

Fertilizers Recommendation System For Disease Prediction

IBM PROJECT-NALAIYA THIRAN

Submitted by

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ABSTRACT

India is the largest agrarian economy in the world, with 54% of its total land area classified as arable. More over half of the world's gross domestic product is made up of agricultural production (GDP). It has been demonstrated that boosting agricultural output has a big influence on lowering poverty. Numerous variables might have an impact on the quantity of harvestable crops grown in a specific area. These three main categories of elements (climate, soil fertility, terrain, water quality, etc.) are made up of a combination of biological, technological, and environmental factors. over-fertilization-related soil infertility, as well as a The various variables that lead to low agricultural production include access issues and a lack of knowledge about modern farming techniques. The major goal of this research project is to create a recommendation system based on machine learning to boost agricultural output. In this work, sophisticated models were designed and developed to predict the crop, suggest fertiliser, and detect plant illness. Based on the regional soil nutrients and rainfall, the XGBoost model forecasts an appropriate crop. Rough Forest [RF] Based on the nutrients available in the soil, a model was utilised to suggest fertiliser and generate suggestions for boosting soil fertility. The plant illness is identified using NB Classifier and Support Vector Machine [SVM], which also offers a treatment. The suggested model offers a high level of accuracy in comparison to existing methods. Additionally, this article advises the farmer to boost crop output by entering input values and local soil conditions, where the model provides 99% accurate crop recommendations.

CHAPTER 1

INTRODUCTION

1.1 PROJECT OVERVIEW

Agriculture accounts for more than half of the world's gross domestic output (GDP). It has been established that increasing agricultural productivity has a significant impact on poverty reduction. A variety of factors can influence the amount of harvestable crops growing in a given location. These three major groups of components (climate, soil fertility, topography, water quality, and so on) are made up of biological, technical, and environmental aspects. A variety of factors impact agricultural practises. Fertilizers and insecticides were made more affordable to Bangladeshi farmers. That they might employ more of them, increasing agricultural output Phosphorus shortage was discovered in sugarcane crops A lime layer had developed in the subsurface, resulting in an uneven potassium/magnesium ratio. Planting too early, planting too close together, planting too deep, weeding too late, and selecting low-yielding cultivars will always result in lower yields.. soil infertility caused by over fertilization, as well as a Access concerns and a lack of understanding about contemporary farming practises are two of the many factors that contribute to low agricultural productivity. The primary purpose of this research project is to develop a machine learning-based recommendation system to increase agricultural productivity. In this study, sophisticated models were devised and developed to estimate crop yield, recommend fertilizer, and identify plant disease

1.2 PURPOSE

To Detect and recognize the plant diseases and to recommend fertilizer, it is necessary to provide symptoms in identifying the disease at its earliest. Hence the authors proposed and implemented new fertilizers Recommendation System for crop disease prediction.

CHAPTER-2

LITERATURE REVIEW

2.1 EXISTING PROBLEM

Adequate mineral nutrition is central to crop production. However, it can also exert considerable Influence on disease development. Fertilizer application can increase or decrease development of diseases caused by different pathogens, and the mechanisms responsible are complex, including effects of nutrients on plant growth, plant resistance mechanisms and direct effects on the pathogen. The effects of mineral nutrition on plant disease and the mechanisms responsible for those effects have been dealt with comprehensively elsewhere. In India, around 40% of land is kept and grown using reliable irrigation technologies, while the rest relies on the monsoon environment for water. Irrigation decreases reliance on the monsoon, increases food security, and boosts agricultural production.

Most research articles use humidity, moisture, and temperature sensors near the plant's root, with an external device handling all of the data provided by the sensors and transmitting it directly to an external display or an Android application. The application was created to measure the approximate values of temperature, humidity and moisture sensors that were programmed into a microcontroller to manage the amount of water.

2.2 REFERENCE

Soil Fertilizer Recommendation System using Fuzzy Logic

J. J. I. Haban, J. C. V. Puno, A. A. Bandala, R. Kerwin Billones, E. P. Dadios and E.Sybingco, "Soil Fertilizer Recommendation System using Fuzzy Logic," 2020 IEEE REGION 10 CONFERENCE (TENCON), 2020, pp. 1171-1175, doi:10.1109/TENCON50793.2020.9293780.

Soil nutrients and season have direct impact on the growth and yield of a crop. Deficiency on the nutrient level of the soil may result to plant disease while applying excessive amount of soil fertilizer on the other hand, may also cause negative results to the development of the crop. Nutrients on the soil also changes as the season changes from wet season to dry season. This study aims to develop a fuzzy logic-based program that will provide an appropriate amount of fertilizer to soil. The parameters such as season, nitrogen, phosphorus and potassium level are the inputs used on the fuzzy logic system

ADVANTAGES:

1. Season, nitrogen, phosphorus and potassium level is used as input parameter of the fuzzy system.
2. Different fertilizer combination is created depending on the range of input parameters used.

DISADVANTAGES:

1. Used the recommended fertilizer to identify the accuracy of the result .
2. Connect the program to a soil test analyzer.

Farmer's Assistant: A Machine LearningBased Application forAgricultural Solutions

Shloka Gupta, Akshay Chopade, Nishit Jain, Aparna Bhonde,” Farmer's Assistant: A Machine LearningBased Application for Agricultural Solutions” [arXiv:2204.11340](https://arxiv.org/abs/2204.11340)
<https://doi.org/10.48550/arXiv.2204.11340>

Farmers face several challenges when growing crops like uncertain irrigation, poor soil quality, etc. Especially in India, a major fraction of farmers do not have the knowledge to select appropriate crops and fertilizers. Moreover, crop failure due to disease causes a significant loss to the farmers, as well as the consumers. While there have been recent developments in the automated detection of these diseases using Machine Learning techniques, the utilization of Deep Learning has not been fully explored. Additionally, such models are not easy to use because of the high-quality data used in their training, lack of computational power, and poor generalizability of the models. To this end, we create an open-source easy-to-use web application to address some of these issues which may help improve crop production.

ADVANTAGES:

1. The user can provide the input using forms on our user interface and quickly get their results.

DISADVANTAGES:

1. 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.
2. Unable to find data on various brands and items available based on the N,P,K values.
3. Unable to detect the correct class for any out-of-domain data.

CNN based Leaf Disease Identification and Remedy Recommendation System

V. Suma, R. A. Shetty, R. F. Tated, S. Rohan and T. S. Pujar, "CNNbased Leaf DiseaseIdentification and Remedy Recommendation System," 2019 3rd International conference on Electronics, Communication and Aerospace Technology (ICECA), 2019, pp. 395-399, doi: 10.1109/ICECA.2019.8821872.

Due to the improvement and development in technology where devices are smart enough to recognize and detect plantdiseases. Recognizing illness can prompt faster treatment in order to lessen the negative impactson harvest. This paper thereforefocus upon plant disease detectionusing image processing approach This work utilizes an open datasetof 5000 picturesof unhealthy and solid plants,where convolution system and semi supervised techniques are used to characterize crop species and detect the sickness status of 4 distinct classes.

ADVANTAGES:

1. The Networkis trained using the images taken in the natural environment andachieved.

DISADVANTAGES:

1. If there is any simple disease, it may predict it as a complex disease

Crop Recommender System Using Machine Learning Approach

S. M. PANDE, P. K. RAMESH, A. ANMOL, B. R. AISHWARYA, K. ROHILLA and K. SHAURYA, "CropRecommender System Using Machine Learning Approach," 2021 5th International Conference on ComputingMethodologies and Communication (ICCMC), 2021, pp. 1066-1071, doi: 10.1109/ICCMC51019.2021.9418351.

The proposed system provides connectivity to farmers via a mobile application. GPS helps to identify the user location. The user provides the area & soil type as input. Machine learning algorithms allow choosing the most profitable crop list or predicting the crop yield for a user-selected crop. To predict the crop yield, selected Machine Learning algorithms such as Support Vector Machine (SVM), Artificial Neural Network (ANN), Random Forest(RF), Multivariate Linear Regression (MLR), and K-NearestNeighbour (KNN) are used. Among them, the Random Forestshowed the best results with 95% accuracy. Additionally, the system also suggeststhe best time to use the fertilizers to boost up the yield.

ADVANTAGES:

1. This paper highlighted the limitations of current systems and their practical usage on yield prediction

DISADVANTAGES:

1. The future work will be focused on updatingthe datasets from time to time to produce accuratepredictions, and the processes can be automated.
2. An analysis of availablestatistical data needs to be done.

KRISHI RAKSHAN - A Machine Learning based New Recommendation System to the Farmer

D. N. V. S. L. S. Indira, M. Sobhana, A. H. L. Swaroop and V. Phani Kumar, "KRISHI RAKSHAN - A Machine Learning based New Recommendation System to the Farmer," 2022 6th International Conference on Intelligent Computing and Control Systems (ICICCS), 2022, pp. 1798-1804,doi: 10.1109/ICICCS53718.2022.9788221.

The main purpose of this research work is to develop a machine learning-based recommendation system to increase agricultural productivity. A variety of datasets were used in this study to design and develop advanced models to estimate the crop, recommend fertiliser, and identify plant disease

ADVANTAGES:

1. This system identifies the plant's ailment and presents the different treatment options.

DISADVANTAGES:

1. Automation can be used for the data entries.
2. This system can be expanded to include additional features such as weather forecasting, drought conditions, and agricultural price forecasting depending on the season.

Image-based Plant Diseases Detection using Deep Learning

V. Panchal, S. C. Patel, K. Bagyalakshmi, P. Kumar, I. Raza Khan, M. Soni, “Image-based Plant Diseases Detection using Deep Learning”, Materials Today: Proceedings, 2021, ISSN 2214-7853, <https://doi.org/10.1016/j.matpr.2021.07.281>.

With the advance in Artificial Intelligence, there is a need to incorporate the facilities of the computer vision in the field of agriculture. Deep Learning rich libraries and user as well as developer friendly environment to work with, all these qualities make Deep Learning as the favorable method to get started with this problem. In this paper we have used Deep Learning because of the advantages it offers to work with images especially in image classification to get improvised results. The methodology includes taking leaves of infected crops and label them as per the disease pattern. The images of infected leaves are processed pixel based operations are applied to improve the information from the image.

ADVANTAGES:

- i. We trained a naïve network of slightly smaller size of varying number of layers and completely tuned parameter four recent models: Inception-v3, and ResNet50, VGG19, VGG16.
- ii. Increased efficiency

DISADVANTAGES:

- 1. Several diseases data collection for all stages can be done by using variety of sensors, like available in infrared camera also in multi camera.

Soil Toxicity Prediction and Recommendation System Using Data Mining In Precision Agriculture

M. Pawar and G. Chillarge, "Soil Toxicity Prediction and Recommendation System Using Data Mining In Precision Agriculture," 2018 3rd International Conference for Convergence in Technology (I2CT), 2018, pp. 1-5, doi: 10.1109/I2CT.2018.8529754.

In this paper, the proposed system can help farmers by making them aware about their soil conditions. Farmers can maximize crops yield by knowing proportion of nutrients present in the soil. Soil toxicity affects the soil nutrients which indirectly affects crops health. The proposed system predicts the level of toxicity present in the soil and makes farmer aware about it. Many farmers are depending on rainfall which is the one of the factor for poor growth and decreases crops yield.

ADVANTAGES:

1. The proposed system also informs farmers about toxicity level present in their soil as today the rate of pollution increasing very fast with industrialization.

DISADVANTAGES:

1. If a single hardware fails, the total system halt.
2. Not able to reuse the hardware in the system

Farmer's Assistant: A Machine LearningBased Application for Agricultural Solutions

In this paper, we propose a user-friendly web application system based on machine learning and web-scraping called the 'Farmer'sAssistant'. 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 Efficient Net model on leaf images. The user can provide the input using forms on our user interfaceand quickly get their results.In addition, we also use the LIME interpretability method to explainour predictions on the diseasedetection image, which can potentially help understand why ourmodel predicts what it predicts, and improve the datasets and models using this information.

ADVANTAGES:

1. For crop recommendation and fertilizer recommendation
2. we can provide the availability of the same on the popular shoppingwebsites
3. And possiblyallow users to buy the crops and fertilizers directly from our application.

DISADVANTAGES:

1. To provide fine-grained segmentations of the diseasedportion of the dataset.
2. This is not possibledue to lack of such data.
3. However, in our application, we can integrate a segmentation annotation tool where the users might be able to help us with the lack.
4. Also, we can use some unsupervised algorithms to pin-pointthe diseased areas in the image.

Intelligent insecticide and fertilizer recommendation system based on TPF-CNN for smart farming

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. This paper applies the dual operator, Transition Probability Function (TPF), and Convolution Neural Network (CNN) to process pest's image discretely and continuously for applying the recommended insecticide. The mathematical model with the objective function is derived in this paper. The proposed system combines two major aspects in farming: pest identification and insecticide recommendation using machine.

vision and CNN. Secondly, the soil nutrient analysis uses a soil NPK sensor with the recommendation of fertilizers according to the obtained nutrient values. On-spot results are obtained, and the time required for insecticide recommendation is within 10 s, and for fertilizer recommendation, it is within 80s.

ADVANTAGE:

1. This system can be used anywhere as it is standalone and does not require an internet connection.
2. Acquires 99.8 of accuracy.

DISADVANTAGE:

1. If any hardware fails, the whole system may fail

2.3 PROBLEM STATEMENT DEFINITION

1. The old traditional methods aren't now suitable to the soil and the weather conditions, that are changing for the bad. In-fact they will have a negative impact on the soil.
2. Sadly, even with the experience a farmer has, it is still not enough to judge about how the climatic conditions or the soil is going to affect the crop.
3. Why? Because the NRT data of the soil is very low, if not zero.
4. So we came up with a recommendation system for farmers that'll help them in making Informed Decisions.

CHAPTER-3

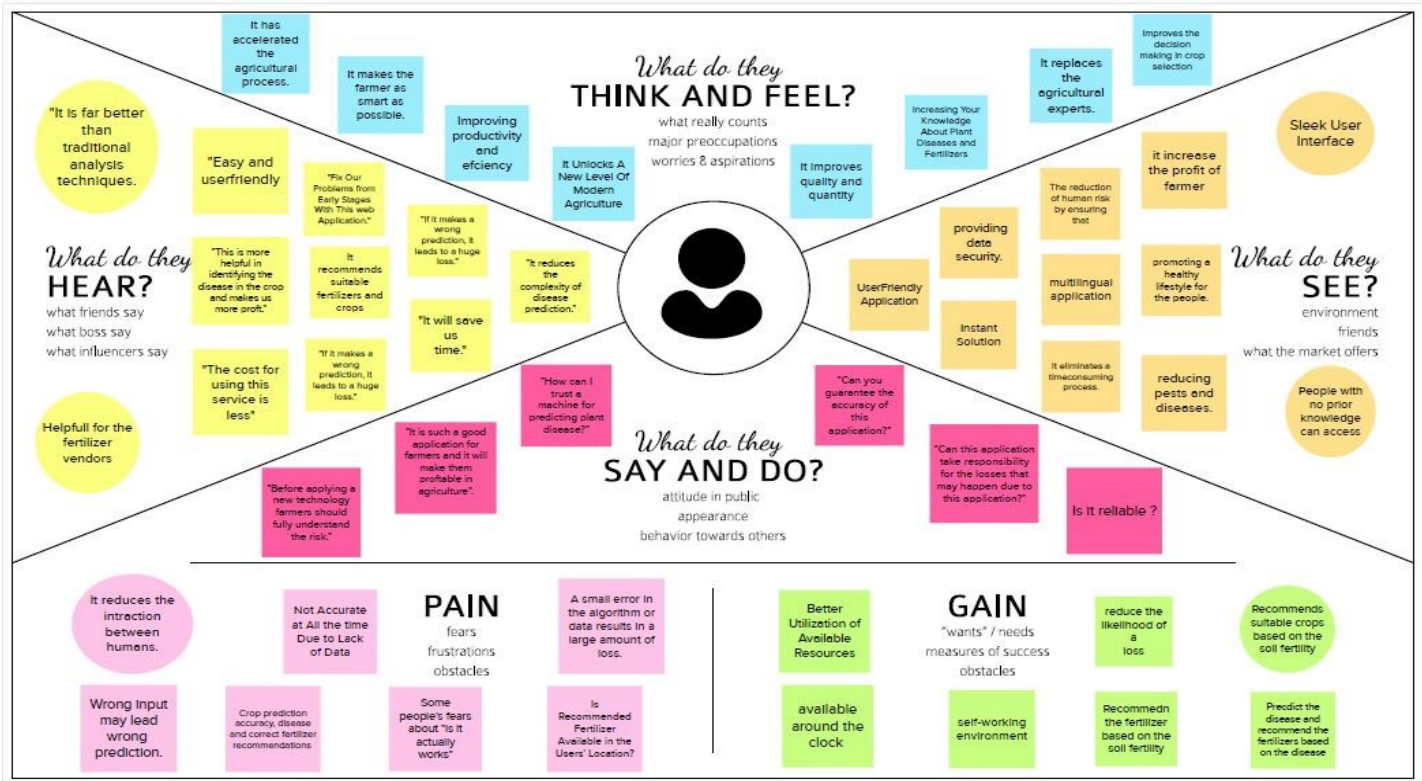
IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

It is a useful tool to help teams better understand their users.


Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.



3.2 Ideation & Brainstorming

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions.

Template



Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

- 🕒 10 minutes to prepare
- 🕒 1 hour to collaborate
- 👤 2-8 people recommended

Share template feedback

➔

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

A

Team gathering

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

B

Set the goal

Think about the problem you'll be focusing on solving in the brainstorming session.

C

Learn how to use the facilitation tools

Use the Facilitation Superpowers to run a happy and productive session.

Open article ➔

1


Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

🕒 5 minutes

PROBLEM

1. Identify the disease on plants using image recognition techniques and to recommend the fertilizers for reducing the diseases.
2. Provide website information for recommend fertilizers.



Key rules of brainstorming

To run an smooth and productive session

🗣️ Stay in topic.

💡 Encourage wild ideas.

⏸️ Defer judgment.

👂 Listen to others.

🗣️ Go for volume.

👁️ If possible, be visual.

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2

Brainstorm

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

🕒 10 minutes

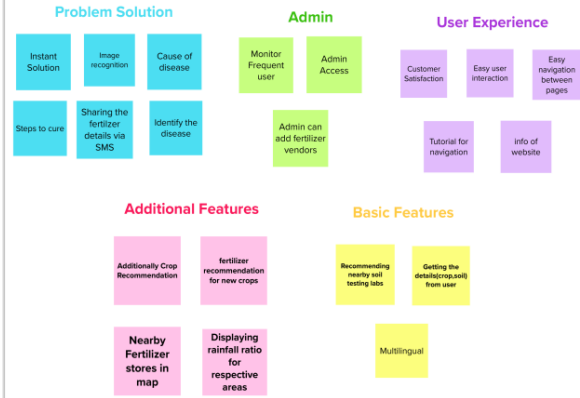


3

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 can break it up into smaller sub-groups.

🕒 20 minutes



4

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.

🕒 20 minutes



3.3 PROPOSED SOLUTION

| S.No. | Parameter | Description |
|-------|--|--|
| 1. | Problem Statement (Problem to be solved) | How to identify the crop disease? What are the fertilizers is used to cure the crop disease? |
| 2. | Idea / Solution description | Ensure the correct prediction of crop disease to help the farmer to identify the crop disease priorly. It reduces the loss and increase the profit |
| 3. | Novelty / Uniqueness | Predicts the disease instantly Predicting the crop baaed soil condition Predicting the fertilizer based on the soil conditions and it tends to reduce the crop disease |
| 4. | Social Impact / Customer Satisfaction | Serves as farmer's friend by helping them to take precautionary steps to minimize the economic losses. |
| 5. | Business Model (Revenue Model) | Collaboration with fertilizer vendors. Providing solutions for farmer's problem. Increase in crop productivity |
| 6. | Scalability of the Solution | Simplifying the model for everyone even the illiterate can use the system To increase the profit, the fertilizer can sold directly to the farmers |

3.4 PROBLEM SOLUTION FIT

| | | |
|--|---|--|
| <p>1. CUSTOMER SEGMENT(S) CS</p> <p>The foremost users of the application are going to be the Farmers and people interested in farming</p> | <p>8. CUSTOMER CONSTRAINTS CC</p> <ul style="list-style-type: none"> Financial instability is a fundamental reason for technological improvement Networking capabilities may be insufficient in remote areas | <p>5. AVAILABLE SOLUTIONS AS</p> <ul style="list-style-type: none"> To predict the disease plant image have to be uploaded Some part time of the farmer include manual detection of disease and fertilizer purchase Part of the solution include fast and reliable fertilizer recommendation |
| <p>2. JOBS-TO-BE-DONE / PROBLEM(S) J</p> <ul style="list-style-type: none"> Crops/plants get affected by insects or by any other plant disease Leaves/roots of the plant may get affected by its own nutrition deficiency Plants may also be spoiled by extreme weather conditions Irrespective of external conditions, irregular/dull manual maintenance can cause delays in plants | <p>9. PROBLEM ROOT CAUSE RC</p> <ul style="list-style-type: none"> One of the reasons that this problem exists is because of the poor understanding of the requirements of the crop/plant As there is a decrease in the yield of many Indian varieties, the software system would be indispensable The farmers can adapt their culture to automation for the betterment of yield | <p>7. BEHAVIOUR BE</p> <ul style="list-style-type: none"> Farmers can use the web application functionalities like computer vision to detect the plant disease and recommend the correct fertilizer Thereby finding the necessary features in the application is significant |
| <p>3. TRIGGER(S) TR</p> <p>Social media platforms and daily television/news or newspaper impact people's mentality to upgrade into a new and easy life/lifestyle of automation and seeing their neighbor using new technology, reading about a more efficient solution in the news</p> <p>4. EMOTIONS: BEFORE / AFTER EM</p> <p>Customers may get stressed after facing a technical error, fertilizer does not render an expected yield or slow processing of the system</p> | <p>10. YOUR SOLUTION SL</p> <p>Finding cause and recommending fertilizer by detecting the image instantly and displaying the nearby fertilizer shops. Recommending crops based on the soil condition</p> | <p>6. CHANNEL(S) of BEHAVIOUR CH</p> <p>ONLINE</p> <ul style="list-style-type: none"> Customer can upload the image of the diseased plant and wait for the processed recommendation from the system. They can view the nearby fertilizer shop <p>OFFLINE</p> <p>People may get an assistance of experienced people to know the disease and then look for homemade remedies to cure the infected plants</p> |

Identify strong TR & EM

Weak online & strong CH or BE

CHAPTER-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(Leaf) | 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 pdf format 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 allowsthe user to perform the tasks easilyand efficiently and effectively. |
| NFR-2 | Security | Assuring all data inside the system or its part will be protected againstmalware attacks or unauthorized access. |
| NFR-3 | Reliability | The websitedoes not recoverfrom failure quickly,it takes time as the application is running in singleserver |
| NFR-4 | Performance | Response Time and Net Processing Time isFast |
| NFR-5 | Availability | The system willbe available up to 95% ofthe time |
| NFR-6 | Scalability | Thewebsite is scalable |

CHAPTER-5

PROJECT DESIGN

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 enter and leaves the system, what changes the information, and where data is stored.

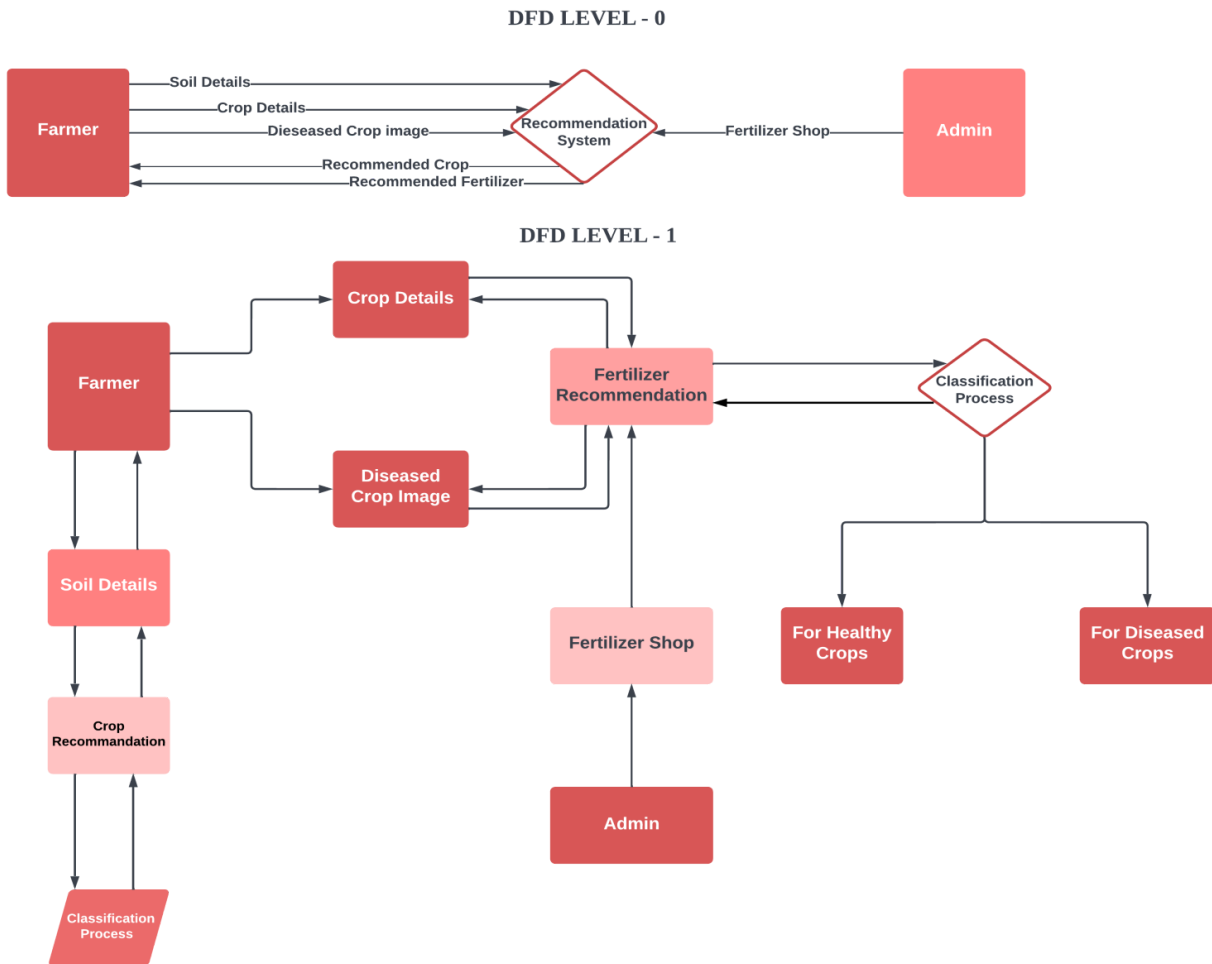
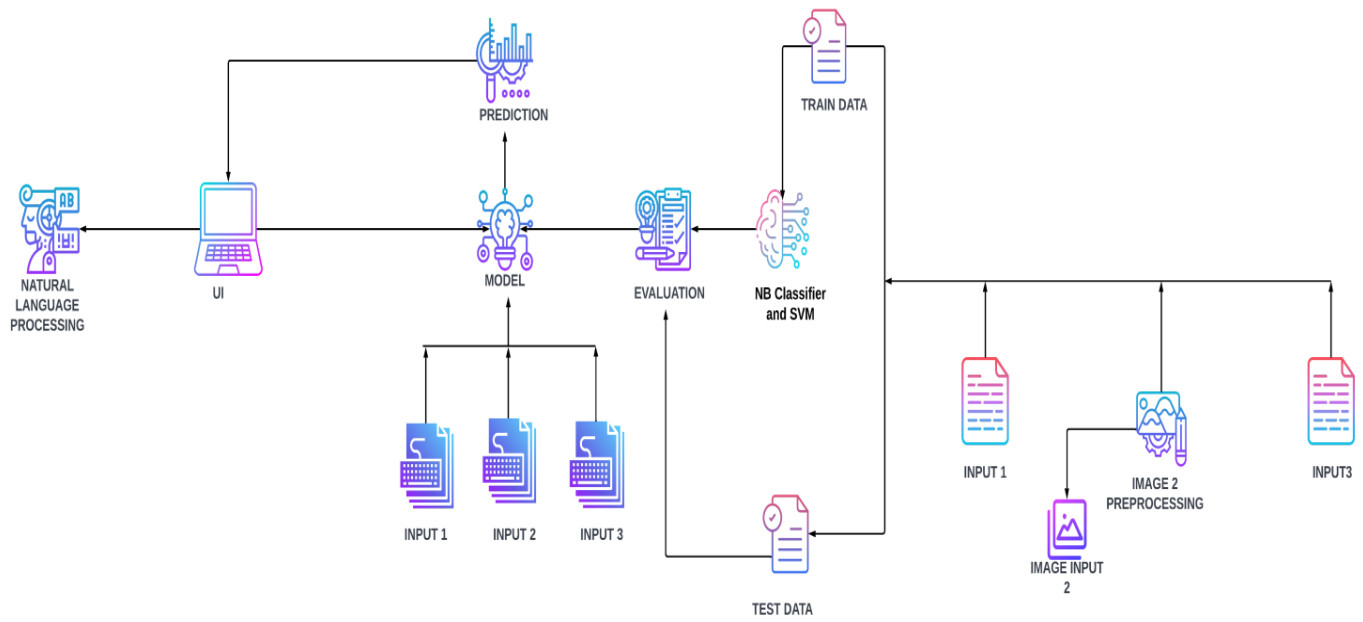


Figure 5.1 DATA FLOW DIAGRAMS

5.2 SOLUTION & TECHNICAL ARCHITECTURE



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, 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 log into web dashboard just like my username and password | 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 credentials | I can login using my User credentials | High | Sprint-3 |
| | 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 |

CHAPTER 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 | Image Processing | USN-1 | As a user, I can retrieve information about the image | 1 | Low | |
| Sprint-2 | Model Building for Fruit Disease Prediction | USN-2 | As a user, I can predict the fruit disease using the model | 4 | Medium | |
| Sprint-2 | Model Building for Vegetable Disease Prediction | USN-3 | As a user, I can predict the vegetable disease using the model | 4 | Medium | |
| Sprint-3 | Disease Prediction in application | USN-4 | As a user, I can use the application to predict the disease | 4 | Medium | |
| Sprint-3 | Crop Suggestion | USN-5 | As a user, I can use application to find a suitable crop for the soil | 1 | Low | |
| Sprint-3 | Fertilizer Suggestion | USN-6 | As a user, I can use the application to find suitable fertilizer to grow healthy crop | 1 | Low | |
| Sprint-4 | Train Model on IBM Cloud | USN-8 | As a user, I can save the information about Fertilizer and crops on IBM Cloud | 4 | High | |

6.2 SPRINT DELIVERY SCHEDULE:

Project Tracker, Velocity & BurndownChart:

| Sprint | Total StoryPoints | 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 | 1 | |
| Sprint-2 | 20 | 6 Days | 31Oct 2022 | 05Nov 2022 | 8 | |
| Sprint-3 | 20 | 6 Days | 07 Nov 2022 | 12 Nov 2022 | 7 | |
| Sprint-4 | 20 | 6 Days | 14 Nov 2022 | Nov 2022 | 4 | |

Velocity

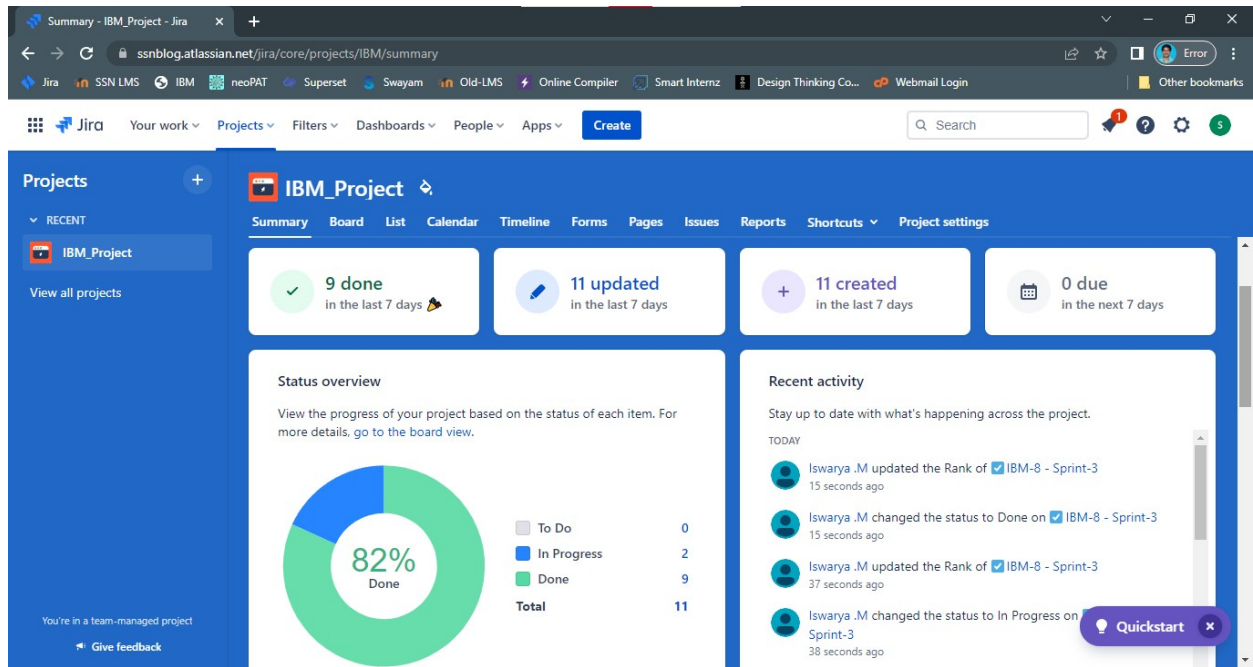
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint).

Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

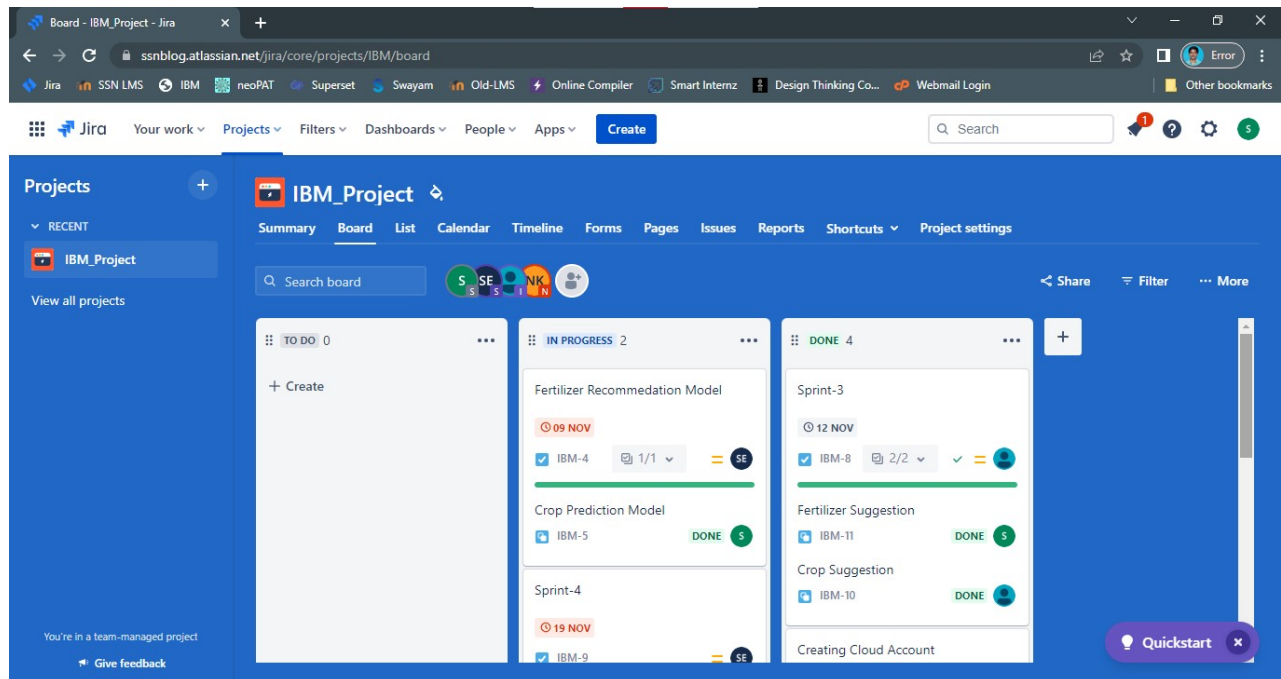
$$AV = \frac{\text{sprint duration}}{\text{velocity}} = \frac{20}{10} = 2$$

6.3 Reports from JIRA:

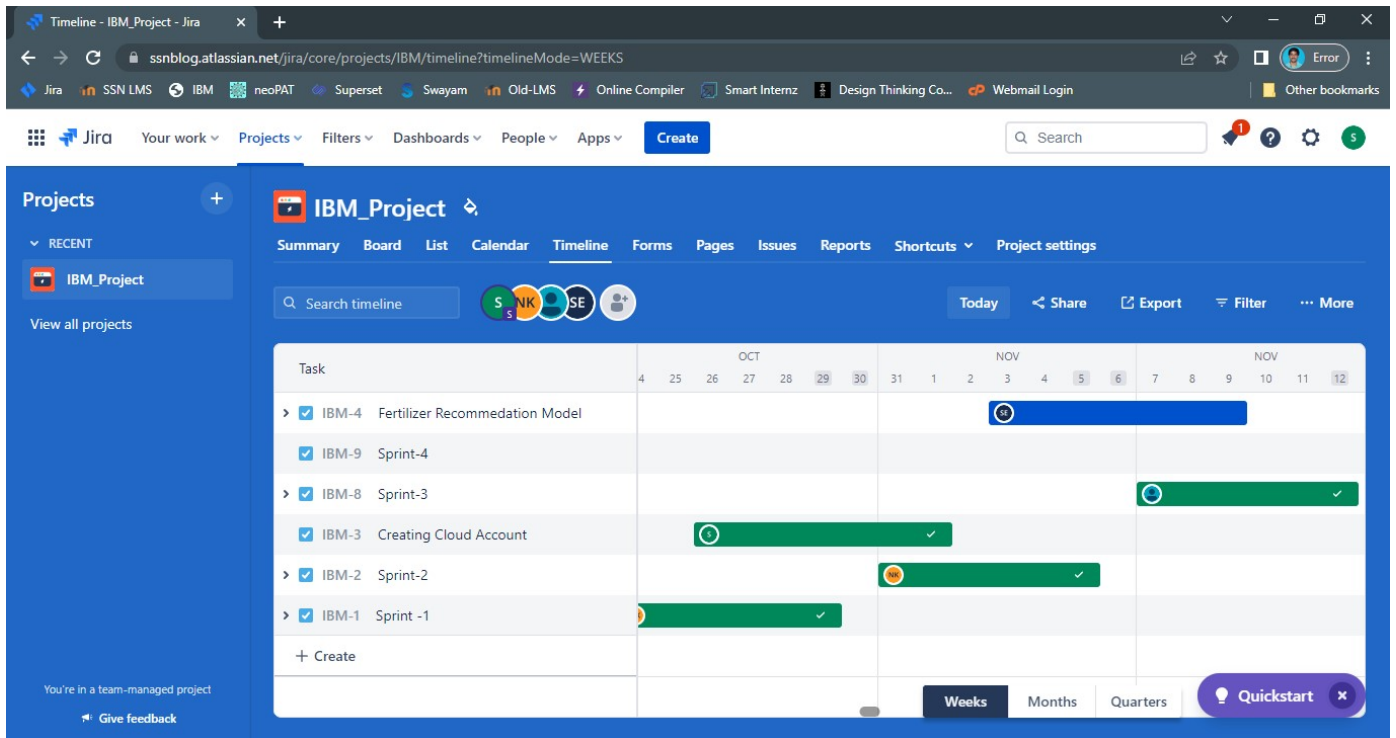
PROJECT PROGRESS



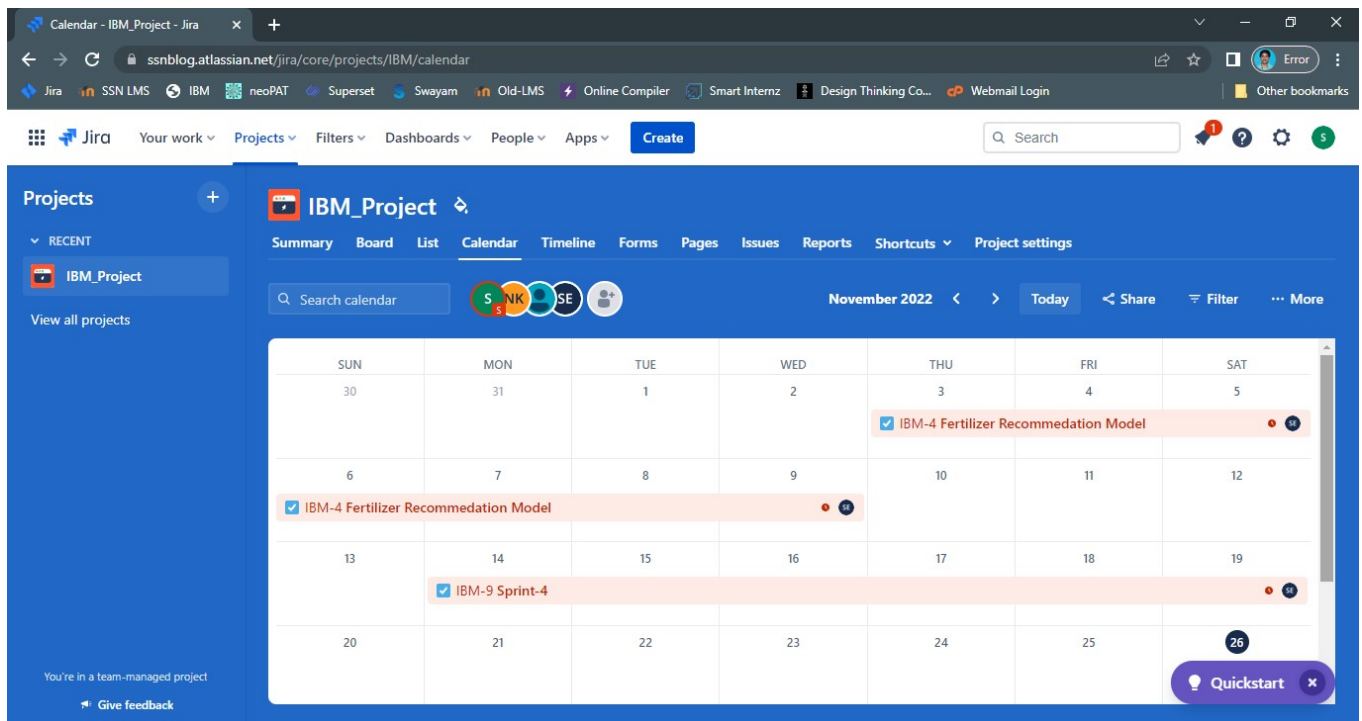
BOARD



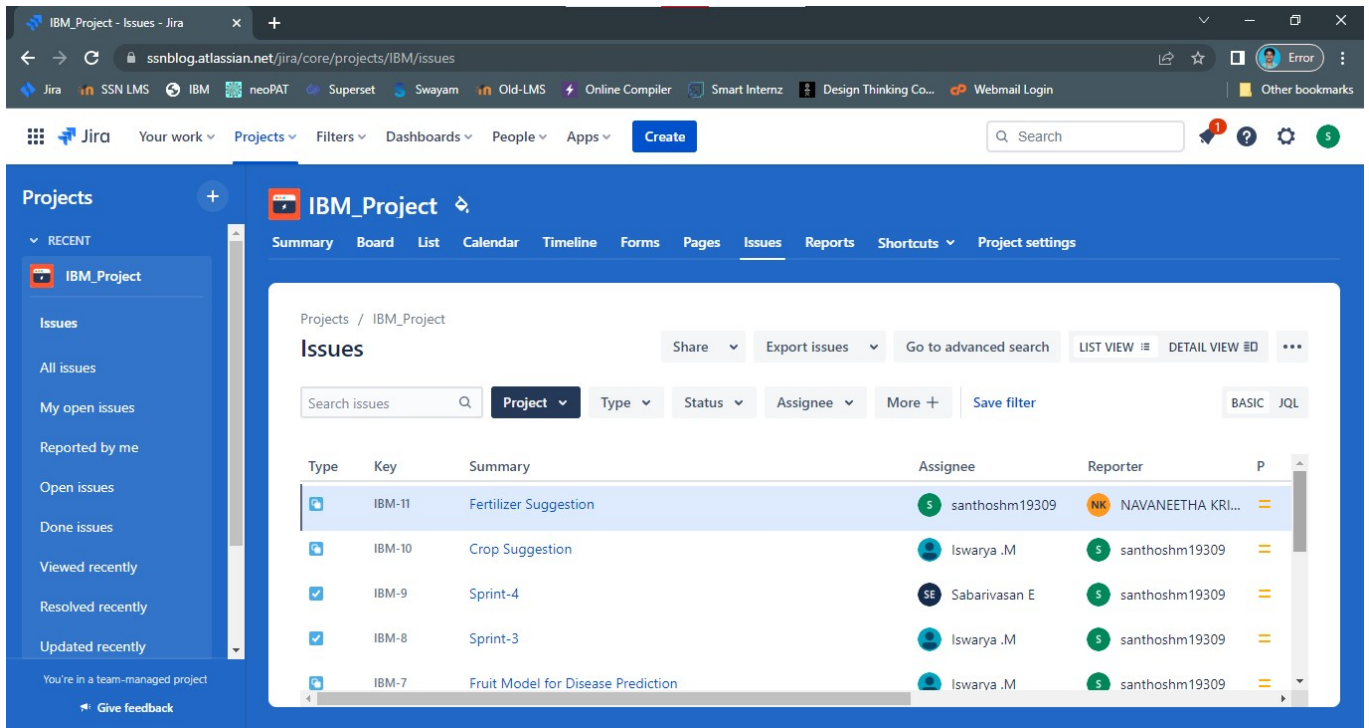
TIMELINE



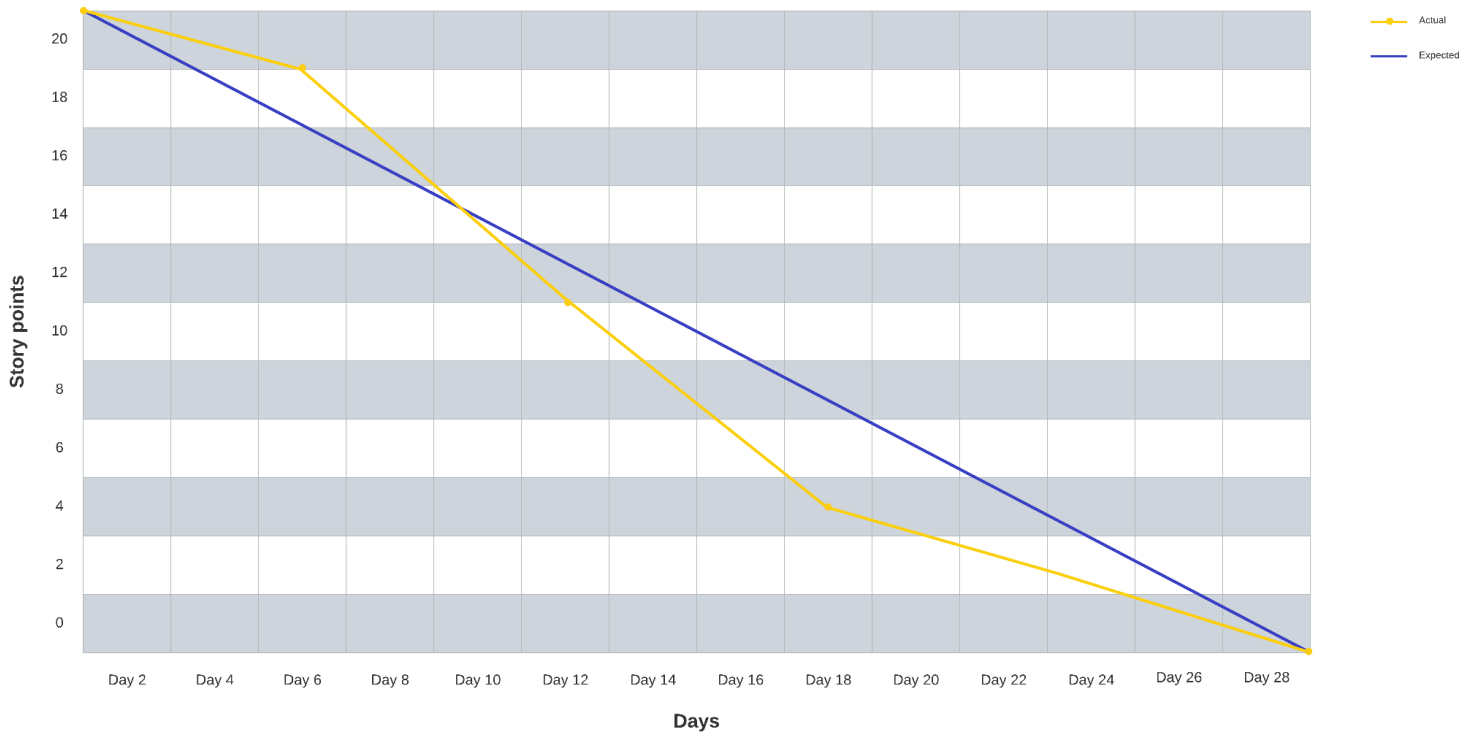
CALENDER



ISSUES



Burndown Chart:



CHAPTER 7

CODING & SOLUTIONING

FEATURE 1: CROP PREDICTION

Crops are the money making factor of the farmers and the living factor to the human beings. Same crops cannot be harvested in a particular land all the time, it would reduce particular minerals present in the soil that are required for the growth of the particular crop. Crop prediction is also determined by the pH value and the rainfall in the particular location. The pH value is varied based on the regions. Crop rotation is the best method to be followed to maintain the minerals balance in the soil. Our platform gets the minerals that are present in the soil from the users, pH of the soil and Rainfall in the locality and provides back the crop that needs to be planted in the soil for the season. It is done by the machine learning and artificial intelligence algorithms.

FEATURE 2: FERTILIZER PREDICTION

Fertilizers are the chemicals that are used to increase the crop yield and reduces the diseases and cure the disease present in the crops. Our platform gets the minerals that are present in the soil at the moment of requirement, rainfall in the locality and Ph of the soil and gives back the fertilizer that is recommended for the field and the amount that is needed for the amount of land. Our platform uses state of art machine learning and Naive bayes classifier algorithms to recommend the fertilizer required for the field.

FEATURE 3: DISEASE PREDICTION

Our platform uses the state of art algorithms like XGBOOST and decision tree to train the set of images and to get the output that the images has the particular disease. The images used are leaves in this case. The trained set of images act as reference to the input image given by the farmer. The farmer gives the input as the image and gets the output as the disease that is caused and recognizes the disease.

CHAPTER-8

8.1 TEST CASES

A test case is a specification of the inputs, execution conditions, testing procedure, and expected results that define a single test to be executed to achieve a specific software testing objective, such as exercising a specific programme path or verifying compliance with a specific requirement, in software engineering. Test cases underpin deliberate rather than chaotic testing. To get the appropriate coverage of the programme being tested, a battery of test cases can be created. Formally stated test cases enable the same tests to be performed against consecutive versions of software, enabling effective and consistent regression testing.

FORMAL TEST CASES

To completely verify that all of an application's criteria are satisfied, there must be at least two test cases for each requirement: one positive test and one negative test. If a requirement is broken down into sub-requirements, each one must contain at least two test cases. A traceability matrix is widely used to keep track of the relationship between the requirement and the test. Written test cases should include a description of the functionality to be tested as well as the preparation needed to ensure that the test can be run.

INFORMAL TESTING CASES

Test cases for applications or systems that lack formal requirements might be built based on the acknowledged typical behaviour of program of a comparable class. In some testing schools, test cases are not written at all, but the activities and results are given after the exams are completed.

Hypothetical tales are used in scenario testing to assist the tester in thinking through a complicated problem or system. Typically, these circumstances are not documented in any depth.

TEST CASES

| Test case ID | Feature Type | Component | Test Scenario | Pre-Requisite | Steps To Execute | Test Data | Expected Result | Actual Result | Status | Comments | TC for Automation(Y/N) | BUG ID | Executed By |
|--------------------|--------------|--------------|--|---------------|---|---|---|---------------------|--------|----------|------------------------|--------|----------------------|
| HomePage_TC_OO1 | Functional | Home Page | Verify user is able to see the homepage or not. | | 1. Enter URL and click go 2. Verify whether the user is able to see the home page. | Enter URL and click go | User able to see the home page | Working as expected | Pass | Nil | N | — | Santhosh M |
| HomePage_TC_OO2 | UI | Home Page | Verify the UI elements in Home Page | | 1. Enter URL and click go 2. Verify the UI elements in Home Page. | Enter URL and click go | Application should show below UI elements: Home Tab & Predict Tab | Working as expected | pass | Nil | N | — | Navaneethakrishnan S |
| PredictPage_TC_OO3 | Functional | Predict page | Verify user is able to redirect to predict page or not. | | 1. Enter URL and click go 2. Click on Predict button 3. Verify whether the user to redirect to predict page or not. | Click the predict button in home page | User should navigate to Predict page | Working as expected | pass | Nil | N | — | Iswarya M |
| PredictPage_TC_OO4 | UI | Predict page | Verify the UI elements in Predict Page | | 1. Enter URL and click go 2. Verify the UI elements in Predict Page. | Click the predict button and redirect to predict page | Application should show below UI elements: Dropdown List , Upload file Button, Predict button. | Working as expected | pass | Nil | N | — | Sabarivasan E |
| PredictPage_TC_OO5 | Functional | Predict page | Verify user is able to select the dropdown value or not. | | 1. Enter URL and click go 2. Click on Predict button 3. Verify whether the user to redirect to predict page or not. 4. Verify user is able to select the dropdown value or not. | Fruit or Vegetable | Application should show user to choose fruit or vegetable option in dropdown list. | Working as expected | pass | Nil | N | — | Iswarya M |
| PredictPage_TC_OO6 | Functional | Predict page | Verify user is able to upload the image or not. | | 1. Enter URL and click go 2. Click on Predict button 3. Verify whether the user to redirect to predict page or not. 4. Verify user is able to select the dropdown value or not. 5. Verify user is able to upload the images or not | Images to be Uploaded | Application should show the uploaded image. | Working as expected | pass | Nil | N | — | Sabarivasan E |
| PredictPage_TC_OO7 | Functional | Predict page | Verify whether the image is predicted correctly or not | | 1. Enter URL and click go 2. Click on Predict button 3. Verify whether the user to redirect to predict page or not. 4. Verify user is able to select the dropdown value or not. 5. Verify whether the images predicted correctly or not | Click the Predict Button | Application shows the predicted output | Working as expected | pass | Nil | N | — | Navaneethakrishnan S |

8.2 USER ACCEPTANCE TESTING

1. Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the Fertilizers Recommendation System for DiseasePrediction project at the time of the release to User Acceptance Testing (UAT).

2. Defect Analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolved

| Resolution | Severity 1 | Severity 2 | Severity 3 | Severity 4 | Subtotal |
|----------------|------------|------------|------------|------------|----------|
| By Design | 0 | 0 | 1 | 0 | 1 |
| Duplicate | 1 | 3 | 2 | 2 | 8 |
| External | 2 | 3 | 0 | 0 | 5 |
| Fixed | 4 | 4 | 4 | 4 | 16 |
| Not Reproduced | 0 | 0 | 0 | 1 | 1 |
| Skipped | 0 | 0 | 0 | 0 | 0 |
| Won't Fix | 0 | 0 | 0 | 0 | 0 |
| Totals | 7 | 10 | 7 | 7 | 31 |

3. Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

| Section | Total Cases | Not Tested | Fail | Pass |
|---------------------|-------------|------------|------|------|
| Print Engine | 1 | 0 | 0 | 1 |
| Client Application | 1 | 0 | 0 | 1 |
| Security | 1 | 0 | 0 | 1 |
| Outsource Shipping | 1 | 0 | 0 | 1 |
| Exception Reporting | 1 | 0 | 0 | 1 |
| Final Report Output | 1 | 0 | 0 | 1 |
| Version Control | 1 | 0 | 0 | 1 |

LOCUST REPORT

Locust Test Report

During: 11/17/2022, 5:24:47 PM - 11/17/2022, 5:34:15 PM

Target Host: http://127.0.0.1:5000

Script: locustfile.py

Request Statistics

| Method | Name | # Requests | # Fails | Average (ms) | Min (ms) | Max (ms) | Average size (bytes) | RPS | Failures/s |
|------------|-------------|------------|---------|--------------|----------|----------|----------------------|-----|------------|
| GET | / | 1890 | 0 | 5 | 4 | 41 | 6381 | 3.3 | 0.0 |
| GET | /prediction | 1828 | 0 | 5 | 4 | 34 | 4484 | 3.2 | 0.0 |
| Aggregated | | 3718 | 0 | 5 | 4 | 41 | 5448 | 6.5 | 0.0 |

Response Time Statistics

| Method | Name | 50%ile (ms) | 60%ile (ms) | 70%ile (ms) | 80%ile (ms) | 90%ile (ms) | 95%ile (ms) | 99%ile (ms) | 100%ile (ms) |
|------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|--------------|
| GET | / | 5 | 5 | 6 | 6 | 7 | 9 | 19 | 41 |
| GET | /prediction | 5 | 5 | 6 | 6 | 7 | 9 | 19 | 34 |
| Aggregated | | 5 | 5 | 6 | 6 | 7 | 9 | 19 | 41 |

Charts

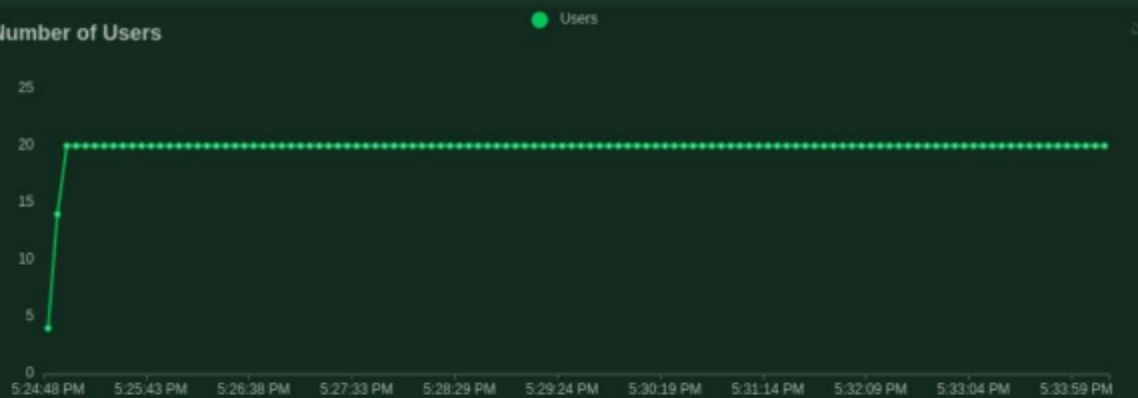
Total Requests per Second



Response Times (ms)



Number of Users



Final ratio

Ratio per User class

- 100.0% AppUser
 - 50.0% home
 - 50.0% prediction

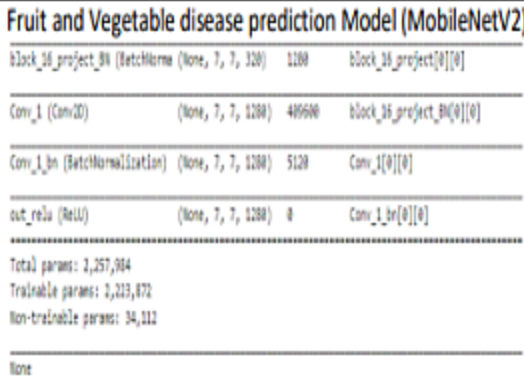
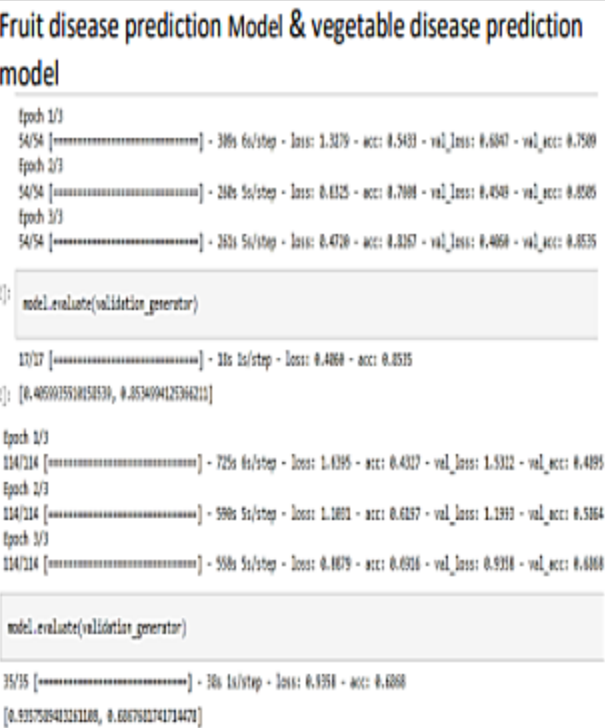
Total ratio

- 100.0% AppUser
 - 50.0% home
 - 50.0% prediction

CHAPTER-9

RESULTS

9.1 PERFORMANCE METRICS

| S.No | Parameter | Values | Screenshot |
|------|---------------|--|--|
| 1. | Model Summary | -Total params: 2,257,984 -Trainable params: 2,223,872 -Non-trainable params: 34,112 | Fruit and Vegetable disease prediction Model (MobileNetV2)  |
| 2. | Accuracy | Training Accuracy - -Fruit disease prediction 82.67% -Vegetable disease prediction 69.16% Validation Accuracy - -Fruit disease prediction 85.35% -Vegetable disease prediction 68.68% | Fruit disease prediction Model & vegetable disease prediction model  |

```

In [21]: acc      = history.history['acc' ]
val_acc  = history.history['val_acc' ]
loss     = history.history['loss' ]
val_loss = history.history['val_loss' ]

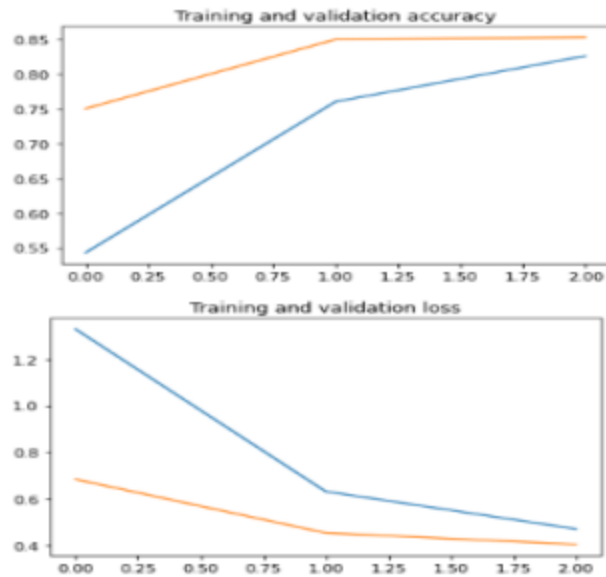
epochs   = range(len(acc))

plt.plot ( epochs,      acc )
plt.plot ( epochs, val_acc )
plt.title ('Training and validation accuracy')
plt.figure()

plt.plot ( epochs,      loss )
plt.plot ( epochs, val_loss )
plt.title ('Training and validation loss' )

```

Out[21]: Text(0.5, 1.0, 'Training and validation loss')



```

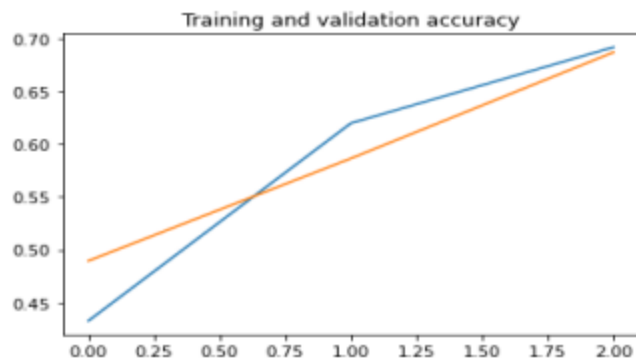
In [34]: acc      = history.history['acc' ]
val_acc  = history.history['val_acc' ]
loss     = history.history['loss' ]
val_loss = history.history['val_loss' ]

epochs   = range(len(acc))

plt.plot ( epochs,      acc )
plt.plot ( epochs, val_acc )
plt.title ('Training and validation accuracy')
plt.figure()

```

Out[34]:



CHAPTER-10

ADVANTAGES & DISADVANTAGES

ADVANTAGES:

- The proposed model could predict the disease just from the image of a particular plant.
- Easy to use UI.
- Model has some good accuracy in detecting the plant just by taking the input (leaf).

DISADVANTAGES

- The machine can also make mistakes. The accuracy may not be a cent percent.

CHAPTER-11

CONCLUSION

Agriculture is the most significant industry in today's society. A vast range of bacterial and fungal diseases afflict the majority of plants. Plant diseases were a serious restraint on productivity and a big danger to food security. As a result, early and precise detection of plant diseases is critical to ensuring high production and quality.

The number of plant illnesses and the extent of damage inflicted have grown in recent years as a result of pathogen variety diversity, changes in cultivation practises, and inadequate plant protection systems. The use of such applications might assist farmers in taking the required safeguards to avoid loss.

CHAPTER-12

FUTURE SCOPE

As of now we have just built the web application which apparently takes the input as an image and then predict the out in the near future we can develop an application which computer vision and AI techniques to predict the infection once you keep the camera near the plant or leaf this could make our project even more usable.

This can be also done in Mobile applications like android, ios. It helps in many ways to improve the agriculture in cultivation of crops and predict the correct fertilizers to the crops.

CHAPTER-13

APPENDIX

SOURCE CODE

```
# Importing essential libraries and modules
```

```
from flask import Flask, render_template, request, Markup
```

```
import numpy as np
```

```
import pandas as pd
```

```
from utils.disease import disease_dic
```

```
from utils.fertilizer import fertilizer_dic
```

```
import requests
```

```
import config
```

```
import pickle
```

```
import io
```

```
import torch
```

```
from torchvision import transforms
```

```
from PIL import Image
```

```
from utils.model import ResNet9
```

```
#
```

```
=====
```

```
=====
```

```
# -----LOADING THE TRAINED MODELS -----
```

```
# Loading plant disease classification model
```

```
disease_classes = ['Apple___Apple_scab',
```

```
                  'Apple___Black_rot',
```

'Apple___Cedar_apple_rust',
 'Apple___healthy',
 'Blueberry___healthy',
 'Cherry_(including_sour)___Powdery_mildew',
 'Cherry_(including_sour)___healthy',
 'Corn_(maize)___Cercospora_leaf_spotGray_leaf_spot',
 'Corn_(maize)___Common_rust_',
 'Corn_(maize)___Northern_Leaf_Blight',
 'Corn_(maize)___healthy',
 'Grape___Black_rot',
 'Grape___Esca_(Black_Measles)',
 'Grape___Leaf_blight_(Isariopsis_Leaf_Spot)',
 'Grape___healthy',
 'Orange___Haunglongbing_(Citrus_greening)',
 'Peach___Bacterial_spot',
 'Peach___healthy',
 'Pepper,_bell___Bacterial_spot',
 'Pepper,_bell___healthy',
 'Potato___Early_blight',
 'Potato___Late_blight',
 'Potato___healthy',
 'Raspberry___healthy',
 'Soybean___healthy',
 'Squash___Powdery_mildew',
 'Strawberry___Leaf_scorch',
 'Strawberry___healthy',
 'Tomato___Bacterial_spot',
 'Tomato___Early_blight',
 'Tomato___Late_blight',
 'Tomato___Leaf_Mold',
 'Tomato___Septoria_leaf_spot',
 'Tomato___Spider_mites Two-spotted_spider_mite',
 'Tomato___Target_Spot',

```

'Tomato___Tomato_Yellow_Leaf_Curl_Virus',
'Tomato___Tomato_mosaic_virus',
'Tomato___healthy']

```

```

disease_model_path = 'models/plant_disease_model.pth'
disease_model = ResNet9(3, len(disease_classes))
disease_model.load_state_dict(torch.load(
disease_model_path, map_location=torch.device('cpu')))
disease_model.eval()

```

```

# Loading crop recommendation model

```

```

crop_recommendation_model_path = 'models/RandomForest.pkl'
crop_recommendation_model = pickle.load(
open(crop_recommendation_model_path, 'rb'))

```

```

#

```

```

=====
==

```

```

# Custom functions for calculations

```

```

def weather_fetch(city_name):

```

```

    """

```

```

    Fetch and returns the temperature and humidity of a city

```

```

:params: city_name

```

```

:return: temperature, humidity

```

```

    """

```

```

api_key = config.weather_api_key

```

```

base_url = "http://api.openweathermap.org/data/2.5/weather?"

```



```

complete_url = base_url + "appid=" + api_key + "&q=" + city_name
response = requests.get(complete_url)
x = response.json()

if x["cod"] != "404":
    y = x["main"]

    temperature = round((y["temp"] - 273.15), 2)
    humidity = y["humidity"]
    return temperature, humidity
else:
    return None

```

```

def predict_image(img, model=disease_model):
    """
    Transforms image to tensor and predicts disease label
    :params: image
    :return: prediction (string)
    """
    transform = transforms.Compose([
        transforms.Resize(256),
        transforms.ToTensor(),
    ])
    image = Image.open(io.BytesIO(img))
    img_t = transform(image)
    img_u = torch.unsqueeze(img_t, 0)

    # Get predictions from model
    yb = model(img_u)

    # Pick index with highest probability
    _, preds = torch.max(yb, dim=1)

```

```

prediction = disease_classes[preds[0].item()]
# Retrieve the class label
return prediction

#
=====

=====
# ----- FLASK APP -----

app = Flask(__name__)

# render home page

@app.route('/')
def home():
    title = 'Agrofy - Home'
    return render_template('index.html', title=title)

# render crop recommendation form page

@app.route('/crop-recommend')
def crop_recommend():
    title = 'Agrofy - Crop Recommendation'
    return render_template('crop.html', title=title)

# render fertilizer recommendation form page

@app.route('/fertilizer')
def fertilizer_recommendation():

```

```

title = 'Agrofy - Fertilizer Suggestion'

return render_template('fertilizer.html', title=title)

# render disease prediction input page


#
=====

=====

# RENDER PREDICTION PAGES

# render crop recommendation result page


@app.route('/crop-predict', methods=['POST'])
def crop_prediction():
    title = 'Agrofy - Crop Recommendation'

    if request.method == 'POST':
        N = int(request.form['nitrogen'])
        P = int(request.form['phosphorous'])
        K = int(request.form['pottasium'])
    ph = float(request.form['ph'])
    rainfall = float(request.form['rainfall'])

    # state = request.form.get("stt")
    city = request.form.get("city")

    if weather_fetch(city) != None:

```

```

    temperature, humidity = weather_fetch(city)
    data = np.array([[N, P, K, temperature, humidity, ph, rainfall]])
    my_prediction = crop_recommendation_model.predict(data)
    final_prediction = my_prediction[0]

    return render_template('crop-result.html', prediction=final_prediction, title=title)

else:

    return render_template('try_again.html', title=title)

# render fertilizer recommendation result page

@app.route('/fertilizer-predict', methods=['POST'])
def fert_recommend():
    title = 'Agrofy - Fertilizer Suggestion'

    crop_name = str(request.form['cropname'])
    N = int(request.form['nitrogen'])
    P = int(request.form['phosphorous'])
    K = int(request.form['pottasium'])
    # ph = float(request.form['ph'])

    df = pd.read_csv('Data/fertilizer.csv')

    nr = df[df['Crop'] == crop_name]['N'].iloc[0]
    pr = df[df['Crop'] == crop_name]['P'].iloc[0]
    kr = df[df['Crop'] == crop_name]['K'].iloc[0]

    n = nr - N
    p = pr - P
    k = kr - K

```

```

    temp = {abs(n): "N", abs(p): "P", abs(k): "K"}
max_value = temp[max(temp.keys())]
    if max_value == "N":
        if n < 0:
            key = 'NHigh'
        else:
            key = "Nlow"
    elif max_value == "P":
        if p < 0:
            key = 'PHigh'
        else:
            key = "Plow"
    else:
        if k < 0:
            key = 'KHigh'
        else:
            key = "Klow"

    response = Markup(str(fertilizer_dic[key]))

    return render_template('fertilizer-result.html', recommendation=response, title=title)

# render disease prediction result page

@app.route('/disease-predict', methods=['GET', 'POST'])
def disease_prediction():
    title = 'Agrofy - Disease Detection'

    if request.method == 'POST':
        if 'file' not in request.files:
            return redirect(request.url)
        file = request.files.get('file')

```

```

if not file:
    return render_template('disease.html', title=title)
try:
    img = file.read()

    prediction = predict_image(img)

    prediction = Markup(str(disease_dic[prediction]))
    return render_template('disease-result.html', prediction=prediction, title=title)
except:
    pass
return render_template('disease.html', title=title)

#
=====

=====

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

```

GIT REPOSITORY

IBM-EPBL/**IBM-Project-15554-1659600341**

DEMO-VIDEO LINK

[AGROFY Demo Video Link](#)