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Project Report Format

1. ***INTRODUCTION***

1.1 Project Overview

Nowadays, artificial intelligence and sensor technology play a vital role in the agriculture field. The use of excess insecticides and fertilizers in farming poses a risk to human health. It is necessary to control them to ensure healthy crop production. Many techniques are used to identify the pest, suggest medications, and do soil nutrient analysis techniques separately. It applies the dual operator, Transition Probability Function (TPF), and Convolution Neural Network (CNN) to process the pest's image discretely and continuously for applying the recommended insecticide. The mathematical model with the objective function is derived.

1.2 Purpose

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 80 s. Successful identification of five pests, namely aphids, bollworms, leaf folder, leaf miner, and green stink bug, was done with more than 90% accuracy. The proposed approach is also compared with the other intelligent approaches, such as Artificial Neural Network (ANN), K-Nearest Neighbour (KNN), and Support Vector Machine (SVM), and it is observed that the proposed TPF-CNN approach gives higher accuracy in the shortest time.

2. ***LITERATURE SURVEY***

2.1 Existing problem

- *Implementation of artificial intelligence for identification of pests and recommendation of insecticides using TPF-CNN.*
- *Implementation of soil sensor for soil NPK nutrient analysis and recommendation of fertilizers accordingly.*
- *The combination of two major things required in farming in one system is spraying proper insecticides and adding the needed fertilizer amount to the soil.*
- *Efficient approach for controlling the overuse of insecticides and fertilizers in farming.*
- *Time efficient approach compared to KNN, SVM and ANN.*

2.2 References

1)https://www.researchgate.net/publication/364316884_Fertilizers_Recommendation_System_for_Fruits_and_Vegetables_Disease_Prediction?_sg=C7t1JYs-NloHdVQQcNAYmVrZ-bJdL5kXIF88Bhx6lpLRGB98jC_-EA9ZpMNFZIrBcDowATgBX54MW94

2)https://www.researchgate.net/publication/363380794_Intelligent_Insecticide_and_Fertilizer_Recommendation_System_based_on_TPF-CNN_for_Smart_Farming?_sg=du38AOnwpAFu8SiOCA03BvE-vCcEgDVLTpUiBGNy_pO6tYPe07fRSEVdKWQTbO2A6StX9npKSoXBaZ0

3)https://www.researchgate.net/publication/342967267_A_Recommended_System_for_Crop_Disease_Detection_and_Yield_Prediction_Using_Machine_Learning_Approach

4)http://www.ijstr.org/final-print/nov2019/Fertilizers-Recommendation-System-FozDisease-Prediction-In-Tree-Leave.pdf

5) https://ijirt.org/master/publishedpaper/IJIRT155991_PAPER.pdf

6)https://www.semanticscholar.org/paper/Fertilizers-Recommendation-System-For-Disease-In-Neela-Nithya/495379d3ef2b461fabd2de8d0605c164cb1e396f

7) https://arxiv.org/pdf/2204.11340

8) https://arxiv.org/pdf/2106.10698

9) https://arxiv.org/pdf/2208.02446

2.3 Problem Statement Definition

- *Farmers usually detect the crop diseases and plant diseases with their naked eye which makes them take tough decisions on which fertilizers to use.*
- *In case the farmer makes wrong predictions and uses the wrong fertilizers or more than the normal dose (or) threshold or Limit (every plant has some threshold fertilizers spraying to be followed), it will mess up the whole plant (or) soil and cause enough damage to plant and fields.*
- *It is necessary to develop crop yield prediction and fertilizer recommendation systems which predict crop yield based on soil nutrients crop yield data and recommend fertilizer*

for selected crops based on different datasets like fertilizer data,location data and crop yield data.

3.IDEATION & PROPOSED SOLUTION

1. Empathy Map Canvas

WHAT DOES HE THINK AND FEEL?

- *He felt that "It is easy to do farming with the automated fertilizer and disease prediction system. Best disease finder*
- *App to do better farming*
- *App which provide confidence farmer*

WHAT DOES HE SEE?

- *He would be looking for a handy device to make farming easy. It will provide the information of disease in his land.*
- *Options to scan field plant Simple menu and settings dashboard*
- *Image of plant Spotted region*

WHAT DOES HE HEAR

- *He would hear like it is nice app you can easily find the disease*
- *Making easier farming It provides best campaign*
- *You can use it is a easier process*

WHAT DOES HE SAY AND DO?

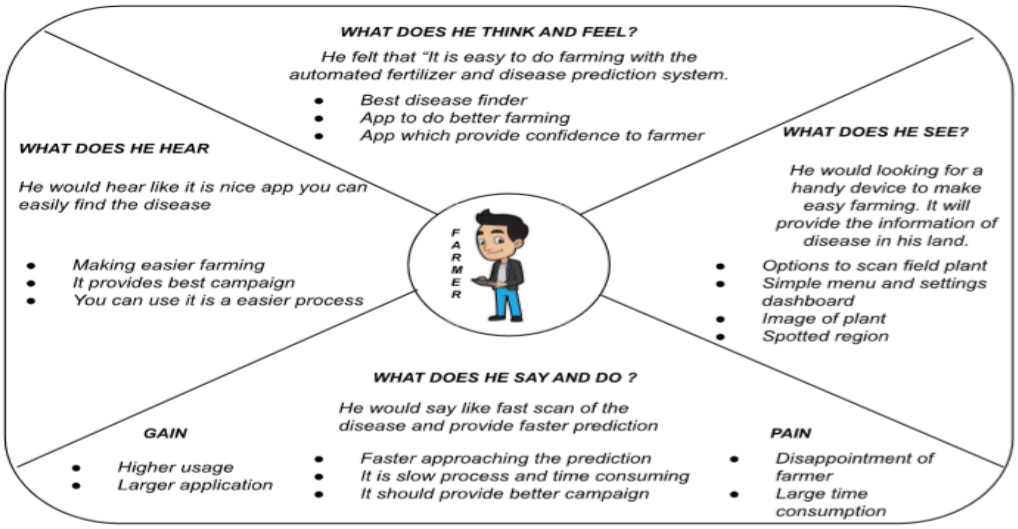
- *He would say like fast scan of the disease and provide faster prediction*
- *Faster approaching the prediction*
- *It is slow process and time consuming*
- *It should provide better campaign*

PAIN

- *Disappointment of*
- *ming*
- *farmer*
- *Large time*
- *consumption*

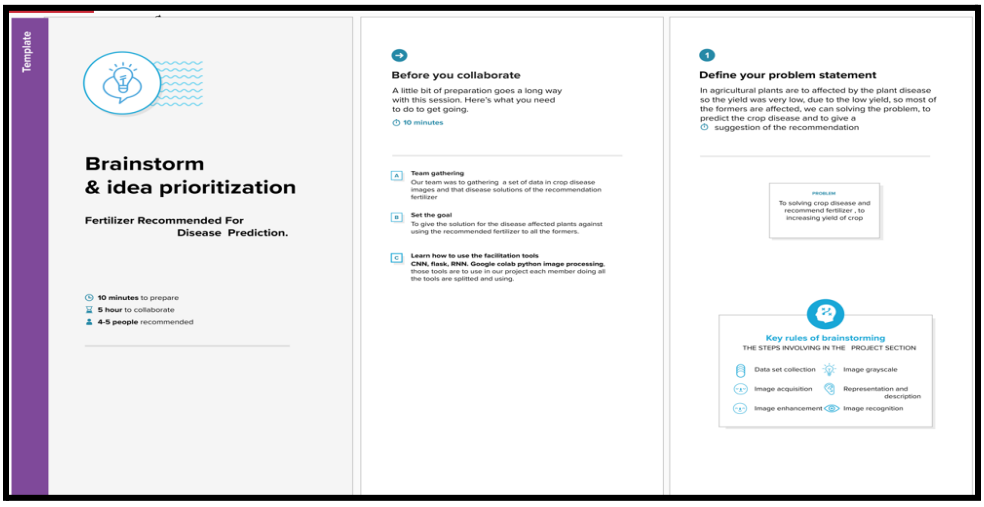
GAIN

- *Higher usage Larger application*

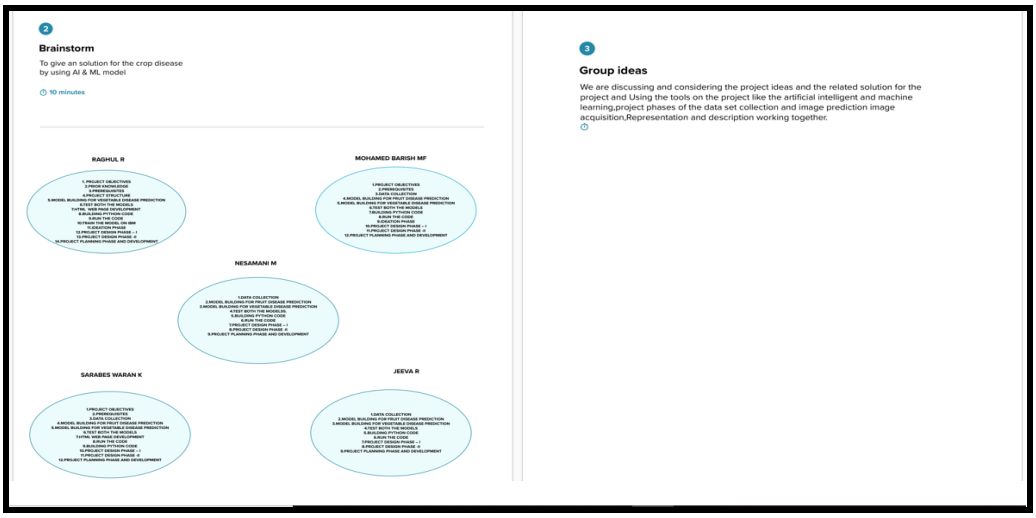


2. Ideation & Brainstorming

Agricultural plants are affected by the plant disease so the yield was very low, due to the low yield, so most of the farmers are affected. We can solve the problem, to predict the crop disease and to give a suggestion of the recommendation.CNN, flask, RNN. Google colab python image processing, those tools are to use in our project each member doing all the tools are splitted and using.Our team was to gathering a set of data in crop disease images and that disease solutions of the recommendation fertilizer



(A)Team Gathering, Collaboration and Select the Problem Statement



(B)Brainstorm, Idea Listing and Grouping

3.Proposed Solution

Problem Statement (Problem to be solved)

- *Farmers usually detect the crop diseases and plant diseases with their naked eye which makes them take tough decisions on which fertilizers to use.*
- *In case the farmer makes wrong predictions and uses the wrong fertilizers or more than the normal dose (or) threshold or Limit (every plant has some threshold fertilizers spraying to be followed), it will mess up the whole plant (or) soil and cause enough damage to plant and fields.*
- *It is necessary to develop crop yield prediction and fertilizers recommendation system which predicts crop yield based on soil nutrients crop yield data and recommend fertilizer for selected crop based on different datasets like fertilizer data,location data and crop yield data*

Idea / Solution description

- *Implementation of artificial intelligence for identification of pests and recommendation of insecticides using TPF-CNN.*
- *The combination of two major things required in farming in one system is spraying proper insecticides and adding the needed fertilizer amount to the soil.*
- *Implementation of soil sensor for soil NPK nutrient analysis and recommendation of fertilizers accordingly*

Novelty / Uniqueness

- *Efficient approach for controlling the overuse of insecticides and fertilizers in farming.*

- *Time efficient approach compared to KNN, SVM andANN.*
- *It can suggest and predict the best and correct fertilizer for disease in the plant.*

Social Impact / Customer Satisfaction

- *Yield the right crop at the right time, balancing the crop production, controlling plant disease, economic growth and planning to reduce the crop scarcity. Hence 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 implemented a new fertilizers Recommendation System for crop disease prediction*

Business Model (Revenue Model)

- *Typically dedicate 10% of their AI investment to algorithms, 20% to technologies and 70% to embedding AI into business processes and agile ways of working. In other words, companies invest twice as much in people and processes as they do in technologies*

Scalability of the Solution

- *This can be improved by introducing online purchases crops, fertilizers,etc., easily*

4.Problem Solution fit

1.CUSTOMER SEGMENT(S)

Who is your customer?

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

2.JOBS-TO-BE-DONE/PROBLEMS Which jobs to be done for problems) do you address for you

Define CS, fit into CC?customers There could be more than one explore different ades

- *Focus on J&P, tap into BE, understand R*
- *It provides a good fertilizer recommendation for their crops.*
- *It analyzes the disease which affects their plants.*
- *Its shows a set of crops which suitable for their soil and their climate*

3.TRIGGERS

- *People will feel that our project provides a bunch of valuable services at an affordable price.*
- *People who are using our project will get great relief in disease precautions.*

4.CUSTOMER CONSTRAINTS

- *What constraints prevent your customers from taking action or limit their choice*

spending power budget no path network connection

- *A web application, Which is supported in almost all devices.*
- *Graphical representation is easy to understand for all the people.*
- *Results for their problem will be in minutes.*

5.PROBLEM ROOT CAUSE

- *Traditional way are expensive*
- *Farmers want to get results instantly*
- *To improve Production in low cost and easy*
- *Traditional way does not contain an easily understandable graphical representation of results.*

6.YOUR SOLUTION

- *By Building an AI, ML based web applications make their issues resolved in seconds.*
- *Expensive process affordable. Minimize the Time for analyzing their problem*

7.AVAILABLE SOLUTIONS

Which are available to the customers when they face the job dime? What have they tried in the past?

- *The Al will end the existing problem, by providing results in low prices.*
- *It's affordable by all people and the results are provided instantly . Its Supports in Mobile Desktop, etc (Almost all device support)*

8.BEHAVIOUR

- *. 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*
- *Ensure the causes previously and provide solutions before the damage happens.*

9.CHANNELS of BEHAVIOUR

- *1.1 ONLINE .Their Data analyzed early with help of cloud rendering.*
- *1.2 OFFLINE It improves their crops production and reduces the losses*

3. REQUIREMENT ANALYSIS

3.1 Functional requirement

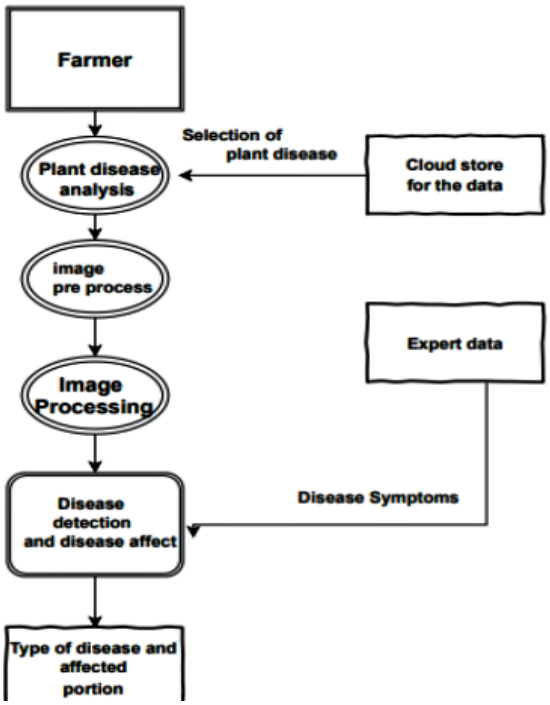
- *The developed **system** helps to give information related to moisture levels and soil **requirements**, **fertilizers**, and pesticides.*
- *Introduced a coordinated descent algorithm for parameter calibration in agricultural models. A calibrated Root Zone Water Quality Model (RZWQM) model is also developed to determine the recommendations for fertilizer, Urea Ammonium Nitrate (UAN) and irrigation amount which would help maximize the profit per hectare of the farm.*
- *In addition, it is used to predict uncertain rainfall that affects the crops. Furthermore, I used Meteorological Data to predict the crop yields.*
- *The data represents different crop nutrients levels. A neural network-based regression model is also proposed to predict the rain occurrence of the relevant geographical area. They collected the data from kaggle and IBM dataset etc,.*
- *The features include temperature, humidity, values, and rainfall for the last ten years. The regression model can improve the selected geo-location rainfall prediction. Different data mining algorithms have also been applied to agriculture.*
- *The model could predict the water in the irrigation system that uses the soil condition, weather, and crop conditions as the major features for prediction.*

3.2Non-Functional requirements

Non-functional requirements are a set of specifications that describe the system's operation capabilities and constraints and attempt to improve its functionality. These are basically the requirements that outline how well it will operate including things like speed, security, reliability, data integrity etc.

4. PROJECT DESIGN

4.1 Data Flow Diagrams



4.2Solution & Technical Architecture;

Solution Architecture:

Detection and recognition of plant diseases using machine learning are very efficient in providing symptoms of identifying diseases at its earliest. Plant pathologists can search 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.

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 bacteria, virus, or other microorganisms that can cause disease, 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 dependent on the segmentation such as segmenting the healthy tissues from diseased tissues of leaves.

Devices, new project management tools and fast, transparent file sharing has changed the way we look at teamwork. By embracing new technology and digital innovations, a whole host of barriers to efficiency and business problems can be solved by technology.

The Convolutional layers are used to classify and process the images and further help in recommending the fertilizers.

The image classification steps are

- ➢ *Image acquisition*
- ➢ *Preprocessing*
- ➢ *Segmentation*
- ➢ *Disease Prediction*
- ➢ *Fertilizer Recommendation*

Insights and customer communication:

One of the most important things for a business to have is insight into its customers and audience. Knowing who you are talking to, and who you want to talk to, is the first step in marketing, design, R&D, and almost every other aspect of a successful company.

New innovations in data gathering, analytics and digital insights mean that modern businesses have an unprecedented amount of information about their current and potential customers at their fingertips.

Security:

Solving problems with technology can also be about preventing problems in the first place. New tech like artificial intelligence and machine learning can make a huge difference when it comes to cyber security, and organizations that embrace this can protect themselves far more effectively against an increasingly sophisticated and dynamic breed of cyber criminal.

Cloud services:

Cloud is changing the way you do business. As a cloud computing services provider, we can migrate your technology to the cloud, integrate your cloud and on-premise technology into a hybrid solution, and train your people on the cloud. With over 25 years in the IT industry, CompuVision is a pioneer in cloud service integration and management.

Challenges:

At the beginning of the 19th century, there were almost no man-made nitrogen compounds in the environment. But in the years after the Haber-Bosch breakthrough, their levels began to skyrocket, driven by the massive uptake of synthetic fertilizers and other human activities like the manufacturing of munitions and the burning of fossil fuels, both of which create chemically reactive forms of nitrogen. Nutrient run-off from farms laced with synthetic fertilizer has adversely affected land ecosystems, according to the United Nations-backed Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

But freshwater and marine habitats have been hit hardest, with recurrent algal blooms such as in Lake Erie, and "dead zones" left of aquatic life as in the Gulf of Mexico, it says. Human health is also at risk.

Agricultural ammonia emissions can combine with pollution from vehicle exhausts to create dangerous particulates in the air and exacerbate respiratory diseases, including COVID-19. One study has estimated that air pollution may increase mortality associated with COVID-19 by 15 per cent. To stem the tide of nitrogen pollution, a growing number of governments, companies and international bodies, including the United Nations Environment Programme (UNEP), have been working with scientists to better understand the risks associated with human use of nitrogen, and to raise awareness. To that end, almost exactly a year ago United Nations Member States endorsed an ambition to halve nitrogen waste from all sources by 2030.UNEP also recently established the global "Halve

Nitrogen Waste" campaign, highlighting the fact that improving nitrogen use efficiency not only supports climate, nature and health goals but also (an estimate based on half the value of global synthetic fertilizer sales).

Solution:

Globally, synthetic fertilizers are behind the bulk of global food production and they're especially important in developing countries. That, experts say, will make a transition away from them challenging.

However, initiatives to stake out a more sustainable way of growing food are plentiful. A recent article from the Soil Association, a United Kingdom-based charity and advocate of organic farming, calls for much greater attention to nitrous oxide emissions in global greenhouse gas accounting; more integrated efforts to tackle nitrogen excess as a climate, nature and health issue; and incentives for better nitrogen management at farm level.

But organic farming methods are not the only example of sustainable nutrient management: including conservation, low-input, and minimum tillage agriculture, are all recognized as "nature-positive" and regenerative practices. From farm to fork, 80 percent of nitrogen is wasted and lost to the environment. according to a study by the Centre for Ecology & Hydrology in the United Kingdom.

More efficient use of animal manure and greater use, in rotations, of nitrogen-fixing crops – such as legumes which convert nitrogen from the air into a form that is biologically useful – will be crucial to replace synthetic nitrogen as part of the process of rebuilding soil fertility.

There is consensus that everyone should be using manure and urine better, says Mark Sutton, a lead author of the study. "Simple actions include putting a lid on the manure tank, which stops ammonia being lost to air. If you can smell your manure, it means you are wasting it in the atmosphere," he says. "Financial incentives and political buy-in will be necessary to overcome the many obstacles in the way of nitrogen-light farming methods," says Susan Gardner, head of the UNEP Ecosystems Division.

"But the bottom line remains: we need to dramatically reduce the quantity of reactive nitrogen being released into the environment from all sources, especially from synthetic fertilizers which represent one of the biggest nitrogen flows." "The sustainable use of nitrogen offers a triple win – for the economy, for human health, and for the environment,".

The International Nitrogen Management System (INMS) is a global science-support system for international nitrogen policy development established as a joint activity of UNEP and the International Nitrogen Initiative. Structure: The fertilizer recommender calculates all of the fertilizer combinations that will suit the crop's needs at the lowest cost. Farmers can use the web to access the system.

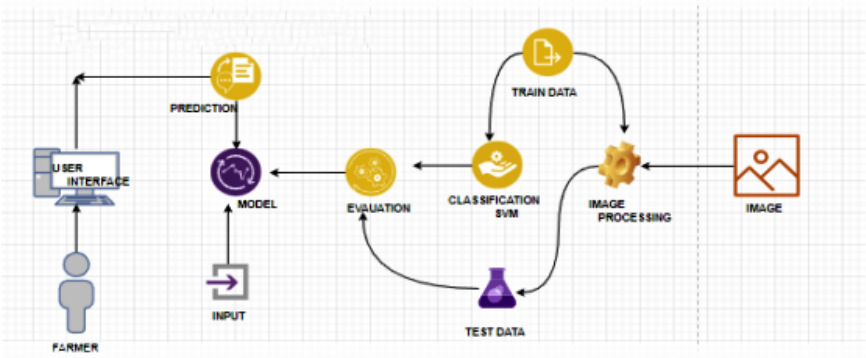
Characteristics:

A good quality, Free-flowing (easily applied) Consistent in particle size with smooth and hard granules. Easily spread – ensuring even distribution patterns. Quickly dissolve when in contact with moist soil or water (avoid run-off) Free from contaminants and additives. Aspects of software: The software requires farmer field location, respective soil and land type, and crop type and variety information to generate crop-specific instant fertilizer recommendations.

Specification and delivered:

We propose an architectural model aid in deploying a smart farming system with limited energy consumption. Moreover, focusing on the application layer, we implement a deep learning approach to build a fertilizer recommendation system that matches the expert's opinion.

Solution Architecture:



Technical Architecture:

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How the user interacts with applications e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	A page to upload images as input	Python
3.	Application Logic-2	To use the Machine Learning model and predict The result.	IBM Watson STT service
4.	Database	Structured data – images	MySQL, NoSQL, etc.
5.	Cloud Database	Database that typically runs on a cloud computing platform and access to the database is providing as a service	IBM DB2, IBM Cloudant etc.
6.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
7.	Machine Learning Model	Here, we use a Support Vector Machine Algorithm that is used widely in classification and regression problems.	Random Forest, XGBoost.

Table-2: Application Characteristics

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Flask micro web framework	Written in python. It is classified as a micro framework because it does not require particular tools or libraries. It has no database abstraction layer, form validation, or any other components where the third party libraries provide common functions.
2.	Security Implementations	With all aspects of the job including detecting malicious attacks, analyzing the network endpoint and vulnerability assessment, Sign in encryption.	IBM Cloud App ID Services
3.	Availability	Available for all data size	500MB
4.	Performance	Can extend the storage according to our needs.	Python

4.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Developer	Registration	USN-1	As a developer, I can sign up and register respective sites to access the required details and data. And import the required libraries for the processes	I can access the account / dashboard	High	Sprint-1
Assistant developer	Login	USN-2	As an assistant developer, I will access the page and test and train the CNN model to predict or detect the plant diseases.	I can test and confirm the error free detections	High	Sprint-2
Customer Care Executive	Worker	USN-3	As a customer care executive ,I am available to the customers .So if the customers have any issues or in need of any assistance they will get help and solve them.	I can be in contact with the customers.	High	Sprint-3
Customer (Web user)	Login	USN-4	As a user , I will have the access to know about the activities in the plant.	I can get messages when there is disease in plants	High	Sprint-4

5.PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation

Sprint	*Functional Requirement (Epic)*	*User Story Number*	*User Story / Task*	*Story Points*	*Priority*	*Team Members*
Sprint-1	*Model Creation and Training (Fruits)*	*USN-1*	*Create a model which can classify diseased fruit plants from given images. I also need to test the model and deploy it on IBM Cloud*	*8*	*High*	*RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M*
Sprint-1	*Model Creation and Training (Vegetables)*	*USN-2*	*Create a model which can classify diseased vegetables plants from given images*	*8*	*High*	*RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M*
Sprint-2	*Model Creation and Training (Fruits)*	*USN-3*	*Create a model which can classify diseased Fruit plants from given images and train on IBM Cloud*	*6*	*High*	*RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M*
Sprint-2	*Registration*	*USN-4*	*As a user, I can register by entering my email, password and confirming my password or*	*3*	*Medium*	*RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M*

			via OAuth API			

Sprint	***Functional Requirement (Epic)***	***User Story Number***	***User Story / Task***	***Story Points***	***Priority***	***Team Members***
			where I can upload my pictures of crops			*SARABES WARAN K JEEVA R NESAMANI M*
Sprint-2	*Suggestion results*	*USN-6*	*As a user, I can view the results and then obtain the suggestions provided by the ML model*	*4*	*High*	*RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M*
Sprint-2	*Base Flask App*	*USN-7*	*A base Flask web app must be created as an interface for the ML model*	*2*	*High*	*RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M*

Sprint-3 *Sprint-3* *Sprint-3* *Sprint-3*	*Login* *User Dashboard* *Integration* *Containerization*	*USN-8* *USN-9* *USN-10* *USN-11*	*As a user/admin/shopkeeper, I can log into the application by entering email & password* *As a user, I can view the previous results and history* *Integrate Flask, CNN model with Cloud ant DB* *Containerize Flask app using Docker*	*2* *3* *5* *2*	*High* *Medium* *Medium* *Low*	*RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M* *RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M* *RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M* *RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M*
Sprint-4	*Dashboard (Admin)*	*USN-12*	*As a admin, I can view other user details and uploads for other purposes*	*2*	*Medium*	*RAGHUL R MOHAMED BARISH MF SARABES WARAN K*

Sprin	***Function***	***User***	***User Story /***	***Story***	***Priori***	***Team Members***

t	al Requirement (Epic)	Story Number	Task	Points	ty	
						JEEVA R NESAMANI M
Sprint -4	Dashboard (Farmer)	USN-13	As a shopkeeper, I can enter fertilizer products and then update the details if any	2	Low	RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M
Sprint -4	Containerization	USN-14	Create and deploy Helm using Docker Image made before	2	Low	RAGHUL R MOHAMED BARISH MF SARABES WARAN K JEEVA R NESAMANI M

Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart

Sprint	Total Story Points	Duration Sprint Start Date	Sprint	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days 31 Oct 2022 06 Nov 2022		3.33	04 Nov 2022
Sprint-2	20	4 Days 05 Nov 2022 09 Nov 2022		5	08 Nov 2022
Sprint-3	20	4 Days 07 Nov 2022 12 Nov 2022		5	15 Nov 2022
Sprint-4	20	6 Days 14 Nov 2022 19 Nov 2022		3.33	19 Nov 2022

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

5.1 Feature 1

You can find here

5.2 Feature 2

You can find here

5.3 Database Schema (if Applicable)

7.TESTING

Test Case Analysis/User Acceptance Testing

This report shows the number of test cases on the Print Engine,Client Application,Security,Outsource Shipping,Exception Reporting,Final Report Output,Version Control,that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

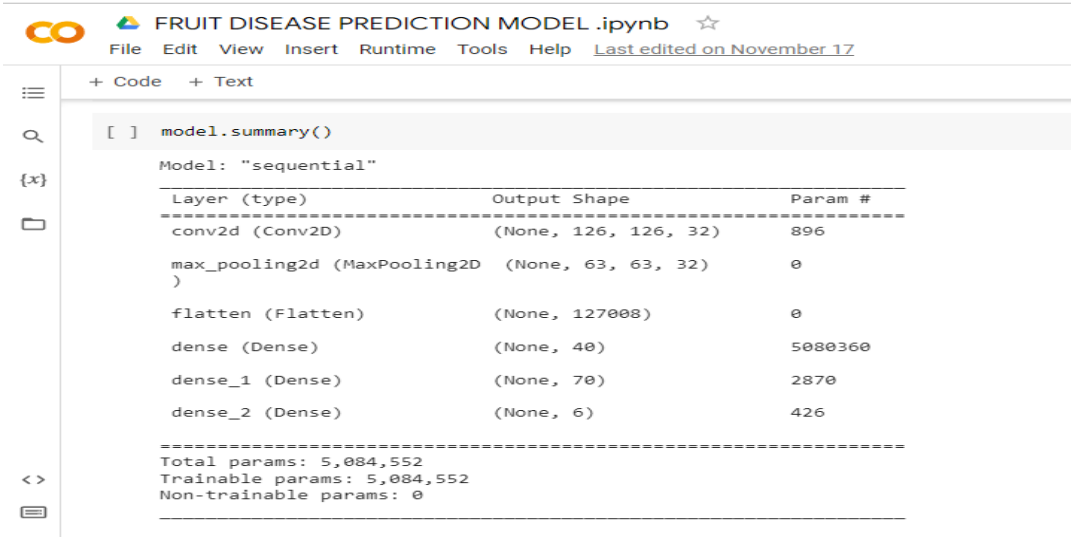
Defect Analysis

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	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

6. *RESULTS*

6.1 Performance Metrics



FRUIT DISEASE PREDICTION MODEL .ipynb

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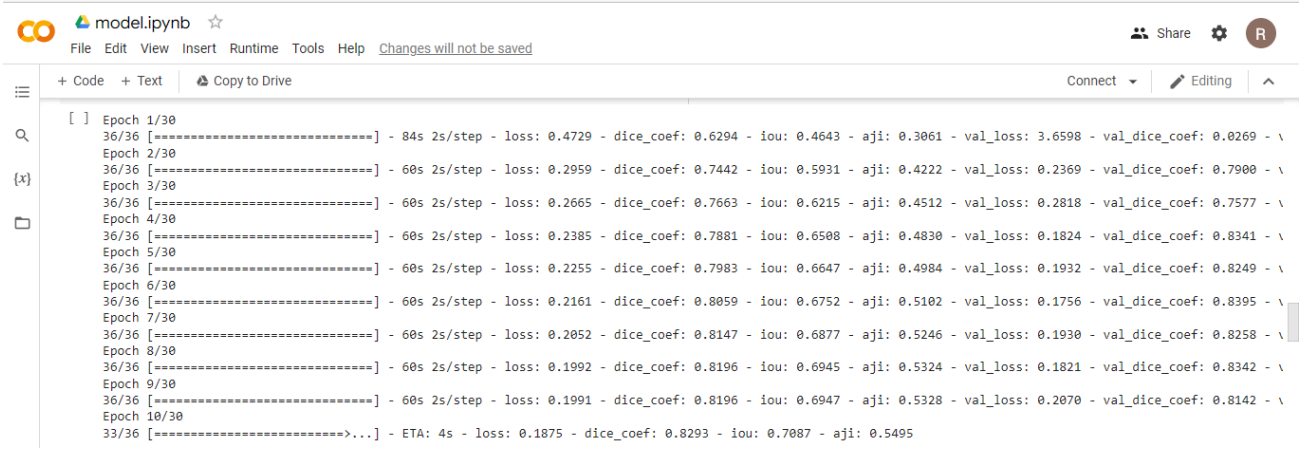
```
[ ]  model.summary()
```

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 126, 126, 32)      896

 max_pooling2d (MaxPooling2D  (None, 63, 63, 32)       0
 )

 flatten (Flatten)           (None, 127008)            0

 dense (Dense)               (None, 40)                5080360

 dense_1 (Dense)             (None, 70)                2870

 dense_2 (Dense)             (None, 6)                 426

=================================================================
Total params: 5,084,552
Trainable params: 5,084,552
Non-trainable params: 0
_________________________________________________________________
```



model.ipynb

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```
[ ]  Epoch 1/30
36/36 [==============================] - 84s 2s/step - loss: 0.4729 - dice_coef: 0.6294 - iou: 0.4643 - aji: 0.3061 - val_loss: 3.6598 - val_dice_coef: 0.0269 - \
Epoch 2/30
36/36 [==============================] - 60s 2s/step - loss: 0.2959 - dice_coef: 0.7442 - iou: 0.5931 - aji: 0.4222 - val_loss: 0.2369 - val_dice_coef: 0.7900 - \
Epoch 3/30
36/36 [==============================] - 60s 2s/step - loss: 0.2665 - dice_coef: 0.7663 - iou: 0.6215 - aji: 0.4512 - val_loss: 0.2818 - val_dice_coef: 0.7577 - \
Epoch 4/30
36/36 [==============================] - 60s 2s/step - loss: 0.2385 - dice_coef: 0.7881 - iou: 0.6508 - aji: 0.4830 - val_loss: 0.1824 - val_dice_coef: 0.8341 - \
Epoch 5/30
36/36 [==============================] - 60s 2s/step - loss: 0.2255 - dice_coef: 0.7983 - iou: 0.6647 - aji: 0.4984 - val_loss: 0.1932 - val_dice_coef: 0.8249 - \
Epoch 6/30
36/36 [==============================] - 60s 2s/step - loss: 0.2161 - dice_coef: 0.8059 - iou: 0.6752 - aji: 0.5102 - val_loss: 0.1756 - val_dice_coef: 0.8395 - \
Epoch 7/30
36/36 [==============================] - 60s 2s/step - loss: 0.2052 - dice_coef: 0.8147 - iou: 0.6877 - aji: 0.5246 - val_loss: 0.1930 - val_dice_coef: 0.8258 - \
Epoch 8/30
36/36 [==============================] - 60s 2s/step - loss: 0.1992 - dice_coef: 0.8196 - iou: 0.6945 - aji: 0.5324 - val_loss: 0.1821 - val_dice_coef: 0.8342 - \
Epoch 9/30
36/36 [==============================] - 60s 2s/step - loss: 0.1991 - dice_coef: 0.8196 - iou: 0.6947 - aji: 0.5328 - val_loss: 0.2070 - val_dice_coef: 0.8142 - \
Epoch 10/30
33/36 [==========================>...] - ETA: 4s - loss: 0.1875 - dice_coef: 0.8293 - iou: 0.7087 - aji: 0.5495
```

7. *ADVANTAGES & DISADVANTAGES:*

Advantages:

- *It concerns time and quantity.*
- *These efficient and compact advantages are achieved by transitioning the frequency distribution of images from continuous to discrete over probability.*

- *The main objective of the proposed work is to enhance agricultural production and productivity by offering smart technology which will recommend insecticides and fertilizers for crops and soil respectively.*

Disadvantages:

- *Unintended consequences also need to be taken into account. For example, an AI system programmed to deliver the best crop yield in the short term might ignore the environmental consequences of its endpoint, leading to overuse of fertilizers and soil erosion in the long term.*
- *Agriculture has its disadvantages in the following areas:* ***increased use of chemicals, uneven water distribution, reliance on organic fertilizers, and increased food miles****.*

8. CONCLUSION:

The proposed system has to predict the plant disease as a sample from a farming land and recommends the suitable fertilizer needed to apply on the correct proportion to nourish the soil for the crop selected. The proposed system helps the farmers to maximize the yield for the given crop cycle without affecting the land and soil properties. This also ensures that healthy crops have been cultivated by reducing the chances of over fertilization. This fertilizer recommendation system opens up new opportunities in the field of robotics to create autonomous mobile robots to spray appropriate fertilizer. Smart farming and precision farming can be advanced by calculating

The TPF-CNN dual operator approach makes the insecticide recommendation operation efficient and compact. The proposed system consists of combined insecticide and fertilizer recommendation systems, which will help farmers gain maximum farm yield. Also, the soil nutrients would be managed efficiently, resulting in nutrient-rich soil. The cost incurred for laboratory testing of soil nutrients will reduce. The proposed approach gives the recommendation of insecticides in a short time of 10 s and fertilizer recommendation in 60 s only. Compared to other approaches such as KNN, SVM, and ANN, it gives nearly 20% higher performance. This system can be used anywhere as it is standalone and does not require an internet connection. In

the future, the system can be integrated with more sensors such as pH, temperature, humidity, and moisture sensors for open and indoor farming. Also, this system can be used in online and offline modes. This system can be recommended for farmers, soil testing laboratories, and seed hybridizing companies. The limitations of this model are it does not save any data on the system or cloud database.

9. FUTURE SCOPE:

The prediction of crop yield based on location and proper implementation of algorithms have proved that the higher crop yield can be achieved. From above work I conclude that for soil classification Random Forest is good with accuracy 86.35% compared to Support Vector Machine. For crop yield prediction Support Vector Machine is good with accuracy 99.47% compared to Random Forest algorithm. The work can be extended further to add following functionality. Websites can be built to help farmers by uploading images of farms. Crop disease detection using image processing in which users get pesticides based on disease images. Implement Smart Irrigation System for farms to get higher yield.

10. APPENDIX

Source Code

You can find the source code here (click on blue line to access)

GitHub & Project Demo Link

You can find Git Repo here (click on blue line to access)

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