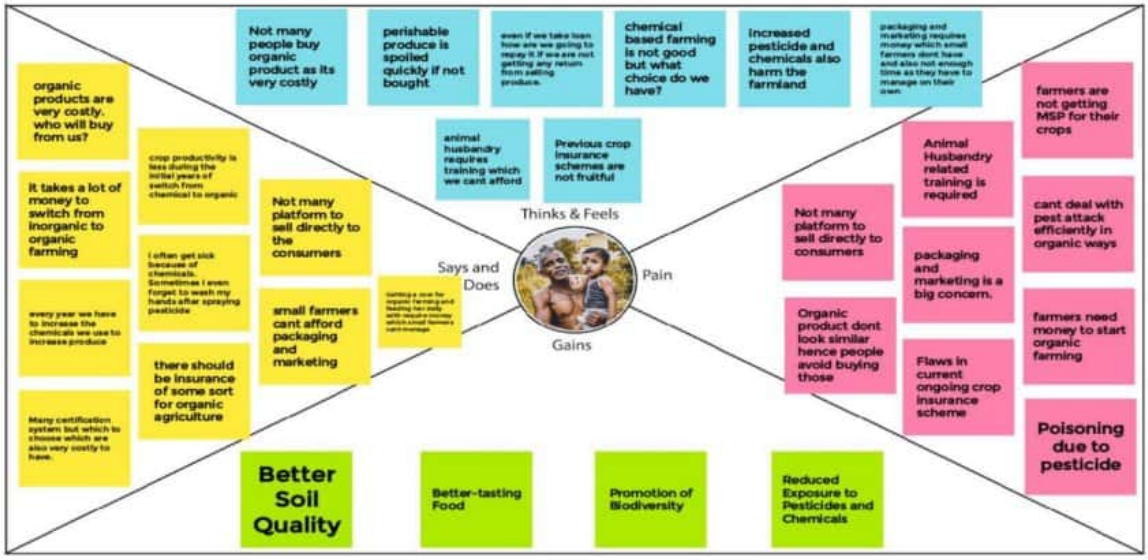
3. IDEATION & PROPOSED SOLUTION:

3.1.Empathy Map Canvas:

FERTILIZER RECOMMANDATION SYSTEM FOR DISEASE PREDICTION

Empathy map



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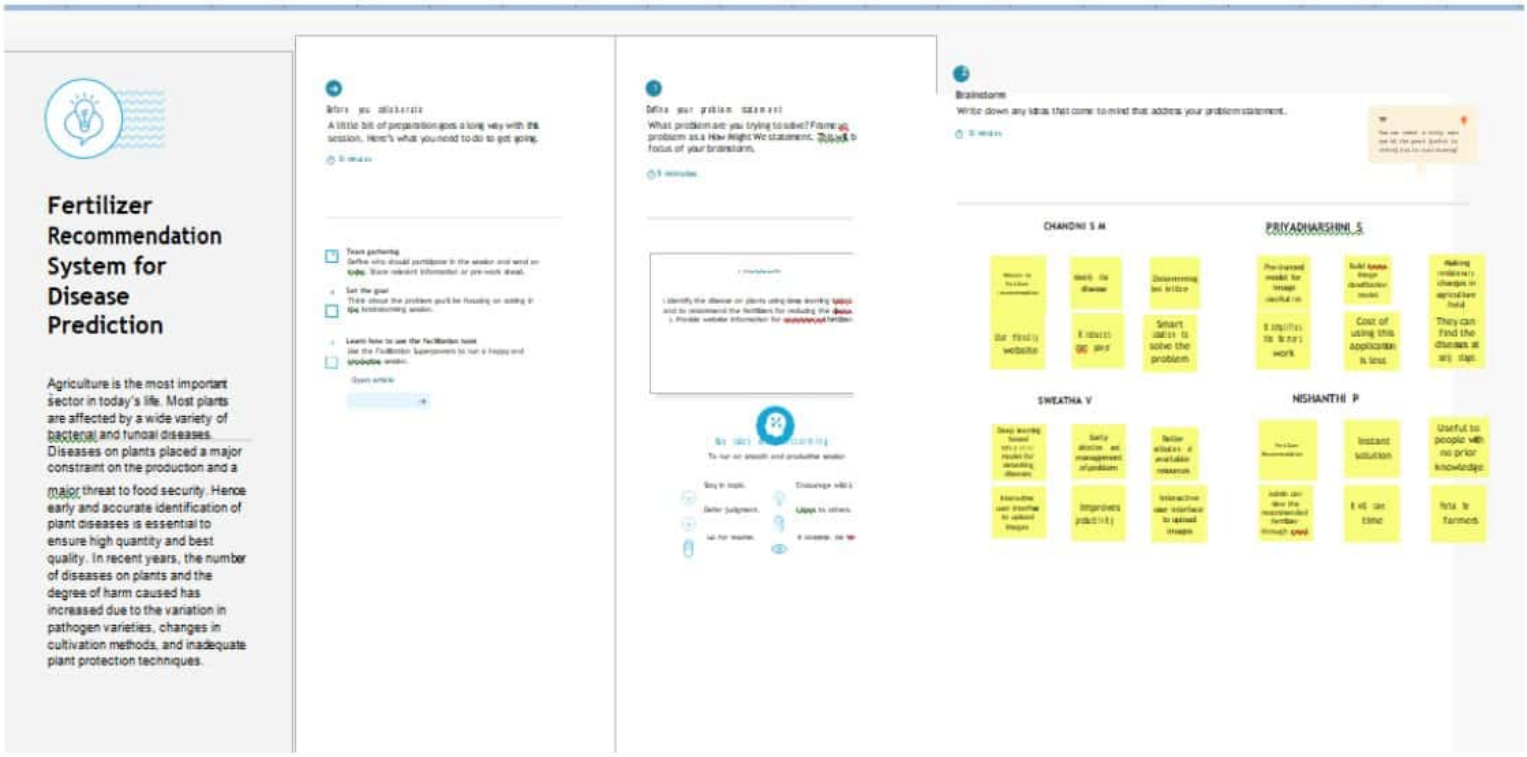
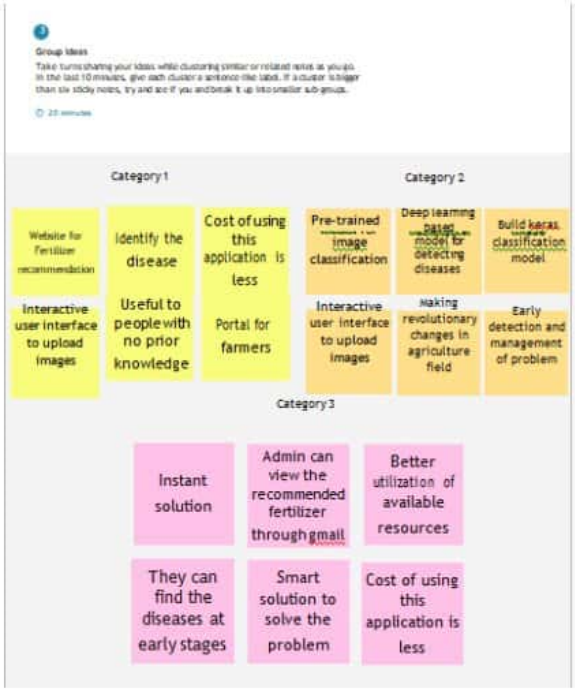
3.2. Ideation & Brainstorming:





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3.3.Proposed Solution:

The project team shall fill in the following information in the propose solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	• In India, the agriculture industry is extremely vital and crucial for economic and social development and jobs. In India, the agricultural sector provides a living for almost 48% of the population. As per the 2019-2020 economic survey, an Indian farmer's median wage in 16 states is Rupees 2500. Most of the Indian population depends on agriculture for their livelihood. • Agriculture gives an opportunity of employment to the village people to develop a country like India on large scale and give a push in the economic sector. • The majority of farmers face the problem of planting an inappropriate crop for their land based on a conventional or non-scientific approach. This is a challenging task for a country like India, where agriculture feeds approximately 42% of the population. • And the outcomes for the farmer of choosing the wrong

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		crop for land is moving towards metro city for livelihoods, suicide, quitting the agriculture and give land on lease to industrialist or use for the non-agriculture purpose. The outcome of wrong crop selection is less yield and less profit.
2.	Idea / Solution description	• The solution to the problem is Machine learning, which is one of the applications of Artificial Intelligence, is being used to implement the proposed system. Crop recommendation is going to recommend you the best crop you can grow in your land as per the soil nutrition value and along with as per the climate in that region. • And recommending the best fertilizer for every particular crop is also a challenging task. And the other and most important issue is when a plant gets caught by heterogeneous diseases that effect on less amount of agriculture production and compromises with quality as well. To overcome all these issues this recommendation has been proposed. • Nowadays a lot of research and work is being implemented in the smart and modern agriculture domain. Crop recommendation is

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		characterized by a soil database comprised of Nitrogen, Phosphorus, potassium. • The ensembles technique is used to build a recommendation model that combines the prediction of multiple machine learning. • Models to recommend the right crop based on • soil value and the best fertilizer to use.
3.	Novelty / Uniqueness	• Our Fertilizer Recommentation system for disease Prediction is in the form of web application to provide this valuable service to the environment and society.
4.	Social Impact / Customer Satisfaction	• Consumers Farming is one of the major sectors that influences a country's economic growth. In country like India, majority of the population is dependent on agriculture for their livelihood. • Many new technologies, such as Machine Learning and Deep Learning, are being implemented into agriculture so that it is easier for farmers to grow and maximize their yield

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5.	Business Model (Revenue Model)	• Predicting the fertilizers, analyzing the disease in a tap makes the life of farmers easy with minimal subscriptions would provide an acceptable return for the organization. This action adds a lot of value to the company and the business in society.
6.	Scalability of the Solution	• In the crop recommendation application, the user can provide the soil data from their side and the application will predict which crop should the user grow. • For the fertilizer recommendation application, the user can input the soil data and the type of crop they are growing, and the application will predict what the soil lacks or has excess of and will recommend improvements. • For the last application, that is the plant disease prediction application, the user can input an image of a diseased plant leaf, and the application will predict what disease it is and will also give a little background about the disease and suggestions to cure it. These all are to improve the Agriculture, that's slightly reduces the poverty, climatic condition, soil erosion etc.

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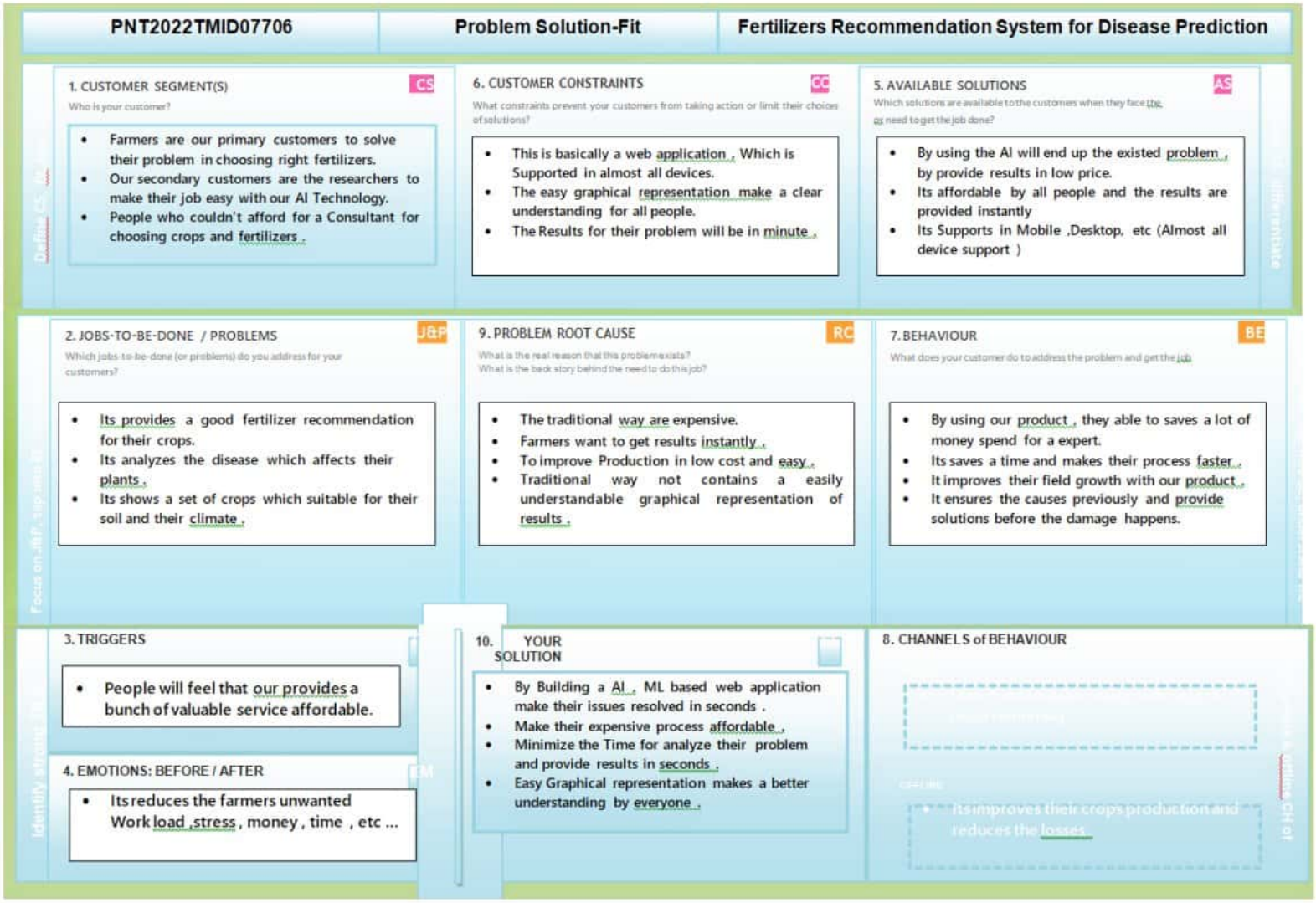
3.4. Problem Solution fit:



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4.REQUIREMENT ANALYSIS

4.1. Functional requirement:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	• NAME: Enter Name • EMAIL: Enter Mail • PASSWORD: Enter Password • PHONE: Enter Phone number
FR-2	User Confirmation	• Thank you for registering by your email • We have received a request from your mail. Please confirm to proceed further. • If any queries please contact our help centre to help get you an instant answer to • your question.
FR-3	Product Features	• It provides data of the fertilizer to full fill the user's demands. • Reading soil and plants characteristics by sensors.
FR-4	Testing Features	• This estimation of nutrient in soil is done using an NPK monitoring unit with Arduino UNO as the microcontroller to read the values from it. • Convolutional Neural Networks (CNN) algorithms recommend appropriate fertilizers that can be used to prevent damage to plants from pathogenic viruses. • The fertilizer data is collected from various markets about the brand name and NPK ratio of the fertilizer is collected.

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FR-5	Objective	• Smart farming and precession farming can be advanced by calculating NPK value for more accurate values. • Analyzing the soil condition of any region and the requirements of the farmer to maximize the soil production.

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4.2. Non-Functional requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	• It is very easily usable for the customer. • The customer gets a notification whenever the insufficient nutrient or disease is detected in the plant.
NFR-2	**Security**	• Security is very much concerned regarding the data collected and customer details. • These securities are mainly related to the cloud services, they have strict security across • the network.
NFR-3	**Reliability**	• The use of artificial intelligence gives appropriate result. • The CNN algorithm model has 95% accuracy. • The reliability is more for the customers.
NFR-4	**Performance**	• The app runs on a mobile device under various loads and circumstances.
NFR-5	**Availability**	• There is a high availability for user's access. Anyone can make use of it.
NFR-6	**Scalability**	• It is an effective way to minimize the damages for a plant by early detection of disease and recommending suitable fertilizers.

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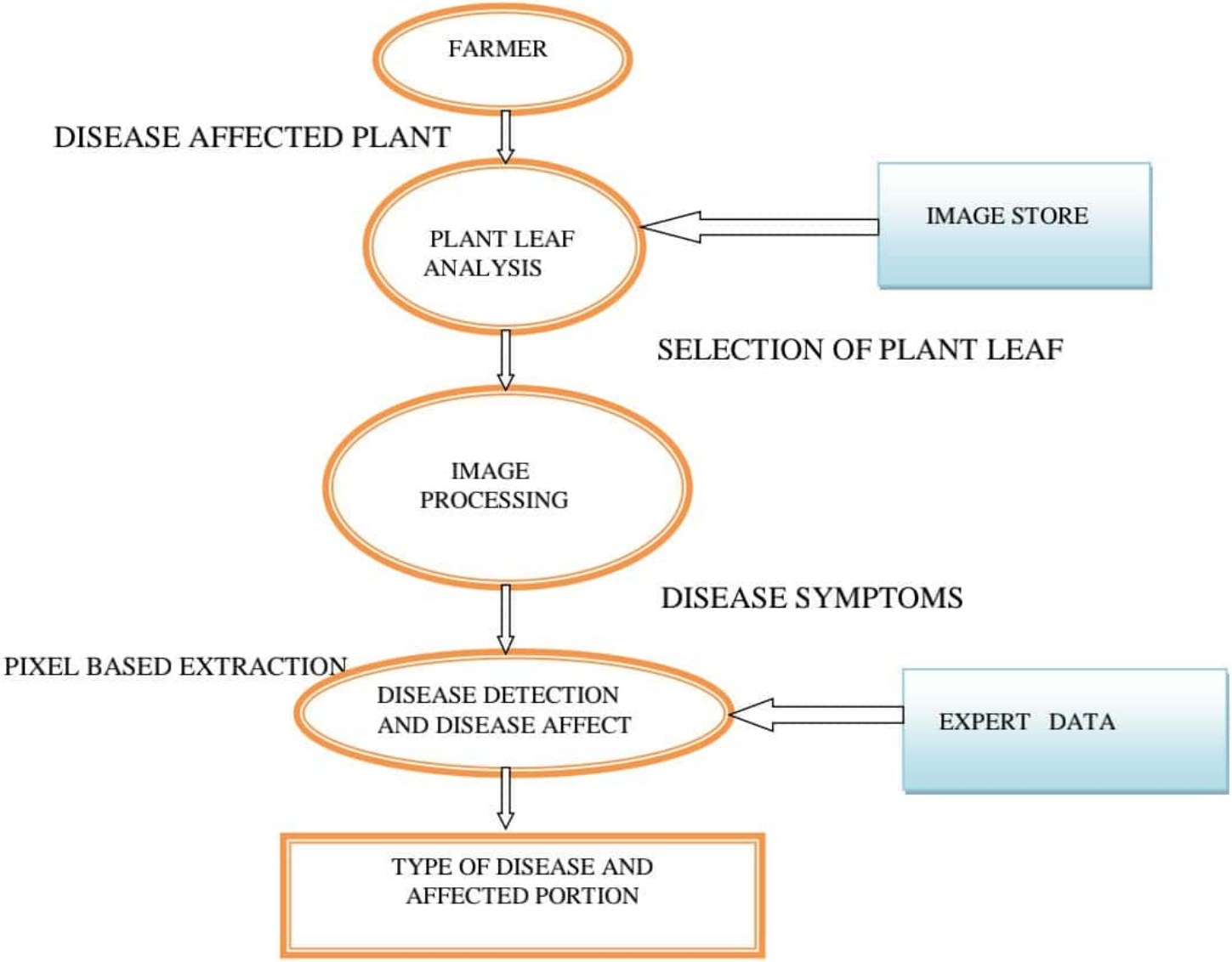
5.PROJECT DESIGN:

Project design is an early phase of the project lifecycle where ideas, processes, resources, and deliverables are planned out. A project design comes before a project plan as it's a broad overview whereas a project plan includes more detailed information.

5.1. Data Flow Diagrams:

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



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5.2.Solution & Technical Architecture:

Guidelines:

1. Include all the processes (As an application logic / Technology Block)
2. Provide infrastructural demarcation (Local / Cloud)
3. Indicate external interfaces (third Pparty API's etc.)
4. Indicate Data Storage components / services
5. Indicate interface to machine learning models (if applicable)

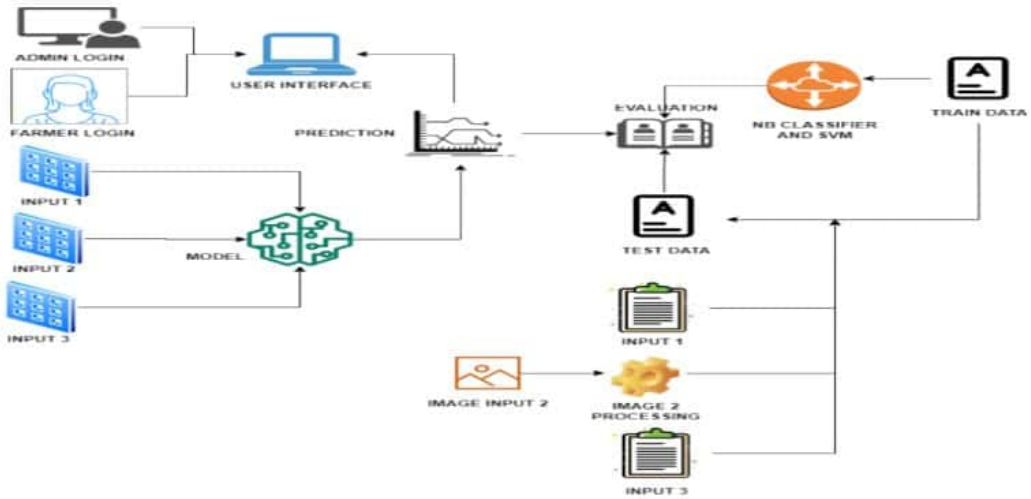

Table-1 :Components & Technologies

S.No	Component	Description	Technology
1.	User Interface	The user interacts with application using WebUI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js /React Js .
2.	Application Logic-1	Logic for a process in the application	Java / Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other StorageService or Local Filesystem

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8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
9.	External API-2	Purpose of External API used in the application	Aadhar API, etc.
10.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System /CloudLocal Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes,etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	The open-source frameworks used areRNN,Python flask.	Technology used for Open sourceframework is python.
2.	Security Implementations	The security / access controls are implemented,use of firewalls .	SHA-256, Encryptions, IBM Controls, OWASP etc.
3.	Scalable Architecture	The scalability of architecture is improved byupdating the software.	Technology used is Deep learning
4.	Availability	The availability of application is based on subscription manner and distributed servers areprovided.	Technology used is IBM Watsoncloudant.
5.	Performance	Design consideration for the performance of the application (number of requests per sec,use of Cache, use of CDN's) etc.	Technology used is Artificial neuralnetwork.

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5.3.User stories:

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Developer	Registration	USN-1	• As a user, I can sign up and register respectiv esites to access the required details • and data. And import the required libraries forthe processes.	I can access the account / dashboard	High	Sprint-1
Assistant developer	Login	USN-2	• As a user, I will access the page and test andtrain the CNN model to predict or detect the plant diseases.	I can test and confirm the error free detections	High	Sprint-2
Customer Care Executive	Worker	USN-3	• As a customer care executive ,i am available to thecustomers .so if the customers have any issues or in need of any assistance they • will get help	I can be in contact with thecustomers.	medium	Sprint 3

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			and solve them.			
Customer (Web user)	Login	USN-4	As a user , i will have the access to know about the activities in the plant.	I can get messages whenthere is disease in plants.	High	Sprint-4

6. PROJECT PLANNING & SCHEDULING

The definition of a sprint is a dedicated period in which a set amount of work will be completed on a project. It's part of the agile methodology, and an Agile project will be broken down into a number of sprints, each sprint taking the project closer to completion.

6.1 Sprint planning & Estimation :

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 sign up and register respective sites to access the required detailsand data. And import the required libraries forthe processes.	2	High	CHANDNI S.M SWEATHA S.V NISHANTHI P PRIYADHARSHINI S
Sprint-2	Login	USN-2	As a user, I will access the page and test andtrain the CNN model to predict or detect the plant disease.	2	High	CHANDNI S.M SWEATHA S.V NISHANTHI P PRIYADHARSHINI S
Sprint-3	Customer Service	USN-3	As a customer care executive , I am available to the customers . so if the customers have any issues or in need of any assistance they will get help and solve them.	1	Medium	CHANDNI S.M SWEATHA S.V NISHANTHI P PRIYADHARSHINI S
Sprint-4	Dashboard	USN-4	As a user, I will have the access to know about the activities in the plant.	2	High	CHANDNI S.M SWEATHA S.V NISHANTHI P PRIYADHARSHINI S

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6.2.Sprint Delivery Schedule:

Project Tracker, Velocity & Burndown Chart:

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	24 Oct 2022	29 Oct 2022	20	04 Nov 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022		06 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022		09 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022		12 Nov 2022

Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

AV:

Sprint 1 = 20/6= 3.33,

Sprint 2 = 20/6= 3.33,

Sprint 3 = 20/6= 3.33,

Sprint 4 = 20/6= 3.33.

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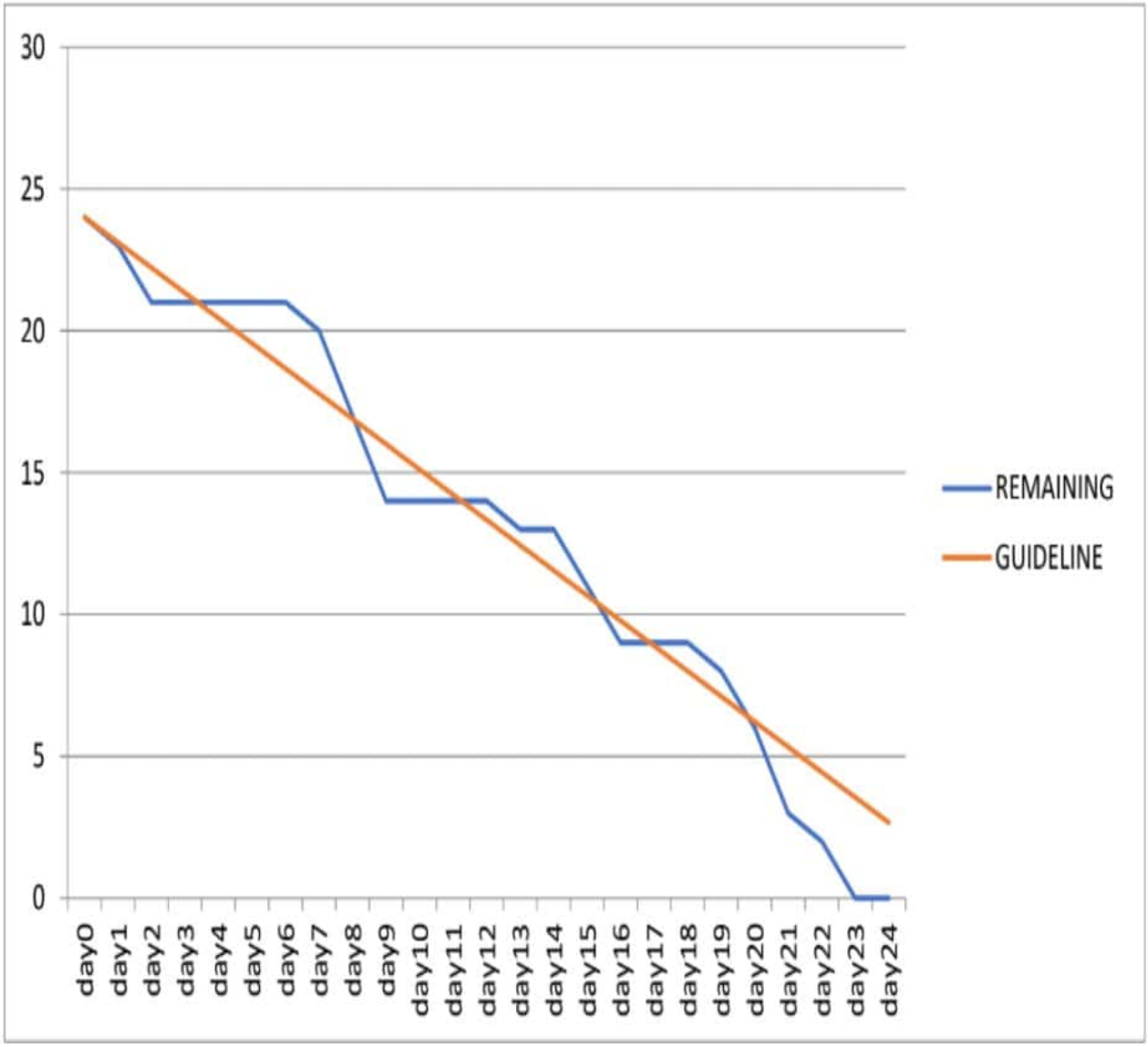
Burndown Chart:

A burn-down chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such as scrum. However, burn-down charts can be applied to any project containing measurable progress over time.



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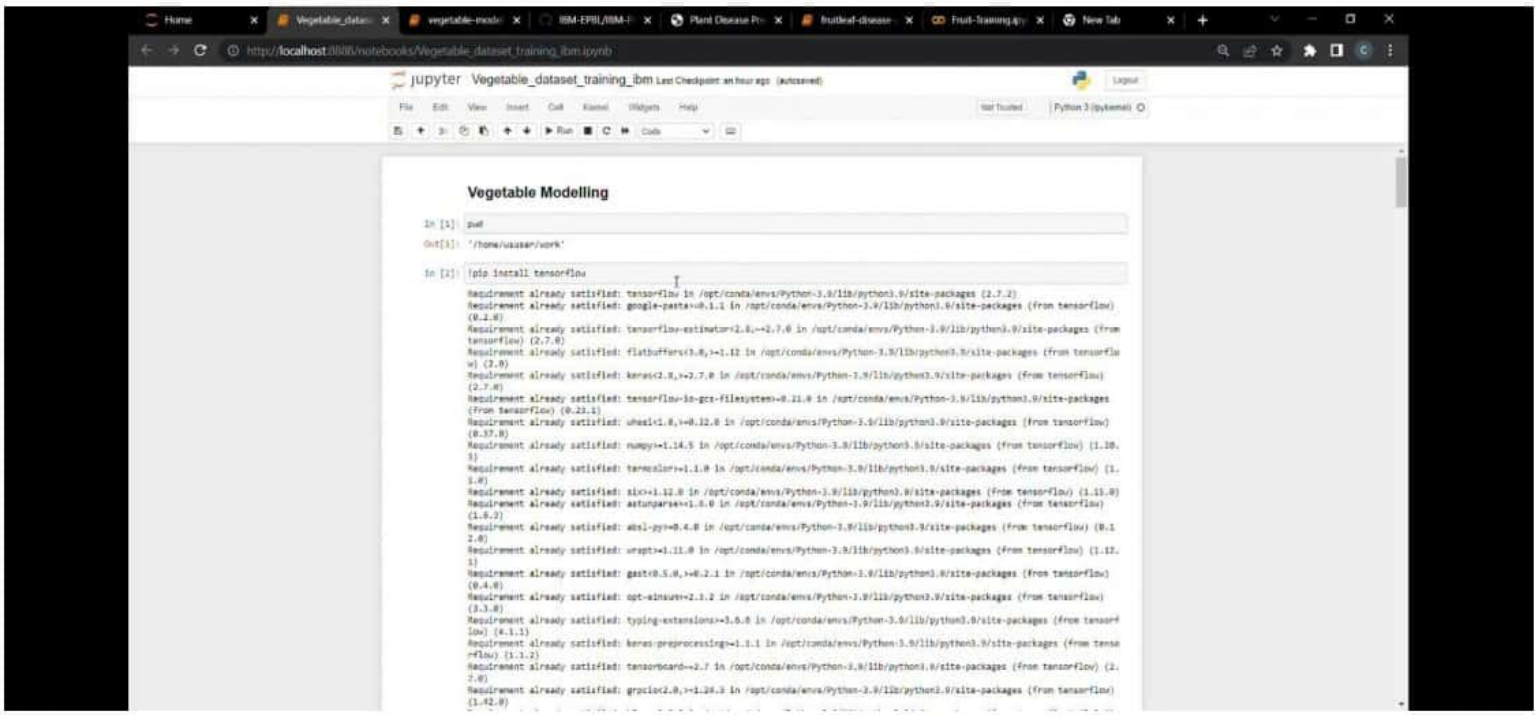
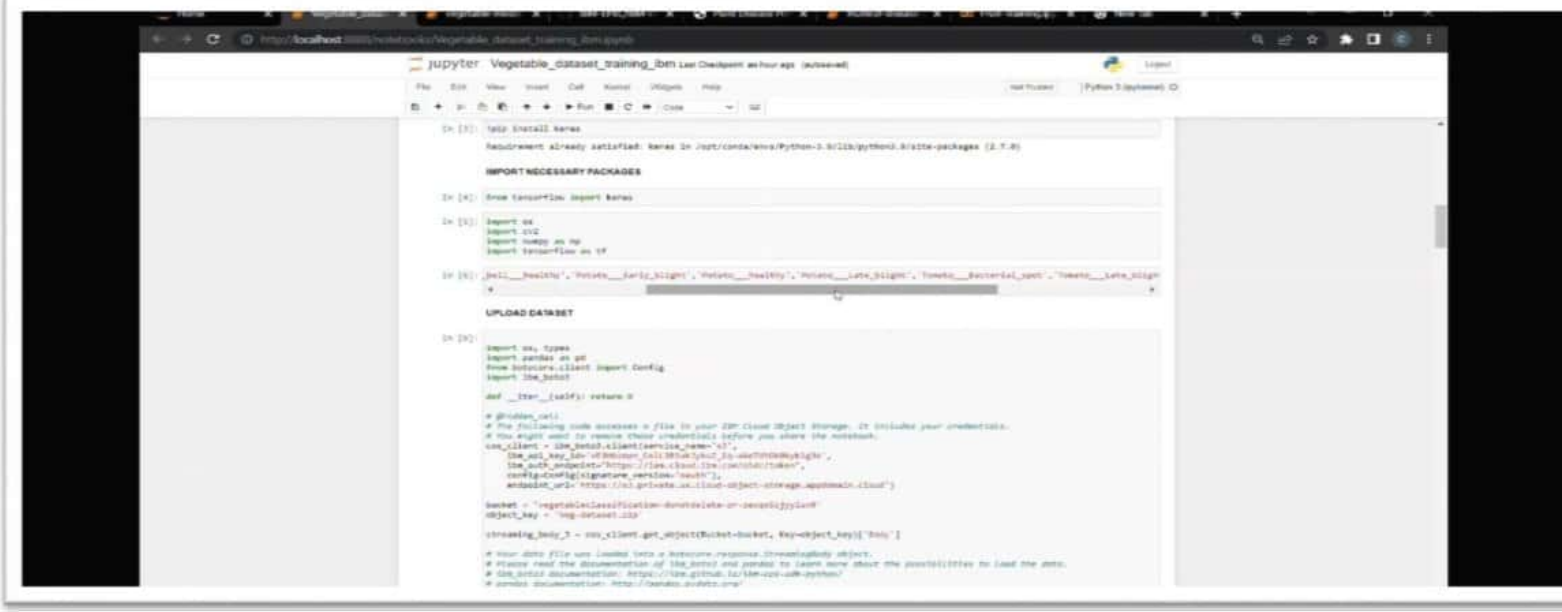
7.CODING & SOLUTION:

(Explain the features added in the project along with code):

7.1 Code :





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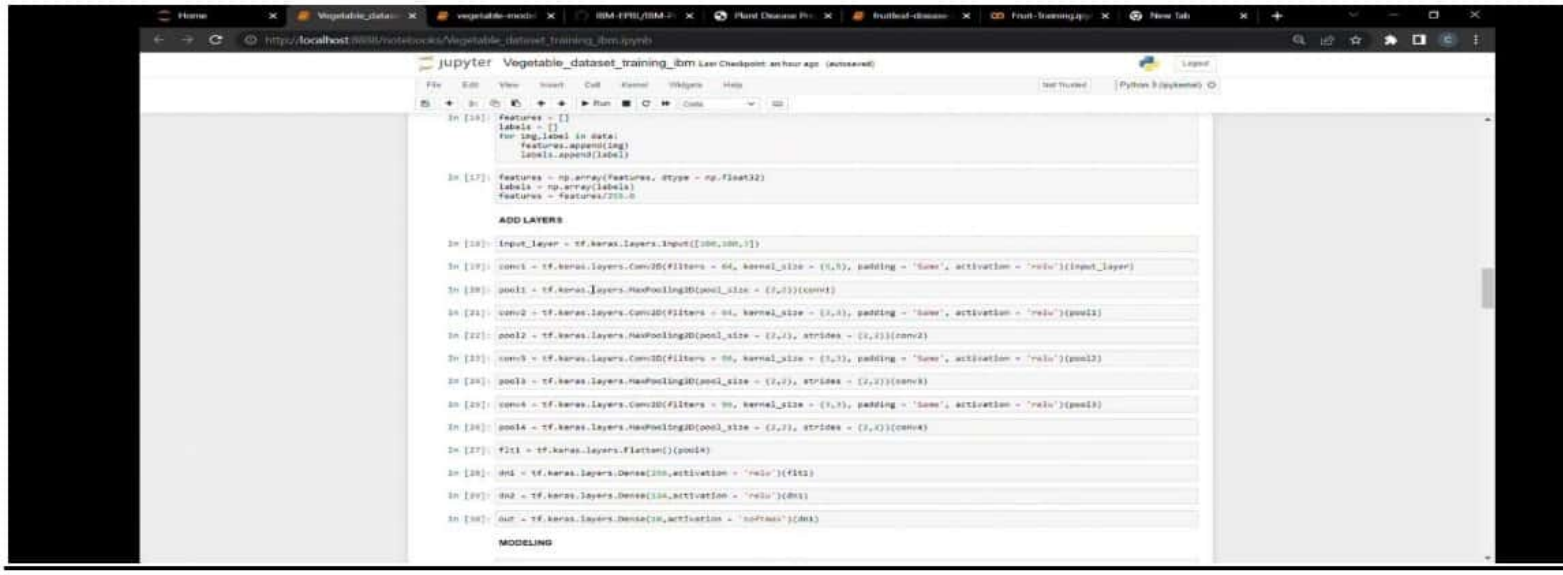


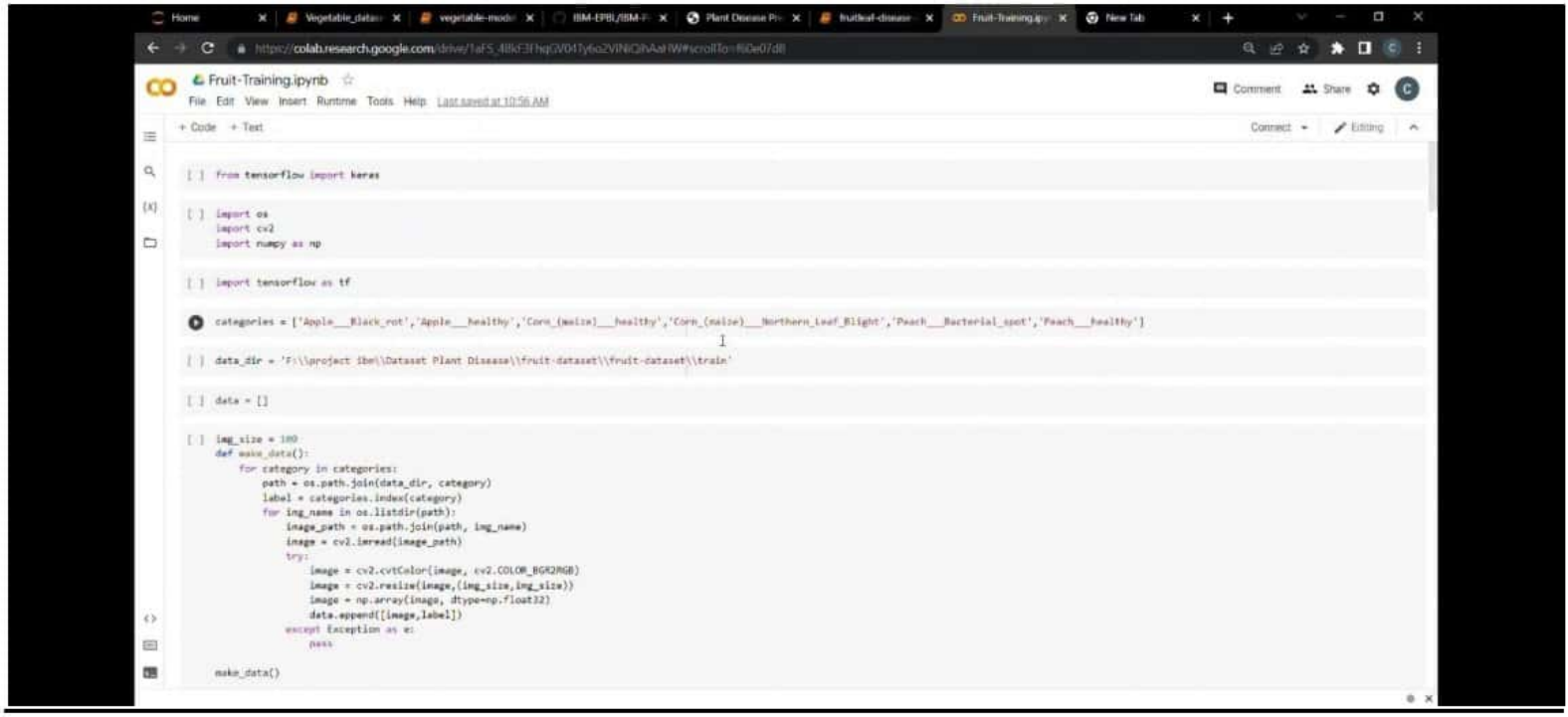
```
features = []
labels = []
for img,label in data:
    features.append(img)
    labels.append(label)
```

```
features = np.array(features, dtype = np.float32)
labels = np.array(labels)
features = features/255.0
```

ADD LAYERS

```
input_layer = tf.keras.layers.Input([100,100,3])
conv1 = tf.keras.layers.Conv2D(filters = 64, kernel_size = (3,3), padding = 'Same', activation = 'relu')(input_layer)
pool1 = tf.keras.layers.MaxPooling2D(pool_size = (2,2))(conv1)
conv2 = tf.keras.layers.Conv2D(filters = 64, kernel_size = (3,3), padding = 'Same', activation = 'relu')(pool1)
pool2 = tf.keras.layers.MaxPooling2D(pool_size = (2,2), strides = (2,2))(conv2)
conv3 = tf.keras.layers.Conv2D(filters = 96, kernel_size = (3,3), padding = 'Same', activation = 'relu')(pool2)
pool3 = tf.keras.layers.MaxPooling2D(pool_size = (2,2), strides = (2,2))(conv3)
conv4 = tf.keras.layers.Conv2D(filters = 96, kernel_size = (3,3), padding = 'Same', activation = 'relu')(pool3)
pool4 = tf.keras.layers.MaxPooling2D(pool_size = (2,2), strides = (2,2))(conv4)
flt1 = tf.keras.layers.Flatten()(pool4)
dn1 = tf.keras.layers.Dense(256,activation = 'relu')(flt1)
dn2 = tf.keras.layers.Dense(134,activation = 'relu')(dn1)
out = tf.keras.layers.Dense(10,activation = 'softmax')(dn1)
```

MODELING



Fruit-Training.ipynb

```
from tensorflow import keras
```

```
import os
import cv2
import numpy as np
```

```
import tensorflow as tf
```

```
categories = ['Apple___Black_rot','Apple___healthy','Corn_(maize)___healthy','Corn_(maize)___Northern_Leaf_Blight','Peach___Bacterial_spot','Peach___healthy']
```

```
data_dir = 'F:\\project ibm\\Dataset Plant Disease\\fruit-dataset\\fruit-dataset\\train'
```

```
data = []
```

```
img_size = 100
def make_data():
    for category in categories:
        path = os.path.join(data_dir, category)
        label = categories.index(category)
        for img_name in os.listdir(path):
            image_path = os.path.join(path, img_name)
            image = cv2.imread(image_path)
            try:
                image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
                image = cv2.resize(image,(img_size,img_size))
                image = np.array(image, dtype=np.float32)
                data.append([image,label])
            except Exception as e:
                pass

make_data()
```

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7.2 Output:

HOME PAGE:

PREDICTION PAGE :

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7.3 RESULT PAGE :

FRUIT:

VEGETABLE:

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8.ADVANTAGES :.

- The proposed model could predict the disease just from the image of a particular plant.
- Easy to use UI.
- Model has some good accuracy in detecting the plant just by taking the input(leaf).

9. CONCLUSION :

- 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. Usage of such applications could help the farmers to necessary precautions so that they don't face any loss as such.

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10.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 can be also done in Mobile applications like android, ios. It helps in many ways to improve the agriculture in cultivation of crops and predict the correct fertilizers to the crops.

11.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__)

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

#home page
app.route('/')
```

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```
def home():
    return render_template('home.html')

#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(x)
            preds=np.argmax(preds)
            print(preds)
            df=pd.read_excel('precautions - veg.xlsx')
            print(df.iloc[preds]['caution'])
        else:
                preds = model1.predict(x)
                preds=np.argmax(preds)
                df=pd.read_excel('precautions - fruits.xlsx')
                print(df.iloc[preds]['caution'])
```

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```
        return df.iloc[preds]['caution']

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

11.1 GitHub & Project Demo Link :

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11.2 Demo Link :

https://youtu.be/q5oHeS32Lr0

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