# FERTILIZERS RECOMMENDATION SYSTEM FOR DISEASE PREDICTION

## NALAIYA THIRAN BASED LEARNING

SUBMITTED BY:


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# ABSTRACT:

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

# 1.INTRODUCTION:

Detection and recognition of plant diseases using machine learning are very efficient in providing image processing for diagnosis of plant diseases. Application of computer vision and image processing strategies simply assist farmers in all of the regions of agriculture. Generally, the plant diseases are caused by the abnormal physiological functionalities of plants. Therefore, the characteristic symptoms are generated based on the differentiation between normal physiological functionalities and abnormal physiological functionalities of the plants. Mostly, the plant leaf diseases are caused by Pathogens which are positioned on the stems of the plants. These different symptoms and diseases of leaves are predicted by different methods in image processing. These different methods include different fundamental processes like segmentation, feature extraction and classification and so on. Mostly, the prediction and diagnosis of leaf diseases are depending on the segmentation such as segmenting the healthy tissues from diseased tissues of leaves.

# 2.MATERIAL AND METHODS:

A digital camera or similar devices are used to take images of different types, and then those are used to identify the affected area in leaves. Then different types of image-processing techniques are applied to them, the process those images, to get different and useful features needed for the purpose of analyzing later-Plant leaf disease identification is especially needed to predict both the quality and quantity of the First segmentation step primarily based on a mild polygonal leaf model is first achieved and later used to guide the evolution of an energetic contour. Combining global shape descriptors given by the polygonal model with local curvature based features, the leaves are then classified overleaf datasets. In this research work introduce a method designed to deal with the obstacles raised by such complex images, for simple and plant leaves. A first segmentation step based on graph-cut approach is first performed and later used to guide the evolution of leaf boundaries, and implement classification algorithm to classify the diseases and recommend the fertilizers to affected leaves as shown in Figure 1.

## 2.1 Image Classification Steps :

The proposed image classification technique is divided into the following steps:

### 2.1.1 Image acquisition:

To get the image of a leaf so that evaluation in the direction of a class can be accomplished.

### 2.1.2 Preprocessing:

The purpose of image preprocessing is improving image statistics so that undesired distortions are suppressed and image capabilities which are probably relevant for similar processing are emphasized. The preprocessing receives an image as input and generates an output image as a grayscale, an invert and a smoothed one.

## PROCESSSING:

Image Processing: Image Processing is a method to convert an image into digit form and perform some operations on it, in order to get an enhanced image or to extract some useful information form it. It is a type of signal Dispensation in which input is image,like video frames or photograph and output may be image or characteristics associated with that image.

BLOCK DIAGRAM:


## 2.1.3 Segmentation:

Implements Guided active contour method. Unconstrained active contours applied to the difficult natural images. Dealing with unsatisfying contours, which would try and make their way through every possible grab cut in the border of the leaf. The proposed solution is used the polygonal model obtained after the first step not only as an initial leaf contour but also as a shape prior that will guide its evolution toward the real leaf boundary.

## 2.1.4 Disease Prediction:

Leaves are affected by bacteria, fungi, virus, and other insects. Support Vector Machine (SVM) algorithm classifies the leaf image as normal or affected. Vectors are constructed based on leaf features such as color, shape, textures. Then hyper plane constructed with conditions to categorize the preprocessed leaves and also implement multiclass classifier, to predict diseases in leaf image with improved accuracy .

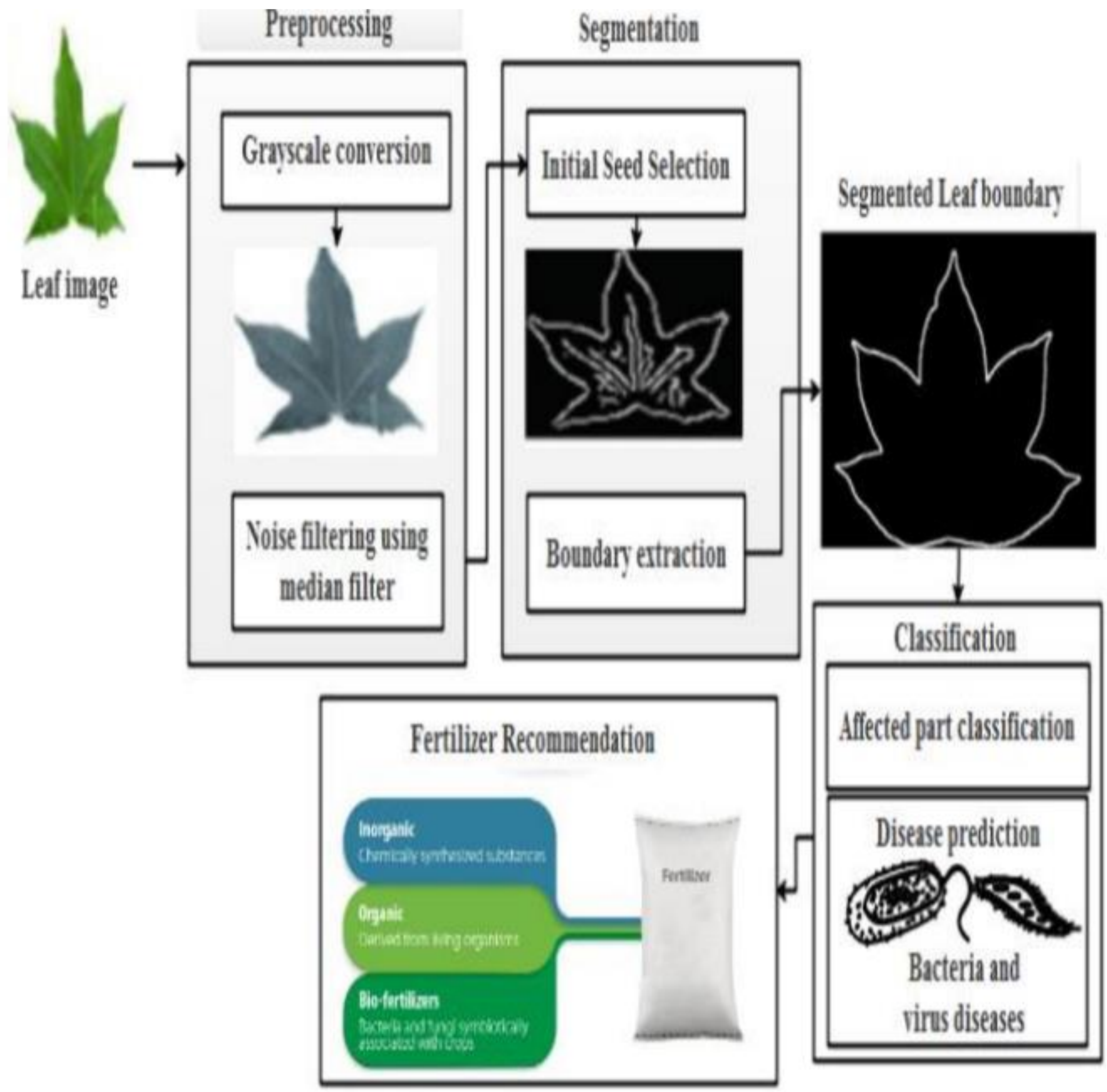



*Figure.1 Proposed Architecture*

## 2.1.5 Fertilizer Recommendation:

Recommendation of the fertilizer for affected leaves based on severity level.Fertilizers may be organic or inorganic. Admin can store the fertilizers based on disease categorization with severity levels. The measurements of fertil izers suggested based on disease severity.

## 2.2. SVM Classification Algorithm:

Support Vector Machine(SVM) SVM is a binary classifier to analyze the data and recognize the pattern for classification. The main goal is to design a hyper plane that classifies all the training vectors in different classes.

The objective of SVM is to identify a function Fx which obtain the hyper-plane. Hyper plane separates two classes of data sets.

The linear classifier is defined as the optimal separating hyper plane. The data sets can be separated in two ways:

linearly separated or nonlinearly separated.

The vectors are said to be optimally separated if they are separated without error and the distance between the two closest vector points is maximum.

For linear separable data sets, training vectors of a different class of pairs (am, bm), where m = 1,2,3,4 …,t am ϵ Rn(Reference Vector) bm ϵ { +1, -1} The decision boundary is placed using a maximal margin between the closest points. w is being a vector perpendicular median to the street. am be the unknown of to be positioned especially elegance according to the decision boundary, and hyper plane (w. a) + c =0 with c as constant For classification (w . am ) + c0 ≥ 1, ∀ bm = +ve samples (1) (w . am ) + c0 ≤ -1, ∀ b m = −v e samples (2) where (w.am ) has a dot product of w and am. The inequalities if added i.e multiplying equations (1) and (2) with +1, −1 and bm. Suppose bm such that bm = 1 for +ve samples bm = -1 for -ve samples it results, bm [ (w.am ) + c0 ] ≥ 1 bm [(w.am ) + c0 ] ≥ -1.

Therefore rearranging the above equations bm (w.am ) + c0 – 1 ≥ 0 for points into dataset to in the gutter i.e on the decision boundary bm (w.am ) + c0 – 1 = 0.

# 3. DISCUSSION :

To compare the performance of the proposed SVM method with the existing CNN (Convolutional Neural Network) method.

Metrics such as True Positive, False Positive, True Negative, False Negative are used. The proposed method is implemented using .NET. The code existing CNN method was written in Python was downloaded from the web [https://github.com/cs-chan/Deep-Plant]. 15 images were captured using a camera for testing purpose is given in Figure2

Firstly, some secondary metrics such as true positive (TP), true negative (TN), false positive (FP), and false-negative (FN) [18] are calculated as follows, True Positive:

True Positive is an outcome where the model correctly predicts positive class. False Positive: False Positive is an outcome where the model incorrectly predicts positive class. True Negative: True Negative is an outcome where the model correctly predicts negative class. False Negative: False Negative is an outcome where the model incorrectly predicts negative class. The True Positive, False Positive, True Negative, and False Negative value for captured 15 images are shown in table 1. The pictorial representation of this comparison is given in Figure 3

## TABLE 1:

COMPARISON OF CNN AND SVM IN TERMS OF TP, FP, TN, AND FN

| Methods | TP | FP | TN | FN |
|---|---|---|---|---|
| Existing[CNN] | 6 | 3 | 2 | 4 |
| Proposed[SVM] | 8 | 4 | 1 | 2 |

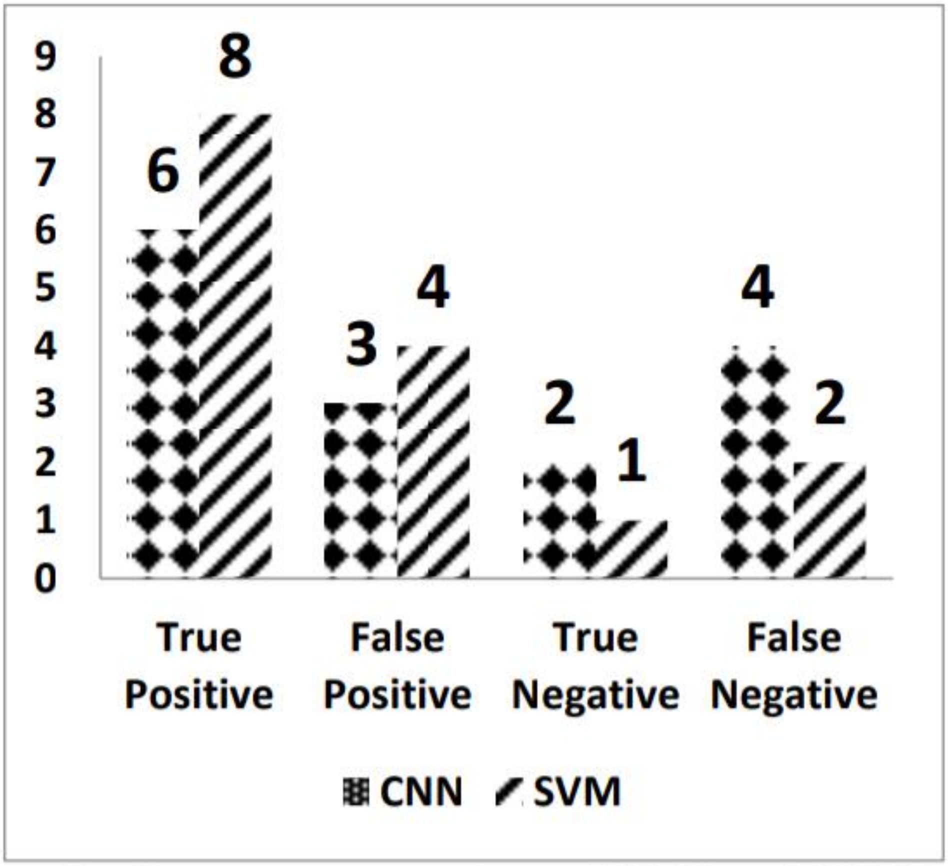



***Figure.3*** *Performance comparison of CNN and SVM in terms of True Positive, False Positive, True Negative and False Negative.*

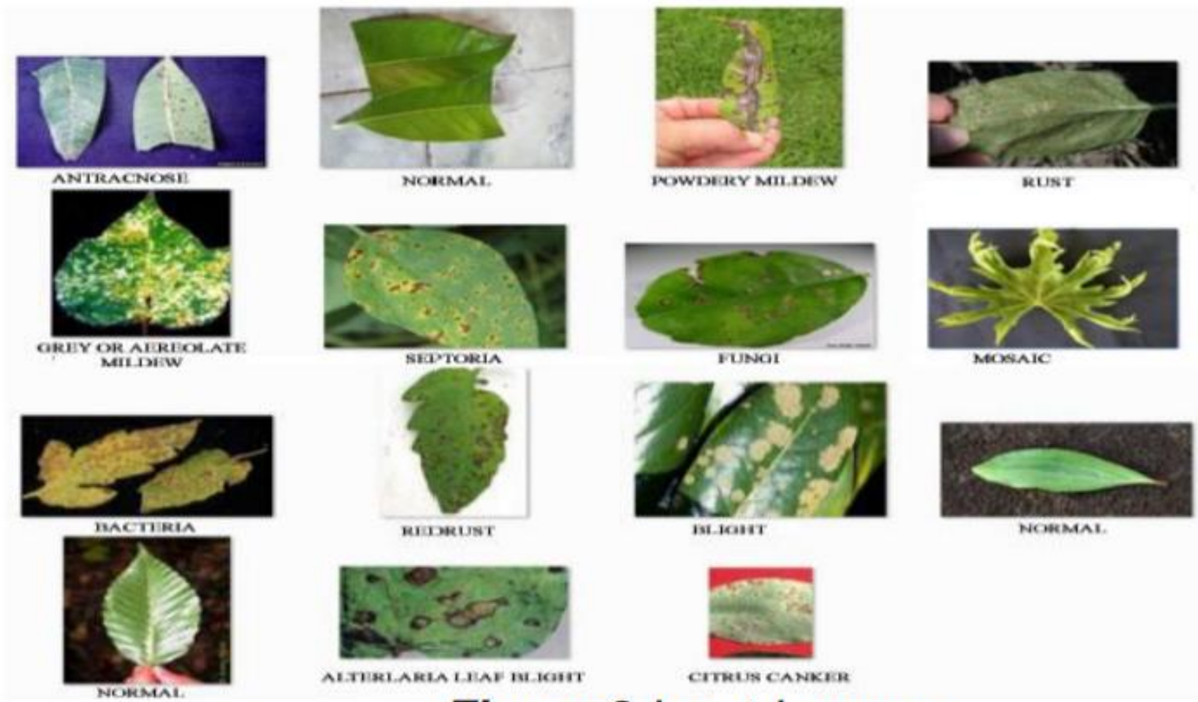



**Figure.2** Input Images

# 3.1 Precision:

The proportion of positive identification is actually correct. Precision = TP / (TP+FP) Recall: The proportion of actual positives is identified correctly. Recall = TP / (TP+FN) F-Measure: Defined as the weighted harmonic mean of precision and recall. F-Measure = 2TP / (2TP + FP + FN) Accuracy: It refers to the closeness of a measured value to a standard or known value. Accuracy = (TP + TN) / (FP + TP + FN + TN) The Precision, Recall, F-Measure and Accuracy for the both CNN and SVM are calculated and given in table 2 the corresponding graph is given in Figure 4

TABLE 2:

PRECISION, RECALL, F-MEASURE AND ACCURACY VALUES OF CNN AND SVM

| Classifiers | Pre | Re | F-M | Acc |
|---|---|---|---|---|
| CNN | 0.8 | 0.6 | 0.7 | 0.6 |

| | | | | |
|---|---|---|---|---|
| SVM | 0.9 | 0.8 | 0.8 | 0.8 |

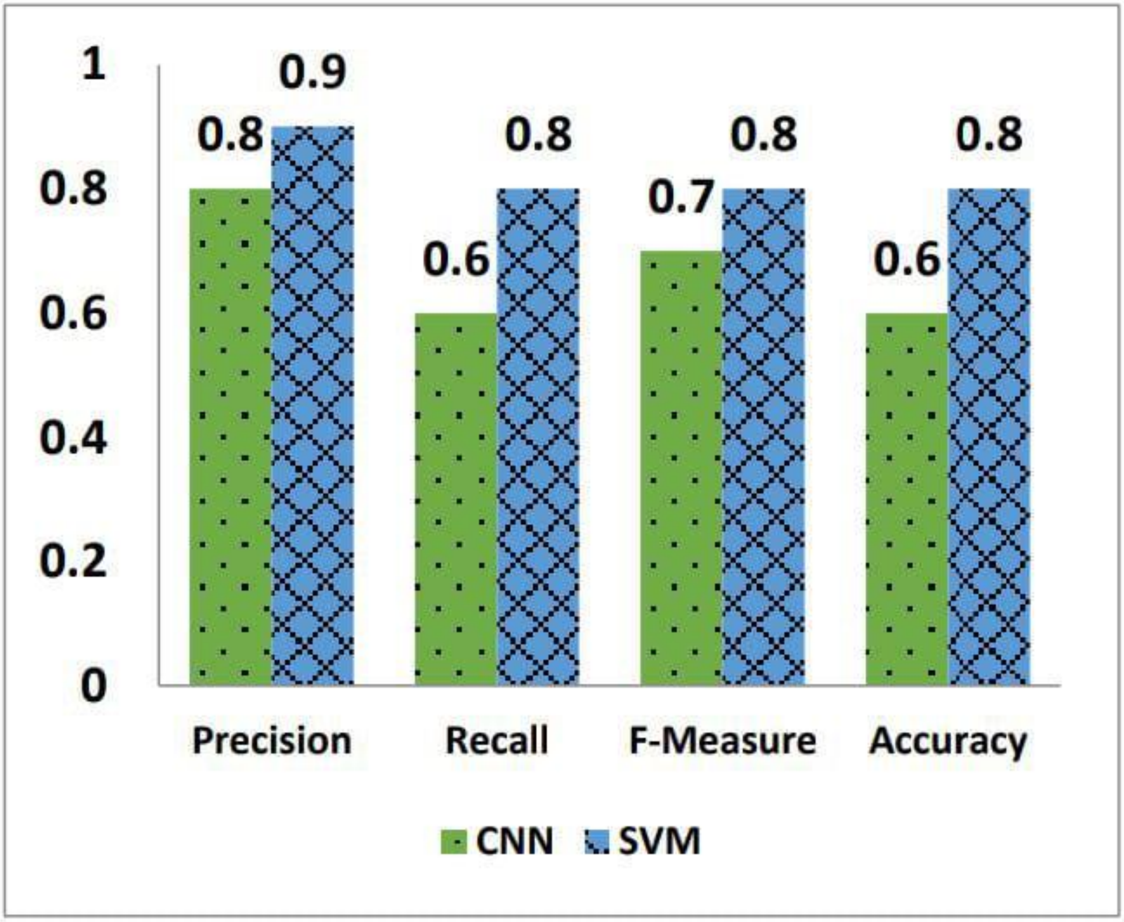



***Figure.4*** *Precision, Recall, F-Measure and Accuracy comparison chart for CNN and SVM*

# 4.Python code:

# -*- coding: utf-8 -*- """Copy of Test the Veg model.ipynb Automatically generated by Colaboratory. Original file is located at

https://colab.research.google.com/drive/1RHpmLZRIo1sq5mAhS8EUL_PAcVbNWolZ

```
"""

!unzip '/content/drive/MyDrive/ibm dataset/Fertilizers_Recommendation_System_For_Disease_ Prediction.zip'

from keras.preprocessing.image import ImageDataGenerator

train_datagen=ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,horizontal_fli p=True)

test_datagen=ImageDataGenerator(rescale=1)

x_train=train_datagen.flow_from_directory('/content/Dataset Plant Disease/Veg-dataset/Vegdataset/train_set',target_size=(128,128),batch_size=2,class_mode='categorical')

x_test=test_datagen.flow_from_directory('/content/Dataset Plant Disease/Veg-dataset/Vegdataset/test_set',target_size=(128,128),batch_size=2,class_mode='categorical')

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

from keras.preprocessing.image import ImageDataGenerator

train_datagen=ImageDataGenerator(rescale=1./255,shear_range=0.2,zoom_range=0.2,horizontal_fli p=True)

test_datagen=ImageDataGenerator(rescale=1)
```

```
x_train=train_datagen.flow_from_directory('/content/Dataset Plant Disease/Veg-dataset/Vegdataset/train_set',target_size=(128,128),batch_size=16,class_mode='categorical')

x_test=test_datagen.flow_from_directory('/content/Dataset Plant Disease/Veg-dataset/Vegdataset/test_set',target_size=(128,128),batch_size=16,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,kernel_initializer='uniform',activation='relu'))
model.add(Dense(units=9,kernel_initializer='uniform',activation='softmax'))
model.compile(loss='categorical_crossentropy',optimizer="adam",metrics=["accuracy"])
model.fit(x_train,steps_per_epoch=89,epochs=20,validation_data=x_test,validation_steps=27)

model.save('fruit.h5')

 model.summary()

 from keras.preprocessing import image

 from tensorflow.keras.preprocessing.image import img_to_array

 from tensorflow.keras.preprocessing import image

from tensorflow.keras.models import load_model

import numpy as nps

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

```
img=image.load_img('/content/Dataset Plant Disease/fruit-dataset/fruitdataset/test/Apple___healthy/011d02f3-5c3c-4484-a384-b1a0a0dbdec1___RS_HL 7544.JPG',grayscale=False,target_size=(128,128))
img

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

pred=(model.predict(x) > 0.5).astype("int32")
pred
import requests
from tensorflow.keras.preprocessing import image
from tensorflow.keras.models import load_model
import numpy as np
import pandas as pd
import tensorflow as tf
from flask import Flask, request , render_template, redirect, url_for
import os
from werkzeug.utils import secure_filename from tensorflow.python.keras.backend import set_session app= Flask(__name__)
model = load_model("fruit.h5")
@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['images']
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=="fruit"):
preds=model.predict_classess(x)
 print(preds)
df=pd.read_excel('precautions-veg.xlsx')
print (df.iloc[preds[0]]['cautions'])
 else:
pred=model1.predict_classes(x)
```

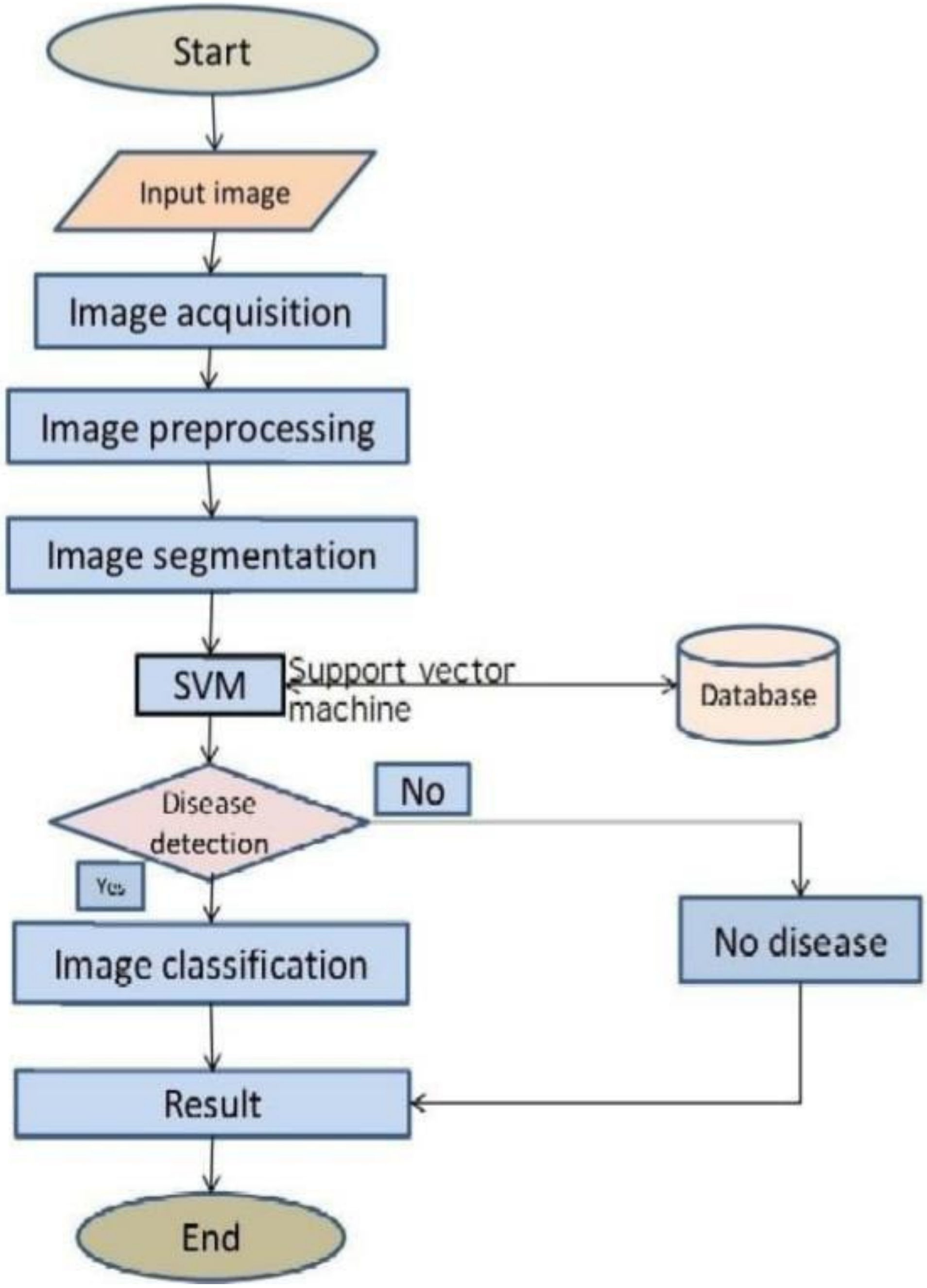
```
 df=pd.read_excel('precautions-fruits.xlsx')
print(df.iloc[preds[0]]['caution'])
 return df.iloc[preds[0]]['caution']
if __name__=="__main__":
app.run(debug=False)
```

## 5.Image Processing in Machine Learning:

Image processing is an play in major role in Computer Vision.Computer Vision is an one of the part in Artificial Intelligences.Computer Vision can interact with a image data types such like Image Classification,object localization,object Detection,Segmentation etc .

In nature of Computer vision using anmachine Learning Algorithms,Open CV,Pose Estimation Python Libraries etc, In machine Learning it has been working on Neural Network which can interact and Extract the feature from the image and creating the machine Learning Model it requires to build with high Accuracy and Less in Model Size can reduce the Computation power of the System,Mobile,cloud interface.

## 6.Data Flow Diagrams and User Stories:


Start
Input image
Image acquisition
Image preprocessing
Image segmentation
SVM
Support vector machine
Database
Disease detection
No
Yes
Image classification
No disease
Result
End

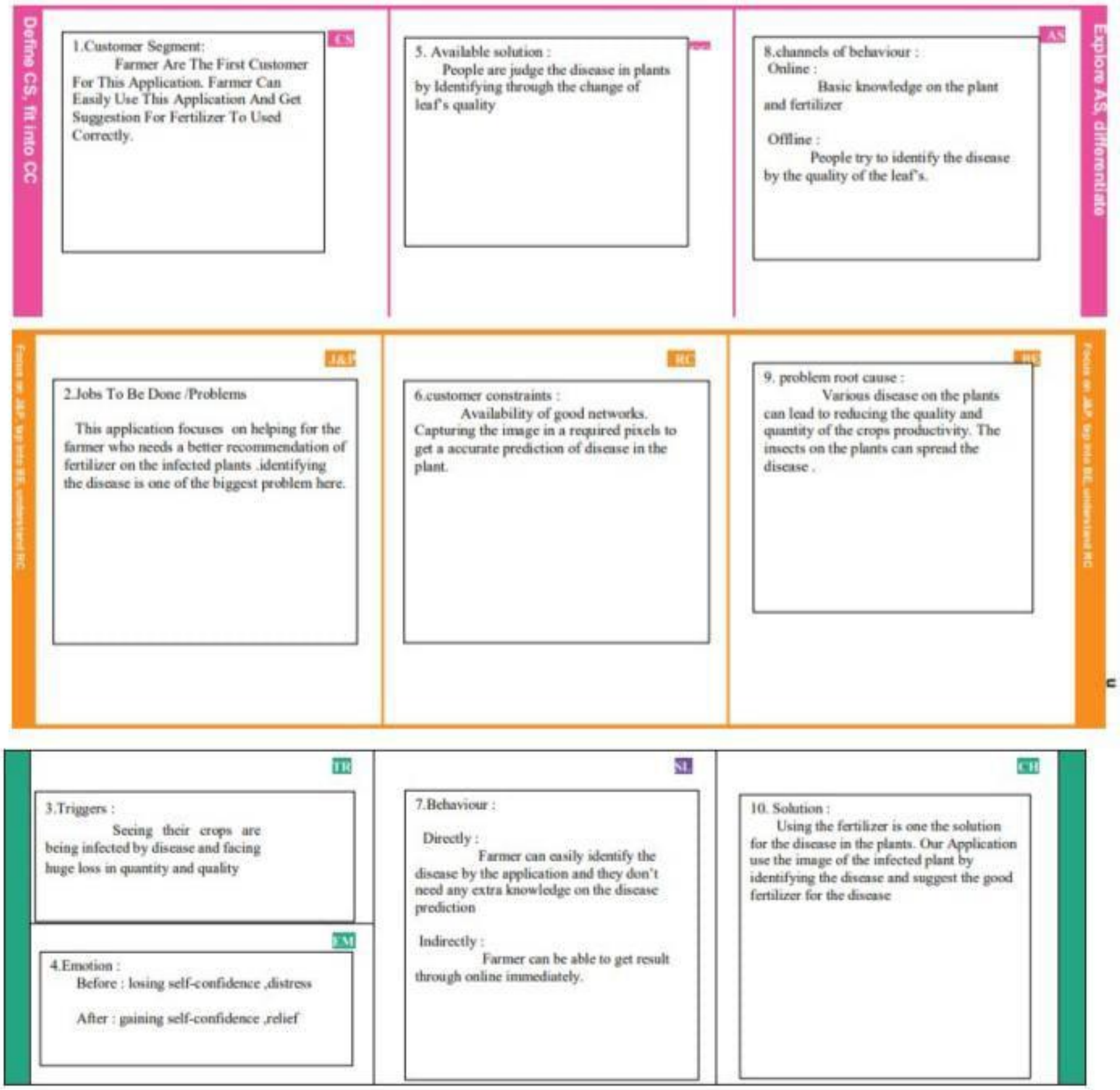
# 7.PROJECT DESIGN PHASE:

## 7.1 CUSTOMER JOURNEY MAP:

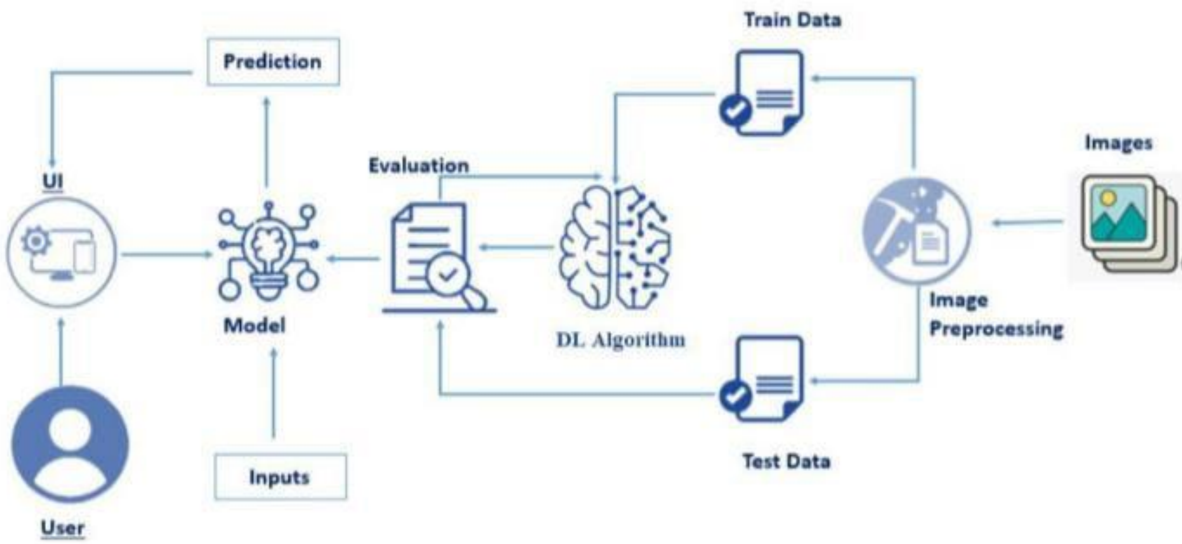
| STAGES | AWARENESS | INFORMATION GATHERING | DECISION MAKING | PESTICIDE SELECTION | BEFORE DETECTION | AFTER DETECTION |
|---|---|---|---|---|---|---|
| GOALS | Understand the type of leaf disease possibilities exist. | Learning | Setting criteria for Healthy leaf | Complete knowledge about pesticides and achieve high yield production. | Leaf with high possibility of diseases. | A well-treated and healthy leaf without any disease. |
| ACTIONS | Sees a demo leaf with high infection which has to be treated. | Know about all the healthy and unhealthy leaf and talk to the specialist. | ✓ Compares healthy leaf possibilities to the unhealthy one and makes a decision<br>✓ Refer to the leaf family | Knowledge about which leaf should treated with what kind of fertilizers | ✓ Check leaf condition<br>✓ Check the weather condition<br>✓ Check the soil condition | ✓ Treats the leaf with suitable<br>✓ fertilizer as suggested<br>✓ Makes sure of the suitable soil and weather condition |
| TOUCH POINTS | ✓ Information provided at research<br>✓ Interactions with the specialists at the research center. | Verify the information provided at research | Information that can be asked/known with others for good healthy leaf production. | Checking pesticide quality and cost . | Get to know the knowledge about leaf and its diseases. | Training all leave with good reference or by using good learning materials. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| FEELINGS | POSITIVE<br>NEUTRAL<br>NEGATIVE | Building excitement, cost of effort | | Interested in yielding | | Satisfied |
| | | | Hesitation, self-doubt | Confusion, Doubt in choice | Frustrated, worried | |
| PAIN POINTS | Information was not clear at first. | Difficult to understand the leaf disease Some information was confusing. | Lack of outside resources Doubt over the specialist information Lack of financing opportunities. | More cost consuming Takes lot of time for detection More confusion over choosing the pesticides. | Missed opportunity for initial pampering of leaf needs Difficult for a farmer to choose amount of soil. | Training was not clear Self-directed training/reference materials also was not clear. |
| KEY INSIGHTS | Awareness over the leaf diseases should be given to farmers. | Information needs to be easily shared outside, through demos and workshops. | Decision depends on specialists and farmers according to their wish for a healthy leaf. | Pesticides has to be selected according to requirements for leaf nourishment. | Leaf was unhealthy and disease infected. | An enhanced customer experiences Increased yield production Data enabled decision making using data analytics. sharing of best fertilizer. |

# 7.2 PROBLEM SOLUTION FIT:



# 7.3 SOLUTION ARCHITECTURE:

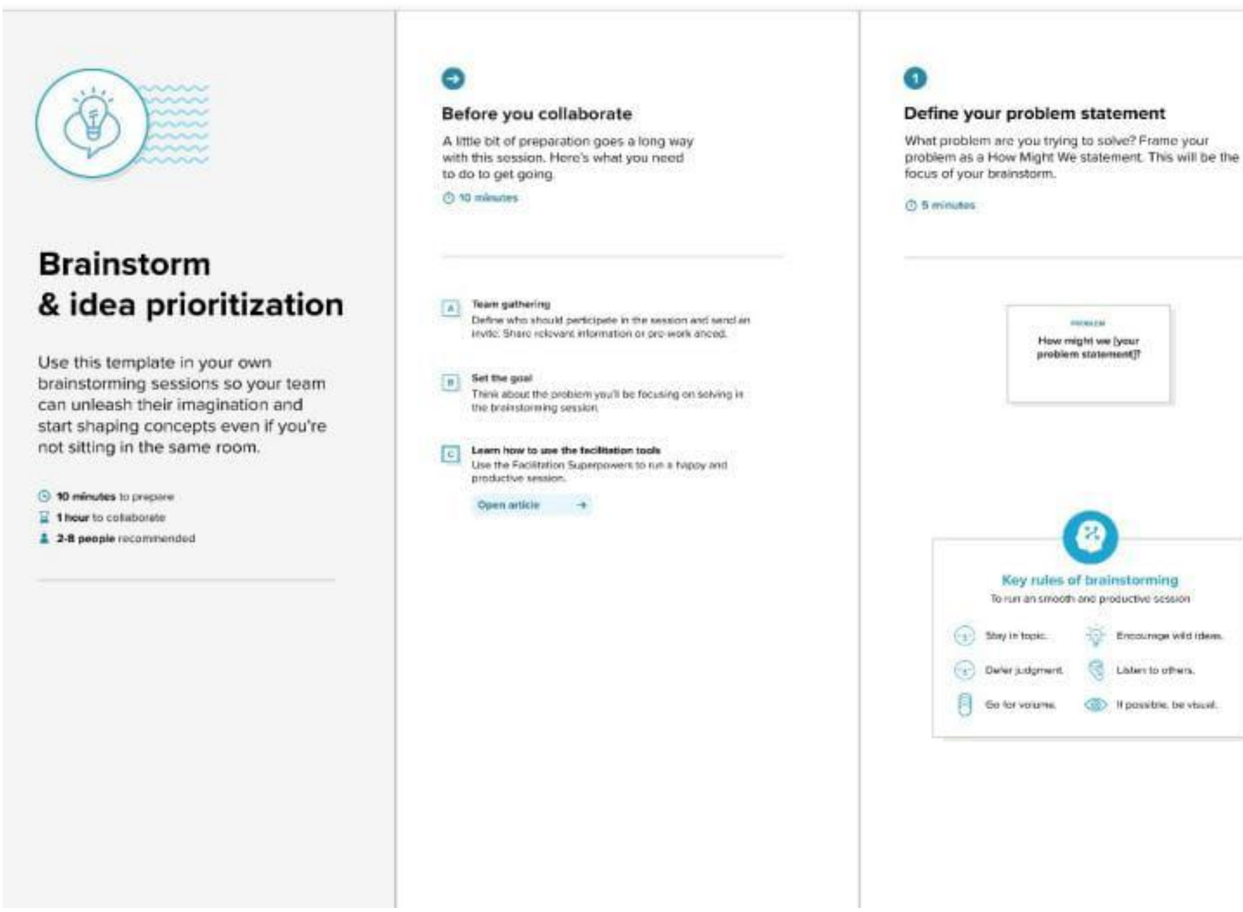


# 7.4 PROPOSED SOLUTION:

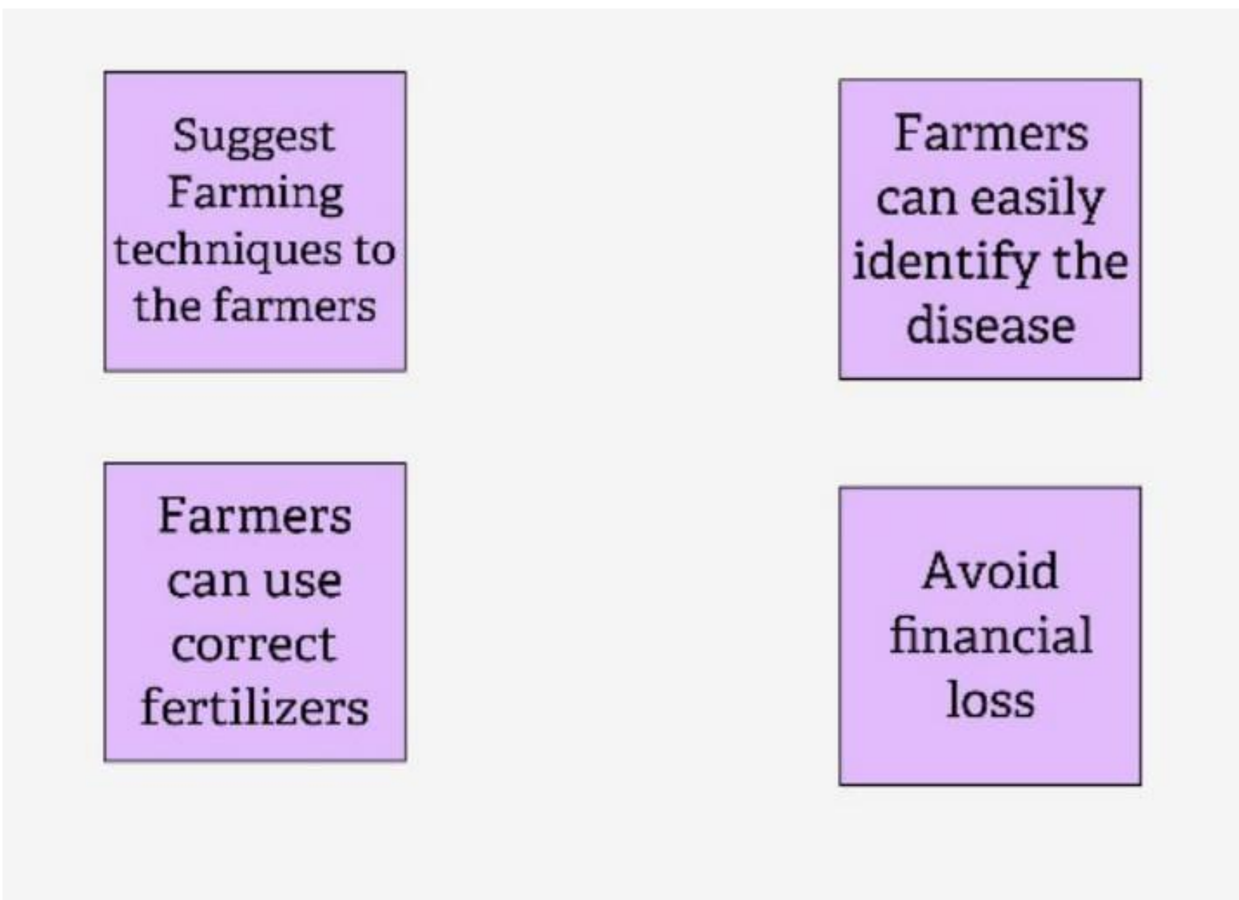
| S.No | Parameter | Description |
|---|---|---|
| **1.** | Problem statement (problem to be solved) | Disease in plants reduced the quantity and quality of the plants productivity. Identifying the disease in plant is hard to find. |
| **2.** | Idea/solution description | One of the solution of the problem is to identifying the disease in early stage and using the correct fertilizer. |
| **3.** | Novelty / uniqueness | This application can suggest good fertilizer for the disease in the plant by recognizing the images. |
| **4.** | Social impact/customer satisfaction | It helps the farmer by identifying the disease in the early stage and increase the quality and quantity of crops in efficient way. |
| **5.** | Business model(revenue model) | The application is recommends to farmer in subscription basis. |
| **6.** | Scalability of the solution | This application can be improved by introducing online purchases of crops, fertilizer easily |

# 8.IDEATION PHASE:

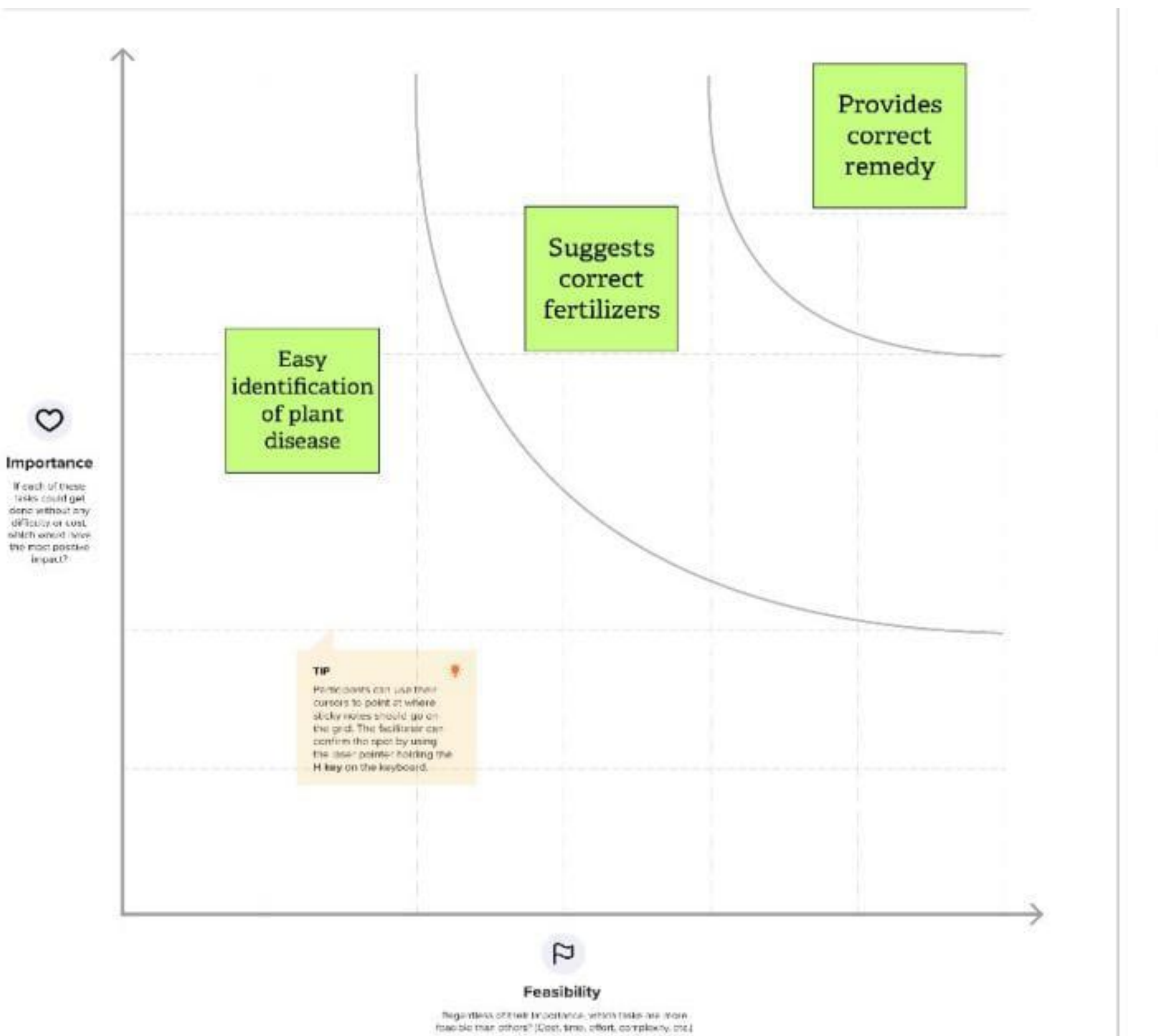
## 8.1 TEAM GATHERING ,COLLABORATION AND SELECT THE PROBLEM STATEMENT:



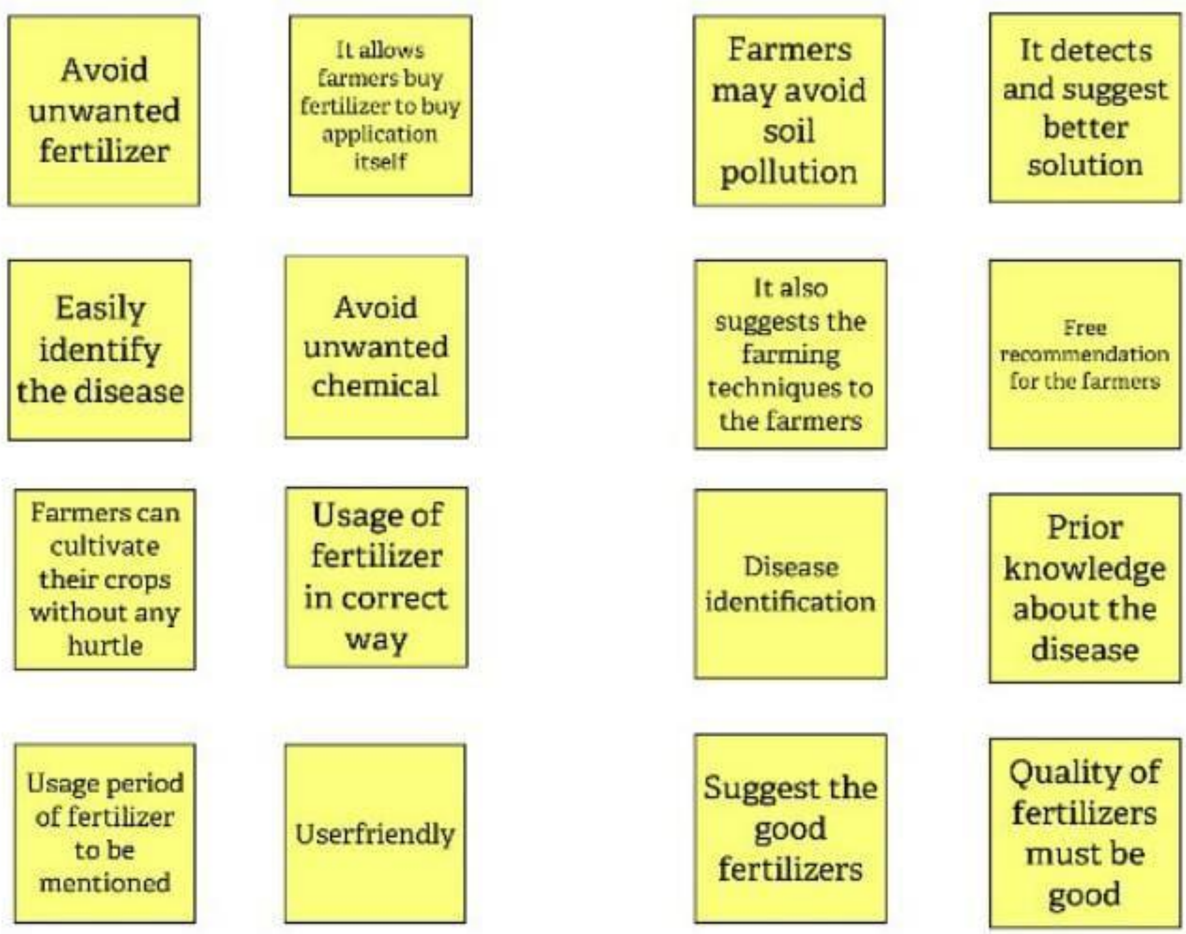
## 8.2 GROUP IDEAS:



# 8.3 PRIORITIZE:



## 8.4 BRAINSTORM:



# 9. PROJECT MILESTONE AND ACTIVITY PLANNING:

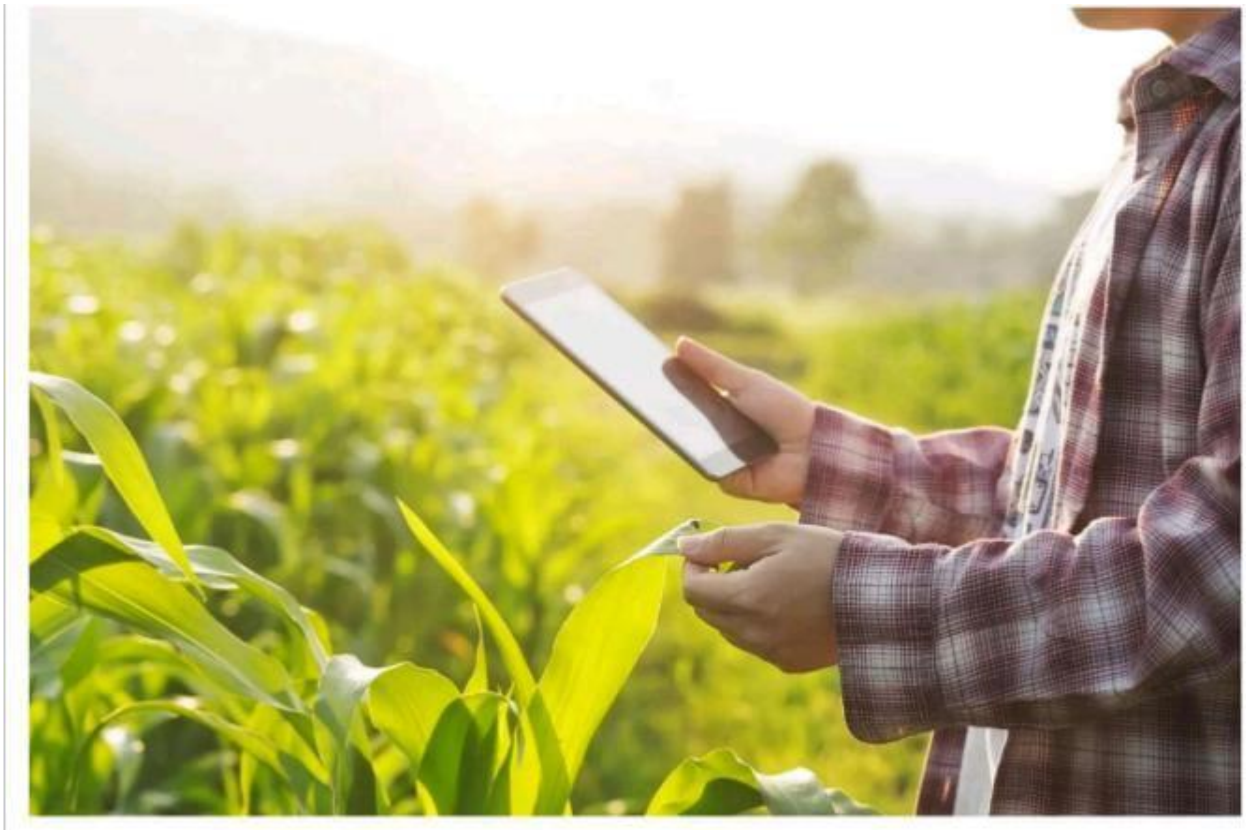
## 9.1MILESTONE:

In modern technology are increasing and optimizing the performance of the artificial intelligence AI model.

In based crop yield disease prediction system it will helpful for farmers to prevent the crop from the various disease which can identify the disease within a process of capturing the image at the plant and machine learning algorithm will give affected disease name.

In this project milestone will be given the best solution for the farmer using the complete friendly and simple user interface web application to fetching the solution by own .

In addition process we are planned to add a valid module that is fertilizer recommendation for the specific disease it can give both artificial fertilizer and natural fertilizer in suggestion manner.



# 9.2 ACTIVITY LIST:

In project management planning is a  important task to scheduling the phrase of the project to the team member.

In this activity can shows the various activity are allocated and done by the team members!

In project we can spilit into four step of phrases are

PHRASE 1:

Information collection and requirement analysis

PHRASE 2:

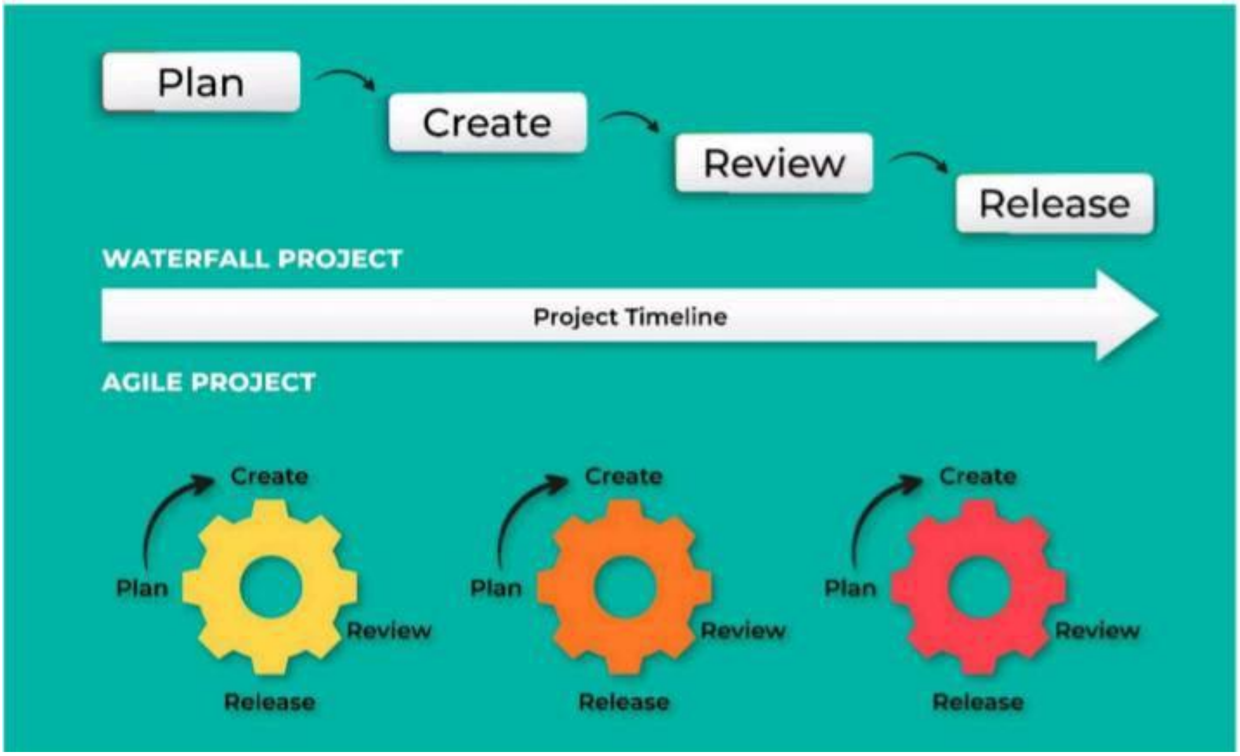
Project planning and development modules

PHRASE 3:

Implementing the high accuracy in machine algorithm to perform.

PHRASE 4:

Deploying the model on cloud and testing the model and UI performance.

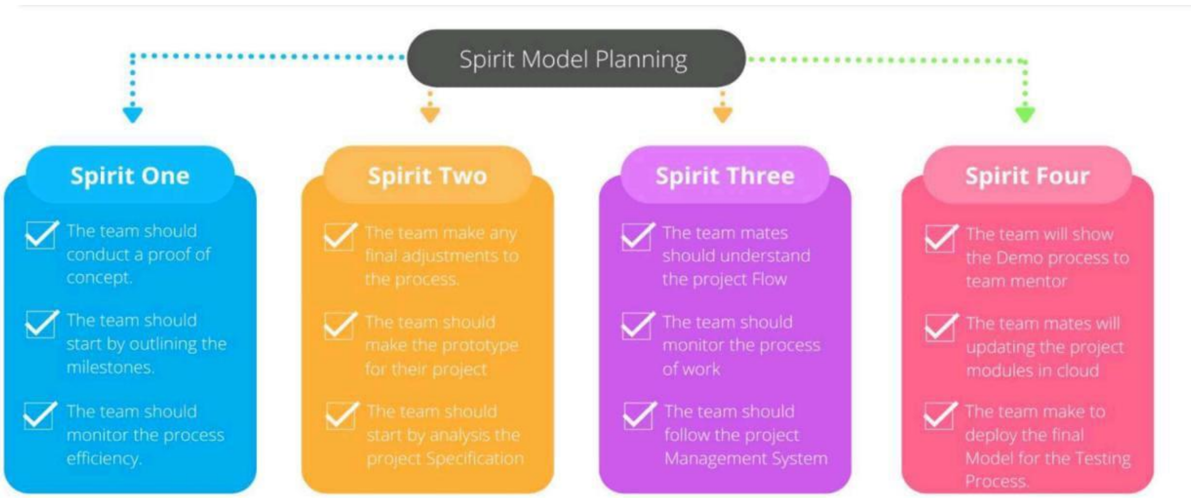



# 10. SPIRIT DELIVERY PLANNING:

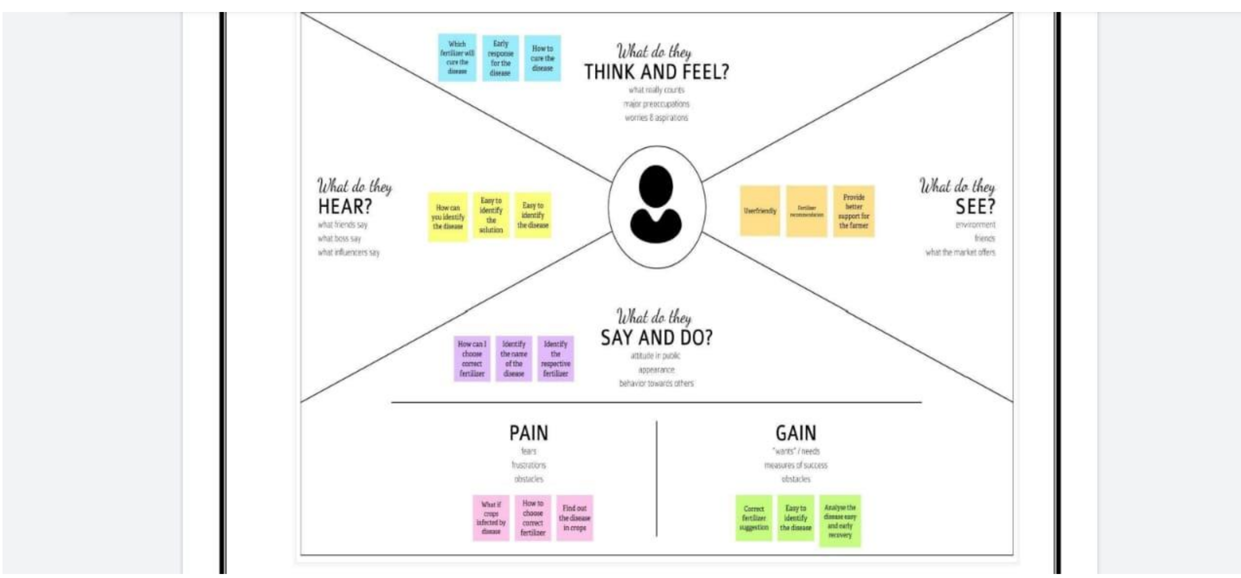
The delivery plan of project deliverables is a strategic elements for every project manager. The goal of every project is in fact to produce a result that serves a specific purpose. With the word purpose we can mean the mean most desperate goals : a software program,a chair,a building ,a translation,etc..

In project spirit delivery planning is one of the process of completing the project and show casing the timeline of the project planning.The delivery planning help to understanding of the process and workflow of the project working by the team mates.

Every single modules are assigned to the team mates to show case their work and contribution of developing the project.




# 11. EMPATHY MAP:



## 12. LITERATURE SURVEY:

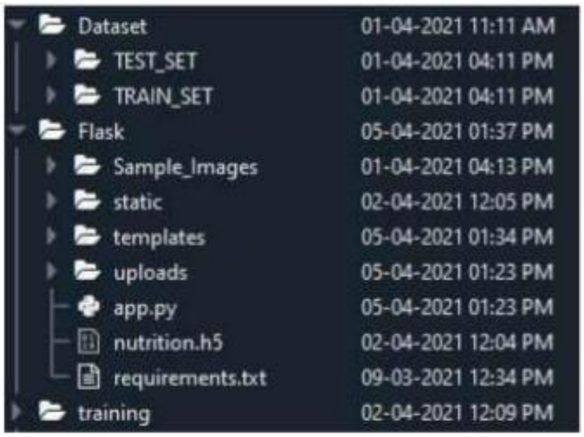
| Title & Author | Year | Technique | Proposed system |
|---|---|---|---|
| Soil Based Fertilizer Recommendation System for Crop Disease Prediction System - P.Pandi Selvi, P.Poornima | 2021 | Long or Short Term Memory algorithm. | The proposed system was able to analyse the soil nutrient type efficiently, kind of leaf disease present in the crop and predict the fertilizer in a proficient manner. The approach was flexible, and can be extended to the needs of the users in a better manner |
| Farmer's Assistant: A Machine Learning Based Application for Agricultural | 2022 | Image Analysis, Deep Learning, Machine Learning | A user-friendly web application system based on machine learning and web-scraping |

| | | | |
|---|---|---|---|
| Solutions- Shloka Gupta, Aparna Bhonde, Akshay Chopade , Nishit Jain | | | 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 a rule based classification system, and crop disease detection using EfficientNet model on leaf images |

| | | | |
|---|---|---|---|
| IOT based Crop Recommendation, Crop Disease Prediction and Its Solution - Rani Holambe, Pooja Patil, Padmaja Pawar , Hrushikesh Joshi, ,Saurabh Salunkhe | 2020 | crop recommendation system, crop disease prediction, Internet of Things, Machine Learning | The ML and IoT based suggestions will significantly educate the farmer and help them minimize costs and make strategic decisions by replacing intuition and passed-down knowledge with |
| | | | far more reliable data-driven ML models. |

# 13. PROJECT STRUCTURE:

Create a project folder that contains files as shown below:

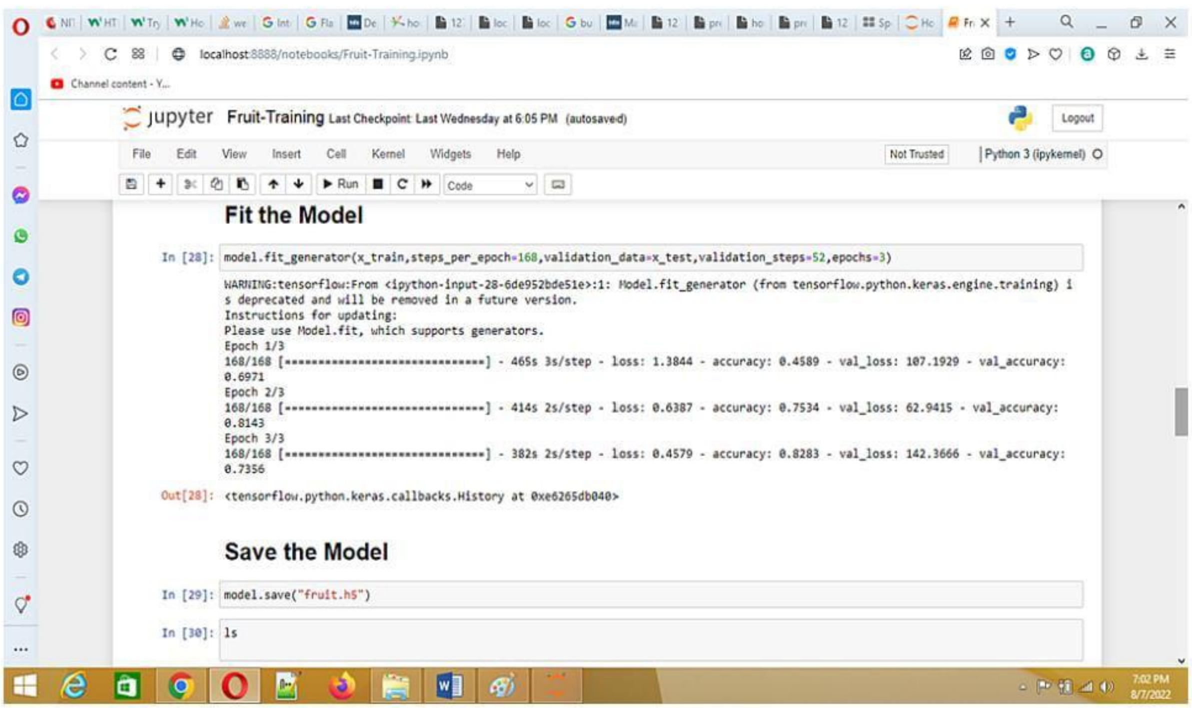


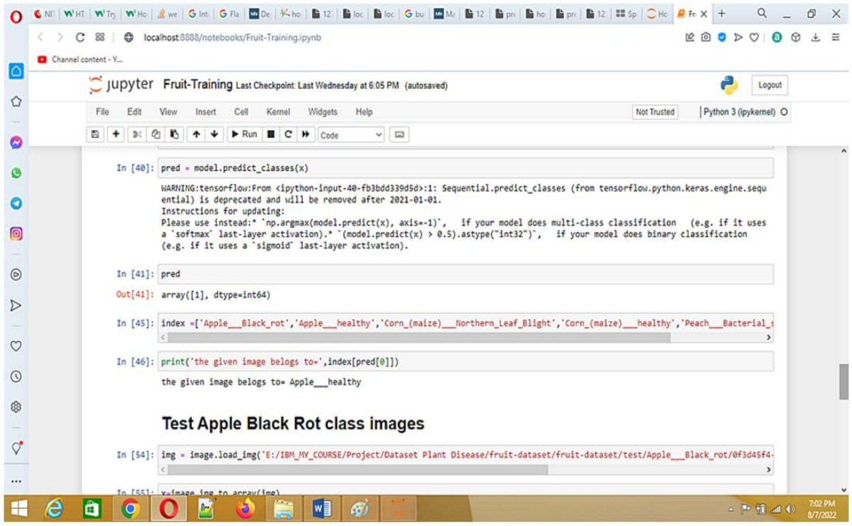

- Dataset folder contains the training and testing images for training our model.
- We are building a Flask Application that needs HTML pages stored in the templates folder and a python script app.py for serverside scripting
- we need the model which is saved and the saved model in this content is a nutrition.h5
- templates folder contains home.html, image.html, imageprediction.html pages.
- Statis folder had the css and js files which are necessary for styling the html page and for executing the actions.
- Uploads folder will have the uploaded images(which are already tested).
- Sample_images will have the images which are used to test or upload.
- Training folder contains the trained model file.

# 14.RESULT:

## 14.1. FIT A MODEL FOR FRUIT DATASET:

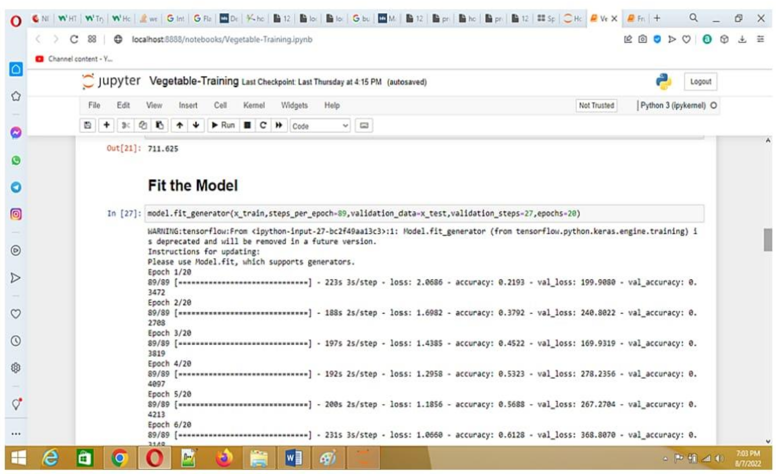
Final findings(output) of the project given below in the form of screenshot:
Training and Testing of Fruit dataset

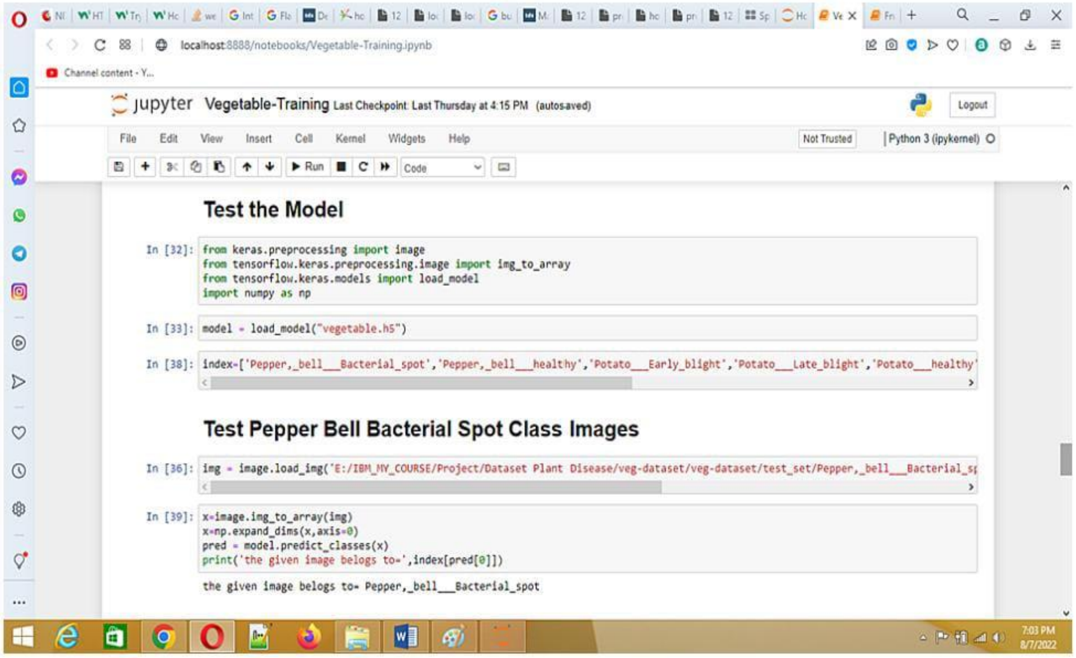





# 14.2 FIT A MODEL FOR VEGETABLE DATA SET:

Train and Test Vegetable dataset






# 15. ADVANTAGES:

## List of advantages:

- The proposed model here produces very high accuracy of classification.
- Very large datasets can also be trained and tested.
- Images of very high can be resized within the proposed itself.

# 16. DISADVANTAGES:

## List of disadvantages:

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

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

## 17.APPLICATIONS:

1. The trained network model used to classify the image patterns with high accuracy.

2. The proposed model not only used for plant disease classification but also for other image pattern classification such as animal classification.

3. This project work application involves not only image classification but also for pattern recognition

## 18. CONCLUSIONS:

The proposed method uses SVM to classify tree leaves, identify the disease and suggest the fertilizer. The proposed method is compared with the existing CNN based leaf disease prediction. The proposed SVM technique gives a better result when compared to existing CNN. For the same set of images, F-Measure for CNN is 0.7and 0.8 for SVM, the accuracy of identification of leaf disease of CNN is 0.6 and SVM is 0.8.

## 19. FUTURE SCOPE :

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.

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21. DEMONSTRATION LINK:

https://youtu.be/Lea4HsthjvA

22. GITHUB LINK:

https://github.com/IBM-EPBL/IBM-Project-49978-1660887041