Fertilizers Recommendation System for Disease Prediction

PROJECT REPORT

Submitted by

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1. INTRODUCTION

1.1 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 trained and then tested with CNN. It has 6 classes and all the classes are trained and tested. Second, the vegetable dataset is trained and tested. The software used for training and testing of datasets is Python. All the Python codes are first written in Jupyter notebook supplied along with Anaconda Python and then the codes are tested in the IBM cloud. Finally, a web-based framework is designed with help Flask a Python library. There are 2 html files are created in templates folder along with their associated files in static folder. The Python program 'app.py' used to interface with these two webpages is 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

[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 0.7and 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(ICIIECS), IEEE, 2017.

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

Disadvantages:System only able to detect the disease from citrus leaves. 2 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. 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. 3

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 0.7and 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 application 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 a 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 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. 4

2.2 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/5d37106 64585153e591a3d20/An-

Overviewof-the-Research-on-Plant-Leaves-Diseae 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-PredictionIn-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 BasedApplication for Agricultural Solutions.

2.3 Problem Statement Definition

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.

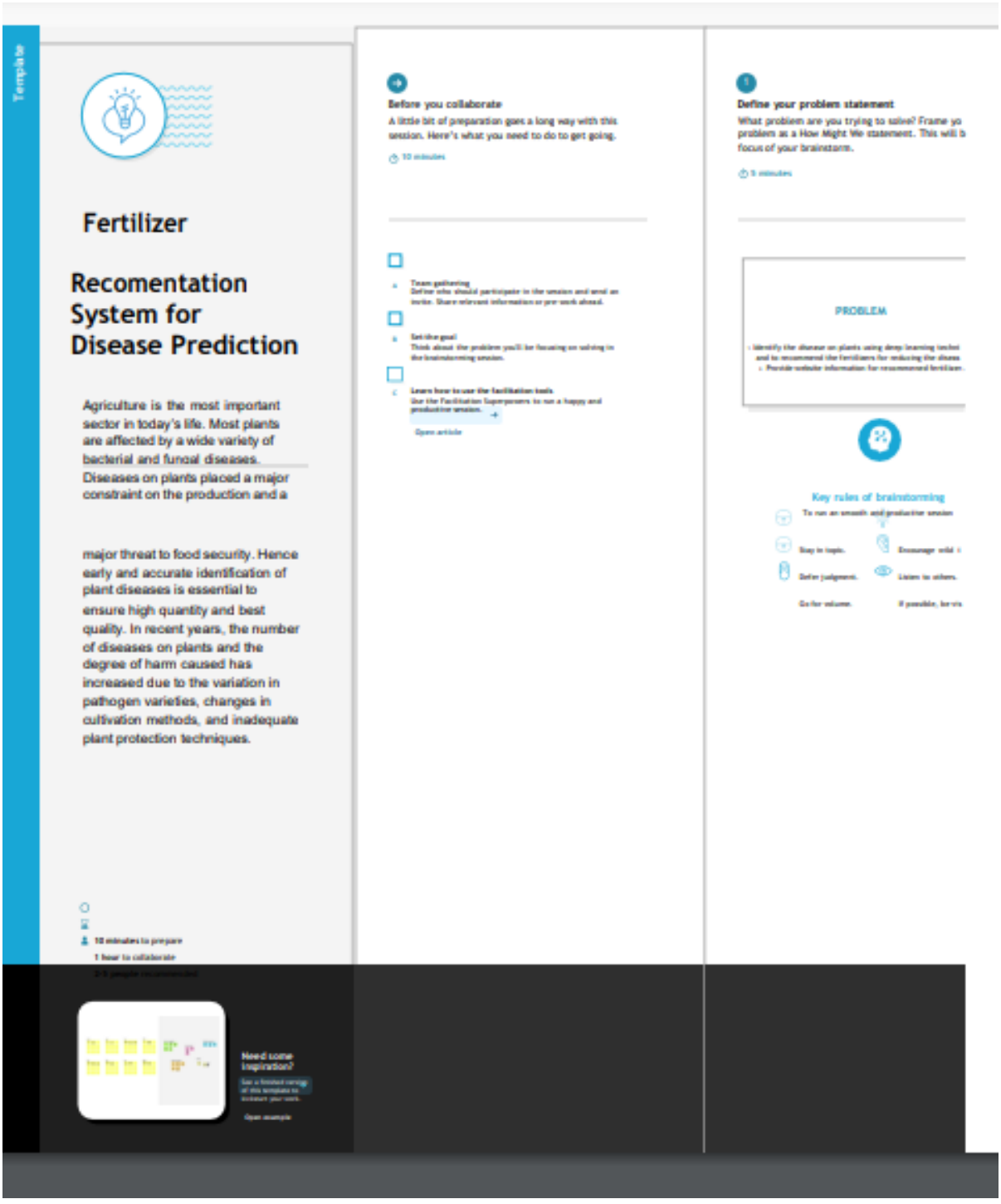
An automated system is introduced to identify different diseases on plants by checking the symptoms shown on the leaves of the plant. Deep learning techniques are used to identify the diseases and suggest the precautions that can be taken for those diseases.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

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.

3.2 Ideation & Brainstorming


Template
Fertilizer
Recomentation System for Disease Prediction
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.
10 minutes to prepare
1 hour to collaborate
Need some inspiration?
Before you collaborate
A little bit of preparation goes a long way with this session. Here's what you need to do to get going.
10 minutes
Define your problem statement
What problem are you trying to solve? Frame yo problem as a How Might We statement. This will b focus of your brainstorm.
5 minutes
PROBLEM
Key rules of brainstorming

2

Brainstorm

Write down any idea that come to mind that address your problem statement.

10 minutes

Tip

SARAVANAN M

Identify the disease

Determining best fertilizer

User friendly website

It reduces man power

Smart solution to solve the problem

MOHAN PRASAT H B

Pre-trained model for image classification

Cost of using this application is less

Making revolutionary changes in agriculture field

They can find the diseases at early stages

MOHAMED SAMSUL H

Early detection and management of problem

Better utilization of available resources

Improves productivity

Interactive user interface to upload images

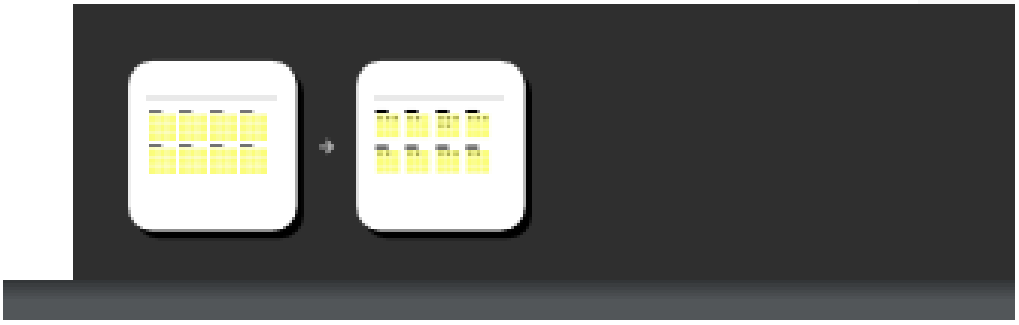
HARISH RAM CBS

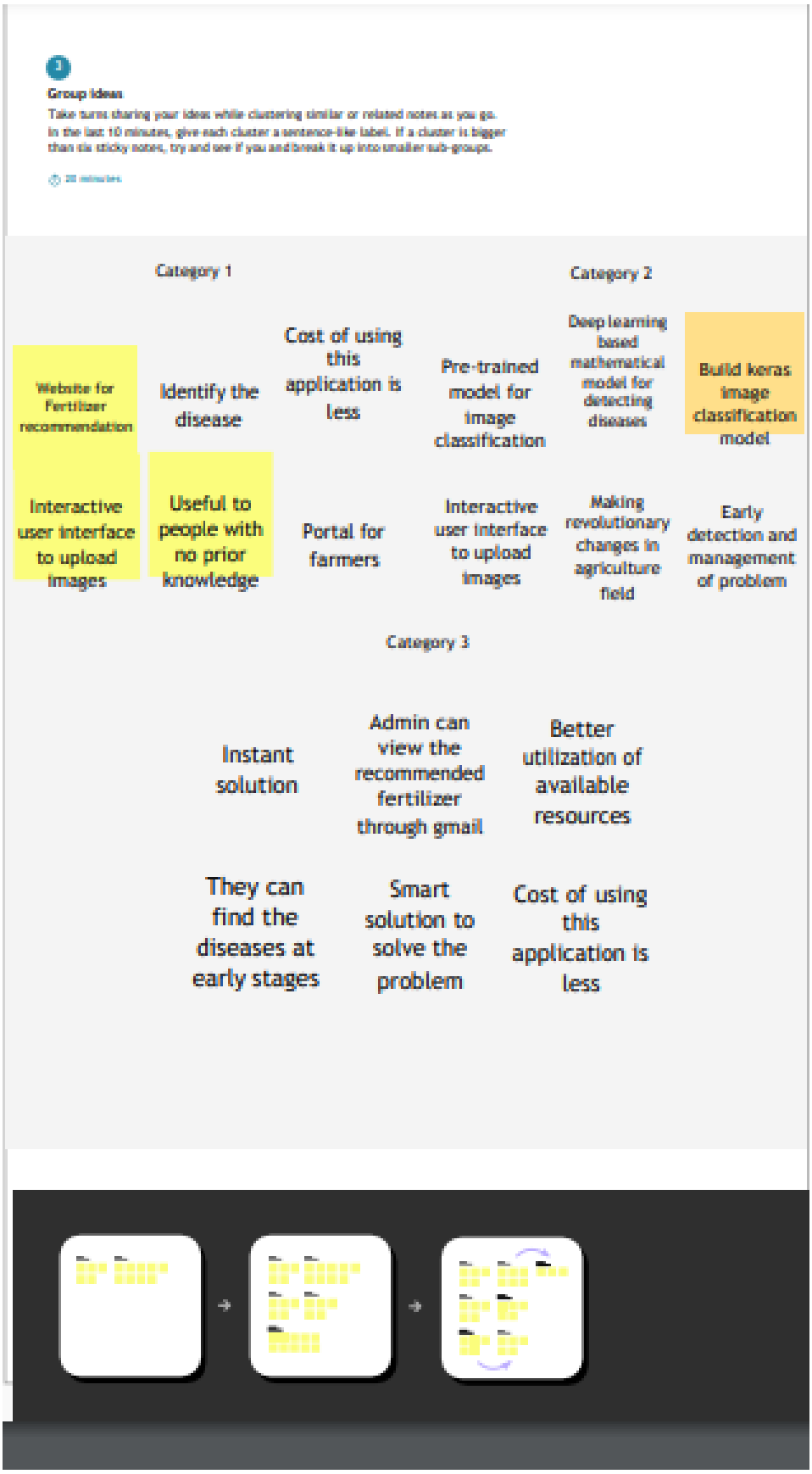
Instant solution

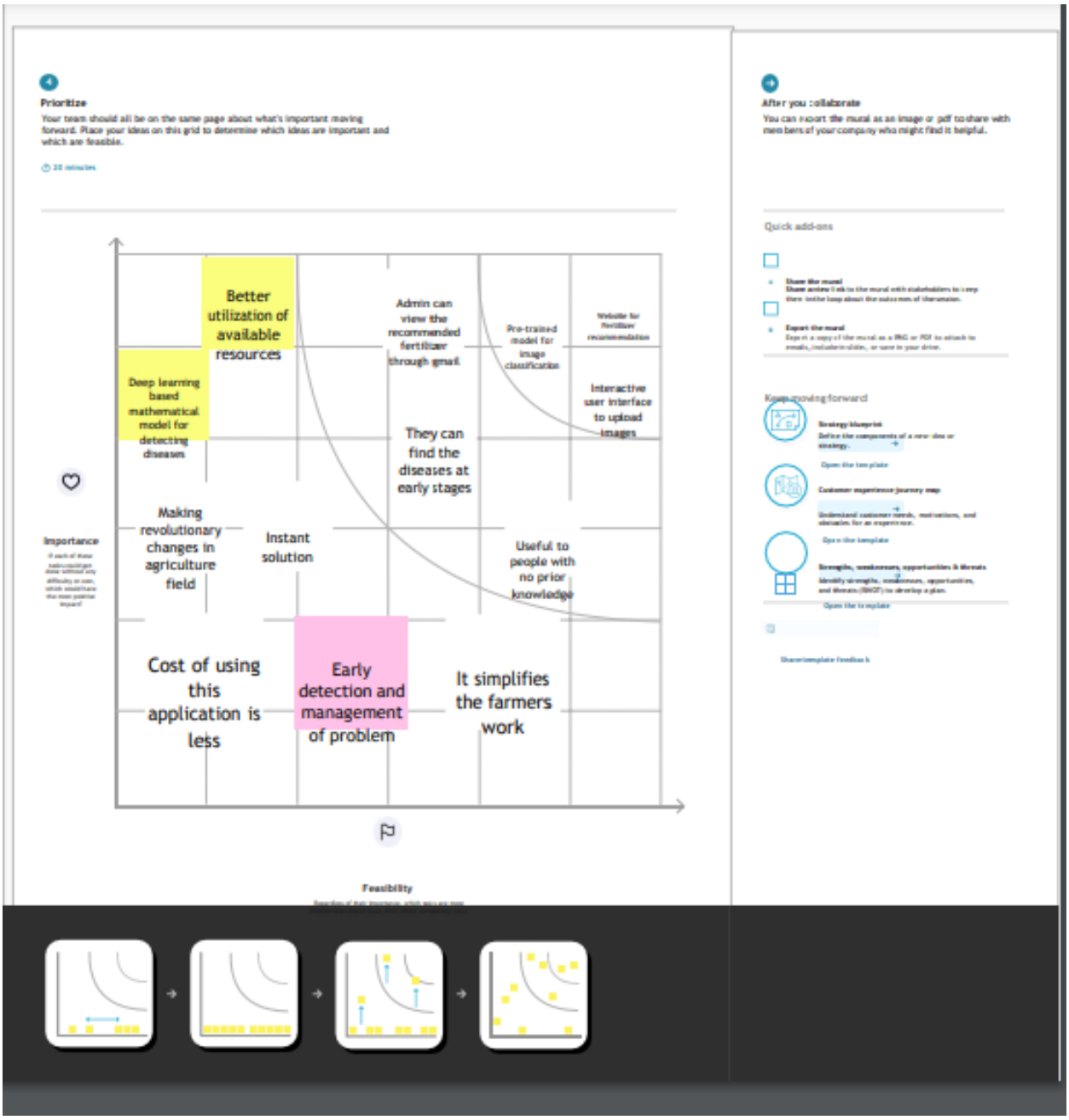
It will save time

Useful to people with no prior knowledge

Portal for farmers




3
Group ideas
Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.
Category 1
Category 2
Website for Fertilizer recommendation
Identify the disease
Cost of using this application is less
Pre-trained model for image classification
Deep learning based mathematical model for detecting diseases
Build keras image classification model
Interactive user interface to upload images
Useful to people with no prior knowledge
Portal for farmers
Interactive user interface to upload images
Making revolutionary changes in agriculture field
Early detection and management of problem
Category 3
Instant solution
Admin can view the recommended fertilizer through gmail
Better utilization of available resources
They can find the diseases at early stages
Smart solution to solve the problem
Cost of using this application is less


Prioritize
Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.
Better utilization of available resources
Admin can view the recommended fertilizer through gmail
Pre-trained model for image classification
Website for fertilizer recommendation
Deep learning based mathematical model for detecting diseases
Interactive user interface to upload images
They can find the diseases at early stages
Importance
Making revolutionary changes in agriculture field
Instant solution
Useful to people with no prior knowledge
Cost of using this application is less
Early detection and management of problem
It simplifies the farmers work
Feasibility
After you collaborate
You can export the mural as an image or pdf to share with members of your company who might find it helpful.
Quick add-ons
Keep moving forward

3.3 Proposed Solution

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 crop for land is

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

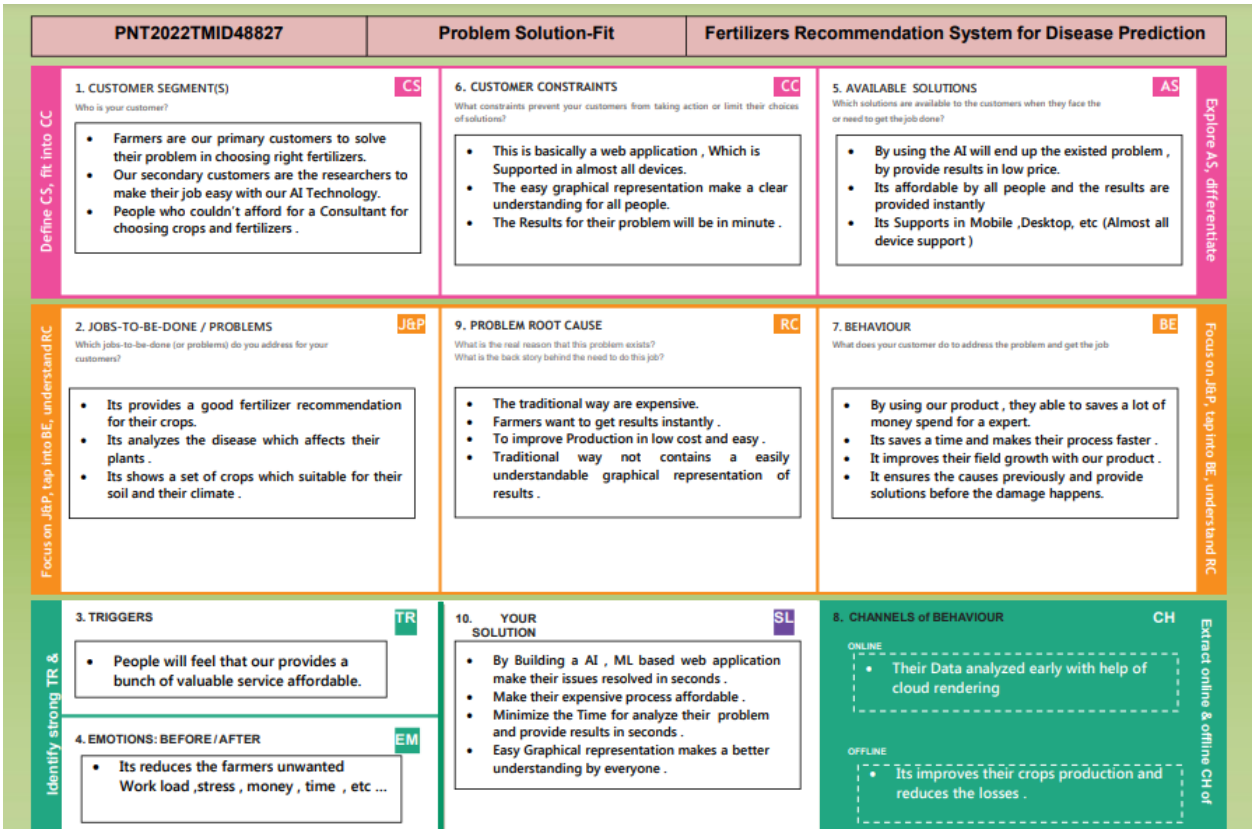
		proposed . Nowadays a lot of research and work is being implemented in the smart and modern agriculture domain. Crop recommendation is characterized by a soil database comprised of Nitrogen, Phosphorus, potassium. The ensembles technique is used to build a recommendation model that combines the prediction 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
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

3.4 Problem Solution fit



4. REQUIREMENT ANALYSIS

4.1 Functional requirement

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
FR-2	User Confirmation	Confirmation via Email
FR-3	User profile	Filling the profile page after logging in
FR-4	Uploading dataset	Images of the leaves are to be uploaded
FR-5	Requesting solution	Uploaded images is compared with the pre-defined Model and solution is generated
FR-6	Downloading solution	The Solution in format of pdf which contains the recommendations of fertilizers and the possible

		diseases.

4.2 Non-Functional requirements

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

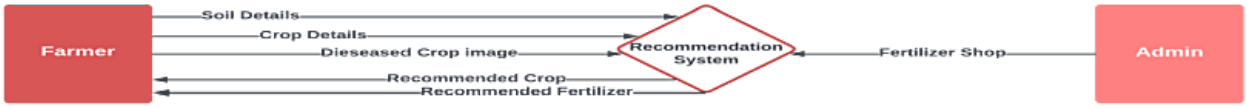
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The system allows the user to perform the tasks easily and effectively and efficiently

NFR-2	Security	All data inside the system will be protected against malware attacks or unauthorized access.
NFR-3	Reliability	The website does not recover from failure quickly and slow in recovery ,it takes time as the application is running in single server
NFR-4	Performance	Response Time and Net Processing Time is Fast
NFR-5	Availability	The system will be available up to 95% of the time
NFR-6	Scalability	The website is scalable

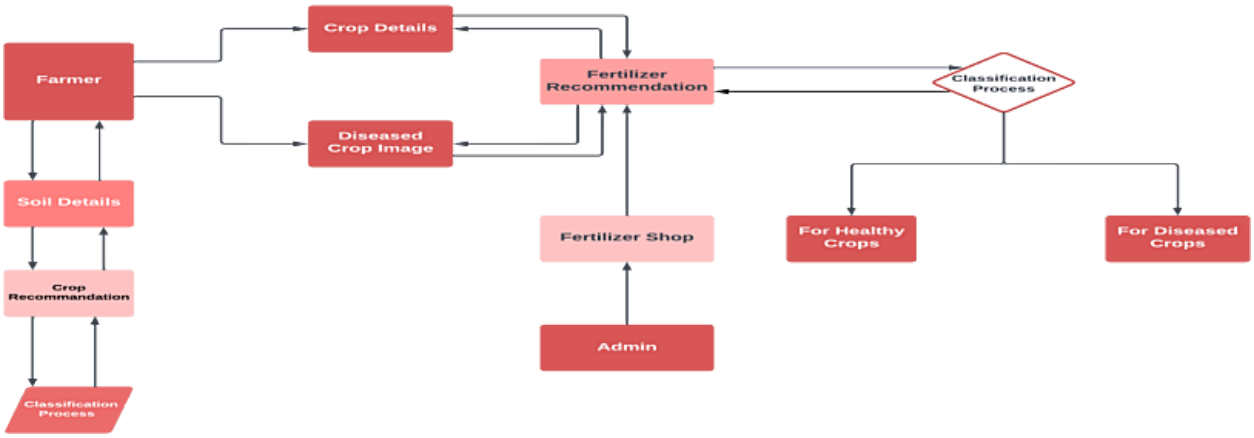
5. PROJECT DESIGN

5.1 Data Flow Diagrams

DFD LEVEL - 0



DFD LEVEL - 1



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 (Web user)	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	I can login using my User credentials	High	Sprint-3

			credentials			
	Dashboard	USN-6	As a user, I can view the web application where i can upload my images and the fertilizer 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 log in to the website using my login credentials	High	Sprint-5

5.2 Solution & Technical Architecture

・Crop disease in plants is predicted and suitable fertilizer is recommended for better yield. The images of the diseased plants are obtained and it is preprocessed against the dataset of diseased plants.

・Agriculture is the most important sector in today's life. Most plants are affected by a wide variety of bacterial and fungal diseases.

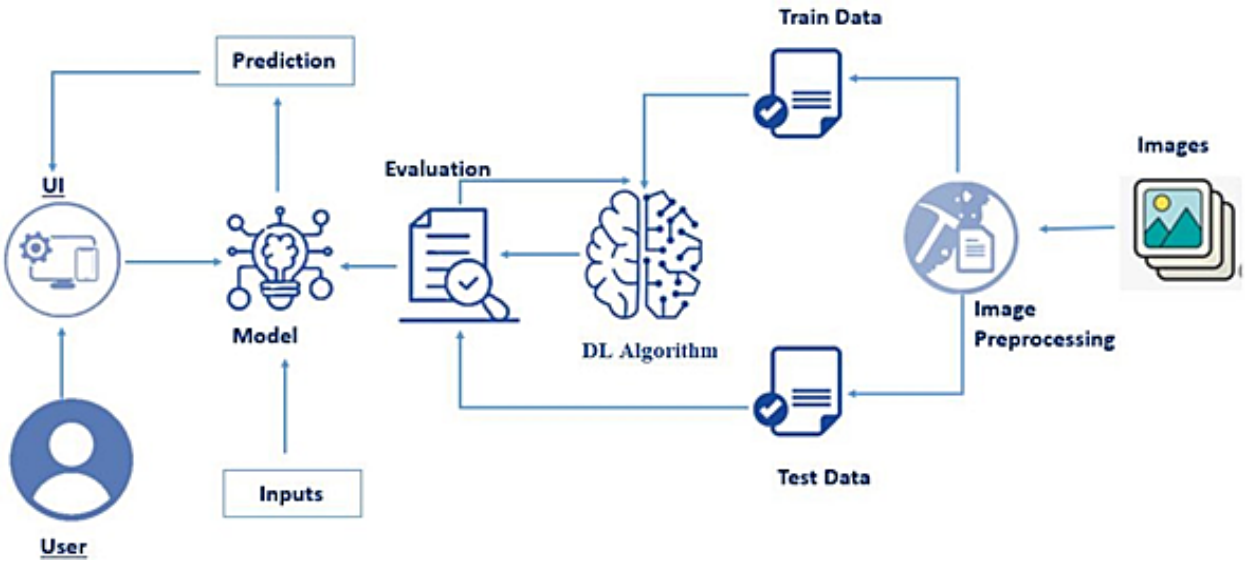
・Deep Learning Algorithm is used to process the images and then it is evaluated. Then a model is built on the evaluations, it is then trained using no. of. inputs and predictions are given to the users which subsequently helps in recommending the fertilizers.

・The Convolutional layers are used to classify and process the images and further helps in recommending the fertilizers. The image classification steps are:

・Image acquisition

- Preprocessing
  - Segmentation
- Disease prediction
  - Fertilizer Recomendation

Solution Architecture Diagram:



6. PROJECT PLANNING & SCHEDULING

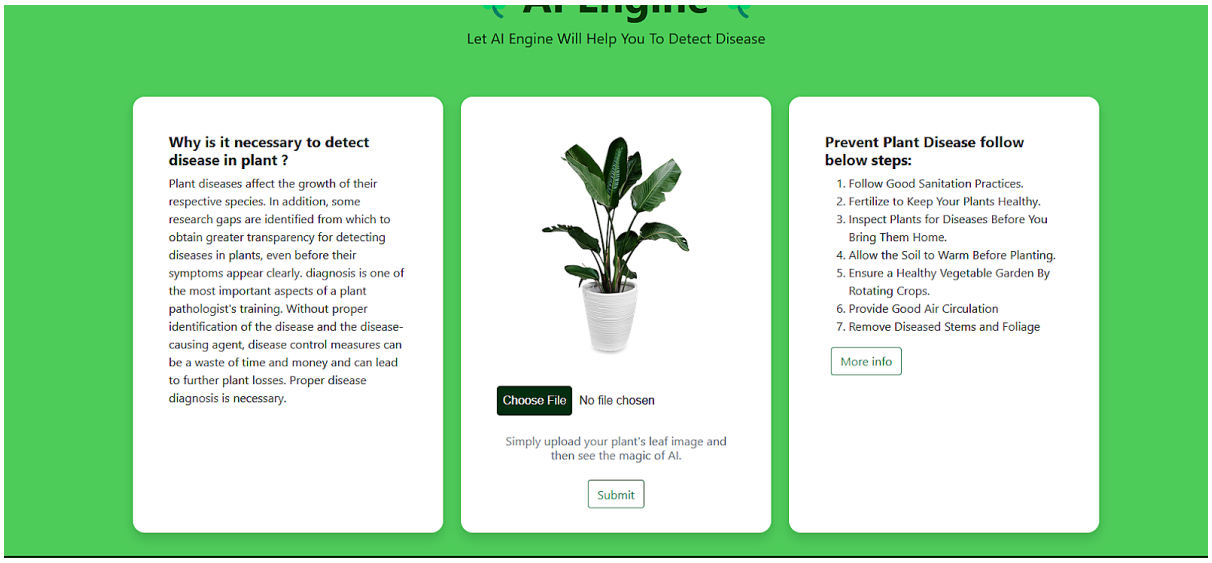
6.1 Sprint Planning & Estimation

Milestone	Function (Epic)	Milesto ne Story Number	Story / Task

Milestone1	**Creating account on google collaboration**	**M1**	**To work on analysis create and login account on google colab**
Milestone2	**Working with dataset**	**M2**	**To understand the given dataset and work on the it**
Milestone3	**Brainstormi ng ideas**	**M3**	**Collect the team ideas on how to explore and analysis the data**
Milestone4	**Coding the dataset**	**M4**	**Using python we can code the given dataset**
Milestone5	**Data visualization and exploration**	**M5**	**To visualization and exploration of dataset should be done**
Milestone6	**Creating dashboard and story**	**M6**	**To create dashboard and story ,report**
Milestone7	**final result of estimated yield output**	**M7**	**To ensure all the activities and resulting the final estimated output**

7. RESULTS


Plant Disease Detection
This AI Engine Will Help To Detect Disease From Following Fruites And Veggies
AI Engine
Apple
Blueberry
Cherry
Corn



8. ADVANTAGES & DISADVANTAGES

- 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.

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.

9. CONCLUSIONS

The model proposed here involves image classification of fruit datasets and vegetable datasets. The following points are observed during model testing and training:

- The accuracy of classification increased by increasing the number of epochs.

- For different batch sizes, different classification accuracies are obtained.

- The accuracies are increased by increasing more convolution layers.

- The accuracy of classification also increased by varying dense layers.

- Different accuracies are obtained by varying the size of kernel used in the convolution layer output.

- Accuracies are different while varying the size of the train and test datasets.

10. FUTURE SCOPE

The proposed model in this project work can be extended to image recognition. The entire model can be converted to application software using python to exe software. The real time image classification, image recognition and video processing are possible with help OpenCV python library. This project work can be extended for security applications such as figure print recognition, iris recognition and face recognition.

11.APPENDIX

Source Code

```
import os
from flask import Flask, redirect, render_template, request
from PIL import Image
import torchvision.transforms.functional as TF
import CNN
import numpy as np
import torch
import pandas as pd


disease_info = pd.read_csv('disease_info.csv' , encoding='cp1252')
supplement_info = pd.read_csv('supplement_info.csv',encoding='cp1252')

model = CNN.CNN(39)
model.load_state_dict(torch.load("plant_disease_model_1_latest.pt"))
model.eval()

def prediction(image_path):
    image = Image.open(image_path)
    image = image.resize((224, 224))
    input_data = TF.to_tensor(image)
    input_data = input_data.view((-1, 3, 224, 224))
```

```
    output = model(input_data)
    output = output.detach().numpy()
    index = np.argmax(output)
    return index

app = Flask(__name__)

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

@app.route('/contact')
def contact():
    return render_template('contact-us.html')

@app.route('/index')
def ai_engine_page():
    return render_template('index.html')

@app.route('/mobile-device')
def mobile_device_detected_page():
    return render_template('mobile-device.html')
```

```
@app.route('/submit', methods=['GET', 'POST'])
def submit():
    if request.method == 'POST':
        image = request.files['image']
        filename = image.filename
        file_path = os.path.join('static/uploads', filename)
        image.save(file_path)
        print(file_path)
        pred = prediction(file_path)
        title = disease_info['disease_name'][pred]
        description =disease_info['description'][pred]
        prevent = disease_info['Possible Steps'][pred]
        image_url = disease_info['image_url'][pred]
        supplement_name = supplement_info['supplement name'][pred]
        supplement_image_url = supplement_info['supplement image'][pred]
        supplement_buy_link = supplement_info['buy link'][pred]
        return render_template('submit.html' , title = title , desc = description , prevent
= prevent ,
                               image_url = image_url , pred = pred ,sname =
supplement_name , simage = supplement_image_url , buy_link =
supplement_buy_link)
```

```
@app.route('/market', methods=['GET', 'POST'])
def market():
    return render_template('market.html', supplement_image =
list(supplement_info['supplement image']),
                           supplement_name = list(supplement_info['supplement name']),
disease = list(disease_info['disease_name']), buy = list(supplement_info['buy
link']))

if __name__ == '__main__':
    app.run(debug=True)
```