# Fertilizers Recommendation System for Disease Prediction

## Final Report

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|---|---|
| Date | 18 November 2022 |
| Team ID | PNT2022TMID13105 |
| Project Name | Fertilizer Recommendation System 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

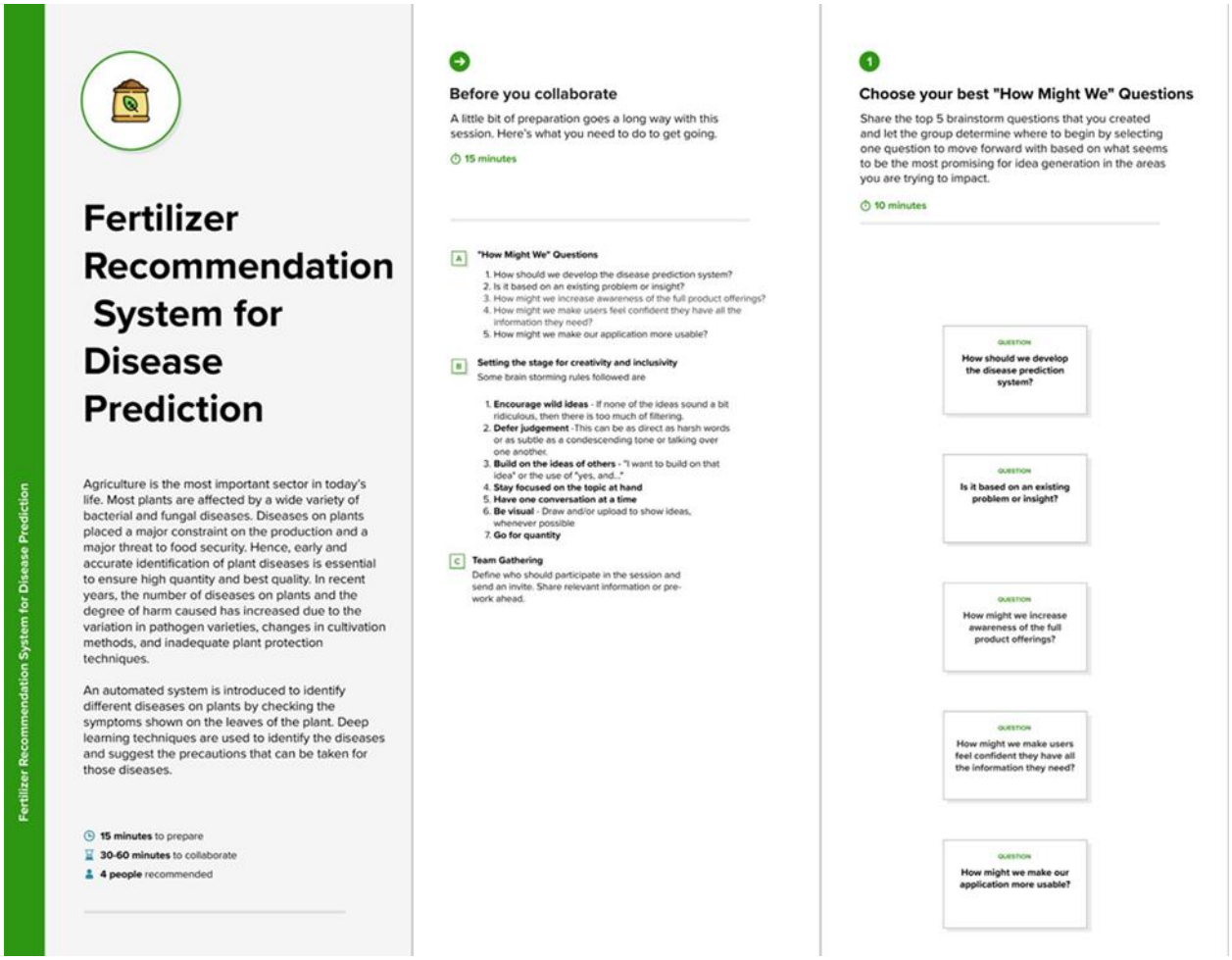

## 3. IDEATION & PROPOSED SOLUTION

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.

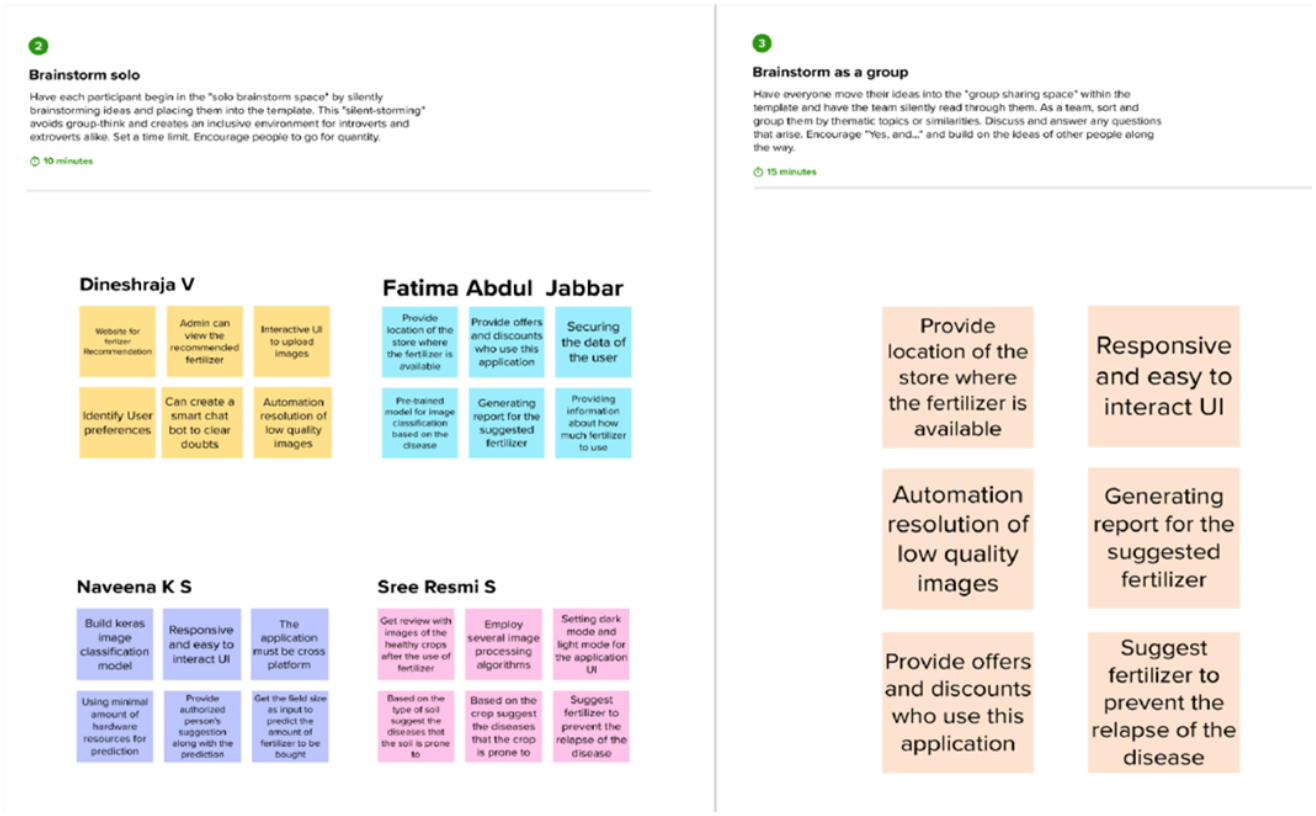
### 3.1 EMPATHY MAP CANVAS

## 3.2 IDEATION & BRAINSTORMING

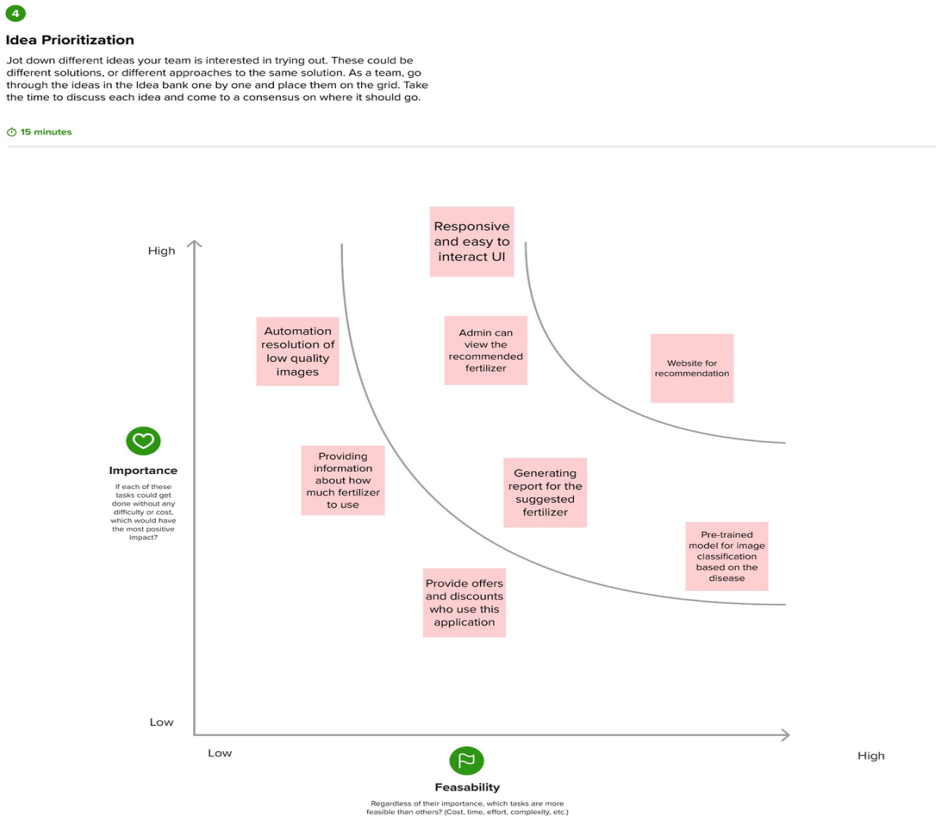
**Step 1**: Team Gathering, Collaboration and Select the Problem Statement



**Step 2:** Brainstorm, Idea Listing and Grouping




**Step 3:** Idea Prioritization

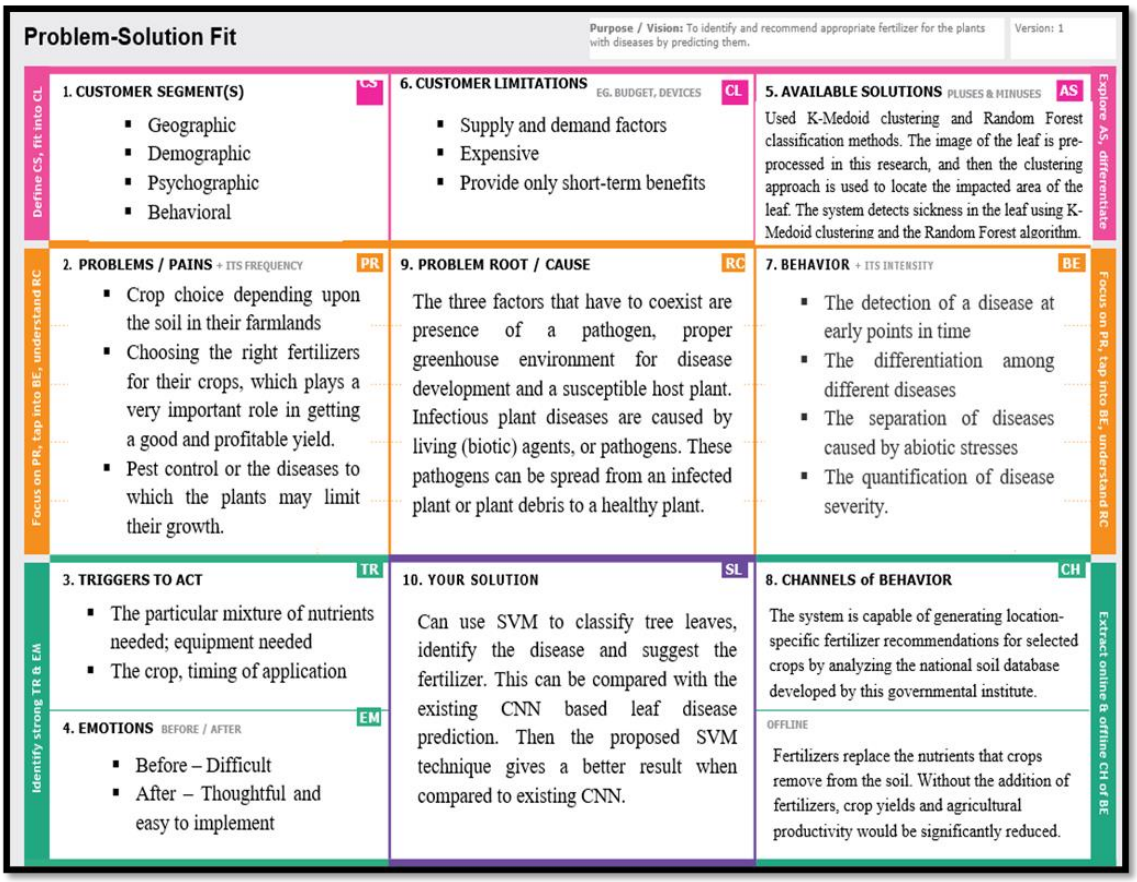


### 3.3 PROPOSED SOLUTION

| 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<br>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-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

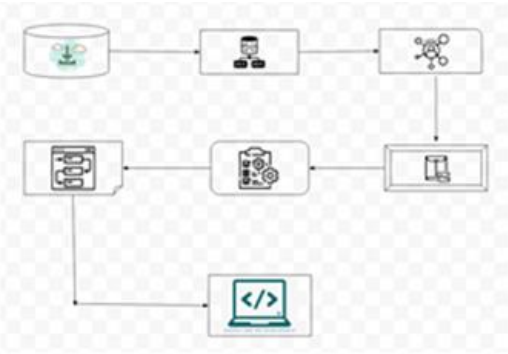
## 5. PROJECT DESIGN

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

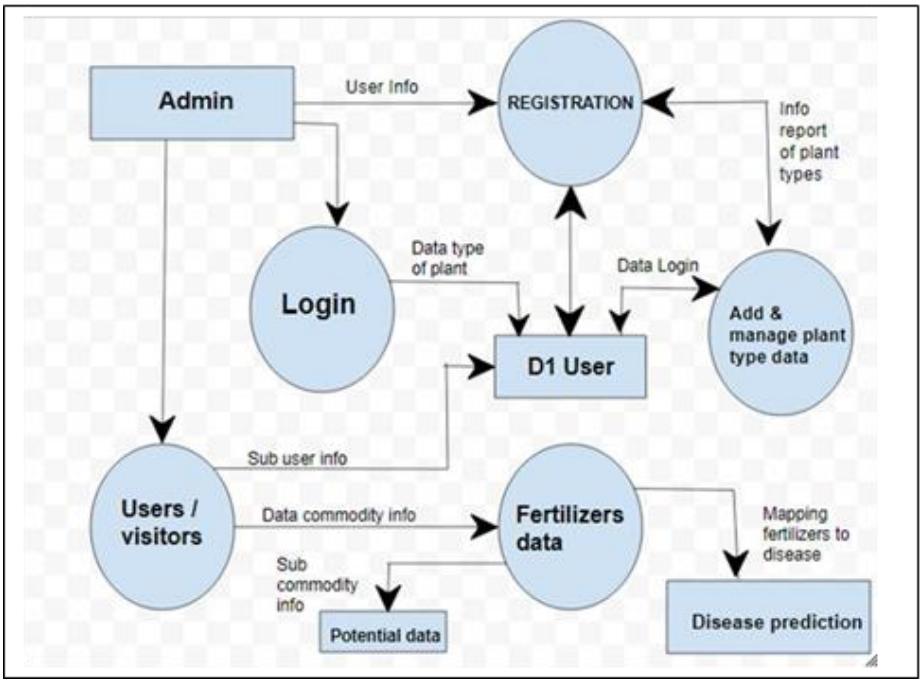
A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

**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.

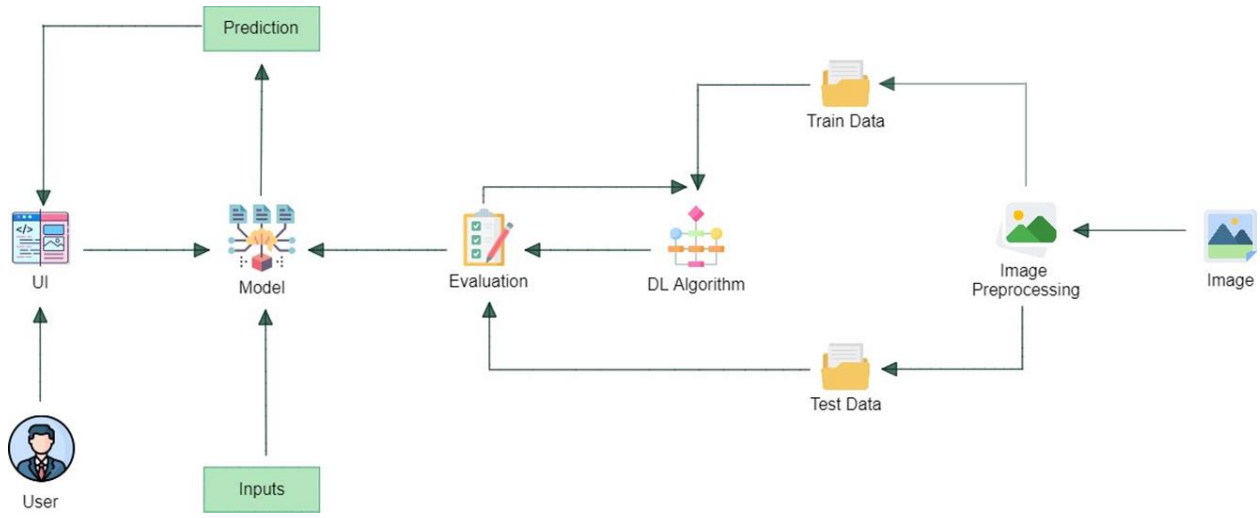


**Table 1 Components & Technologies**

| 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 confirmation email & click confirm | High | Sprint-1 |
| | | USN-3 | As a user, I can register for the application via mobile/desktop. | 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 dashboar d 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-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** | **Functional Requirement (Epic)** | **User Story Number** | **User Story / Task** | **Story Points** | **Priority** | **Team Members** |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 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 recommendatio n | 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 |

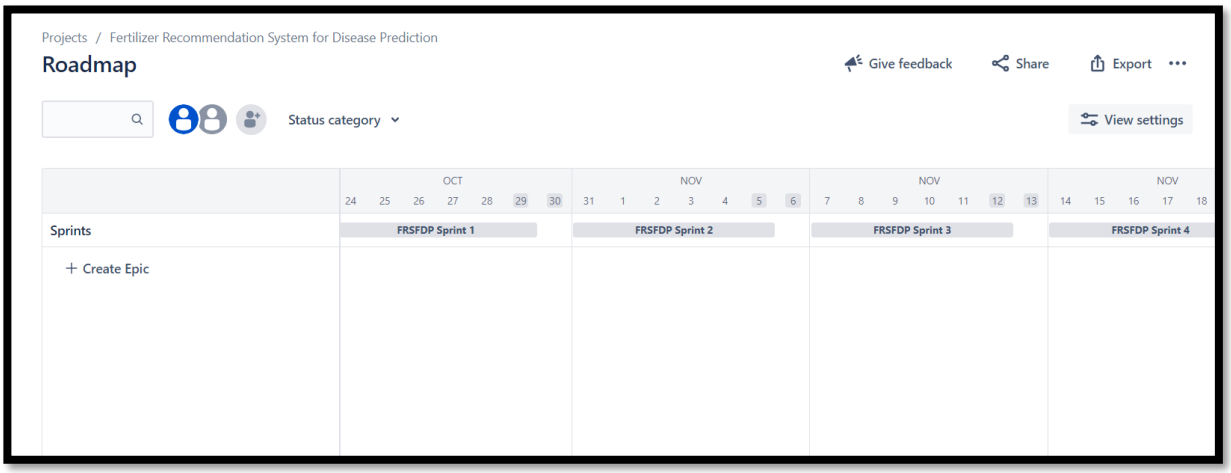
| | | | | | | |
|---|---|---|---|---|---|---|
| Sprint-4 | | USN-14 | As a user, I should have the access to delete some contents from the history of searches | 2 | High | Naveena K S, Sree Resmi S |
| Sprint-4 | Report Generation | USN-15 | As a user, I should be able to generate a report for the fertilizer 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 |

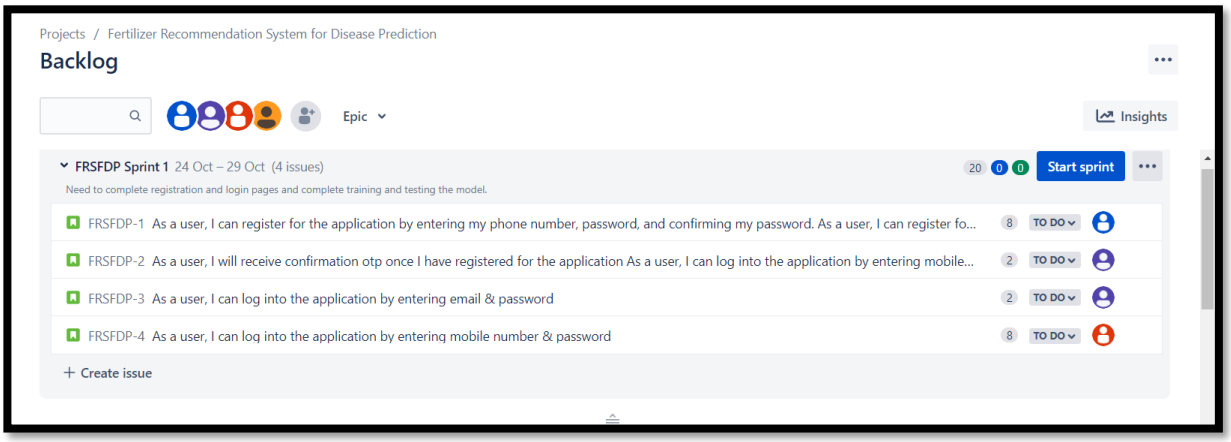
**6.2 SPRINT DELIVERY SCHEDULE**

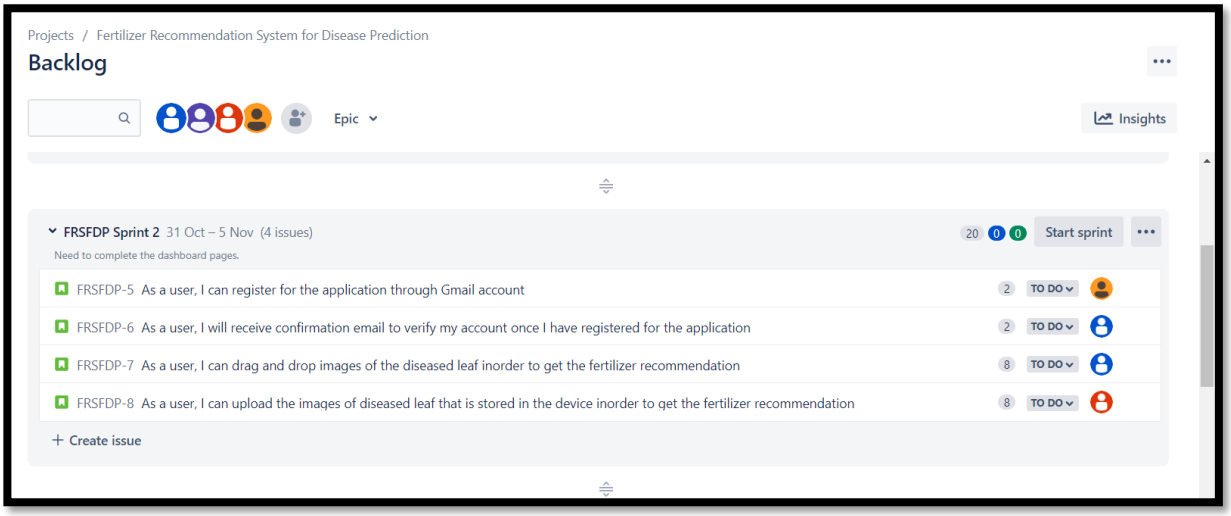
| Sprint | Total Story Points | Duration | Sprint Start Date | Sprint End Date (Planned) | Story Points Completed (as on Planned End Date) | Sprint Release Date (Actual) |
|---|---|---|---|---|---|---|

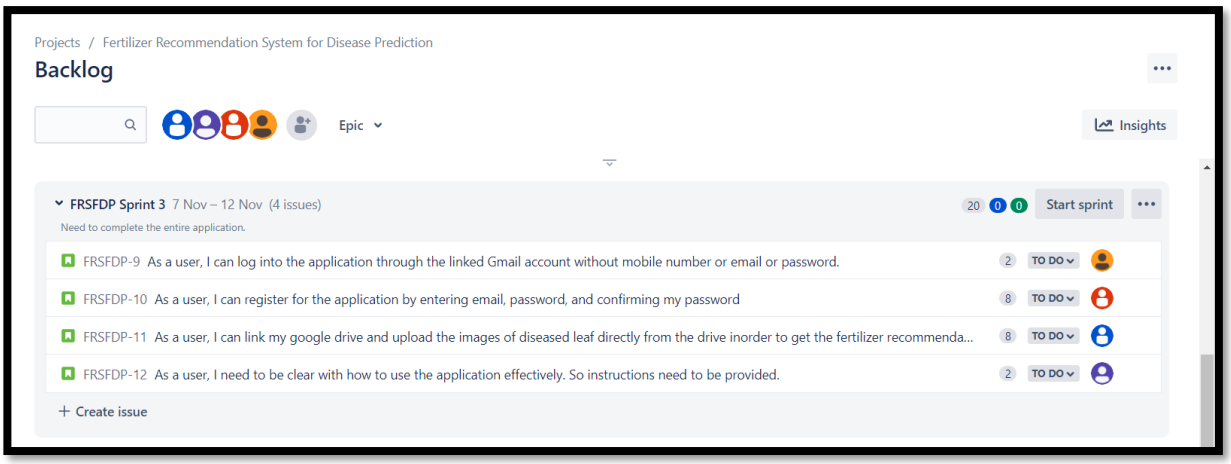
| | | | | | | |
|---|---|---|---|---|---|---|
| Sprint-1 | 20 | 6 Days | 24 Oct 2022 | 29 Oct 2022 | 20 | 29 Oct 2022 |
| Sprint-2 | 20 | 6 Days | 31 Oct 2022 | 05 Nov 2022 | 20 | 05 Nov 2022 |
| Sprint-3 | 20 | 6 Days | 07 Nov 2022 | 12 Nov 2022 | 20 | 07 Nov 2022 |
| Sprint-4 | 20 | 6 Days | 14 Nov 2022 | 19 Nov 2022 | 20 | 14 Nov 2022 |

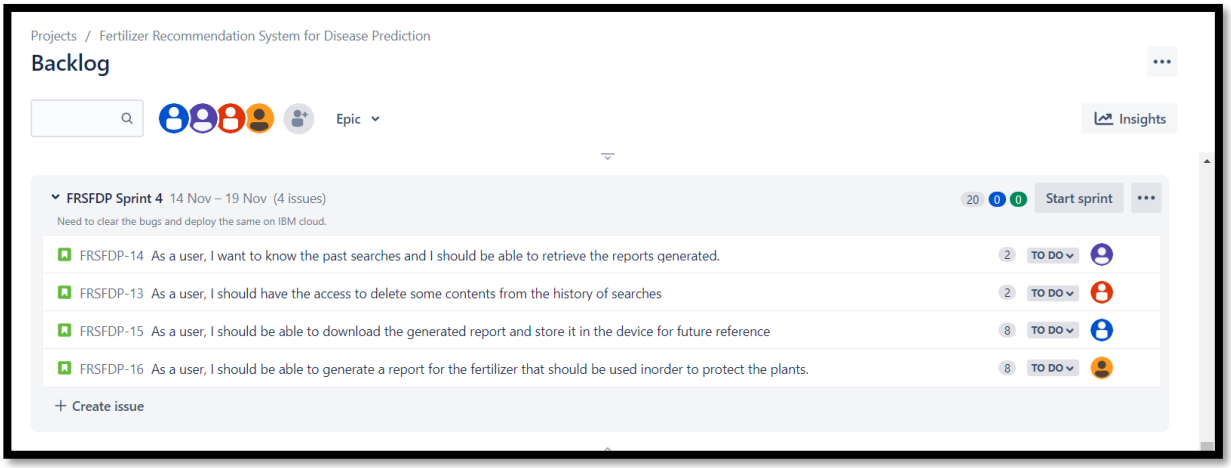
## 6.3 REPORTS FROM JIRA

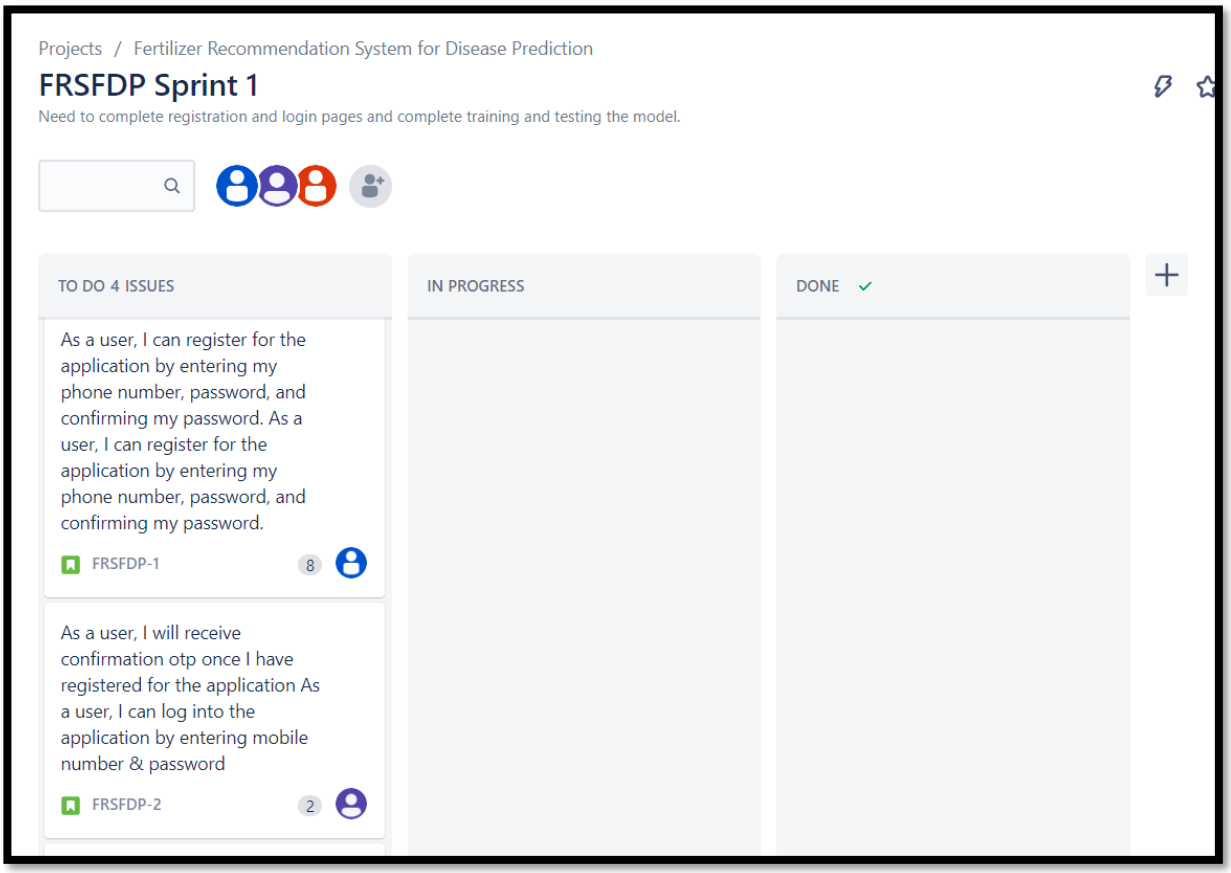


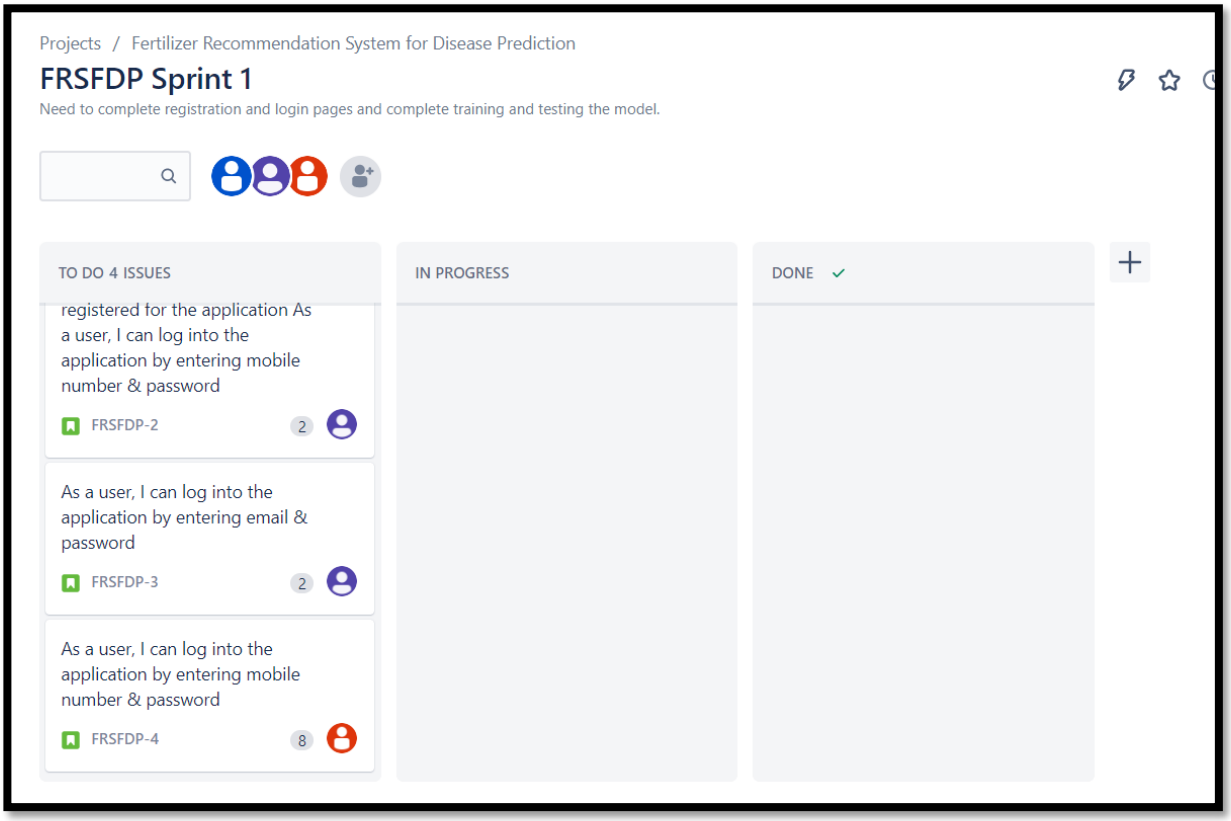




Projects / Fertilizer Recommendation System for Disease Prediction
Backlog
Epic
Insights
FRSFDP Sprint 2 31 Oct – 5 Nov (4 issues)
Need to complete the dashboard pages.
20 0 0
Start sprint
FRSFDP-5 As a user, I can register for the application through Gmail account
FRSFDP-6 As a user, I will receive confirmation email to verify my account once I have registered for the application
FRSFDP-7 As a user, I can drag and drop images of the diseased leaf inorder to get the fertilizer recommendation
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
TO DO
Create issue


Projects / Fertilizer Recommendation System for Disease Prediction
Backlog
Epic
Insights
FRSFDP Sprint 3 7 Nov – 12 Nov (4 issues)
Need to complete the entire application.
20 0 0
Start sprint
FRSFDP-9 As a user, I can log into the application through the linked Gmail account without mobile number or email or password.
FRSFDP-10 As a user, I can register for the application by entering email, password, and confirming my password
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...
FRSFDP-12 As a user, I need to be clear with how to use the application effectively. So instructions need to be provided.
TO DO
Create issue


Projects / Fertilizer Recommendation System for Disease Prediction
Backlog
Epic
Insights
FRSFDP Sprint 4 14 Nov – 19 Nov (4 issues)
Need to clear the bugs and deploy the same on IBM cloud.
20 0 0
Start sprint
FRSFDP-14 As a user, I want to know the past searches and I should be able to retrieve the reports generated.
FRSFDP-13 As a user, I should have the access to delete some contents from the history of searches
FRSFDP-15 As a user, I should be able to download the generated report and store it in the device for future reference
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.
TO DO
Create issue


Projects / Fertilizer Recommendation System for Disease Prediction
FRSFDP Sprint 1
Need to complete registration and login pages and complete training and testing the model.
TO DO 4 ISSUES
IN PROGRESS
DONE
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


Projects / Fertilizer Recommendation System for Disease Prediction
FRSFDP Sprint 1
Need to complete registration and login pages and complete training and testing the model.
TO DO 4 ISSUES
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

## 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

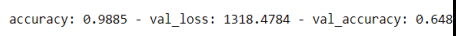
The purpose of this document is to briefly explain the test coverage and open issues of the [Fertilizer recommendation system for disease prediction] project at the time of the release to User Acceptance Testing (UAT).

| 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 | - | - |

| | | | |
|---|---|---|---|
| 2. | Accuracy | **1) Fruit Dataset:**<br>Training Accuracy - 98.8<br>Validation Accuracy - 64.8<br><br>**2)Vegetable Dataset:**<br>Training Accuracy - 96.8<br>Validation Accuracy - 35.3 | **1) Fruit Dataset:**<br>  <br>**2) Vegetable Dataset:**<br>  |
| 3. | Confidence Score (Only Yolo Projects) | Class Detected - NA<br>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

```
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