Fertilizers Recommendation System for Disease Prediction

Final Report

Date	18 November 2022
Team ID	PNT2022TMID13105
Project Name	Fertilizer Recommendation for Disease Prediction

1. INTRODUCTION

The three essential plant nutrients nitrogen, phosphorus, and potassium are included in the majority of fertilizers that are frequently used in agriculture. Certain "micronutrients," including zinc and other metals, that are essential for plant growth are also present in some fertilizers. Commonly referred to as "soil amendments," these substances are used on the land primarily to improve the qualities of the soil (rather than as plant nourishment). Fresh raw materials, composts, and other organic matter wastes like sewage sludge and industrial wastes can all be used to make fertilizers and soil supplements. Groundwater and surface water have been contaminated as a result of excessive fertilizer use. Unless otherwise forbidden by other State or local legislation, agricultural producers are allowed to use manure and crop leftovers.

1.1 PROJECT OVERVIEW

The primary driver of a nation's economic development in agriculture. For most Indians, agriculture is their livelihood and their heart. However, in recent days the field was deteriorating as a result of different natural disasters. Numerous problems in this area must be resolved to solve the problem. The kind of soil, the suggested fertilizer, and plant and leaf diseases. All of these aspects must be taken into account. The suggested system was designed to examine the soil type, identify diseases in the leaves, and then advise the farmers on the fertilizers that would be most helpful to them. One of the main things that lower the yield of food crops in terms of both quality and quantity is plant disease, especially on the leaves. Finding leaf disease is a crucial part of keeping agriculture alive. In agriculture, clever analysis and thorough prediction models assist the farmer in producing the right crop at the appropriate time. The following are the key advantages of the suggested system: production of the proper crop at the right time, crop production balance, plant disease control, economic growth, and planning to lessen crop shortage. Therefore, in to detect and recognise plant diseases and to provide fertilizer, it is vital to provide symptoms that may be used to diagnose the disease as soon as possible.

1.2 PURPOSE

Nearly 48% of the people in India rely on the agriculture sector for their livelihood. According to the 2019–2020 Economic Survey, the median income for Indian farmers is Rs. 2500 across 16 states. The majority of Indians rely on agriculture for their livelihood. Villagers in India can work in agriculture, which helps the country develop economically and on a huge scale. The issue of planting the wrong crop on their property based on a conventional or non-scientific approach affects the majority of farmers. For a nation like India, where

agriculture provides food for over 42% of the population, this is a difficult undertaking and the consequences for the farmer of selecting the incorrect crop for the land include migrating to a big city for work, committing suicide, giving up farming, and leasing out the land to an industrialist or using it for purposes unrelated to agriculture. The result of poor crop selection is a lower yield and lower revenue.

2. LITERATURE SURVEY

A literature review is intended to help readers understand the current research and discussions that are pertinent to a particular subject or field of study and to communicate that understanding in the form of a written report. The below review helps in a better understanding of this project.

2.1 EXISTING PROBLEM

Agriculture is the heart and life of most Indians. But in recent days, the field was going down due to various natural calamities. To overcome the problem, various issues in this field need to be addressed. The soil type, fertilizer recommendation, and diseases in plants and leaves. All these features need to be considered. Soil nutrients and season have a direct impact on the growth and yield of a crop. Deficiency in the nutrient level of the soil may result in plant disease while applying excessive amounts of soil fertilizer, on the other hand, may also cause negative results to the development of the crop. Nutrients in the soil also change as the season changes from wet season to dry season. Artificial intelligence and sensor technology play a vital role in the agriculture field. The use of excess insecticides and fertilisers in farming poses a risk to human health. It is necessary to control them to ensure healthy crop production. Many techniques are used to identify the pest, suggest medications, and do soil nutrient analysis techniques separately. The work done concentrated on crop prediction using different soil properties and Data Mining Techniques. Fertilizer Recommendation is not taken into consideration. So, it is necessary to develop crop yield prediction and fertilizer recommendation systems which predict crop yield based on soil nutrients crop yield data and recommend fertilizer for selected crops based on different datasets like fertilizer data, location data and crop yield data.

2.2 REFERENCES

[1] Selvi, P. P., & Poornima, P. Soil Based Fertilizer Recommendation System for Crop Disease Prediction System.

[2] Bondre, D. A., & Mahagaonkar, S. (2019). Prediction of crop yield and fertilizer recommendation using machine learning algorithms. International Journal of Engineering Applied Sciences and Technology, 4(5), 371-376.

[3] Haban, J. J. I., Puno, J. C. V., Bandala, A. A., Billones, R. K., Dadios, E. P., & Sybingco, E. (2020, November). Soil Fertilizer Recommendation System using Fuzzy Logic. In 2020 IEEE REGION 10 CONFERENCE (TENCON) (pp. 1171-1175). IEEE.

[4] Thorat, T., Patle, B. K., & Kashyap, S. K. (2022). Intelligent Insecticide and Fertilizer Recommendation System based on TPF-CNN for Smart Farming. Smart Agricultural Technology, 100114.

[5] Ahmed, U., Lin, J. C. W., Srivastava, G., & Djenouri, Y. (2021). A nutrient recommendation system for soil fertilization based on evolutionary computation. Computers and Electronics in Agriculture, 189, 106407.

2.3 PROBLEM STATEMENT DEFINITION

I am	I'm trying to	But	Because	Which makes me feel
a farmer	grow and harvest healthy crops	my crops are affected by some disease	of not using the needed fertilizers	sad and disappointed
a gardener	grow some vegetable plants in the home	there are spots appearing on the leaves	of not maintaining and providing the needed nutrients	not productive and not useful
a nursery manager	grow and sell the plant saplings	the baby plants are not growing after some stage	not doing the needed tasks in order to maintain the growth	unprofitable in the future

3. IDEATION & PROPOSED SOLUTION

The ideation stage of a Design Thinking project is frequently the most exciting since it aims to produce a huge number of ideas that the team can then sort through and narrow down to the best, most useful, or most creative ones to inspire new and improved design solutions and products. The primary objective of a business proposal is to address a problem that a potential customer may be experiencing. This section needs to be as thorough as it can be and be able to fulfil every demand as mentioned.

3.1 EMPATHY MAP CANVAS

Fertilizer Recommendation - Empathy Map

What does the user Think & feel?
What really counts
Major preoccupations
Worries & aspirations

- "Better than human prediction of diseases and fertilizers"
- Feels to have basic knowledge about the different diseases and the fertilizers
- Want to increase the yield and make sure the harvests are market-worthy.
- Feels sad when the crops are affected by different diseases
- Wants simple ways to figure out the diseases and find the correct fertilizer
- "This is very much simple when compared to the conventional method"
- Wants the plants to grow healthy without diseases
- Wants to protect the crops from the diseases
- Feels sad when the crops are affected by different diseases
- Feels exhausted to go to agricultural centres to find out the diseases.
- An instant solution for a huge problem and user friendly approach

What does the person Hear?
What friends say
What boss says
What influencers say

- "Time required to find out the disease is very less"
- "Getting rid of the problems at an early stage and come up with efficient solutions"
- "As the process reduces time you can invest your time in other farming activities"
- "Because of using the correct fertilizers your harvest has increased significantly"
- "If the prediction is wrong then the loss caused will be very huge"
- "Will the application take responsibility if there is any loss"
- "Very good initiative and approach to solve the tedious method of disease prediction"
- "How can I trust my result of hard-working harvests with a machine"

FARMER

What does the person See?
Environment
Friends
What the market offers

- Gains more profit when compared to the traditional methods.
- Growth of healthy crops after using the correct fertilizer
- Significantly reduced persistant and repeated occurence of diseases
- Neighbouring farmers will be envious about the new modern technology used
- Provides data security and protection to the crop data
- "As I shifted to the modern approach my harvests are more worthy"
- Leads to healthy ripe crop harvest when only the required amount of fertilizer is used
- "Comparison between the machine predicted and the traditional found disease inorder to gain the trust of the farmers who are new to the tecnology"
- "Because of this modern application I was able to get more profit than usual"

What does the person Say and do?
Attitude in public
Appearance
Behavior towards others

- "How can you be sure about the accuracy of the result provided by this modern application"
- "You should be ready to face the consequences of making use of this application"

Pain
Fears
Frustrations
Obstacles

- There may be errors because of lack of required data
- Some wrong predictions may occur which will lead to a huge loss
- "What if the recommended fertilizer is not available in the user location"
- This technology reduces interaction between humans
- It is hard to gain the trust of all people

Gain
Wants/Needs
Measures of Success
Obstacles

- It leads to utilize the available resources more efficiently
- More likely to reduce the loss suffered by the user
- Improves the condition of the crops ajnd brings more profit to the user
- Diseases can be detected early and the crops can be protected
- It helps to develop a self-working environment without depending on others

3.2 IDEATION & BRAINSTORMING

Step 1: Team Gathering, Collaboration and Select the Problem Statement

Fertilizer Recommendation 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.

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.

- 15 minutes to prepare
- 30-60 minutes to collaborate
- 4 people recommended

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.

15 minutes

"How Might We" Questions

1. How should we develop the disease prediction system?
2. Is it based on an existing problem or insight?
3. How might we increase awareness of the full product offerings?
4. How might we make users feel confident they have all the information they need?
5. How might we make our application more usable?

Setting the stage for creativity and inclusivity
Some brain storming rules followed are

1. **Encourage wild ideas** - If none of the ideas sound a bit ridiculous, then there is too much of filtering.
2. **Defer judgement** -This can be as direct as harsh words or as subtle as a condescending tone or talking over one another.
3. **Build on the ideas of others** - "I want to build on that idea" or the use of "yes, and..."
4. **Stay focused on the topic at hand**
5. **Have one conversation at a time**
6. **Be visual** - Draw and/or upload to show ideas, whenever possible
7. **Go for quantity**

Team Gathering
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

Choose your best "How Might We" Questions

Share the top 5 brainstorm questions that you created and let the group determine where to begin by selecting one question to move forward with based on what seems to be the most promising for idea generation in the areas you are trying to impact.

10 minutes

QUESTION
How should we develop the disease prediction system?

QUESTION
Is it based on an existing problem or insight?

QUESTION
How might we increase awareness of the full product offerings?

QUESTION
How might we make users feel confident they have all the information they need?

QUESTION
How might we make our application more usable?

Step 2: Brainstorm, Idea Listing and Grouping

2

Brainstorm solo

Have each participant begin in the "solo brainstorm space" by silently brainstorming ideas and placing them into the template. This "silent-storming" avoids group-think and creates an inclusive environment for introverts and extroverts alike. Set a time limit. Encourage people to go for quantity.
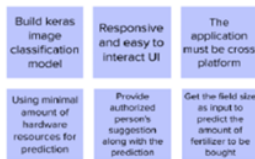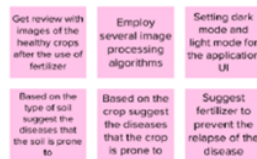
⏱ 10 minutes

3

Brainstorm as a group

Have everyone move their ideas into the "group sharing space" within the template and have the team silently read through them. As a team, sort and group them by thematic topics or similarities. Discuss and answer any questions that arise. Encourage "Yes, and..." and build on the ideas of other people along the way.

⏱ 15 minutes

Dineshraja V

Website for fertilizer Recommendation	Admin can view the recommended fertilizer	Interactive UI to upload images
Identify User preferences	Can create a smart chat bot to clear doubts	Automation resolution of low quality images

Fatima Abdul Jabbar

Provide location of the store where the fertilizer is available	Provide offers and discounts who use this application	Securing the data of the user
Pre-trained model for image classification based on the disease	Generating report for the suggested fertilizer	Providing information about how much fertilizer to use

Naveena K S

Build keras image classification model	Responsive and easy to interact UI	The application must be cross platform
Using minimal amount of hardware resources for prediction	Provide authorized person's suggestion along with the prediction	Get the field size as input to predict the amount of fertilizer to be bought

Sree Resmi S

Get review with images of the healthy crops after the use of fertilizer	Employ several image processing algorithms	Setting dark mode and light mode for the application UI
Based on the type of soil suggest the diseases that the soil is prone to	Based on the crop suggest the diseases that the crop is prone to	Suggest fertilizer to prevent the relapse of the disease

Group sharing space:

- Provide location of the store where the fertilizer is available
- Responsive and easy to interact UI
- Automation resolution of low quality images
- Generating report for the suggested fertilizer
- Provide offers and discounts who use this application
- Suggest fertilizer to prevent the relapse of the disease

Step 3: Idea Prioritization

4

Idea Prioritization

Jot down different ideas your team is interested in trying out. These could be different solutions, or different approaches to the same solution. As a team, go through the ideas in the Idea bank one by one and place them on the grid. Take the time to discuss each idea and come to a consensus on where it should go.

⏱ 15 minutes

Importance — If each of these tasks could get done without any difficulty or cost, which would have the most positive impact?

Feasability — Regardless of their importance, which tasks are more feasible than others? (Cost, time, effort, complexity, etc.)
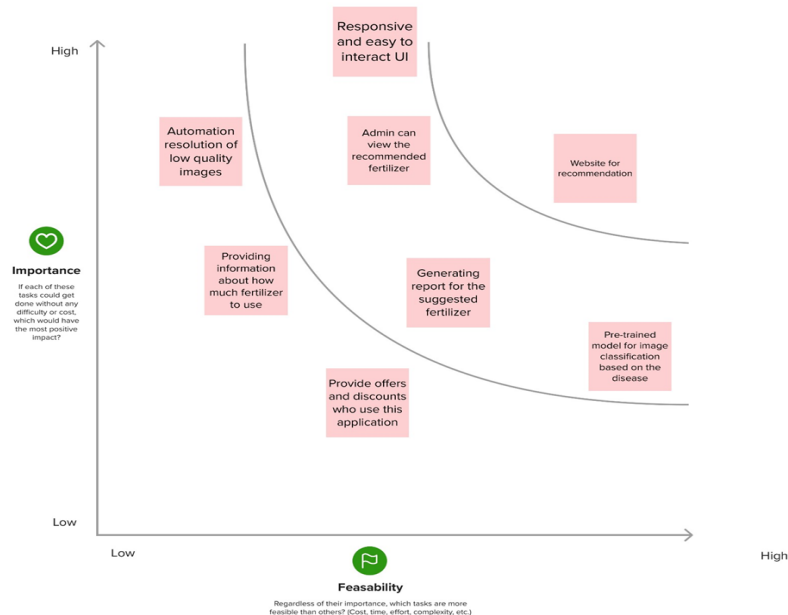
3.3 PROPOSED SOLUTION

S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The problem statement is that when a crop's leaf image is given as the input to an AI model, the essential features from the leaves are taken, analyzed and the AI model will predict the disease and will suggest a suitable fertilizer to cure the disease that the crop has been infected with.
2.	Idea / Solution description	To predict the disease and to suggest a suitable fertilizer to cure the disease that the crop has been infected with, an artificially intelligent system has to be introduced to provide farmers with the best solution possible.
3.	Novelty / Uniqueness	AI models developed will be able to predict the disease accurately and be able to suggest suitable fertilizer for the disease that the crop has been infected with while the input is only the image of the leaf of the infected crop.
4.	Social Impact / Customer Satisfaction	The AI model is built in such a way that each farmer can get benefitted and be fully satisfied in terms of production as well as the quality of the goods produced without spending huge amounts of money.
5.	Business Model (Revenue Model)	Employing an AI model will be a cost-effective solution for agriculture. It eliminates the need for soil testing and the results are provided instantly and much faster than conventional methods for crop disease prediction.

6.	Scalability of the Solution	The AI model developed can be scaled to predict the source of the disease when the crop leaf image is given as an input and also can be scaled to suggest suitable relevant diseases that the crop might get infected with in the future as well.

3.4 PROBLEM - SOLUTION FIT

4. REQUIREMENT ANALYSIS

Requirements analysis or requirements engineering is a process used to determine the needs and expectations of a new product. It involves frequent communication with the stakeholders and end-users of the product to define expectations, resolve conflicts, and document all the key requirements. The subsequent steps comprise a requirements analysis process:

Step 1: Determine Key Stakeholders and End-Users.

Step 2: Capture Requirements

Step 3: Classify the requirements.

Step 4: Interpret requirements and record them.

Step 5: Sign off.

4.1 FUNCTIONAL REQUIREMENTS

The service aims to provide access to crop-related content that will be seen by various actors through an interface (web browser; Copywriter, Editor). The Content Manager (Copywriter, Editor) will create the crop-related content that will be posted online. This Content may take the form of Text content, audio content or video content.

Data Input:

All crop-related information, including crop details, POPs, details for crop cycle management from pre-sowing to post-harvest, crop diseases, data from pest roving surveys, CROPSAP advisory data, and statistical data like APY, MSP, and FASAL, must be entered by the copywriter.

Data verification:

The Editor must be able to confirm the information that the Copy Writer entered. The information pertaining to the crops may also be changed by the Editor.

View Crop Data:

The user shall have the ability to view crop-related data.

Assumptions:

There won't be any problems with the Internet. The system administrator has created roles for copywriters and editors with the appropriate access privileges for those positions.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form
FR-2	User Confirmation	Confirmation Via mail & OTP.
FR-3	Uploading the images	Drag and drop feature Browse through device folders
FR-4	Image Pre-processing	Uploaded images are pre-processed using the pre-processing model deployed in the IBM cloud.

FR No.		Description
FR-5	Disease Prediction	The disease prediction model is trained with a large dataset and deployed in the IBM cloud to predict the disease by analyzing the uploaded images.
FR-6	Fertilizer Recommendation	Based on the disease predicted by the model the fertilizer required to cure the disease is suggested to the user
FR-7	Report Generation	The fertilizer to be used and the amount and other details are specified in the report which can be downloaded by the user.

4.2 NON-FUNCTIONAL REQUIREMENTS

Non-functional requirements are those that are not specifically related to the specific function that the system provides. Instead of defining specific behaviours, they define the standards that can be used to assess how well a system is functioning. They might have to do with emergent system characteristics like dependability, response time, and store occupancy. Non-functional requirements can be a result of user needs, financial restrictions, organizational policies, or the necessity for compatibility with other hardware and software systems. Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The website is designed to be responsive and user-friendly so that it can be used on any device and by anyone.
NFR-2	Security	The user details are confidential and the user account is verified with the email id provided to ensure security.

NFR-3	Reliability	As the deployment is done in a cloud environment the model and the website are highly reliable with efficient and accurate outputs.
NFR-4	Performance	As the models are deployed in the IBM cloud the performance will be efficient.
NFR-5	Availability	The website will be hosted so that it is available for a large number of people.
NFR-6	Scalability	As the models are deployed in the IBM cloud they can easily be scaled for large inputs and to handle many requests.

PRODUCT SPECIFICATIONS:

Correctness: It used a pre-trained classification model to compute and adhered to well-defined procedures and regulations. Rigorous testing is also carried out to check the accuracy of the data.

Modularity: To explore the value of the product's versatility, the entire thing is divided into numerous modules, and well-defined interfaces are created.

Robustness: This program is being created so that the overall performance is maximized and the user may anticipate outcomes quickly with the highest level of relevance and accuracy.

REQUIREMENTS FOR BASIC OPERATION:

The eight fundamental tasks of systems engineering are performed by the customers, with the operator serving as the primary client. Operational criteria will specify the fundamental necessity and, at the very least, be connected to these the following:

Scenario: It defines the methods utilized to achieve the mission's goals in the mission profile or scenario. It determines the system's effectiveness or efficiency as well.

Performance and related parameters: This section highlights the crucial system parameters needed to complete the mission.

Environments for system use: It provides a basic overview. discovers the ideal settings for a system's efficient performance.

Operational life cycle: This determines how long a system will last.

SYSTEM CONFIGURATION:

HARDWARE SYSTEM CONFIGURATION:

Processor: 2 gigahertz (GHz) or faster processor or SoC.

RAM: 6 gigabytes (GB) for 32-bit or 8 GB for 64-bit.

Hard disk space: 16GB.

SOFTWARE CONFIGURATION:

Operating System: Windows XP/7/8/8.1/10, Linux and Mac

Coding Language: Python

Tools: Pandas, Numpy, Tensorflow, Keras

5. PROJECT DESIGN

The project lifecycle's initial stage, project design is where concepts, procedures, resources, and deliverables are organized. A project design comes before a project plan because it provides a broad picture while the latter contains more specific details.

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.

Simplified DFD

- Download the dataset.
- Classify the dataset into train and test sets.
- Add the neural network layers.
- Load the trained images and fit the model.
- Test the model.
- Save the model and its dependencies.
- Build a Web application using a flask that integrates with the model built.

DFD Level 0 (Industry Standard)
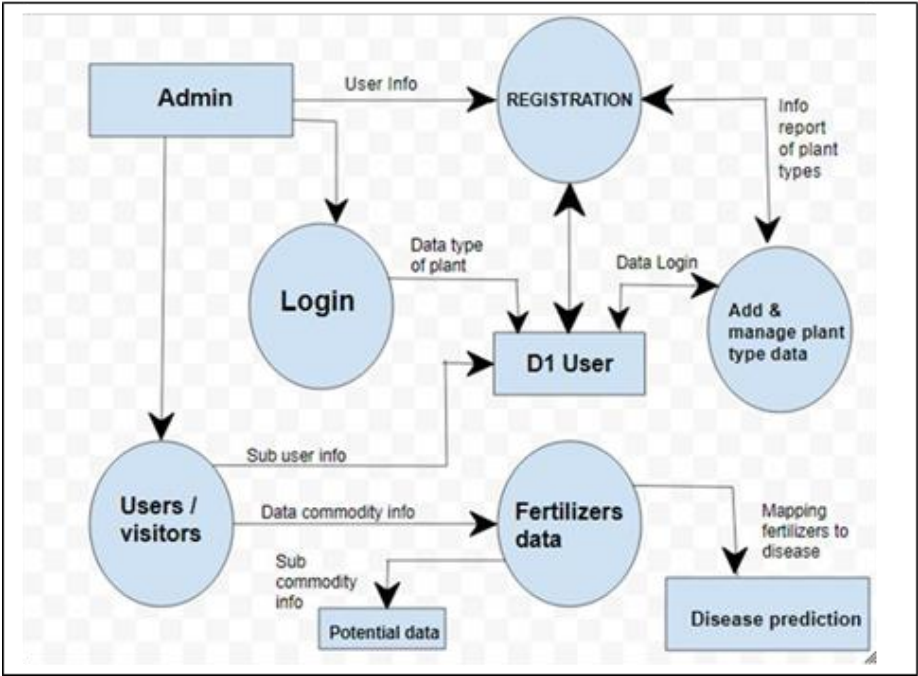
5.2 SOLUTION & TECHNICAL ARCHITECTURE

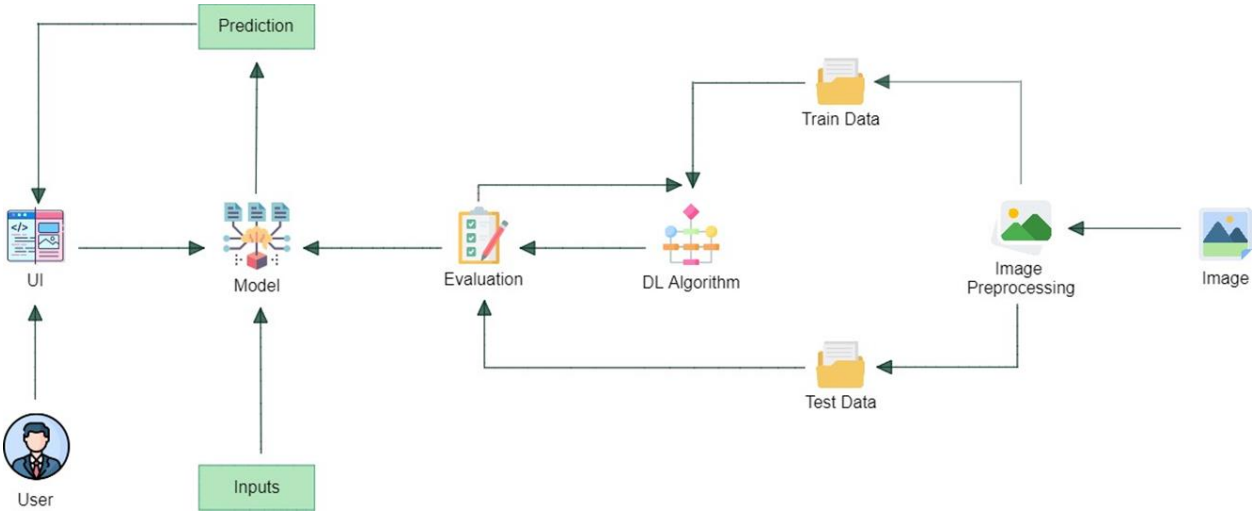The Deliverable shall include the architectural diagram below and the information as per the table1 & table 2.

Table 1 Components & Technologies

S.No	Components	Technology	Description
1.	User Interface	User interacts with the application using a website	Python Flask
2.	Image Preprocessing	Image of the diseased leaf is uploaded through the website and the image is pre-processed using machine learning algorithms.	Python
3.	Disease Prediction	Machine learning model to predict the diseases from the images of the leaves uploaded through the website	Python
4.	Fertilizer Recommendation	After predicting the disease suitable fertilizer for that particular disease is suggested.	Python
5.	Database	Images are stored in the database	Google drives
6.	Cloud Database	The above-described model is deployed in the IBM cloud.	IBM DB2, IBM Cloudant etc.
7.	Machine Learning Model	Machine learning models are used for image pre-processing, disease prediction and fertilizer recommendation.	Image pre-processing model, Disease Prediction model.

5.3 USER STORIES

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release

Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, and password, and confirming my password.	I can access my account/ account/ dashboard	High	Sprint-1
		USN-2	As a user, I will receive a confirmation email once I have registered for the application	I can receive a confirmat ion email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application via mobile/deskto p.	I can Register & access the dashboard with login credentials.	Low	Sprint-2
		USN-4	As a user, I can register for the application through Google service/cloud .	Valid Google account to be linked and verified.	Medium	Sprint-1

	Login	USN-5	As a user, I can see or access the data for crops and diseases respectively.	To access, his credentials must be verified.	High	Sprint-1
	Dashboard	USN-6	As a user I want the dashboard to be glitch-free and the records to be updated effectively.	Valid and accurate records are to be entered.	Low	Sprint-2
Customer (Web user)	Login	USN-7	As a web user, I can log in to the application so that it presents me with my preferences.	Preference presentation must be accurate and necessary	Medium	Sprint-1
	Dataset	USN-8	As a web user, I want to view the dataset so that I can know which plants are there.	The plant types should be of different species and of a wide variety.	Medium	Sprint-1
Customer Care Executive	Validation	USN-9	As a customer care executive, I want the customer's	customer's SSN details are to be provided with proof.	High	Sprint-1

			portfolio to be verified and of high priority.			
	Capital	USN-10	As a customer care executive, I need minimal amounts/fees for those who access datasets and resources.	Payment modes can be done through valid banks or digitally (Gpay,Paytm etc)	High	Sprint-1
Administrator	Access/Privileges	USN-11	As an admin, I want to allow access and restrict to whom I prefer.	Customer Records to be provided	High	Sprint-1
	Modification/ Update	USN-12	As an admin, I want to modify or update records or applications if required.	Only valid requests to modify will be allowed access	High to Medium	Sprint-1

6.PROJECT PLANNING & SCHEDULING

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 register for the application by entering my phone number, password, and confirming my password.	8	High	Dineshraja V
Sprint-1		USN-2	As a user, I will receive confirmation otp once I have registered for the application	2	High	Fatima Abdul Jabbar
Sprint-3		USN-3	As a user, I can register for the application by entering email, password, and confirming my password	8	Low	Naveena K S
Sprint-2		USN-4	As a user, I can register for the application through Gmail account	2	Medium	Sree Resmi S
Sprint-2		USN-5	As a user, I will receive confirmation email to verify my account once I have registered for the application	2	Medium	Dineshraja V

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Login	USN-6	As a user, I can log into the application by entering mobile number & password	2	High	Fatima Abdul Jabbar
Sprint-1		USN-7	As a user, I can log into the application by entering email & password	8	Medium	Naveena K S
Sprint-3		USN-8	As a user, I can log into the application through the linked Gmail account without mobile number or email or password.	2	Low	Sree Resmi S
Sprint-2	Dashboard	USN-9	As a user, I can drag and drop images of the diseased leaf inorder to get the fertilizer recommendation	8	High	Dineshraja V, Fatima Abdul Jabbar

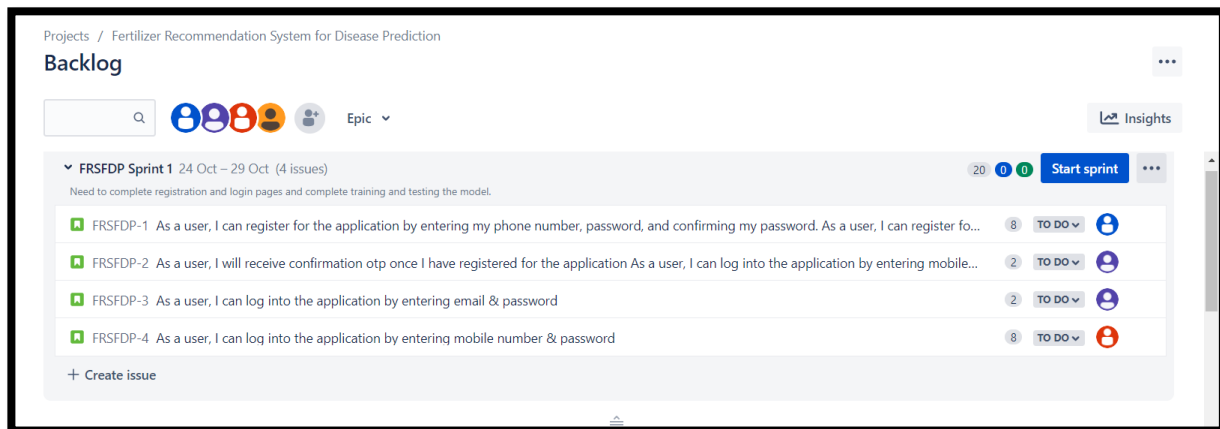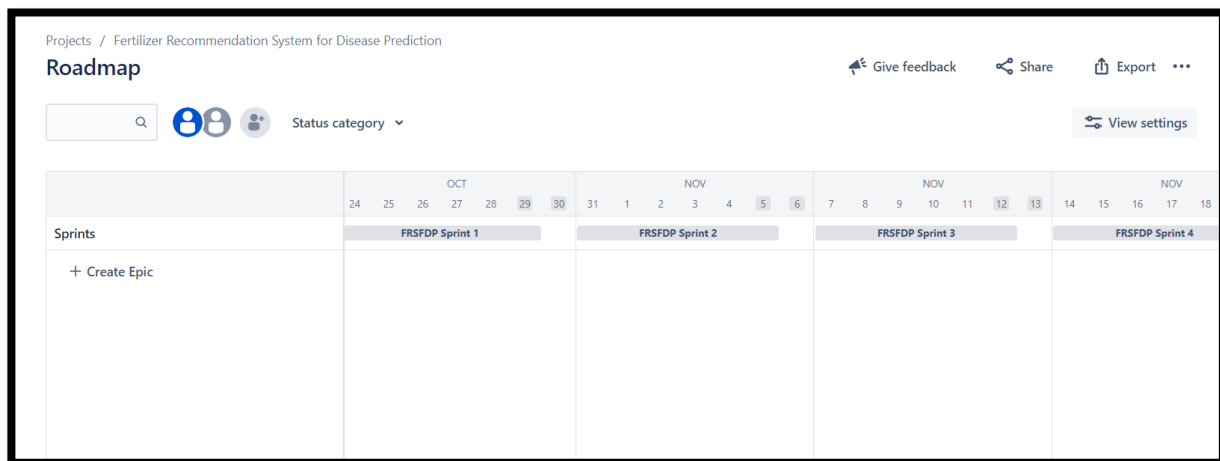| Sprint		USN	User Story			
Sprint-2		USN-10	As a user, I can upload the images of diseased leaf that is stored in the device inorder to get the fertilizer recommendation	8	High	Naveena K S, Sree Resmi S
Sprint-3		USN-11	As a user, I can link my google drive and upload the images of diseased leaf directly from the drive inorder to get the fertilizer recommendation	8	Low	Dineshraja V, Fatima Abdul Jabbar
Sprint-3		USN-12	As a user, I need to be clear with how to use the application effectively. So instructions need to be provided.	2	High	Naveena K S, Sree Resmi S
Sprint-4	History	USN-13	As a user, I want to know the past searches and I should be able to retrieve the reports generated.	2	High	Dineshraja V, Fatima Abdul Jabbar

Sprint-4		USN-14	As a user, I should have the access to delete some contents from the history of searches	2	High	Naveena K S, Sree Resmi S
Sprint-4	Report Generation	USN-15	As a user, I should be able to generate a report for the fertilizer that should be used inorder to protect the plants.	8	High	Dineshraja V, Fatima Abdul Jabbar
Sprint-4		USN-16	As a user, I should be able to download the generated report and store it in the device for future reference	8	High	Naveena K S, Sree Resmi S

6.2 SPRINT DELIVERY SCHEDULE

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

6.3 REPORTS FROM JIRA

Backlog

...

Epic ⌄   📈 Insights

▾ **FRSFDP Sprint 2** 31 Oct – 5 Nov (4 issues)   20 **0** **0**   Start sprint ...
Need to complete the dashboard pages.

📗 FRSFDP-5 As a user, I can register for the application through Gmail account   2 TO DO ⌄ 👤

📗 FRSFDP-6 As a user, I will receive confirmation email to verify my account once I have registered for the application   2 TO DO ⌄ 👤

📗 FRSFDP-7 As a user, I can drag and drop images of the diseased leaf inorder to get the fertilizer recommendation   8 TO DO ⌄ 👤

📗 FRSFDP-8 As a user, I can upload the images of diseased leaf that is stored in the device inorder to get the fertilizer recommendation   8 TO DO ⌄ 👤

+ Create issue

Backlog

...

Epic ⌄   📈 Insights

▾ **FRSFDP Sprint 3** 7 Nov – 12 Nov (4 issues)   20 **0** **0**   Start sprint ...
Need to complete the entire application.

📗 FRSFDP-9 As a user, I can log into the application through the linked Gmail account without mobile number or email or password.   2 TO DO ⌄ 👤

📗 FRSFDP-10 As a user, I can register for the application by entering email, password, and confirming my password   8 TO DO ⌄ 👤

📗 FRSFDP-11 As a user, I can link my google drive and upload the images of diseased leaf directly from the drive inorder to get the fertilizer recommenda...   8 TO DO ⌄ 👤

📗 FRSFDP-12 As a user, I need to be clear with how to use the application effectively. So instructions need to be provided.   2 TO DO ⌄ 👤

+ Create issue

Backlog

...

Epic ⌄   📈 Insights

▾ **FRSFDP Sprint 4** 14 Nov – 19 Nov (4 issues)   20 **0** **0**   Start sprint ...
Need to clear the bugs and deploy the same on IBM cloud.

📗 FRSFDP-14 As a user, I want to know the past searches and I should be able to retrieve the reports generated.   2 TO DO ⌄ 👤

📗 FRSFDP-13 As a user, I should have the access to delete some contents from the history of searches   2 TO DO ⌄ 👤

📗 FRSFDP-15 As a user, I should be able to download the generated report and store it in the device for future reference   8 TO DO ⌄ 👤

📗 FRSFDP-16 As a user, I should be able to generate a report for the fertilizer that should be used inorder to protect the plants.   8 TO DO ⌄ 👤

+ Create issue

FRSFDP Sprint 1

Need to complete registration and login pages and complete training and testing the model.

TO DO 4 ISSUES

As a user, I can register for the application by entering my phone number, password, and confirming my password. As a user, I can register for the application by entering my phone number, password, and confirming my password.

FRSFDP-1   8

As a user, I will receive confirmation otp once I have registered for the application As a user, I can log into the application by entering mobile number & password

FRSFDP-2   2

IN PROGRESS

DONE ✓

---

registered for the application As a user, I can log into the application by entering mobile number & password

FRSFDP-2   2

As a user, I can log into the application by entering email & password

FRSFDP-3   2

As a user, I can log into the application by entering mobile number & password

FRSFDP-4   8

IN PROGRESS

DONE ✓

7.CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1 FEATURE 1

Discrete processing of image:

The image of diseased leaf is given as input to the model. It processes the image discretely using image processing techniques available.

7.2 FEATUR E 2

Fertilizer Recommendation:

After image processing, the processed image is given as input to the model and corresponding fertilizer is recommended.

8.TESTING

8.1 TEST CASES

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

8.2 USER ACCEPTANCE TESTING

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).

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

9. RESULTS

9.1 PERFORMANCE METRICS

S.No.	Parameter	Values	Screenshot
1.	Model Summary	-	-

		1) **Fruit Dataset:** Training Accuracy - 98.8 Validation Accuracy - 64.8 2)**Vegetable Dataset:** Training Accuracy - 96.8 Validation Accuracy - 35.3	1) **Fruit Dataset:** `accuracy: 0.9885 - val_loss: 1318.4784 - val_accuracy: 0.648` 2) **Vegetable Dataset:** `accuracy: 0.9689 - val_loss: 2867.6646 - val_accuracy: 0.353`
2.	Accuracy		
3.	Confidence Score (Only Yolo Projects)	Class Detected - NA Confidence Score - NA	NA

10. ADVANTAGES & DISADVANTAGES

The main benefits of the proposed system are as follows: Yield right crop at the right time, Balancing the crop production, control plant disease, Economic growth, and planning to reduce the crop scarcity. The farmers will be aware of the particular pest and use government-approved insecticides. The time required for fertilizer recommendation is faster than the laboratory technique. Using the proposed model, crop yield production increased and gave super ability to decide the right combination of different types of available resources. This will helps farmers and agriculture experts to adopt the method for other crops. The method also improved if a high volume dataset of different crops can be accessible and targets yield values properly indexed with soil type and location. The multi-objective optimization models can also be considered to solve the limitation of the optimization issue if there is a suitable model to tune the parameters for further implementation efficiently

11. CONCLUSION

Convolution Neural Network (CNN) is used to process the image of the diseased leaf discretely and continuously for applying the recommended fertilizer. Thus the model is trained for several epochs on fruit and vegetable datasets. The training and validation accuracy of fruit datasets are 98.8 and 64.8 respectively. The training and validation accuracy of Vegetable dataset are 96.8 and 35.3 respectively.

12.FUTURE SCOPE

In the future, the system can be integrated with more sensors such as pH, temperature, humidity, and moisture sensors for open and indoor farming. Also, this system can be used in online and offline modes.

This system can be recommended for farmers, soil testing laboratories, and seed hybridizing companies. To optimize the search strategy and individual repair methods to extract valuable parameters. This will help to reduce the computation resources and improve the recommendation to maintain crops for soil fertilization.

13.APPENDIX

SOURCE CODE

app.py

```python
def upload():
    if request.method=='POST':
        f=request.files['image']
        basepath=os.path.dirname(__file__)
        filepath=os.path.join(basepath,'uploads',f.filename)
        f.save(filepath)
        img=image.load_img(filepath,target_size=(128,128))
        x=image.img_to_array(img)
        x=np.expand_dims(x,axis=0)
        pred=np.argmax(model.predict(x),axis=1)

index=['Apple___Black_rot','Apple___healthy','Corn_(maize)___healthy','Corn_(maize)___Northern_Leaf_Blight','Peach___Bacterial_spot','Peach___healthy']
        if(pred[0]==0):
            text="The Classified Plant Disease is : " +str(index[pred[0]] + ". Fertilizers recommended are Captan and fungicides containing a strobulurin (FRAC Group 11 Fungicides) as an active ingredient are effective controlling black rot on fruit.")
        elif(pred[0]==3):
            text="The Classified Plant Disease is : " +str(index[pred[0]] + ". Fertilizers recommended are Bio-fungicides based on Trichoderma harzianum, or Bacillus subtilis can be applied at different stages to decrease the risk of infection. Application of sulfur solutions is also effective.")
        elif(pred[0]==4):
            text="The Classified Plant Disease is : " +str(index[pred[0]] + ". Fertilizers recommended are Copper-based sprays alone or together with an antibiotic can be used preventively with moderate efficacy. Dosage must be reduced progressively to avoid damage to leaves.")
        else:
            text="The Classified Plant is : " +str(index[pred[0]] + ". And the plant is healthy.")
    return text
```

GITHUB REPO LINK:

https://github.com/IBM-EPBL/IBM-Project-1257-1658381885

PROJECT DEMO LINK:

https://drive.google.com/file/d/1y4SjUsTmImOr9Sdg5Z-WX-i_K32oNUGz/view?usp=sharing