PROJECT REPORT

Department Of Electronics And Communication Engineering

IBM-NALAIYA THIRAN

PROJECT NAME:

SMART FORMER-IOT ENABLED SMART

FARMING APPLICATION

TEAM ID:

PNT2022TMID38164

TEAM MEMBERS:

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1.INTRODUCTION

Project Overview

Agriculture plays a important role in country’s economy and provides a large scale employment to the people. However, agriculture is highly dependent upon weather and climate. For example, changes in temperature, soil moisture, carbon dioxide may result in low yield of crops. It is Significant to monitor environmental parameters in order to manage crop growth and increase the agricultural production yield. The sensed information is not only important for decision making but also for evaluating impacts of agricultural practices on environment. Nowadays, it is more necessary than ever to increase the crop yields food grain production. Cloud connected, wireless system aid in this crop yield maximization, which automates day-to-day agricultural tasks and real time monitoring for smart decision-making.

Purpose

- Need for technology to monitor important parameters like soil moisture, temperature, Humidity etc. to improve the cultivation process.
- Need for technology to monitor weather of particular area with reliable source to save the crops at the time of natural calamities like flood, cyclone etc.
- Development of certain techniques to reduce the workforce, energy and time for cultivation.
- Development of a feasible method to control the electrical equipment in the farm from any part of the world.

2. LITERATURE SURVEY

EXISTING PROBLEM

1. Controlling the device from longer distance from web application.
2. Getting the weather data from weather station.
3. Transfer of node data to the gateway at faster rate.
4. Unavailability of data’s such as PH level, potassium, Nitrogen etc related to the soil.

PROPOSED SOLUTION

1. To control a device from longer distance from web application.
2. To get the weather details like wind speed, temperature, humidity from weather station through weather API.
3. To display the data in the web application.

References

1) IoT Enabled Smart Farming and Irrigation System:

Authors: M. Rohith, R Sainivedhana, Dr. N. Sabiyath Fatima

Published: IEEE 2021

Description: In this paper, authors have demonstrated a IoT enabled smart farming and irrigation system to automate the process of watering to plants. This system helps to measure the values of various parameters such as humidity, moisture and temperature of plants and water them accordingly. This system consists of three sensors which will sense the values of humidity, moisture and temperature of plants. If any of the sensor values decreases the motor automatically turns on the water for plants. The ultimate significance of the paper is that most of the manual work is reduced and watering process is automated with the help of IoT enabled devices as a result of which healthy plants can be grown.

2) A Systematic Review of IoT Solutions for Smart Farming:

Authors: Emerson Navarro, Nuno Costa, and António Pereira

Published: MDPI 2020

Description: In this work, authors have presented a systematic review of the state-of-the-art of IoT adoption in smart agriculture and identified the main components and applicability of IoT solutions. In this particular work it was observed that the use of artificial intelligence and image processing techniques has become more common to improve the management of smart farming. From the identified applications of IoT for smart farming it was observed that the most common application is the monitoring of crops. Here, authors showed that different network protocols may be simultaneously used in IoT solutions for smart farming.

3) A Multi-collective, IoT-enabled, Adaptive Smart Farming Architecture:

Authors: G. Kakamoukas, P. Sariciannidis, G. Livanos, M. Zervakis, D. Ramnalis, V. Polychrnos, T. Karamitsou, A. Folinas, N. Tsitsiokas

Published: IEEE 2019

Description: In this paper, authors have proposed a precision architecture for Smart Farming in order to use precise and efficient approaches for monitoring and processing information from farms, crops, forestry, and livestock aiming at more productive and sustainable rural development. This proposed architecture encloses wireless sensor networks, meteorological stations and unmanned aerial vehicles along with an information processing system that leverages machine learning and computing technologies. The innovation of the proposed architecture lies in the creation of an integrated monitoring and decision support system for efficient allocation of resources and protection of plant capital from the diseases.

4) Internet of Things and LoRaWAN – Enabled Future Smart Farming

Authors: Bruno Citoni, Francesco Fioranelli, Muhammad A. Imran, Qammer H. Abbasi

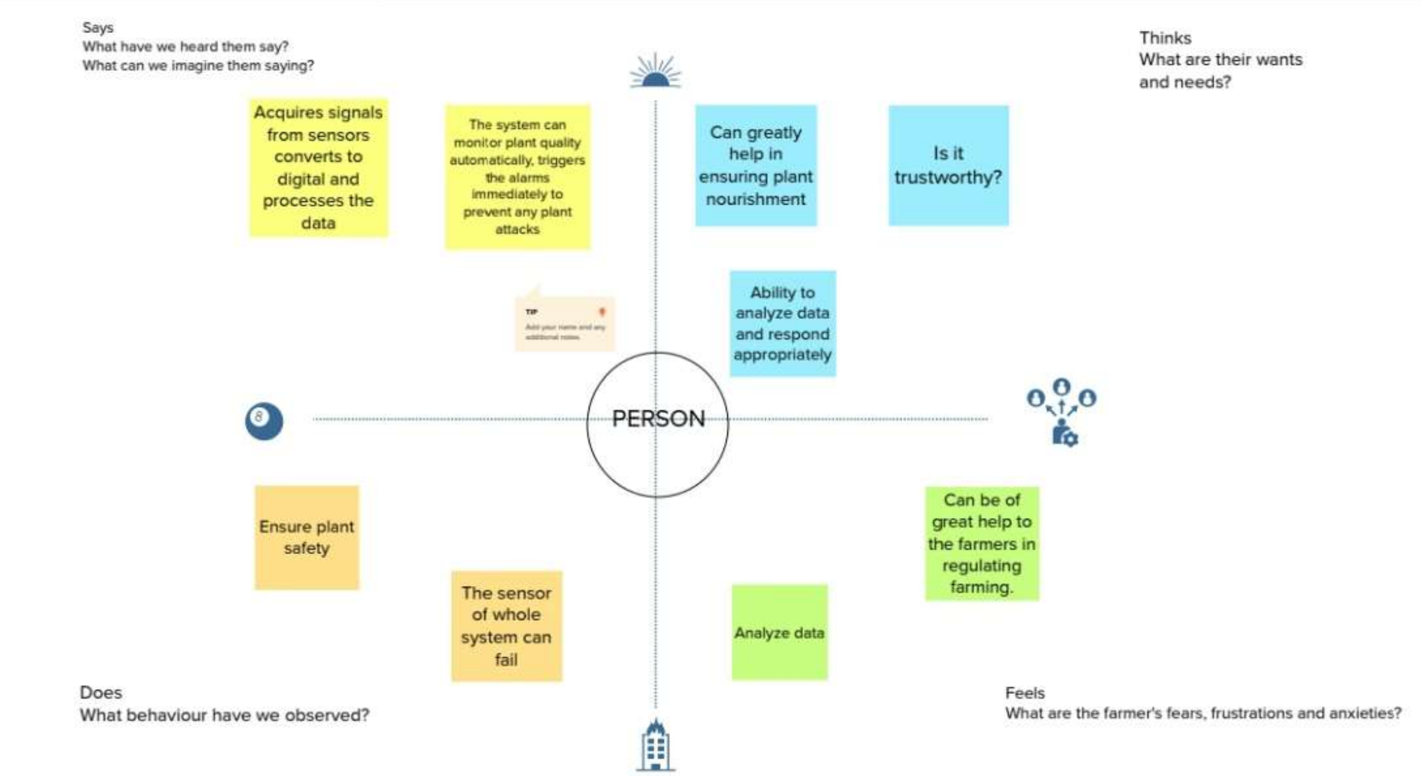
Published: IEEE 2019

Description: In this paper authors have explained about LoRaWAN which is been under the spotlight in recent years due to its suitability to be the standard communication protocol for IoT deployments. It provides long communication range and low energy consumption by drastically reducing the available data rate. They also explained about the development of LoRaWAN enabled smart agriculture test to improve the understanding about the impact of the limitations using experimental test data, and moving towards building predictive models and adaptive network management algorithms for smart farming using the data collected.

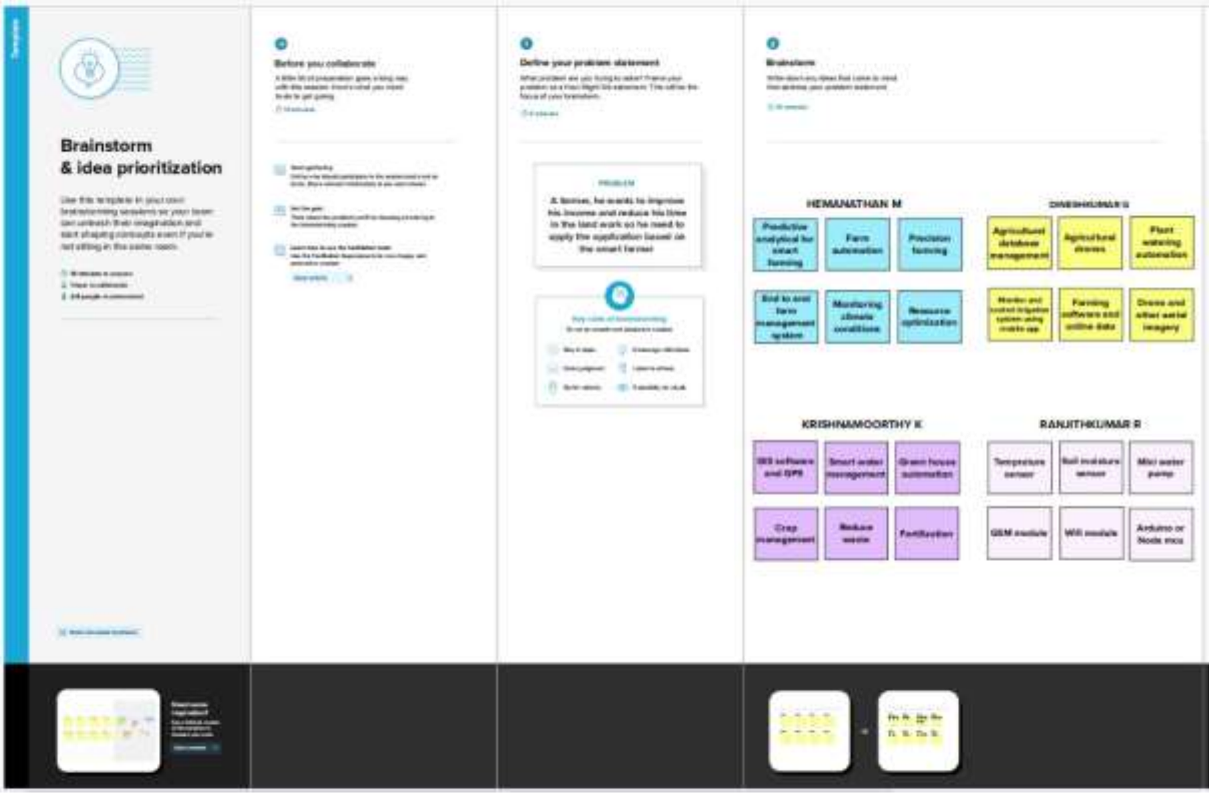
Problem Statement Definition

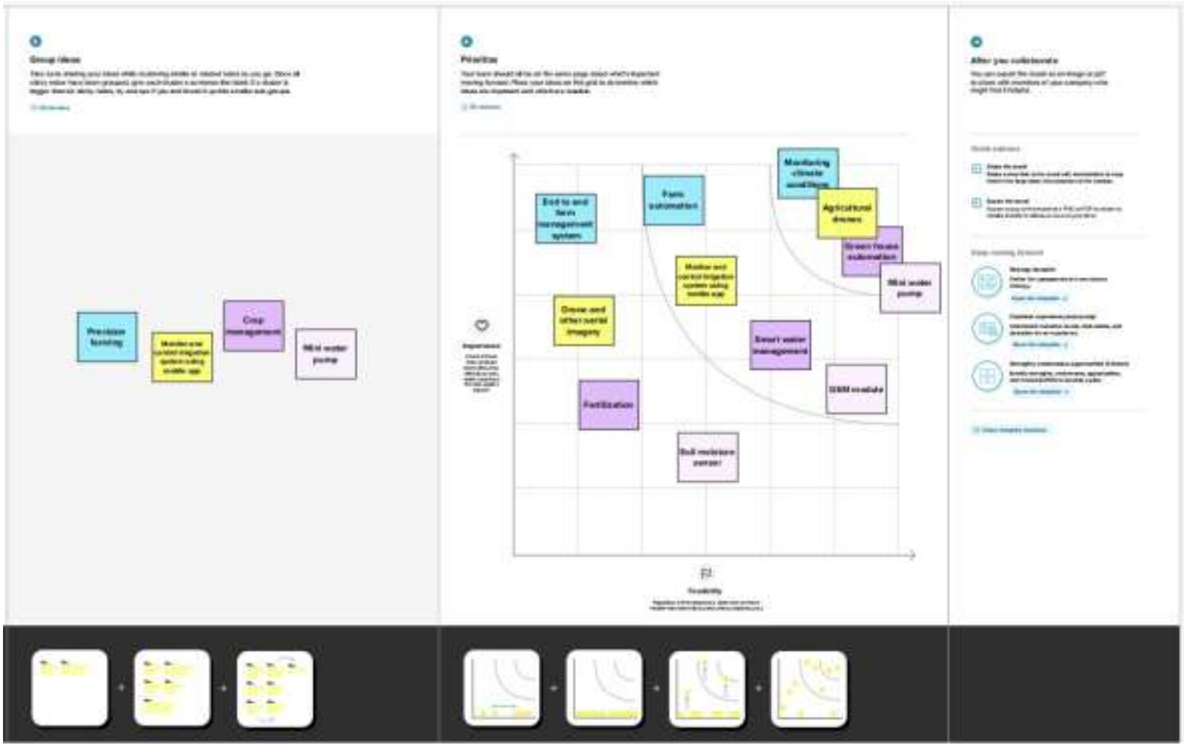
3. IDEATION & PROPOSED SOLUTION

Empathy Map Canvas



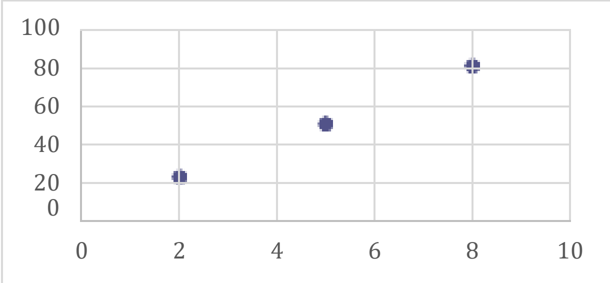
Ideation & Brainstorming





Proposed Solution

S. No	Parameter	Description
1.	Problem Statement (Problem to be solved)	• Watering the field is a difficult process, Farmers have to wait in the field until the water covers the whole farm field. • Power Supply is also one of the problems. In Village Side, the power supply may vary. • The Biggest Challenges Faced by IoT in the Agricultural Sector are Lack of Information, High Adoption, Cost and Security Concerns, etc
2.	Idea / Solution description	• As is the case of precision Agriculture Smart Farming Technique Enables Farmers better to monitor the fields and maintain the humidity level accordingly. • The Data collected by sensors, In terms of humidity, temperature, moisture, and dew detections help in determining the weather pattern in Farms. So cultivation is done for suitable crops.
3.	Novelty / Uniqueness	**ALERT MESSAGE –** IoT sensor nodes collect information from the farming environment, such as soil moisture, air humidity, temperature, nutrient ingredients of soil, pest images, and water quality, then transmit collected data to IoT backhaul devices. **REMOTE ACCESS –** It helps the farmer to operate the motor from anywhere.
4.	Social Impact / Customer Satisfaction	• Reduces the wages for labours who work in the agricultural field. • It saves a lot of time. • IoT can help improve customer relationships by enhancing the customer's overall experience. • Easily identify maintenance needs, build better products, send personalized communications, and more. • IoT can also help e-commerce businesses thrive and increase sales. • It make a wealthy society.
5.	Business Model (Revenue Model)	No.Users(X) Vs Month(Y)

		
6.	Scalability of the Solution	Scalability in smart farming refers to the adaptability of a system to increase the capacity, for example, the number of technology devices such as sensors and actuators, while enabling timely analysis.

Problem Solution fit

Project Title: Smart Farmer – IOT Enabled Smart Farming Application **Project Design Phase-I -** Solution Fit Template **Team ID:** PNT2022TMID37214

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

The main customer for our project are:

- ✓ Farmers who wants to improve the yield of their crops.
- ✓ Farmers who wants to know the condition of their crops and it's environmental conditions so they could take the necessary methods immediately.

6. CUSTOMER CONSTRAINTS CC

Network connectivity would be the main constraint as we use Wi-Fi which has major limitations like in coverage, scalability and power consumption.

5. AVAILABLE SOLUTIONS AS

For smart farming, lot of Iot based solutions are there. But ,one huge disadvantage of smart farming is that it requires an unlimited or continuous internet connection to be successful. This means that in rural communities, especially in the developing countries where we have mass crop production, it is completely impossible to operate this farming method. In places where internet connections are frustratingly slow, smart farming will be an impossibility.

Explore AS, differentiate

Focus on J&P, tap into BE, understand

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

- ✓ The farmers will initially find it hard to use the device as they have to get familiar with the technologies.
- ✓ They must be with their phone/laptop always so that they would be alarmed when they get the message/mail.
- ✓ Our main job would be making the technologies feasible for the farmers

9. PROBLEM ROOT CAUSE RC

Technologies keep developing but still the farmers are not able to achieve their goals(i.e.) receiving the expected profit due to various reasons like the presence of excess water in the field, varying climatic conditions etc. which affects the crop. So in order to avoid this there is a need for smart farming which helps to improve the time efficiency, crop monitoring, soil management etc.

7. BEHAVIOUR BE

IoT applications help farmers to collect data regarding the location, well-being, and health of their crops. Weather stations equipped with smart sensors can collect weather data and send useful information to a farmer. As in the case of weather condition monitoring, sensors for crop monitoring also collect all information like crop health, humidity, precipitation, temperature, and other parameters.

Focus on J&P, tap into BE, understand

3. TRIGGERS TR

Customers get triggered mainly because to save their crops and to prevent them from the damage as they feel depressed when they face the losses and it indirectly affects their family too. This device is also a budget friendly device.

10. YOUR SOLUTION SL

To provide an alternate to avoid the network problems we are also going to introduce the manual mode where the farmers can stop the water flow /provide limited amount of water flow into the field., Make it more user friendly(like appoint the help center team to guide them whenever they are facing any trouble with our app),.. Additional features like create an awareness about where to get agricultural loans, government agriculture schemes and get the feedback of every farmers on every month end and if its related to government, then make it to reach the government. It also ensures whether the crops are well nourished and watered without human intervention. It helps in increasing farming productivity and quality, reducing labour costs and maintaining the sustainability of the entire value chain.

8.CHANNELS of BEHAVIOUR

Offline:

The IoT-based smart farming not only helps in modernizing the conventional farming methods but also targets other agriculture methods like organic farming, family farming (complex or small spaces, particular cattle and/or cultures, preservation of particular or high quality varieties, etc.), and enhances highly transparent farming.

Online:

IoT-based smart farming is also beneficial in terms of environmental issues. It can help the farmers to efficiently use water, optimize the inputs and treatments.

4. EMOTIONS: BEFORE / AFTER EM

Before:

Depressed ,loss of time ,Facing more losses

After:

Confident , Gets chance to spend time efficiently,95%

4. REQUIREMENT ANALYSIS

Functional requirement

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Log in to system	Check Credentials Check Roles of Access.
FR-4	Manage Modules	Manage sensor data Manage weather data Control System Plant details
FR-5	Log out	Exit

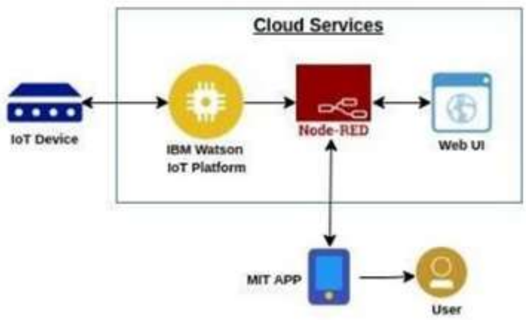
Non-Functional requirements

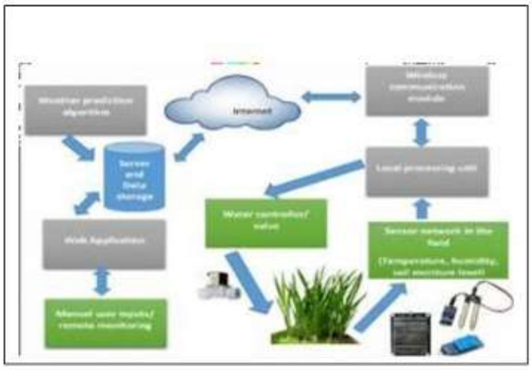
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability includes easy learn ability, efficiency in use, remember ability, lack of errors in operation and subjective pleasure.
NFR-2	**Security**	Sensitive and private data must be protected from their production until the decision-making and storage stages.
NFR-3	**Reliability**	The shared protection achieves a better trade-off between costs and reliability. The model uses dedicated and shared protection schemes to avoid farm service outages.
NFR-4	**Performance**	The idea of implementing integrated sensors with sensing soil and environmental or ambient parameters in farming will be more efficient for overall monitoring.
NFR-5	**Availability**	Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc.
NFR-6	**Scalability**	Scalability is a major concern for IoT platforms. It has shown that different architectural choices of IoT platforms affect system scalability and that automatic real time decision-making is feasible in an environment composed of dozens of thousand.

5. PROJECT DESIGN

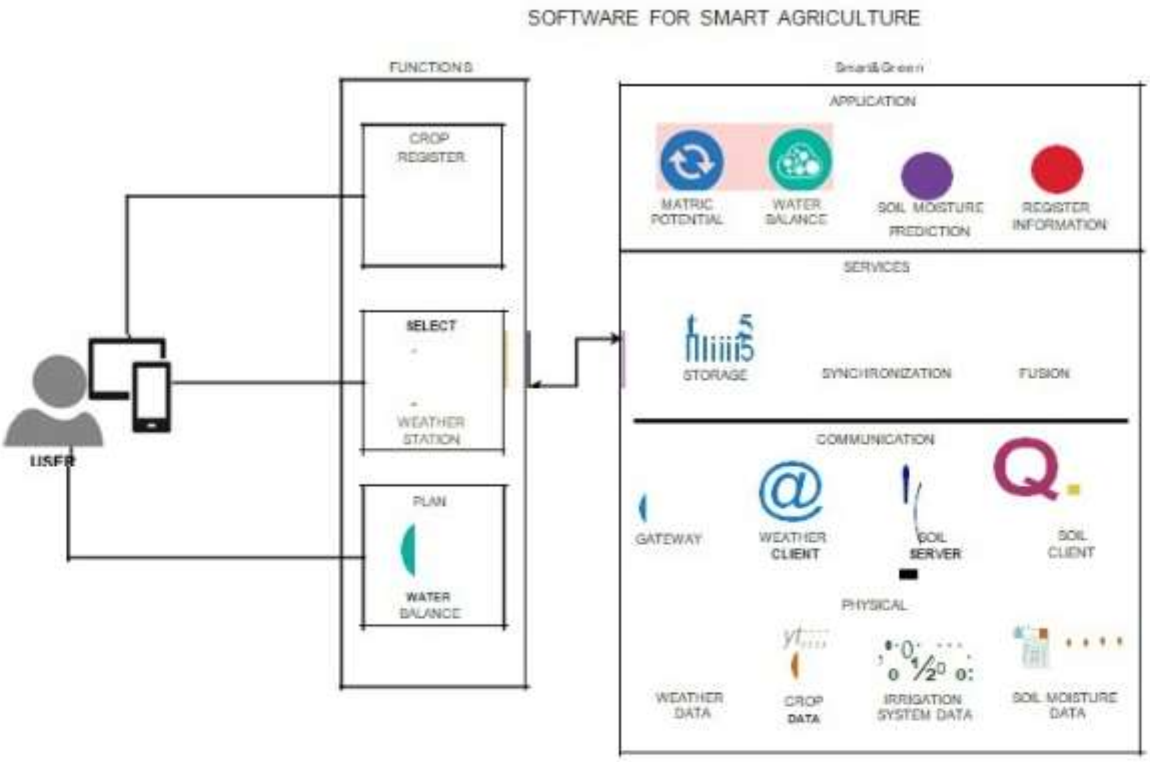
Data Flow Diagrams

Example: (Simplified)





Solution & Technical Architecture



User Stories

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 Gmail		Low	Sprint-1
	Login	USN-4	As a user, I can log into the application by entering email & password		Medium	Sprint-1
Customer (Web user)	Dashboard	USN-5	Main Menu Is Apprised And Manages Modules.	Can View The Main Menu And Access The Mainframe.	High	Sprint-2
		USN-6	User Can Access All Sort Of Sensor Details And Access From All Over His Places.	Smart Farming Application.	High	Sprint-2
	Multiple User	USN -7	User can switch the application different login credentials			Sprint-3
Administrator			User Can Manage And Access The			Sprint-3

3. PROJECT PLANNING & SCHEDULING

velocity 10

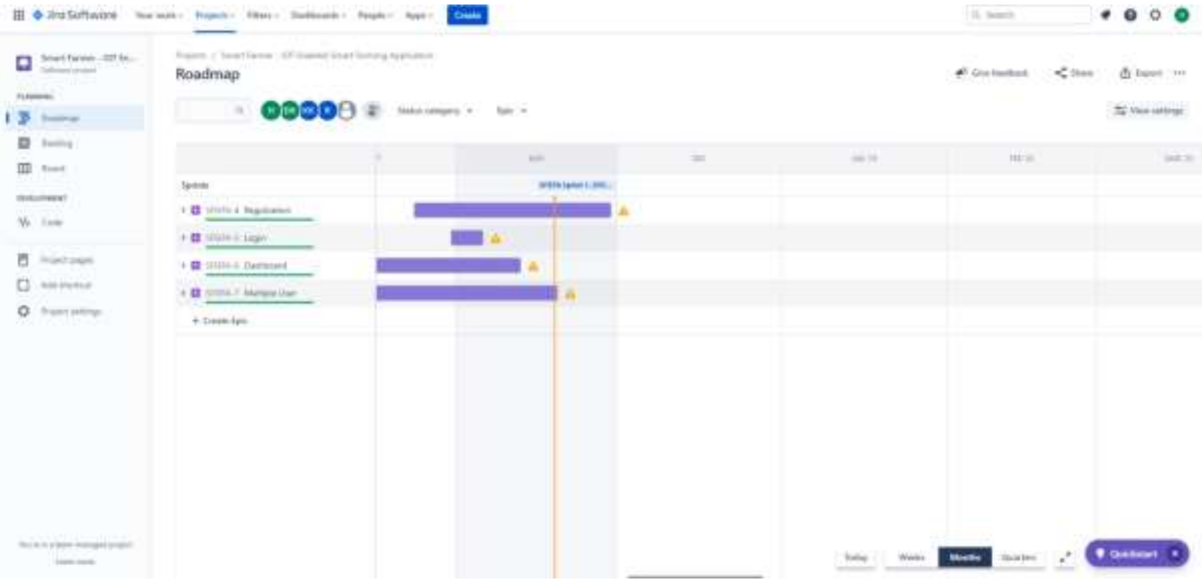
Product Backlog, Sprint Schedule, and Estimation (4 Marks)

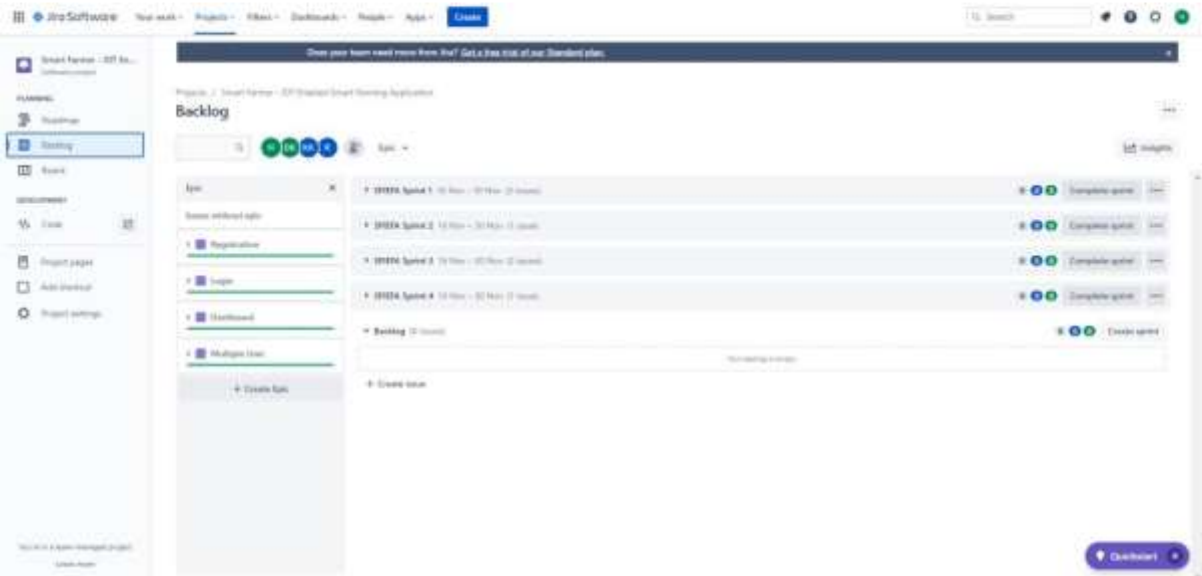
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Simulation creation	USN-1	Connect Sensors and Arduino with python code	2	High	Bavadharani k,Sathish.M
Sprint-2	Software	USN-2	Creating device in the IBM Watson IoT platform, workflow for IoT scenarios using Node-Red	2	High	Esakkiraja n.M ,Arunkum ar.A
Sprint-3	MIT App Inventor	USN-3	Develop an application for the Smart farmer project using MIT App Inventor	2	High	Bavadhara ni.k ,Sathish.M
Sprint-3	Dashboard	USN-3	Design the Modules and test the app	2	High	Sathish.M
Sprint-4	Web UI	USN-4	To make the user to interact with software.	2	High	Bavadhara ni.k,Sathis h.M, Arunkuma r.A

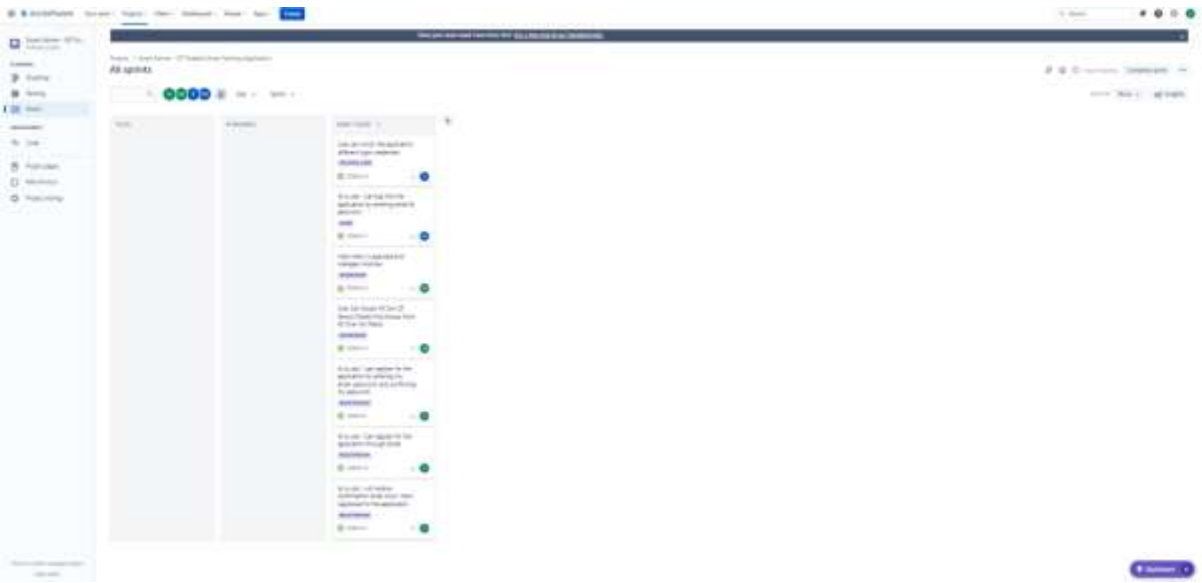
Project Tracker, Velocity & Burndown Chart: (4 Marks)

	Total Story Points	n	Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	7 Days	30 Oct 2022	06 Nov 2022	20	29 Oct 2022
Sprint-2	20	9 Days	31 Oct 2022	09 Nov 2022		05 Oct 2022

Reports from JIRA



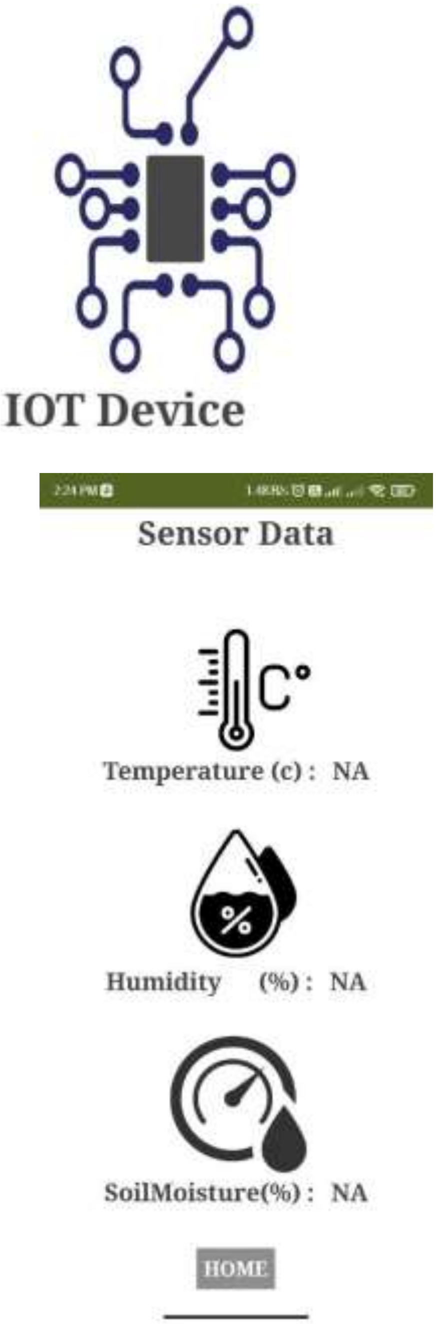


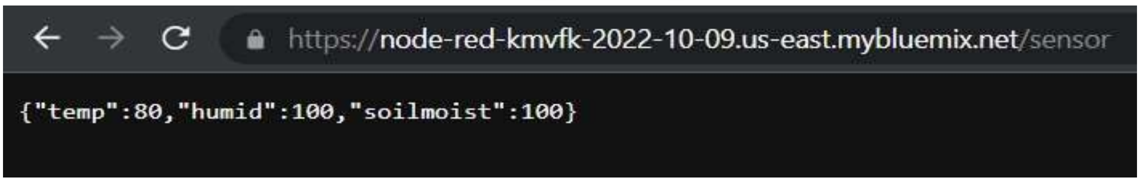


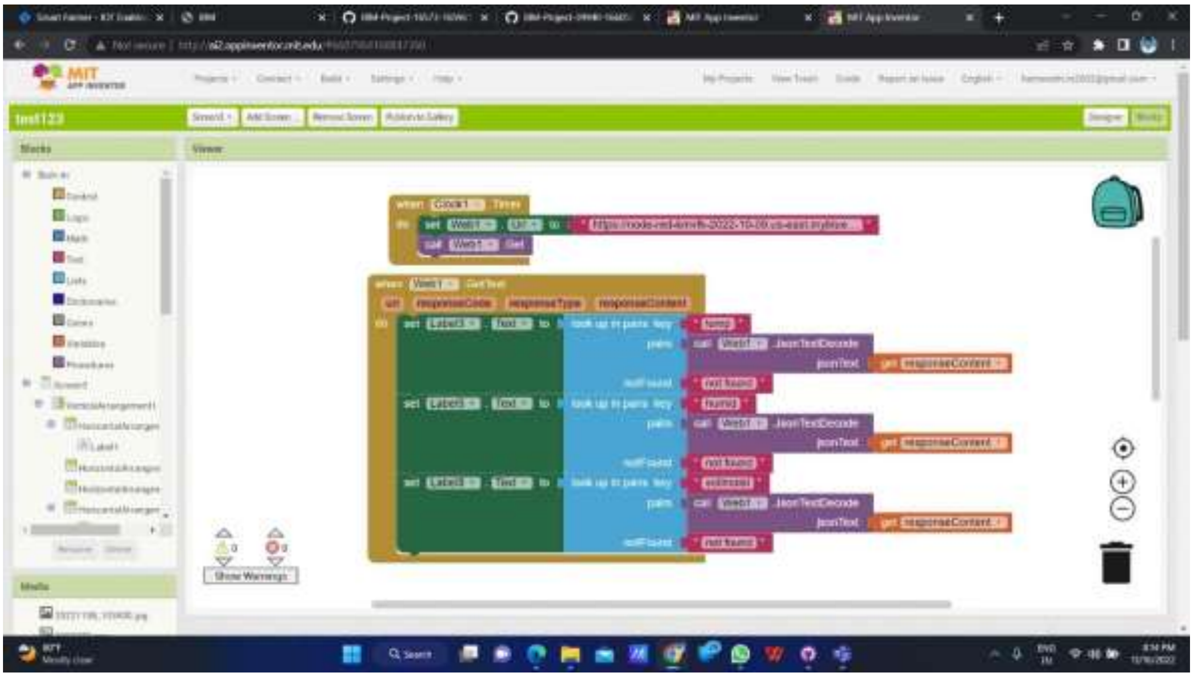
4. CODING & SOLUTIONING

Feature 1

Monitor the Realtime sensor data



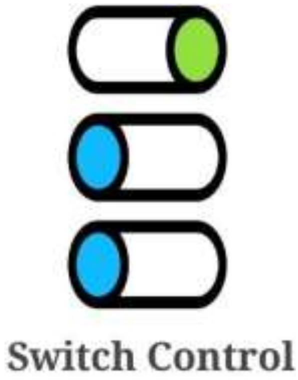


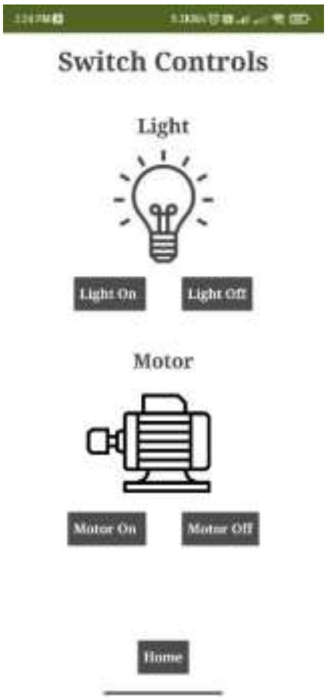


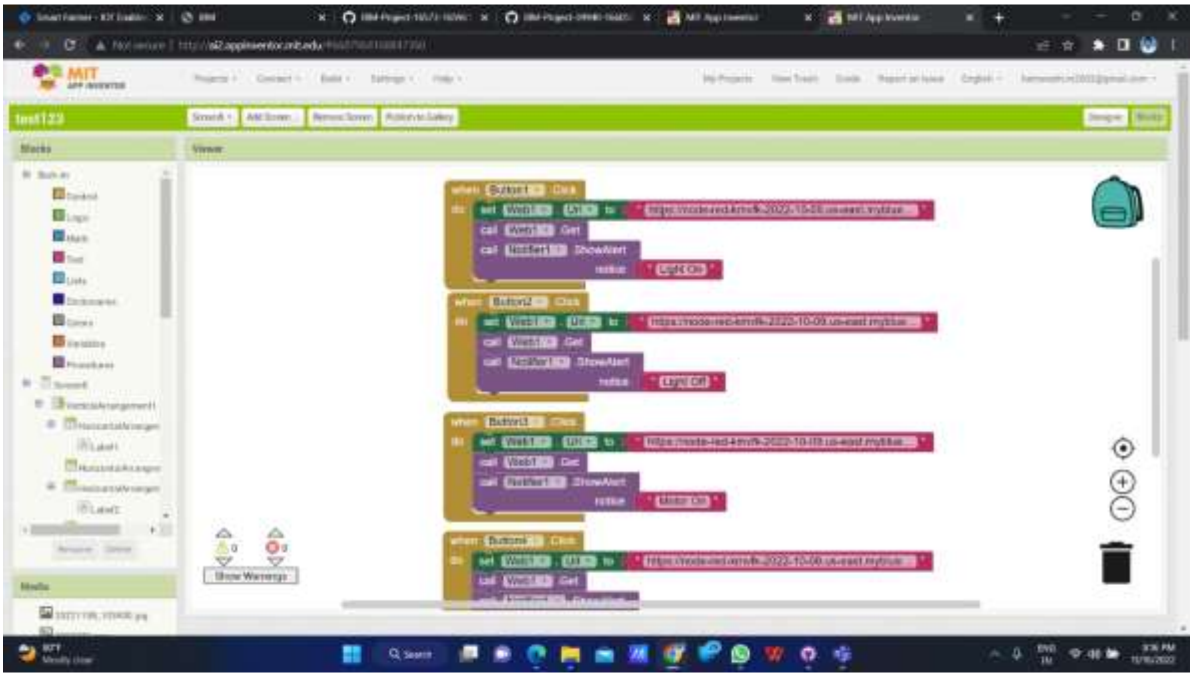
test123
Show Warnings
look up in pairs key
pairs
jsonText
responseType

Feature 2

Control the switch remotely



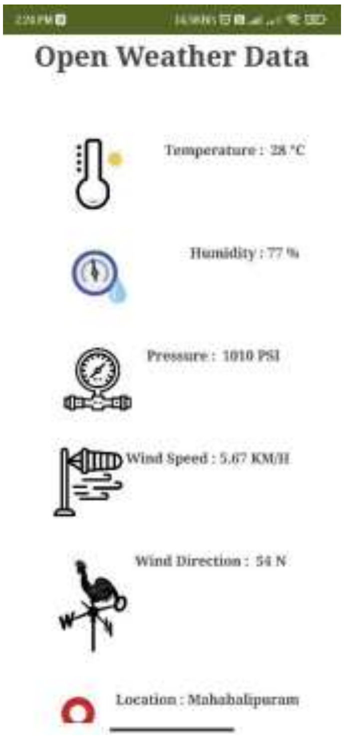


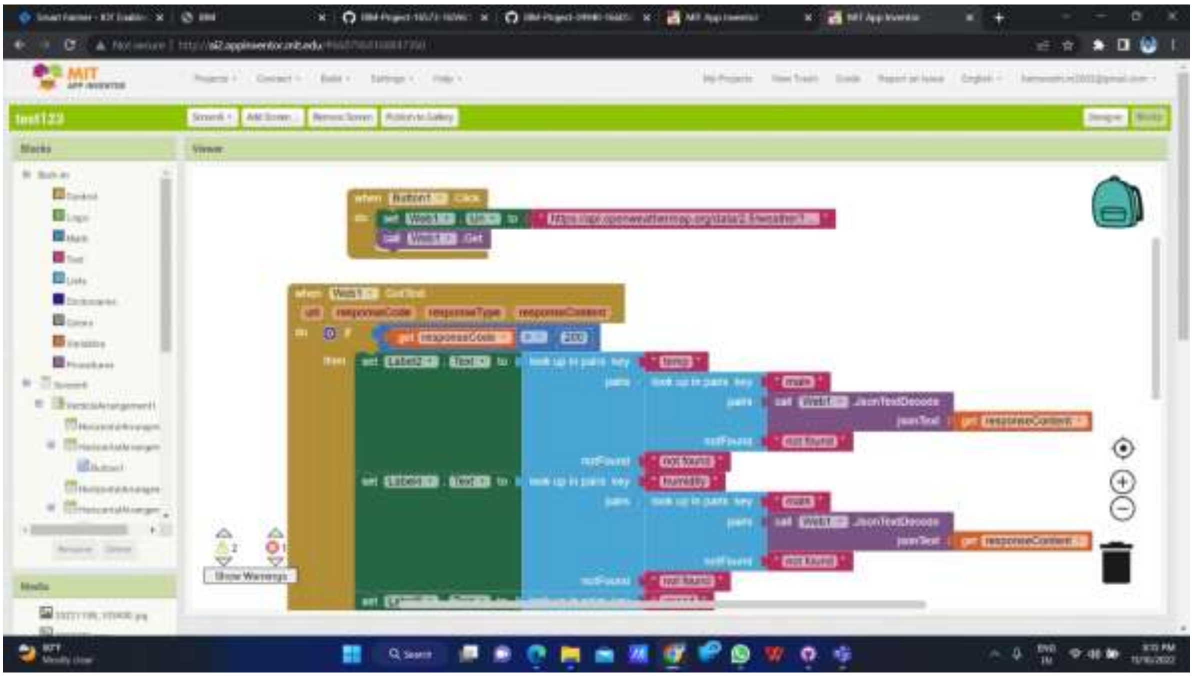


test123
Blocks
Viewer
when Button1 Click
do set Web1 Url to
call Web1 Get
call Notifier1 ShowAlert
notice
Light On
when Button2 Click
Light Off
when Button3 Click
Motor On
Show Warnings

Feature 3

Get the Realtime weather data




test123
Blocks
Viewer
when Button1 Click
when Web1 GotText
responseCode
responseType
responseContent
look up in pairs key
notFound
JsonTextDecode
Show Warnings

5. TESTING

Test Cases

1. Verify user is able to see the Login/Signup popup when user clicked on My account button.
2. Verify the UI elements in Login/Signup popup.
3. Verify user is able to log into application with Valid credentials.
4. Verify user is able to log into application with InValid credentials.

User Acceptance Testing

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).

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

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

6. RESULTS

9.1 Performance Metrics

Hence a helpful and useful system is built for farmers to assist them in farming and also prevent them from natural calamities. It also saves farmers time to maintain all these things as this is working on cloud he can turn on/off motor from anywhere so basically it helps farmers and make them relived thus helping our economy to grow.

7. ADVANTAGES & DISADVANTAGES

ADVANTAGE

1. Communicating the device at larger distance through web application. It will play an important role in reducing the man power and travelling expenses of a farmer.
2. Monitoring the parameter like temperature, humidity etc will play an important role in improving the growth of the plant.
3. Integrating the weather station to the web browser will provide the details of status of the cloud, wind speed etc. It will allow the farmer to prevent their plants from natural calamities.

DISADVANTAGE

1. Since the real time sensor will be connected to the controller, the controller requires continuous supply of internet to transfer the data.
2. Non availability of weather prediction for long period of time. Since the long weather prediction require additional payment to open weather.

10. CONCLUSION

The various parameters like temperature, humidity etc were monitored using web application. The data from weather station like wind speed, temperature, humidity etc were displayed in the web browser. The device like motor, light etc can also controlled by the web application.

11. FUTURE SCOPE

1. The various data's of soil nutrients is not added in the web browser, that can be added to the web application.
2. Long range forecast is not available in the web application, it can also be added to provide accurate information about weather.
3. Controlling the device through mobile application and voice will play important role in enhancing this project.
4. Providing the GPS and GIS information will also improve productivity of the farmer.

12. APPENDIX

12.1 Source Code

1)Python Code

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

organization = "22r9m3"
deviceType = "123"
deviceId = "1234567"
authMethod = "token"
authToken = "12345678"


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")
   elif status == "motoron":
      print("motor is on")
   elif status == "motoroff":
      print("motor is off")
   else :
      print ("please send proper command")
```

```
    #print(cmd)




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()

deviceCli.connect()

while True:


        temp=random.randint(0,100)
        humid=random.randint(0,100)
        soilmoist=random.randint(0,100)

        data = { 'temp' : temp, 'humid': humid, 'soilmoist': soilmoist }

        def myOnPublishCallback():
            print ("Published Temperature = %s C" % temp, "Humidity = %s %%" %
humid,"Soilmoisture = %s %%" % soilmoist, "to IBM Watson")

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoTF")
        time.sleep(1)

        deviceCli.commandCallback = myCommandCallback

deviceCli.disconnect()
```

2)Wokwi Simulator

```
#include  <WiFi.h>
#include <PubSubClient.h>
#include "DHT.h"
#define DHTPIN 15
#define DHTTYPE DHT22
#define LED 2
```

```
#define MOTOR 4

DHT dht (DHTPIN, DHTTYPE);

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength);



#define ORG "22r9m3"//IBM ORGANITION ID
#define DEVICE_TYPE "123"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "1234567"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345678" //Token
String data3;
float h, t;



char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server Name
char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type of event perform and
format in which data to be send
char subscribetopic[] = "iot-2/cmd/command/fmt/String";// cmd REPRESENT command
type AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication method
char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id



WiFiClient wifiClient;
PubSubClient client(server, 1883, callback ,wifiClient);


void setup()
{
  Serial.begin(115200);
  dht.begin();
  pinMode(LED,OUTPUT);
  pinMode(MOTOR,OUTPUT);
  delay(10);
  Serial.println();
  wificonnect();
  mqttconnect();
}

void loop()
{

  h = dht.readHumidity();
```

```
  t = dht.readTemperature();
  Serial.print("temp:");
  Serial.println(t);
  Serial.print("humid:");
  Serial.println(h);

  PublishData(t, h);
  delay(1000);
  if (!client.loop()) {
    mqttconnect();
  }
}





void PublishData(float temp, float humid) {
  mqttconnect();

  String payload = "{\"temp\":";
  payload += temp;
  payload += "," "\"humid\":";
  payload += humid;
  payload += "," "\"soilmoist\":";
  payload += humid;
  payload += "}";


  Serial.print("Sending payload: ");
  Serial.println(payload);


  if (client.publish(publishTopic, (char*) payload.c_str())) {
    Serial.println("Publish ok");
  } else {
    Serial.println("Publish failed");
  }

}


void mqttconnect() {
  if (!client.connected()) {
    Serial.print("Reconnecting client to ");
    Serial.println(server);
    while (!!!client.connect(clientId, authMethod, token)) {
      Serial.print(".");
```

```
     delay(500);
    }

    initManagedDevice();
    Serial.println();
  }
}
void wificonnect()
{
  Serial.println();
  Serial.print("Connecting to ");

  WiFi.begin("Wokwi-GUEST", "", 6);
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

void initManagedDevice() {
  if (client.subscribe(subscribetopic)) {
    Serial.println((subscribetopic));
    Serial.println("subscribe to cmd OK");
  } else {
    Serial.println("subscribe to cmd FAILED");
  }
}

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength)
{

  Serial.print("callback invoked for topic: ");
  Serial.println(subscribetopic);
  for (int i = 0; i < payloadLength; i++) {
    data3 += (char)payload[i];
  }
  Serial.println("data: "+ data3);
  if(data3=="lighton")
  {
Serial.println(data3);
digitalWrite(LED,HIGH);
  }
  else if(data3=="motoron")
  {
```

```
Serial.println(data3);
digitalWrite(MOTOR,HIGH);
  }
  else if(data3=="motoroff")
  {
Serial.println(data3);
digitalWrite(MOTOR,LOW);
  }
  else
  {
Serial.println(data3);
digitalWrite(LED,LOW);
  }
data3="";
}
```

GitHub & Project Demo Link

GitHub **: -** https://github.com/IBM-EPBL/IBM-Project-53971-1661585887/tree/main

Project Demo Link : h t t p s : / / y o u t u . b e / N 6 f p 9 W o s i 2 E