19L039 - PROFESSIONAL READINESS FOR INNOVATION,EMPLOYABILITY AND ENTREPRENEURSHIP

IOT BASED SMART CROP PROTECTION SYSTEM FOR AGRICULTURE

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Dissertation submitted in partial fulfillment of the requirements for the degree of

BACHELOR OF ENGINEERING

Branch: ELECTRONICS AND COMMUNICATION ENGINEERING

of Anna University

NOVEMBER 2022

PSG COLLEGE OF TECHNOLOGY

(Autonomous Institution)

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Bonafide record of work done by

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Project report submitted in partial fulfillment of the requirements for the degree of

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NOVEMBER 2022

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CONTENTS

CHAPTER 1
INTRODUCTION

1.1. PROJECT OVERVIEW

The Internet of Things (IoT)-based Smart Crop Protection System project uses Watson IoT services to measure soil moisture and temperature conditions for agriculture. The Internet of Things (IoT) is a network that links real objects or items with integrated electronics, software, and sensors. It collects and transmits data via the cloud. A user can access a linked device at any time and from any location. Without any interaction from either humans or computers, data is transported via the internet. IBM IoT Simulator sensors are utilized instead of actual soil and temperature conditions since they can send soil moisture temperature as needed.

1.2. PURPOSE

Processes are managed in the field more effectively with the use of IoT in agriculture. Remote crop monitoring allows farmers to better manage natural resources. The application of IoT in agriculture not only saves time but also curbs wasteful resource usage, including water and power. Farmers will find the system easy to use because it conserves water, replenishes soil nutrients during long days, and increases agricultural productivity. Therefore, good yield may be easily reached without manual intervention.

CHAPTER 2
LITERATURE SURVEY

2.1 EXISTING PROBLEM

Paper [1] provides a solution to unexpected rainfalls and Animal threats. The technology offered is designed in three steps. The first stage is intended to sense/detect the animal using a PIR sensor and generate a digital output. The second stage is aimed to determine whether it is an animal or not by utilizing a Pi camera to capture the region and record animal video. The third stage is intended to offer farmers information on animal entry by providing video. As a result, our proposed methodology assists farmers in removing animals from agricultural lands. When farmers are aware that a specific animal is entering a field at a specific time, they may easily employ their regulated methods to remove animals from agricultural grounds.

Paper [2] provides an Automated perspicacious crop aegis system is proposed utilizing Internet of Things (IOT). The system consists of esp8266 (nodeMCU), soil moisture sensor, dihydrogen monoxide sensor, GPRS and GSM module, servo motor, dihydrogen monoxide pump, etc. to obtain the required output. As soon as any kineticism is detected the system will engender an alarm to be taken and the lights will glow up implemented at every corner of the farm. This will not harm any animal and the crops will stay forfended.

Paper [3] provides the agriculture pest monitoring device is a moving bot or a line following bot which monitors the amount of pest in farmland. The image that is captured using camera module is processed using convolution neural network involving processes like image acquisition, preprocessing, gray scale conversion blurring, max pooling and using ReLU for faster training of dataset. It calculates and sends the amount of pest present in a particular crop and suggest the amount of pesticide to be sprayed.

Paper [4] provides a solution to the destruction of crops by animals. This system will provide a complete technical solution using the Internet of things (IOT) to the farmers to prevent their crops from wild animals and provide information to the farmers to maximize their production. Animals are detected using PIR sensors and cameras where animals are identified using TensorFlow image processing Techniques. Raspberry PI is used as the processing unit of the system and sound buzzers are used to emit the ultrasound frequencies.

Paper [5] provides an approach for irrigating and persecutor watching and dominant for the crops. IoT based mostly sensible irrigation system is projected, which calculates the exact water supply of the crop that aids in its life cycle and climate. When this calculated crop water demand is mistreated, there is a pump motor that operates instinctively each time the dampness of the soil goes low beyond the enduring welting purpose. The motor is closedown once the desired water is wired resolute crops. This ensures acceptable level of water is used for watering the crops that might aid in higher quality crop production. During this work, numerous parameters like wetness, wetness and temperature area unit being monitored endlessly mistreatment acceptable sensors. The information nonheritable by these sensors area unit collected mistreatment Arduino microcontroller. The pump motors and therefore the RF / GSM transceivers area unit operated mistreatment AT Mega controllers.

Paper [6] presents an effective water system framework that advances the accessible water in the water supply and in this manner giving an effective and powerful mechanism for the irrigation purposes. Irrigation framework would automatically begin/stop water siphons, on the agricultural site depending upon the dampness content obtained by the moisture sensor as soon as it senses the level of water in the reservoir. The deliberate sensor estimates are sent to the Arduino Uno microcontroller for arranging the controlled calculation. The protection is done through the voice detection and movement detection methods to enable high frequency sound, hence protecting the crops from insects, pests and small animals.

Paper [7] presents the development of Internet of Things application for crop protection to prevent animal intrusions in the crop field. A repelling and a monitoring system is provided to prevent potential damages in Agriculture, both from wild animal attacks and weather conditions.

2.2 REFERENCES

[1] Mahammad Firose Shaik,Ravipati Mounika,A. Durga Prasad,Inakoti Ramesh Raja,B.Prajakatha Sekhar and D. Sampath, “Intelligent Secure Smart Crop protection From Wild Animals”2022 8th International Conference on Advanced Computing and Communication Systems (ICACCS)and Added to IEEE Xplore on 07 June 2022.

[2] Priyanka Deotale and Prasad Lokulwar “Smart Crop Protection System from Wild Animals Using IoT”, 2021 International Conference on Computational Intelligence and Computing Applications (ICCICA) issue 27 November 2021.

[3] S. Karthika,Kalyana Rangan V,Aditya K,Anand Anil Kumar and D. Selvakumar, “IOT BASED CROP PROTECTION SYSTEM”,2021 6th International Conference on Communication and Electronics Systems (ICCES) and Added to IEEE Xplore on 02 August 2021.

[4] N S Gogul Dev,K S Sreenesh and P K BinuP K Binu “IoT Based Automated Crop Protection System”Published in 2019 2nd International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT) and Conference dated, 06 July 2019.

[5] R. M. Joany,E. Logashanmugam,E. Anna Devi,S. Yogalakshmi,L. Magthelin Therase and G. Jegan, “IoT based Crop Protection System during Rainy Season”2022 Second International Conference on Artificial Intelligence and Smart Energy (ICAIS),25 February 2022.

[6] Damini Kalra,Praveen Kumar, K Singh and Apurva Soni “Sensor based Crop Protection System with IOT monitored Automatic Irrigation”2020 2nd International Conference on Advances in Computing, Communication Control and Networking (ICACCCN) and Date of Conference is 19 December 2020.

[7] Stefano Giordano,Ilias Seitanidis; Mike Ojo,Davide Adami andFabio Vignoli“IoT solutions for crop protection against wild animal attacks”Published in 2018 IEEE International Conference on Environmental Engineering (EE) 14 March 2018 and Added to IEEE Xplore on 14 June 2018.

2.3 **PROBLEM STATEMENT DEFINITION**

Agriculture is considered as the basis of life for the human species as it is the main source of food grains and raw materials. As the world is trending into new technologies and implementations it is necessary goal to trend up in agriculture also. The problem arises when the climate varies, the field parameters also changes suddenly and Whenever there is heavy rainfall or temperature varies or may be any mammals are roaming or grazing in the field, this may become very hard to analyze and it causes a major problem.

CHAPTER 3

IDEATION & PROPOSED SOLUTION

3.1.EMPATHY MAP CANVAS

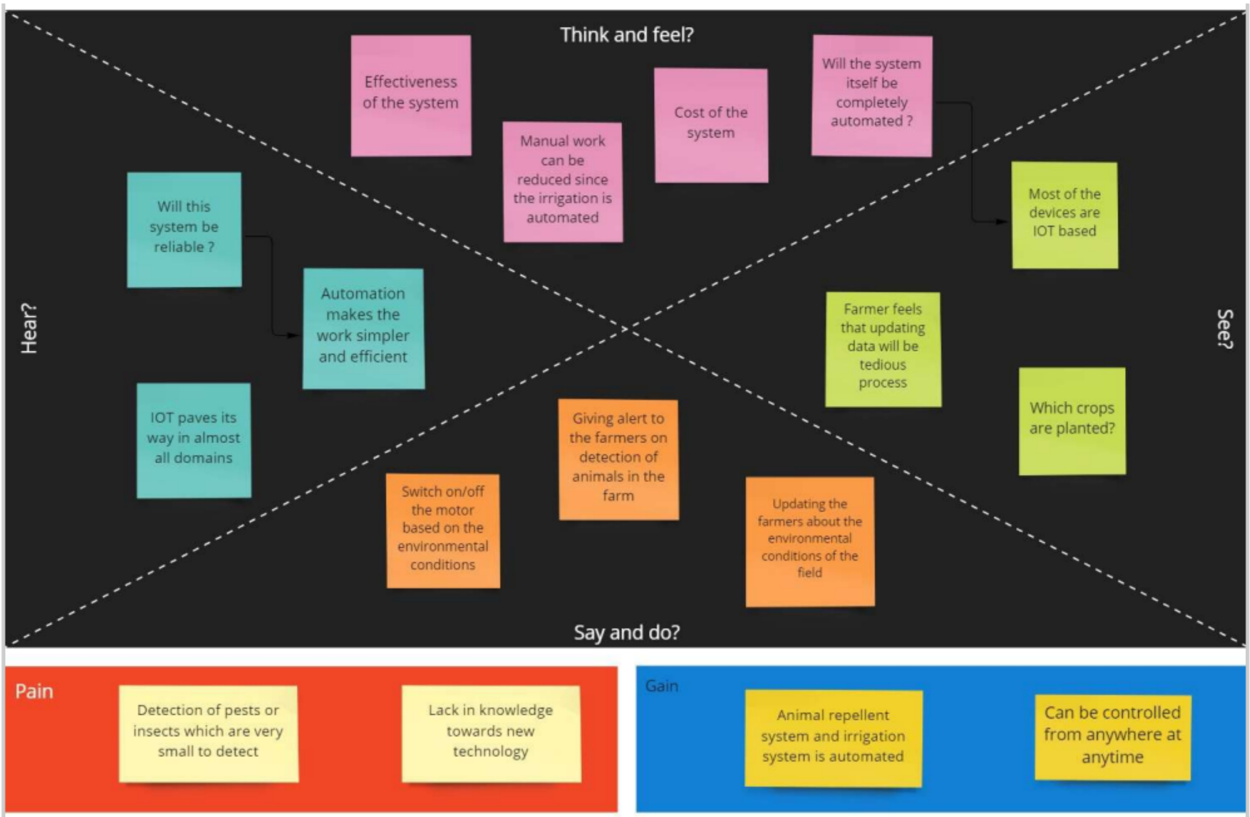


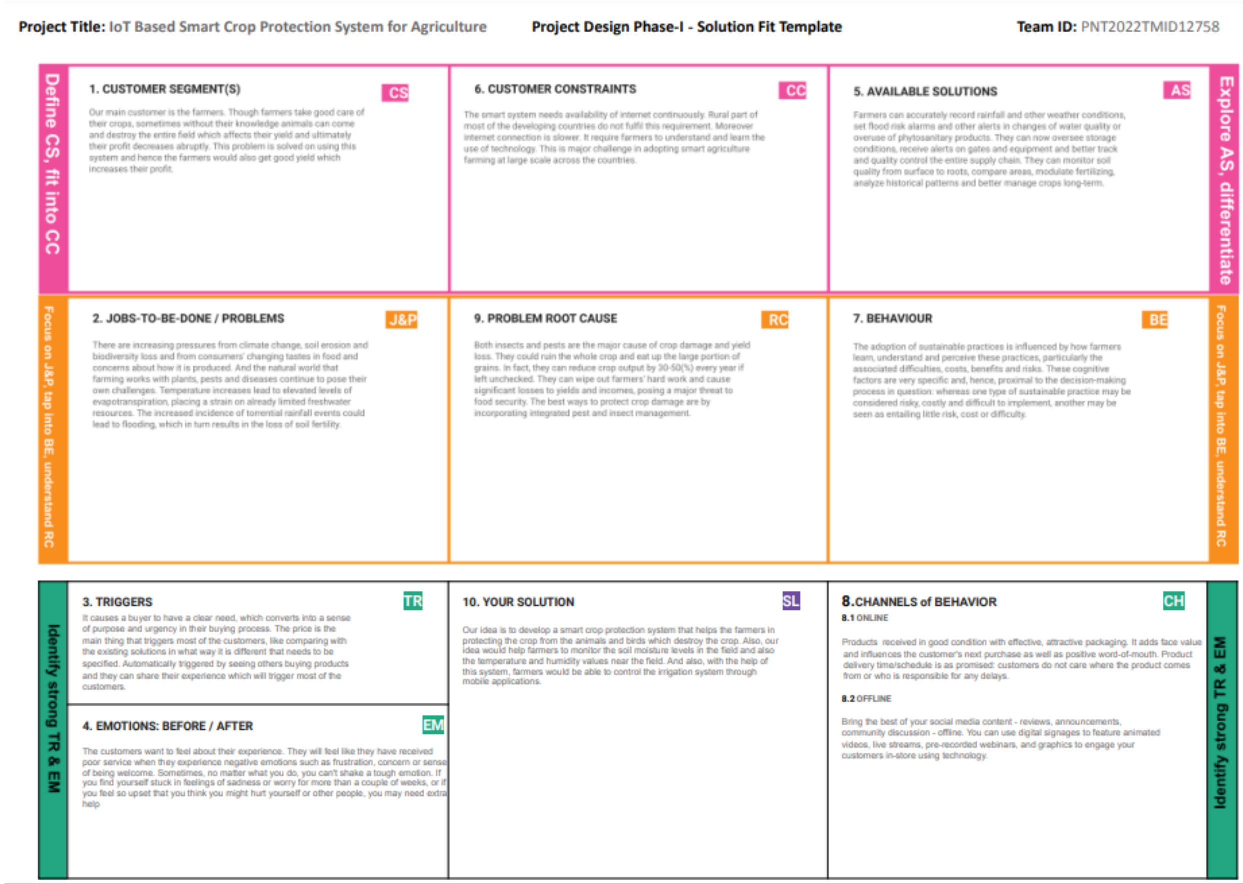
Figure 3.1. Empathy Map

3.3. PROPOSED SOLUTION

S.No.	Parameter	Description
1	Problem Statement (Problem to be solved)	To develop a smart crop protection system that helps the farmers in protecting the crop from the animals and birds which destroy the crop. Also, this system must help farmers to monitor the soil moisture levels in the field and also the temperature and humidity values near the field. And also, with the help of this system, farmers must be able to control the irrigation system through mobile application.
2	Idea / Solution description	Our idea is in such a way that it gives a solution to the above problem statement. Our idea is to develop a smart crop protection system that helps the farmers in protecting the crop from the animals and birds which destroy the crop. Also, our idea would help farmers to monitor the soil moisture levels in the field and also the temperature and humidity values near the field. And also, with the help of this system, farmers would be able to control the irrigation system through mobile application.
3	Novelty / Uniqueness	Even though there are many existing solutions for this problem they failed to satisfy the needs of farmer. The existing irrigation system is just time basis. If the system is set to on a for a particular time, it will be switched on during that time even when there is a rain in the farm. Whereas our system takes into account the environmental conditions and based on that irrigation system is controlled which leads to saving water. And the other novelty is farmer can control the irrigation system from the place where he/she resides rather than coming to the field because of IOT whereas this is not possible in present systems. And also, when the animal or bird is detected in the field, it not only indicates the farmer who is in the remote place but also produce alarm to make animals or birds run away.

4	Social Impact / Customer Satisfaction	When this IOT system is introduced to the farmers, then farming becomes automated and it can be in the control of farmers always. And also, anyone who is interested in farming but cannot be in farm always, can also do farming with the help of this system since this system provides all the comfort to do farming from the remote place. It also helps the farmers to get good yield. Not only that, the irrigation system used here will also help the farmers to save water which is the most precious resources.
5	Business Model (Revenue Model)	Our main target is the farmers. So, we have planned to visit the farmers about the importance of this system and what all the benefits they get on using this system. And also, we target on the industries, who are very much into irrigation system to discuss and make them understand about the need for this system. Though farmers take good care of their crops, sometimes without their knowledge animals can come and destroy the entire field which affects their yield and ultimately their profit decreases abruptly. This problem is solved on using this system and hence the farmers would also get good yield which increases their profit.
6	Scalability of the Solution	Our solution can be scaled for any further future uses. Because the solution we have provided suits for all types of farms in general.

3.4. PROBLEM SOLUTION FIT



Project Title: IoT Based Smart Crop Protection System for Agriculture **Project Design Phase-I - Solution Fit Template** **Team ID:** PNT2022TMID12758

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Our main customer is the farmers. Though farmers take good care of their crops, sometimes without their knowledge animals can come and destroy the entire field which affects their yield and ultimately their profit decreases abruptly. This problem is solved on using this system and hence the farmers would also get good yield which increases their profit.

6. CUSTOMER CONSTRAINTS CC

The smart system needs availability of internet continuously. Rural part of most of the developing countries do not fulfil this requirement. Moreover internet connection is slower. It require farmers to understand and learn the use of technology. This is major challenge in adopting smart agriculture farming at large scale across the countries.

5. AVAILABLE SOLUTIONS AS

Farmers can accurately record rainfall and other weather conditions, set flood risk alarms and other alerts in changes of water quality or overuse of phytosanitary products. They can now oversee storage conditions, receive alerts on gates and equipment and better track and quality control the entire supply chain. They can monitor soil quality from surface to roots, compare areas, modulate fertilizing, analyze historical patterns and better manage crops long-term.

Explore AS, differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE / PROBLEMS J&P

There are increasing pressures from climate change, soil erosion and biodiversity loss and from consumers' changing tastes in food and concerns about how it is produced. And the natural world that farming works with plants, pests and diseases continue to pose their own challenges. Temperature increases lead to elevated levels of evapotranspiration, placing a strain on already limited freshwater resources. The increased incidence of torrential rainfall events could lead to flooding, which in turn results in the loss of soil fertility.

9. PROBLEM ROOT CAUSE RC

Both insects and pests are the major cause of crop damage and yield loss. They could ruin the whole crop and eat up the large portion of grains. In fact, they can reduce crop output by 30-50(%) every year if left unchecked. They can wipe out farmers' hard work and cause significant losses to yields and incomes, posing a major threat to food security. The best ways to protect crop damage are by incorporating integrated pest and insect management.

7. BEHAVIOUR BE

The adoption of sustainable practices is influenced by how farmers learn, understand and perceive these practices, particularly the associated difficulties, costs, benefits and risks. These cognitive factors are very specific and, hence, proximal to the decision-making process in question: whereas one type of sustainable practice may be considered risky, costly and difficult to implement, another may be seen as entailing little risk, cost or difficulty.

Focus on J&P, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS TR

It causes a buyer to have a clear need, which converts into a sense of purpose and urgency in their buying process. The price is the main thing that triggers most of the customers, like comparing with the existing solutions in what way it is different that needs to be specified. Automatically triggered by seeing others buying products and they can share their experience which will trigger most of the customers.

4. EMOTIONS: BEFORE / AFTER EM

The customers want to feel about their experience. They will feel like they have received poor service when they experience negative emotions such as frustration, concern or sense of being welcome. Sometimes, no matter what you do, you can't shake a tough emotion. If you find yourself stuck in feelings of sadness or worry for more than a couple of weeks, or if you feel so upset that you think you might hurt yourself or other people., you may need extra help

10. YOUR SOLUTION SL

Our idea is to develop a smart crop protection system that helps the farmers in protecting the crop from the animals and birds which destroy the crop. Also, our idea would help farmers to monitor the soil moisture levels in the field and also the temperature and humidity values near the field. And also, with the help of this system, farmers would be able to control the irrigation system through mobile applications.

8. CHANNELS of BEHAVIOR CH

8.1 ONLINE

Products received in good condition with effective, attractive packaging. It adds face value and influences the customer's next purchase as well as positive word-of-mouth. Product delivery time/schedule is as promised: customers do not care where the product comes from or who is responsible for any delays.

8.2 OFFLINE

Bring the best of your social media content - reviews, announcements, community discussion - offline. You can use digital signages to feature animated videos, live streams, pre-recorded webinars, and graphics to engage your customers in-store using technology.

Identify strong TR & EM

CHAPTER 4
REQUIREMENT ANALYSIS

4.1. FUNCTIONAL REQUIREMENT

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through application using Gmail
FR-2	User Confirmation	Confirmation via Email
FR-3	Authentication	Authentication through Password and Username
FR-4	External Interfaces	Web application/ Android mobile application for a user-friendly GUI.
FR-5	Installation	The designed system should be installed properly to provide the best results. The system should be periodically checked for better performance.
FR-6	User preferences	The user can prefer to use the system for multiple places according to the area of the field. The user can configure the system based on their preference.

4.2. NON-FUNCTIONAL REQUIREMENTS

FR No.	Non-Functional Requirement	Description
FR-1	Usability	The user can easily interact with the system using the Simple User Interface of the specially designed application to monitor the crop and protect the crops from the animals and catastrophic failure.
FR-2	Security	The encrypted user details and data collected would be stored in a highly secure database.
FR-3	Reliability	The sensors would have a higher accuracy to increase the reliability of the solution.
FR-4	Performance	The application developed would require minimum processing time and faster response, thus providing a satisfactory user experience for the farmers.
FR-5	Availability	The system would be easily available to all sectors of the population and can be accessed from anywhere.
FR-6	Scalability	Multiple systems can be installed to provide efficient protection of the crops from climatic conditions and from animals.

CHAPTER 5
PROJECT DESIGN

5.1. DATA FLOW DIAGRAMS

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

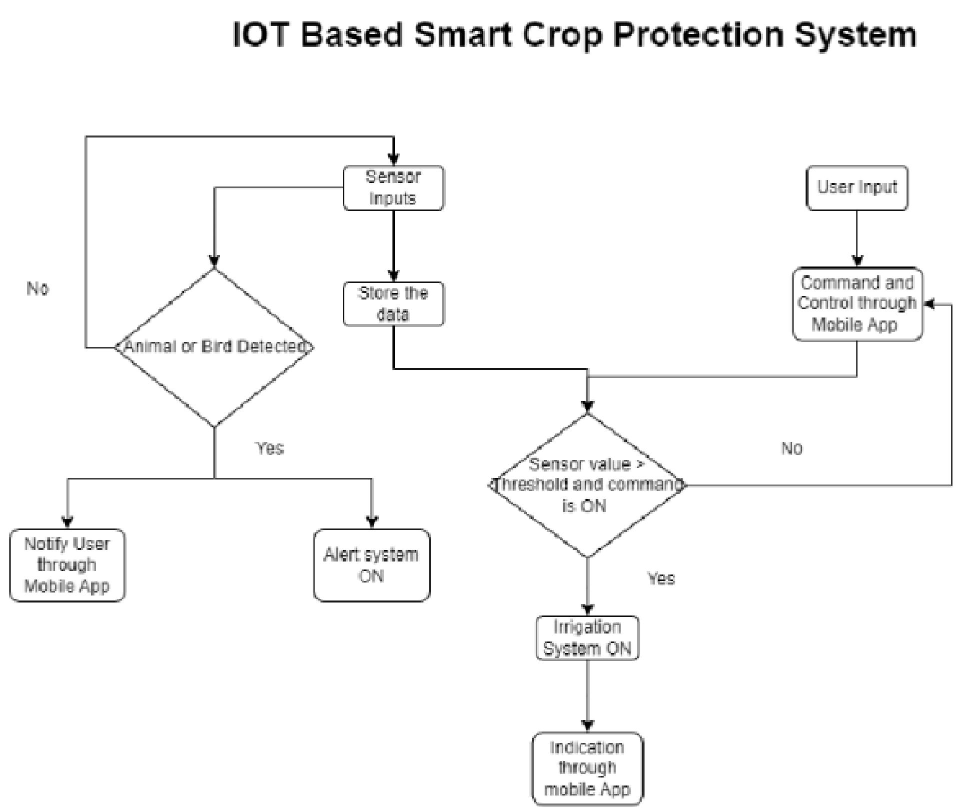


Figure 5.1. Data flow diagram

5.2. SOLUTION & TECHNICAL ARCHITECTURE

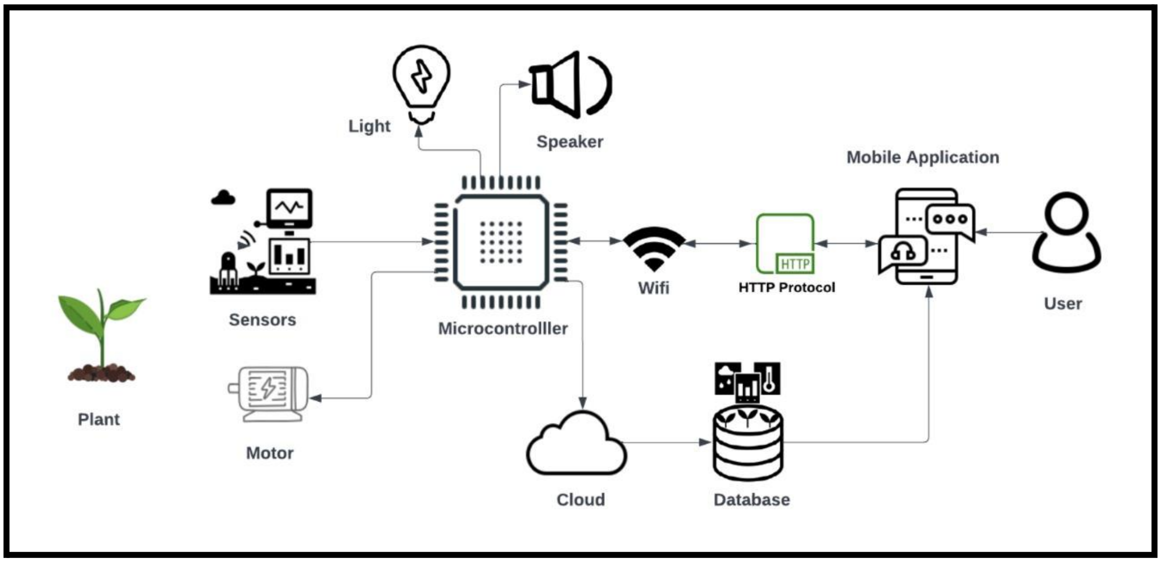
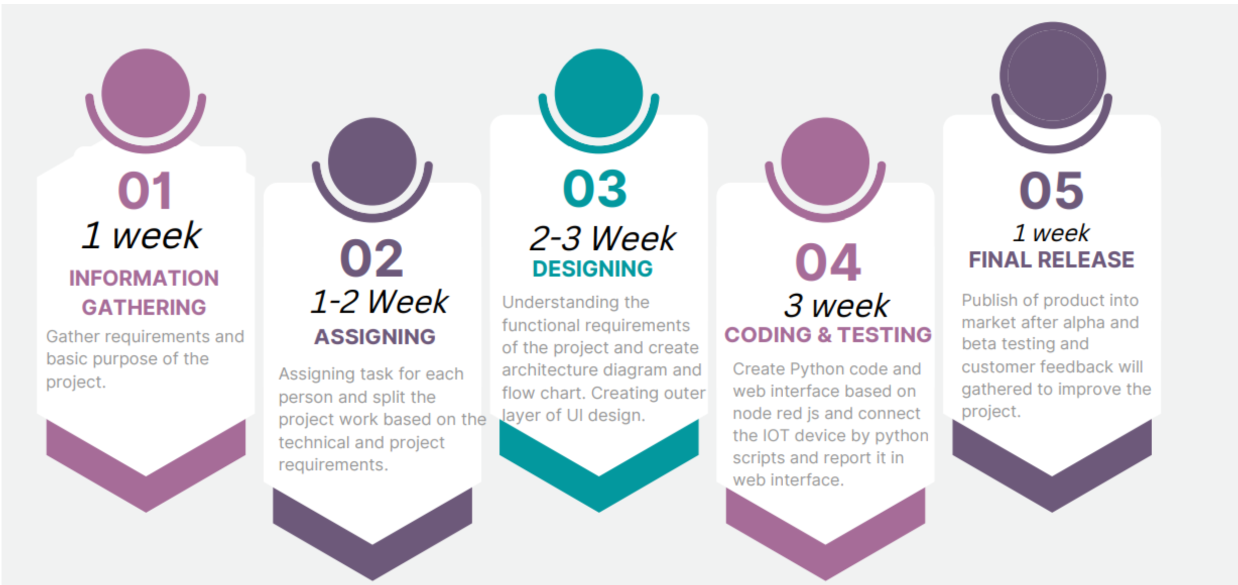


Figure 5.2. Solution Architecture

5.3. Customer Journey Map

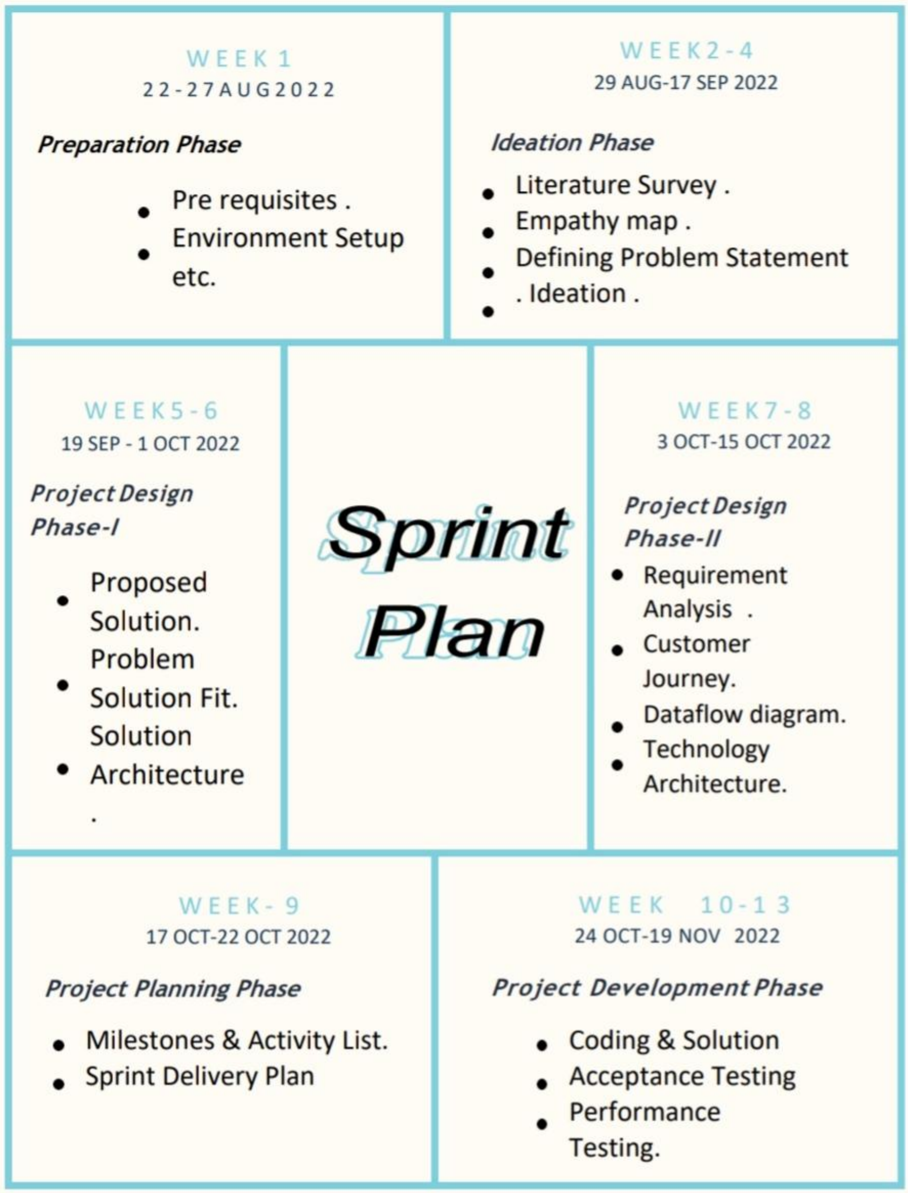
CHAPTER 6
PROJECT PLANNING & SCHEDULING

6.1. SPRINT PLANNING & ESTIMATION



S.No	Activity Title	Activity Description	Duration
1.	Understanding the Project Requirement	Assign the team members & create the repository in github. Assign the task to each members and teach how to use and open access the GitHub and IBM Career Education.	1 Week
2.	Starting of Project	Advice student to attend classes of IBM portal create and develop an rough diagram based on the project description and gather information of IOT and IBM project.	1 week
3.	Attend classes	Team members & team lead must watch and learn from classes provided by IBM and Nalaya thiran and must gain access of MIT license for their project.	4 Week
4.	Budget and scope of the project	Budget & analyse the use of IOT in the project and discuss with the team for budget prediction to predict the favourability of the customer to buy the product for efficient use of the product among the environment.	1 week

6.2. SPRINT DELIVERY SCHEDULE



CHAPTER 7
CODING AND SOLUTIONING

```
import random
import ibmiotf.application
import ibmiotf.device
from time import sleep
import sys
#IBM Watson Device Credentials...
organization = "tw9ckq"
deviceType = "jade"
deviceId = "7010"
authMethod = "use-auth-token"
authToken = "9944893843"
defmyCommandCallback(cmd):
print("Command received: %s" %cmd.data['command'])
status=cmd.data['command']
if status=="sprinkler_on":
print ("sprinkler is turning ON")
else :
print ("sprinkler is turning OFF")
try:
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId,
"auth-method": authMethod, "authtoken": authToken}
deviceCli = ibmiotf.device.Client(deviceOptions)
except Exception as e:
print("Exception detected in connecting device: %s" % str(e))
sys.exit()
#Connecting to IBM watson...
deviceCli.connect()
```

```
while True:
#Getting values from sensors...
temp_sensor = round( random.uniform(0,80),2)
PH_sensor = round(random.uniform(1,14),3)
camera = ["Detected","Not Detected","Not Detected","Not Detected","Not
Detected","Not Detected",]
camera_reading = random.choice(camera)
flame = ["Detected","Not Detected","Not Detected","Not Detected","Not
Detected","Not Detected",]
flame_reading = random.choice(flame)
moist_level = round(random.uniform(0,100),2)
water_level = round(random.uniform(0,30),2)
#storing the sensor data to send in json format to cloud…
temp_data = { 'Temp' : temp_sensor }
PH_data = { 'PH value' : PH_sensor }
camera_data = { 'Animal attack' : camera_reading}
flame_data = { 'Flame' : flame_reading }
moist_data = { 'Moisture level' : moist_level}
water_data = { 'Water level' : water_level}
# publishing Sensor datas to IBM Watson for every 5-10 seconds…
success = deviceCli.publishEvent("Temperature sensor", "json", temp_data,
qos=0)
sleep(1)
if success:
print ("... ...publish ok.......... ")
print ("Published Temp = %s C" % temp_sensor, "to IBM Watson")
success = deviceCli.publishEvent("PH sensor", "json", PH_data,qos=0)
sleep(1)
ifsuccess:
```

```
print ("Published PH value = %s" % PH_sensor, "to IBM Watson")
success = deviceCli.publishEvent("camera", "json", camera_data,qos=0)
sleep(1)
ifsuccess:
print ("Published Animal attack %s " % camera_reading, "to IBM Watson")
success = deviceCli.publishEvent("Flame sensor", "json", flame_data,qos=0)
sleep(1)
if success:
print ("Published Flame %s " % flame_reading, "to IBM Watson")
success = deviceCli.publishEvent("Moisture sensor", "json",
moist_data,qos=0)
sleep(1)
ifsuccess:
print ("Published Moisture level = %s " % moist_level, "to IBM Watson")
success = deviceCli.publishEvent("Watersensor", "json", water_data, qos=0)
sleep(1)
ifsuccess:
print ("Published Water level = %s cm" % water_level, "to IBM Watson")
print ("")
#Automation to control sprinklers by present temperature an to send alert
message to IBM Watson…
if (temp_sensor > 35):
print("sprinkler-1 is ON")
success = deviceCli.publishEvent("Alert1", "json",{ 'alert1' : "Temperature(%s)
is high, sprinkerlers are
turned ON" %temp_sensor }, qos=0)
sleep(1)
ifsuccess:
```

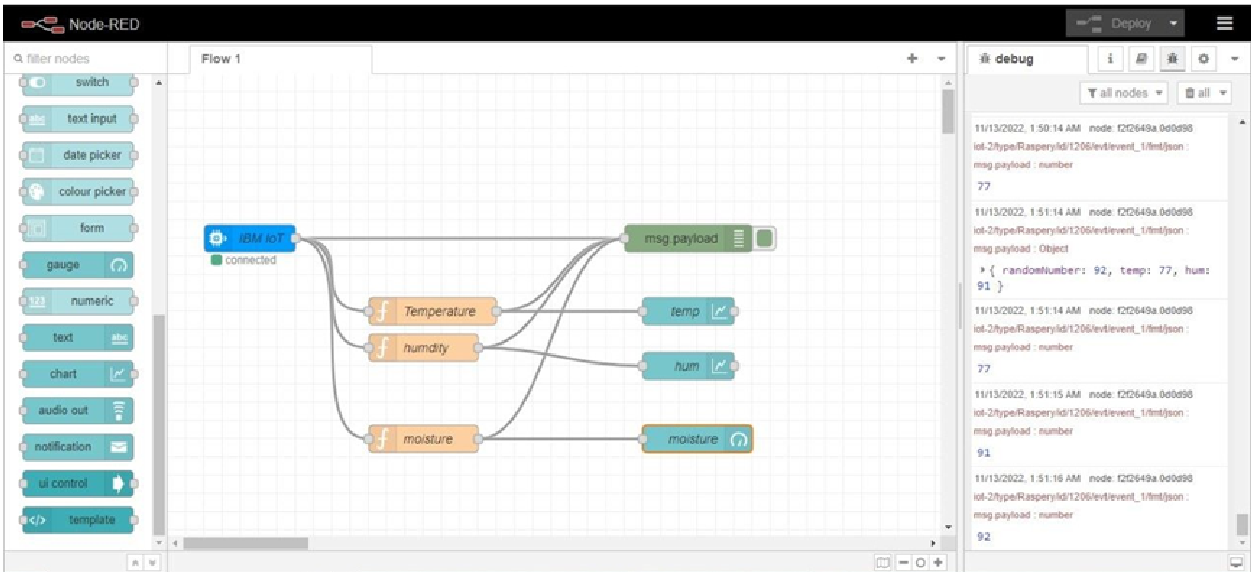
```
print( 'Published Alert1 : ', "Temperature(%s) is high, sprinkerlers are turned
ON" %temp_sensor,"to IBM
Watson")
print("")
else:
print("sprinkler-1 is OFF")
print("")
#To send alert message if farmer uses the unsafe fertilizer to crops…
if (PH_sensor > 7.5 or PH_sensor < 5.5):
success = deviceCli.publishEvent("Alert2", "json",{ 'alert2' : "Fertilizer PH
level(%s) is not safe,use other
fertilizer" %PH_sensor } , qos=0)
sleep(1)
ifsuccess:
print('Published Alert2 : ' , "Fertilizer PH level(%s) is not safe,use other
fertilizer" %PH_sensor,"to IBM
Watson")
print("")
#To send alert message to farmer that animal attack on crops…
if (camera_reading == "Detected"):
success = deviceCli.publishEvent("Alert3", "json", { 'alert3' : "Animal attack on
crops detected" }, qos=0)
sleep(1)
if success:
print('Published Alert3 : ' , "Animal attack on crops detected","to IBM
Watson","to IBM Watson")
print("")
#To send alert message if flame detected on crop land and turn ON the
splinkers to take immediate action…
```

```
if (flame_reading == "Detected"):
print("sprinkler-2 is ON")
success = deviceCli.publishEvent("Alert4", "json", { 'alert4' : "Flame is
detected crops are in
danger,sprinklers turned ON" }, qos=0)
sleep(1)
ifsuccess:
print( 'Published Alert4 : ' , "Flame is detected crops are in danger,sprinklers
turned ON","to IBM Watson")
print("")
else:
print("sprinkler-2 is OFF")
print("")
#To send alert message if Moisture level is LOW and to Turn ON Motor-1 for
irrigation…
if (moist_level < 20):
print("Motor-1 is ON")
success = deviceCli.publishEvent("Alert5", "json", { 'alert5' : "Moisture
level(%s) is low, Irrigation started"
%moist_level }, qos=0)
sleep(1)
ifsuccess:
print('Published Alert5 : ' , "Moisture level(%s) is low, Irrigation started"
%moist_level,"to IBM Watson" )
print("")
else:
print("Motor-1 is OFF")
print("")
```

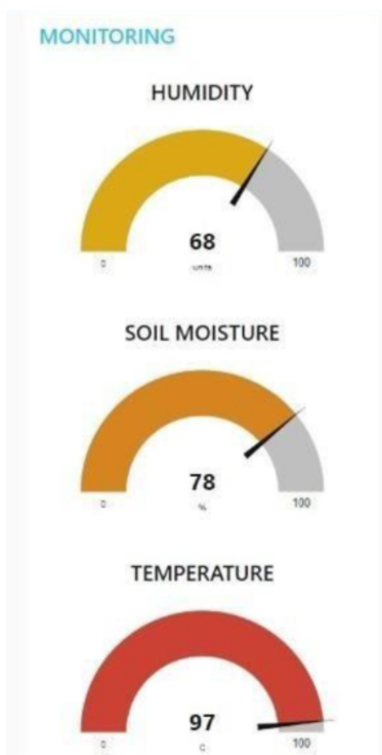
```
#To send alert message if Water level is HIGH and to Turn ON Motor-2 to take
water out…
if (water_level > 20):
print("Motor-2 is turning ON")
success = deviceCli.publishEvent("Alert6", "json", { 'alert6' : "Water level(%s)
is high, so motor is ON to take
water out " %water_level }, qos=0)
sleep(1)
ifsuccess:
print('Published Alert6 : ' , "water level(%s) is high, so motor is ON to take
water out " %water_level,"to
IBM Watson" )
print("")
else:
print("Motor-2 is turning OFF")
print("")
#command recived by farmer
deviceCli.commandCallback = myCommandCallback
# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

CHAPTER 8
TESTING AND RESULTS

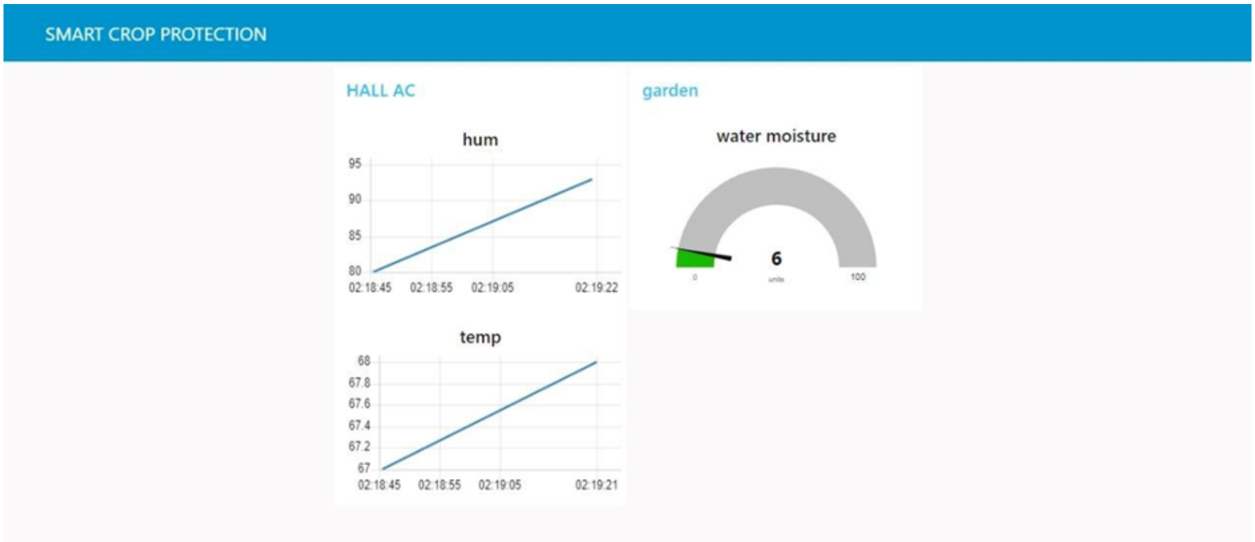
8.1 Implementation and Results



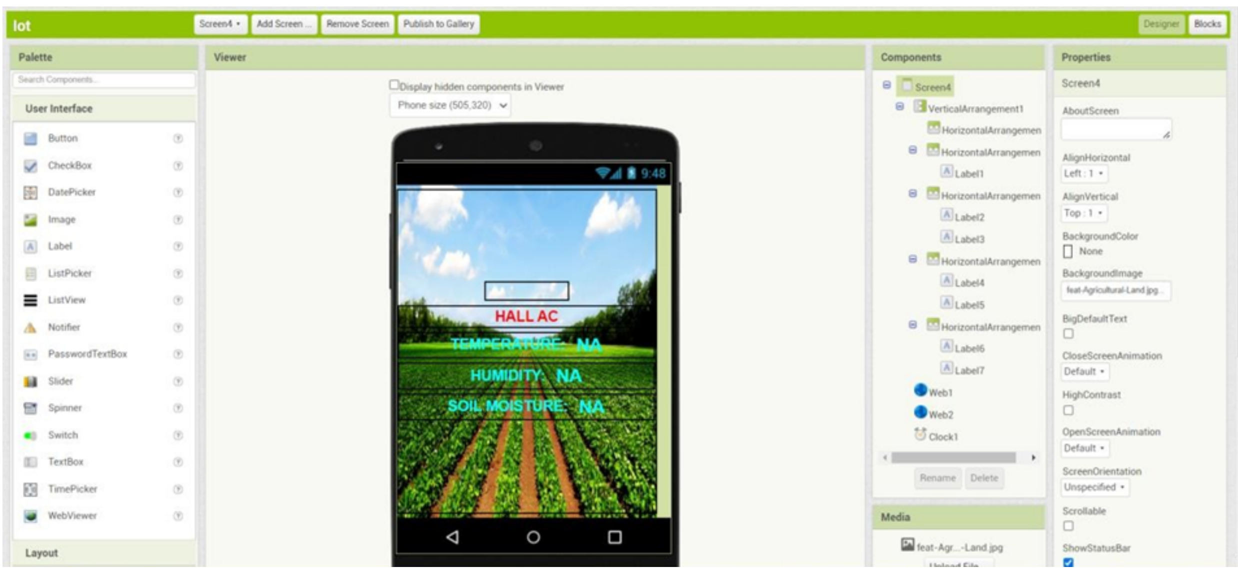
NodeRED Output



Monitoring of Crop Surrounding Parameters



Representation through graph



Mobile Application for the User

8.2 USER ACCEPTANCE TESTING

https://docs.google.com/spreadsheets/d/1Cwq_Wb2R7XnX0Fn1D0sGRAbRdreN8mqX/edit?usp=sharing&ouid=101527500274356792632&rtpof=true&sd=true

8.3 PERFORMANCE TESTING

https://github.com/IBM-EPBL/IBM-Project-36821-1660298100/tree/main/Project%20Development%20Phase/Performance%20of%20Product%20(Testing)

CHAPTER 10
ADVANTAGES AND DISADVANTAGES

Advantages

- ➢ Real-time updates
- ➢ Get instant notifications and warnings
- ➢ Through remote sensing, waste can be reduced, productivity can be increased, and more resources can be managed.
- ➢ Data analytics for improved decision

Disadvantages

- ➢ Chances that the data could occasionally be incorrect.
- ➢ Farms are situated in isolated locations with little internet access.
- ➢ Connection troubles would render an advanced monitoring system ineffective because farmers want reliable access to agricultural data at all times and from any location.

CHAPTER 11
CONCLUSION

As agriculture is the backbone of our Indian economy, in order to overcome food scarcity and also to get good yield with limited amount of our precious resource water, this system will be eco friendly as well as the user friendly for the farmers to achieve the above-mentioned features.The farmers will be able to monitor the environmental conditions of the field and take necessary decisions to get good yield which improves their standard of living. Good Food production would be achieved by blending software and Hardware.

CHAPTER 12
FUTURE SCOPE

IoT can be adopted in most regions in the future due to increased consumer demand for goods and the need for more farming to be done in a given amount of time, improving crops and lowering the consumption of expensive resources like energy and water.IoT-enabled devices are likely to be found everywhere, from businesses to homes.The potential of IoT is vast and varied, and it won't be long before the aforementioned uses of the technology become a reality.

CHAPTER 13
APPENDIX

Source Code

```
import random
import ibmiotf.application
import ibmiotf.device
from time import sleep
import sys
#IBM Watson Device Credentials...
organization = "tw9ckq"
deviceType = "jade"
deviceId = "7010"
authMethod = "use-auth-token"
authToken = "9944893843"
defmyCommandCallback(cmd):
print("Command received: %s" %cmd.data['command'])
status=cmd.data['command']
if status=="sprinkler_on":
print ("sprinkler is turning ON")
else :
print ("sprinkler is turning OFF")
try:
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId,
"auth-method": authMethod, "authtoken": authToken}
deviceCli = ibmiotf.device.Client(deviceOptions)
except Exception as e:
print("Exception detected in connecting device: %s" % str(e))
```

```
sys.exit()
#Connecting to IBM watson...
deviceCli.connect()
while True:
#Getting values from sensors...
temp_sensor = round( random.uniform(0,80),2)
PH_sensor = round(random.uniform(1,14),3)
camera = ["Detected","Not Detected","Not Detected","Not Detected","Not
Detected","Not Detected",]
camera_reading = random.choice(camera)
flame = ["Detected","Not Detected","Not Detected","Not Detected","Not
Detected","Not Detected",]
flame_reading = random.choice(flame)
moist_level = round(random.uniform(0,100),2)
water_level = round(random.uniform(0,30),2)
#storing the sensor data to send in json format to cloud…
temp_data = { 'Temp' : temp_sensor }
PH_data = { 'PH value' : PH_sensor }
camera_data = { 'Animal attack' : camera_reading}
flame_data = { 'Flame' : flame_reading }
moist_data = { 'Moisture level' : moist_level}
water_data = { 'Water level' : water_level}
# publishing Sensor datas to IBM Watson for every 5-10 seconds…
success = deviceCli.publishEvent("Temperature sensor", "json", temp_data,
qos=0)
sleep(1)
if success:
print ("... ...publish ok.......... ")
print ("Published Temp = %s C" % temp_sensor, "to IBM Watson")
```

```
success = deviceCli.publishEvent("PH sensor", "json", PH_data,qos=0)
sleep(1)
ifsuccess:
print ("Published PH value = %s" % PH_sensor, "to IBM Watson")
success = deviceCli.publishEvent("camera", "json", camera_data,qos=0)
sleep(1)
ifsuccess:
print ("Published Animal attack %s " % camera_reading, "to IBM Watson")
success = deviceCli.publishEvent("Flame sensor", "json", flame_data,qos=0)
sleep(1)
if success:
print ("Published Flame %s " % flame_reading, "to IBM Watson")
success = deviceCli.publishEvent("Moisture sensor", "json",
moist_data,qos=0)
sleep(1)
ifsuccess:
print ("Published Moisture level = %s " % moist_level, "to IBM Watson")
success = deviceCli.publishEvent("Watersensor", "json", water_data, qos=0)
sleep(1)
ifsuccess:
print ("Published Water level = %s cm" % water_level, "to IBM Watson")
print ("")
#Automation to control sprinklers by present temperature an to send alert
message to IBM Watson…
if (temp_sensor > 35):
print("sprinkler-1 is ON")
success = deviceCli.publishEvent("Alert1", "json",{ 'alert1' : "Temperature(%s)
is high, sprinkerlers are
turned ON" %temp_sensor }, qos=0)
```

```
sleep(1)
ifsuccess:
print( 'Published Alert1 : ', "Temperature(%s) is high, sprinkerlers are turned
ON" %temp_sensor,"to IBM
Watson")
print("")
else:
print("sprinkler-1 is OFF")
print("")
#To send alert message if farmer uses the unsafe fertilizer to crops…
if (PH_sensor > 7.5 or PH_sensor < 5.5):
success = deviceCli.publishEvent("Alert2", "json",{ 'alert2' : "Fertilizer PH
level(%s) is not safe,use other
fertilizer" %PH_sensor } , qos=0)
sleep(1)
ifsuccess:
print('Published Alert2 : ' , "Fertilizer PH level(%s) is not safe,use other
fertilizer" %PH_sensor,"to IBM
Watson")
print("")
#To send alert message to farmer that animal attack on crops…
if (camera_reading == "Detected"):
success = deviceCli.publishEvent("Alert3", "json", { 'alert3' : "Animal attack on
crops detected" }, qos=0)
sleep(1)
if success:
print('Published Alert3 : ' , "Animal attack on crops detected","to IBM
Watson","to IBM Watson")
print("")
```

```
#To send alert message if flame detected on crop land and turn ON the
splinkers to take immediate action…
if (flame_reading == "Detected"):
print("sprinkler-2 is ON")
success = deviceCli.publishEvent("Alert4", "json", { 'alert4' : "Flame is
detected crops are in
danger,sprinklers turned ON" }, qos=0)
sleep(1)
ifsuccess:
print( 'Published Alert4 : ' , "Flame is detected crops are in danger,sprinklers
turned ON","to IBM Watson")
print("")
else:
print("sprinkler-2 is OFF")
print("")
#To send alert message if Moisture level is LOW and to Turn ON Motor-1 for
irrigation…
if (moist_level < 20):
print("Motor-1 is ON")
success = deviceCli.publishEvent("Alert5", "json", { 'alert5' : "Moisture
level(%s) is low, Irrigation started"
%moist_level }, qos=0)
sleep(1)
ifsuccess:
print('Published Alert5 : ' , "Moisture level(%s) is low, Irrigation started"
%moist_level,"to IBM Watson" )
print("")
else:
print("Motor-1 is OFF")
```

```
print("")
#To send alert message if Water level is HIGH and to Turn ON Motor-2 to take
water out…
if (water_level > 20):
print("Motor-2 is turning ON")
success = deviceCli.publishEvent("Alert6", "json", { 'alert6' : "Water level(%s)
is high, so motor is ON to take
water out " %water_level }, qos=0)
sleep(1)
ifsuccess:
print('Published Alert6 : ' , "water level(%s) is high, so motor is ON to take
water out " %water_level,"to
IBM Watson" )
print("")
else:
print("Motor-2 is turning OFF")
print("")
#command recived by farmer
deviceCli.commandCallback = myCommandCallback
# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

DEMO LINK
https://drive.google.com/drive/folders/1Wt-3-fvej9UNmUm_286gwU7iG6i44MyH?usp=share_link