1. INTRODUCTION

Agriculture is the most important sector in today's life. Most plants are affected by a wide variety of bacterial and fungal diseases. Diseases on plants placed a major constraint on the production and a major threat to food security. Hence, early and accurate identification of plant diseases is essential to ensure high quantity and best quality. In recent years,the number of diseases on plants and the degree of harm caused has increased due to the variation in pathogen varieties,changes in cultivation methods, and inadequate plant protection techniques.The agriculture sector in India is advancing due to globalization.

1.1 Project Overview

Agriculture is the main aspect of country development. Many people lead their life from agriculture field, which gives fully related to agricultural products. Plant disease, especially on leaves, is one of the major factors of reductions in both quality and quantity of the food crops. Detection and recognition of plant diseases using machine learning are very efficient in providing symptoms of identifying diseases at its earliest. Plant pathologists can analyze the digital images using digital image processing for diagnosis of plant diseases. Application of computer vision and image processing strategies simply assist farmers in all of the regions of agriculture. Generally, the plant diseases are caused by the abnormal physiological functionalities of plants. Therefore, the characteristic symptoms are generated based on the differentiation between normal physiological functionalities and abnormal physiological functionalities of the plants. Mostly, the plant leaf diseases are caused by Pathogens which are positioned on the stems of the plants. These different symptoms and diseases of leaves are predicted by different methods in image processing. These different methods include different fundamental processes like segmentation, feature extraction and classification and so on. Mostly, the prediction and diagnosis of leaf diseases are depending on the segmentation such as segmenting the healthy tissues from diseased tissues of leaves.

1.2 Purpose

In agricultural aspects, if the plant is affected by leaf disease then it reduces the growth of the agricultural level. Finding the leaf disease is an important role of agriculture preservation. The major problems that 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.Our System will help the farmers to deal with these problems by providing Fertilizer suggestion and Disease Detection System. We will develop an System that will detect crop diseases on scanning the leaves of the crops and also recommend the fertilizers based on the disease. The proposed concept also allows people to detect ailments by simply taking a picture with their smartphones and uploading it to the website.These different symptoms and diseases of leaves are predicted by different methods in image processing. These different methods include different fundamental processes like segmentation, feature extraction and classification and so on. Mostly, the prediction and diagnosis of leaf diseases are depending on the segmentation such as segmenting the healthy tissues from diseased tissues of leaves. They will be better equipped to recover their crops if they have a better understanding of the sickness that has affected their crop.

2. LITERATURE SURVEY

1.The proposed method uses SVM to classify tree leaves, identify the disease and suggest the fertilizer. The proposed method is compared with the existing CNN based leaf disease prediction. The proposed SVM technique gives a better result when compared to existing CNN. For the same set of images, F-Measure for CNN is 0.7and 0.8 for SVM, the accuracy of identification of leaf disease of CNN is 0.6 and SVM is 0.8. modified further to identify the disease that affects the various plant organs such as stems and fruits.

Detection of Leaf Diseases and Classification using Digital Image Processing International Conference on Innovations in Information, Embedded and Communication Systems(ICIIECS), IEEE, 2017.

Advantages: The system detects the diseases on citrus leaves with 90% accuracy. Disadvantages:System only able to detect the disease from citrus leaves. The main objective of this paper is image analysis and classification techniques for detection of leaf diseases and classification. The leaf image is firstly pre processed and then does the further work. K-Means Clustering used for image segmentation and then system extract the GLCM features from disease detected images. The disease classification done through the SVM classifier. Algorithm used: Gray-Level Co-Occurrence Matrix (GLCM) features, SVM, K-Means Clustering.

2.Semi-automatic leaf disease detection and classification system for soybean culture IET Image Processing, 2018 Advantages:The system helps to compute the disease severity. Disadvantages:The system uses leaf images taken from an online data set, so cannot implement in real time. This paper mainly focuses on the detecting and classifying the leaf disease of soybean plant. Using SVM the proposed system classifies the leaf disease in 3 classes like i.e. downy mildew, frog eye, and septoria leaf blight etc. The proposed system gives maximum average classification accuracy reported is ~90% using a big data set of 4775 images. Algorithm used: SVM.

3.Cloud Based Automated Irrigation And Plant Leaf Disease Detection System Using An Android Application. International Conference on Electronics, Communication and Aerospace Technology, ICECA 2017. Advantages:It is simple and cost effective system for plant leaf disease detection. Disadvantages:Any H/w failures may affect the system performance. The current paper proposes an android application for irrigation and plant leaf disease detection with cloud and IoT. For monitoring irrigation system they use soil moisture and temperature sensor and sensor data send to the cloud. The user can also detect the plant leaf disease. K-means clustering used for feature extraction. Algorithm used: K-means clustering, Other than this there are some other levels which can be used for sentimental analysis these are-document level, sentence level, entity and aspect level to study positive and

negative, interrogative, sarcastic, good and bad functionality, sentiment without sentiment,conditional sentence and author and reader understanding points.

The author proposes a method which helps us predict crop yield by suggesting the best crops. It also focuses on soil types in order to identify which crop should be planted in the field to increase productivity. In terms of crop yield, soil types are vital. By incorporating the weather details of the previous year into the equation, soil information can be obtained. Advantages :It allows us to predict which crops would be appropriate for a given climate. Using the weather and disease related data sets, the crop quality can also be improved. Prediction algorithms help us to classify the data based on the disease, and data extracted from the classifier is used to predict soil and crop. Disadvantages:Due to the changing climatic conditions, accurate results cannot be predicted by this system.

4.The current work examines and describes image processing strategies for identifying plant diseases in numerous plant species. BPNN, SVM, K-means clustering, and SGDM are the most common approaches used to identify plant diseases. Disadvantages : Some of the issues in these approaches include the impact of background data on the final picture, optimization of the methodology for a specific plant leaf disease, and automation of the technique for continuous automated monitoring of plant leaf diseases in real-world field circumstances.

5.The proposed method uses SVM to classify tree leaves, identify the disease and suggest the fertilizer. The proposed method is compared with the existing CNN based leaf disease prediction. The proposed SVM technique gives a better result when compared to existing CNN. For the same set of images, F-Measure for CNN is 0.7and 0.8 for SVM, the accuracy of identification of leaf disease of CNN is 0.6 and SVM is 0.8. Advantages : The prediction and diagnosing of leaf diseases are depending on the segmentation such as segmenting the healthy tissues from diseased tissues of leaves. Disadvantages : This further research is implementing the proposed algorithm with the existing public datasets. Also, various segmentation algorithms can be implemented to improve accuracy. The proposed algorithm can be

modified further to identify the disease that affects the various plant organs such as stems and fruits.

6.In this paper, we propose a user-friendly web application system based on machine learning and web-scraping called the 'Farmer's Assistant'. With our system,we are successfully able to provide several features - crop recommendation using Random Forest algorithm, fertilizer recommendation using arule 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 interface and quickly get their results. Advantages : For crop recommendation and fertilizer recommendation, we can provide the availability of the same on the popular shopping websites, and possibly allow users to buy the crops and fertilizers directly from our application. Disadvantages : To provide fine-grained segmentations of the diseased portion of the data set. this is not possible due to lack of such data. However, in our application,we can integrate a segmentation annotation tool where the users might be able to help us with the lack. Also, we can use some unsupervised algorithms to pin-point the diseased areas in the image. We intend to add these features and fix these gaps in our upcoming work.

2.1 EXISTING PROBLEM

The main walk of life of our Country is Agriculture. More than 70% of the population's lives depend upon agriculture. It is also a great source of country's economy.Finding the leaf disease is an important role of agriculture preservation.It does not make proper use of all available resources. Farmers are unable to detect crop diseases due to a lack of knowledge and old practices, which often result in soil nutrient deterioration and exhaustion. As a result, crop failure occurs. Growing only certain crops depletes the soil, and if the crops are harmed by illnesses, farmers are uninformed of how to recover such crops. Food needs cannot be met until and unless efficient resource management and use is implemented.

2.2 REFERENCE

1.Semi-automatic leaf disease detection and classification system for soybean culture IET Image Processing, 2018.

2.Cloud Based Automated Irrigation And Plant Leaf Disease Detection System Using An Android Application. International Conference on Electronics, Communication and Aerospace Technology, ICECA 2017.

3. Ms. Kiran R.Gavhale, Ujwalla Gawande, Plant Leaves Disease detection using Image Processing Techniques, January 2014.

4. Duan Yan-e, Design of Intelligent Agriculture Management Information System Based on IOT‖, IEEE,4th, Fourth International reference on Intelligent Computation Technology and Automation, 2011 https://ieeexplore.ieee.org/document/5750779

5. R. Neela, P. Fertilizers Recommendation System For Disease Prediction In Tree Leave International journal of scientific & technology research volume 8, issue 11, november 2019.

6. Swapnil,Jori1,Rutuja Bhalshankar2,Dipali Dhamale3, Sulochana Sonkamble ,Healthy Farm

7. Detection of Leaf Diseases and Classification using Digital Image Processing International Conference on Innovations in Information, Embedded and Communication Systems(ICIIECS), IEEE, 2017.

8.Shloka Gupta ,Nishit Jain ,Akshay Chopade, Farmer’s Assistant: A Machine Learning Based Application for Agricultural Solutions.

2.3 Problem Statement Definition

The agriculture sector in India is advancing due to globalization. As people become more health-conscious, producing quality crops is needed for today's world. Farmers add fertilizers to the soil to obtain maximum production. In agricultural aspects, if the plant is affected by leaf disease then it reduces the growth of the agricultural level.Finding the leaf disease is an important role of agriculture preservation. The major problems that 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. This project is truly based on Agriculture, this system will detect the plant disease based on snap and it will recommend the fertilizers for that particular disease.Consumers Farming is one of the major sectors that influences a country’s economic growth. In country like India, majority of the population is dependent on agriculture for their livelihood. Many new technologies, such as Machine Learning and Deep Learning, are being implemented into agriculture so that it is easier for farmers to grow and maximize their yield.Predicting the fertilizers, Analyzing the disease in a tap makes the life of farmers easy with minimal subscriptions would provide an acceptable return for the organization.An automated system is introduced to identify different diseases on plants by checking the symptoms shown on the leaves of the plant. Deep learning techniques are used to identify the diseases and suggest the precautions that can be taken for those diseases.

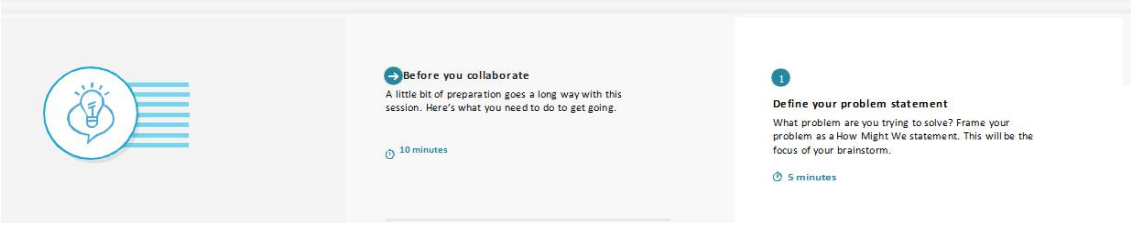
3. IDEATION AND PROPOSED SOLUTION

3.1 Empathy Map Canvas

Agriculture is the main aspect of the economic development of a country. Agriculture is the heart and life of most Indians. By understanding their feelings and problems, we can create a better product and contribute to their lives. For our project, we are getting surveys from farmers to understand what they truly require and desire.

3.2 Ideation and Brainstorming

Fertilizer Recommendation System For Diseases prediction



Fertilizer Recomentation System for Disease Prediction

Agriculture is the most important sector in today's life. Most plants are affected by a wide variety of bacterial and fungal diseases. Diseases on plants placed a major constraint on the production and a major threat to food security. Hence early and accurate identification of plant diseases is essential to ensure high quantity and best quality. In recent years, the number of diseases on plants and the degree of harm caused has increased due to the variation in pathogen varieties, changes in cultivation methods, and inadequate plant protection techniques.

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

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

Learn how to use the facilitation tools
Use the Facilitation Superpowers to run a happy and productive session.

Open article →

PROBLEM

1) In agricultural aspects, if the plant is affected by leaf disease, then it reduces the growth and productiveness. Generally, the plant diseases are caused by the abnormal physiological Functionalities of plants.
2) People who Grow Crops and facing Issues of Plant Disease .
3) The Traditional methods of Fertilizer prediction and Disease analysis are Expensive and takes a lot of time.

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.

2

Brainstorm

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

⏱10 minutes

TIP
You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!

Bairavi J

- Website for Fertilizer recommendation
- Identify the disease
- Determining best fertilizer
- User friendly website
- It reduces man power
- Smart solution to solve the problem

Devishree

- Pre-trained model for image classification
- Build keras image classification model
- Making revolutionary changes in agriculture field
- It simplifies the farmers work
- Cost of using this application is less
- They can find the diseases at early stages

Meera A

- Deep learning based mathematical model for detecting diseases
- Early detection and management of problem
- Better utilization of available resources
- Interactive user interface to upload images
- Improves productivity
- Interactive user interface to upload images

Sangeetha R

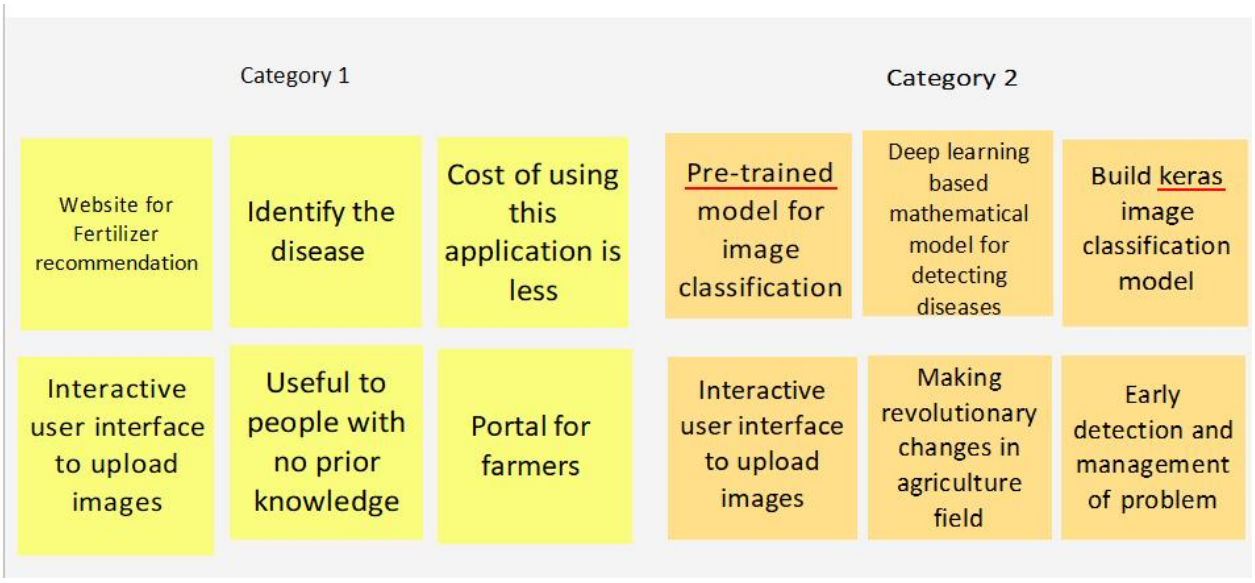
- Fertilizer Recommendation
- Instant solution
- Useful to people with no prior knowledge
- Admin can view the recommended fertilizer through gmail
- It will save time
- Portal for farmers

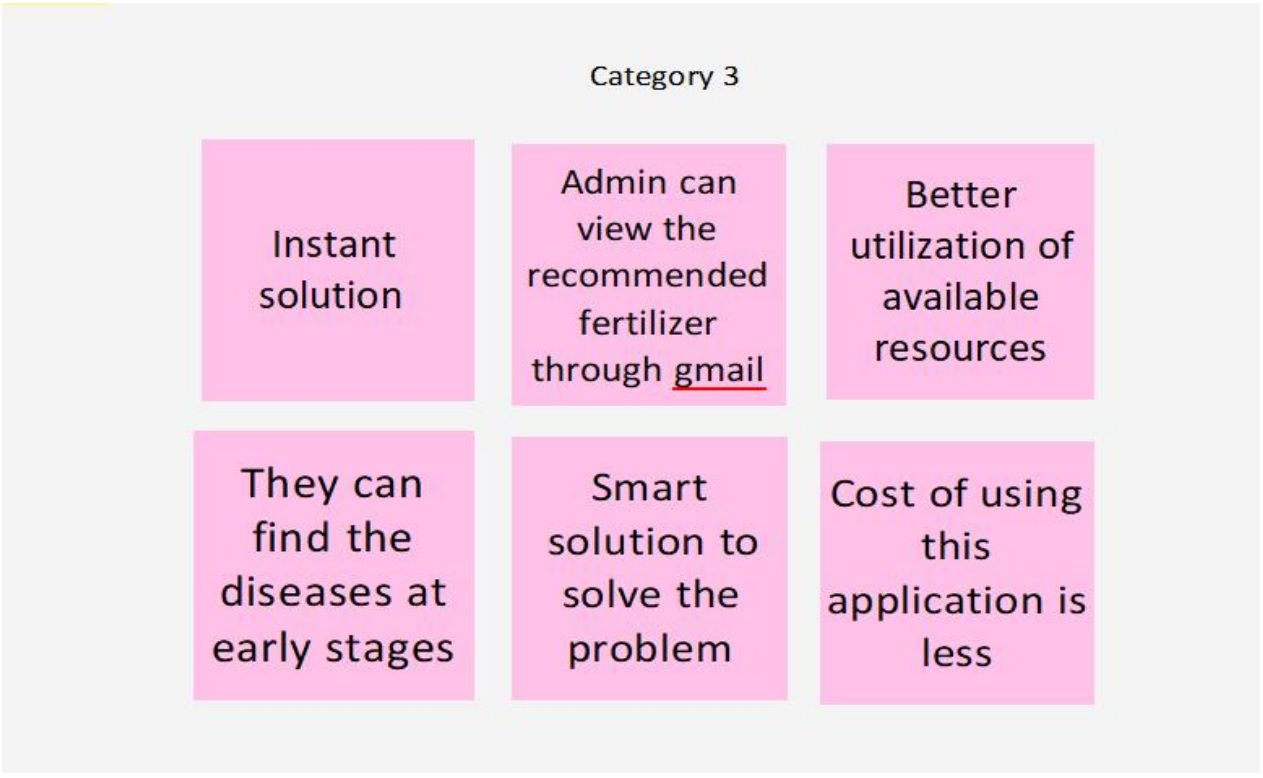
3

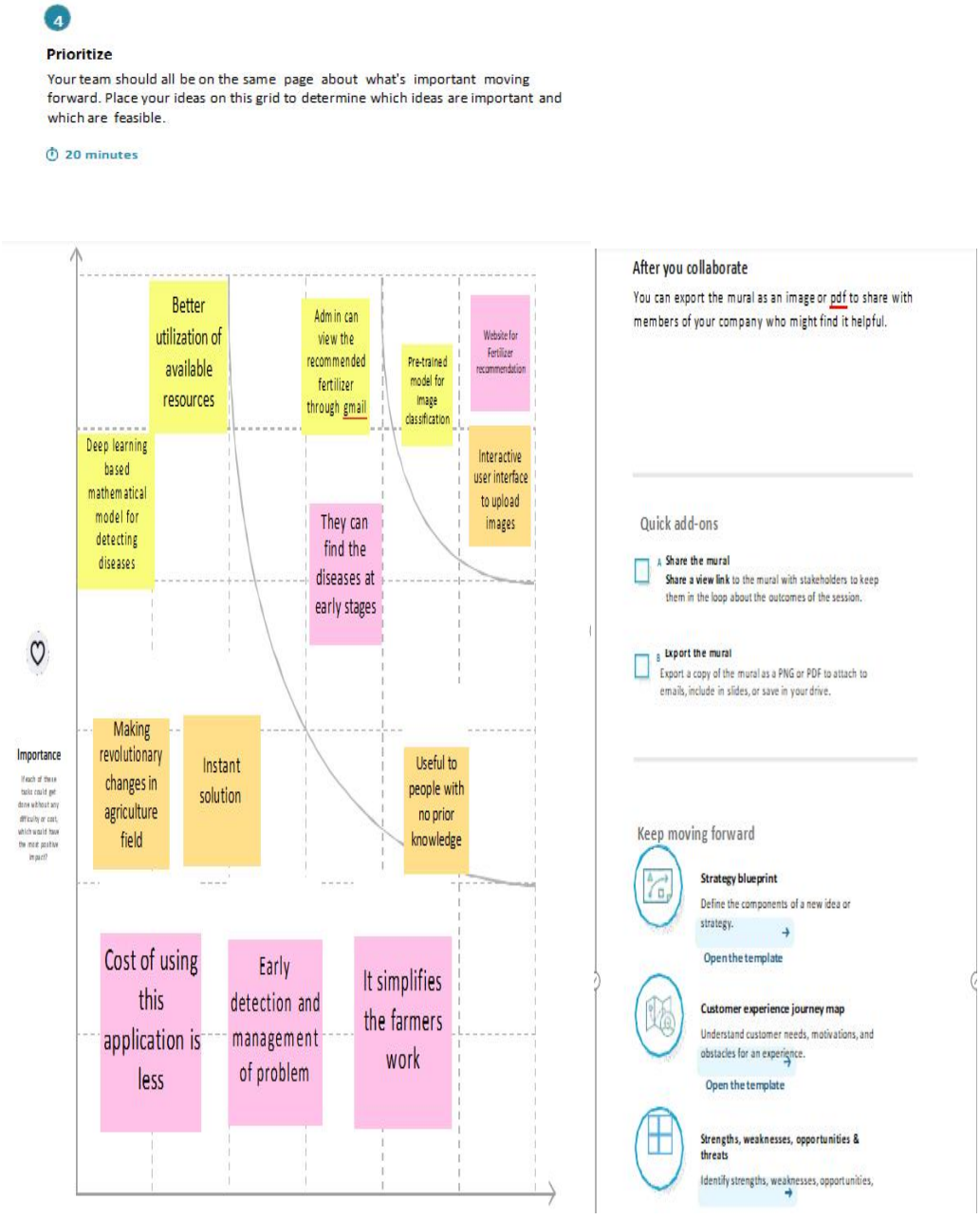
Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. In the last 10 minutes, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

⏱ 20 minutes





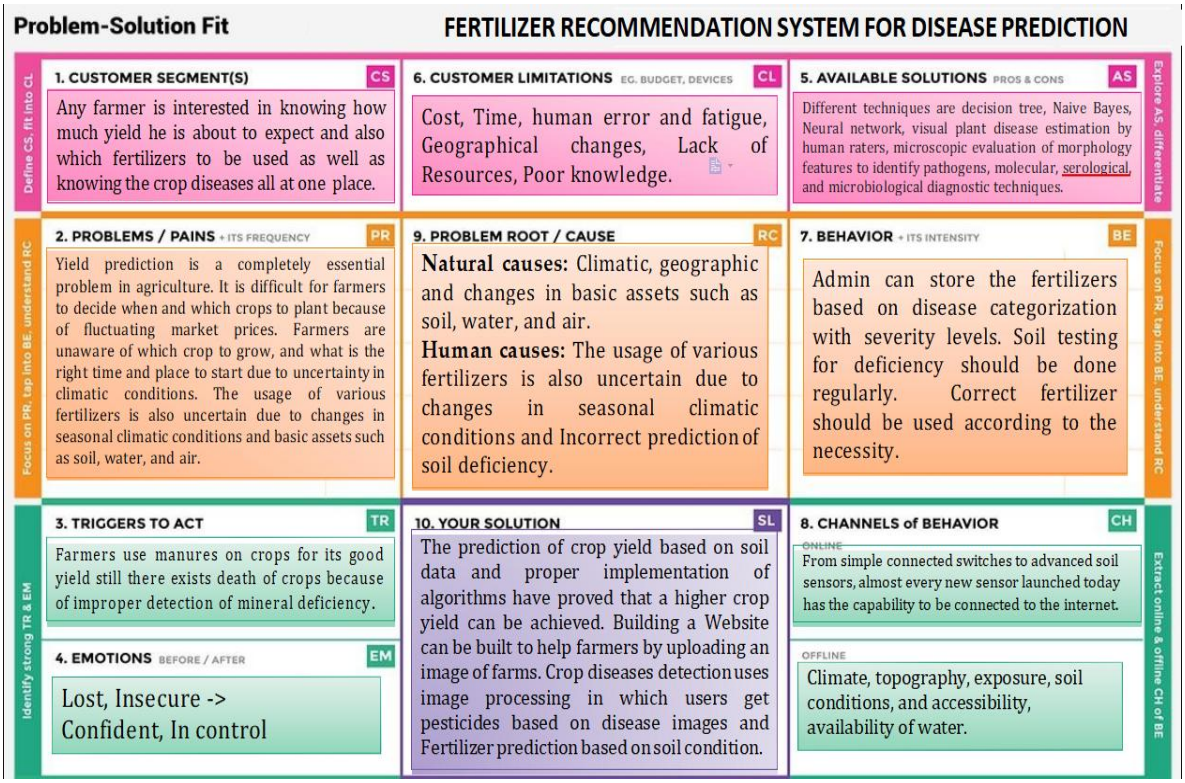


3.3 Proposed Solution

The solution to the problem is Machine learning, which is one of the applications of Artificial Intelligence,is being used to implement the proposed system. To overcome all these issues this recommendation has been proposed . Nowadays a lot of research and work is being implemented in the smart and modern agriculture domain.Crop recommendation is characterized by a soil database comprised of Nitrogen, Phosphorus, potassium.The

ensembles technique is used to build a recommendation model that combines the prediction of multiple machine learning. Models to recommend the right crop based on soil value and the best fertilizer to use.

3.4 Problem Solution Fit



The prevalent problem among the farmers is Crop choice depending upon the soil in their farmlands. Another challenge faced by farmers is choosing the right fertilizers for their crops, which plays a very important role in getting a good and profitable yield. There is another major problem which they have to give more attention is the pest control or the diseases to which the plants may limit their growth.The above listed problems may solved using the advanced techniques of Precision Agriculture and data mining.

4. REQUIREMENT ANALYSIS

Functional Requirements:

FR No.	Functional Requirement (Epic	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Specific characterist	It identifies the diseases especia lly rice bran diseases
FR-4	Functions	The proposed methods uses the SVM to class leaves, identify the diseases and suggest the
FR-5	Fault tolerance	This study enables a possible prediction of crop yie from the historic data collected and offers a sugge to farmers.
FR-6	Ana lyze	It helps us to classify the data based on the d and data extracted from the classifier is used soil and crop.

Non Functional Requirements:

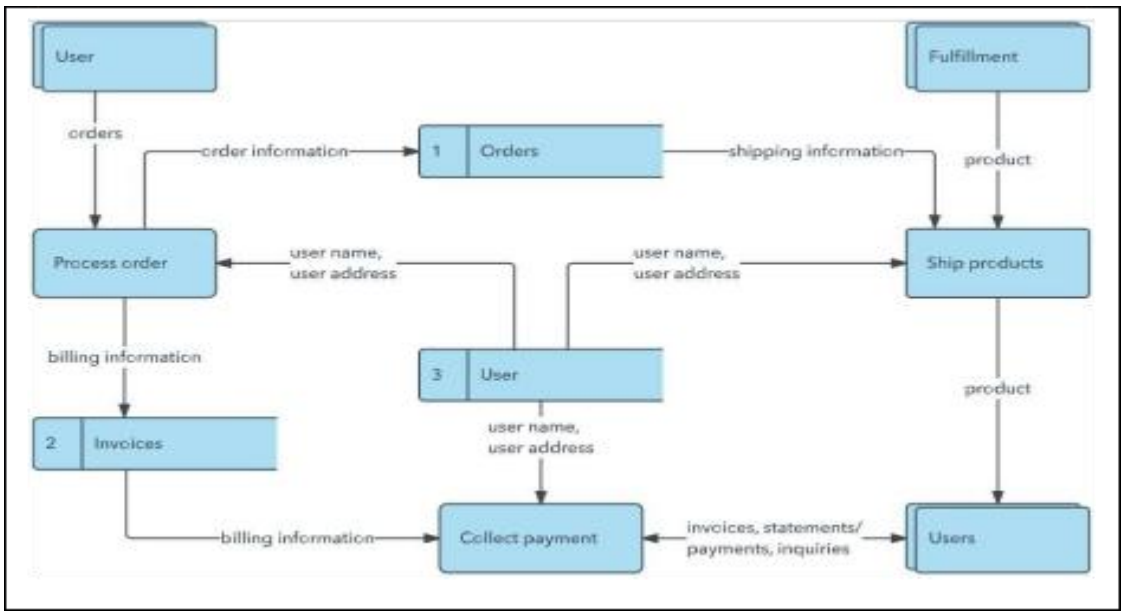
Non-Functional Requirement	Description
Usability	Crop and fertilizer recommendation system hel farmer to identify the diseases.
Security	The proposed method combines two major asp in farming , pest identification and insecticide recommendation.
Reliability	It is easy use so that health issues can be avoide
Performance	Precision fertilizer and precision crops is mostly used. They used to predict the crop in artificial intelligence.
Availability	reduces the losses as ammonia , nitrate apply the right rate, apply accurately.

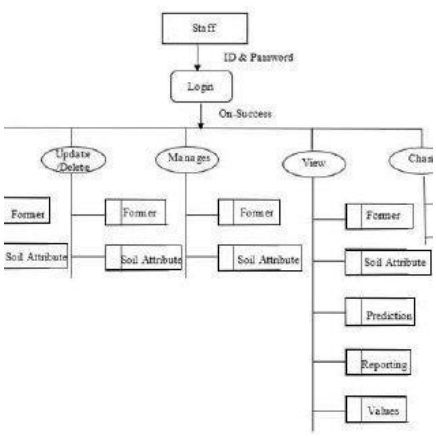
5. PROJECT DESIGN

5.1 Data Flow Diagram

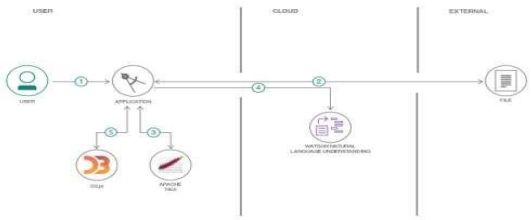
A Data Flow Diagram(DFD) is a traditional visual representation of the information with in a system.A neat and clear DFD can deplicit the right amount of the system requirement graphically.It shows how data enters and leaves the system,what changes the system,what changes the information and where data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

Example:DFD Level 0(Industry Standard)



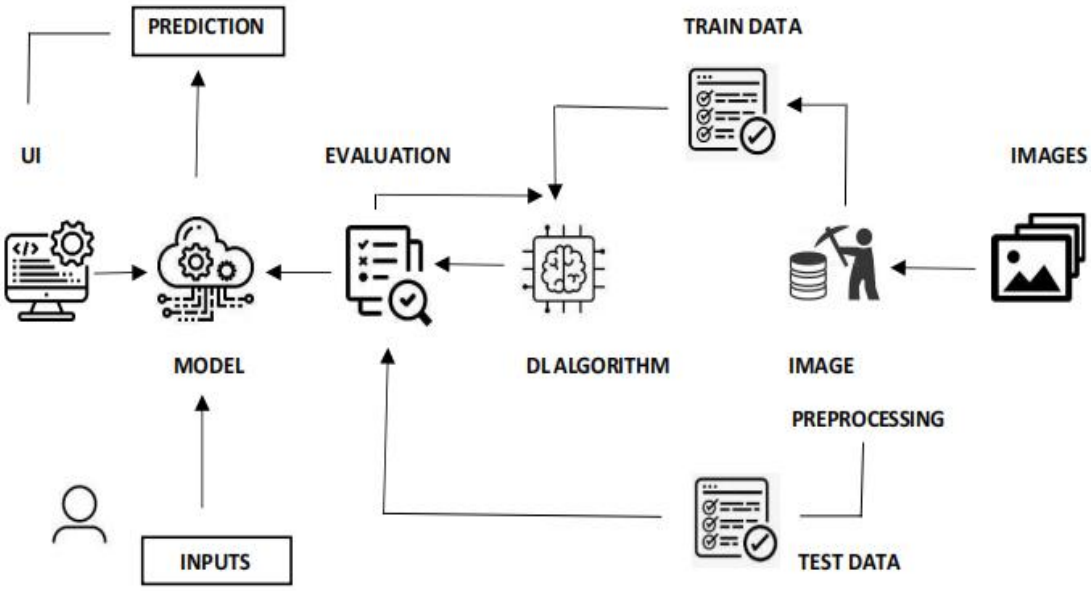


Flow



1. User configures credentials for the Watson Natural Language Understanding service and starts the app.
2. User selects data file to process and load.
3. Apache Tika extracts text from the data file.
4. Extracted text is passed to Watson NLU for enrichment.
5. Enriched data is visualized in the UI using the D3.js library.

5.2 Solution and Technical Architecture



5.3 User Stories

Use the below template to list all the user stories for the product.

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
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1

6. PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning and Estimation

7. CODING AND SOLUTIONING

i) Exploratory data analysis

For better understanding data set and their relationship we will use some statistical and visualization function.

In [1]:

```
# Importing libraries and packages for basic statistics
import os
#To change working directory
import pandas as pd
# to read and manipulating data
import numpy as np
# to calculate mean and standard deviations
pd.options.display.max_columns = 100pd.options.display.max_rows = 100
import warnings warnings.simplefilter(action='ignore',
category=FutureWarning)warnings.simplefilter(action='ignore',
category=UserWarning)
```

Reading the data as Pandas DataFrame

In [2]:

```
#Load dataset to start EDA
#Changing working directoryos.chdir(r'C:\Users\asUs\Downloads')gfbqn d
# To read 'csv' file with panda librarydf = pd.read_csv('Fertilizer
Prediction.csv')
```

After reading the dataset, we use head() function to display the dataset and columns function for column name.

In [3]:

```
# To display the first 10 rows of datasetdisplay
```

	Temperature	Humidity	Rainfall	pH	N	P	K	Soil	Crop	Fertilizer
0	24.87	82.84	295.61	6.59	4.0	2.0	2.5	Clayey	rice	DAP and MOP
1	28.69	96.65	178.96	6.08	4.0	4.0	4.0	laterite	Coconut	Good NPK
2	20.27	81.64	270.44	5.01	4.0	4.0	2.0	silty	clay rice	MOP
3	25.07	95.02	192.90	5.55	2.0	2.1	3.5	sandy	Coconut	Urea and DAP
4	25.04	95.90	174.80	6.18	2.0	3.9	2.1	coastal	Coconut	Urea and MOP
5	20.82	84.13	230.22	6.46	2.5	4.0	3.0	clay	rice	Urea
6	25.95	93.41	172.05	5.84	2.5	4.0	2.0	alluvial	Coconut	Urea and MOP
7	26.49	80.16	242.86	6.98	4.2	2.3	3.2	Clayey	rice	DAP
8	25.01	95.59	165.81	6.00	2.0	3.9	2.1	coastal	Coconut	Urea and MOP
9	21.87	80.19	224.56	5.95	2.9	3.5	3.9	silty	clay rice	Urea

Observations:

Number of rows = **200**

Number of columns = **10** (**9** feature variables and **1** target variable)

Number of categorical(object) variables = **3**: Soil, Crop, Fertilizer (target variable)

Number of numerical variables = **7**: Temparature, Humidity, Rainfall, pH, N, P, K

In [6]:

```
# checking the no. of missing values in the dataset
df.isnull().sum()
```

```
Temperature    0
Humidity       0
Rainfall       0
pH             0
N              0
P              0
K              0
Soil           0
Crop           0
Fertilizer     0
dtype: int64
```

*# statistics of the numerical variables*display(df**.**describe()**.**T)

	count	mean	std	min	25%	50%	75%	max
Temperature	200.0	25.55720	2.544626	20.05	23.8200	25.975	27.310	29.87
Humidity	200.0	88.56315	6.636224	80.12	82.2250	87.495	94.930	99.98
Rainfall	200.0	206.07385	43.954794	131.09	172.3725	203.435	233.115	298.56
pH	200.0	6.21130	0.622228	5.01	5.7600	6.125	6.440	7.87
N	200.0	3.11550	0.910193	2.00	2.2000	2.500	4.000	4.20
P	200.0	3.13050	0.929213	2.00	2.0750	3.900	4.000	4.00
K	200.0	2.95600	0.721364	1.90	2.1000	3.000	3.500	4.00

*# statistics of the category variables*display(df**.**describe(include='object'))

	Soil	Crop	Fertilizer
count	200	200	200
unique	7	2	7
top	silty clay	Coconut	Urea and MOP
freq	42	100	42

Importing libraries for data visualization

In [9]:

import matplotlib.pyplot **as** plt *# to visualize graph***%matplotlib** inline
import seaborn **as** sns *# for better visualization of graph with the help of Matplotlib#%pip install dython* **from** dython **import** nominal *# to find out correlation and visualize it*

Explore the Target variable: Fertilizer

In [10]:

 # print the unique class of the Fertilizer print("There are seven class in Fertilizer: ", df['Fertilizer']**.**unique())

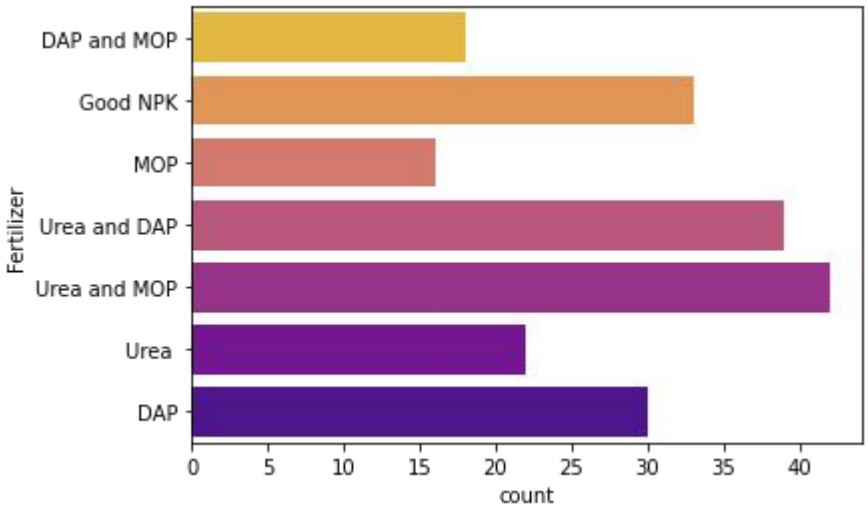
There are seven class in Fertilizer: ['DAP and MOP' 'Good NPK' 'MOP' 'Urea and DAP' 'Urea and MOP' 'Urea '

'DAP']

In [11]:

*#Visualization of the class in Fertilizer category with countplot*sns.countplot(y='Fertilizer',data=df,palette="plasma_r")

Out[11]:



Explore the continuous and categorical feature variables

In [12]:

*# Defining function for Continuous variable and their relationship with target variable***def** plot_conti(x):

fig, axes = plt.subplots(nrows=1,ncols=3,figsize=(20,6),tight_layout=**True**)

axes[0].set_title('Distogram')

sns.distplot(x,ax=axes[0])

axes[1].set_title('Checking Outliers')

sns.boxplot(x,ax=axes[1])

axes[2].set_title('Relation with target variable')

sns.boxplot(y = x,x = df['Fertilizer'])

Univariate Analysis

In [13]:

*# EDA - Temparature variable*plot_conti(df['Temperature'])

10.ADVANTAGES

- In the crop recommendation application, the user can provide the soil data from their side and the application will predict which crop should the user grow.
- For the fertilizer recommendation application, the user can input the soil data and the type of crop they are growing, and the application will predict what the soil lacks or has excess of and will recommend improvements.
- For the last application, that is the plant disease prediction application, the user can input an image of a diseased plant leaf, and the application will predict what disease it is and will also give a little background about the disease and suggestions to cure it.
- These all are to improve the Agriculture, that's slightly reduces the poverty, climatic condition, soil erosion etc …
- Predicting the fertilizers, Analyzing the disease in a tap makes the life of farmers easy with minimal subscriptions would provide an acceptable return for the organization. This action adds a lot of value to the company and the business in society.
- Our Fertilizer Recommentation system for disease Prediction is in the form of web application to provide this valuable service to the environment and society.

11.CONCLUSION

Different approaches and models of Deep Learning methods were explored and used in this project so that it can detect and classify plant diseases correctly through image processing of leaves of the plants. The procedure starts from collecting the images used for training, testing and validation to image pre processing and augmentation and finally comparison of different pre trained models over their accuracy. Finally, at the end , our model detects and distinguishes between a healthy plant and different

diseases and provides suitable remedies so as to cure the disease.This paper proposed and developed a system which uses plant leaf images to detect different types of disease in tomato crops, and also provides appropriate fertilizer suggestions.

12. FUTURE SCOPE

The system successfully interprets various Diseases and is also capable of providing fertilizers suggestion for the respective disease. Furthermore, this system can be made more robust by incorporating more image data set with wider variations like more than one leaf in a single image. An App could also be developed for the project which could make the work of the farmers easier.They could directly upload image on the app and it would tell the disease and the cure then and there.This would reduce the time and efforts.This project is limited to just one crop for now but in the future more crops and even flowers data set can be added so that it is helpful for every agricultural need.Newer models can also be added and tried with time which may result in better accuracy and would make the model even faster.