IOT ENABLED SMART FARMING APPLICATION

NALAIYA THIRAN PROJECT BASED LEARNING

Project

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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. 1.2. Purpose

Increasing control over production leads to better cost management and waste reduction. ľhe ability to tíace anomalies in crop growth oí livestock health, foí instance, helps eliminate the risk of losing yields. Additionally, automation boosts efficiency. Smart farming reduces the ecological footprint of faíming.

Minimized oí site-specific application of inputs, such as fertilizers and pesticides, in píecision agricultre systems will mitigate leaching problems as well as the emission of greenhouse gases.

2. Literature Survey

2.1 Existing Problem

Iot based Smart Farming improves the entire Agriculture system by monitoring the field in real-time. With the help of sensors and interconnectivity, the Internet of things in Agriculture has not only saved the time of the farmers but has also reduced the extravagant use of resources such as Water and Electricity. Climate plays a very critical role for farming. And having improper knowledge about climate heavily deteriorates the quantity and quality of the crop production. Precision

Agriculture/Precision Farming is one of the most famous applications of IoT in Agriculture. It makes the farming practice more precise and controlled by realizing smart farming applications such as livestock monitoring,

vehicle tracking, field observation, and inventory monitoring. To make our greenhouses smart, IoT has enabled weather stations to automatically adjust the climate conditions according to a particular set of instructions. Adoption of IoT in Greenhouses has eliminated the human intervention, thus making entire process cost-effective and increasing accuracy at the same time.

2.2 References

1) Sustainable agriculture by the Internet of Things – A practitioner's approach to monitor sustainability progress. 2022, Computers and Electronics in Agriculture.
2) The Interplay between the Internet of Things and agriculture: A metric analysis and research agenda. 2022, International Journal of Intelligent Networks.
3) Agriculture 4.0 and its Barriers in the Agricultural Production Chain Development in Southern Brazil. 2022, SSRN
4) IoT based Agriculture (IoTA): Architecture, Cyber Attack, Cyber Crime and Digital

Forensics Challenges. 2022, Research Square

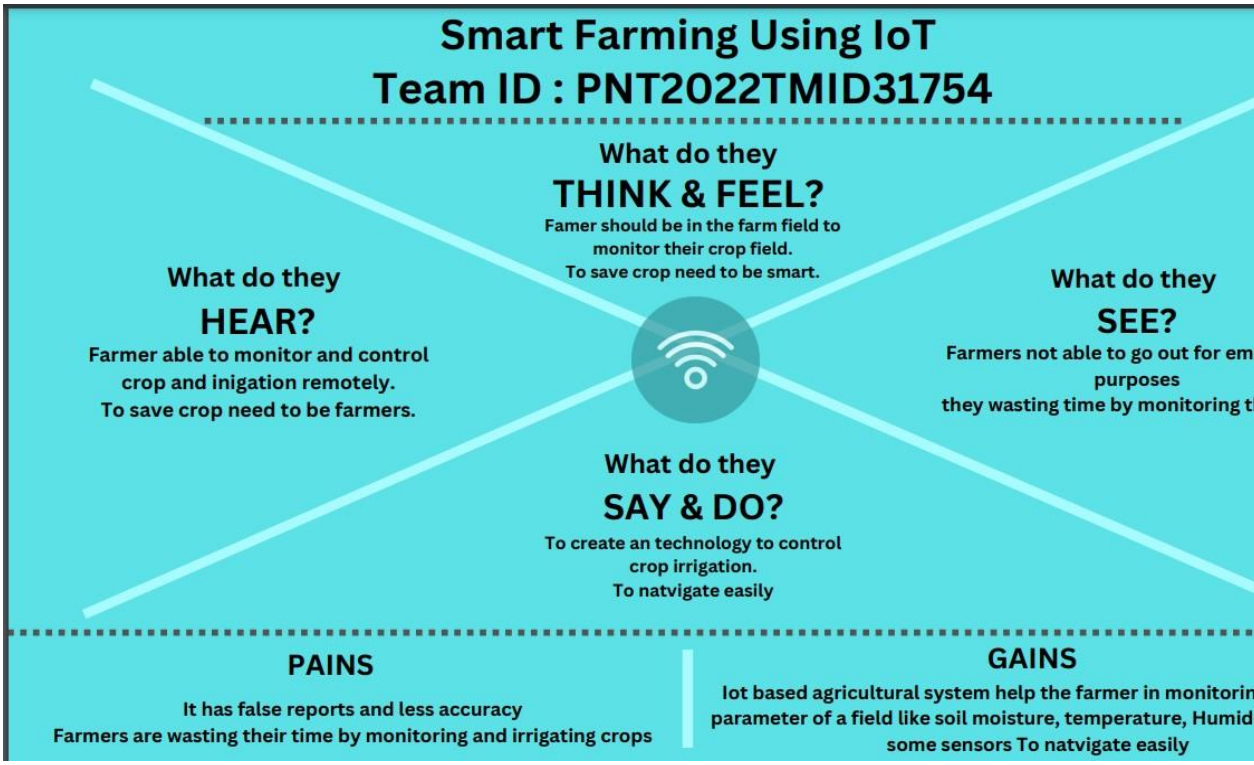
2.3 Problem Statement Solution

The traditional agriculture and allied sector cannot meet the requirements of modern agriculture which requires high-yield, high quality and efficient output. Thus, it is very important to turn towards modernization of existing methods and using the information technology and data over a certain period to predict the best possible productivity and crop suitable on the very particular land. The adoptions of access to high-speed internet, mobile devices, and reliable, low-cost satellite (for imagery and positioning) are few key technologies characterizing the precisionprecisionagriculture0agriculture trend. Precision agriculture is one of the most famous applications of IoT in the agricultural sector and numerous organizations are leveraging this technique around the world. Some products and services in use are VRI optimization, soil moisture probes, virtual optimizer PRO, and so on. VRI (Variable Rate Irrigation) optimization maximizes profitability on irrigated crop

fields with topography or soil variability, improve yields, and increases water use efficiency. Iot has been making deep inroads into sectors such as manufacturing, health-care and automotive. When it comes to food production, transport and storage, it offers a breadth of options that can improve India's per capita food availability. Sensors that offer information on soil nutrient status, pest infestation, moisture conditions etc. which can be used to improve crop yields over time. Some of the sample problem statements related to Agriculture & allied sectors where Iot application will be beneficial are given below.

3. Ideation & Proposed Solution

3.1. Prepare Empathy Map



3.2 Ideation & Brainstorming

3.3 Proposed Solution

S.No	Parameter	Description
	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

	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.
	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.

	Social Impact / Customer Satisfaction	● Reduces the wages for labors 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

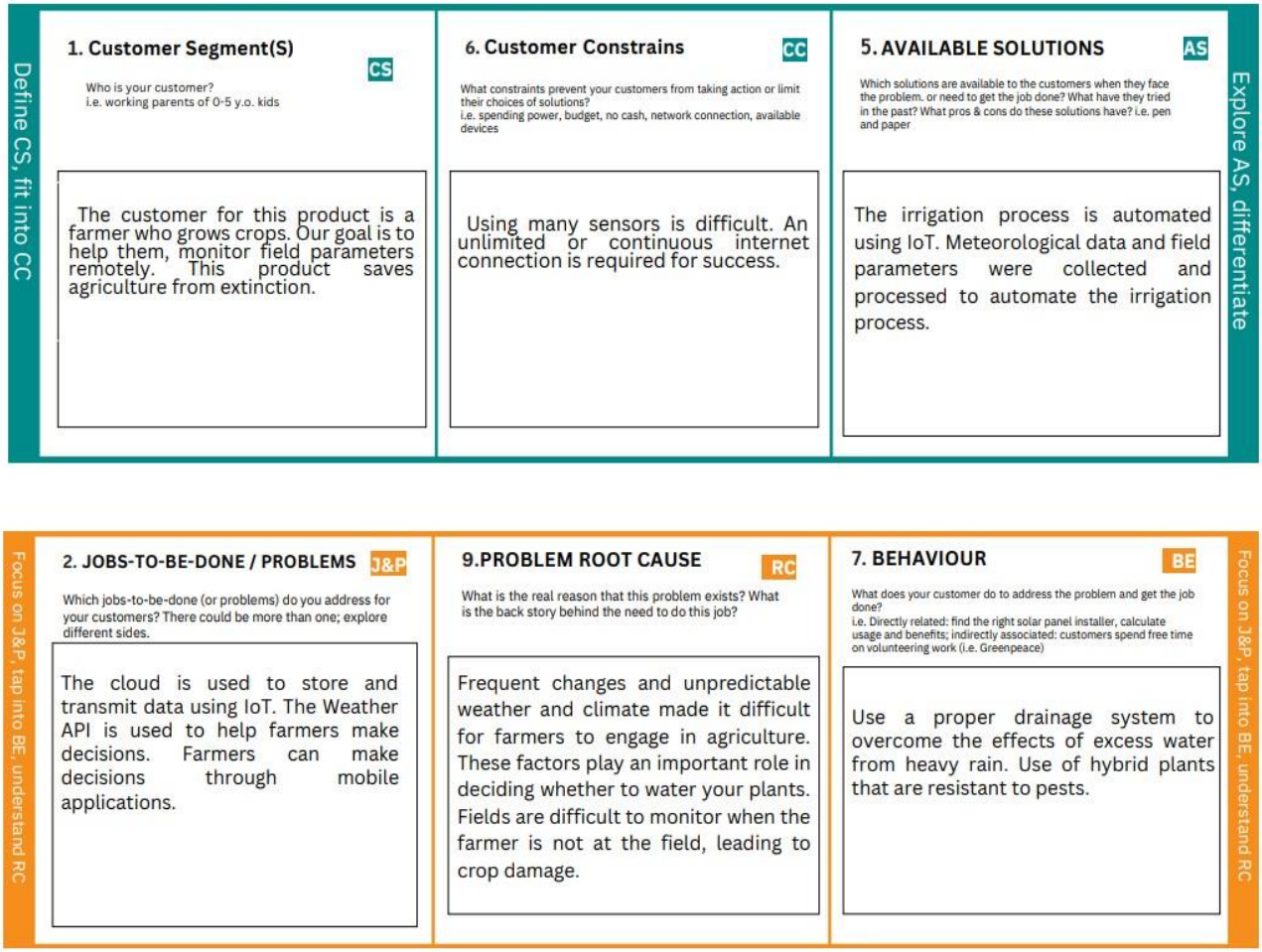
	Business Model (Revenue Model)	Revenue (No. of Users vs Months) User Months
	Scalability of the Solution	Scalability in smart farming refers to the adaptability of a system to increase the capacity, for example, the number of technology devices such as sensors and actuators, while enabling timely analysis.

3.4 Problem Solution fit

Project Title : SmartFarmer - IoT Enabled Smart Farming Application

Project Design - Solution Fit Phase- I

Team ID: PNT2022TMID31754



4.REQUIREMENT ANALYSIS

4.1 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 Roles of Access. Check Credentials
FR-4	Manage Modules	Manage System Admins Manage Roles of User Manage User permission
FR-5	Check whether details	Temperature details Humidity details
FR-6	Log out	Exit

4.2Non-Functional Requirement

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability is defined as the ability to learn quickly, use something effectively, remember something,

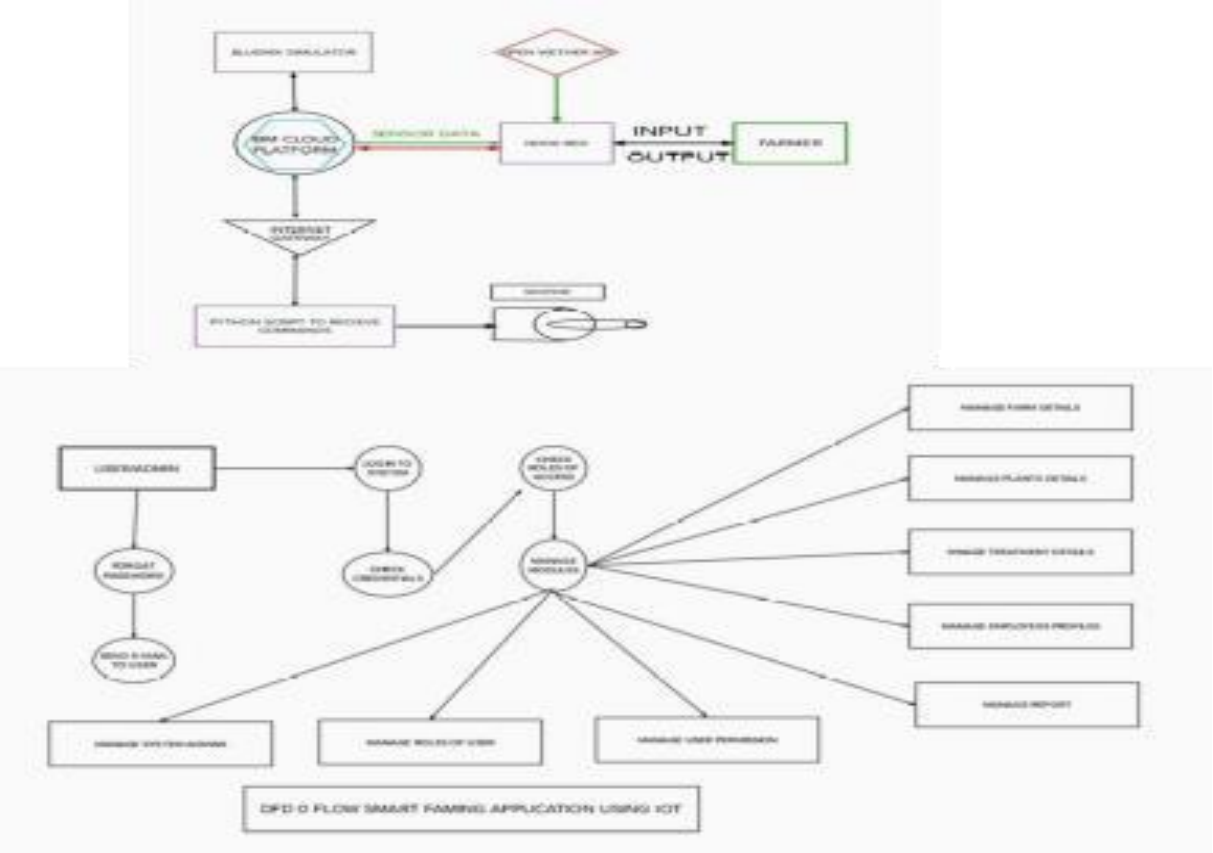
		operate something without making a mistake, and enjoy something.
NFR-2	**Security**	Private and confidential information must be kept secure at all times, including during collection, processing, and storage.
NFR-3	**Reliability**	A superior cost-to-reliability trade-off is achieved with shared protection. To prevent agricultural service interruptions, the approach employs specialised and shared protection methods.
NFR-4	**Performance**	It will be more effective to monitor farming operations overall if integrated sensors are used to measure soil and ambient characteristics.
NFR-5	**Availability**	By tying information about crops, weather, and equipment together, it is feasible to automatically alter temperature, humidity, and other factors in farming equipment.

NFR-6	**Scalability**	For IoT platforms, scalability is a big challenge. It has been demonstrated that different IoT platform architectural decisions impact system scalability and that automatic real-time decision-making is possible in a setting with thousands of users.

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.



- The different soil parameters temperature, soil moistures and then humidity are

Sensed using different sensors and obtained value is stored in the ibm cloud.

- Aurdino UNO is used at 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 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

The different soil parameters temperature, soil moistures and then humidity are sensed using different sensors and obtained value is stored in the IBM B2 cloud.

1. Arduino UNO is used as a processing Unit that process the data obtained from the sensors .The different soil parameters temperature, soil moistures and then humidity are sensed using different sensors and obtained value is stored in the IBM B2 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 field or not depending upon the sensor values. By using the app they can remotely operate the motor switch.

Table-1 : Components & Technologies:

Component	Description	Technology
1. User Interface	How user interacts with application e.g. Web	MIT App Inventor
2. Application Logic-1	Logic for a process in the application	Python
3. Application Logic-2	Logic for a process in the application	IBM Watson IOT service
4. Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5. Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6. Cloud Database	Database Service on Cloud	IBM Cloud
7. File Storage	File storage requirements	IBM Block Storage or Other Storage

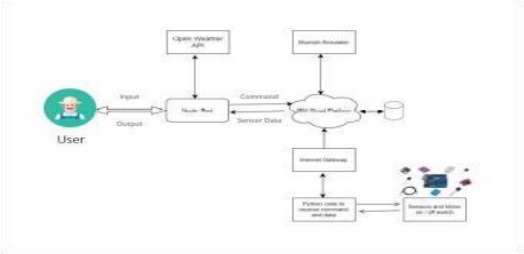
8. External API-1	Purpose of External API used in the application	Open Weather API
9. Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration:	Local, Cloud Foundry.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensource framework
2.	Security Implementations	Sensitive and private data must be protected from their production until the decision making and storage stages.	Node-Red, Open weather App API, MIT App Inventor

3.	Scalable Architecture	scalability is a major concern for IoT platforms. It has been 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.	Technology used

1. d whether data from the weather API.
2. NODE-RED is used as a programming tool to write the hardware, software and APIs. The MQTT protocol is followed for the communication.
3. 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 field or not depending upon the sensor values. By using the app they can remotely operate the motor switch.



5.3 User Stories

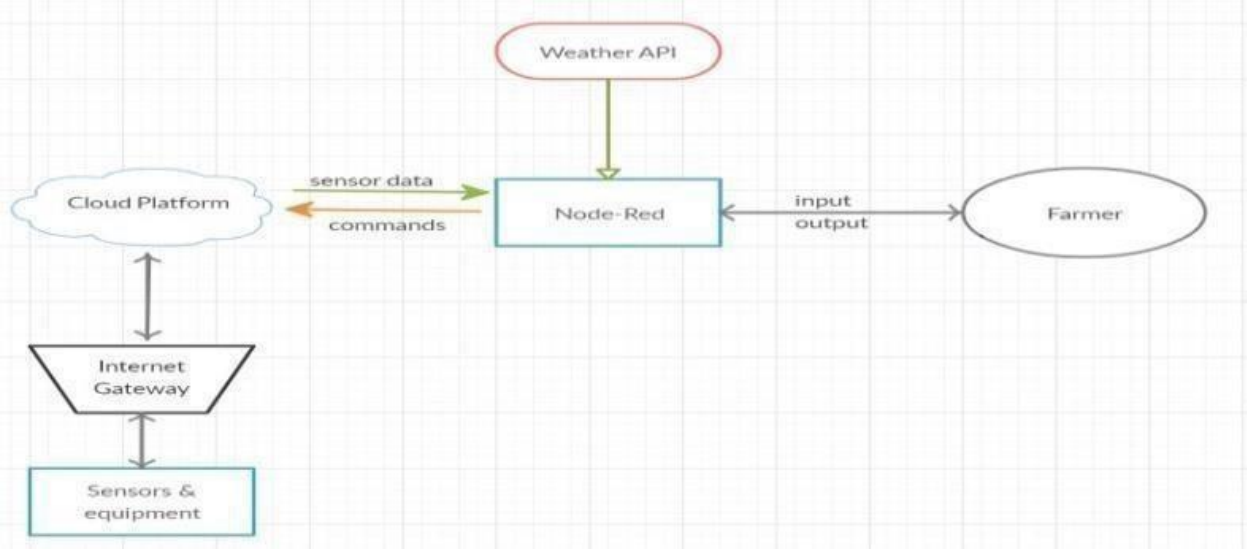
SCENARIO **Browsing, booking, attending, and rating a local city tour**	**Entice** How does someone initially become aware of this process?	**Enter** What do people experience as they begin the process?
Steps What does the person (or group) typically experience?	Opening App View details on sensor data Motor Control Visually treat will be there and widgets in arranged position for better experiences Where data is represented in filling color in a bar or numeric value for better understanding Providing switch style button to control the motor	Information about their land More about sensor data Get to know about their land When they click, they gets detailed info about it
Interactions What interactions do they have at each step along the way? ▪ **People:** Who do they see or talk to? ▪ **Places:** Where are they? ▪ **Things:** What digital touchpoints or physical objects would they use?	Interaction with widgets for more info	Interaction with data
Goals & motivations At each step, what is a person's primary goal or motivation? ("Help me..." or "Help me avoid...")	What's happening currently in my land	What we can do in the land Think about next step
Positive moments What steps does a typical person find enjoyable, productive, fun, motivating, delightful, or exciting?	Users become productive Their work will be easy	

6. Project Planning & Scheduling

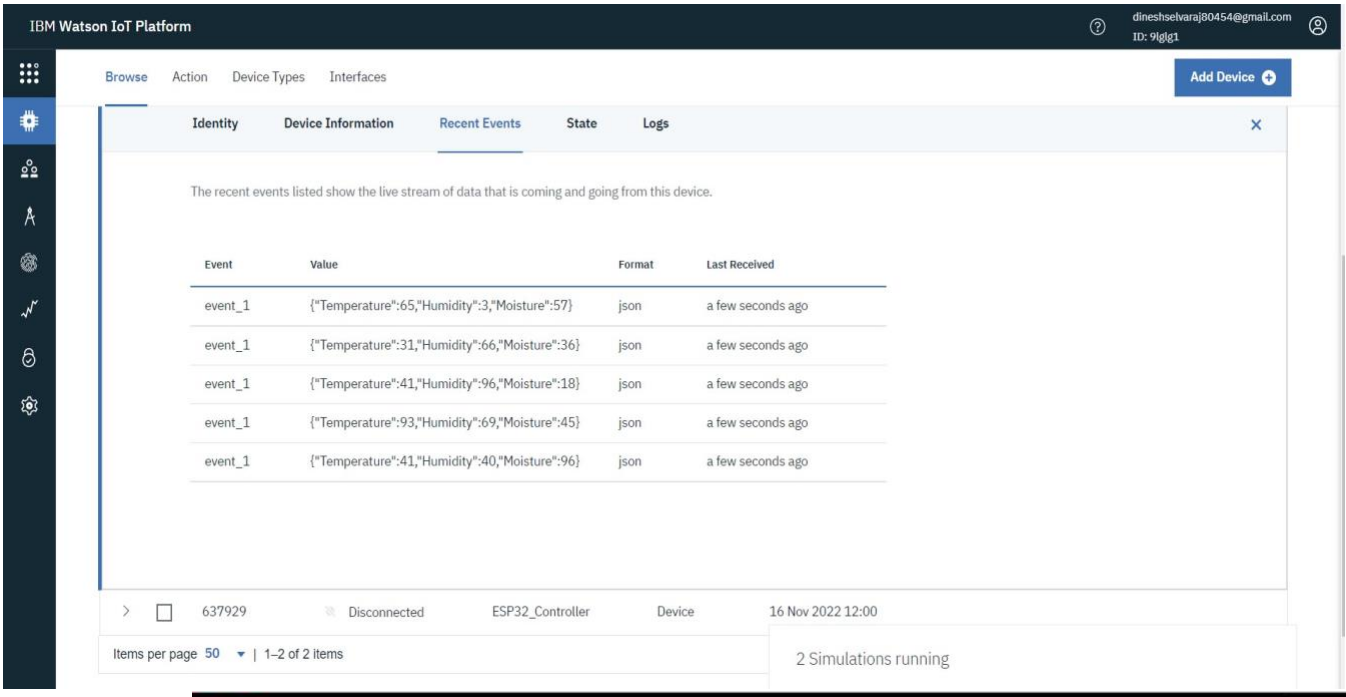
6.1 Sprint Planning & Estimation

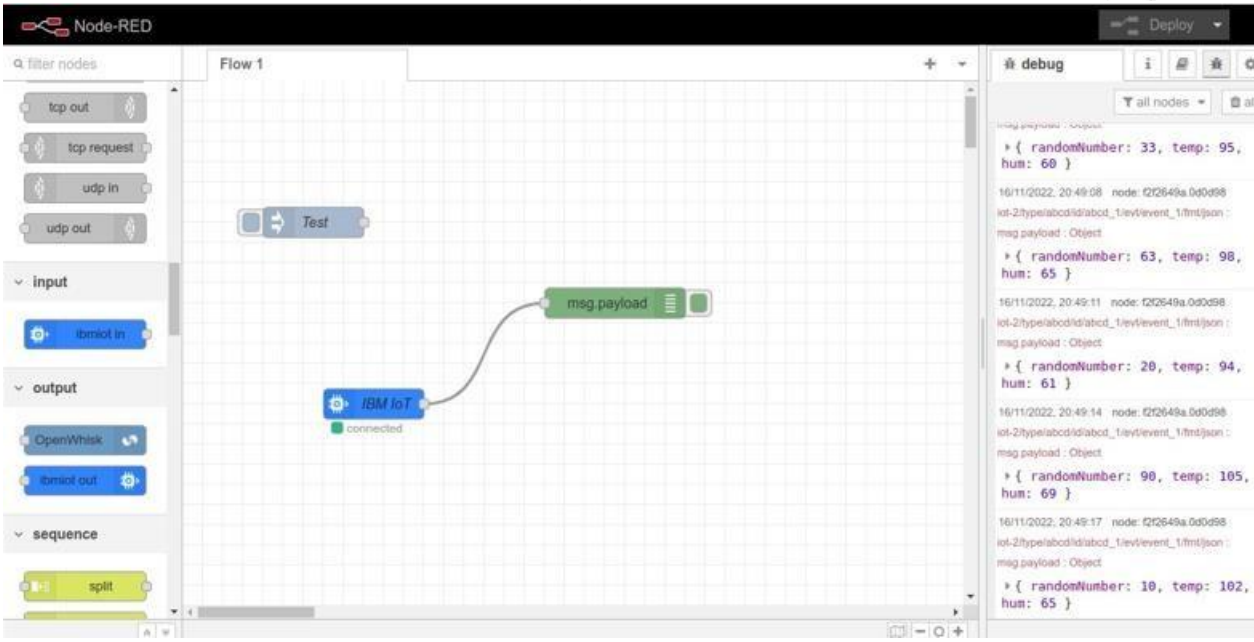
SPRINT OVERVIEW:

In order to implement the solution, the following approach as shown in the block diagram is used

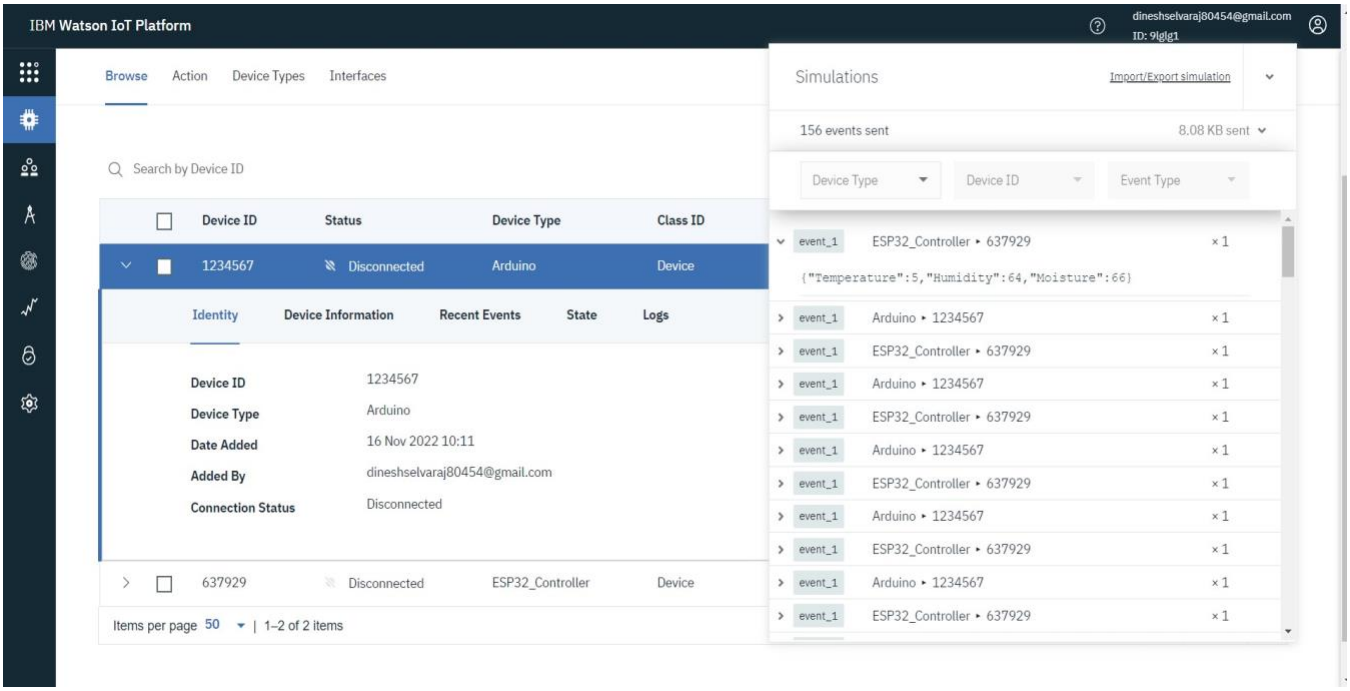


NODE RED


IBM Watson IoT Platform
dineshselvaraj80454@gmail.com
ID: 9lglg1
Browse
Action
Device Types
Interfaces
Add Device
Identity
Device Information
Recent Events
State
Logs
The recent events listed show the live stream of data that is coming and going from this device.
Event
Value
Format
Last Received
event_1
{"Temperature":65,"Humidity":3,"Moisture":57}
json
a few seconds ago
event_1
{"Temperature":31,"Humidity":66,"Moisture":36}
json
a few seconds ago
event_1
{"Temperature":41,"Humidity":96,"Moisture":18}
json
a few seconds ago
event_1
{"Temperature":93,"Humidity":69,"Moisture":45}
json
a few seconds ago
event_1
{"Temperature":41,"Humidity":40,"Moisture":96}
json
a few seconds ago
637929
Disconnected
ESP32_Controller
Device
16 Nov 2022 12:00
Items per page 50
1–2 of 2 items
2 Simulations running


Node-RED
Deploy
filter nodes
Flow 1
debug
all nodes
tcp out
tcp request
udp in
udp out
input
ibmiot in
output
OpenWhisk
ibmiot out
sequence
split
Test
msg.payload
IBM IoT
connected
{ randomNumber: 33, temp: 95, hum: 60 }
{ randomNumber: 63, temp: 98, hum: 65 }
{ randomNumber: 20, temp: 94, hum: 61 }
{ randomNumber: 90, temp: 105, hum: 69 }
{ randomNumber: 10, temp: 102, hum: 65 }

WATSON


IBM Watson IoT Platform
dineshselvaraj80454@gmail.com
ID: 9lglg1
Browse
Action
Device Types
Interfaces
Search by Device ID
Device ID
Status
Device Type
Class ID
1234567
Disconnected
Arduino
Device
Identity
Device Information
Recent Events
State
Logs
Device ID
1234567
Device Type
Arduino
Date Added
16 Nov 2022 10:11
Added By
dineshselvaraj80454@gmail.com
Connection Status
Disconnected
637929
Disconnected
ESP32_Controller
Device
Items per page 50
1–2 of 2 items
Simulations
Import/Export simulation
156 events sent
8.08 KB sent
Device Type
Device ID
Event Type
event_1 ESP32_Controller ▸ 637929 × 1
{"Temperature":5,"Humidity":64,"Moisture":66}
event_1 Arduino ▸ 1234567 × 1
event_1 ESP32_Controller ▸ 637929 × 1
event_1 Arduino ▸ 1234567 × 1
event_1 ESP32_Controller ▸ 637929 × 1
event_1 Arduino ▸ 1234567 × 1
event_1 ESP32_Controller ▸ 637929 × 1
event_1 Arduino ▸ 1234567 × 1
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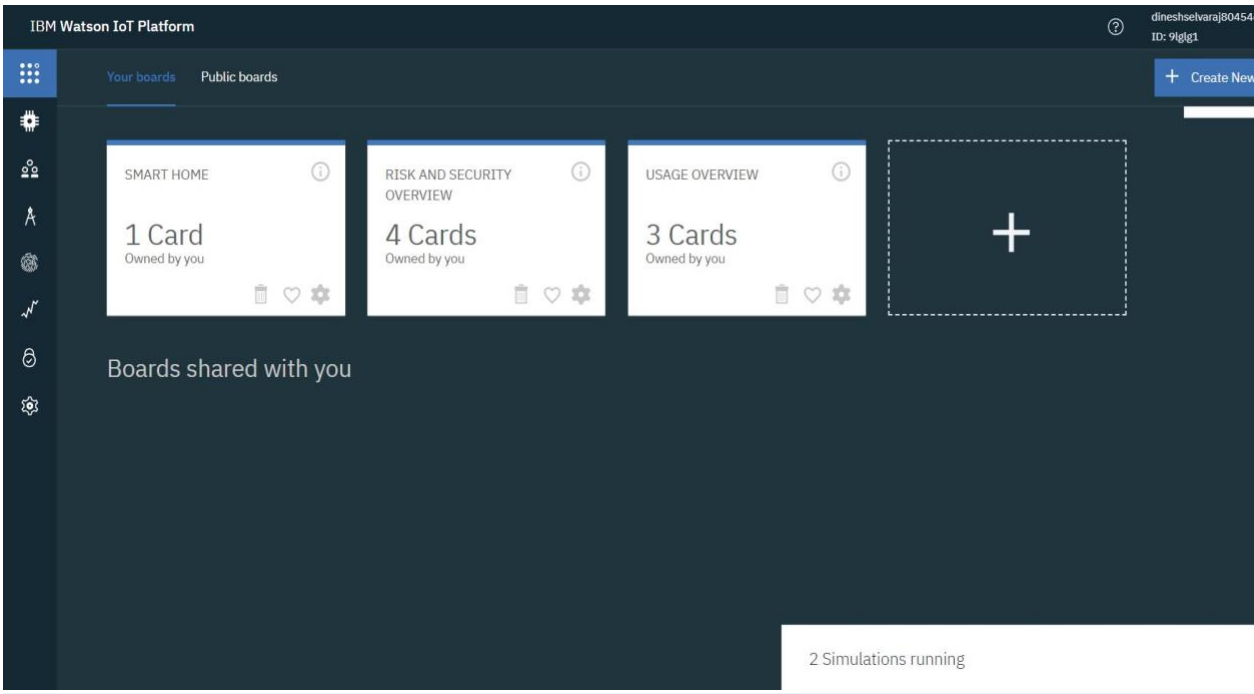
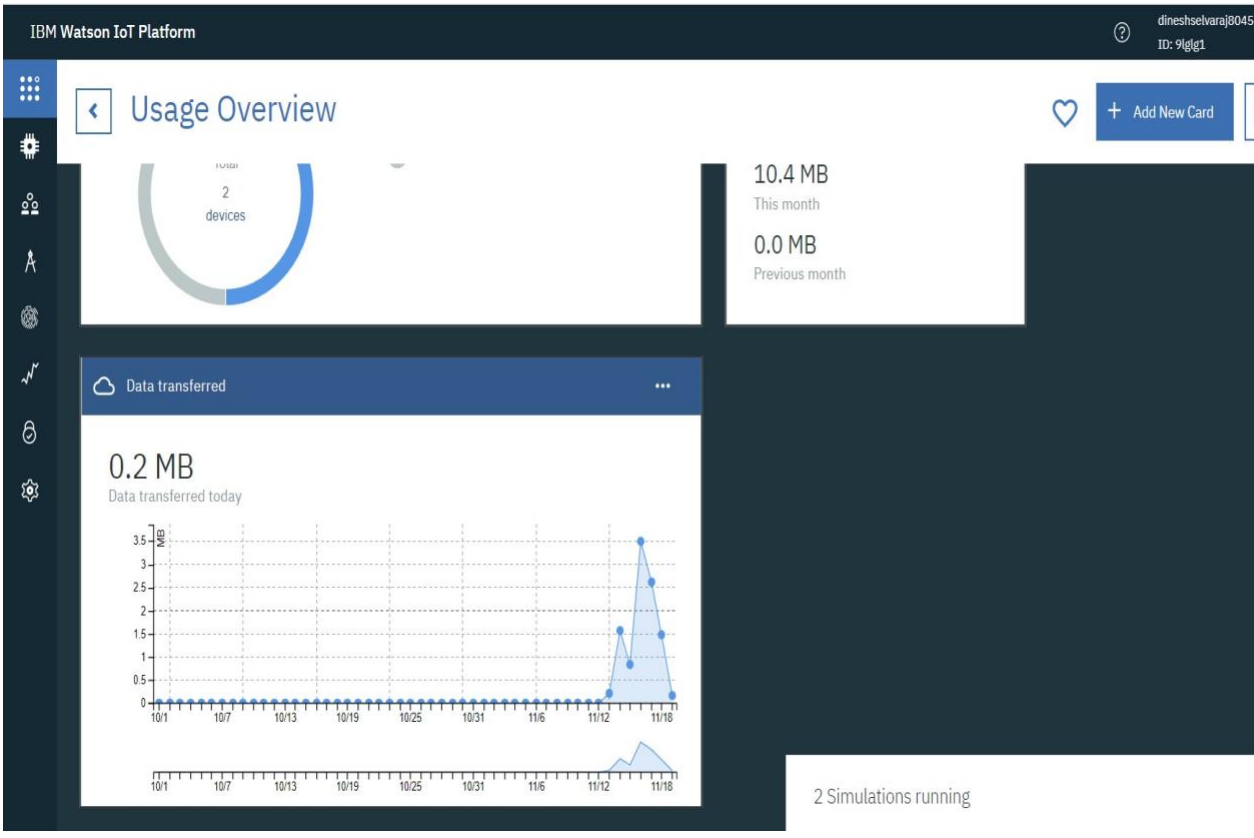
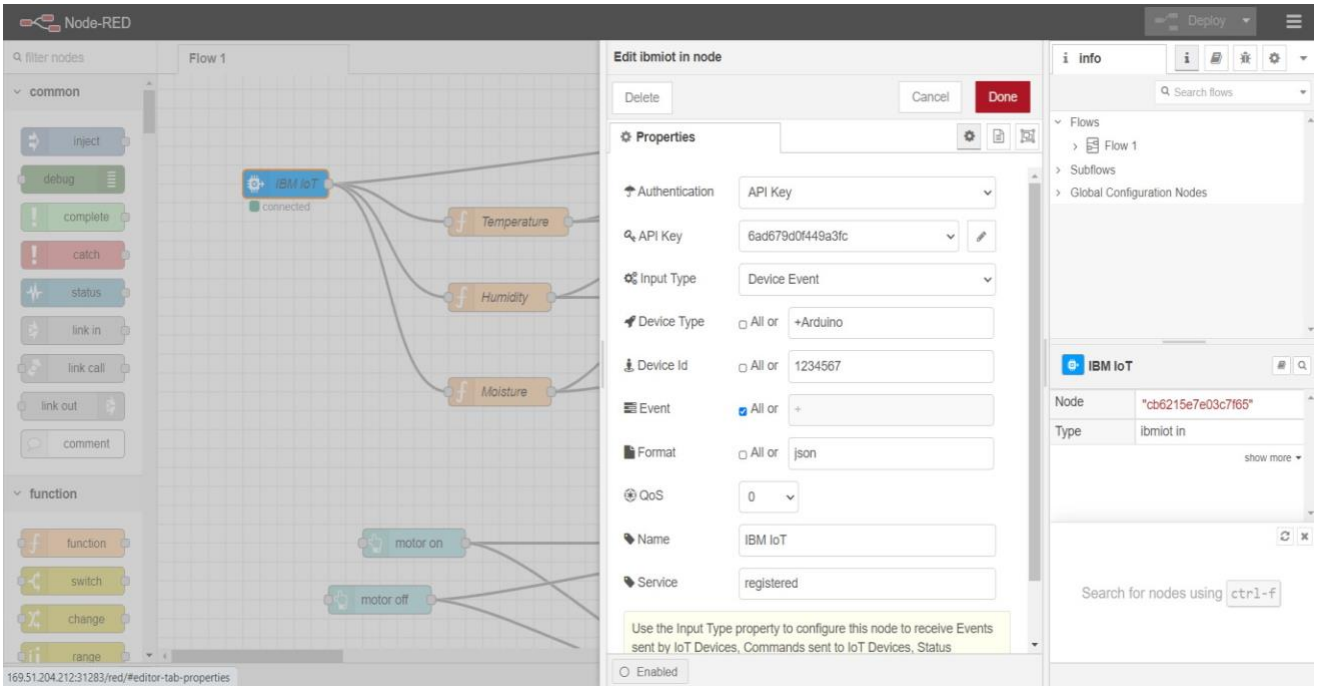
event_1 Arduino ▸ 1234567 × 1
event_1 ESP32_Controller ▸ 637929 × 1


IBM Watson IoT Platform
dineshselvaraj80454
ID: 9lglg1
Your boards
Public boards
Create New
SMART HOME
1 Card
Owned by you
RISK AND SECURITY OVERVIEW
4 Cards
Owned by you
USAGE OVERVIEW
3 Cards
Owned by you
Boards shared with you
2 Simulations running


IBM Watson IoT Platform
dineshselvaraj8045
ID: 9lglg1
Usage Overview
Add New Card
2
devices
10.4 MB
This month
0.0 MB
Previous month
Data transferred
0.2 MB
Data transferred today
MB
3.5
3
2.5
2
1.5
1
0.5
0
10/1
10/7
10/13
10/19
10/25
10/31
11/6
11/12
11/18
2 Simulations running

Configuration of Node-Red to send command to IBM cloud



Here we add two buttons in UI

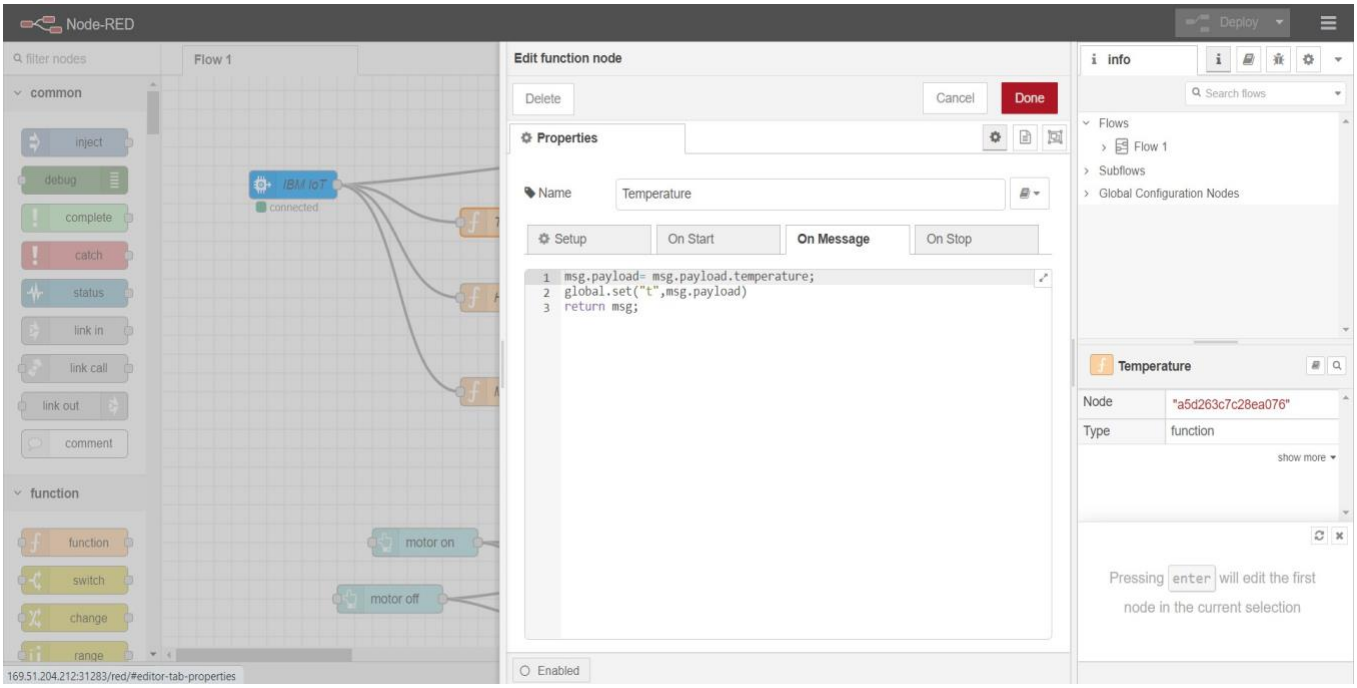
1) for light on 2)for light off

We used a function node to analysis the data recevied

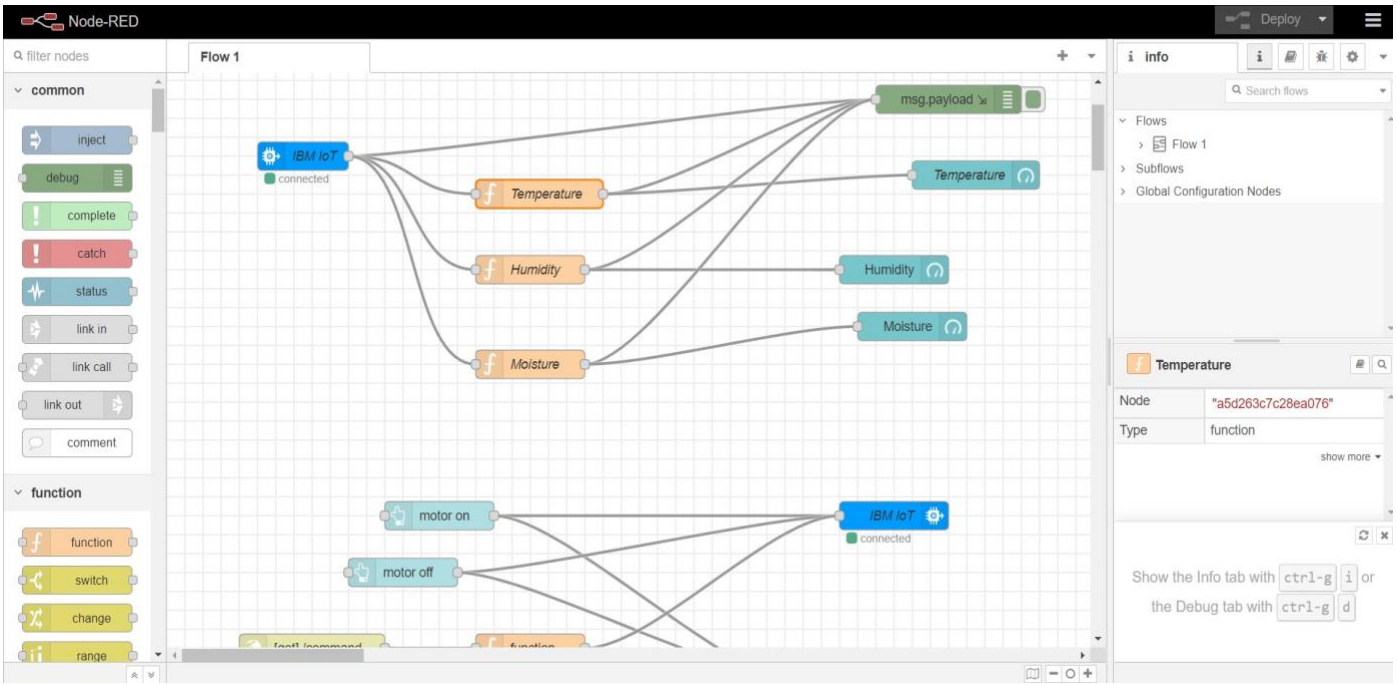
and assign command to each number Java scrip code

for the analyses is:

```
if(msg.payload==1)     msg.payload={"command":"ON"};
elseif(msg.payload==0)
msg.payload={"command":"OFF"};
```

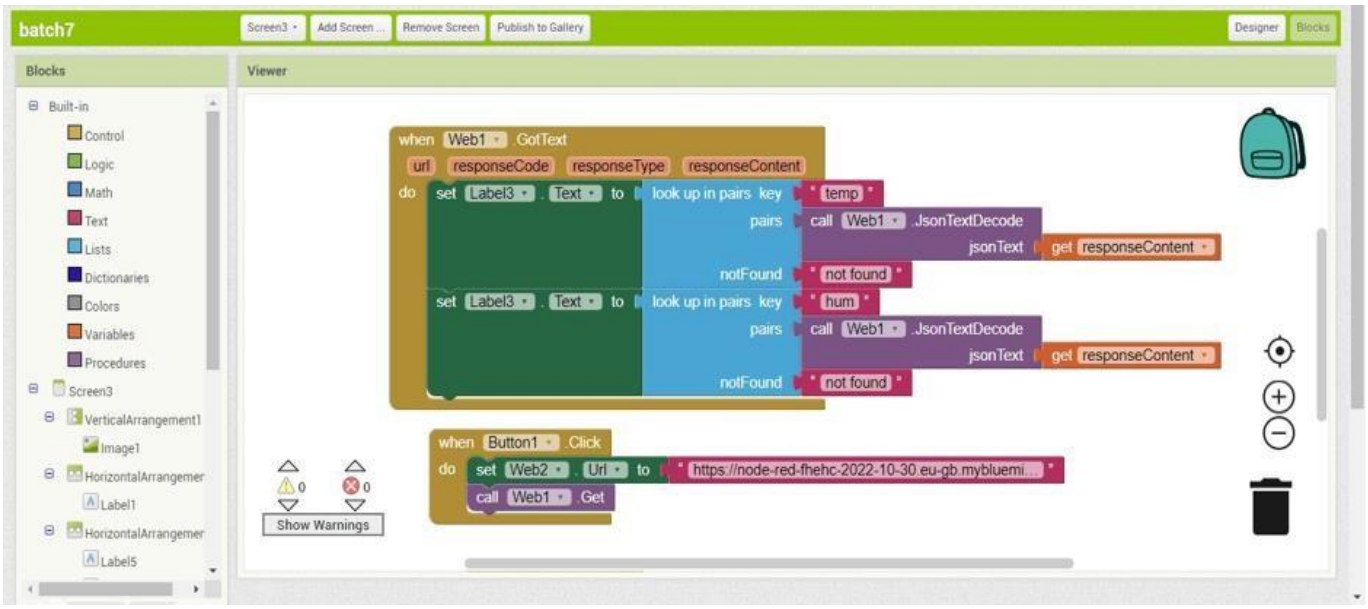


COMPLETE FLOW DIAGRAM:

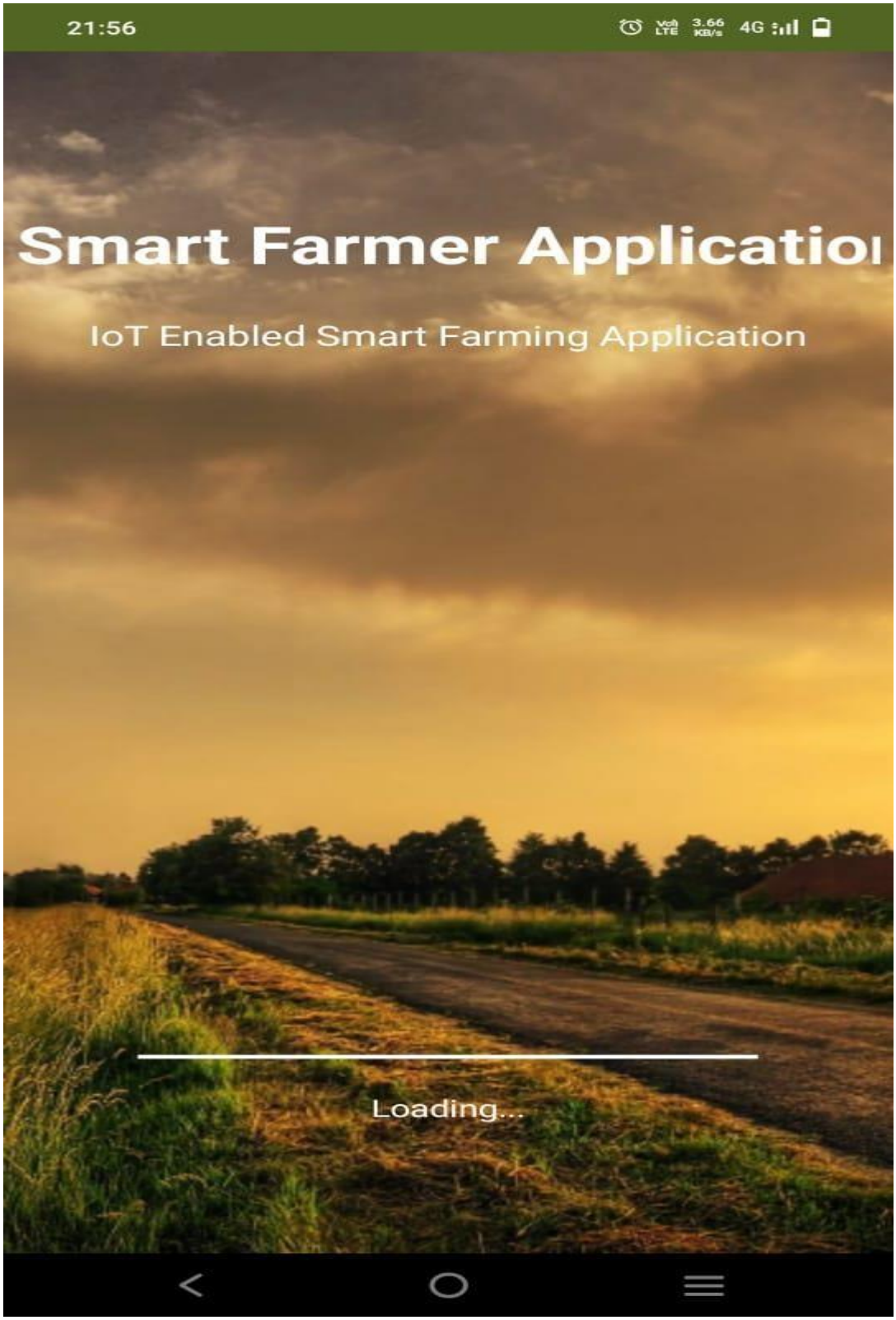


MOBILE APP WEB:

BLOCK DIAGRAM



SCREEN 1


21:56
Smart Farmer Applicatio
IoT Enabled Smart Farming Application
Loading...

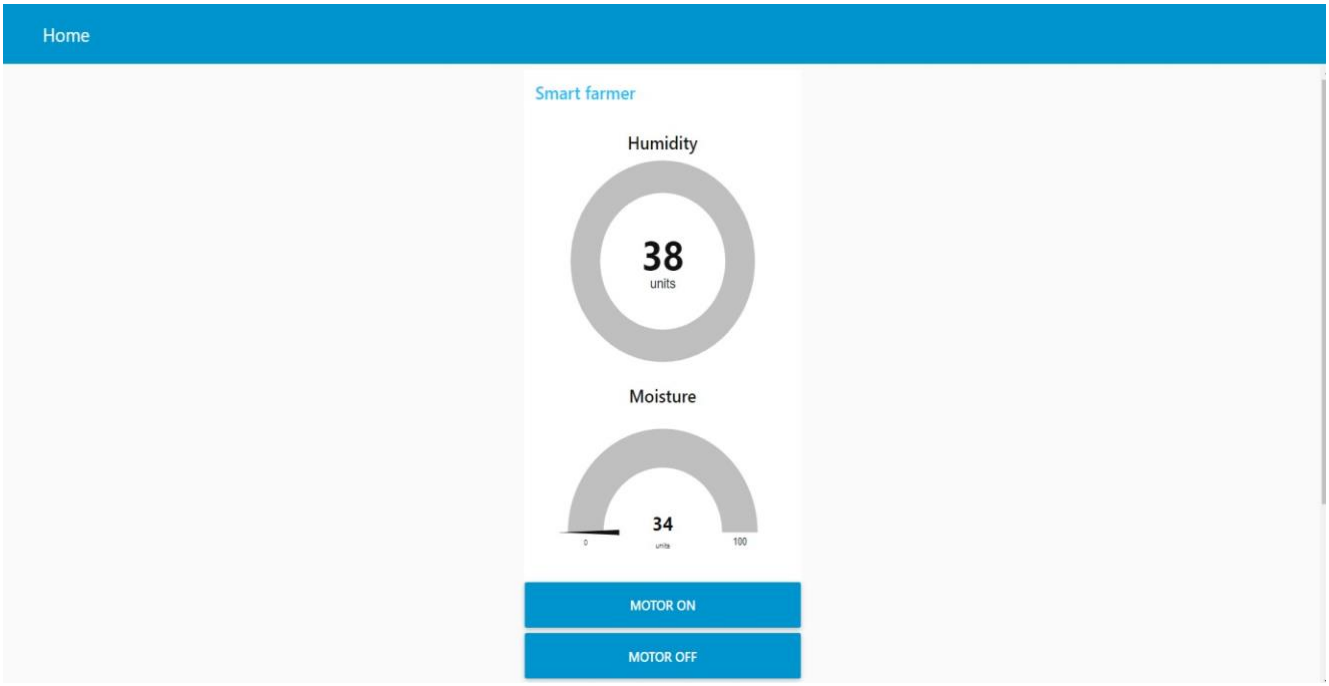
Humidity	41
Temperature	24
Moisture	34

Motor Switch ON/OFF

Coimbatore, Tamilnadu

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	2	High	Naren Krishna N A G (Leader)

Output



			confirming my password.			
Sprint-1	Login	UNS-2	As a user, I will Receive confirmation email once I have registered for the application	1	High	Dinesh S (Member 1)

6.2 Sprint Delivery Schedule

Sprint-2	User Interface	UNS-3	As a user, I can register for the application through Facebook	3	Low	Manoj N (Member 2)
Sprint-1	Data Visualization	UNS-4	As a user, I can register for the application through GMAIL	2	Medium	Manoj N (Member 2)

Sprint -2	Login	USN-2	As a registered user, I need to easily login log into my registered account via the webpage in minimum time	3	High	Naren Krishna N A (Leader)
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	Dinesh S (Member 1)

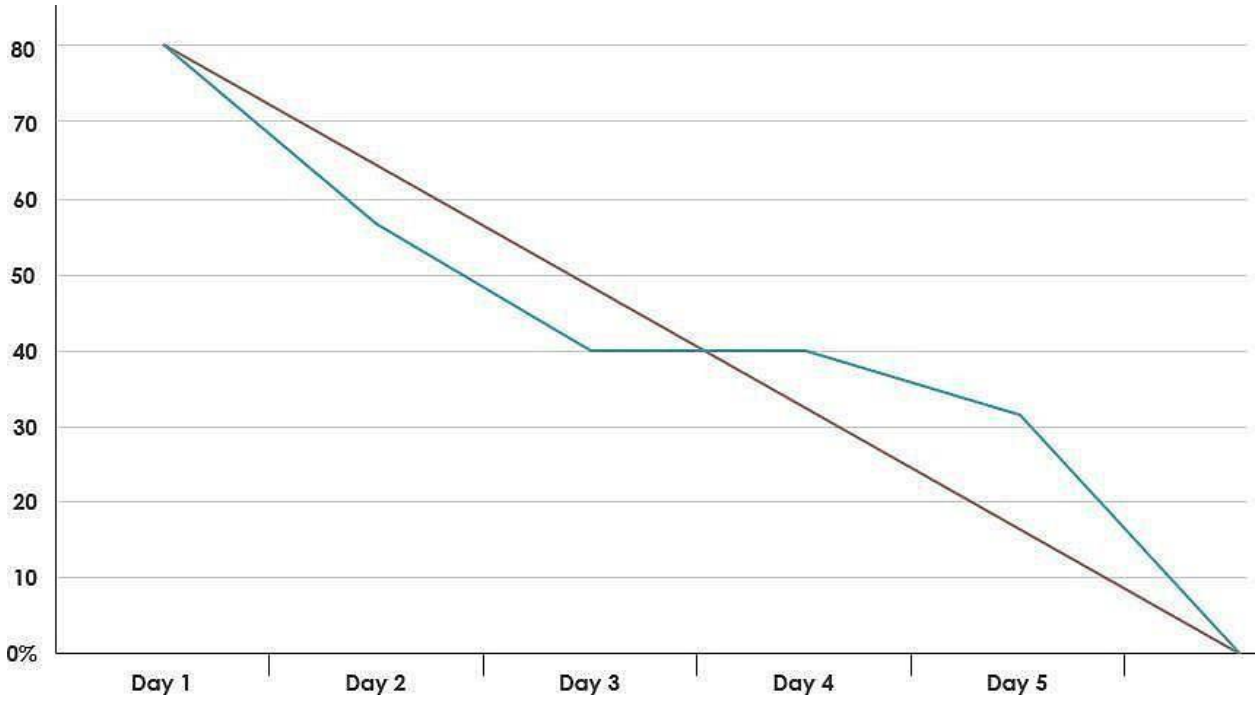
Sprint -1	Registration(Chemical Manufacturer - Web user)	USN-1	As a new user, I want to first register using my organization email and create a password for the account.	2	High	Anand Kumar S (Member 2)
Sprint -4	Login	USN-2	As a registered user, I need to easily log in using the registered accountvia the web page.	3	High	V.K.Oviya (Member 3)

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date(Planned)	Sprint Release Date(Actual)
Sprint1	12	6Days	24Oct2022	29Oct2022	29Oct2022
Sprint2	6	6Days	31Oct2022	05Nov2022	30OCT2022
Sprint3	6	6Days	07Nov2022	12Nov2022	6NOV 2022
Sprint4	6	6Days	14Nov2022	19Nov2022	7NOV 2022

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	Naren Krishna N A G (Leader)
Sprint -1	Login	USN -2	As a registered user,I need to easily log in to the application.	2	Low	Dinesh S (Member 1

Velocity:

AV for sprint 1= Sprint Duration /velocity =12/6=2AV for sprint 2= Sprint Duration/Velocity=6/6=1AV for Sprint 3=Sprint Duration/Velocity=6/6=1AVfor Sprint4=Sprint Duration/Velocity=6/6=1 **Burndown Chart:**



7 . CODING & SOLUTIONING

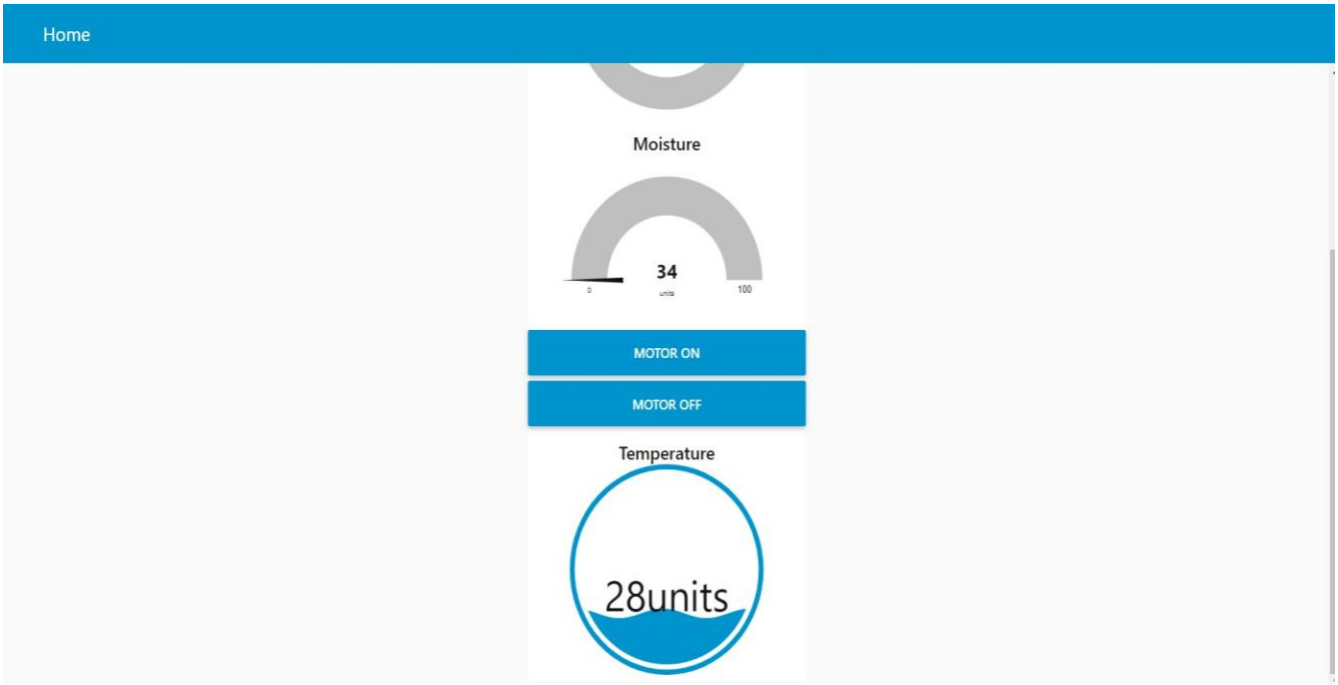
7.1 Feature 1

Receiving commands from IBM cloud using Python program

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

```
#Provide your IBM Watson Device Credentials organization
= " 9lglg1" deviceType = " Arduino"
deviceId = " 1234567"
authMethod = " use-token-
auth" authToken =
"123456789"

# Initialize GPIO


def myCommandCallback(cmd): print("Command
received: %s" % cmd.data['command'])
status=cmd.data['command'] if status=="lighton":
print ("led is on") else :
    print ("led is off")

  #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:
    #Get Sensor Data from DHT11

    temp=random.randint(0,100)
    Humid=random.randint(0,100)

    data = { 'temp' : temp, 'Humid': Humid }
    #print  data                 def
myOnPublishCallback():
       print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid,
"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

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

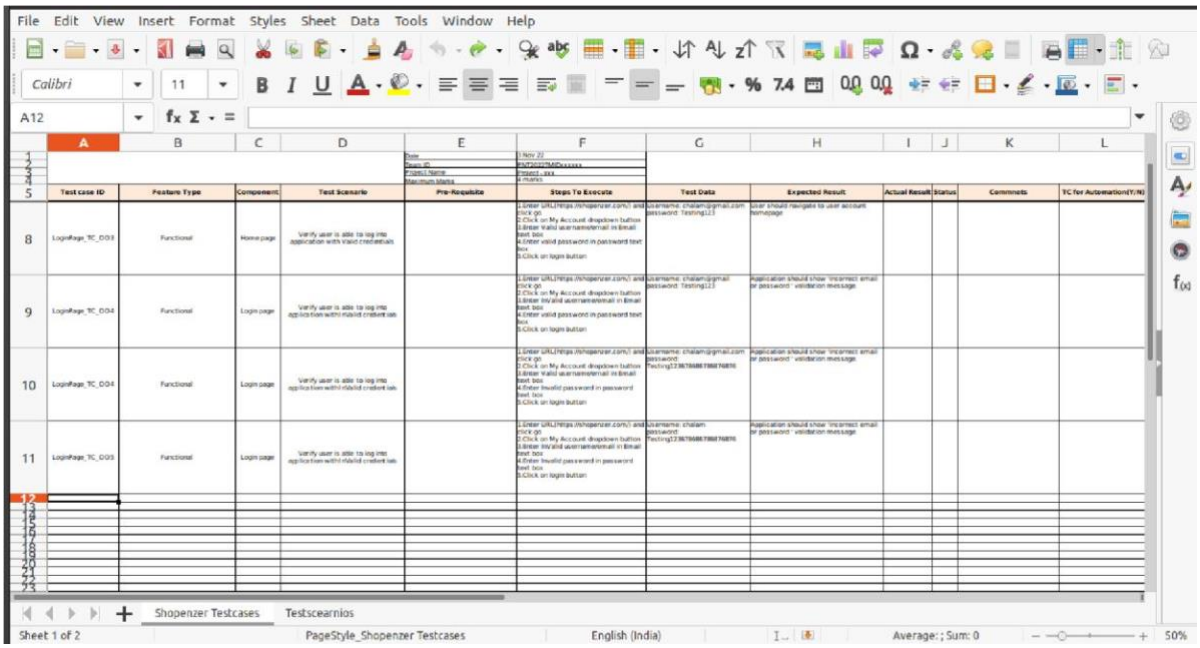

Home
Moisture
34
0
units
100
MOTOR ON
MOTOR OFF
Temperature
28units

7.2 Feature 2


Python 3.7.0 Shell
File 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
Type "copyright", "credits" or "license()" for more information.
>>>
====== RESTART: C:\Users\Admin\Downloads\ibmiotpublishsubscribe (1).py ======
2022-11-17 22:37:40,636 ibmiotf.device.Client INFO Connected successfully: d:xmscv:fireboard:123
Published Temperature = 2 C Humidity = 91 % to IBM Watson
Published Temperature = 12 C Humidity = 41 % to IBM Watson
Published Temperature = 57 C Humidity = 79 % to IBM Watson
Published Temperature = 83 C Humidity = 22 % to IBM Watson
Published Temperature = 71 C Humidity = 35 % to IBM Watson
Published Temperature = 73 C Humidity = 93 % to IBM Watson
Published Temperature = 100 C Humidity = 79 % to IBM Watson
Published Temperature = 23 C Humidity = 53 % to IBM Watson

8.Testing

8.1Test Case



8.2 User Acceptance Testing

1. Purpose of Document

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

2. Defect Analysis

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

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

3. Test Case Analysis

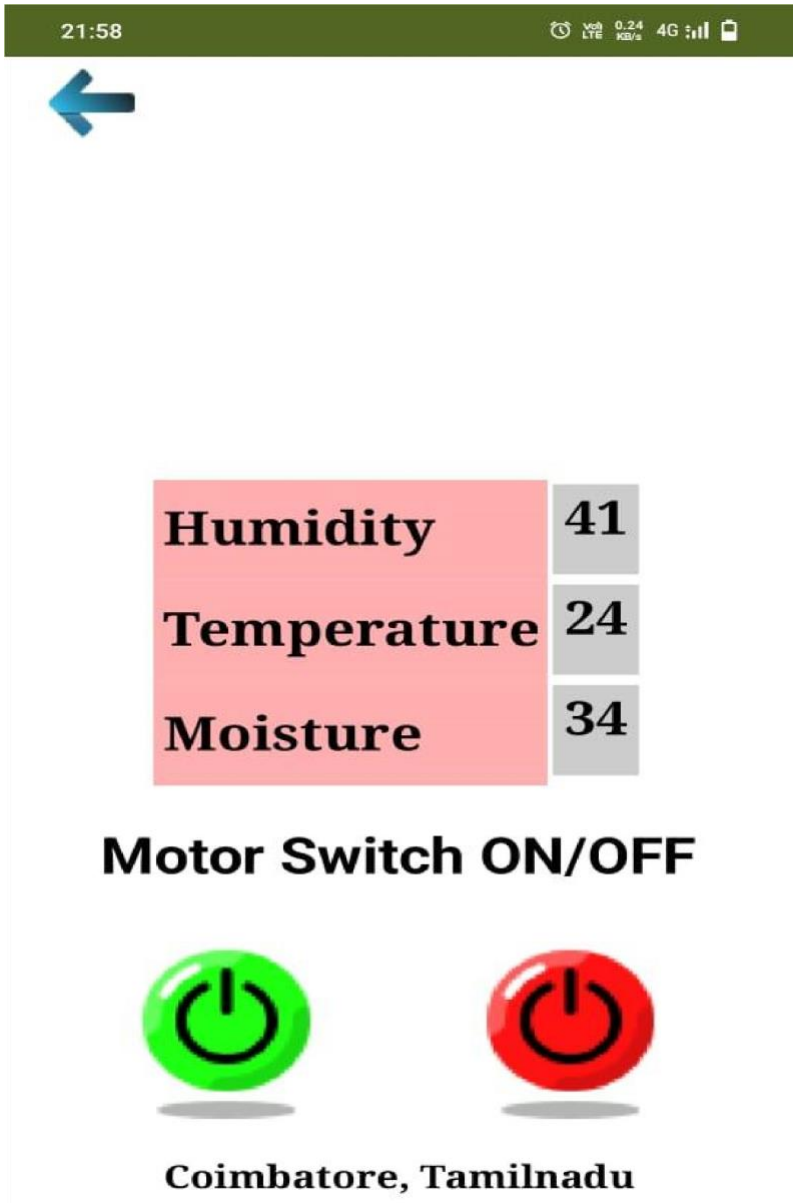
This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Outsource Shipping	3	0	0	3

Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

9.Result

9.1 Performance Metrics




"Python 3.7.0 Shell"
File 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
Type "copyright", "credits" or "license()" for more information.
>>>
====== RESTART: C:\Users\Admin\Downloads\ibmiotpublishsubscribe (1).py ======
2022-11-17 22:37:40,836 ibmiotf.device.Client INFO Connected successfully: d:mscv4:iotdevice123
Published Temperature = 2 C Humidity = 54 % to IBM Watson
Published Temperature = 12 C Humidity = 41 % to IBM Watson
Published Temperature = 17 C Humidity = 79 % to IBM Watson
Published Temperature = 83 C Humidity = 32 % to IBM Watson
Published Temperature = 71 C Humidity = 35 % to IBM Watson
Published Temperature = 73 C Humidity = 93 % to IBM Watson
Published Temperature = 100 C Humidity = 79 % to IBM Watson
Published Temperature = 23 C Humidity = 53 % to IBM Watson

10.Advantages & Disadvantages **Advantages:**

i)Farms can be monitored and controlled remotely.

ii)Increase in convenience to

farmers. iii)Less labour cost.

iv)Better standards of living.

Disadvantages:

i)Lack of internet/connectivity issues.

ii)Added cost of internet and internet gateway infrastructure.

iii) Farmers wanted to adapt the use of Web App.

11.Conclusion

Thus the objective of the project to implement an IoT system in order to help farmers to control and monitor their farms has been implemented successfully.

12. Future Scope

Through collecting data from sensors using Iot devices, you will learn about the realtime state of your crops. The future of Iot in agriculture allows predictive analytics to help you make better harvesting decisions.InShot_20221118_112302897

Smart farming refers to managing farms using modern Information and communication technologies to increase the quantity and quality of products while optimizing the human labour required. Among the technologies available for present-day farmers are: Sensors: soil, water, light, humidity, temperature management.

IOT TECHNOLOGIES IN AGRICULTURE. Iot smart agriculture products are designed to help monitor crop fields using sensors and by automating irrigation systems.

As a result, farmers and associated brands can easily monitor the field conditions from anywhere without any hassle.

13. Appendix

Source code :

https://drive.google.com/drive/folders/1qEx536WIRNiwjeQ6K_3NX_Oyf1gyff9y **Links:**

IBM cloud reference: https://cloud.ibm.com/

Github link : https://github.com/IBM-EPBL/IBM-Project-47258-1660797751

Demo Link : https://github.com/IBM-EPBL/IBM-Project-472581660797751/tree/main/Final%20Deliverables