

SMART FARMER-IOT ENABLED SMART FARMING
APPLICATION

PROJECT REPORT

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THINDAL, ERODE

PROJECT REPORT

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1.INRODUCTION

1.1 Project Overview

IOT- Enabled Smart Farming agriculture system helps the farmer in monitoring different parameters of his field like soil moisture, temperature, humidity using some sensors. Farmer can monitor all the sensor parameters by using a web or mobile application even if the farmer is not near his field. Watering the crop is one of the Important task for the farmers. They can make the decision whether to water the crop or postpone it by monitoring the sensor parameters and control the motor pumps from the mobile application itself. All the sensor parameters are stored in the IBM Cloudant DB

IoT is network that connects physical objects or things embedded with electronics, software and sensors through network connectivity that collects and transfers data using cloud for communication. Data is transferred through internet without human to human or human to computer interaction. In this project we have not used any hardware. Instead of real soil and temperature conditions, sensors IBM IoT Simulator is used which can transmit soil moisture temperature as required..

Project requirements:

Node-RED, IBM Cloud, IBM Watson IoT, Node.js, IBM Device, IBM IoT Simulator, Python 3.7, Open Weather API platform.

Project Deliverables: Application for IoT based Smart Agriculture System

1.2 Purpose

IoT based farming improves the entire agriculture system by monitoring the field in real-time. With the help of IoT in agriculture not only saves the time but also reduces the extravagant use of resources such as water and electricity. Sometimes due to over or less supply of water in the agricultural field crops may not grow proper. Using IoT supply of water and growth of plants can be satisfied to a greater extent. The flow of water can be controlled from the application.

Smart agriculture is a farming system which uses IoT technology. This emerging system increases the quantity and quality of agricultural products. IoT devices provide information about nature of farming fields and then take action depending on the farmer input.

The main goal of my project is to use IoT in the agriculture field in order to collect data instantly(soil Moisture, temperature, humidity...), which will help one to monitor some environment conditions remotely, effectively and enhance tremendously the production and therefore the income of farmers. The present prototype is developed using Arduino technology, which comprise specific sensors, and a WIFI module that helps to collect instant data online. Worth mentioning the testing of this prototype generated, highly accurate data because while we were collecting them remotely any environmental changes were detected instantly and taking in consideration to make decisions.

2. LITERATURE SURVEY

2.1 Existing Problem

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 The farmers do not have that much knowledge on the internet of things and good internet connection is required. So farmers don't know how to use the web application and to make a connection if any component get failed.

2.2 References

- [1] Divya J., Divya M.,Janani V.”IoT based Smart Soil Monitoring System for Agricultural Production” 2017.
- [2] H.G.C.R.Laksiri, H.A.C.Dharmagunawardhana, J.V.Wijayakulasooriya ”Design and Optimization of IoT Based Smart Irrigation System in Sri Lanka”2019 .
- [3] Anushree Math, Layak Ali, Pruthviraj U ”Development of Smart Drip Irriga- tion System Using IoT”2018.
- [4] Dweepayan Mishra¹ ,Arzeena Khan² Rajeev Tiwari³ , Shuchi Upadhay,”Automated Irrigation System-IoT Based Approach”,2018.
- [5] R. Nageswara Rao, B.Sridhar,”IOT BASED SMART CROP-FIELD MONI- TORING AND AUTOMATION IRRIGATION SYSTEM”. 2018
- [6] Shweta B. Saraf, Dhanashri H. Gawal,”IoT Based Smart Irrigation Monitoring And Controlling System”.2017
- [7] Shrihari M, ”A Smart Wireless System to Automate Production of Crops and Stop Intrusion Using Deep Learning” 2020.
- [8] G. Sushanth¹, and S. Sujatha, ”IOT Based Smart Agriculture System”2018.
- [9] Vaishali S, Suraj S, Vignesh G, Dhivya S and Udhayakumar S, ”Mobile Integrated Smart Irrigation Management and Monitoring System Using IOT”,2017

2.3 Problem Statement Definitions

The Biggest Challenges Faced by IoT in the Agricultural Sector are Lack of Information, High Adoption, Cost and Security. The farmers do not have that much knowledge on the internet of things and good internet connection is required. Power Supply is also one of the problems In Village Side, the power supply may vary. So farmers don't know how to use the web application and to make a connection if any component get failed.

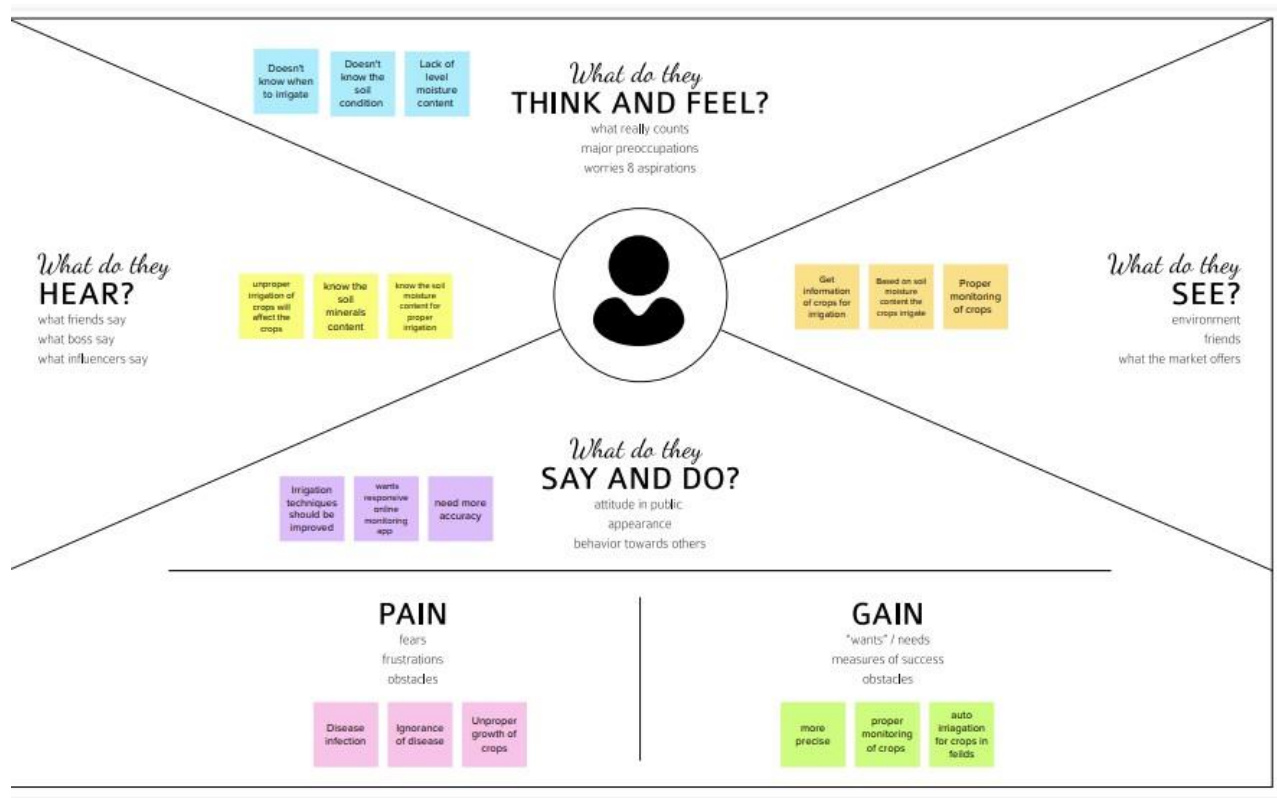
3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges

Empathy Map



3.2 Ideation and Brainstorming

Reference :

<https://app.mural.co/t/sivabalan7158/m/sivabalan7158/1666065800436/7b1e33e04dbcf54716d63ecef45f5a8b8545b5?sender=u373bdfd6cdd38c88e9152869>

Step-1: Team Gathering, Collaboration and Select the Problem Statements:

Template

Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

10 minutes to prepare
 1 hour to collaborate
 2-5 people recommended

Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

10 minutes

- Team gathering**
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.
- Set the goal**
Think about the problem you'll be focusing on solving in the brainstorming session.
- Learn how to use the facilitation tools**
Use the Facilitation Superpowers to run a happy and productive session.

[Open article](#) →

1 Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.

5 minutes

PROBLEM

How might we [your problem statement]?

Key rules of brainstorming

To run a smooth and productive session

- Stay in topic
- Encourage wild ideas
- Defer judgment
- Listen to others
- Go for volume
- If possible, be visual

Step-2: Brainstorm ,Idea Listing and Grouping

2 Brainstorm

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

10 minutes

TIP
You can select a sticky note and hit the pin button to lock it down!

TEAM LEAD	Member 1	Member 2	Member 3
<ul style="list-style-type: none"> Identify the problem Define the goal Set the rules Generate ideas Group ideas Present ideas 	<ul style="list-style-type: none"> Identify the problem Define the goal Set the rules Generate ideas Group ideas Present ideas 	<ul style="list-style-type: none"> Identify the problem Define the goal Set the rules Generate ideas Group ideas Present ideas 	<ul style="list-style-type: none"> Identify the problem Define the goal Set the rules Generate ideas Group ideas Present ideas

3 Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you can break it up into smaller sub-groups.

20 minutes

TIP
Add customizable tags to sticky notes to make it easier to find, browse, organize and categorize important ideas as they relate to your needs.

Watering the crops based on time and weather	Identify the problem	Define the goal
More crops used in structure	Set the rules	Generate ideas
Group and design structure	Group ideas	Present ideas

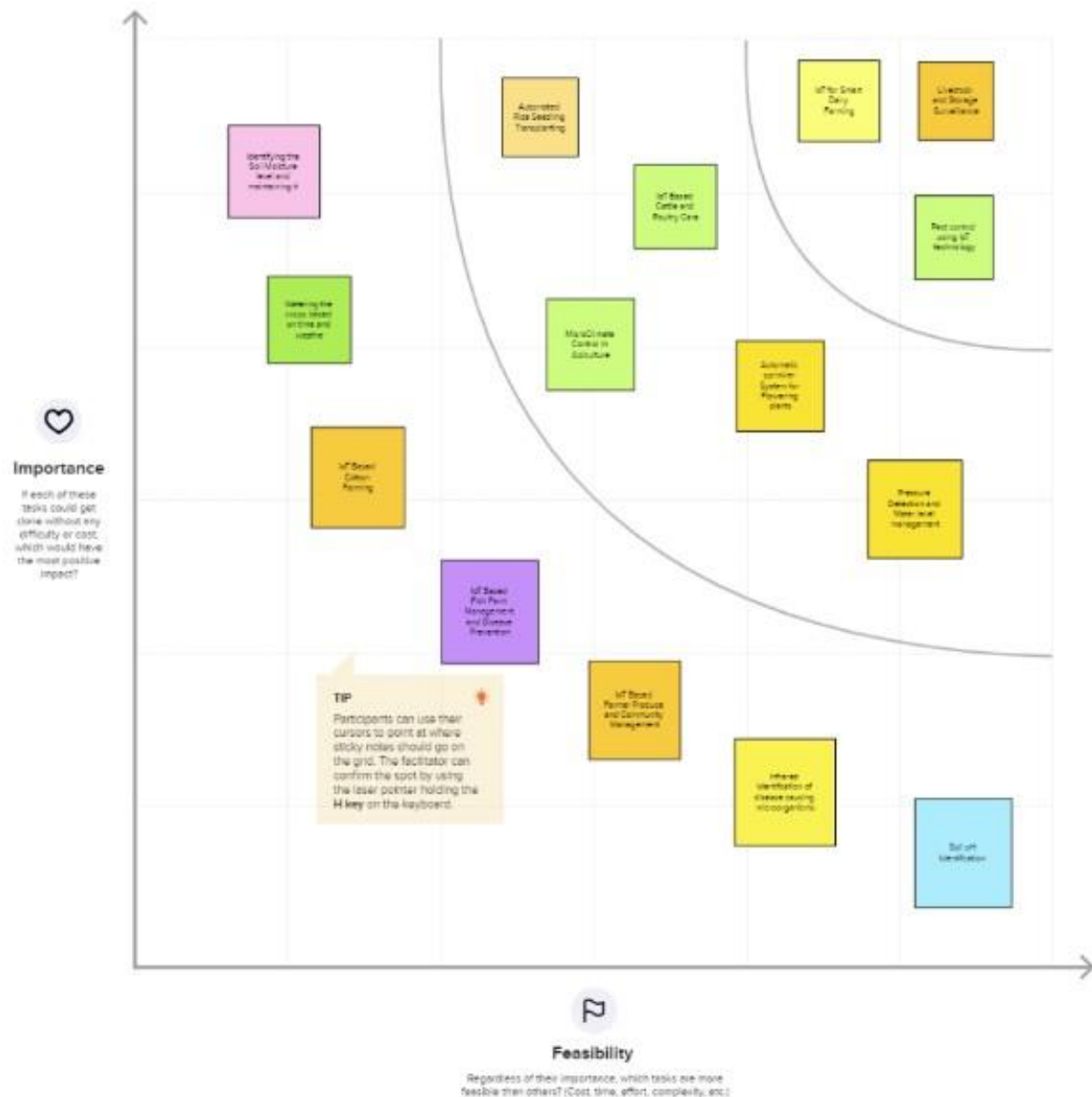
Step-3: Idea Prioritization

4

Prioritize

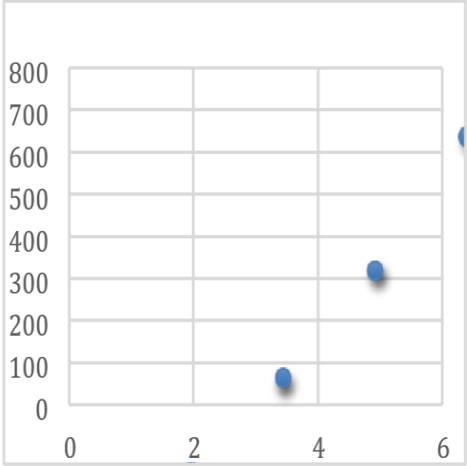
Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

⌚ 20 minutes



3.3 Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	<ul style="list-style-type: none"> ● The act of watering a field is challenging; farmers must wait in the field until the entire farm field is submerged in water. ● One of the issues is the power supply. Power availability in Village Side may be variable. ● The IoT in Agriculture Faces the Following Major Challenges ● High Lack of Information ● Security, Cost, and Adoption ● worries, etc.
2.	Idea / Solution description	<ul style="list-style-type: none"> ● As with smart farming and precision agriculture ● Farmers are better able to keep an eye on their fields and adjust the humidity level as needed thanks to technology. ● The information gathered by sensors—which includes information on humidity, temperature, wetness, and dew detections—helps forecast the weather in farms. So, cultivation for suitable crops is carried out.
3.	Novelty / Uniqueness	ALERT MESSAGE – IoT sensor nodes gather data from the agricultural environment, including soil moisture, air humidity, temperature, the nutrients in the soil, pest images, and water quality, and then send the gathered information to IoT backhaul devices.

4.	Social Impact / Customer Satisfaction	<ul style="list-style-type: none"> • Reduces the pay for workers in the agricultural sector. • It helps you save lots of time. • By boosting the consumer experience overall, IoT can help strengthen customer relationships. • Identify maintenance requirements quickly, create better products, provide tailored communications, and more. • IoT may also boost sales and make ecommerce companies successful. It creates a prosperous society.
5.	Business Model (Revenue Model)	<p>Revenue (No. of Users vs Months)</p>  <p>User</p> <p>Months</p>
6.	Scalability of the Solution	Scalability in smart farming refers to a system's ability to expand its capacity, such as the number of technological components like sensors and actuators, while allowing for prompt analysis.

3.4 Problem Solution fit

SMARTFARMER - IoT ENABLED SMART FARMING APPLICATION					
Define CS, fit into CC	1. CUSTOMER SEGMENT(S) Farmers can monitor their land like soil moisture, humidity, water level through application	6. CUSTOMER CONSTRAINTS The major constraint is Farmer cannot predict the crop yield through this application and they are only allowed to use the given features.	5. AVAILABLE SOLUTIONS Remotely monitoring crop yield	Explore AS, differentiate	
	2. JOBS-TO-BE-DONE / PROBLEMS Monitoring data fetch by sensors in the field to know about the current situation in the field	9. PROBLEM ROOT CAUSE Lack of management Increasing incomes	7. BEHAVIOUR They can make the decision whether to water the crop or postponed.	Focus on J&P, tap into BE, understand RC	
Identify strong TR & EM	3. TRIGGERS Manage irrigation and crop Sensors and IoT devices	10. YOUR SOLUTION Instead of went to field for each and every time, using IoT device connected with various sensors, farmer can get knowledge about their field from anywhere.	8. CHANNELS of BEHAVIOUR 8.1 ONLINE Through online farmer can analyze the field using apt sensors.	Extract online & offline CH of BE	
	4. EMOTIONS: BEFORE / AFTER Farmers didn't know what happened in their land but by using technology they can get knowledge about their field	The time can be saved.	8.2 OFFLINE In offline, each and every time farmer need to went to their field to analyze the field		

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	Registration through gmail/LinkedIn Mobile Application Via wifi
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Authentication	Using biometrics or PIN authentication to carry out some delicate app operations.
FR-4	Cloud Database	Database service on cloud
FR-5	Cloud Connectivity	Connecting Hardware to cloud

4.2 Non-Functional Requirements:

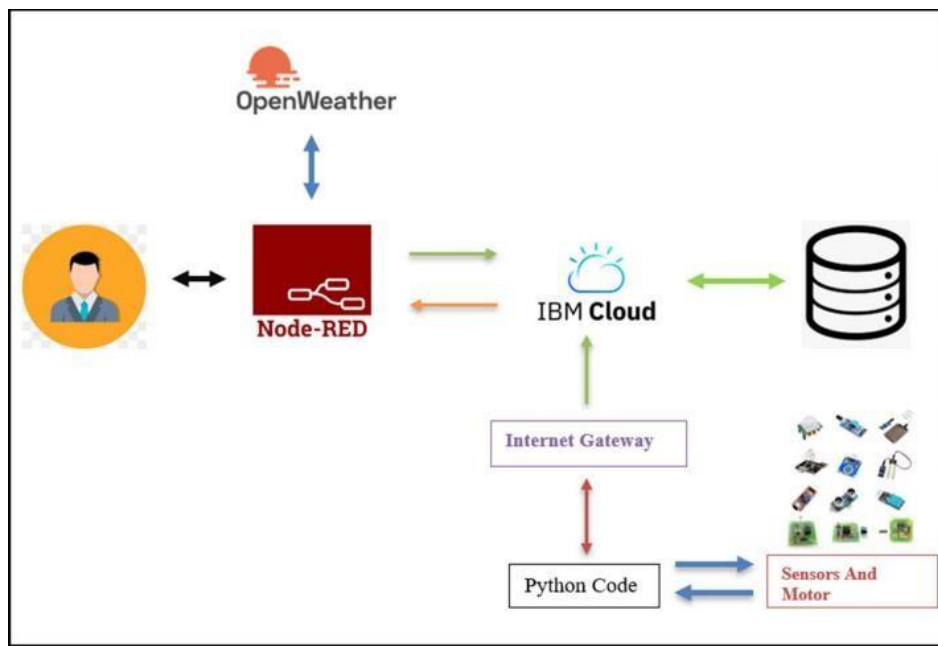
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The dashboard needs to be clear, uncluttered, and adaptable.
NFR-2	Security	Authentication - The user have a private dashboard for secured access.
NFR-3	Reliability	High-quality sensors were employed to provide long-lasting high precision and accuracy.
NFR-4	Performance	Performance can be enhanced by employing efficient sensors and developing efficient code.

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.



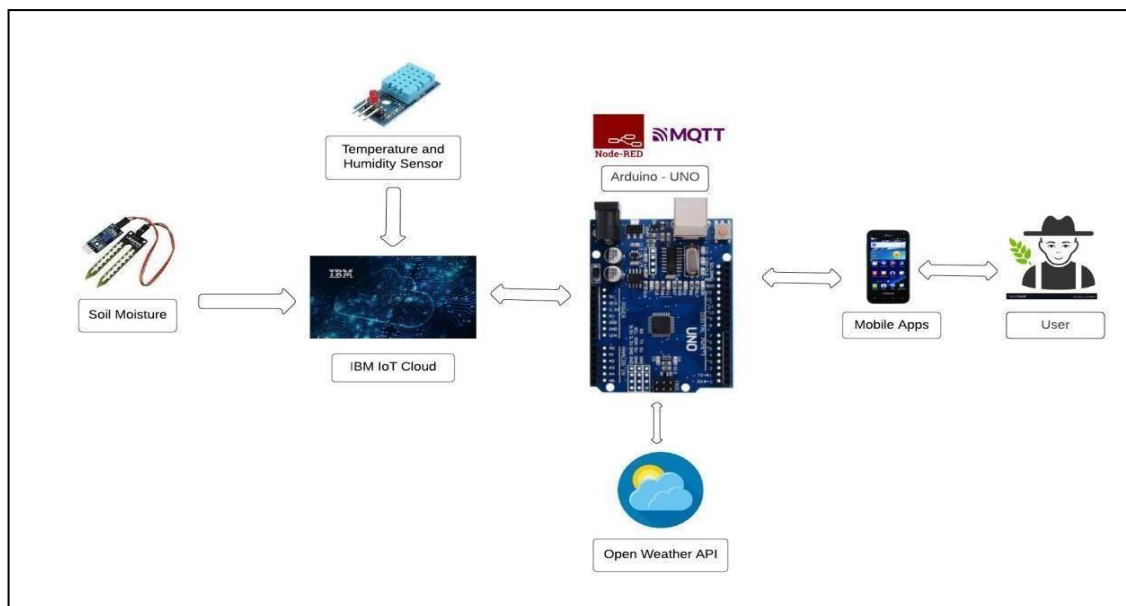
1. The different soil parameters temperature, soil moistures and then humidity are sensed using different sensors and obtained value is stored in the Ibm cloud.
2. Arduino UNO is used as a processing Unit that process the data obtained from the sensors and whether data from the weather API.
3. NODE-RED is used as a programming tool to write the hardware, software and APIs. The MQTT protocol is followed for the communication.
4. All the collected data are provided to the user through a mobile application that was developed using the MIT app inventor. The user could make a decision through an app, weather to water the crop or not depending upon the sensor values. By using the app they can remotely operate to the motor switch.

5.2 Solution & Technical Architecture

Solution Architecture:

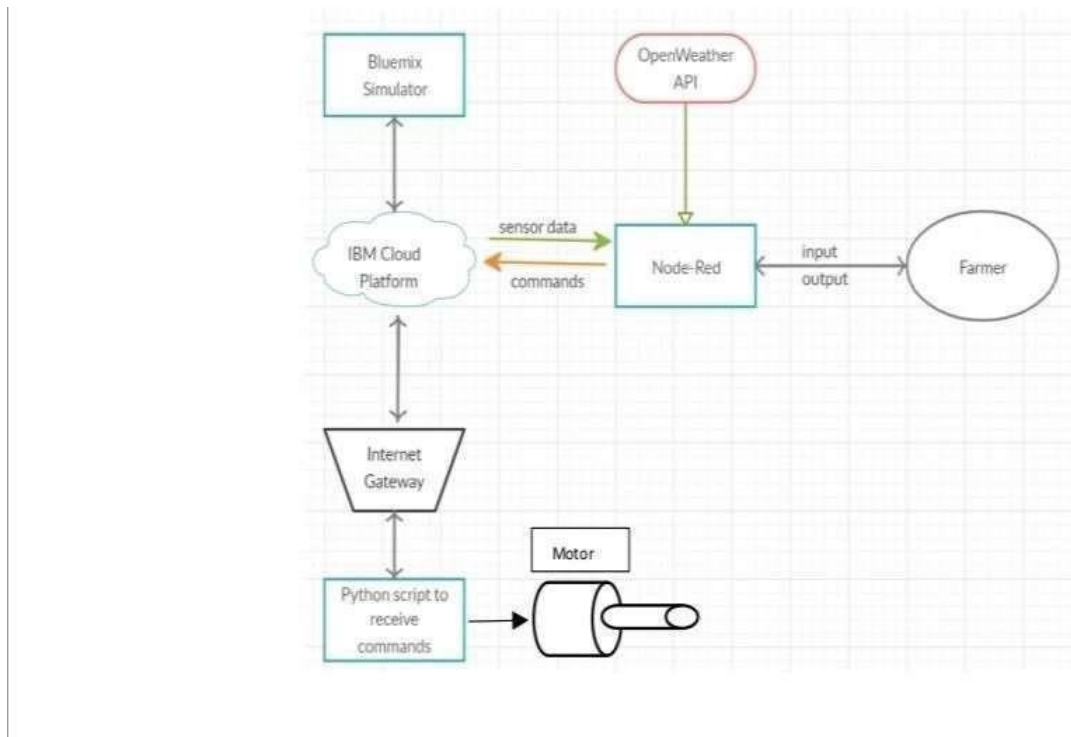
1. Different sensors are used to measure the various soil characteristics (temperature, humidity, and soil moisture), and the results are saved in the IBM cloud.
2. The data from sensors and weather data from weather API are processed using an Arduino UNO as a processing unit.
3. Node-red is employed as a programming tool to connect the APIs, hardware, and software. It uses the MQTT protocol for communication.
4. A mobile application that was created utilising the MIT app inventor gives the user access to all the collected data. Depending on the sensor results, the user might decide via an app whether to irrigate the crop or not. They are able to remotely control the motor switch by utilising the app.

Solution Architecture Diagram:



Technical Architecture

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2



The different soil parameters temperature, soil moistures and then humidity are sensed using different sensors and obtained value is stored in the IBM cloud.

Arduino UNO is used as a processing Unit that process the data obtained from the sensors and whether data from the weather API.

NODE-RED is used as a programming tool to write the hardware, software, and APIs. The MQTT protocol is followed for the communication.

All the collected data are provided to the user through a mobile application that was developed using the MIT app inventor. The user could decide through an app, weather to water the crop or not depending upon the sensor values. By using the app, they can remotely operate the motor switch.

5.3 User Stories

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Simulation creation	USN-1	Connect Sensors Wi-fi Module with python code	2	High	SAMPATH S, PRABHAKARAN R, SARANYA M, SRIDARSHINI D
Sprint-2	Software	USN-2	Creating device in the IBM Watson IoT platform, workflow for IoT scenarios using NodeRed	2	High	SAMPATH S, PRABHAKARAN R, SARANYA M, SRIDARSHINI D
Sprint-3	MIT App Inventor	USN-3	To Develop an application for the Smart farmer project using MIT App Inventor	2	High	SAMPATH S, PRABHAKARAN R, SARANYA M, SRIDARSHINI D
Sprint-4	Web UI	USN-5	To make the user to interact with software.	2	High	SAMPATH S, PRABHAKARAN R, SARANYA M, SRIDARSHINI D

6.PROJECT PLANNING & SCHEDULING

6.1 Sprint planning & Estimation

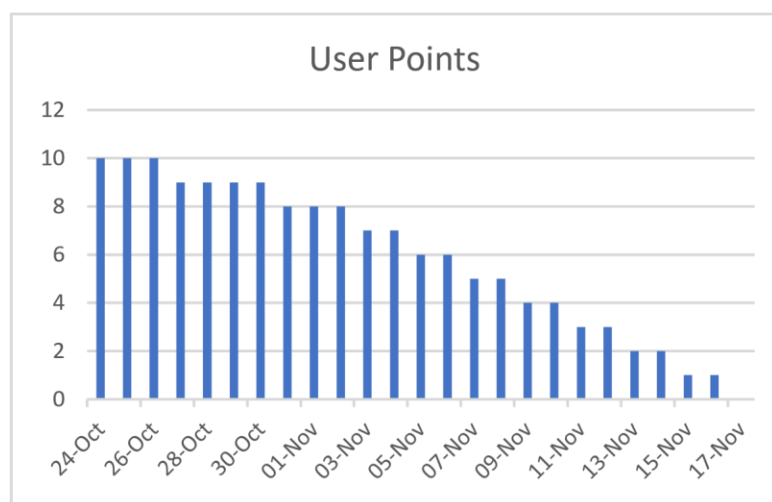
Title	Description	Duration
Literature Survey & Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	1 st - 5 th September 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list of problem statements.	6 th -10 th September 2022
Brainstorming ideas	List the ideas by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	12 th -18 th September 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	20 th -25 th September 2022
Problem Solution Fit	Prepare problem - solution Fit document.	26 th September-01 st October 2022
Solution Architecture	Prepare solution Architecture document.	26 th September-01 th October 2022
Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application	03 rd – 08 th October 2022
Data Flow Diagrams	Draw the data flow Diagrams and submit for review.	10 th -15 th October 2022
Technology Architecture	Architecture diagram.	16 th -21 th October 2022

Milestone & Activity List	Prepare the milestones & Activity list of the project.	17-22 October 2022
Sprint Delivery	Prepare the Sprint delivery on Number of Sprint planning meetings organized, Minutes of meeting recorded.	22-31 October 2022
Project Development Delivery of Sprint- 1,2,3&4	Develop & submit the developed code by testing it.	1-16 November

6.2 Sprint Delivery Schedule:

Sprint	Total Points	Story	Duration	Sprint Start Date	Sprint End Date (Planned)	Sprint Release Date (Actual)
Sprint-1	20		7 Days	30 Oct 2022	06 Nov 2022	01 Nov 2022
Sprint-2	20		9 Days	01 Nov 2022	09 Nov 2022	05 Nov 2022
Sprint-3	20		7 Days	06 Nov 2022	13 Nov 2022	10 Nov 2022
Sprint-4	20		5 Days	11 Nov 2022	15 Nov 2022	12 Nov 2022

6.3 Report from JIRA



7. CODING & SOLUTIONING 7.1 Feature 1

```
pythonprog.py - C:\Users\Admin\AppData\Local\Programs\Python\Python37\pythonprog.py (3.7.0)
File Edit Format Run Options Window Help

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

#Provide your IBM Watson Device Credentials
organization = "xr454u"
deviceType = "ibm"
deviceId = "ibmsensor"
authMethod = "token"
authToken = "12345678"

def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['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()

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

while True:
    temperature=random.randint(0,100)
    humidity=random.randint(0,100)
    soil= random.randint(0,100)

    data = {'temperature': temperature, 'humidity': humidity, 'soil':soil}
    #print data
    #Send Data
```

```
pythonprog.py - C:\Users\Admin\AppData\Local\Programs\Python\Python37\python.exe
File Edit Format Run Options Window Help

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

#Provide your IBM Watson Device Credentials
organization = "1r454u"
deviceType = "ibm"
deviceId = "ibmsensor"
authMethod = "token"
authToken = "12345678"

def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    print(cmd)

try:
    deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "authMethod": authMethod, "authToken": authToken}
    deviceClt = ibmiotf.device.Client(deviceOptions)
    #.....

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

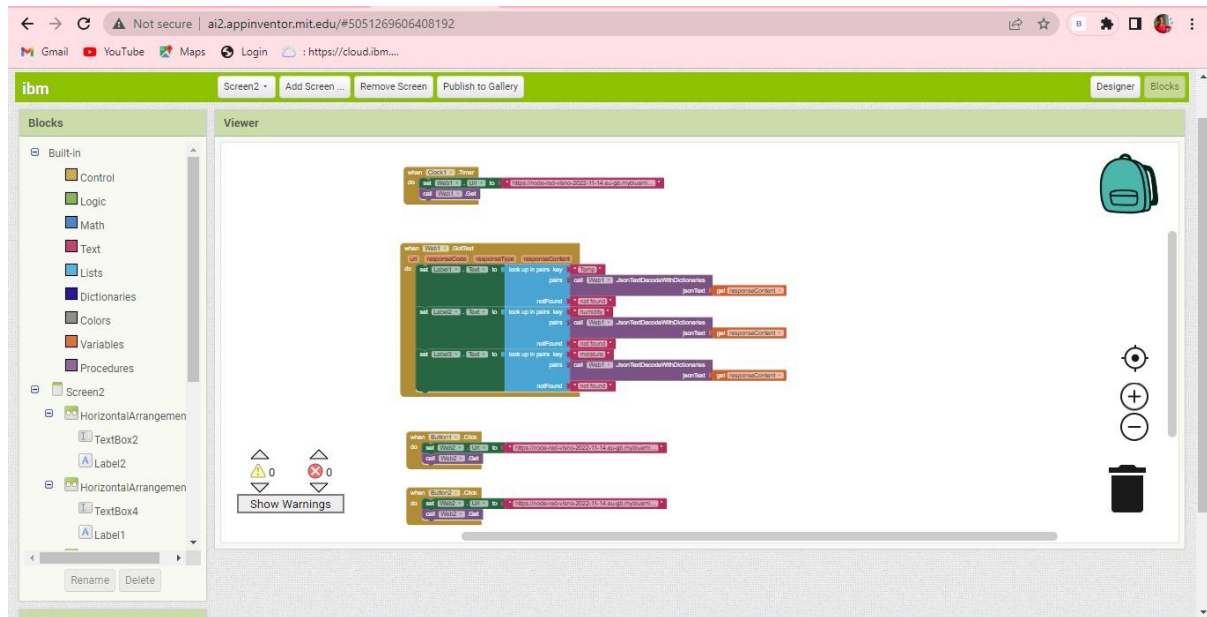
# Connect and send a datapoint "hello" with value 1234567890
deviceClt.connect()

while True:
    temperature = random.randint(0,100)
    humidity = random.randint(0,100)
    soil = random.randint(0,100)

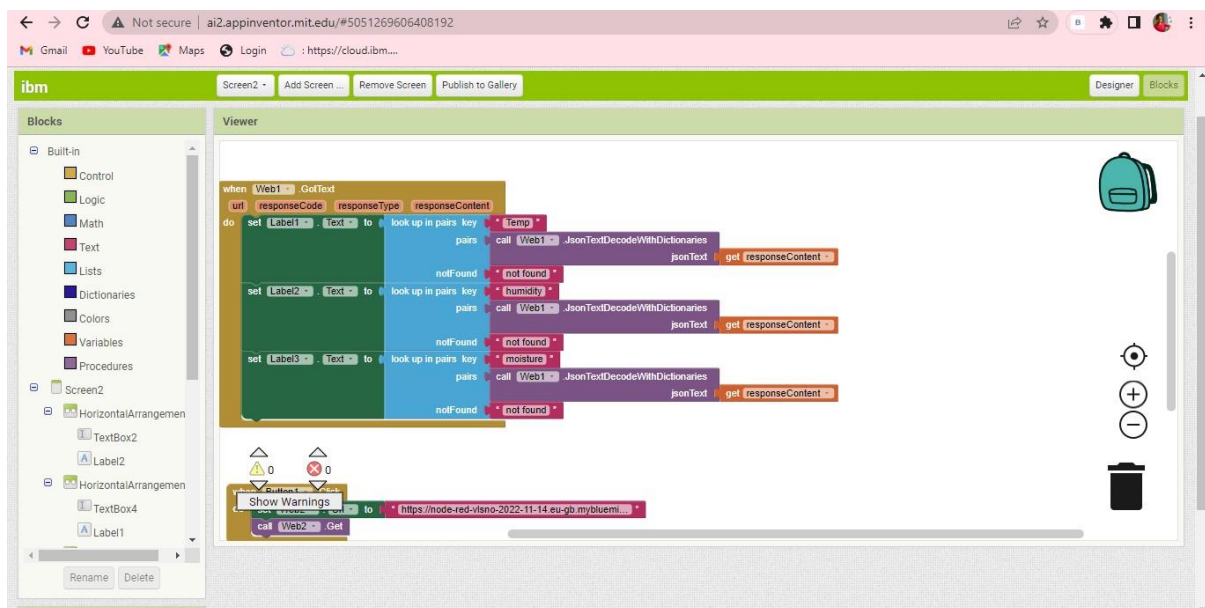
    data = {'temperature': temperature, 'humidity': humidity, 'soil': soil}
    #print data
    deviceClt.publish(data)
```

7.2 Feature 2

These are the blocks of the login and signup page of mobile application.



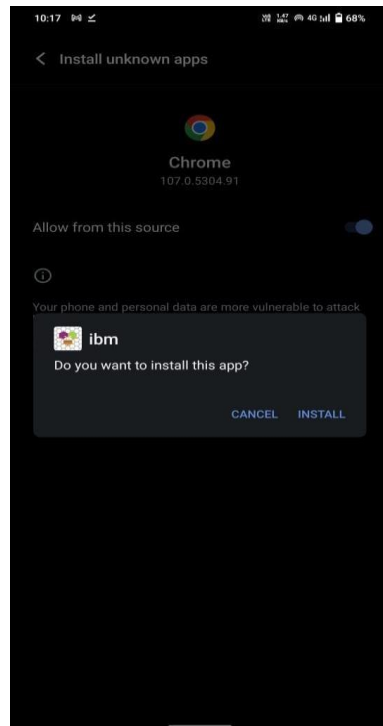
These are the blocks in the second page of the mobile application.



8. TESTING

8.1 Test Cases

Step-1: First user need to download the android APK file from MIT app inventor where we developed our mobile application and install in their mobiles.



Step-2: After successful installation we can find app icon in our mobile as shown below.

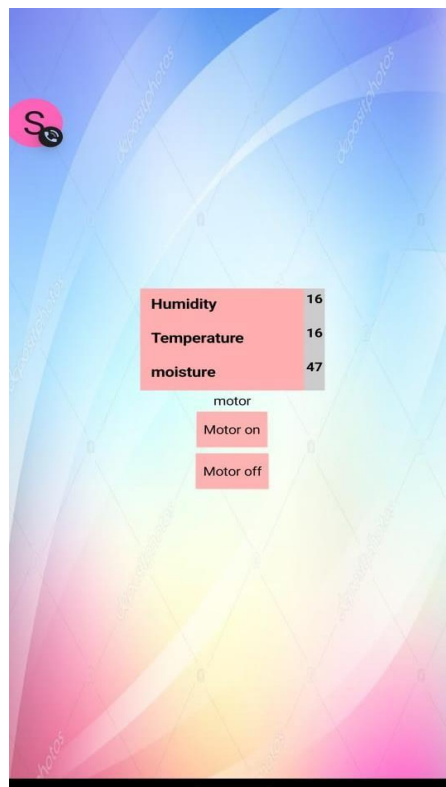


Step-3: After clicking the app icon it ask the user need to create username and password.so give username and password and click the signup button. The user can see interface like these as shown below.



8.2 User Acceptance Testing

After successful login. The next page will be open. In that page we can see the real time temperature , humidity and soil moisture reading and motor ON and motor OFF control button also as shown below.



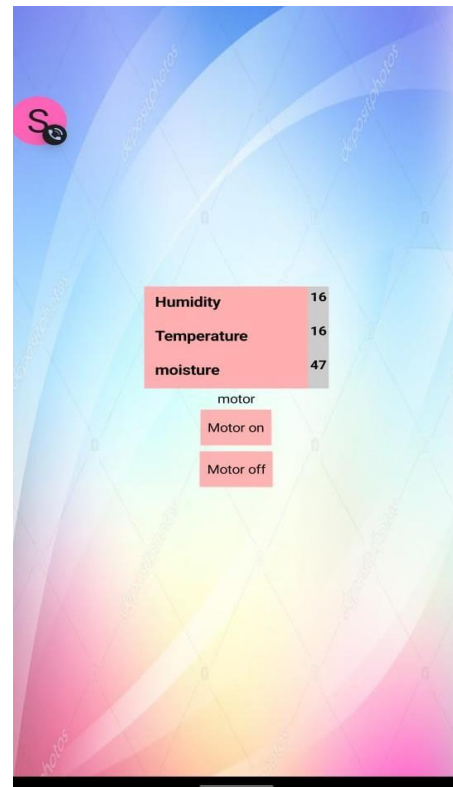
we are successfully created the IOT enabled smart farming application.

9. RESULTS 9.1 Performance Metrics

So finally when we run the python code it is going to connect the IBM Watson platform and connecting to the node-red after that is going to connect the mobile application.so we can see output in the fourth window.

```
Python 3.7.0 Shell
: Edit Shell Debug Options Window Help
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD64)] on win32
pe "copyright", "credits" or "license()" for more information.
>
ESTART: C:\Users\Admin\AppData\Local\Programs\Python\Python37\pythonprog.py
22-11-15 22:02:37,861 ibmiotf.device.Client INFO Connected successfully
y: d:rr454u:ibm:ibmsensor
blished Temperature = 22 C Humidity = 6 % soil Moisture = 24 % to IBM Watson
blished Temperature = 57 C Humidity = 1 % soil Moisture = 96 % to IBM Watson
blished Temperature = 55 C Humidity = 57 % soil Moisture = 26 % to IBM Watson
blished Temperature = 46 C Humidity = 18 % soil Moisture = 87 % to IBM Watson
blished Temperature = 39 C Humidity = 76 % soil Moisture = 44 % to IBM Watson
blished Temperature = 7 C Humidity = 98 % soil Moisture = 2 % to IBM Watson
blished Temperature = 37 C Humidity = 73 % soil Moisture = 64 % to IBM Watson
blished Temperature = 82 C Humidity = 19 % soil Moisture = 27 % to IBM Watson
blished Temperature = 40 C Humidity = 81 % soil Moisture = 0 % to IBM Watson
blished Temperature = 17 C Humidity = 2 % soil Moisture = 26 % to IBM Watson
blished Temperature = 21 C Humidity = 6 % soil Moisture = 52 % to IBM Watson
blished Temperature = 24 C Humidity = 70 % soil Moisture = 43 % to IBM Watson
blished Temperature = 72 C Humidity = 44 % soil Moisture = 93 % to IBM Watson

Ln: 7 Co
```



10.ADVANTAGES & DISADVANTAGES

ADVANTAGES

All the data like climatic conditions and changes in them, soil or crop conditions everything can be easily monitored.

Risk of crop damage can be lowered to a greater extent.

Many difficult challenges can be avoided making the process automated and the quality of crops can be maintained.

The process included in farming can be controlled using the web applications from anywhere, anytime.

DISADVANTAGES:

Smart Agriculture requires internet connectivity continuously, but rural parts cannot fulfill this requirement.

Any faults in the sensors can cause great loss in the agriculture, due to wrong records and the actions of automated processes.

IoT devices need much money to implement.

11. CONCLUSION: So finally we build A IoT Web Application for smart agricultural system using Watson IoT platform, Watson simulator, IBM cloud and Node-RED and MIT app Inventor

12. FUTURE SCOPE: In future due to more demand of good and more farming in less time, for betterment of the crops and reducing the usage of extravagant resources like electricity and water IoT can be implemented in most of the places.

13. APPENDIX

Source Code:

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQTT
#include "DHT.h"// Library for dht11
#define DHTPIN 15      // what pin we're connected to
#define DHTTYPE DHT22  // define type of sensor DHT 11
#define LED 2

DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and typr of dht
connected

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

//-----credentials of IBM Accounts-----

#define ORG "rr454u"//IBM ORGANITION ID
#define DEVICE_TYPE "sensor_1"//Device type mentioned in ibm watson IOT Platform
#define DEVICE_ID "sensor"//Device ID mentioned in ibm watson IOT Platform
#define TOKEN "12345678"      //Token
String data3;
float h, t;

//----- Customise the above values -----
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; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the predefined
client id by passing parameter like server id,portand wificredential

void setup()// configureing the ESP32
{
    Serial.begin(115200);
    dht.begin();
    pinMode(LED,OUTPUT);
    delay(10);
    Serial.println();
    wificonnect();
    mqttconnect();
}

void loop()// Recursive Function
{
    h = dht.readHumidity();
```

```

t = dht.readTemperature();
Serial.print("temperature:");
Serial.println(t);
Serial.print("Humidity:");
Serial.println(h);

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

/*.....retrieving to
Cloud. .... */

void PublishData(float temperature, float humidity) {
    mqttconnect();//function call for connecting to ibm
    /*
        creating the String in in form JSon to update the data to ibm cloud
    */
    String payload = "{\"temperature\":";
    payload += temperature;
    payload += "," "\"Humidity\":";
    payload += humidity;
    payload += "}";

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

    if (client.publish(publishTopic, (char*) payload.c_str())) {
        Serial.println("Publish ok");// if it sucessfully upload data on the cloud
        then it will print publish ok in Serial monitor or else it will print publish
        failed
    } 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() //function definition for wificonnect
{
    Serial.println();
    Serial.print("Connecting to ");

    WiFi.begin("Wokwi-GUEST", "", 6); //passing the wifi credentials to establish the
connection
    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++) {
        //Serial.print((char)payload[i]);
        data3 += (char)payload[i];
    }
    Serial.println("data: "+ data3);
    if(data3=="lighton")
    {
        Serial.println(data3);
        digitalWrite(LED,HIGH);
    }
    else
    {
        Serial.println(data3);
        digitalWrite(LED,LOW);
    }
    data3="";
}

```

GitHub:

Name	GitHub (User Name)
Team Leader(SAMPATH S)	SAMPATHSAMINATHAN
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Team Member(SRIDARSHINI D)	Sridarshinidevaraj

GitHub Link:

<https://github.com/IBM-EPBL/IBM-Project-36893-1660298435>

Project Demonstration Video Link:

https://drive.google.com/file/d/1QO7cLd82CldaDZpv7h0h248aRZwL1bru/view?usp=drive_sdk