PROJECT REPORT

FERTILIZERS RECOMMENDATION SYSTEM FOR DISEASE PREDICTION

submitted by

PNT2022TMID33189

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INTRODUCTION

Agriculture production in the Indian economy is more than just food. Today's agricultural land mass has grown so large that it has become an important part of its economy. In India, 60-70% of population relies on agriculture sector. Plant diseases often cause severe loss of vegetables and crops. Plant diseases can also affect human health by secreting toxic metabolites. The study of plant disease involves detection of visual patterns in the plants. Diagnosis of plant diseases is an important part of cultivation as failure will affect the quantity and quality of product and human health . There are various types of plant diseases caused by organisms like virus, bacteria and fungus. An automated disease identification process can be helpful in identifying plant pathology at an early stage. The early detection of disease has a positive effect on plant health. In most of the cases, disease symptoms are seen on the leaves, stem and fruit. The indications on the plant leaves are used to diagnose the disease faster, more reliably and at lower costs. In general, the technique for diagnosing plant diseases is naked eye inspection by farmers, which allows for disease recognition and detection. A large number of specialists and constant plant monitoring is required for this, which incur a cost when dealing with large farms. However, in certain nations, farmers lack adequate facilities or even the knowledge of how to contact experts.This means that consulting professionals is both expensive and time consuming.

1.1 PROJECT OVERVIEW

In this project, two datasets name fruit dataset and vegetable dataset are collected. The collected datasets are trained and tested with deep learning neural network named Convolutional Neural Networks(CNN). First, the fruit dataset is trainedandthentestedwithCNN.Ithas6classesandalltheclassesaretrainedand tested. Second, the vegetable dataset is trained and tested.The software used for training and testing of datasets is Python. All the Python codes arefirst written in Jupyter notebook supplied along with Anaconda Python and then the codes are tested in IBM cloud. Finally a web based framework is designed withhelp Flask a Python Library.There are2htmlfiles are created in templates folder along with their associated files in static folder.The Python Program 'app.py' used to interface with These two Web pages are written in Spyder-Anaconda python and tested.

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

2.1 EXISTING PROBLEM

We proposed a method for leaf disease detection and suggest fertilizers to cure leaf diseases.But the method involves less number of train and test sets which result in poor accuracy. We proposed A simple prediction method for soil based fertilizer recommendation systems for predicted crop diseases. This method gives less accuracy and prediction.

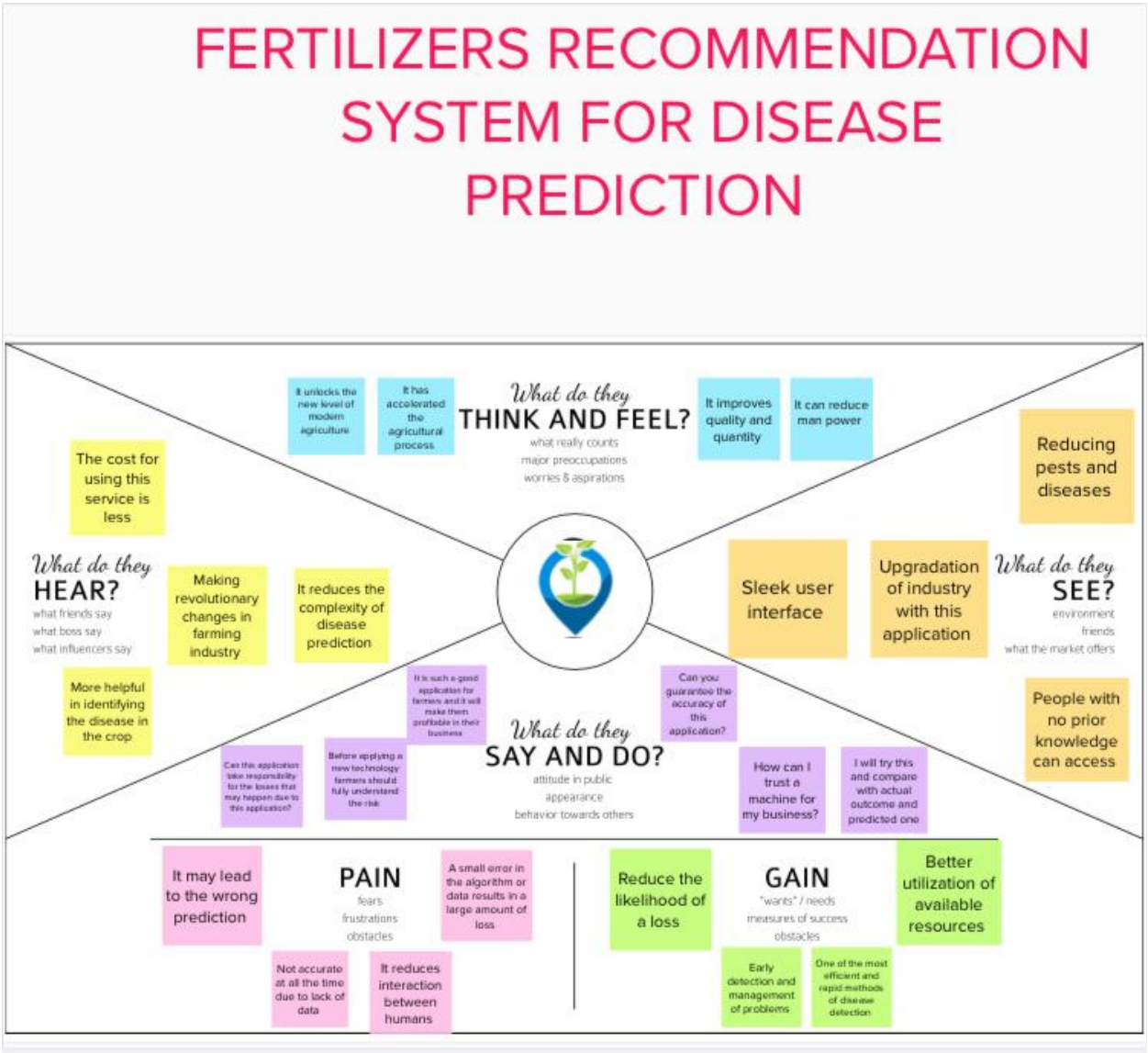
2.2 REFERENCES

2.3 PROBLEM STATEMENT DEFINITION

Farmers usually detect the crop diseases and plant diseases with their naked eye which makes them take tough decisions on which fertilisers to use. In case the farmer makes wrong predictions and uses the wrong fertilizers or more than the normal dose (or) threshold or Limit (every plant has some threshold fertilizers spraying to be followed), it will mess up the whole plant (or) soil and cause enough damage to plant and fields. It is necessary to develop crop yield prediction and fertilizers recommendation system which predicts crop yield based on soil nutrients crop yield data and recommend fertilizer for selected crop based on different datasets like fertilizer data,location data and crop yield data.

3.**IDEATION AND PROPOSED SOLUTION**

3.1 EMPATHY MAP CANVAS



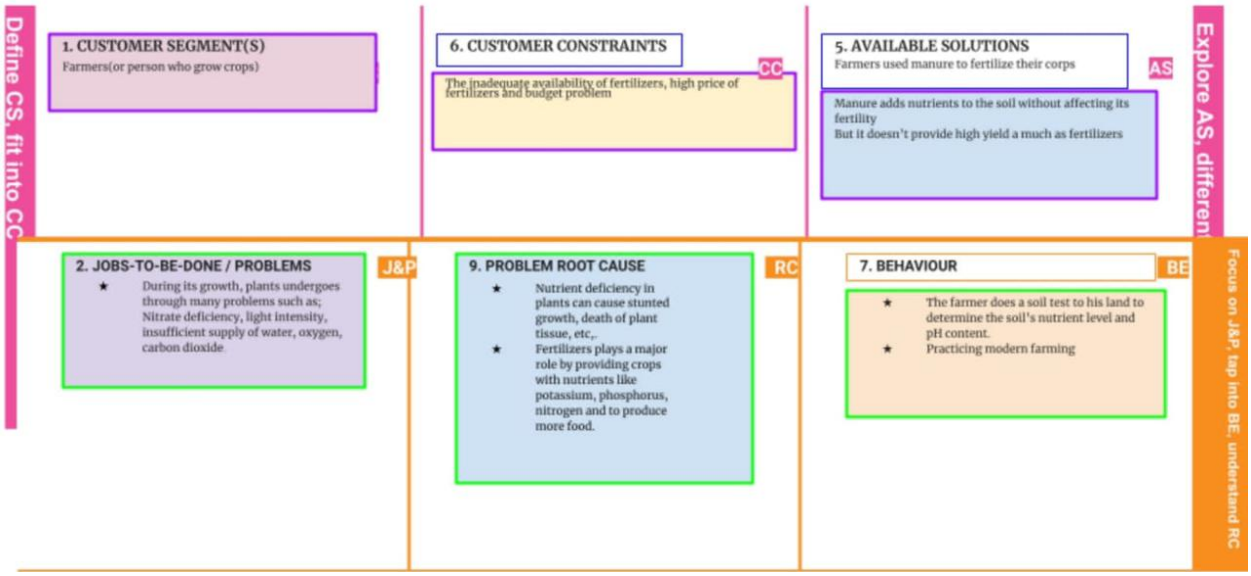
3.2 IDEATION & BRAINSTORMING

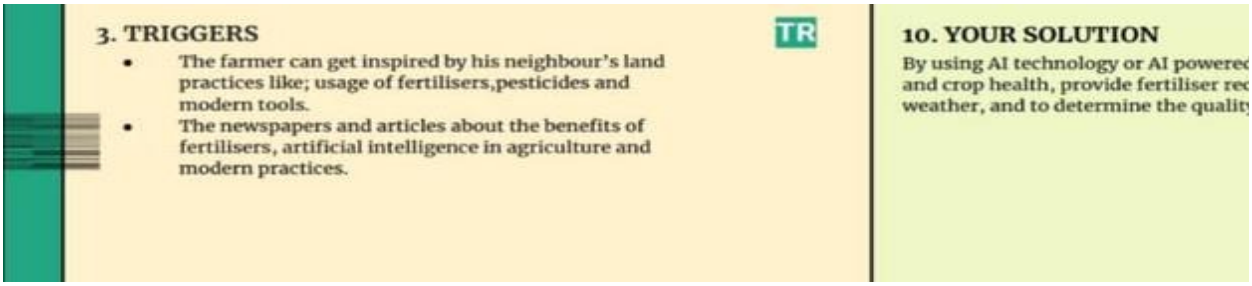
3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	• Farmers usually detect the crop diseases and plant diseases with their naked eye which makes them take tough decisions on which fertilisers to use. • In case the farmer makes wrong predictions and uses the wrong fertilizers or more than the normal dose (or) threshold or Limit (every plant has some threshold fertilizers spraying to be followed), it will mess up the whole plant (or) soil and cause enough damage to plant and fields. • It is necessary to develop crop yield prediction and fertilizers recommendation system which predicts crop yield based on soil nutrients crop yield data and recommend fertilizer for selected crop based on different datasets like fertilizer data,location data and crop yield data
2.	Idea / Solution description	• Implementation of artificial intelligence for identification of pests and recommendation of insecticides using TPF-CNN. • The combination of two major things required in farming in one system is spraying proper insecticides and adding the needed fertilizer amount to the soil. • Implementation of soil sensor for soil NPK nutrient analysis and recommendation of fertilizers accordingly.
3.	Novelty / Uniqueness	• Efficient approach for controlling the overuse of insecticides and fertilizers in farming.

		• Time efficient approach compared to KNN, SVM and ANN. • It can suggest and predict best and correct fertilizers for disease in the plant.
4.	Social Impact / Customer Satisfaction	• Yield right crop at the right time, balancing the crop production, control plant disease, economic growth and planning to reduce the crop scarcity. Hence 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 implemented new fertilizers Recommendation System for crop disease prediction.
5.	Business Model (Revenue Model)	• Typically dedicate 10% of their AI investment to algorithms, 20% to technologies and 70% to embedding AI into business processes and agile ways of working. In other words, companies invest twice as much in people and processes as they do in technologies.
6.	Scalability of the Solution	• This can be improved by introducing online purchases crops, fertilizers,etc., easily

3.4 PROBLEM SOLUTION FIT





4 REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

Project Design Phase-II
Solution Requirements (Functional & Non-functional)

Date	16 October 2022
Team ID	PNT2022TMID33189
Project Name	Project – Fertilizer recommendation system for disease prediction
Maximum Marks	4 Marks

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	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.
FR-5	Objective	Smart farming and precession farming can be advanced by calculating NPK value for more accurate values.

4.2 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**	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.

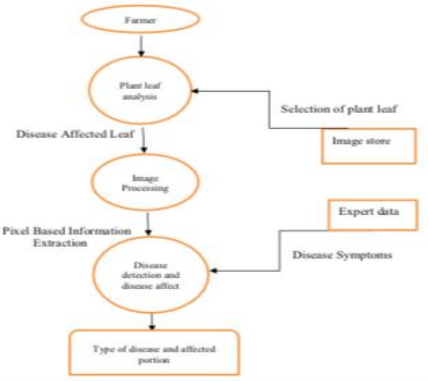
5 PROJECT DESIGN

5.1 DATA FLOW DIAGRAM

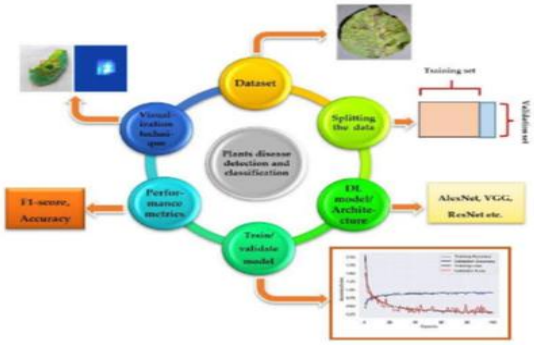
Project Design Phase-II Data Flow Diagram &User Stories

Team ID	PNT2022TMID33189
Project Name	FERTILIZERS RECOMMENDATION SYSTEM FOR DISEASE PREDICTION
Maximum Marks	4 Marks

Data Flow Diagrams:



Detection Plants Disease:

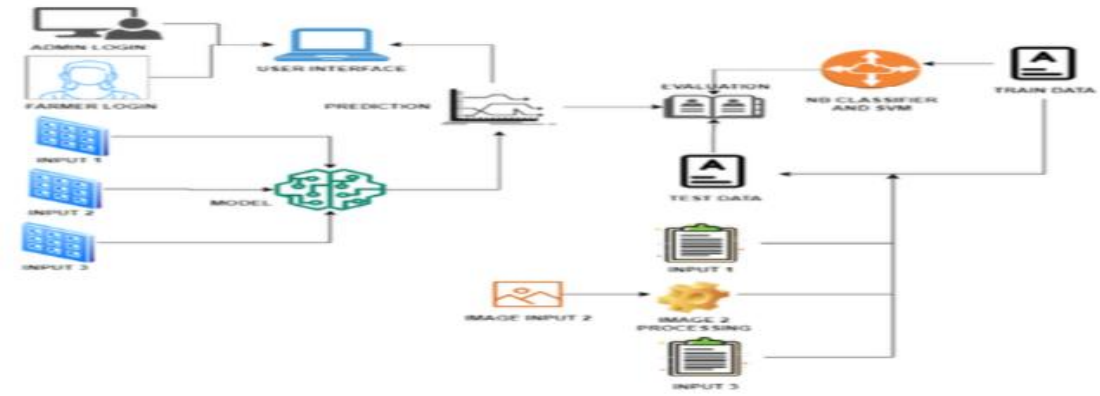


5.2 SOLUTION & TECHNICAL ARCHITECTURE

Project Design Phase-II
Technology Stack (Architecture & Stack)

Date	16 October 2022
Team ID	PNT2022TMID33189
Project Name	Project - Fertilizer Recommendation System For Disease Prediction
Maximum Marks	4 Marks

Technical Architecture:



Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application.To depict the human-computer interaction and communication.	HTML, CSS, JSP
2.	Application Logic-1	Option to Upload image as input file	Python
3.	Application Logic-2	To use the Model and Predicting the result	Python
4.	Database	To store the image as CLOB/BLOB as structured data image	MySQL
5.	Cloud Database	Database that runs on a cloud computing platform and access to the database as service	IBM Cloud
6.	File Storage	Data are stored in hierarchical architecture	Local File system
7.	Machine Learning Model	Support Vector Machine Algorithm is used widely in Regression problems	Random Plants, XG Boost

5.3 USER STORIES

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 respective sites 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 the customers .so if the customers have any issues or in need of any assistance they will get help and solve them.	I can be in contact with the customers.	medium	Sprint 3
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 when there is disease in plants.	High	Sprint-4

6 PROJECT PLANNING AND SCHEDULING

6.1 SPRINT PLANNING AND ESTIMATION

Project Planning Phase

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

Date	18 October 2022
Team ID	PNT2022TMID33189
Project Name	Project - Fertilizers Recommendation system for disease prediction
Maximum Marks	8 Marks

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

Use the below template to create product backlog and sprint 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 sign up and register respective sites to access the required details and data. And import the required libraries for the processes.	2	High	Divyadharshini.M Febronia.J Divyadharshini.R Abirami.T
Sprint-2	Login	USN-2	As a user, I will access the page and test and train the CNN model to predict or detect the plant disease.	2	High	Divyadharshini.M Febronia.J Divyadharshini.R Abirami.T
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	Divyadharshini.M Febronia.J Divyadharshini.R Abirami.T
Sprint-4	Dashboard	USN-4	As a user, I will have the access to know about the activities in the plant.	2	High	Divyadharshini.M Febronia.J Divyadharshini.R Abirami.T

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	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.

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

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AV:

Sprint 1 = 20/6= 3.33,

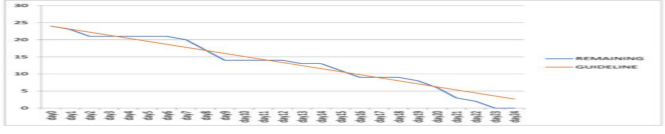
Sprint 2 = 20/6= 3.33,

Sprint 3 = 20/6= 3.33,

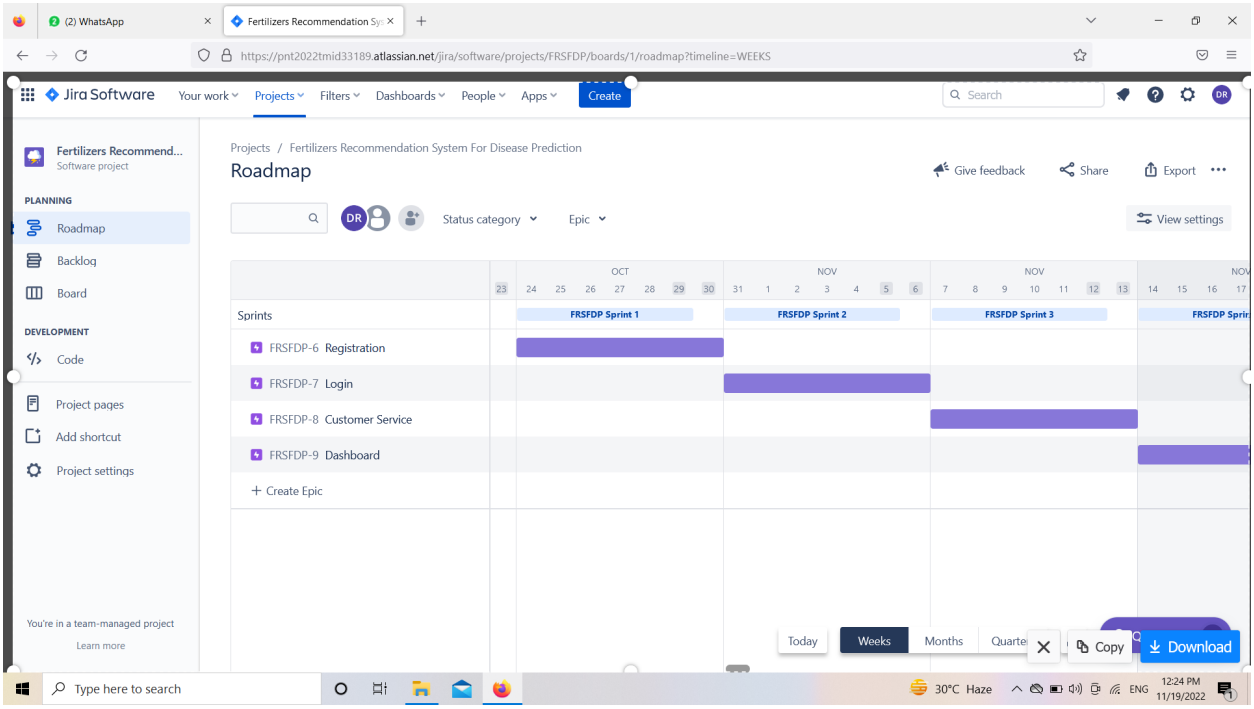
Sprint 4 = 20/6= 3.33.

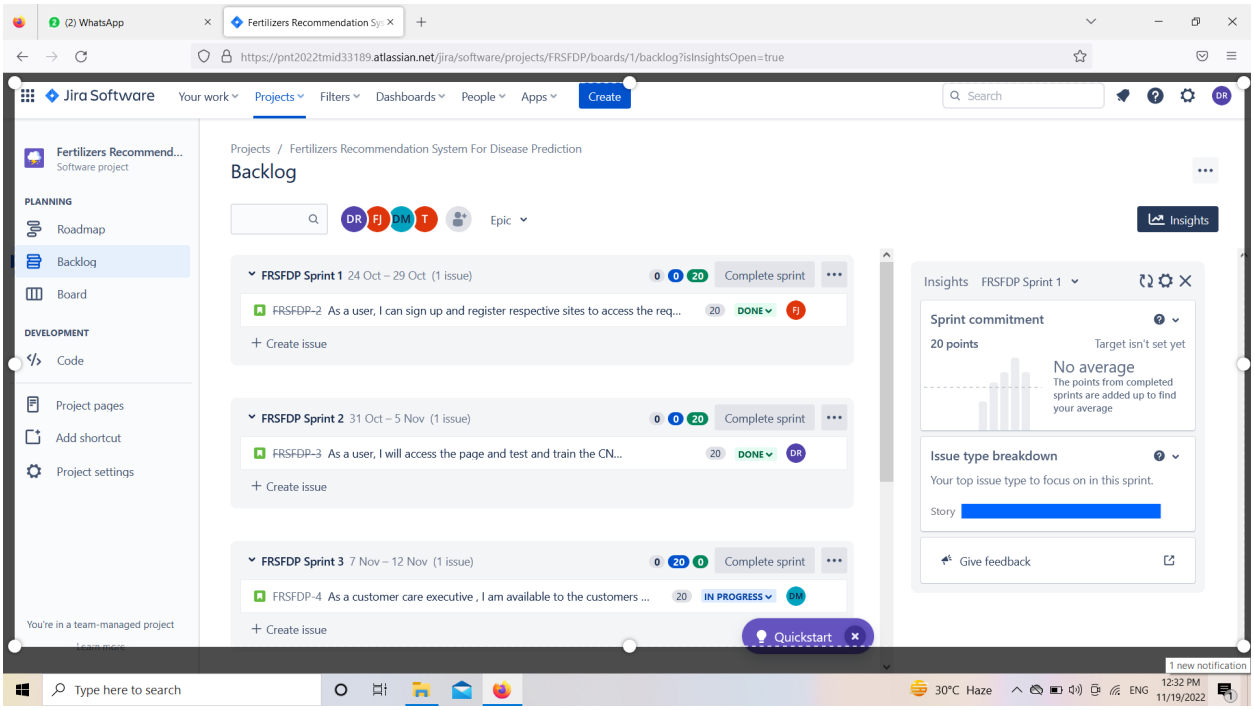
Burndown Chart:

A burndown 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.



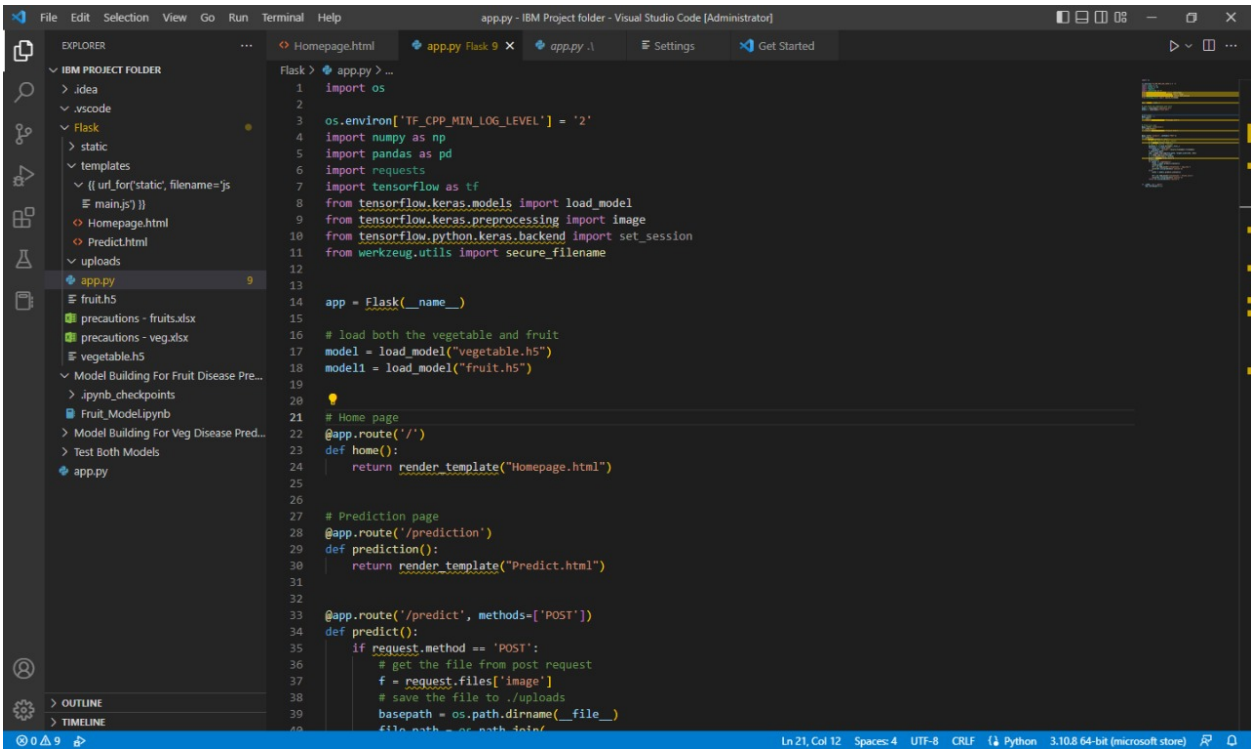
6.2 SPRINT DELIVERY SCHEDULE REPORTS FROM JIRA





7 CODING & SOLUTIONING

FEATURE 1



PYTHON CODE FOR FLASK:

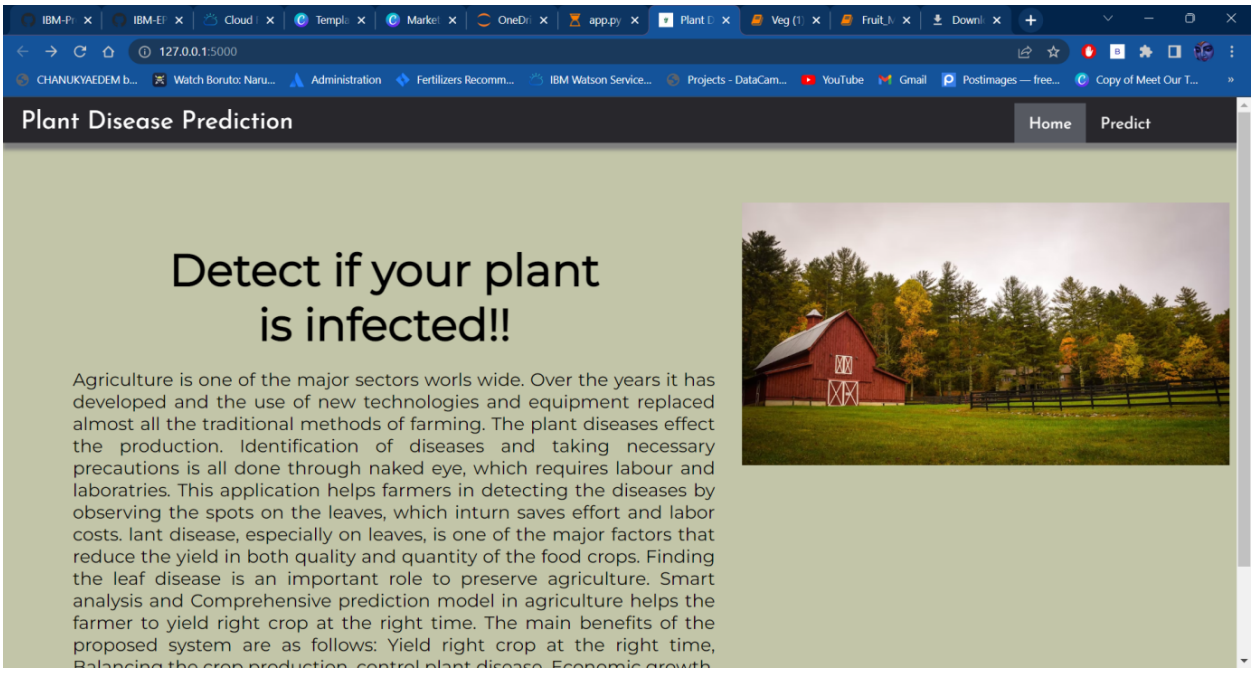
```
import requests
from tensorflow.keras.preprocessing import image
from tensorflow.keras.models import load_model
import numpy as np
import pandas as pd
import tensorflow as tf
from flask import Flask, request, render_template, redirect, url_for
import os
from werkzeug.utils import secure_filename
```

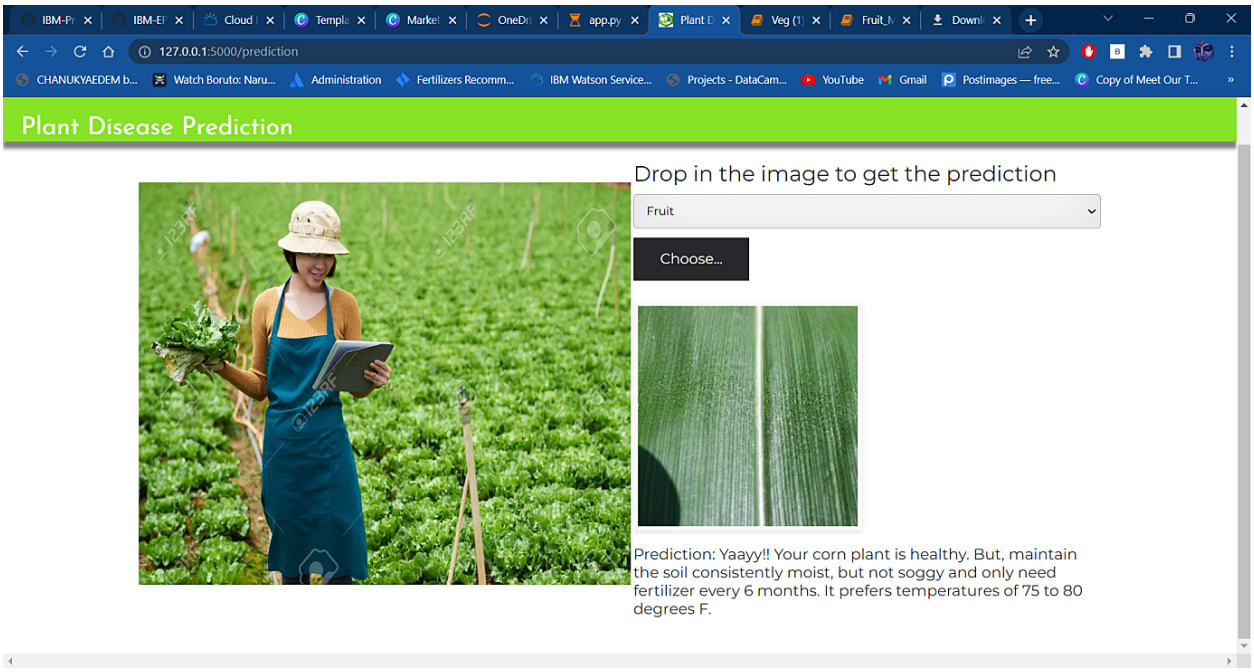
```
from tensorflow.python.keras.backend import set_session

app = Flask(__name__)

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

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

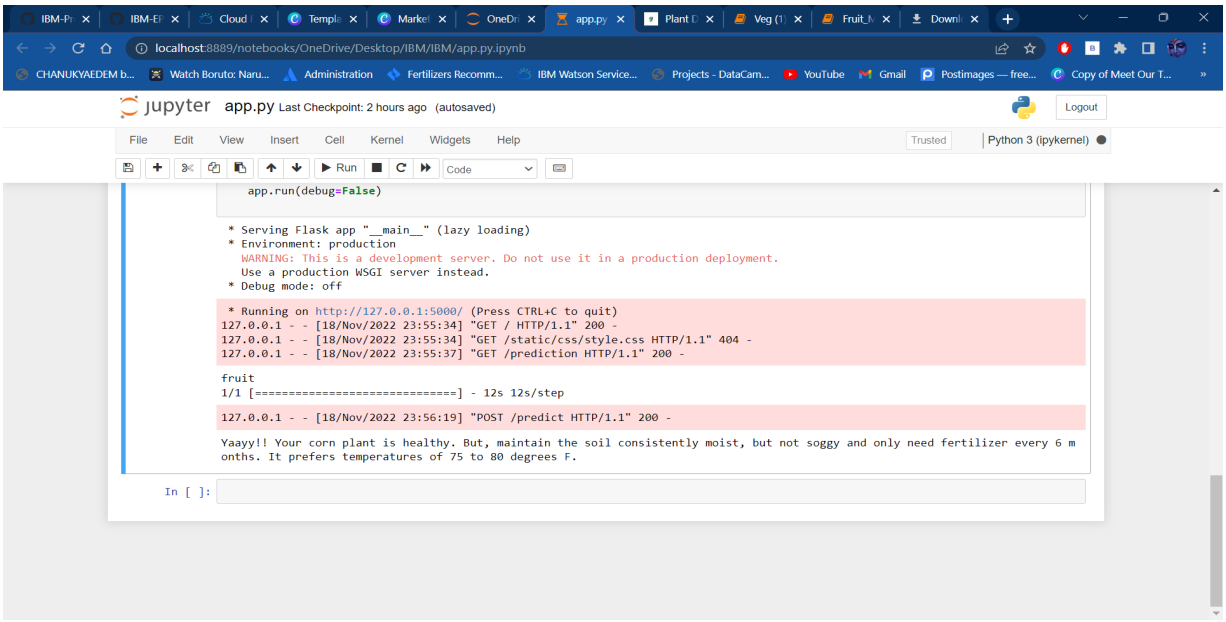
```
    x = np.expand_dims(x, axis=0)

    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'])


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

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

FEATURE 2:

HTML PAGES FOR WEB APPLICATION:

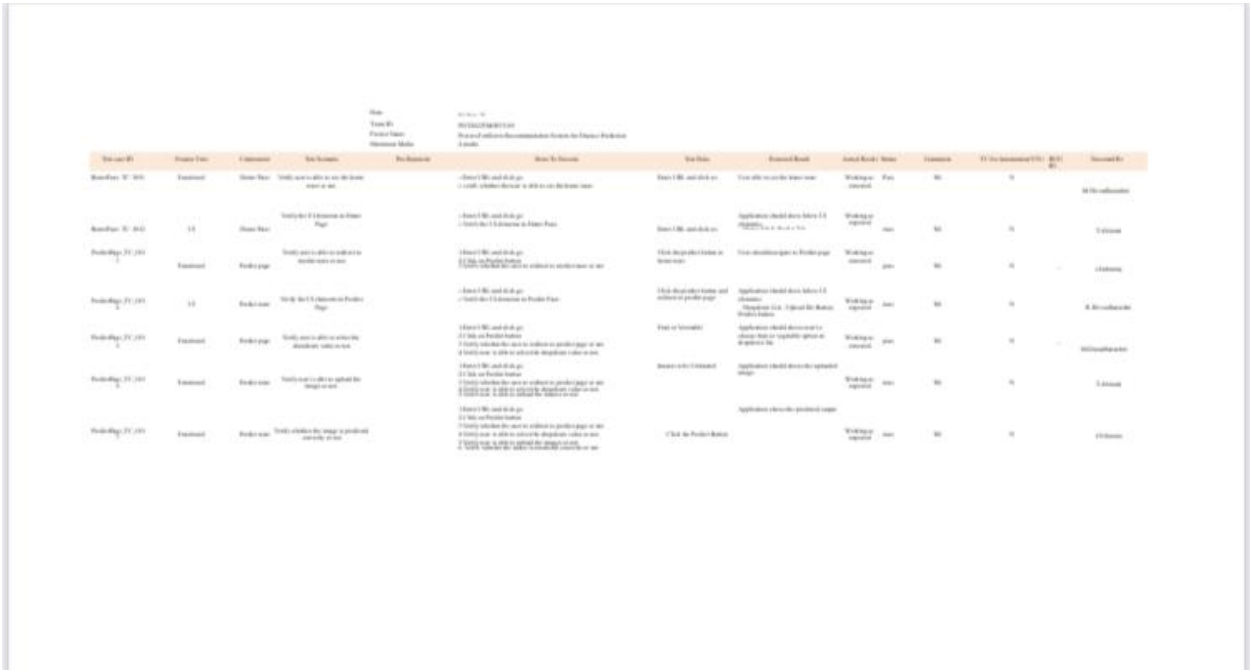

127.0.0.1:5000
Plant Disease Prediction
Home
Predict
Detect if your plant is infected!!
Agriculture is one of the major sectors worls wide. Over the years it has developed and the use of new technologies and equipment replaced almost all the traditional methods of farming. The plant diseases effect the production. Identification of diseases and taking necessary precautions is all done through naked eye, which requires labour and laboratries. This application helps farmers in detecting the diseases by observing the spots on the leaves, which inturn saves effort and labor costs. lant disease, especially on leaves, is one of the major factors that reduce the yield in both quality and quantity of the food crops. Finding the leaf disease is an important role to preserve agriculture. Smart analysis and Comprehensive prediction model in agriculture helps the farmer to yield right crop at the right time. The main benefits of the proposed system are as follows: Yield right crop at the right time,


127.0.0.1:5000/prediction
Plant Disease Prediction
Drop in the image to get the prediction
Fruit
Choose...
Prediction: Yaayy!! Your corn plant is healthy. But, maintain the soil consistently moist, but not soggy and only need fertilizer every 6 months. It prefers temperatures of 75 to 80 degrees F.



8 TESTING

8.1 TEST CASES



8.2 USER ACCEPTANCE TESTING

Acceptance Testing
UAT Execution & Report Submission

Date	03 November 2022
Team ID	PNT2022TMID33189
Project Name	Fertilizers recommendation system for disease prediction
Maximum Marks	4 Marks

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the [Fertilizer 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
Yellow Leaves	10	4	5	15	34
Blights	1	5	2	4	12
Fruit rots	3	1	0	2	6
Leaf spots	9	2	4	18	33
Mosaic leaf pattern	3	9	6	6	24
Fruit Spots	3	1	5	1	10
Leaves misshapen	0	7	2	1	10
Totals	29	29	24	47	129

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
Yellow Leaves	20	0	0	20
Blights	43	0	0	43
Fruit rots	9	0	0	9
Leaf spots	5	0	0	5
Mosaic leaf pattern	19	0	0	19
Fruit Spots	2	0	0	2
Leaves misshapen	4	0	0	4

9 RESULTS

9.1 PERFORMANCE METRICS

Project Development Phase Model Performance Test

Date	10 November 2022
Team ID	PNT2022TMID33189
Project Name	Fertilizers recommendation system for disease prediction
Maximum Marks	10 Marks

Model Performance Testing:

S.No.	Parameter	Values	Scre
1.	Model Summary	**Total Params:896** Trainable Params:896 Non-Trainable Params:0	
2.	Accuracy	**Training Accuracy = 90.3** Valuation Accuracy = 89.62	
3.	Confidence Score (Only Yolo Projects)	Class Detected - NA Confidence Score - NA	

10 ADVANTAGES & DISADVANTAGES

ADVANTAGES

The system comes with a model to be precise and accurate in predicting crop yield and deliver the end user with proper recommendations about required fertilizer ratio based on atmospheric and soil parameters of the land which enhance to increase the crop yield and increase farmer revenue. The prediction of crop yield based on location and proper implementation of algorithms have proved that the higher crop yield can be achieved. From above work I conclude that for soil classification Random Forest is good with accuracy 86.35% compare to Support Vector Machine. For crop yield prediction Support Vector Machine is good with accuracy 99.47% compare to Random Forest algorithm. The work can be extended further to add following functionality. Mobile application can be build to help farmers by uploading image of farms. Crop diseases detection using image processing in which user get pesticides based on disease images. Implement Smart Irrigation System for farms to get higher yield.

· Fertilizers have all nutrients required for plants growth.
· It is soluble and easily absorbed by plants.
· It enhances the metabolism of plants.
· It is easily available in the market.
· Highly needed for large production.

DISADVANTAGES

- Fertilizers are more expensive than manure.
- Over fertilization can damage the plants.
- It is toxic and can harm humans.
- It affected the environment and echo system.
- Long term use reduce soil quality.

11. CONCLUSION

The core strategy of this project is to predict the cropbased on the soil nutrient content and the locationwhere the crop is growing. This system will

help hefarmers to choose the right crop for their land and togive the suitable amount of fertilizer to produce themaximum yield. The Support Vector Machine algorithmhelps to predict the crop the precisely based on thepre-processed crop data. This system will also help thenew comers to choose the crop which will grow intheir area and produce them a good profit.

A decentamount of profit will attract more people towards theagriculture. Also, the crop growth is based on theclimate conditions in the particular area and theseasonal monsoons happens now are unpredictable, hence it is easy for the farmers when the predictionresult is also based on the climatic conditions. Liveweather prediction will also help the users to predictthe crop water needs and also it will help the farmersto decrease the crop damage due to the rain ordrought

The prediction of crop yield based on soil data and proper implementation of algorithms have proved that a higher crop yield can be achieved. From the above work, we conclude that for soil classification Random Forest is a suitable algorithm with an accuracy of 99.09% compare to Gaussian Naive Bayes. The work can be extended further to add the following functionality. Building a Website can be built to help farmers by uploading an image of farms. Crop diseases detection uses image processing in which users get pesticides based on disease images and Fertilizer prediction based on soil condition.

By categorizing the soil samples according to the soil type, land type and macro nutrients Nitrogen (N), Phosphorus (P) and Potassium (K) present in the soil the suitable crop along with its appropriate fertilizer is suggested to the agricultural stakeholder. The month in which the yield will be high is also suggested to the user. The yield calculation is also provided for the crop selected by the farmer. The proposed crop recommendation system provides 82% of accuracy.

12. FUTURE SCOPE :

The future work is to implement Machine Learning Algorithms like Ensemble Classifiers to predict the crop yield and recommend the crop with appropriate fertilizer. In the existing system only soil characteristics were considered to provide crop recommendations. In the future work the climatic parameters will also be taken into account to provide crop recommendations. Also the method can be extended to include diverse varieties of crop to be cultivated and to analyse it's performance.

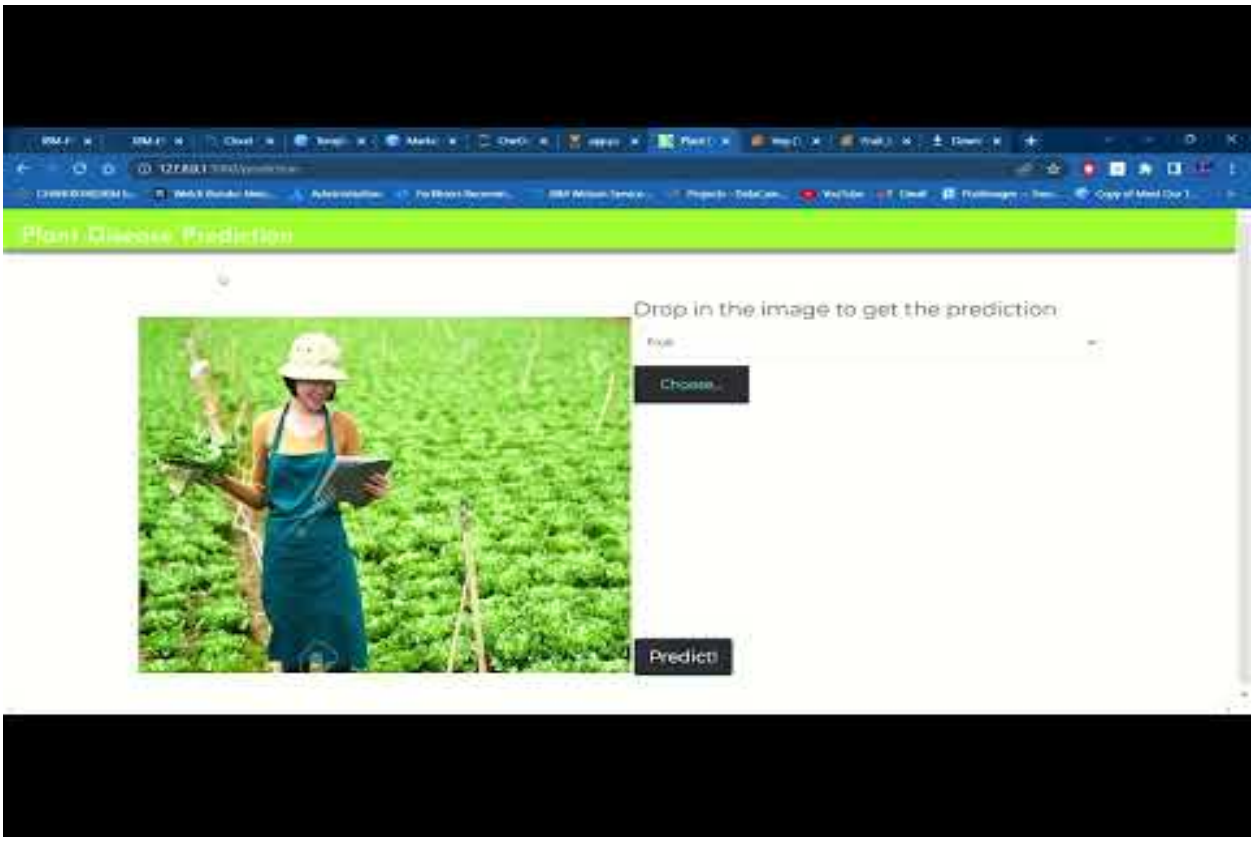
This further research is implementing the proposed algorithm with the existing public datasets. Also, various segmentation algorithms can be implemented to improve accuracy. The proposed algorithm can be modified further to identify the disease that affects the various plant organs such as stems and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

13 APPENDIX

GITHUB LINK

https://github.com/IBM-EPBL/IBM-Project-2214-1658466966

PROJECT DEMO LINK


Plant Disease Prediction
Drop in the image to get the prediction
Choose...
Predict