IOT BASED SMART CROP PROTECTION SYSTEM FOR AGRICULTURE

TEAM ID: PNT2022TMID15088

NALAIYA THIRAN PROJECT BASED LEARNING ON PROFESSIONAL READINESS FOR INNOVATION EMPLOYMENT AND ENTERPRENEURSHIP

A PROJECT REPORT BY

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1. INTRODUCTION

1.1 Project overview

- The device will detect the animals and birds using the Clarifai service.
- If any animal or bird is detected the image will be captured and stored in the IBM Cloud object storage.
- It also generates an alarm and avoid animals from destroying the crop .
- The image URL will be stored in the IBM Cloudant DB service.
- The device will also monitor the soil moisture levels, temperature, and humidity values and send them to the IBM IoT Platform.
- The image will be retrieved from Object storage and displayed in the web application.
- A web application is developed to visualize the soil moisture, temperature, and humidity values .
- Users can also control the motors through web application.

1.2 PURPOSE

An intelligent crop protection system helps the farmers in protecting the crop from the animals and birds which destroy the crop. This system also helps farmers to monitor the soil moisture levels in the field and also the temperature and humidity valuesnear the field. The motors and sprinklers in the field can be controlled using the mobile application.

2. LITERATURE SURVEY

2.1 Existing Problem

Most of the farmers are facing many problems nowadays due to many reasons.

Our problem to solve is the invasion of various species such as birds and animals that harm the crops that are being cultivated. Various types of species such as birds and animals come to the cultivation field according to the crop that is being cultivated andalso according to the season of cultivation. Some wild animals enterthe field during night times when the field is near a forest region or when the farm cultivates some fruits and other crops that attractanimals. Some animals cross the field in search of food and waterand also the birds enter the field for food and they damage all the crops. When the animals enter the field they not only eat food but they also damage the entire field by walking upon the crops and alsoby spoiling the food crops. The birds, by entering the field they

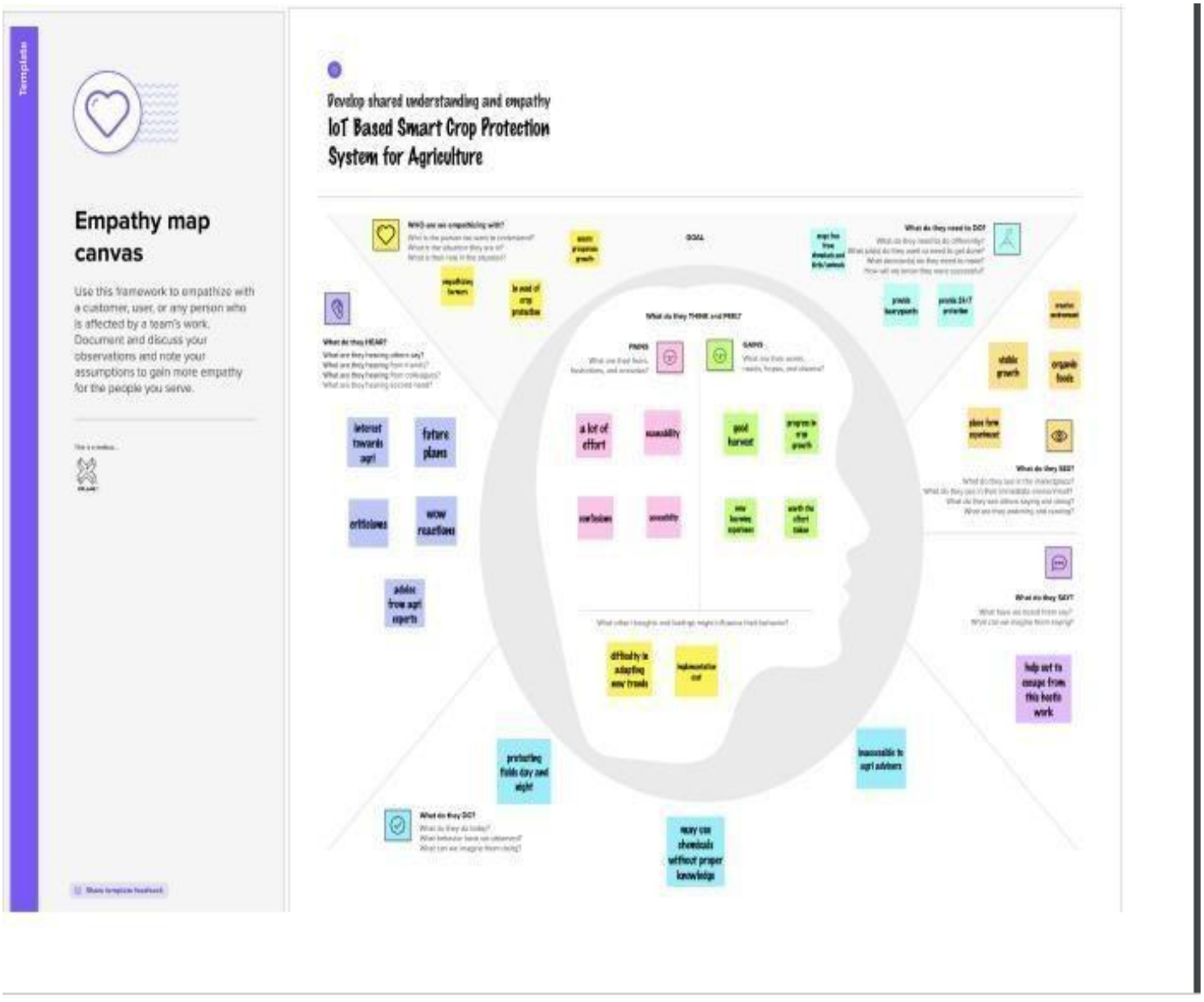
come to eat seeds of the crops and also they tend to drag the crops and ruin the entire field. Some birds enter the field to eat the insects and pests in the field.

2.2 Problem Statement Definition

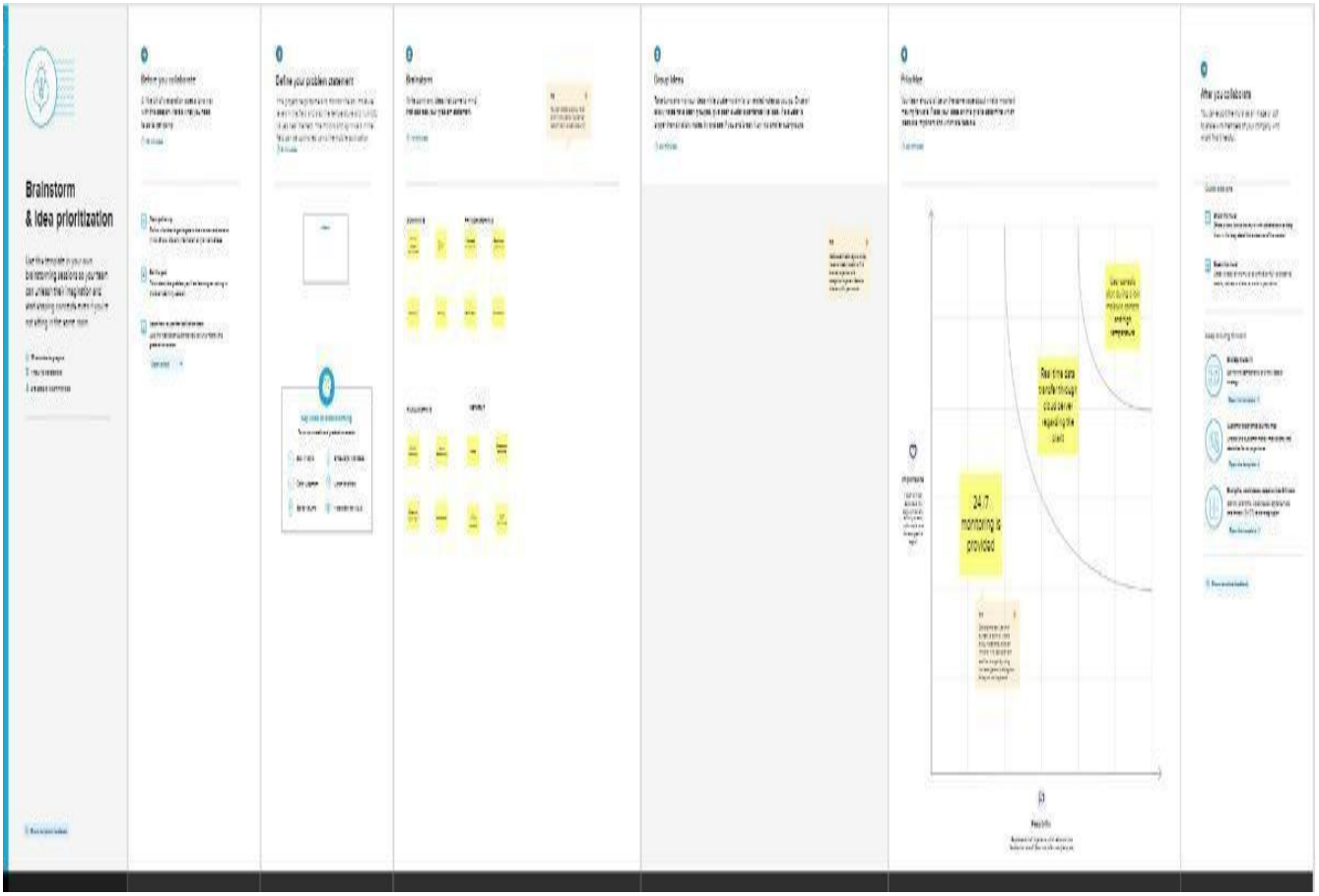
Most of the farmers are facing many problems nowadays due to many reasons. Our problem to solve is the invasion of various species such as birds and animals that harm the crops that are being cultivated. Various types of species such as birds and animals come to the cultivation field according to the crop that is being cultivated andalso according to the season of cultivation. Some wild animals enter thefield during night times when the field is near a forest region or when the farm cultivates some fruits and other crops that attract animals.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.1 Ideation and Brainstorming



3.3 Proposed Solution

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	➢ Farm crops are frequently destroyed by neighborhood animals including buffalo, cows, goats, birds, etc. ➢ The farmer suffers enormous losses as a result.
2.	Idea/Solution description	➢ Here, we suggest a mechanism for automatically protecting crops from animals. ➢ This microcontroller-based system uses a microcontroller from the PIC family. ➢ These systems employ a motion sensor to identify approaching wild animals close to the field
3.	Novelty / Uniqueness	➢ Certain cultural techniques can stop or lessen crop damage caused by insects. ➢ These include where crop residues are placed, deep ploughing , crop rotation, fertilizer use, strip-cropping, irrigation, and planned planting activities.
4.	Social Impact / Customer Satisfaction	➢ The number of smartphone applications that can help farmers make better crop protection decisions is steadily rising. ➢ Despite the fact that recent studies have concentrated on smart phone adoption generally and farmers' willingness to pay for crop protection apps, none have concentrated on the initial adoption choice. ➢ Traditional farming practices relied heavily on the farmer

		being present in the field to continuously assess the state of the soil and the health of the crop.
5.	Scalability of the Solution	➢ Utilizing crop leftover for increased animal protection and manures for increased crop protection might be considered integration. ➢ Integration is a strategy for increasing outputs (family food, agricultural products for sale, etc) while reducing input (purchase, labor).

3.4 Problem Solution Fit

PROJECT TITLE: IOT BASED SMART CROP PROTECTION SYSTEM FOR AGRICULTURE

PROJECT DESIGN PHASE 1: SOLUTION FIT

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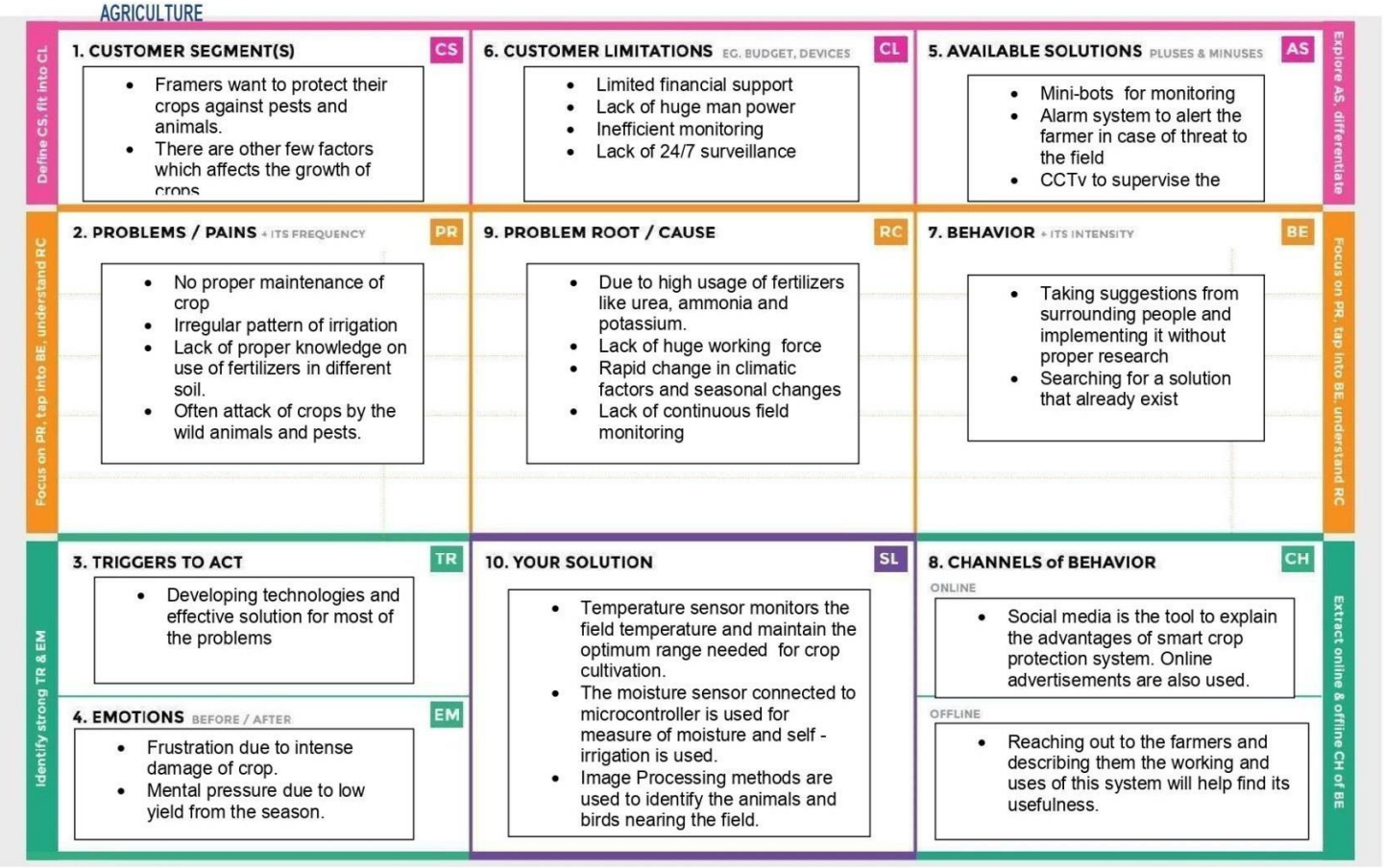


4.REQUIREMENT ANALYSIS

4.1 Functional Requirements:

Following are the functional requirements of the proposed solution

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	• Install the application. • Sign up with the g-mail. • Create a profile.
FR-2	User Confirmation	For confirmation, user will be sent OTP to the Registered -mail ID.
FR-3	User Visibility	• Sensors sense the animals that comes nearer to the field. • The alarm sound (ultrasonic sound) is activated to scare them away and sends alert message to the farmers to notify what happens here using the cloud service.
FR-4	Accessing datasets	• Data is obtained by Cloudant DB. • If any animal or bird is detected, the image will be captured and stored in the IBM Cloud object storage. • The image will be retrieved from Object storage And displayed in the application.
FR-5	Interface sensor	• Connect the sensor and the application through IBM Watson platform. • When animals enter the field the alarm sound rings which is not harmful for animals, it only scares them away.
FR-6	Mobile application	• It is used to control motors and field sprinklers. • It is used to send alarm

4.2 Non-functional Requirements:

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

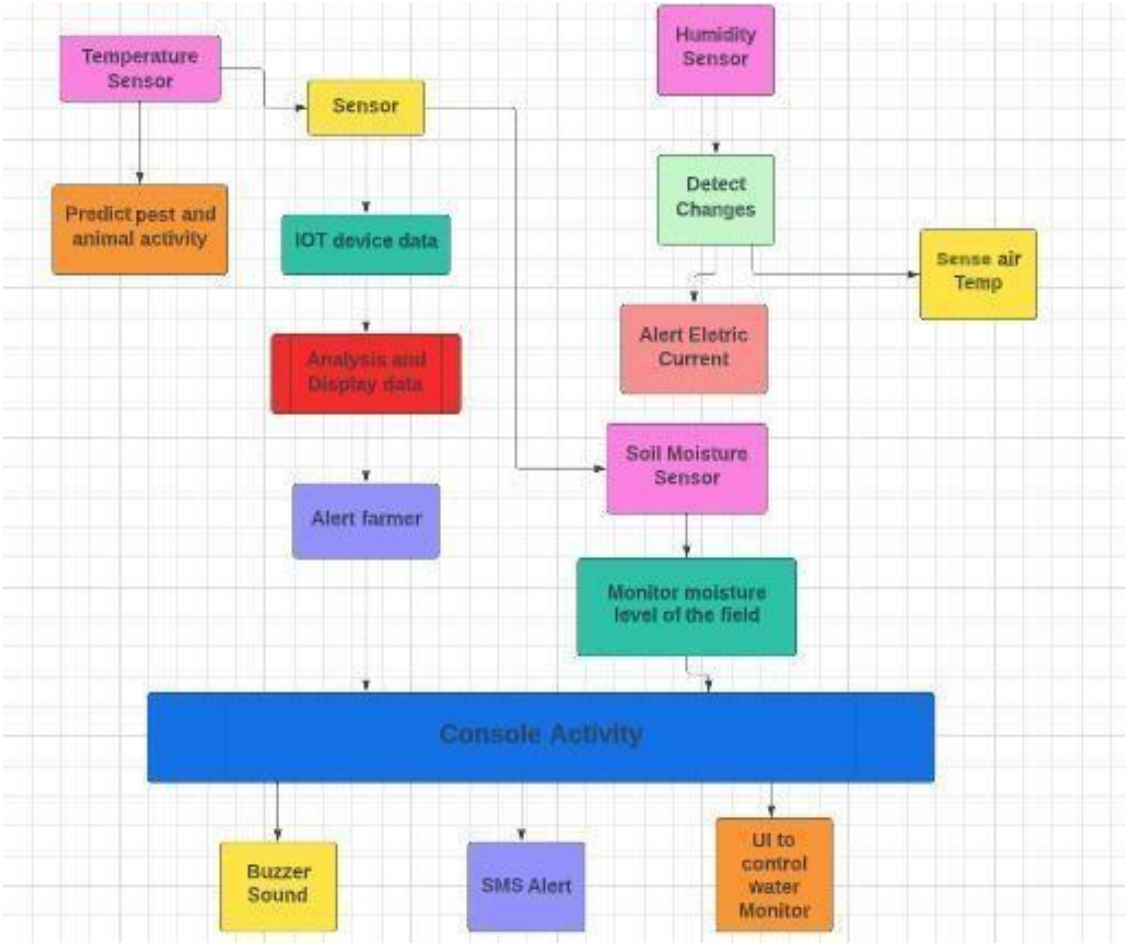
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	• This project is developed for the purpose of farm protection using the smart technology “IOT” to increase its quality and quantity. • Mobile support helps the users to interact easily just with their mobile phones.

NFR-2	**Security**	• The goal of this work is to provide a repelling and monitoring system for crop protection against animal attacks. • Data requires secure access to register and communicate securely on devices and authorized users of the system who exchange information
NFR-3	**Reliability**	• Farmers would be able to protect their land using this technology. • It has the capacity to recognize the wild animals near the field and doesn't give a false caution signal. • Increase the food quality reduce and there source damages.
NFR-4	**Performance**	• Animal friendly ultrasound is generated, which neither cause any kind of harm to the animals nor the sound is audible to humans so the performance is not degraded. • Must provide acceptable response time to users regardless of the volume of data that is stored and the analytics that occurs in background.
NFR-5	**Availability**	• Agriculture fences are quite effective while protecting wild animals. • IoT solutions and domains demand highly available systems for 24x7 operations. • Alarm system are available when farmers are notable to come to the field on time. • This project has a backup plan. Hence availability of this project is also high.
NFR-6	**Scalability**	• System must handle expanding load and data retention needs that are based on the up scaling of the solution scope. • It can be enhanced by sending messages directly to the fire department in case there is a mass wild animals attack in the fields. • It will be safe for human beings also. • The controlling and monitoring of the soil moisture level can be automated by taking care of the crops in case of • Low moisture level, without notifying the farmers.

5. PROJECT DESIGN

5.1 Data Flow Diagram

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

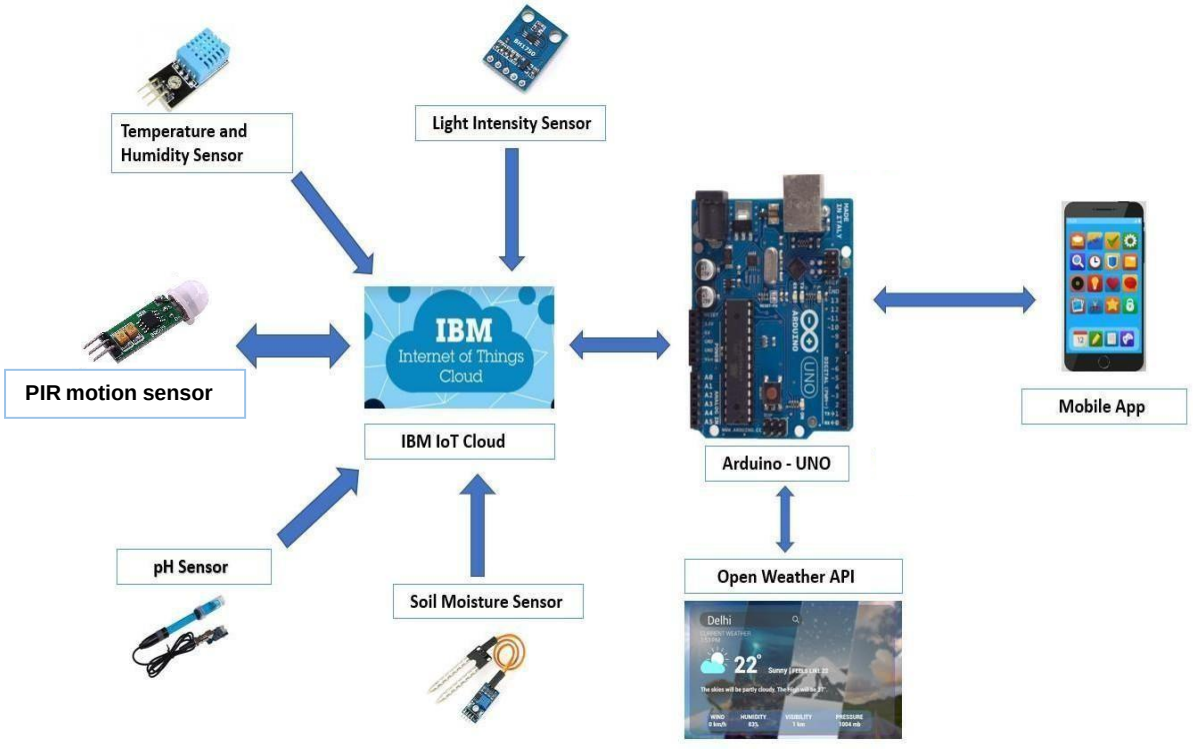


5.2 Solution Architecture:

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to :

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.

5.3 Solution Architecture Diagram:



6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	IBM Cloud Services	USN-1	Create a Cloud Account in IBM	10	High	Sowmiya.B Rajalakshmi.G Priyadarshini.S Nethraa.T
	Python IDE	USN-2	Install the Python IDE	5	High	Sowmiya.B Rajalakshmi.G Priyadarshini.S Nethraa.T
	Clarifai	USN-3	Create an Account in Clarifai	5	High	Sowmiya.B Rajalakshmi.G Priyadarshini.S Nethraa.T
Sprint-2	IBM Watson Platform	USN-4	Create IBM Watson IoT Platform and Device	5	High	Sowmiya.B Rajalakshmi.G Priyadarshini.S Nethraa.T
	Node Red Services	USN-5	Create Node Red Services (To Create a Web Application)	4	High	Sowmiya.B Rajalakshmi.G Priyadarshini.S Nethraa.T
	Cloudant DB	USN-6	Create a Database in Cloudant DB (To Store the Image URL, Launch the Cloudant DB)	4	High	Rajalakshmi.G Priyadarshini.S
	Cloud Object Storage	USN-7	Create a Cloud Object Storage Service	4	High	Sowmiya.B Nethraa.T
Sprint-3	Python Code	USN-8	Develop a Python Script	15	High	Sowmiya.B Priyadarshini.S
Sprint-4	Web UI(User Interface)	USN-9	Develop a Web Application using Node-RED Service. (Display the image in the Node-RED web UI and also display the temperature, humidity, and soil moisture levels.)	15	High	Rajalakshmi.G Nethraa.T

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	3 Days	15 Nov 2022	18 Nov 2022	20	
Sprint-2	20	3 Days	20 Nov 2022	23 Nov 2022	20	
Sprint-3	20	3 Days	25 Nov 2022	28Nov 2022	20	
Sprint-4	20	3 Days	29 Nov 2022	1 Dec 2022	20	

7. CODING & SOLUTION :

7.1 Features

Feature 1: Detect the

Temperature Feature 2:

Detect the Humidity

Feature 3: Detect the

Moisture Feature 4:

Detect the Animals

7.2 Code :

PYTHON CODE TO IBM:

```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "iritj7"
deviceType = "abcd"
```

```
deviceId = "12345"
authMethod = "token"
authToken = "12345678"


# Initialize GPIO
def myCommandCallback(cmd):
print("Command received: %s" % cmd.data['command'])
status=cmd.data['command']
if status=="lighton":
print ("led is on")
elif status == "lightoff":
print ("led is off")
else :
print ("please send proper command")

try:
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId,
"auth-method": authMethod, "auth-token": authToken}
deviceCli = ibmiotf.device.Client(deviceOptions)
#.....................................

except Exception as e:
print("Caught exception connecting device: %s" % str(e))
sys.exit()

# Connect and send a datapoint "hello" with value "world" into the cloud as an
event of type "greeting" 10 times
deviceCli.connect()

while True:
        #Get Sensor Data from DHT11

temp=random.randint(90,110)
Humid=random.randint(60,100)
Moist=random.randint(20,100)
Animal_dect=random.randint(1,20)

 data = { 'temp' : temp, 'Humid': Humid, 'Moist' : Moist, 'Animal_dect' :
Animal_dect }
 #print data
 def myOnPublishCallback():
```

```
 print ("Published Temperature = %s C" % temp, "Humidity = %s %%"
% Humid, "to IBM Watson", "Published Moisture= %s" % Moist, "Published
Animal detection = " , Animal_dect)

 success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
if not success:
print("Not connected to IoTF")
time.sleep(10)

deviceCli.commandCallback = myCommandCallback

# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

NODE RED CODE:

TEMPERATURE:

msg.payload=msg.payload.”temp”

return msg;

HUMIDITY:

msg.payload=msg.payload.”Humid”

return msg;

MOISTURE:

msg.payload=msg.payload.”Moist”

return msg;

ANIMAL DETECTION:

msg.payload=msg.payload.”Animal_dect”

return msg;

8. TESTING:

8.1 TESTING :

- PYTHON CODE TO IBM
- IoT SENSOR OUTPUT
- IBM CLOUD TO NODE RED OUTPUT

8.2 User Acceptance Testing:

8.2.1 Purpose of Document

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

8.2.2 Defect Analysis

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

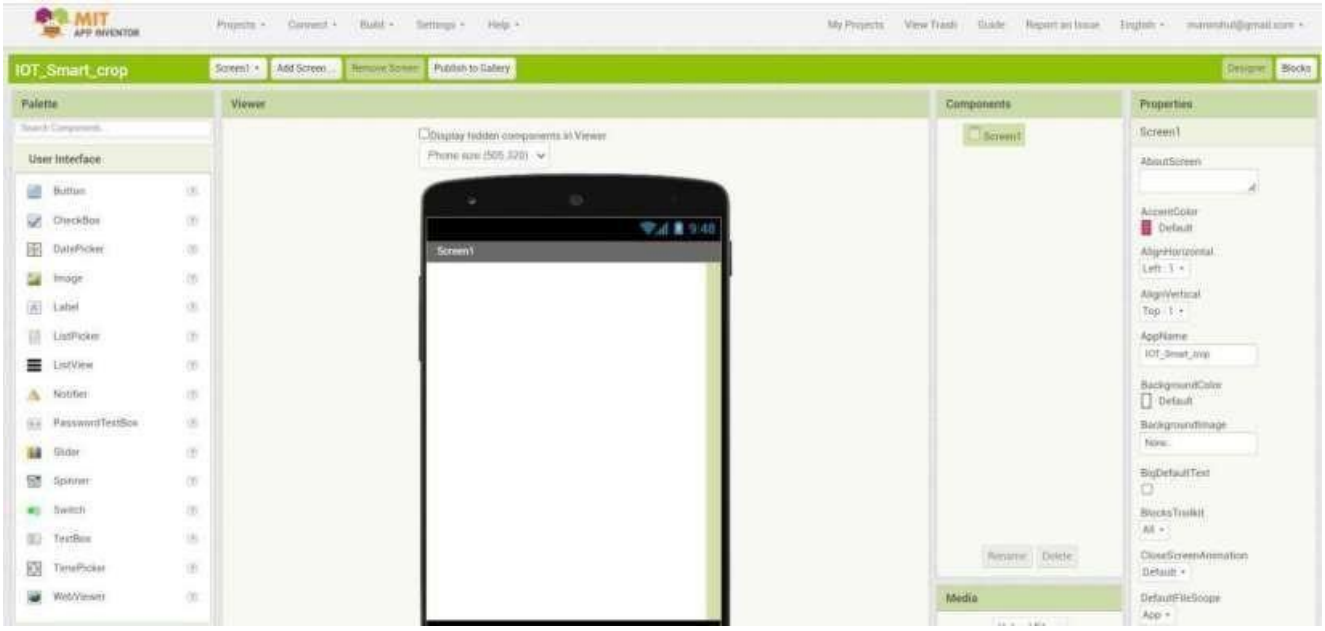
Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37
Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

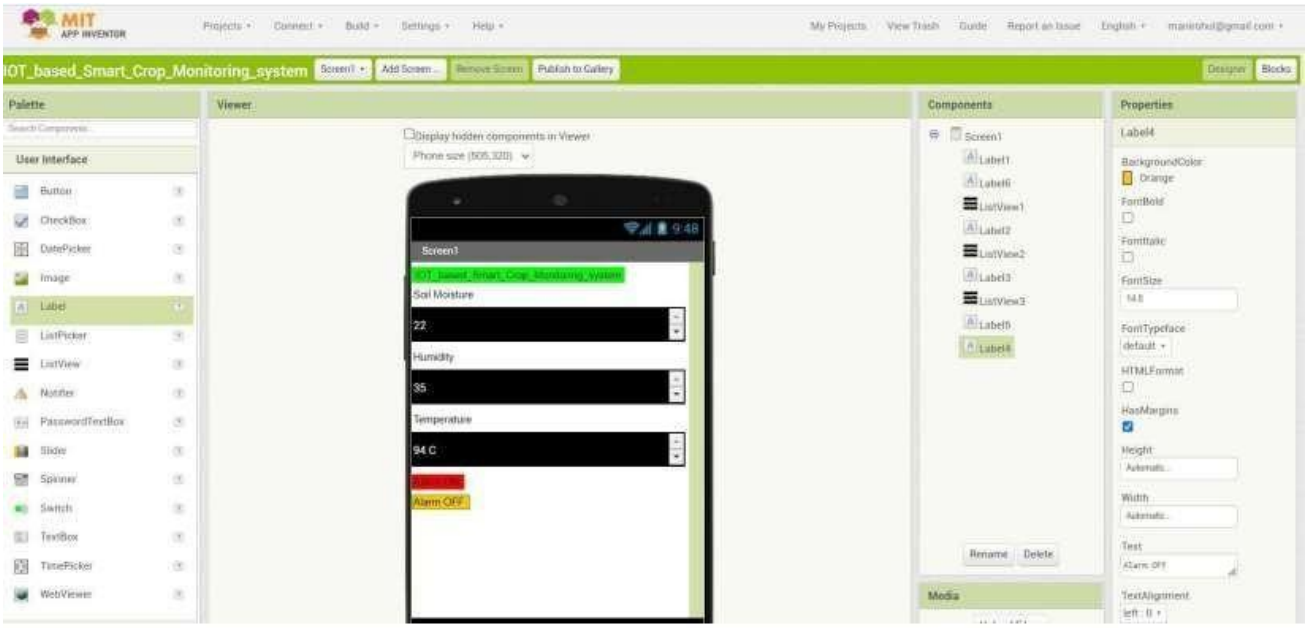
8.3 Test Case Analysis

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

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	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

9. RESULT





ADVANTAGES :

- Farmers can monitor the health of farm animals closely, even if they are physically distant.
- Smart farming systems reduce waste, improve productivity and enable management of a greater number of resources through remote sensing.
- High reliance.
- Enhanced Security.

DISADVANTAGES:

- Farms are located in remote areas and are far from access to the internet.
- A farmer needs to have access to crop data reliably at any time from any location, so connection issues would cause an advanced monitoring system to be useless.
- High Cost
- Equipment needed to implement IoT in agriculture is expensive.

APPLICATIONS:

- Monitoring the crop field with the help of sensors (light , humidity, temperature, soil moisture, etc.).
- Automating the irrigation system
- Soil Moisture Monitoring (including conductivity)

CONCLUSION:

The problem of crop being damaged by wild animals and fire has become a major social problem in current time. It requires urgent attention as no effective solution exists till date for this problem. Thus, this project carries a great social relevance as it aims to address this problem. This project will help farmers in protecting their orchards and fields and save them from significant financial losses and will save them from the unproductive efforts that they endure for the protection their fields. This will also help them in achieving better crop yields thus leading to their economic wellbeing.

FUTURE SCOPE:

Study and analysis of the developed Crop protection systems for its cost effectiveness with the development of Arduino Deterrent circuit. outline of the crop damage caused by a particular Wild animal if the behavioral features of the With the reduced cost in the smart phones.

DEMO LINK:

Github link:

1) Git page link: https://github.com/IBM-EPBL/IBM-Project-33884-1660228589
2) Final deliverables: https://github.com/IBM-EPBL/IBM-Project-33884-1660228589/tree/main/Final%20Deliverables

Google drive link:

https://drive.google.com/drive/folders/1sOA33ny1LHDYyCEHPNuhpJ3tgUjqx7NW?usp=share_link

Youtube link:

https://youtu.be/1s2ON1YM5bg