PROJECT REPORT

Fertilizers Recommendation System for Disease Prediction

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1.INTRODUCTION :

- Disease prediction in plants is used to detect and recognize the plant diseases. The disease may lead to abnormal functionalities which may lead to the death of the plant. Computer vision and image processing are used to capture and analyze images of the plants and their parts like leaves. By analyzing the images, based on certain symptoms like yellowing of leaves, curling, black spots, etc., the deficit nutrients that lead to the disease are found. Based on the available data on fertilizers, the necessary nutrient rich fertilizers are recommended.

1.1.PROJECT OVERVIEW:

- 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 changes in cultivation method and inadequate
plant protection techniques and suggest all the precautions that can be taken for those diseases.

1.2.PURPOSE:

- To Detect and recognize the plant diseases and to recommend fertilizer, it is necessary to identify the diseases and to recommend to get different and useful features needed for the purpose of analyzing later.

- To provide symptoms in identifying the disease at its earliest. Hence the authors proposed and implemented new fertilizers Recommendation System for Crop Disease Prediction.

2.LITERATURE SURVEY:

2.1.EXISTING PROBLEM:

- **Prediction of crop yield and fertilizer recommendation using machine learning algorithmsAdvantage**: It recommends fertilizer suitable for every particular crop. Disadvantage: Requires Third Party applications to display information on weather, temperature, humidity, atmospheric pressure, etc. Algorithm used: Random Forest and Support Vector Machine algorithms are used for theclassification of the soil to classify, display confusion matrix, Precision, Recall, predict crop based on the given inputs, etc.

- **Plant Infection Detection Using Image Processing Advantage**: This system was capable of identifying the infection and classifies them accordingly with 98.27% of accuracy. Disadvantage: The farmers must afford mobile phones or digital camera to take images of infected leaves of different plants. Algorithm used: Infections are detected based on K-means clustering and GLCM techniques.GLCM is used for texture analysis, while K-mean segmentation technique uses hue estimation method for dividing and clustering the image.

- **Fertilizers Recommendation System for Disease Prediction in Tree Leaves Advantages:** Recommend the fertilizer for affected leaves and its measurement or quantity are suggested based on severity level of the disease. Disadvantage: The proposed algorithm cannot be used to identify the disease that affects the other plant organs such as stems and fruits. Algorithm used: Support Vector Machine (SVM) algorithm classifies the leaf image as normalor affected. And it is used to identify a function Fx which obtain the hyper-plane.

- **Plant Disease Detection Using Image Processing and Machine Learning Advantage:** Accuracy scores were 93% which is nearly equal to f1 scores. It requires lesstime for prediction than other deep learning-based approaches since it uses statistical machine learning and image processing algorithm. Disadvantage: The proposed system is able to detect 20 different diseases only. Algorithm used: Random Forest classifier, a combination of multiple decision trees is usedwhere each tree is trained by using different subsets of the whole dataset to reduce the overfitting and improves the accuracy of the classifier.

- Cloud Based Automated Irrigation and Plant Leaf Disease Detection System Using an Android Application. Advantage: It is simple and cost-effective system for plant leaf disease detection. Disadvantage: Any H/w failures may affect the system performance. Algorithm used: K-means clustering is used for feature extraction.

- **Farmer's Assistant**: A Machine Learning Based Application for Agricultural Solutions Advantages: It is expected that boosting (Random Forest) and bagging (XG Boost) modelswill usually perform and generalize better than non-ensemble methods. Disadvantage: This model performs well only on the images which are from those classes that the model already knows and it will not be able to detect the correct class for any datathat is out of the domain. Algorithm used: XG Boost, which stands for Extreme Gradient Boosting, is a scalable, distributed gradient-boosted decision tree (GBDT) machine learning library. It provides parallel tree boosting and is the leading machine learning library for regression,.classification,and ranking problems. Random forest algorithm is also used.

2.2-References :

- G. Preethi, P. Rathi, S. M. Sanjula, S. D. Lalitha, B. V. Bindhu, "Agro based crop and fertilizer recommendation system using machine learning", European Journal of Molecular & Clinical Medicine, 7, 4, 2020, 2043-2051 https://deepai.org/publication/farmer-s-assistant-a-machine-learning-based-application-foragricultural-solutions
- International Journal of Engineering Applied Sciences and Technology, 2019 Vol. 4, Issue 5, ISSN No. 2455-2143, Pages 371-376 https://www.ijeast.com/papers/371-376,Tesma405,IJEAST.pdf
- Plant Disease Detection Using Image Processing and Machine Learning Pranesh Kulkarni1 , Atharva Karwande1 , Tejas Kolhe1 , Soham Kamble1 , Akshay Joshi1 , Medha Wyawahare1 1Department of Electronics and Telecommunication, Vishwakarma Institute of Technology. https://arxiv.org/ftp/arxiv/papers/2106/2106.10698.pdf
- Plant Infection Detection Using Image Processing - Senthilkumar Meyyappan, Nalla Malla Reddy Engineering college, Corresponding Author: Dr. Sridhathan C https://www.researchgate.net/publication/326803995_Plant_Infection_Detection_Using_Image_Processing
- Plant Disease Detection Using Image Processing DOI10.1109/ICCUBEA.2015.153https://ieeexplore.ieee.org/document/7155951
- Metrics for Performance Measurements https://www.mathworks.com/matlabcentral/answers/418986-how-to-calculate-truepositive-true-negative-false-positive-and-false-negative-as-we-have-segment
- International journal of scientific & technology research volume 8, issue 11, November 2019 ISSN 2277-8616 3343 Fertilizers Recommendation System for Disease Prediction In Tree Leafhttp://www.ijstr.org/final-print/nov2019/Fertilizers-Recommendation-System-ForDisease- Prediction-In-Tree-Leave.pdf

2.3-PROBLEM STATEMENT DEFINITION:

Mr.Narasimma Rao is a 65 years old man. He had a own farming land and do Agriculture for past 30 Years , In this 30 Years he Faced a problem in Choosing Fertilizers and Controlling of Plant Disease.
- Narasimma Rao wants to know the better recommendation for fertilizers for plants with the disease.
- He has faced huge losses for a long time.
- This problem is usually faced by most farmers.
- Mr. Narasimma Rao needs to know the result immediately. Who does the problem affect?

3.IDEATION & PROPOSED SOLUTION :

3.1.Empathy Map canvas:
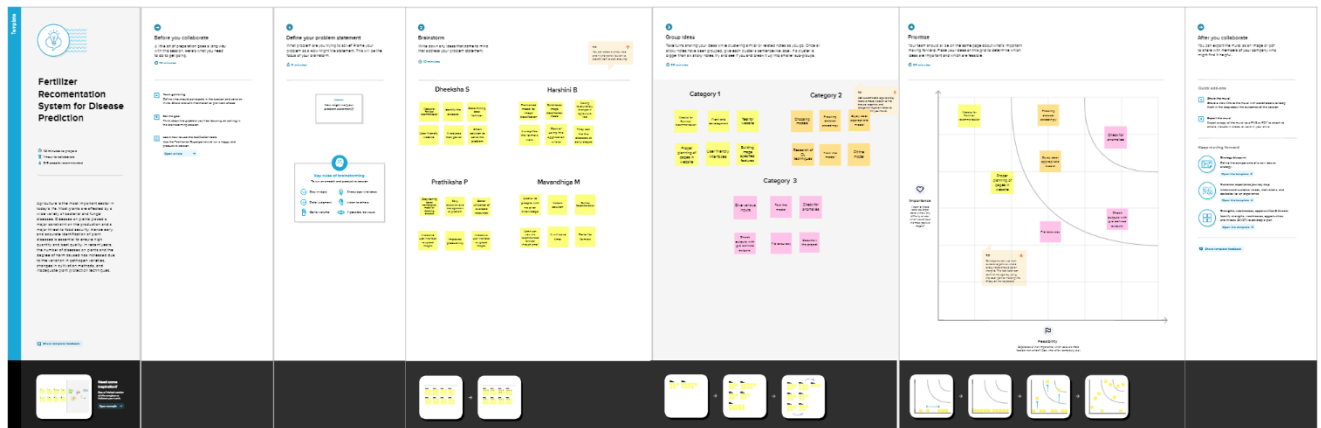
3.2.Ideation and Brainstorming:

3.3-Proposed Solution:

Project team shall fill the following information in proposed solution template.

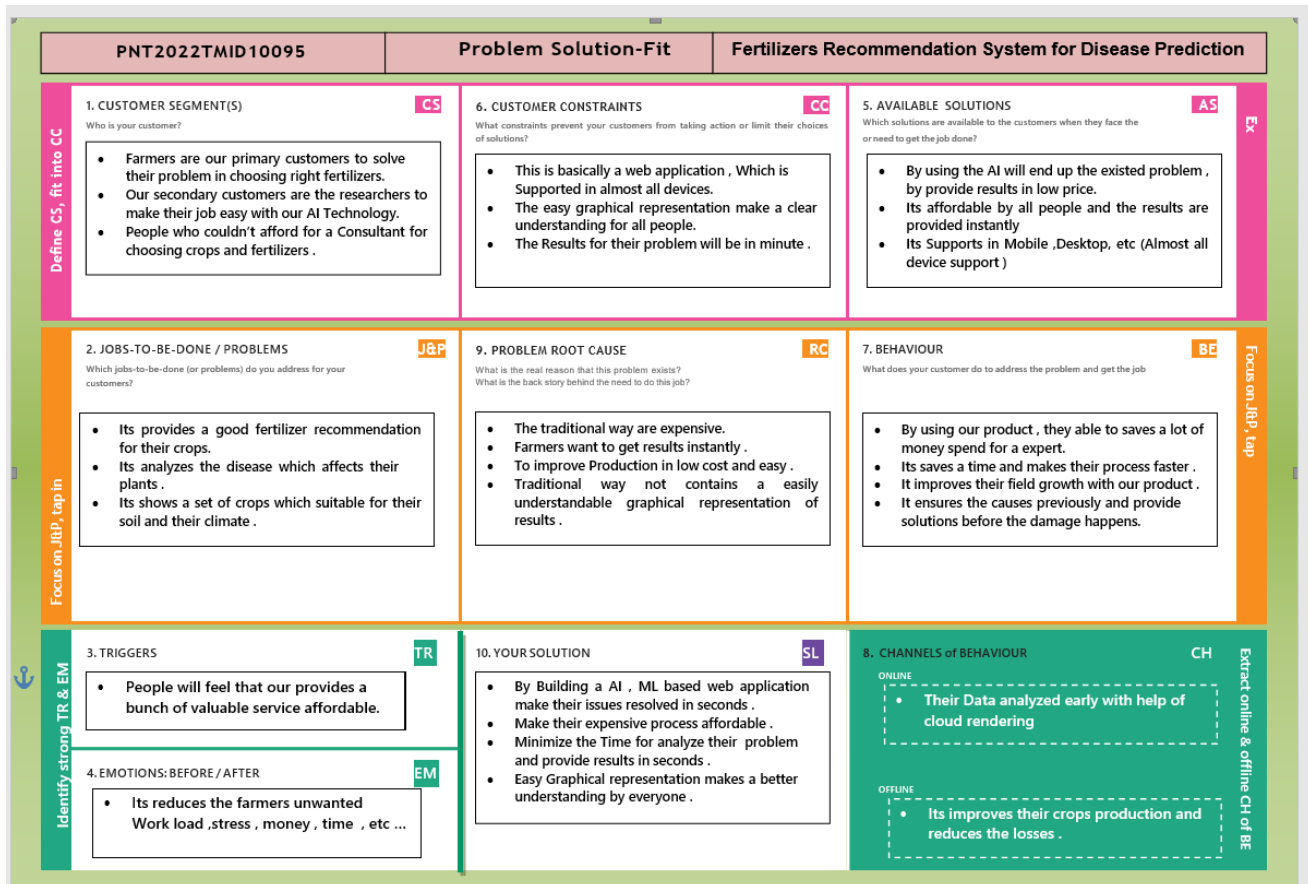| S.No.	Parameter	Description
1.	Problem Statement (Problemto be solved)	Agriculture is having a great impact on the country's economy.Different diseases effect plant that reduces their production and is a major threatto food security.The major problemsthat the farmers of our country are currently facing includes Crop Failure, Lack of adequate knowledge, Crop damage due to ignorance/carelessness, Lack of professional assistance, Inaccessibility to agro-tech solutions.Most of the diseases are detected in later stage that to manually which is time consuming and results in heavy loss so it is important to build an automated system that detects disease at early stage and provides fertilizer recommendation accordingly.
2.	Idea / Solution description	An automated system is built that takes the input as picture of leaves which is uploaded by the user,identifies different diseases onplants by checking the symptoms shown on the leaves of the plant. Deep learning techniques are used to identify the diseases and suggest the fertilizer needed for the plant.
3.	Novelty / Uniqueness	It does not require user to consult any specialist for identification ofdiseases that affected the leaves

		and the fertilizers that is required for the same.It detects Plant disease attheir early stage.
4.	Social Impact / Customer Satisfaction	The whole process of identifying disease and recommendation of fertilizer happens just by uploading image so it is user friendly.It helps farmers to get good yield out of the crop.People will get good quality food products.
5.	Business Model (RevenueModel)	Social media is the best way to spreadthe word about our application. And with the influencers we can reach outto people.Clustering and targeting thefarmers for identifying diseases on their plants and recommending them fertilizers for the same
6.	Scalability of the Solution	It can be used in research areas to study about the diseases in plant and the best fertilizer that can be recommended for it among the list of fertilizers available .It can beused by anyone in the world

3.4-Problem Solution fit:

PNT2022TMID10095	Problem Solution-Fit	Fertilizers Recommendation System for Disease Prediction

1. CUSTOMER SEGMENT(S) — CS
Who is your customer?

- Farmers are our primary customers to solve their problem in choosing right fertilizers.
- Our secondary customers are the researchers to make their job easy with our AI Technology.
- People who couldn't afford for a Consultant for choosing crops and fertilizers .

6. CUSTOMER CONSTRAINTS — CC
What constraints prevent your customers from taking action or limit their choices of solutions?

- This is basically a web application , Which is Supported in almost all devices.
- The easy graphical representation make a clear understanding for all people.
- The Results for their problem will be in minute .

5. AVAILABLE SOLUTIONS — AS
Which solutions are available to the customers when they face the or need to get the job done?

- By using the AI will end up the existed problem , by provide results in low price.
- Its affordable by all people and the results are provided instantly
- Its Supports in Mobile ,Desktop, etc (Almost all device support)

(Left side label: Define CS, fit into CC)
(Right side label: Ex)

2. JOBS-TO-BE-DONE / PROBLEMS — J&P
Which jobs-to-be-done (or problems) do you address for your customers?

- Its provides a good fertilizer recommendation for their crops.
- Its analyzes the disease which affects their plants .
- Its shows a set of crops which suitable for their soil and their climate .

9. PROBLEM ROOT CAUSE — RC
What is the real reason that this problem exists? What is the back story behind the need to do this job?

- The traditional way are expensive.
- Farmers want to get results instantly .
- To improve Production in low cost and easy .
- Traditional way not contains a easily understandable graphical representation of results .

7. BEHAVIOUR — BE
What does your customer do to address the problem and get the job

- By using our product , they able to saves a lot of money spend for a expert.
- Its saves a time and makes their process faster .
- It improves their field growth with our product .
- It ensures the causes previously and provide solutions before the damage happens.

(Left side label: Focus on J&P, tap in)
(Right side label: Focus on J&P, tap)

3. TRIGGERS — TR

- People will feel that our provides a bunch of valuable service affordable.

4. EMOTIONS: BEFORE / AFTER — EM

- Its reduces the farmers unwanted Work load ,stress , money , time , etc ...

10. YOUR SOLUTION — SL

- By Building a AI , ML based web application make their issues resolved in seconds .
- Make their expensive process affordable .
- Minimize the Time for analyze their problem and provide results in seconds .
- Easy Graphical representation makes a better understanding by everyone .

8. CHANNELS of BEHAVIOUR — CH

ONLINE
- Their Data analyzed early with help of cloud rendering

OFFLINE
- Its improves their crops production and reduces the losses .

(Left side label: Identify strong TR & EM)
(Right side label: Extract online & offline CH of BE)

4.REQUIREMENT ANALYSIS:

4.1. Functional Requirements:

These 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-definedModel and solution is generated**
FR-6	**Downloading Solution**	**The Solution in pdf format which contains the recommendations of fertilizers and the possiblediseases.**

4.2-Non-functional Requirements:

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

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The system allows the user to perform the taskseasily and efficiently and effectively.
NFR-2	Security	Assuring all data inside the system or its part willbe protected against malware attacks or unauthorizedaccess.
NFR-3	Reliability	The website does not recover from failure quickly ,it takes time as the application is running in singleserver
NFR-4	Performance	Response Time and Net Processing Time is Fast
NFR-5	Availability	The system will be available up to 95% of the time
NFR-6	Scalability	The website is scalable

5. PROJECT DESIGN

5.1. Data Flow Diagram

DFD LEVEL - 0
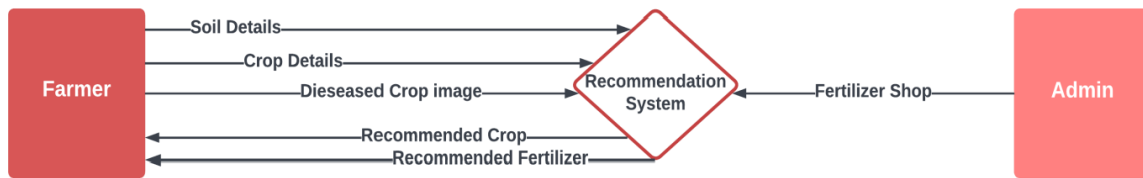
DFD LEVEL - 1
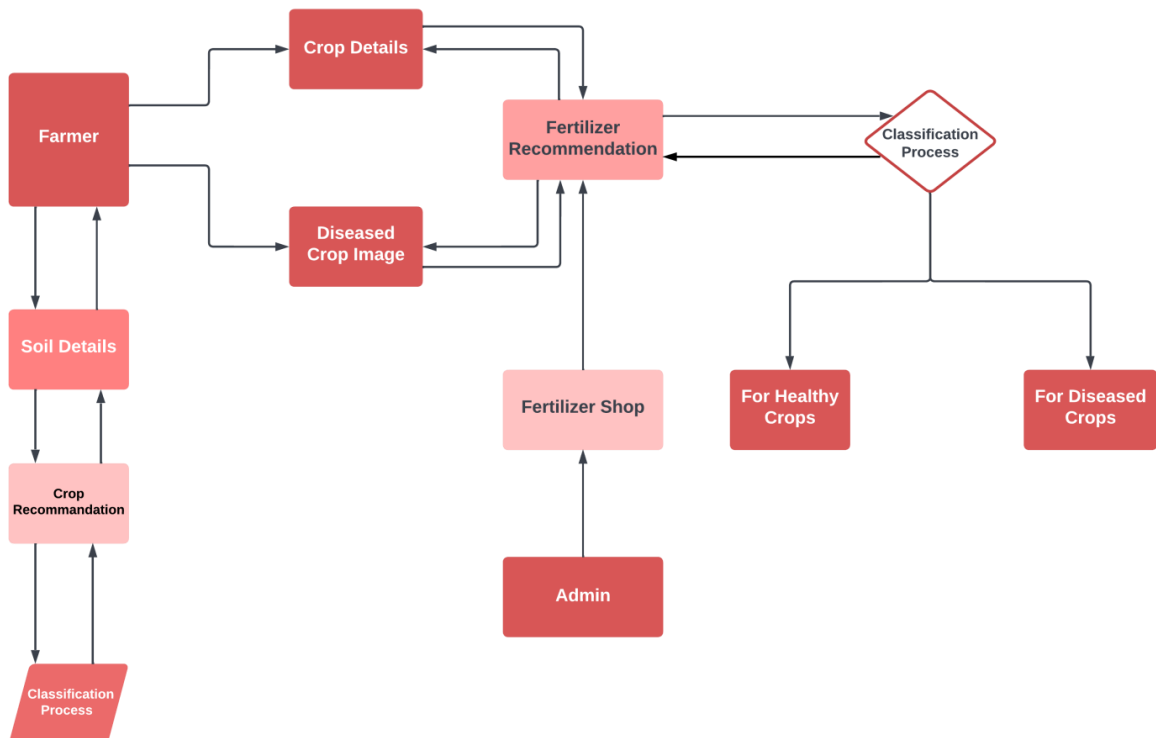
5.2. SOLUTION &TECHNICAL AECHITECTURE:

Table 1: Components & Technologies:

S. No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Java / Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
9.	External API-2	Purpose of External API used in the application	Aadhar API, etc.
10.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.
11.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

Table 2: Application Characteristics:

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensource

			framework
2.	Security Implementations	List all the security / access controls implemented,use of firewalls etc.	e.g. SHA-256, Encryptions, IAM Controls, OWASP etc.
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	Technology used
4.	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	Technology used
5.	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	Technology used

5.3. User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance ecriteria	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 needed	I can access my account/ dashboard	High	Sprint-2
Customer (Web user)	Registration	USN-4	As a user, I can login to web dashboard just Like website dashboard	I can register using	High	Sprint-3

				my username and password		
	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	High	**Sprint -4**
Administrator	**Login**	USN-8	As a admin, I can login to the website using my login credentials	I can login to the website using my login credentials	High	**Sprint -5**
	Dashboard	USN-9	As a admin, I can view the dashboard of the application	I can access my dashboard	High	**Sprint -5**

6. PROJECT PLANNING & SCHEDULING:

6.1. SPRINT PLANNING & ESTIMATION:

TITLE	DESCRIPTION	DATE
IDEATION PHASE	• Literature survey • Empathy Map • Brainstorming • Problem Statement	03 October 2022- 15 October 2022
PROJECT DESIGN PHASE - I	• Problem Solution Fit • Proposed Solution • Solution Architecture	12 October 2022- 22 October 2022

PROJECT DESIGN PHASE - II	- Requirement Analysis - Customer Journey - Data Flow Diagrams - Technical Architecture	19 October 2022 - 28 October 2022
PROJECT PLANNING PHASE	- Sprint Delivery Plan - JIRA Files	26 October 2022 - 07 November 2022
PROJECT DEVELOPMENT PHASE	- Sprint 1 - Sprint 2 - Sprint 3 - Sprint 4	30 October 2022 - 19 November 2022

6.2. SPRINT PLANNING SCHEDULE:

The delivery plan of project deliverables is a strategic element for every Project Manager. The goal of every project is, in fact, to produce a result that serves a specific purpose. With the word "purpose ", we can mean the most disparate goals: a software program, a chair, a building, a translation, etc.... In Project Spirit Delivery Planning is one of the processes of completing the project and Show Casing the Time Line of the Project Planning. This Delivery plan help to understanding the process and Work Flow of the Project working by the Team Mates. Every Single Modules are assigned to the team mates to show case their work and contribution of developing the Project.

Delivery plan:

Spirit Model Planning:
Spirit One:
- Team should conduct a period of concept
- Team should start by outlining the milestones
- Team should monitor the process efficiency

Spirit Two:
- Team mates should reserach on concepts
- Team should gather information from sources available
- Team should work on pre preparation

Spirit Three:
- Team mates should understand the overflow
- Team should monitor the process of work
- Team should follow the Project Management System

Spirit Four:
- Team should show demo process to mentor.

10. ADVANTAGES & DISADVANTAGES:

Advantages:
- Early detection of plant diseases.
- Proper fertilizer recommendation to prevent or cure the plant infection or disease.
- No need to consult any specialists.
- Fully automated system.
- Traditionally, people used to guess the plant disease by visually examining symptoms such as curling of leaves and change of colour. But with the help of scientific advancements, this application helps people to get more clarity regarding the diseases and an accurate fertilizer recommendation.
- As a result, farmers especially do not need significant knowledge on all the diseases and fertilizers. They can make use of the application in order to determine the appropriate and effective fertilizers for their affected crops.
- Essentially, farmers can anticipate any problems or abnormalities and obtain the results online instantly. Moreover, financial losses due to widespread infections leading to poor crop yield can be reduced effectively.
- The application mainly focuses on helping farmers who need a recommendation on usage of best fertilizers for the predicted disease on their crops thereby helping them improve the crop yield. The spread of diseases due to improper guidance can be avoided by early identification of these diseases and usage of appropriate fertilizers.

Disadvantages:
- Requires training the system with large dataset.
- Works only on the pretrained diseases.
- When a plant is infected with multiple diseases the system may not predict all the diseases due to the mixed symptoms.
- Requires a good device connected to the internet.
- The Deep Learning model requires extremely high time complexities due to the enormous amounts of data utilized by the model for training and testing purposes. As a result, these time complexities affect the performance of the model on training and validation datasets.
- The application requires the availability of a good quality internet connection for obtaining results, which is yet another struggle in a developing country like India in remote areas. Moreover, the images of the crop should be captured using a device that meets the availability of a minimum suggested pixels in order to capture the images of the affected crop with greater clarity for accurate identification.
- Lastly, this application is built basically for identifying a set of diseases targeting fruits and vegetables having 6 classes and 9 classes respectively. However, the sky's the limit to such diseases that farmers may or may not have a fair knowledge of.
- Thus handling various classes of diseases in both fruits and vegetables is an extremely challenging task that takes a prolonged period in order to collect training and validation data and subsequently train and test the model.

11. CONCLUSION:

The proposed model employs Deep Learning techniques in order to identify diseases observed both in fruits and vegetables and suggest appropriate fertilizers that can be taken for those diseases. In this image classification problem, during model training it was observed that increasing the convolutional layers as well as the Dense layers resulted in significant improvement in accuracies during evaluation. However, the time complexities are extremely high and may take up to a few hours for model training and testing purposes. The model trained in IBM Watson Studio cloud platform using Machine Learning Client was observed to produce results with greater accuracies during model training in addition to relatively better time complexities compared to model built and trained in the local system using Anaconda. Subsequently, the trained model is integrated with the web application using a light-weight framework that is open to all the end users. The core strategy of this project is to predict the crop based on the soil nutrient content and the location where the crop is growing. This system will help he farmers to choose the right crop for their land and to give the suitable amount of fertilizer to produce the maximum yield. The Support Vector Machine algorithm helps to predict the crop the precisely based on the pre-processed crop data. This system will also help the new comers to choose the crop which will grow in their area and produce them a good profit. A decent amount of profit will attract more people towards the agriculture. Hence, a system that takes in images as user input, analyses those for certain symptoms and identifies the disease, recommends the fertilizer to counter the deficiency of the nutrients is built and deployed.

12. FUTURE SCOPE:

The system must be trained with numerous images of plant disease symptoms. In case of presence of multiple diseases, suitable classification must be done to predict each disease accurately and recommend separate fertilizers as a solution to each deficiency or infection.
This further research is implementing the proposed algorithm with the existing public datasets. Also, various segmentation algorithms can be implemented to improve accuracy. The proposed algorithm can be modified further to identify the disease that affects the various plant organs such as vegetables and fruits. Additionally, helpline support for resolving app related issues can address problems and challenges commonly faced by farmers. Service availability depends on the plans devised and subscribed by the farmers. Moreover, the services provided can be used on a large or small scale, making it practical for farmers as well as common people. Future diseases that are found and the preventative fertilizer for them can easily be incorporated into the current model, making it highly scale

Github I'd : https://github.com/IBM-EPBL/IBM-Project-18892-1659691187