SmartFarmer - IoT Enabled Smart Farming Application

Team id: PNT2022TMID08726

SUBMITTED BY

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In partial fulfilment for the award of the degree of
BACHELOR OF ENGINEERING
in
ELECTRONICS AND COMMUNICATION ENGINEERING

Dr . MAHALINGAM COLLEGE OF ENGINEERING AND TECHNOLOGY An Autonomous Institution Affiliated to ANNAUNIVERSITY CHENNAI – 600 025

1.INTRODUCTION :

1.1 Project Overview

IoT-based agriculture system helps the farmer in monitoring different parameters of his field like soil moisture, temperature, and humidity using some sensors. Farmers 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 tasks for the farmers. They can make the decision whether to water the crop or postpone it by monitoring the sensor parameters and controlling the motor pumps from the mobile application itself. Agriculture implements IoT through the use of robots, drones, sensors, and computer imaging integrated with analytical tools for getting insights and monitoring the farms. Placement of physical equipment on farms monitors and records data, which is then used to get valuable insights.

1.2 Purpose

Smart farming is a management concept focused on providing the agricultural industry with the infrastructure to leverage advanced technology – including big data, the cloud and the internet of things (IoT) – for tracking, monitoring, automating and analyzing operations.

2. LITERATURE SURVEY

Zuraida Muhammad, Muhammad Azri Asyraf Mohd Hafez, Nor Adni MatLeh, Zakiah Mohd Yusoff , Shabinar Abd Hamid [1] The term "Internet of Things" refers to the connection of objects, equipment, vehicles, and other electronic devices to a network for the purpose of data exchange (IoT). The Internet of Things (IoT) is increasingly being utilised to connect objects and collect data. As a result, the Internet of Things' use in agriculture is crucial. The idea behind the project is to create a smart agriculture system that is connected to the internet of things. The technology is combined with an irrigation system to deal with Malaysia's variable weather. This system's microcontroller is a Raspberry Pi 4 Model B. The temperature and humidity in the surrounding region, as well as the moisture level of the soil, are monitored using the DHT22 and soil moisture sensor. The data will be available on both a smartphone and a computer. As a result, Internet of Things (IoT) and Raspberry Pi-based Smart Agriculture Systems have a significant impact on how farmers work. It will have a good impact on agricultural productivity as well. In Malaysia, employing IoT-based irrigation systems saves roughly 24.44 percent per year when compared to traditional irrigation systems. This would save money on labour expenditures while also preventing water waste in daily needs.

Divya J., Divya M.,Janani V. [2] Agriculture is essential to India's economy and people's survival. The purpose of this project is to create an embedded-based soil monitoring and irrigation system that will reduce manual field monitoring and provide information via a mobile app. The method is intended to help farmers increase their agricultural output. A pH sensor, a temperature sensor, and a humidity sensor are among the tools used to examine the soil. Based on the findings, farmers may plant the best crop for the land. The sensor data is sent to the field manager through Wi-Fi, and the crop advice is created with the help of the mobile app. When the soil temperature is high, an automatic watering system is used. The crop image is gathered and forwarded to the field manager for pesticide advice.

2.1 Existing Problem

As we can see, the use cases for IoT in agriculture are endless. There are many ways smart devices can help you increase your farm's performance and revenue. However, agriculture IoT apps development is no easy task.

2.2 References

[1] https://www.ws.com/analytics/tfarming powered by analytics/.

[2] https://www.ibm.com/case-studies/smartrural-cloud-analystics-farming

[3] https://www.ibm.com/case-studies/farming-watson-cloud

[4] http://www.ewaterautosys.com/water-automation-system.html

[5]http://www.wplawinc.com/agricultural-irrigation-blog/the-most-common-problems-with-farm-irrigationsystems

[6]https://www.pwc.com/us/en/increasing-it-effectiveness/assets/future-of-the-internet-of-things.pdf

[7] IOT based Smart Irrigation System SrishtiRawalDepartment of Computer Science, VIT University rawal-2017-ijca-913001.pdf

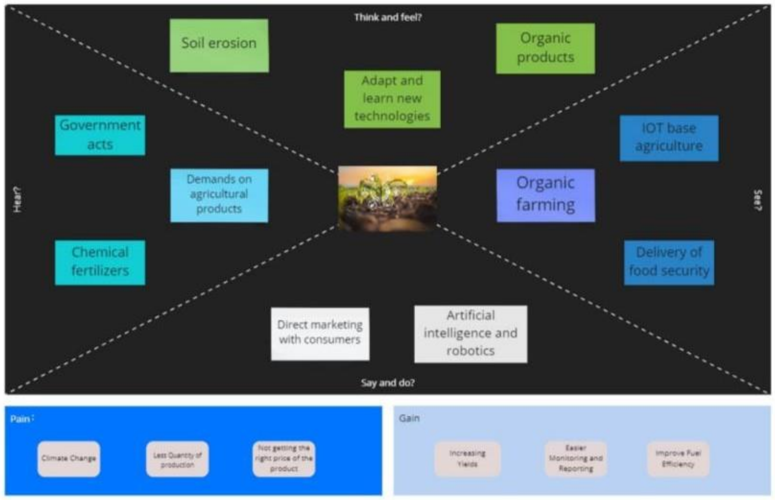
[8] Thingspeak : https:// thingspeak.com

2.3 Problem Statement Definition

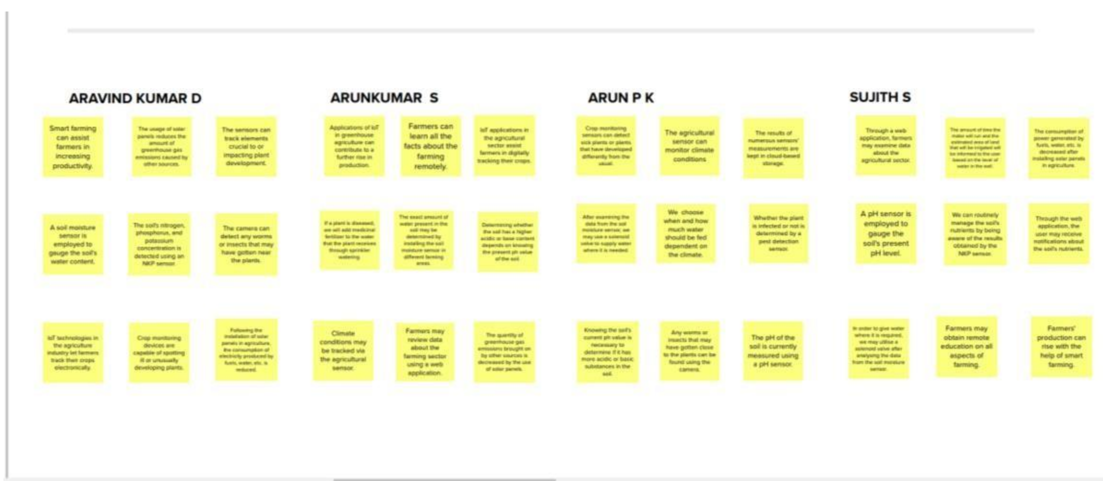
The biggest challenge faced by iot in agriculture are lack of information, cost analysis and quantity of fertilizers/seeds needed at specifc time. Monitoring climate change and take any precautions to avoid the spoilage of yields. Analyze the growth and intimate any need of fertilizer or water for each area of farming. Indicate of irrigation periodically. Reduction of greenhouse gas is biggest challenges in IOT.

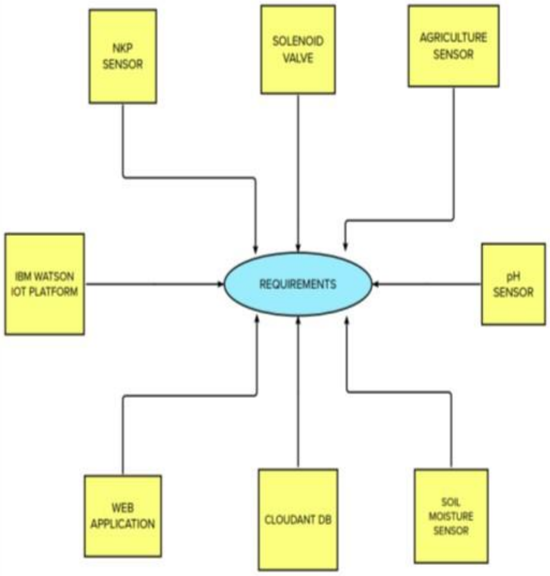
3.IDEATION AND PROPOSED SOLUTION

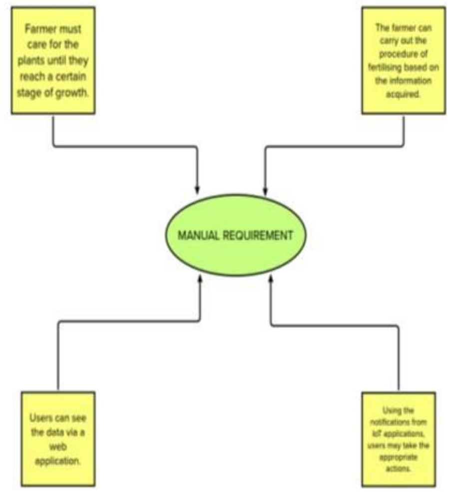
3.1 Empathy Map Canvas

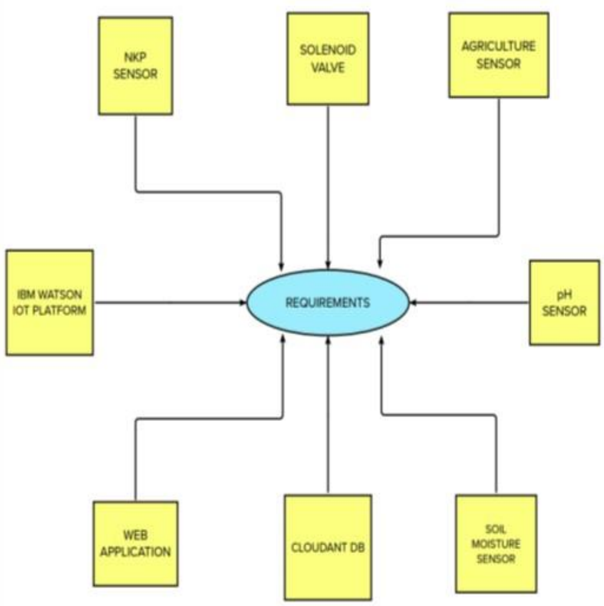


3.2 Ideation and Brainstorming




NKP SENSOR
SOLENOID VALVE
AGRICULTURE SENSOR
IBM WATSON IOT PLATFORM
REQUIREMENTS
pH SENSOR
WEB APPLICATION
CLOUDANT DB
SOIL MOISTURE SENSOR


Farmer must care for the plants until they reach a certain stage of growth.
The farmer can carry out the procedure of fertilising based on the information acquired.
MANUAL REQUIREMENT
Users can see the data via a web application.
Using the notifications from IoT applications, users may take the appropriate actions.


NKP SENSOR
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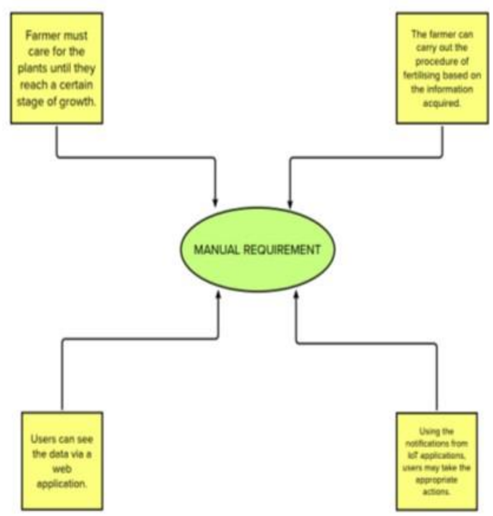
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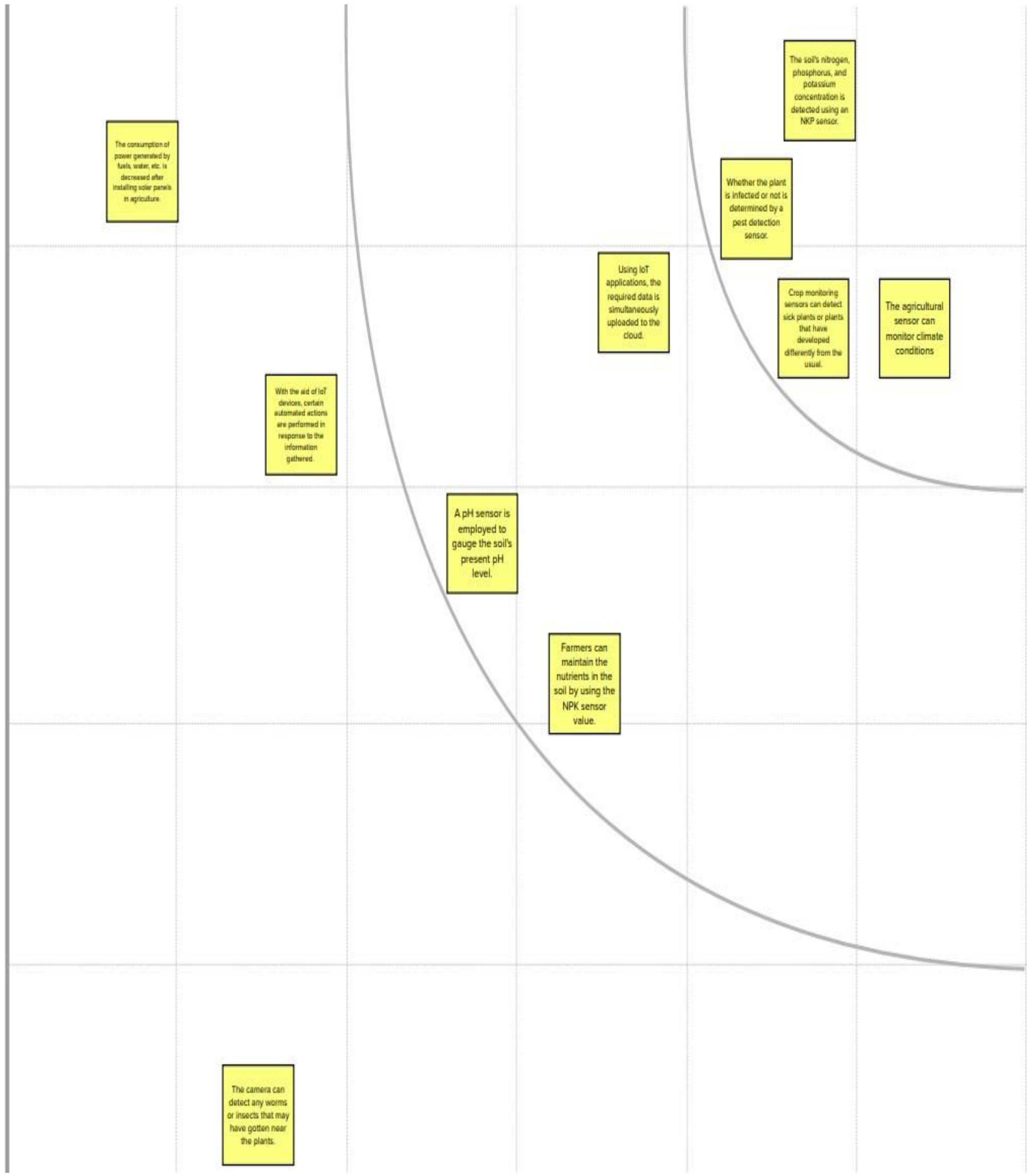

The consumption of power generated by fuels, water, etc. is decreased after installing solar panels in agriculture.
The soil's nitrogen, phosphorus, and potassium concentration is detected using an NKP sensor.
Whether the plant is infected or not is determined by a pest detection sensor.
Using IoT applications, the required data is simultaneously uploaded to the cloud.
Crop monitoring sensors can detect sick plants or plants that have developed differently from the usual.
The agricultural sensor can monitor climate conditions
With the aid of IoT devices, certain automated actions are performed in response to the information gathered.
A pH sensor is employed to gauge the soil's present pH level.
Farmers can maintain the nutrients in the soil by using the NPK sensor value.
The camera can detect any worms or insects that may have gotten near the plants.

3.3 Proposed Solution

Proposed Solution

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The biggest challenge faced by Iot in agriculture are lack of information, cost analysis and quantity of fertilizers/seeds needed at specifc time. Monitoring climate change and take any precautions to avoid the spoilage of yields. Analyze the growth and intimate any need of fertilizer or water for each area of farming. Indicate of irrigation periodically. Reduction of greenhouse gas is biggest challenges in IOT.
2.	Idea / Solution description	The basic idea is to monitor the crop, weather, soil quality and irrigation control by using sensors. And through cloud publish the sensed data in web application to notify the farmer about their field.
3.	Novelty / Uniqueness	It gives great support for farmer and farming related activities. It reduced man force and enhancement of automated irrigation provides healthy plant growth.
4.	Social Impact / Customer Satisfaction	• Increases crop productivity • It makes crop pest free and control the irrigation for crops. • Constantly monitoring land and condition of crops. • It modernize farm management system
5.	Business Model (Revenue Model)	Revenue is generated for smart farming and IOT supported irrigation system by farmers, land lords, green house, roof top farming, private agro, organization and government.
6.	Scalability of the Solution	Our system with modernized technology allows the farmers to upgrade from traditional agriculture to modern methods and also enhances the productivity of cultivation and efficiency in yield.

3.4 Problem Solution Fit

CUSTOMER SEGMENT Farmers and Green house management	**CUSTOMER CONSTRAINTS** • It is impossible to regularly irrigate a field. • Agriculturalist was unaware of soil nutrients and soil moisture • Insect and disease attacks have not been previously reported	**AVAILABLE SOLUTION** • Numerous smartphone applications are available to track crop wealth. • GSM-based method for water irrigation
JOBS-TO-BE-DONE / PROBLEMS • Monitoring the pH level and soil fertility • moister in the soil is to be maintained • keeping an eye on the weather	**PROBLEM ROOT CAUSE** Wastage of water, Affection of disease to plants, Unknown level of feeding fertilization its leads to dramatic loss for both agricultural field and farmer	**BEHAVIOUR** Focus their major concentrate on crop yields. Avoid unwanted loss such as water, fertilizers, Time
TRIGGERS Crop production falls due to unavoidable situations **BEFORE:** Insecure, Wastage, Physical Monitoring **AFTER:** Secure, Savings, Report acknowledgement	**YOUR SOLUTION** Using NKP sensor the nutrients of soil can be monitor periodically. pest detection sensor periodically watch over the plants to find insect. if any one is diseased it will be notified to farmers immediately . Soil moister sensor used to water irrigate the crops whenever needed.	**CHANNELS of BEHAVIOUR** ONLINE : Information will be conveyed rapidly to avoid further loss OFFLINE : Acknowledgement is difficult but flow of process goes on

4. REQUIREMENT ANALYSIS

4.1 Functional Requirements

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 Phone number Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	IoT Kit	ESP 8266(Wi-Fi module), Sensors, Solenoid value
FR-4	Sensors	Tensiometer, BMP280, Acoustic sensor, RS-PH-N01-TR-1, Camera.
FR-5	Power supply	Switched Mode Power supply (SMPS)

4.2 Non-Functional Requirements

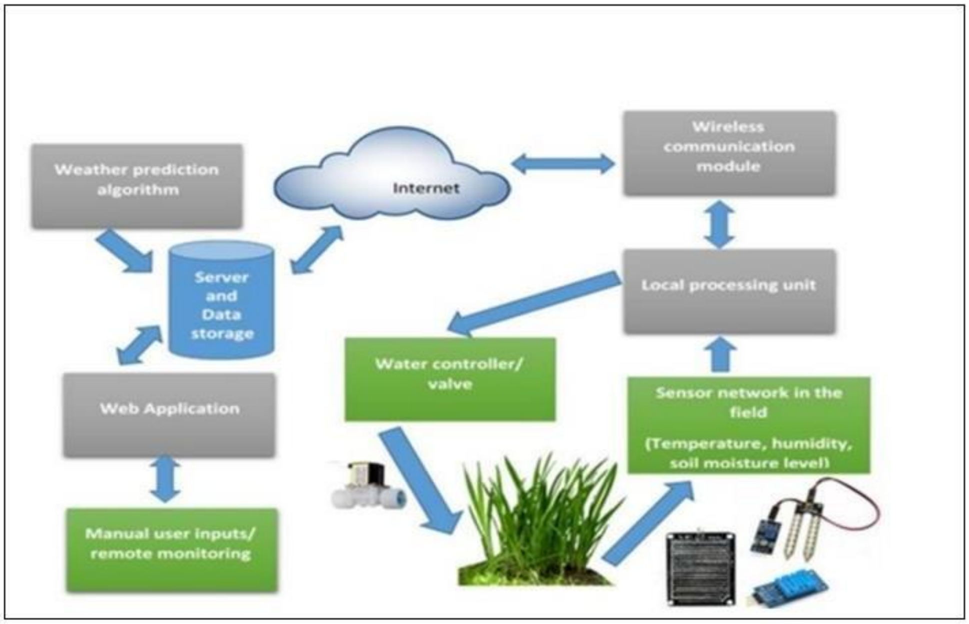
Non-functional Requirements:

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

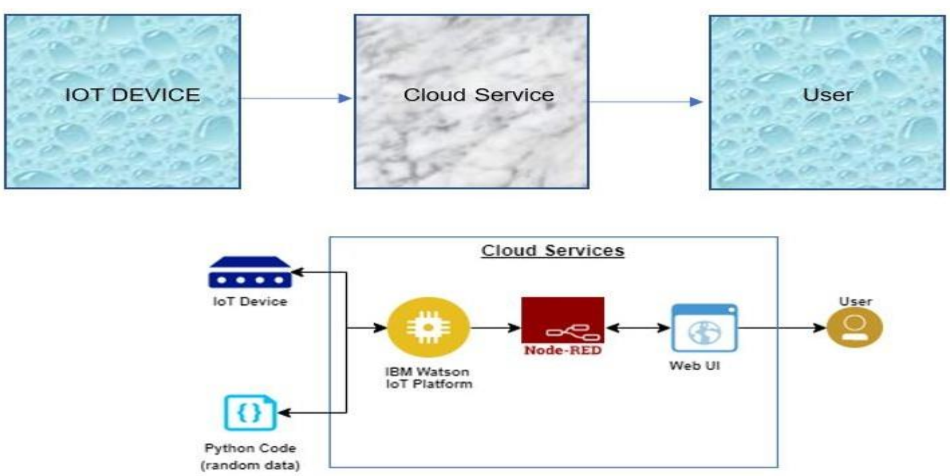
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Soil and water management, crop health monitoring.
NFR-2	**Security**	It has user authentication.
NFR-3	**Reliability**	Made of reliable components and IoT protocols.
NFR-4	**Performance**	The project has very high performance.
NFR-5	**Availability**	IoT kits we used are available in the market.

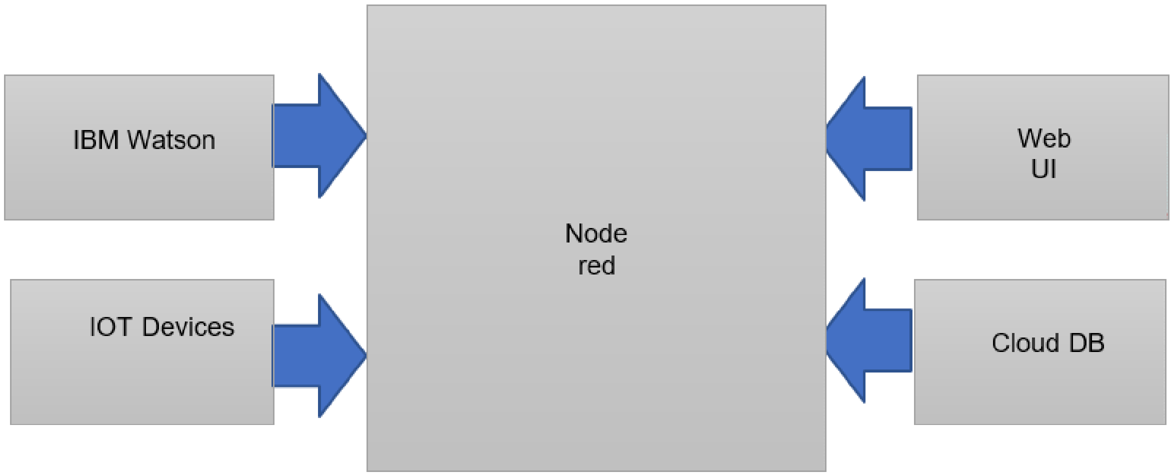
5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Solution Architecture





5.3 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, and password, and confirming my password.	I can access my account/dashboard	High	Sprint-1
		USN-2	As a user, I will receive a confirmation email once I have registered for the application	I can receive a confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard					
Customer (Web user)	Login page	USN-6	The user can log in to the web page using their password and user name.		High	Sprint-2
Customer Care Executive	Contact	USN-7	If there is any issue faced by the user, they can raise a quire in the contact or support section.		High	Sprint-1
Administrator	Admin Login	USN-8	The admin can login to see the activities of the website.		Medium	Sprint-2

6.PROJECT PLANNING AND SCHEDULING

6.1 Sprint Planning and Estimation

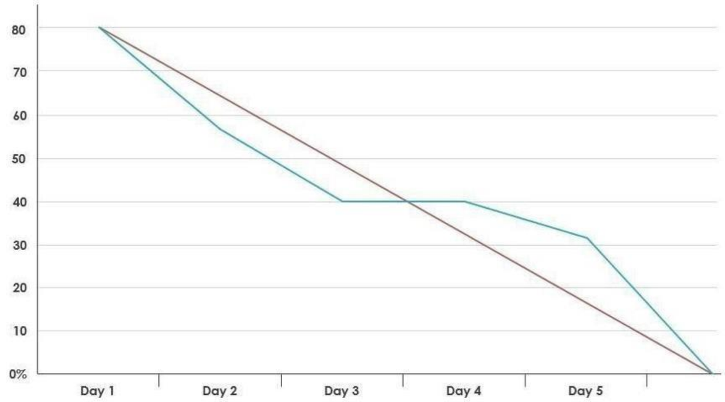
Sprint	Functional Requirement (Epic)	User Story Number	User Story /Task	Story Points	Priority	Team Member
Sprint-1	Registration (Farmer Mobile User)	UNS-1	As a user, I can register for the application by entering my email, password, and confirming my password.	2	High	ARAVIND KUMAR D (Leader)
Sprint-1	Login	UNS-2	As a user, I will receive confirmation email once I have registered for the application	1	High	SUJITH S (Member 1)
Sprint-2	User Interface	UNS-3	As a user, I can register for the application through Facebook	3	Low	ARUN PK (Member 2)
Sprint-1	Data Visualization	UNS-4	As a user, I can register for the application through GMAIL	2	Medium	ARUNKUMAR S (Member 3)
Sprint-3	Registration (Farmer -Web User)	USN - 1	As a user, I can log into the application by entering email and password	3	High	ARAVIND KUMAR D (Leader)
Sprint - 2	Login	USN - 2	As a registered user, I need to easily login log into my registered account via the web page in minimum time	3	High	SUJITH S (Member 1)
Sprint - 4	Web UI	USN - 3	As a user, I need to have a friendly user interface to easily view and access the resources	3	Medium	ARUN PK (Member 2)

Sprint - 1	Registration (Chemical Manufacturer - Web user)	USN - 1	As a new user, I want to first register using my organization email and create a password for the account.	2	High	ARUNKUMAR S (Member 3)
Sprint - 4	Login	USN - 2	As a registered user, I need to easily log in using the registered account via the web page.	3	High	ARAVIND KUMAR D (Leader)
Sprint - 3	Web UI	USN - 3	As a user, I need to have a user friendly interface to easily view and access the resources.	3	Medium	SUJITH S(Member 1)
Sprint - 1	Registration (Chemical Manufacturer - Mobile User)	USN - 1	As a user, I want to first register using my email and create a password for the account.	1	High	ARUN PK(Member 2)
Sprint - 1	Login	USN - 2	As a registered user, I need to easily log in to the application.	2	Low	ARUNKUMAR S(Member 3)

6.2 Sprint Delivery Plan

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	12	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	6	6 Days	31 Oct 2022	05 Nov 2022	20	30 OCT 2022
Sprint-3	6	6 Days	07 Nov 2022	12 Nov 2022	20	6 NOV 2022
Sprint-4	6	6 Days	14 Nov 2022	19 Nov 2022	20	7 NOV 2022

6.2 Reports From JIRA



7.CODING AND SOLUTIONING

7.1 Feature 1

- IOT Device
- IBM Watson Platform
- Node red
- Cloudant DB
- Web UI
- MIT App
- Python Code

7.2 Feature 2

- Registration Farmer User
- Registration Fertilizer User
- Farmer User Login
- Fertilizer User Login
- Verification

SAMPLE CODING:

```
#include <WiFi.h>

#include <PubSubClient.h>
#include "DHT.h"

#define DHTPIN 15

#define DHTTYPE DHT22

#define LED 2



DHT dht (DHTPIN, DHTTYPE); void callback(char* subscribetopic,

byte* payload, unsigned int payloadLength);

#define ORG "tu4jce"//IBM ORGANITION ID

#define DEVICE_TYPE "NodeMCU"//Device type
```

```
#define DEVICE_ID "12345"//Device ID

#define TOKEN "2W?*d5U83t+ICiNhyJ"
//Token String data3; float h, t; char server[] =
ORG ".messaging.internetofthings.ibmcloud.com";
char publishTopic[] = "iot-2/evt/Data/fmt/json";

char subscribetopic[] = "iot-

2/cmd/command/fmt/String"; char authMethod[] =

"use-token-auth"; char token[] = TOKEN; char

clientId[] = "d:" ORG ":" DEVICE_TYPE ":"

DEVICE_ID;

//------------------------------------------------------------------------

WiFiClient wifiClient;

PubSubClient client(server, 1883, callback,wifiClient); void setup()

{

  Serial.begin(115200);

dht.begin();

pinMode(LED,OUTPUT);

delay(10);

Serial.println();

wificonnect();

mqttconnect();

}




void loop()

{
```

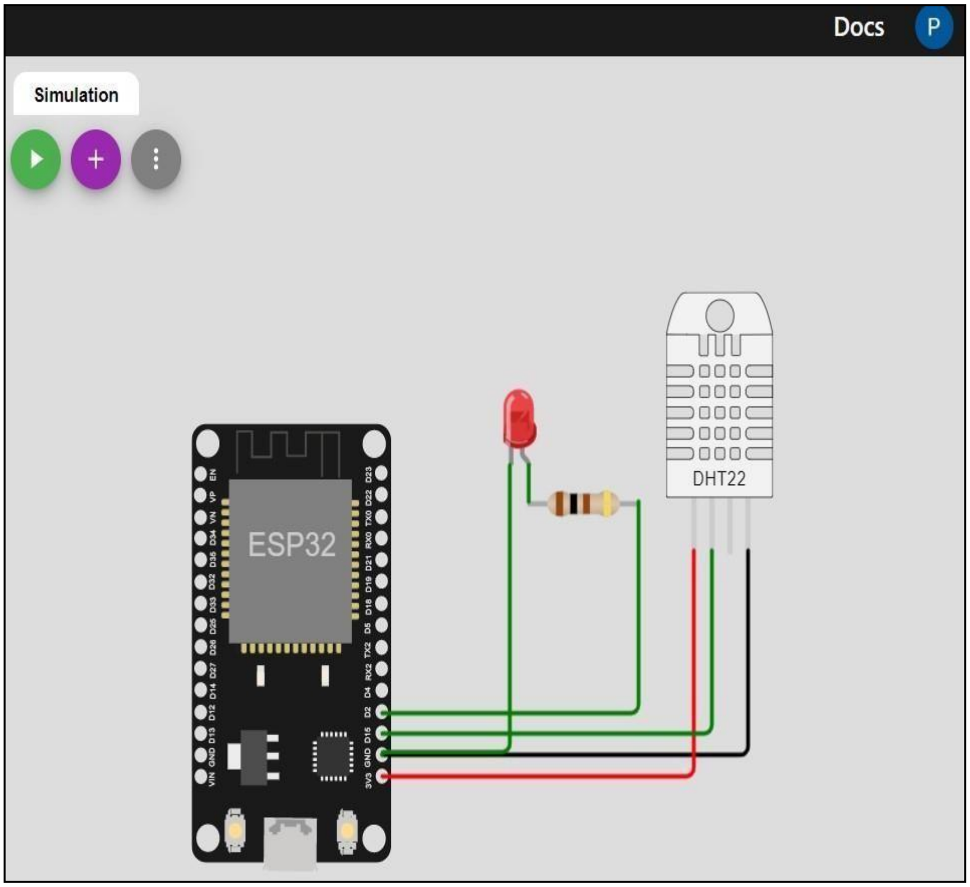
```
  h = dht.readHumidity();  t= dht.readTemperature();

  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 += "}";


  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++) {

//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="";

}
```

8.Test Case

8.1 Test Case 1



SERIALMONITOR

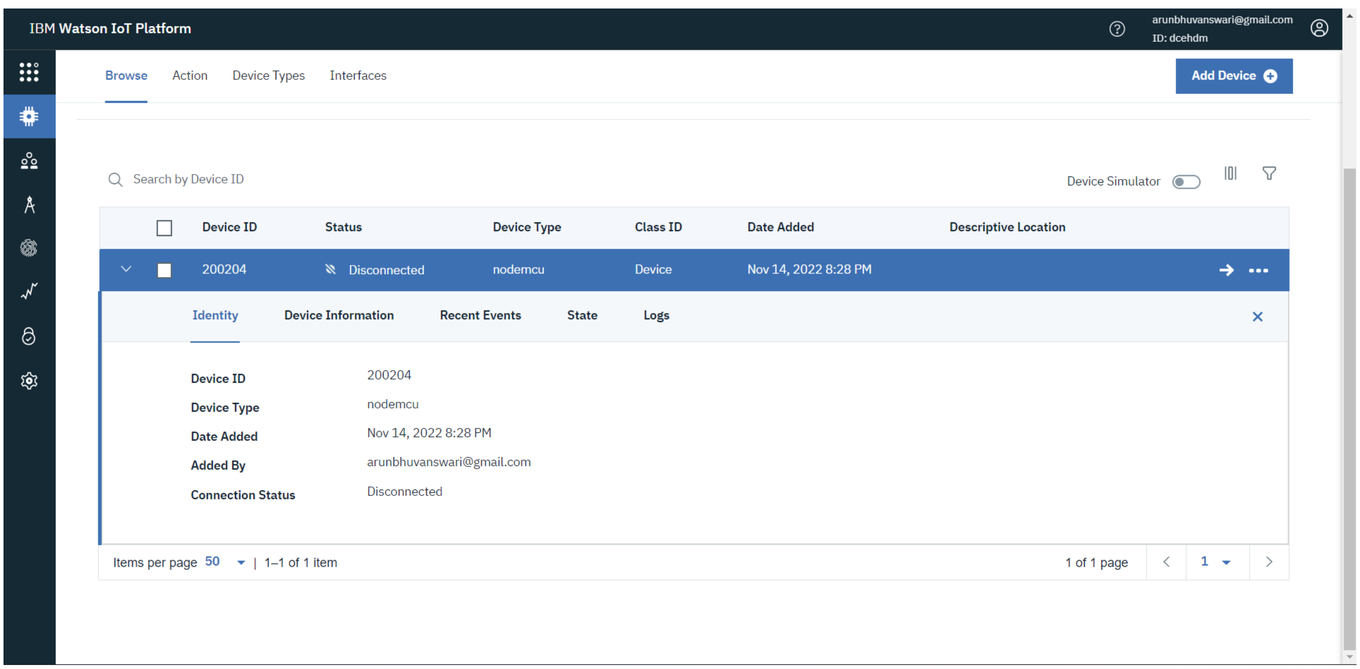
```
Connecting to ...
WiFi connected
IP address:
10.10.0.2
Reconnecting client to tu4jce.messaging.internetofthings.ibmcloud.com
iot-2/cmd/command/fmt/String
subscribe to cmd OK
```

Connecting to IBM Watson IoT platform

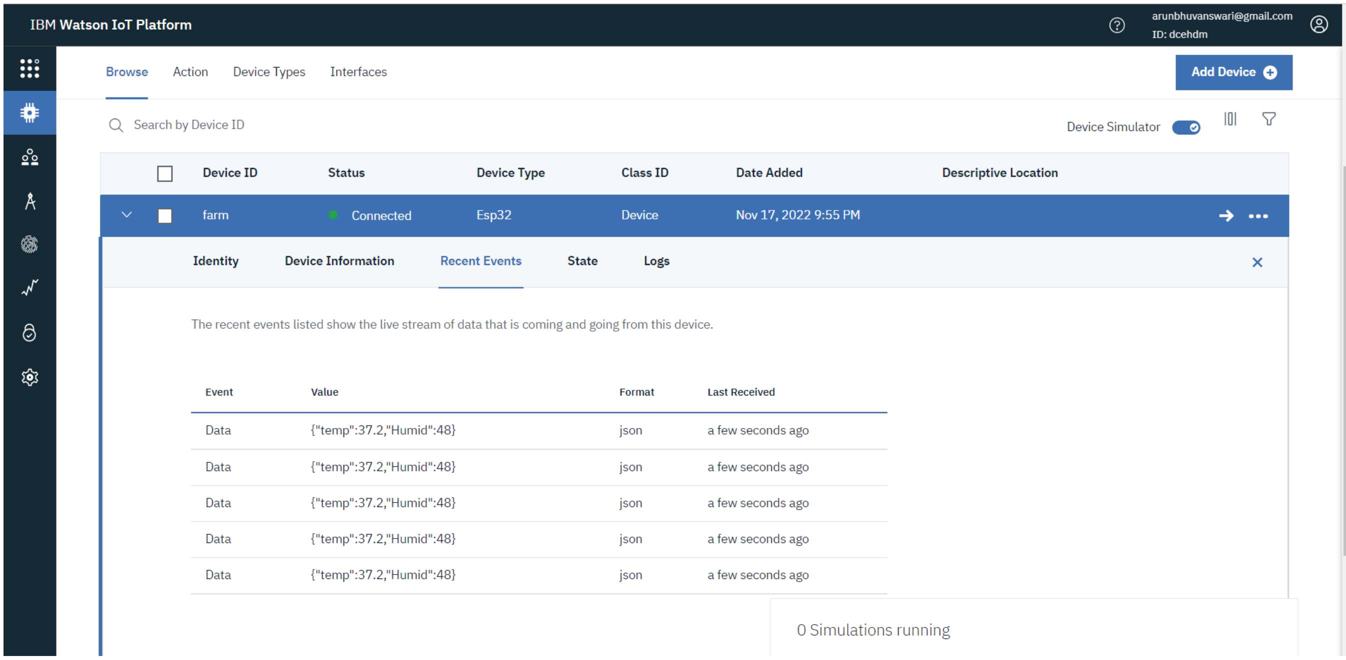
```
temp:24.00
Humid:40.00
Sending payload: {"temp":24.00,"Humid":40.00}
Publish ok
temp:24.00
Humid:40.00
Sending payload: {"temp":24.00,"Humid":40.00}
Publish ok
```

Publishing temperature and humidity values to the IBM Watson IoT platform

IBM Watson IoT platform:



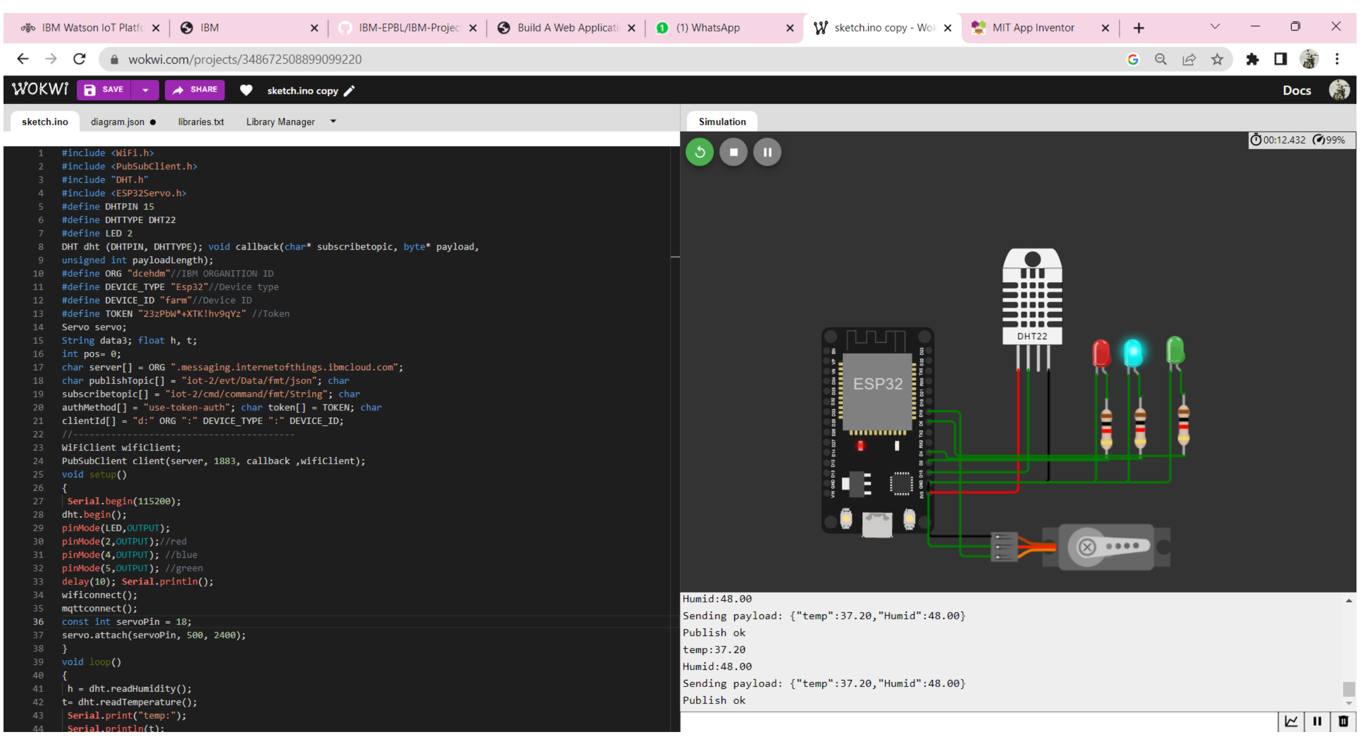
Connected Status in IBM Watson IoT platform

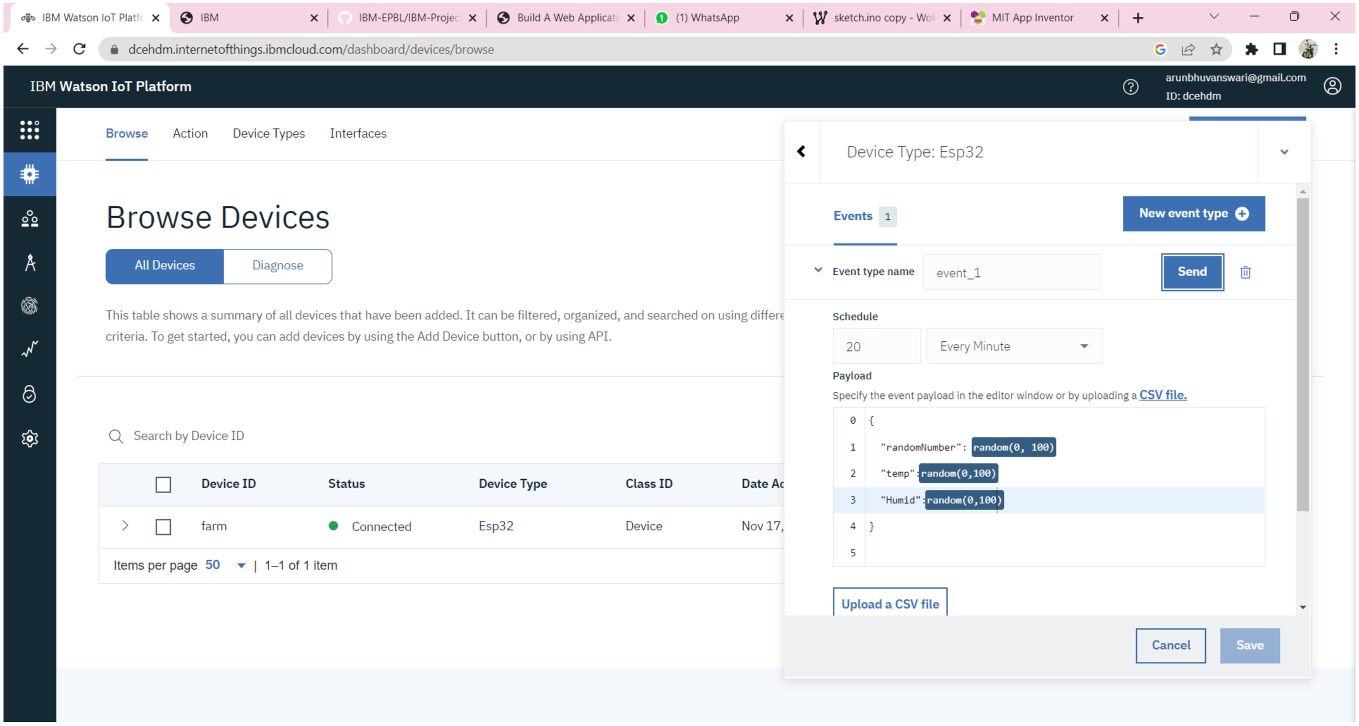


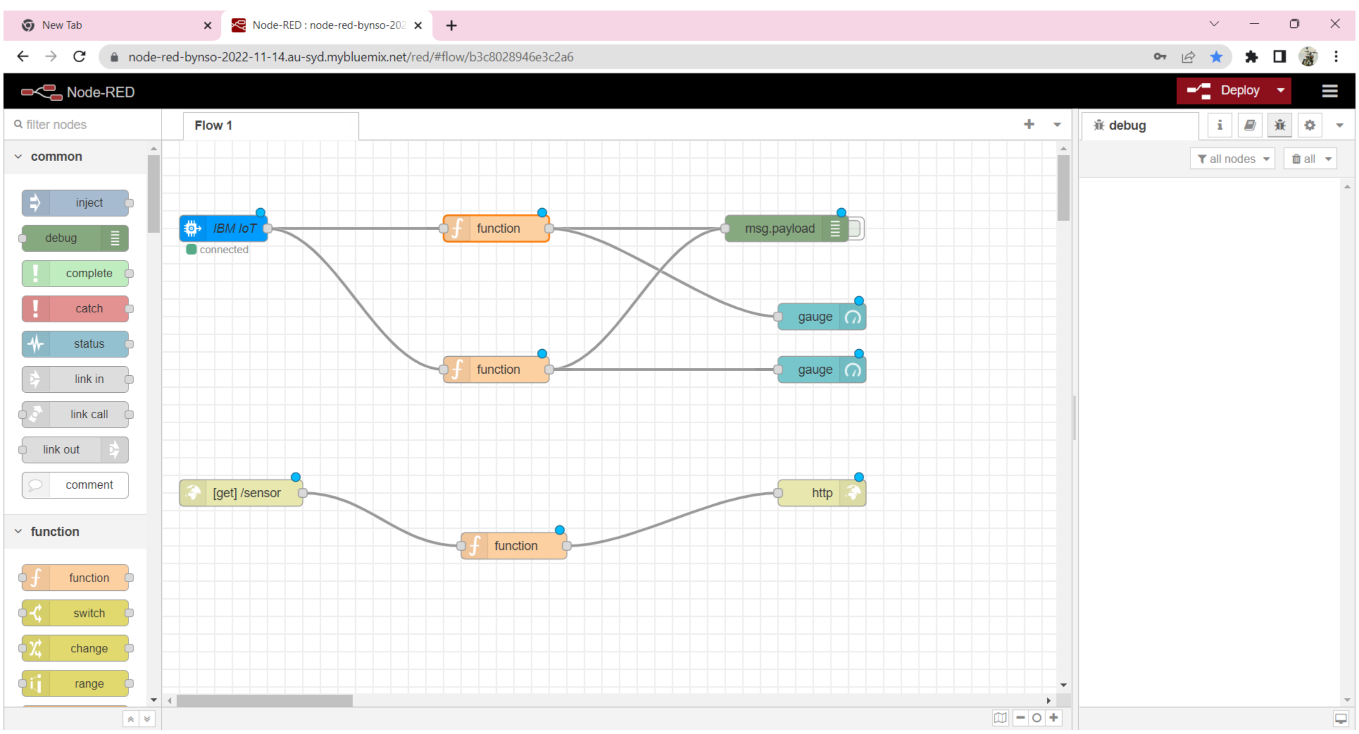
Recent Events in IBM Watson IoT platform

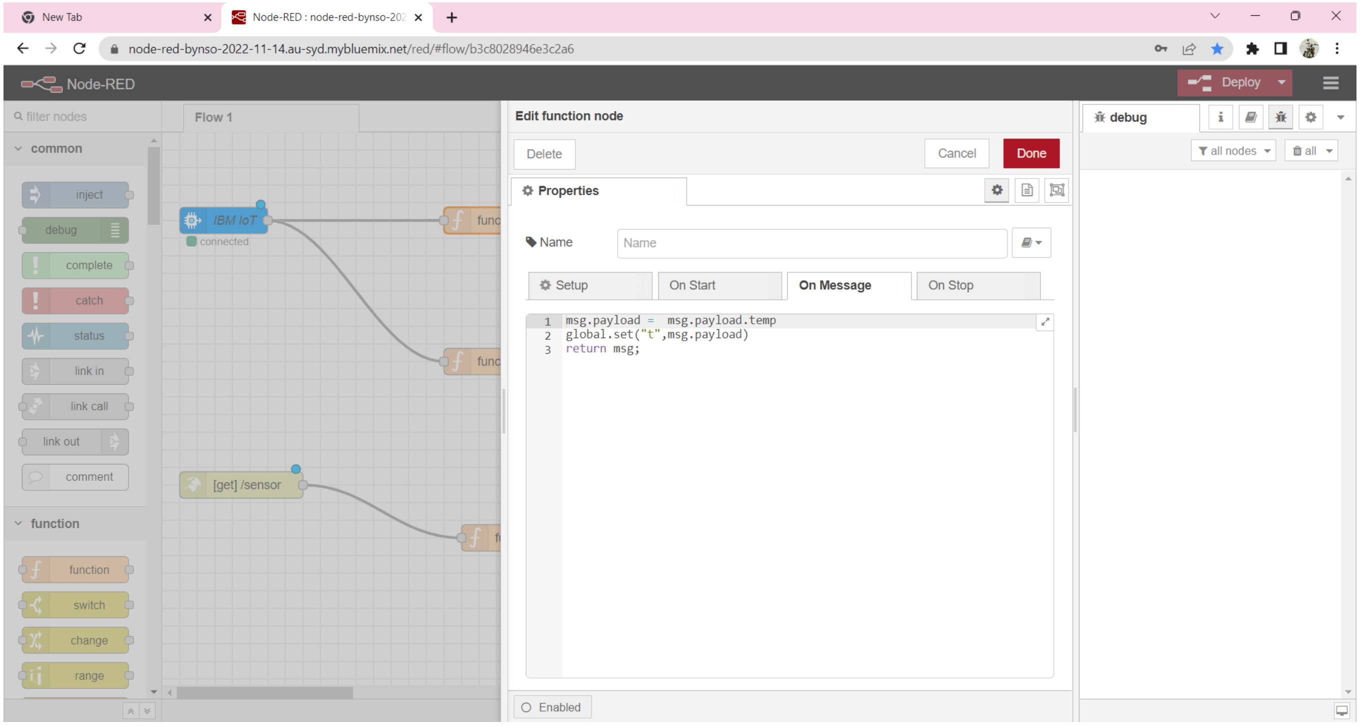
Once the sensor data like temperature and humidity gets updated in the IBM Watson IoT platform, those sensor data's will be available under recent events.

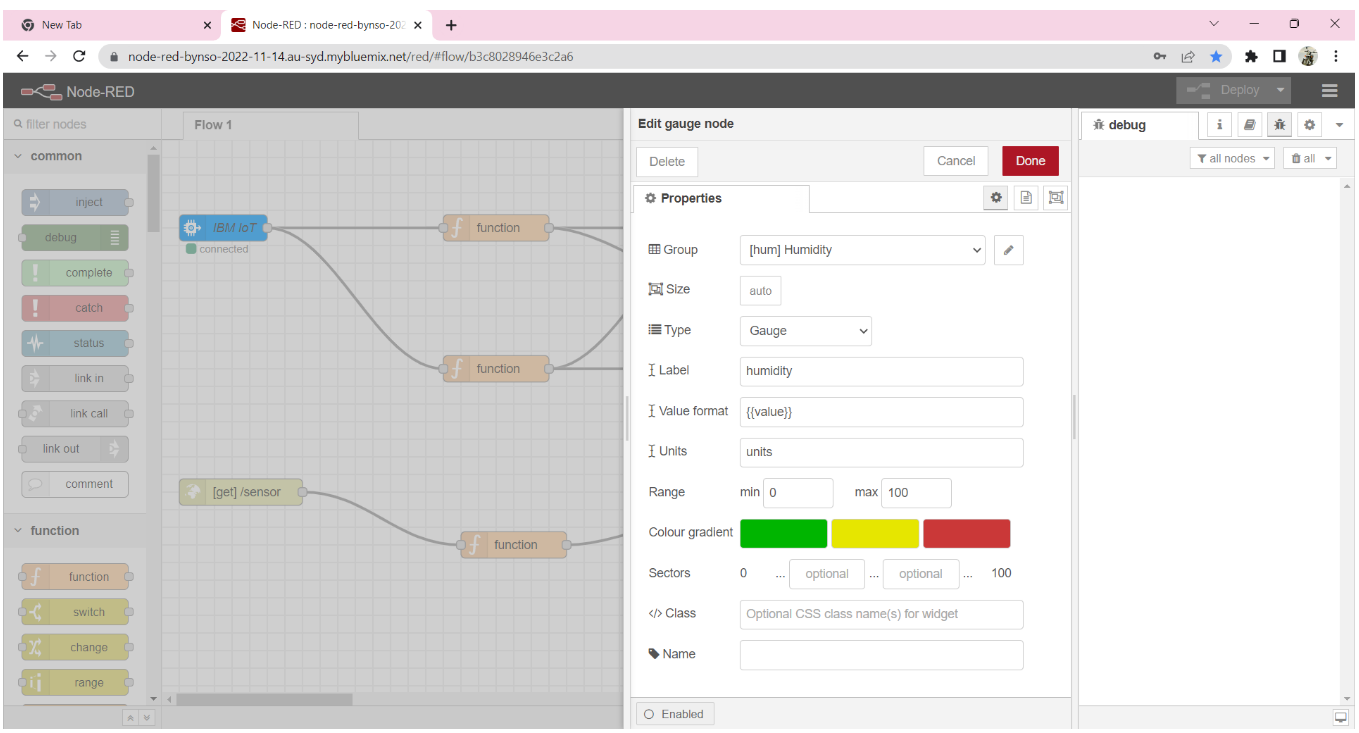
9.RESULT:

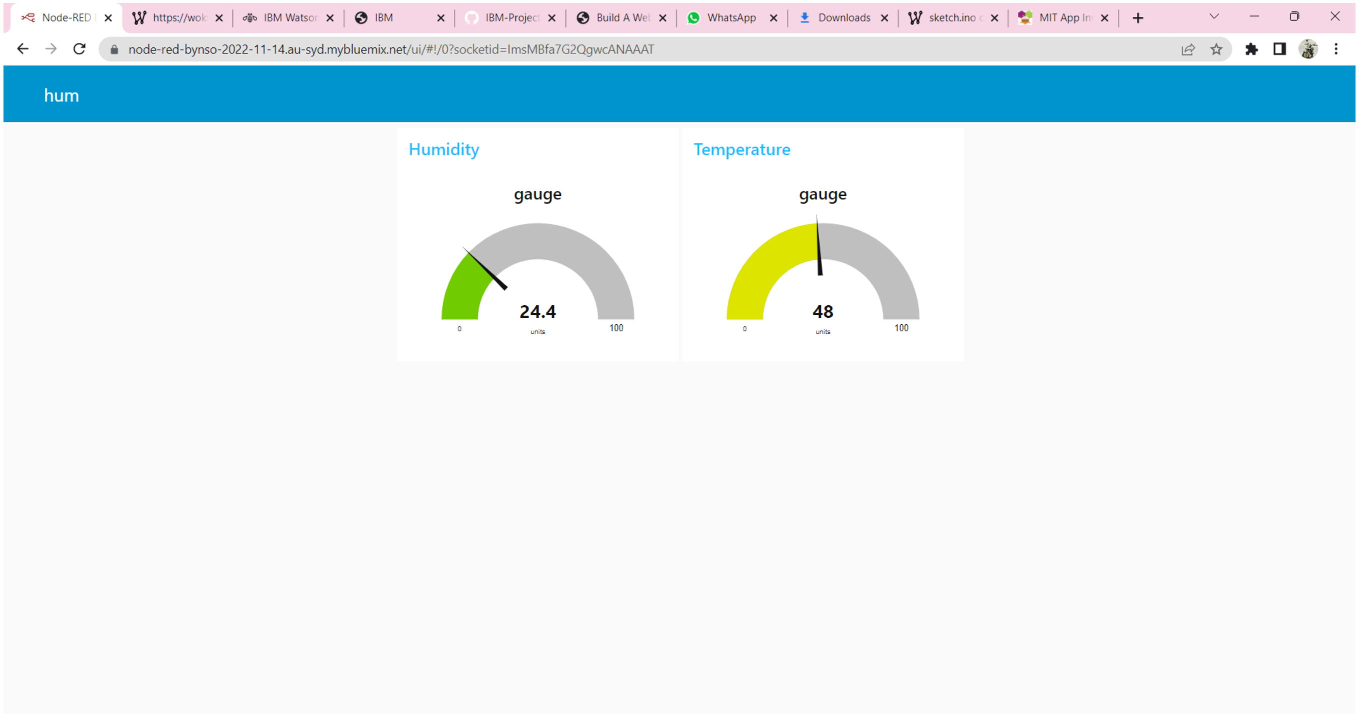



IBM Watson IoT Platform
Browse
Action
Device Types
Interfaces
Browse Devices
All Devices
Diagnose
This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using differe
criteria. To get started, you can add devices by using the Add Device button, or by using API.
Search by Device ID
Device ID
Status
Device Type
Class ID
farm
Connected
Esp32
Device
Items per page 50 | 1–1 of 1 item
Device Type: Esp32
Events 1
New event type
Event type name
event_1
Send
Schedule
20
Every Minute
Payload
Specify the event payload in the editor window or by uploading a CSV file.
"randomNumber": random(0, 100)
"temp":random(0,100)
"Humid":random(0,100)
Upload a CSV file
Cancel
Save

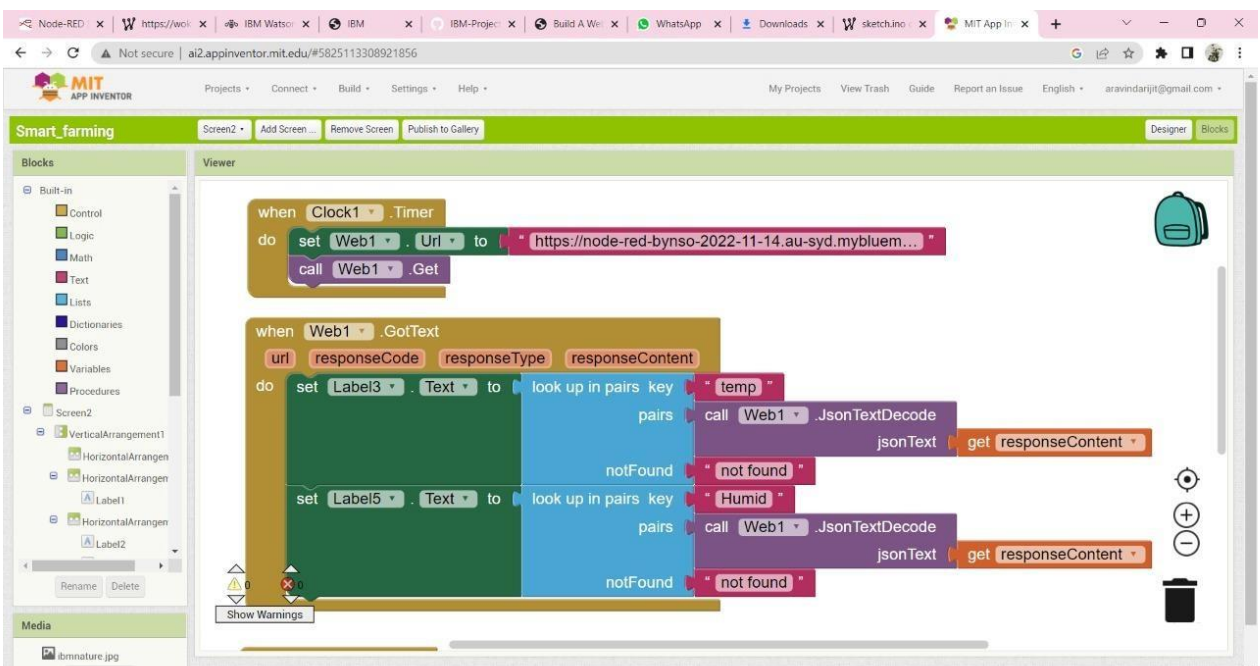

Node-RED
Deploy
Flow 1
debug
common
inject
debug
complete
catch
status
link in
link call
link out
comment
function
function
switch
change
range
IBM IoT
connected
function
function
msg.payload
gauge
gauge
[get] /sensor
function
http

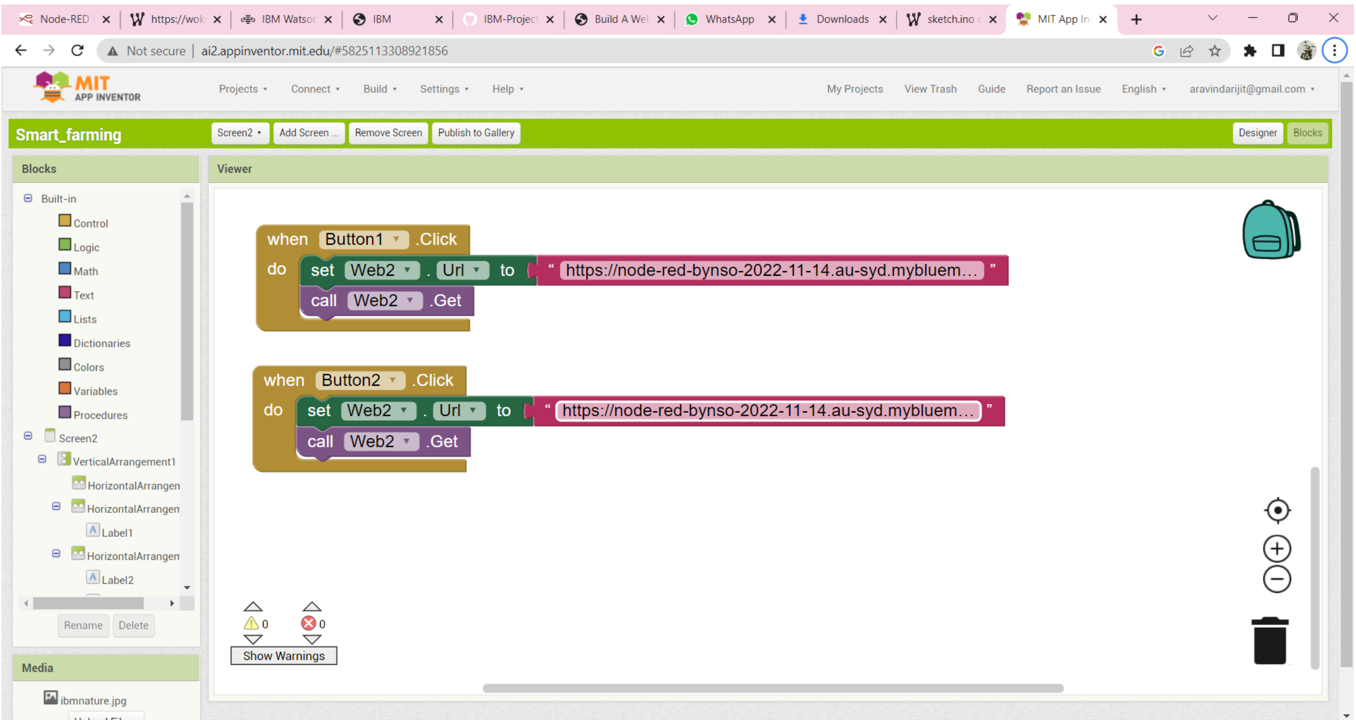

New Tab
Node-RED : node-red-bynso-202
node-red-bynso-2022-11-14.au-syd.mybluemix.net/red/#flow/b3c8028946e3c2a6
Node-RED
Deploy
filter nodes
Flow 1
common
inject
debug
complete
catch
status
link in
link call
link out
comment
function
function
switch
change
range
IBM IoT
connected
[get] /sensor
Edit function node
Delete
Cancel
Done
Properties
Name
Setup
On Start
On Message
On Stop
msg.payload = msg.payload.temp
global.set("t",msg.payload)
return msg;
Enabled
debug
all nodes
all


New Tab
Node-RED : node-red-bynso-202
node-red-bynso-2022-11-14.au-syd.mybluemix.net/red/#flow/b3c8028946e3c2a6
Node-RED
Deploy
filter nodes
Flow 1
common
inject
debug
complete
catch
status
link in
link call
link out
comment
function
function
switch
change
range
IBM IoT
connected
function
function
[get] /sensor
function
Edit gauge node
Delete
Cancel
Done
Properties
Group
[hum] Humidity
Size
auto
Type
Gauge
Label
humidity
Value format
{{value}}
Units
units
Range
min
0
max
100
Colour gradient
Sectors
0
optional
optional
100
Class
Optional CSS class name(s) for widget
Name
Enabled
debug
all nodes
all

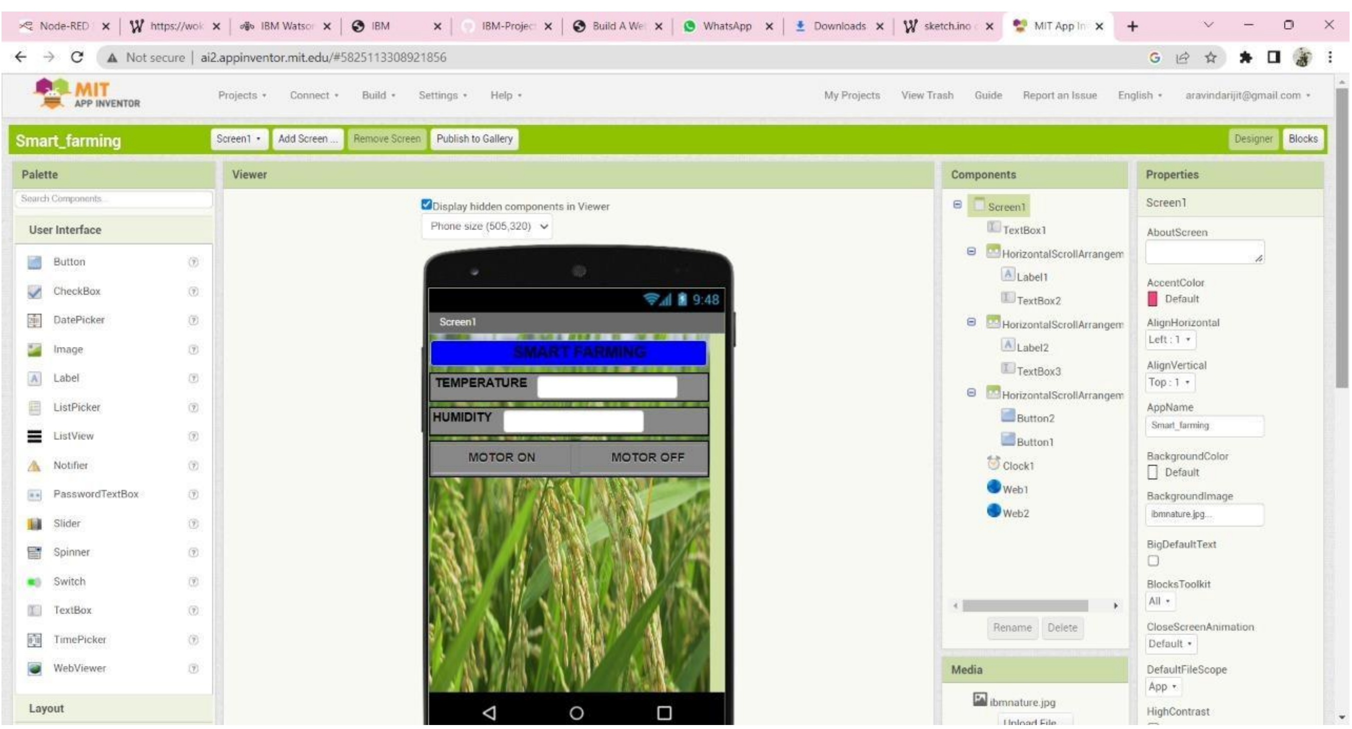


BACKEND CODE:

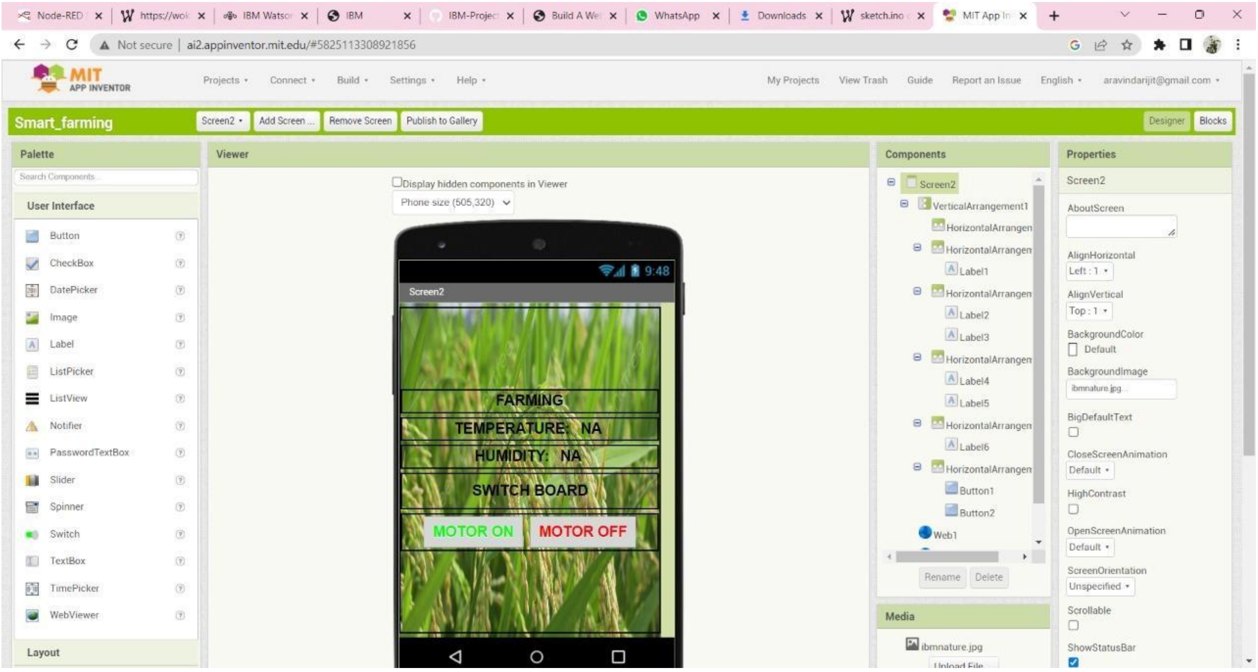




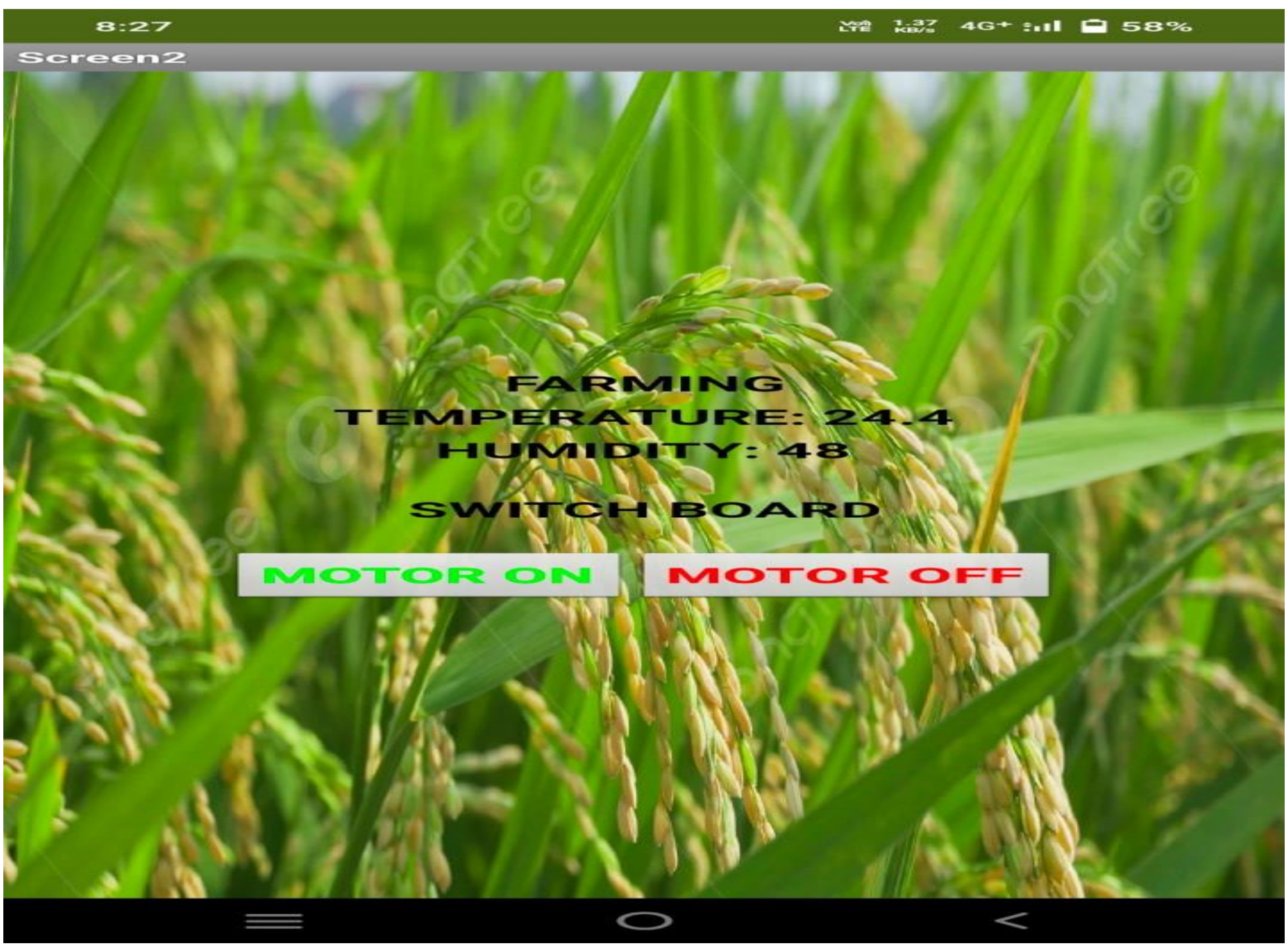
ai2.appinventor.mit.edu/#5825113308921856
MIT APP INVENTOR
Smart_farming
Screen2
Add Screen ...
Remove Screen
Publish to Gallery
Designer
Blocks
Viewer
when Button1 .Click
do set Web2 . Url to " https://node-red-bynso-2022-11-14.au-syd.mybluem... "
call Web2 .Get
when Button2 .Click
do set Web2 . Url to " https://node-red-bynso-2022-11-14.au-syd.mybluem... "
call Web2 .Get
Show Warnings



ai2.appinventor.mit.edu/#5825113308921856
MIT APP INVENTOR
Smart_farming
Screen1
Add Screen ...
Remove Screen
Publish to Gallery
Designer
Blocks
Palette
Viewer
Components
Properties
Display hidden components in Viewer
Phone size (505,320)
9:48
Screen1
SMART FARMING
TEMPERATURE
HUMIDITY
MOTOR ON
MOTOR OFF



FINAL APP DESIGN:



10. Advantages and Disadvantages

10.1 Advantages of Smart Agriculture

- It allows farmers to maximize yields using minimum resources such as water, fertilizers, seeds etc.
- Solar powered and mobile operated pumps save cost of electricity.
- Smart agriculture use drones and robots which helps in many ways. These improves data collection process and helps in wireless monitoring and control.
- It is cost effective method.
- It delivers high quality crop production.

10.2 Disadvantages of Smart Agriculture

- Automated irrigation system uses only two parameters of soil like soil moisture and temperature other parameters humidity, light, air moisture, soil ph value not taken for decision making.
- Excessive seepage and leakage of water forms marshes and ponds all along the channels. The marshes and the ponds in course of time become the colonies of the mosquito, which gives rise to a disease like malaria.
- The smart agriculture needs availability of internet continuously. Rural part of most of the developing countries do not fulfil this requirement. Moreover internet connection is slower.
- The smart farming based equipments require farmers to understand and learn the use of technology. This is major challange in adopting smart agriculture farming at large scale across the countries.

11. Conclusion

A system to monitor temperature, humidity, moisture levels in the soil was designed and the project provides an opportunity to study the existing systems, along with their features and drawbacks. Agriculture is one of the most water-consuming activities. The proposed system can be used to switch the motor (on/off) depending on favorable condition of plants i.e sensor values, thereby automating the process of irrigation. which is one of the most time efficient activities in farming, which helps to prevent over irrigation or underirrigation of soil thereby avoiding crop damage. The farm owner can monitor the process online through a android App. Though this project can be concluded that there can be considerable development in farming with the use of IOT and automation.

12. Future Scope

- The performance of the system can be further improved in terms of the operating speed, memory capacity, and instruction cycle period of the microcontroller by using other high end controllers. The number of channels can be increased to interface more number of sensors which is possible by using advanced versions of controllers.

- The system can be modified with the use of a data logger and a graphical LCD panel showing the measured sensor data over a period of time.A speaking voice alarm could be used.The device can be made to perform better by providing the power supply with the help of renewable source. Time bound administration of fertilizers, insecticides and pesticides can be introduced.

13. Appendix

13.1 Source Code

```
#include <WiFi.h>

#include <PubSubClient.h>

#include "DHT.h"

#include <ESP32Servo.h>

#define DHTPIN 15

#define DHTTYPE DHT22

#define LED 2

DHT dht (DHTPIN, DHTTYPE); void callback(char* subscribetopic, byte* payload,

unsigned int payloadLength);

#define ORG "dcehdm"//IBM ORGANITION ID

#define DEVICE_TYPE "Esp32"//Device type

#define DEVICE_ID "farm"//Device ID

#define TOKEN "23zPbW*+XTK!hv9qYz" //Token

Servo servo;

String data3; float h, t;

int pos= 0;

char server[] = ORG ".messaging.internetofthings.ibmcloud.com";

char publishTopic[] = "iot-2/evt/Data/fmt/json"; char

subscribetopic[] = "iot-2/cmd/command/fmt/String"; char

authMethod[] = "use-token-auth"; char token[] = TOKEN; char

clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;
```

```
//-------------------------------------------------------------

WiFiClient wifiClient;

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

void setup()

{

 Serial.begin(115200);

dht.begin();

pinMode(LED,OUTPUT);

pinMode(2,OUTPUT);//red

pinMode(4,OUTPUT); //blue

pinMode(5,OUTPUT); //green

delay(10); Serial.println();

wificonnect();

mqttconnect();

const int servoPin = 18;

servo.attach(servoPin, 500, 2400);

}

void loop()

{

 h = dht.readHumidity();

t= dht.readTemperature();

Serial.print("temp:");

Serial.println(t);
```

```
Serial.print("Humid:");
Serial.println(h);
if((t<=40)&&(t>=25))
  {
    pos=90;
    servo.write(pos);
    digitalWrite(4, HIGH);
    digitalWrite(2, LOW);digitalWrite(5, LOW);

  }
 if(t>40)
  {
    pos=180;
    servo.write(pos);
    digitalWrite(2, HIGH);
     digitalWrite(4, LOW);digitalWrite(5, LOW);
  }
 if(t<25)
  {
    pos=0;
    servo.write(pos);
     digitalWrite(5, HIGH); digitalWrite(2, LOW); digitalWrite(4, LOW);
  }
```

```
 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 += "}";

 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++) {
//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="";
}
```

13.2 Github Link

https://github.com/IBM-EPBL/IBM-Project-6567-1658831925

Project demo link

https://github.com/IBM-EPBL/IBM-Project-6567-1658831925/blob/main/FINAL%20DELIVERABLES/final%201%20video.mp4