SMARTFARMER - IOT ENABLED SMART FARMING APPLICATION

1. INTRODUCTION

1.1 Overview:

The backbone of a nation's economic development is agriculture. For the benefit of the future, major scientific developments have recently been applied in a variety of agricultural domains. Despite many studies, accurate evaluation and productivity couldn't be achieved. The IOT Technology and system accessibility that draw in these things are being used by the Agriculture Parameters to gather and distribute information. In addition to acknowledging improved capacity, precision, and financial interconnected preferred stance, the IOT enables things to be selected recognised or potentially forced remotely across existing configuration. It also creates open gateways for all additional obvious merge of the substantial earth into PC-based frameworks. IOT specifically changes into an instance of the all-encompassing category of electronic physical structures when it is expanded with sensors and actuators, which also includes advances like smart grids, beautiful residences, intelligent movement, and smart urban communities.

1.2 Purpose:

We have made an effort to concentrate on several scientific applications that can be combined in the agricultural sector to improve accuracy and productivity while requiring less labour. We also provide a method to monitor agricultural fields from any remote point and evaluate the fundamental state of the farm. This project was inspired by the farmers whose livelihoods in agricultural areas depend entirely on the rain and irrigation from bore wells. Farmers have been irrigating the ground manually in recent years by manually turning the water pump ON/OFF as needed. This practise allows farmers to irrigate the land at regular intervals.

2.LITERATURE & PROPOSED SOLUTION

2.1 Existing Map Canvas

Our country's foundation is horticulture. In the distant past, agriculturalists determined the soil's ripeness and impacted assumptions to develop the type of product. They neglected to consider factors that would have made farming more difficult, such as moisture content, water level, and notably climate conditions. They use pesticides because of some suspicions, which could have a real influence on the crop production if the suspicions are incorrect. The final stage of the crop, which agriculturalists depend on, determines profitability.

2.2 References

1.https://smartinternz.com/assets/docs/Smart%20Home%20Automation%20using%20IBM%20cloud%20Services%20(1).pdf

2.https://smartinternz.com/assets/docs/Smart%20Home%20Automation%20using%20IBM%20cloud%20Services%20(1).pdf

3. https://openweathermap.org/

4.https://smartinternz.com/assets/docs/Sending%20Http%20request%20to%20Open%20weather%20map%20website%20to%20get%20the%20weather%20forecast.pdf

5. https://www.youtube.com/watch?v=cicTw4SEdxk

6.https://smartinternz.com/assets/docs/Smart%20Home%20Automation%20using%20IBM%20cloud%20Services%20(1).pdf

2.3 Problem Statement Definition:

Statement:

The proposed system collects information about different agricultural parameters(temperature, humidity) using an IoT sensor. These values collected are then sent over the mobile. Farmers can view all the parameters required for a smart farming system through the webpage.

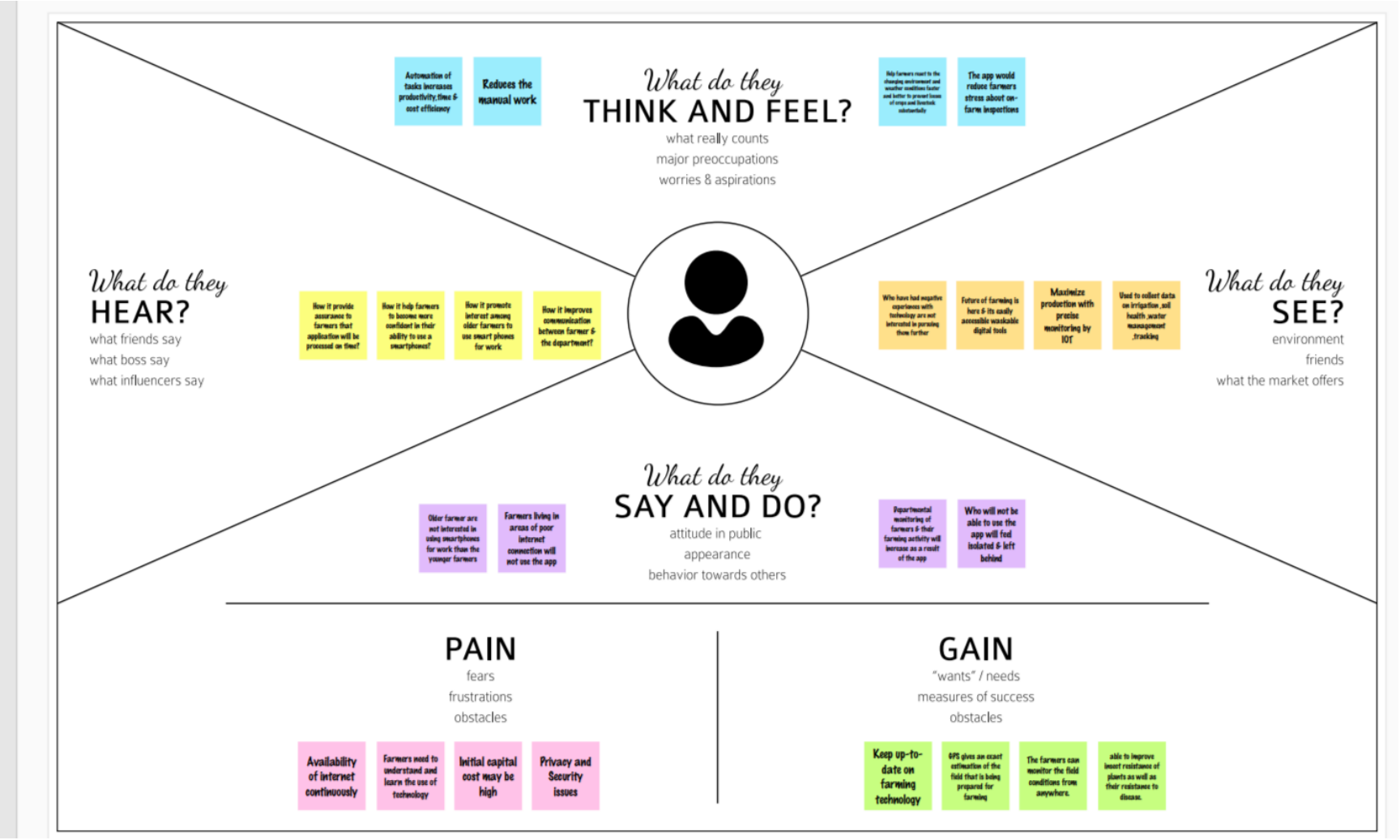
Definition:

The modern agricultural methods allow the use of sophisticated systems to be implementeed for the betterment of job quality and increasing productivity. Such systems can provide a helping hand to the farmers and give them a chance to grow.

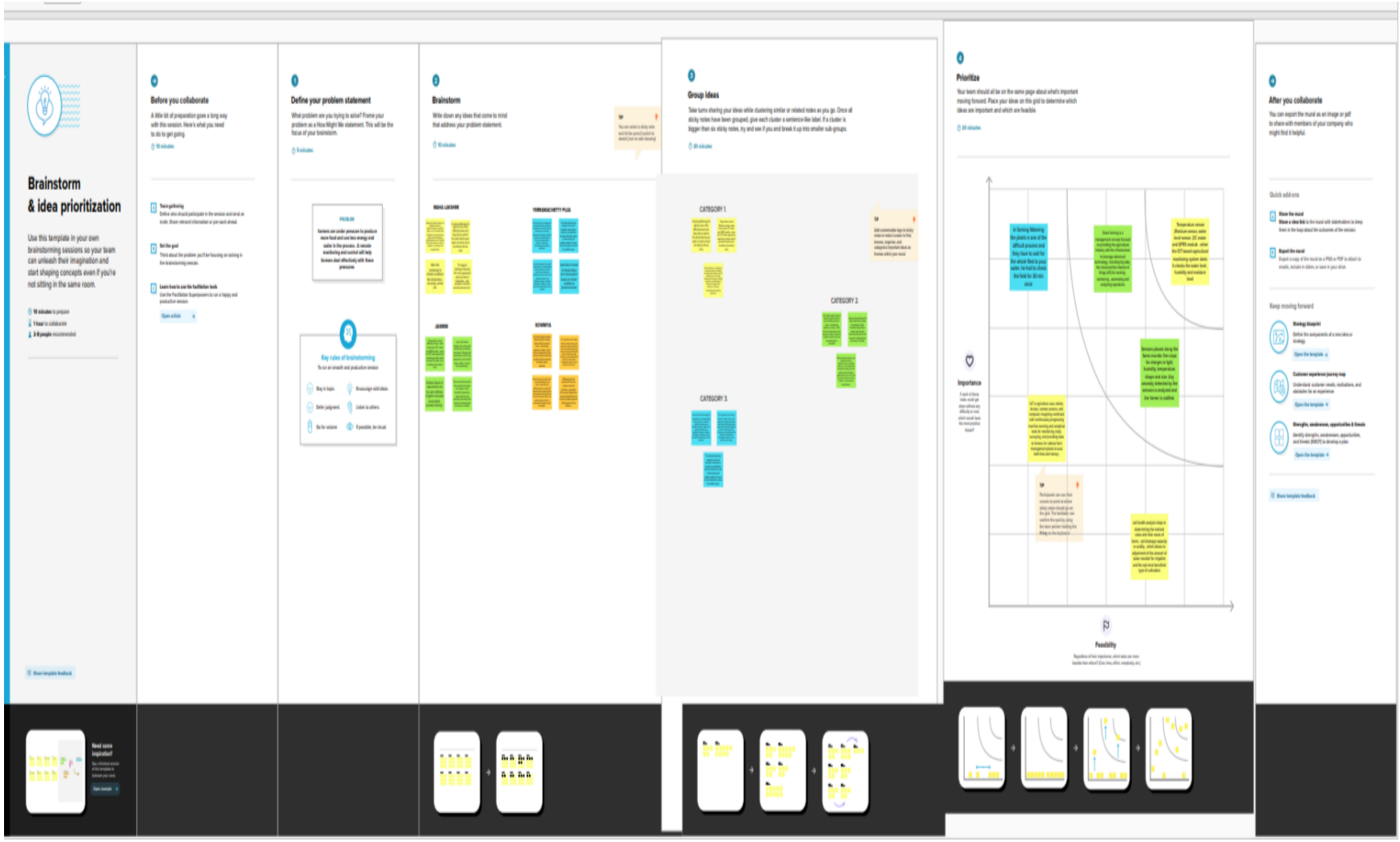
The proposed "Smart Farming" collects information about different agricultual parameters (temperature, humidity) using wireless sensor networks. These values collected are then sent over the mobile. All the values required by farmers for smart farming are viewing on the webpage which is stored in the databases. The system also facilitates the controlling of pump motors through IoT. This facility helps farmers to turn the motor in their farm on or off at any time.

3. IDEATION & PROPOSED SOLUTION:

3.1 Empathy Map Canvas:



3.2 Ideation & Brainstorming:

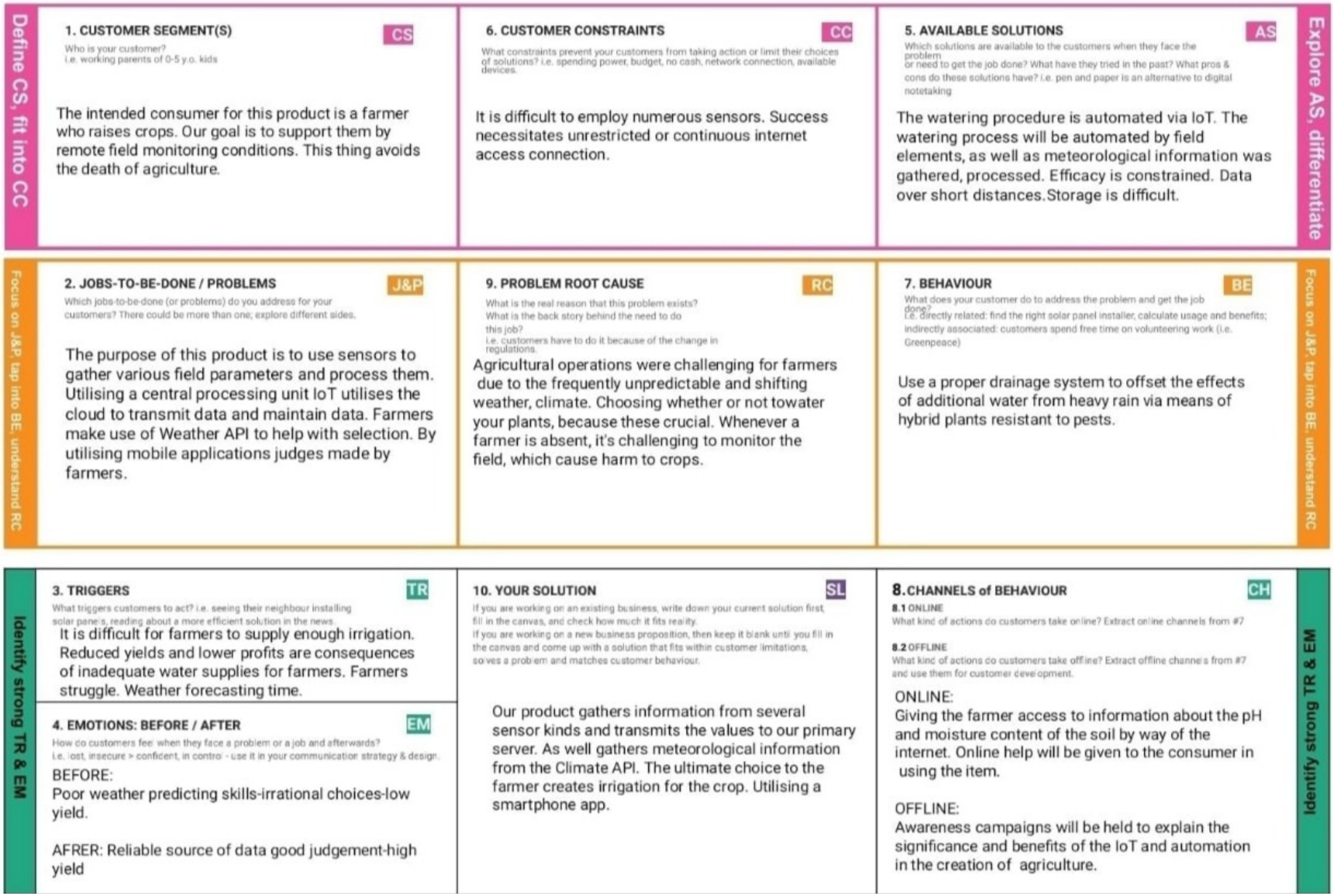


3.3 Proposed Solution: -

S. NO	Parameter	Description
1	Problem Statement (Problem to be solved)	● Farmers often findit difficult to dotheirpersonal tasks while monitoring the field. ● Farmers spend extra time watering their fields becausethey have to waitfor the water to completely cover theentire area. ● Farmers also need to be aware of thesoil's moisture, temperature, and humidity levelsbecause these factorshave an impacton plant development and crop yield. ● The motor's powerconsumptionprocedure. Only occasionally is electricity available in communities
2	Idea / Solution description	● Description of an idea or solution • By using sensors to gather data on temperature, humidity, soil moisture,and other variables and providing that data to farmers, we can simply improve plant productivity. ● Precision farming uses drones to monitor crop status and identify which crops need nutrients and water, among other things. We canuse timecontrol systems to turn onand off motors and irrigation systems

3	Novelty / Uniqueness	Remote access: ● It enables farmers to remotely turnonand off irrigation systems and motors. Alert messages; ● IOT sensors, such as those that measure temperature, humidity, soil moisture, and motion, gather **data** from the farming environment andpass it to a controller unit(such as an Arduino UNO) so that it can besent to a communication device to reach the farmers (customer).
4	Social Impact/ Customer Satisfaction	● It frequently savestime. ● It lessens therequirement foradditional labour. ● It has thepotential to boostproduction efficiency. ● Offerhealthy, organic foods. ● IoT can also boost salesin e-commerce businesses. ● It createsa prosperous society.
5	Social Impact/ Customer Satisfaction	Revenue (No.of Users vs Months)
6	Scalability of the Solution	● Scalability in smartfarming refers toa system's abilityto expand its capacity, such as the number of technological components like sensors and actuators, while allowing for prompt analysis.

3.4 Problem Solution fit: -



4.REQUIREMENT ANALYSIS:

4.1 Functional Requirements:

Following are the functional requirements of the proposedsolution.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Gmail
FR-2	User Confirmation	Confirmation via EmailConfirmation via OTP
FR-3	Log in to system	Check Roles of Access CheckCredentials
FR-4	Manage Modules	Manage System AdminsManage Roles of User ManageUser permission
FR-5	Check whether details	Temperature detailsHumidity details
FR-6	Log out	Exit

4.2 Non-functional Requirements:

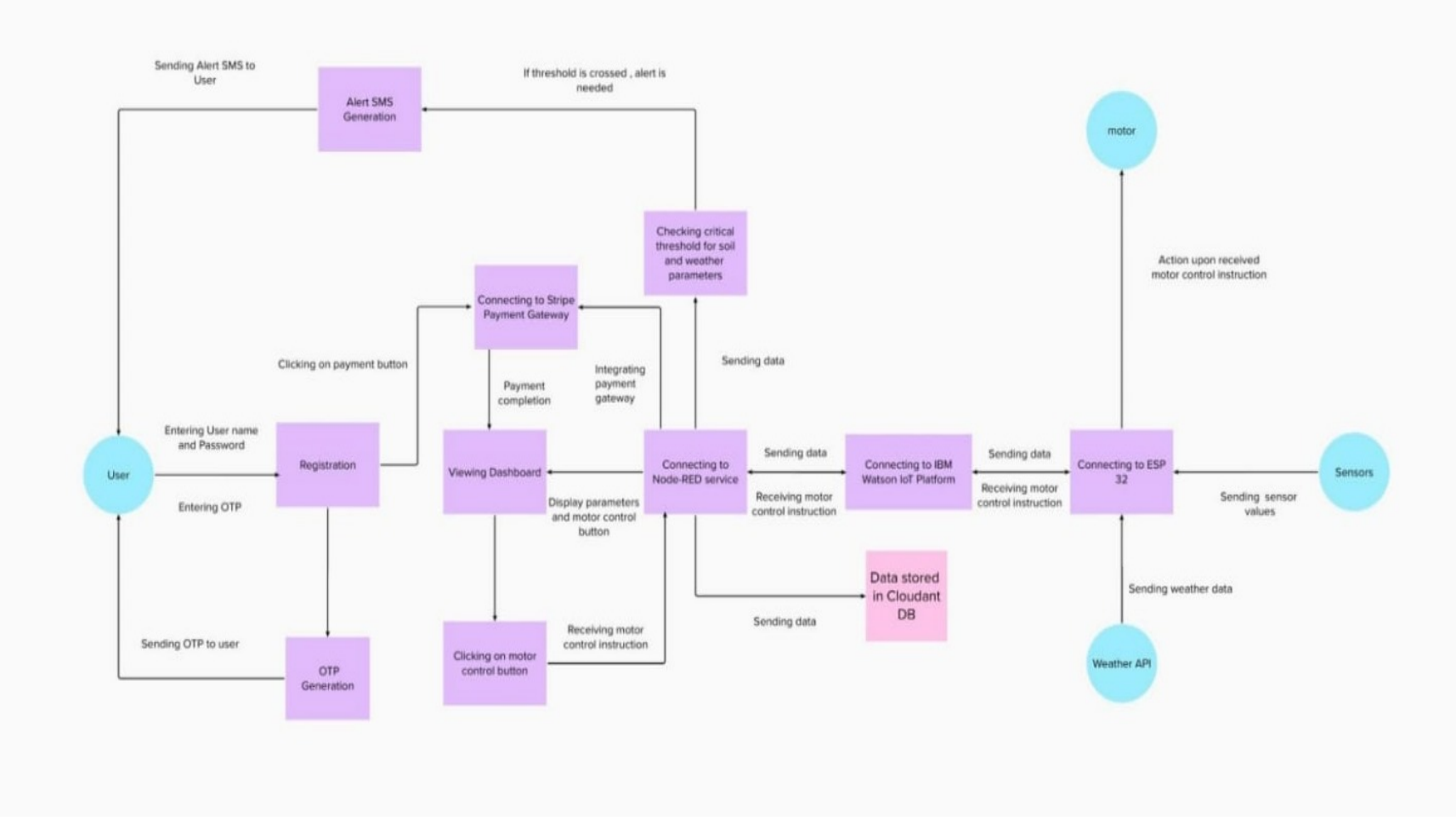
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability is the capacity to pick something up fast, utilise it efficiently, retain it, use it without making amistake, and enjoyit.
NFR-2	**Security**	Information that is private or confidential must always be kept secure, including when beinggathered, processed, and stored.
NFR-3	**Reliability**	With shared protection, a better cost-to-reliabilitytrade-off is realised. The strategy makes use of specialised and sharedprotective techniques to prevent interruptions in agricultural service.
NFR-4	**Performance**	If integrated sensors are employed to monitor soil and environmental features, farming operations will be monitored more successfully overall.
NFR-5	**Availability**	It is possible to automatically change temperature, humidity, and other aspects of farming equipment by connecting data about crops,weather, and equipment.
NFR-6	**Scalability**	Scalability for IoT platforms is a significant concern.It has been shown that different architectural choicesmade for IoT platforms affect the scalability of the system and that automatic real-time decision-makingis feasible evenin a situation with a large number

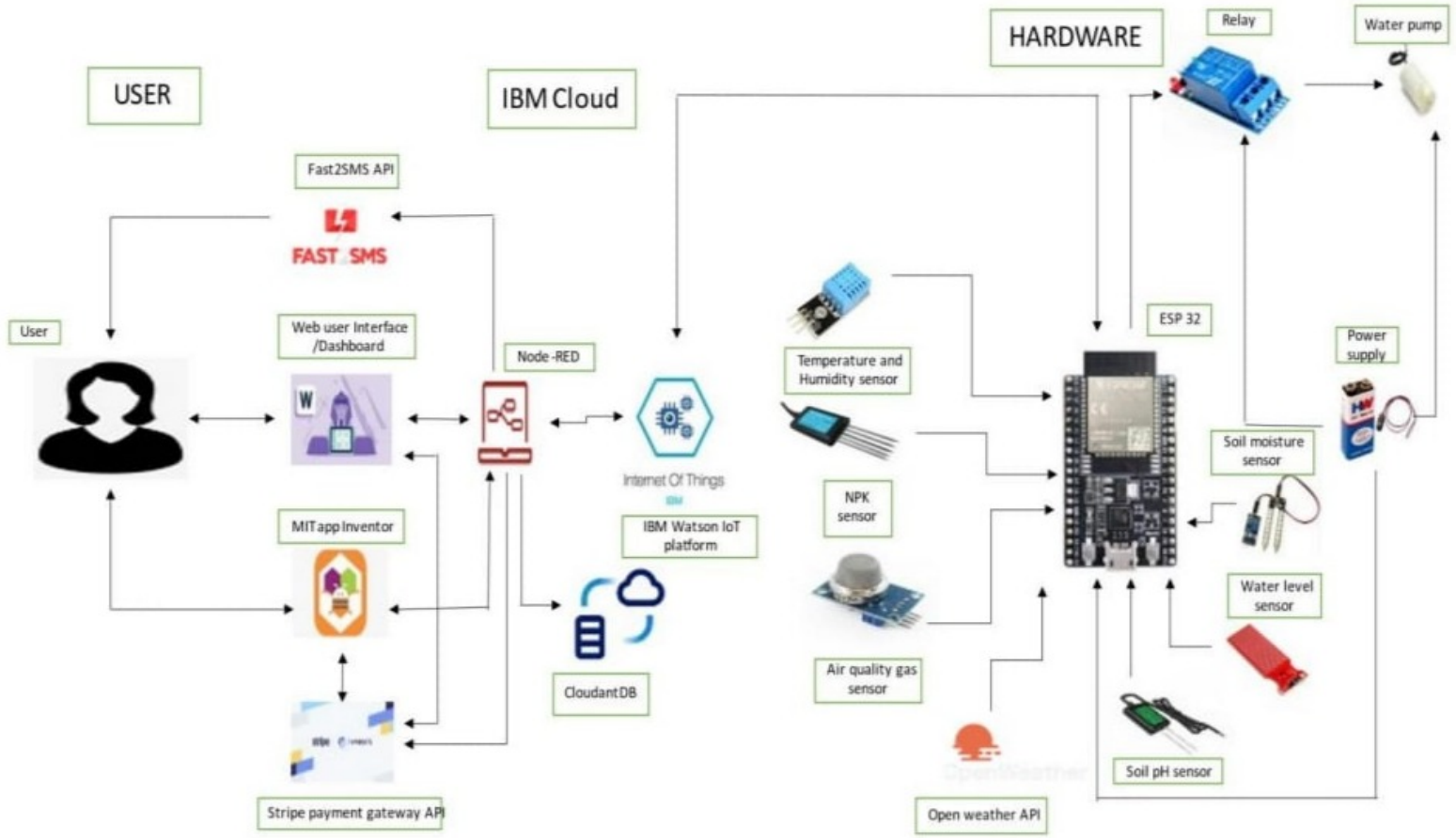
		of users

5.PROJECT DESIGN:

5.1 Data flow Diagram



5.2 Solution & Technical Architecture:



1. Different sensors and APIs are used to sense the various soil and environmental factors (temperature, humidity), which are then connected to an ESP32,from which the obtained value is sent over MQTT to IBM's cloud.

2. A web application or mobile application made with MIT App Inventor collects data via MQTT, allowing a farmer to monitor theparameters even when the farmer is far from his field and utilizingFast2SMS to send the farmer important alert messages.

3. One of the most important duties for farmers is watering the crops,and they may decide whether to water the crops now or later by keeping an eye on the sensor parameters and managing the motor pumps directly from the mobileor online application using MQTT.

4. Node-RED is a flow-based programming tool that is used to wire and connect hardware, APIs, and online services together. In the design,coordination is carried out between applications (web andmobile), hardware (ESP32, sensors and actuators), and services (SMS).

Table-1: Components & Technologies:

S.No	Component	Technology	Description
1.	User Interface-1	NodeRED Dashboard	NodeRED dashboard is utilized to display values from the IBM Watson IoT Platform, from which the user can note sensor values and run motors.
2.	User Interface-2	MIT App Inventor	The user can note sensor values and operate a motor by applying a mobile application that shows values from the IBM Watson IoT platform.
3.	Hardwarecomponent-1	ESP32 board (ESP32 Devkit V1),C++	ESP32 board (ESP32 Devkit V1),C++ Sensor values are sent to the IBM Watson IoT Platform, and operations are performed via button clicks in the user interface.
4.	Hardware component -2	Waterlevel Sensor (FS-37A)	used to measure the water level in a container where water is dispensed
5.	Hardwarecomponent-3	Soil pH sensor	Soil pH sensor used to determine soil acidity using the pH level of the soil
6.	Hardware component-4	Soil moisture sensor (AR 605)	Soil moisture sensor (AR 605) utilized to calculate the volumetric water content of

			soil
7.	Hardwarecomponent-5	Temperatureand Humidity sensor (DHT 11)	used to measure the humidity and of the environment
8.	Hardware component-6	NPK sensor	used to estimate soil fertility by measuring nutrients in soil such as nitrogen, phosphorus, and potassium.
9.	Hardwarecomponent-7	Airquality gas sensor (MQ135)	used to identify airborne pollutants including smoke, CO2, and ammonia
10.	Hardwarecomponent-8	Relay	used to boost the output of an ESP32 with an external power supply in order to power a pump.
11.	Hardwarecomponent-9	Water pump (EK1893)	used to release water from a container and hydrate soil
12.	Hardwarecomponent-10	Power supply (5V battery)	used to supply the ESP32 board and the Relay with electricity
13.	Application Logic-1	IBM Watson IoT Platform	The IBM Watson IoT platform collects data from the devices handles device connections, and aids in the development of software applications.
14.	Application Logic-2	Node RED Service, NodeJS	The NodeRED service offers a means to analyze data acquired, present information online, and use APIs to integrate external

			services and communicate with mobile applications.
15.	Cloud Database	IBM Cloudant DB	Sensor data is kept in a cloud database service.
16.	External API-1	Fast2SMS API	enables the farmer to receive warnings when a sensor parameter value threshold is reached
17.	External API-2	OpenWeather API	used to offer analysis with precise local weather information such as temperature, humidity, pressure, wind speed, etc.
18.	External API-3	Stripe Payment Gateway API	uses a single API to take a multitude of payment methods for subscription payments.

Table-2: Application Characteristics:

S. No	Characteristics	Technology	Description
1.	Open-SourceFrameworks	Fast2SMSAPI, OpenWeather API,Stripe Payment gatewayAPI	Describe the utilized open-source frameworks.

2.	Security Implementations	Twostep authentications (Password and OTP)	List every security and access control measure used, including firewalls.
3.	ScalableArchitecture	3 tierarchitecture	User interface, cloud services, and hardware are all implemented using a three-layer design.
4.	Availability	IBM WatsonIoT Platform, IBM loadbalancer	The IoT platform offers global application availability so that users can remotely access data from anywhere in the world. A load balancer balances the availability of information for several users at once.
5.	Performance	IBMWatson IoT Platform, MQTT, ESP32 Board	The usage of MQTT for data transfer aids in maximizing data transfer performance, and the use of the multi-core, fast-processing ESP32 processor aids in offering high performance.

5.3 User Stories:

User Type	Functional Requirement	User Story No	User story/Task	Acceptance Criteria	Priority	Release
Customer(Mobile User)	Registration	USN-1	As a user, I can register for application by entering my email, mobile number, password, and confirming my password.	I can access my account/dashboard	High	Sprint-2
		USN-2	As a user, I will receive OTP	I can authenticate my account by submitting the OTP.	High	Sprint-2
		USN-3	As a user, I can register for the application through Facebook	I can register and access account using Facebook	Low	Sprint-2
		USN-4	As a user, I can opt for different subscription plans available in the app and make payment for that.	I will go to payment gateway to pay for subscription	Medium	Sprint-3

	Login	USN-5	As a user, if I can log into the application by entering email/mobile number& password	I can access my Dashboard	High	Sprint-2
		USN-6	As a user, if I forget my password I will receive an auto-generated password through my email.	I will receive my new password through email.	High	Sprint-2
	Dashboard	USN-7	As a user, I can enter into dashboard by using navigation panel.	I can access the dashboard by using the navigation panel.	High	Sprint-2
Customer(web user)	Registration	USN-1	As a user, I can register for the application by entering my email, mobile number, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive an email to confirm my registration.	I can authenticate my account by confirming through the mail sent.	High	Sprint-1

		USN-3	As a user, I can register for the application through Facebook	I can register and access account using Facebook	Low	Sprint-1
		USN-4	As a user, I can opt for different subscription plans available in the website and make payment for that.	I will go to payment gateway to pay for subscription	Medi um	Sprint-3
	Login	USN-5	As a user, I can log into the application by entering email & password	I can access my Dashboard	High	Sprint-1
		USN-6	As a user, if I forget my password I will receive an auto-generated password through my email.	I will receive my new password through email.	High	Sprint-1
	Dashboard	USN-7	As a user, I can enter into dashboard by using navigation panel.	I can access the dashboard by using the navigation panel	High	Sprint-1

6.PROJECT PLANNING & SCHEDULING:

6.1 Sprint Planning & Estimation:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Simulation creation	USN-1	Connect Sensors and Arduino with python code	2	High	Jaishree P, Sowmiya M
Sprint-2	Software	USN-2	Creating device in theIBM Watson IoT platform, workflow for IoT scenarios using Node-Red	2	High	Sowmiya M, Jaishree P
Sprint-3	MIT AppInventor	USN-3	Develop an application for the Smart farmerproject using MIT App Inventor	2	High	Sowmiya M Mahalakshmi E
Sprint-3	Dashboard	USN-3	Design the Modules and test the app	2	High	Yerramachetty Puja, E.Mahalakshmi
Sprint-4	Web UI	USN-4	To make the user to interact with software.	2	High	Yerramachetty Puja, E.Mahalakshmi

6.2 Sprint Delivery Schedule

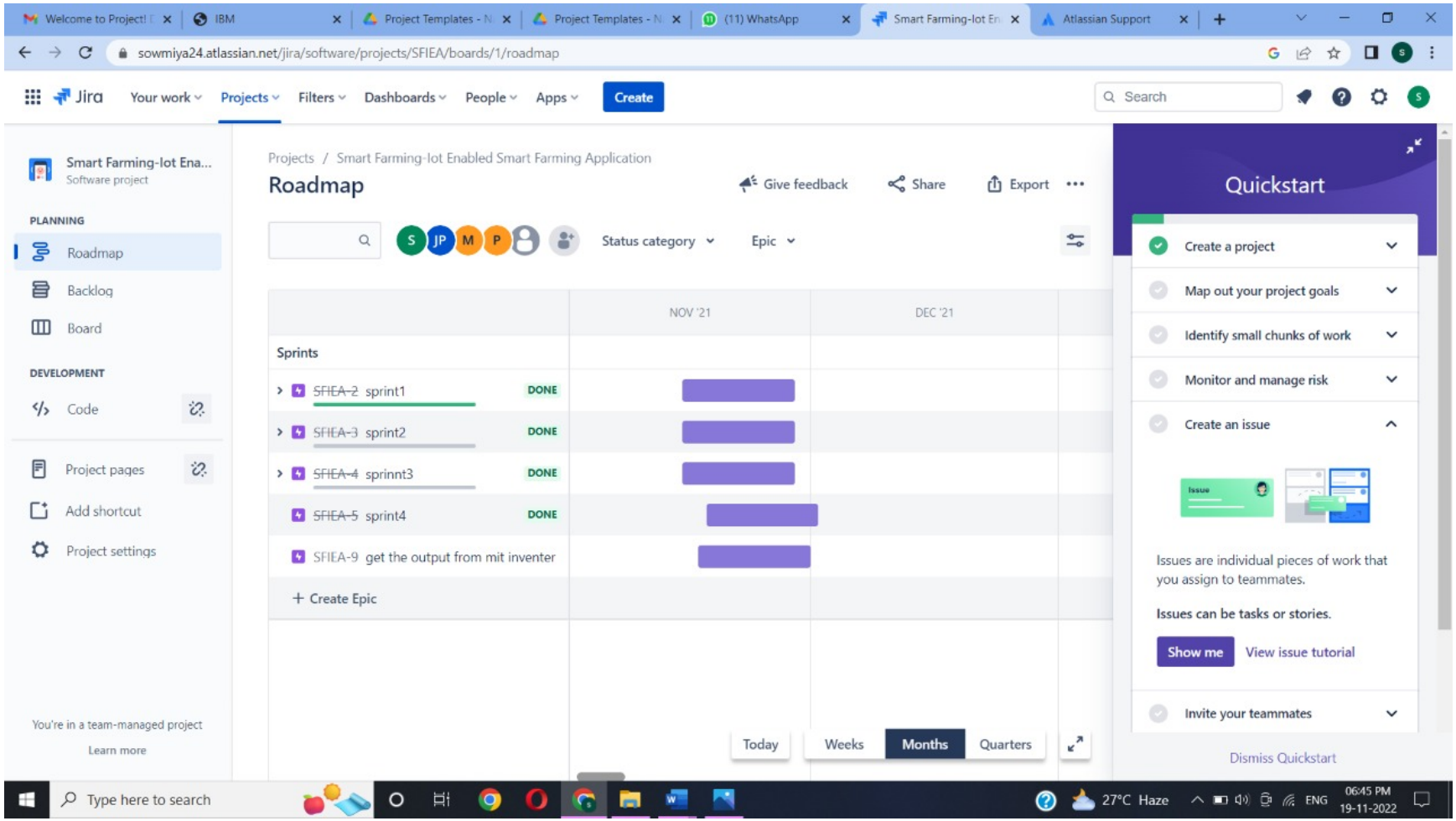
Sprint	Total Story Points	Duration	Sprint StartDate	Sprint End Date(Planned)	Story Points Completed (ason PlannedEnd Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022		05 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022		12 Oct 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022		15 Oct 2022

Velocity:

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) periteration unit (story points per day)

6.3 REPORTS FROM JIRA:



7.CODING AND SOLUTION :

Python Code

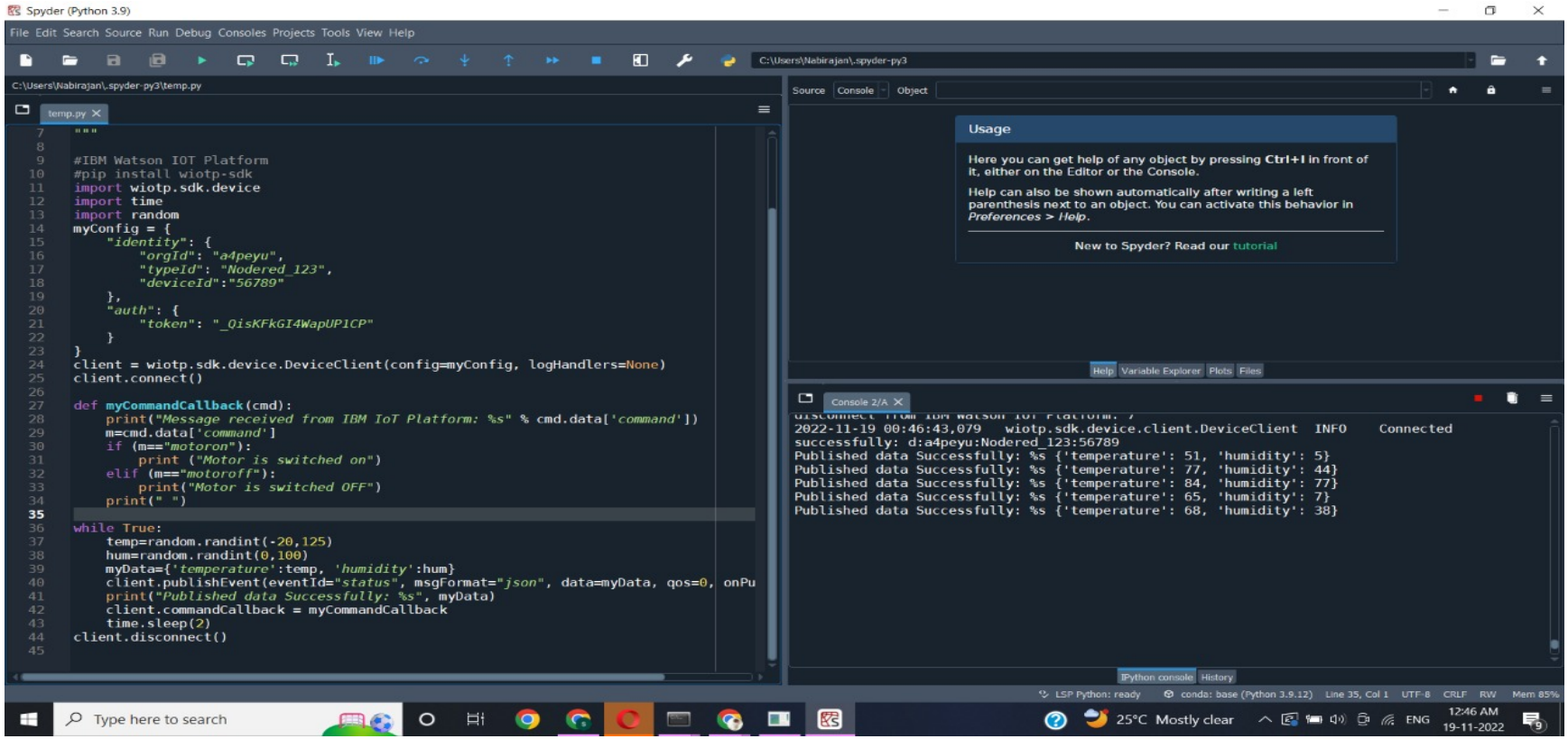
```
import wiotp.sdk.device
import time
import random
myConfig = {
    "identity": {
        "orgId": "a4peyu",
        "typeId": "Nodered_123",
        "deviceId":"56789"
    },
    "auth": {
        "token": "_QisKFkGI4WapUP1CP"
    }
}
client = wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()
```

```
def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    m=cmd.data['command']
    if (m=="motoron"):
        print ("Motor is switched on")
    elif (m=="motoroff"):
        print("Motor is switched OFF")
    print(" ")


while True:
    temp=random.randint(-20,125)
    hum=random.randint(0,100)
    myData={'temperature':temp, 'humidity':hum}
    client.publishEvent(eventId="status", msgFormat="json", data=myData, qos=0, onPublish=None)
    print("Published data Successfully: %s", myData)
    client.commandCallback = myCommandCallback
```

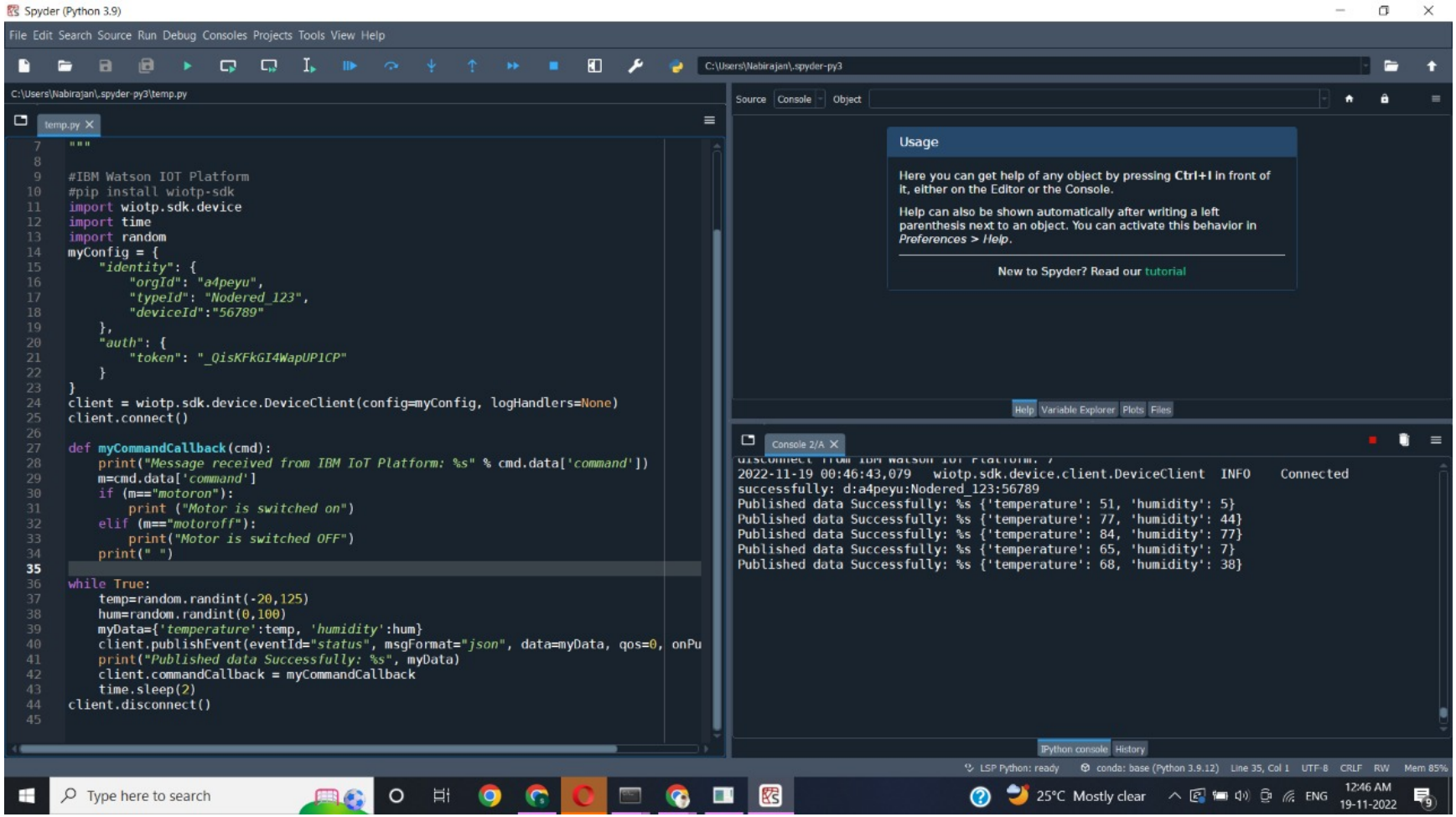
```
    time.sleep(2)
client.disconnect()
```

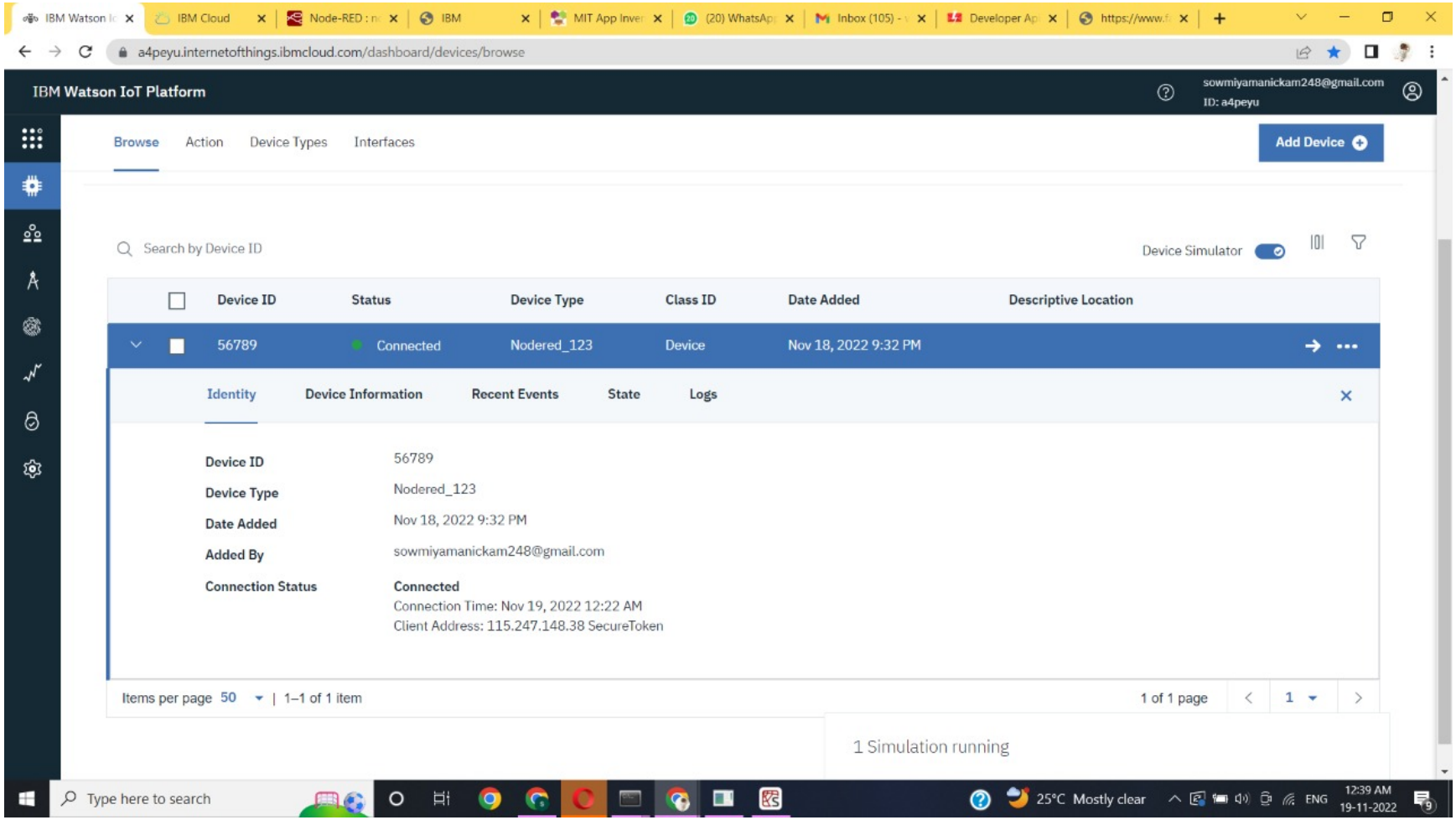
Output:



8.TESTING:

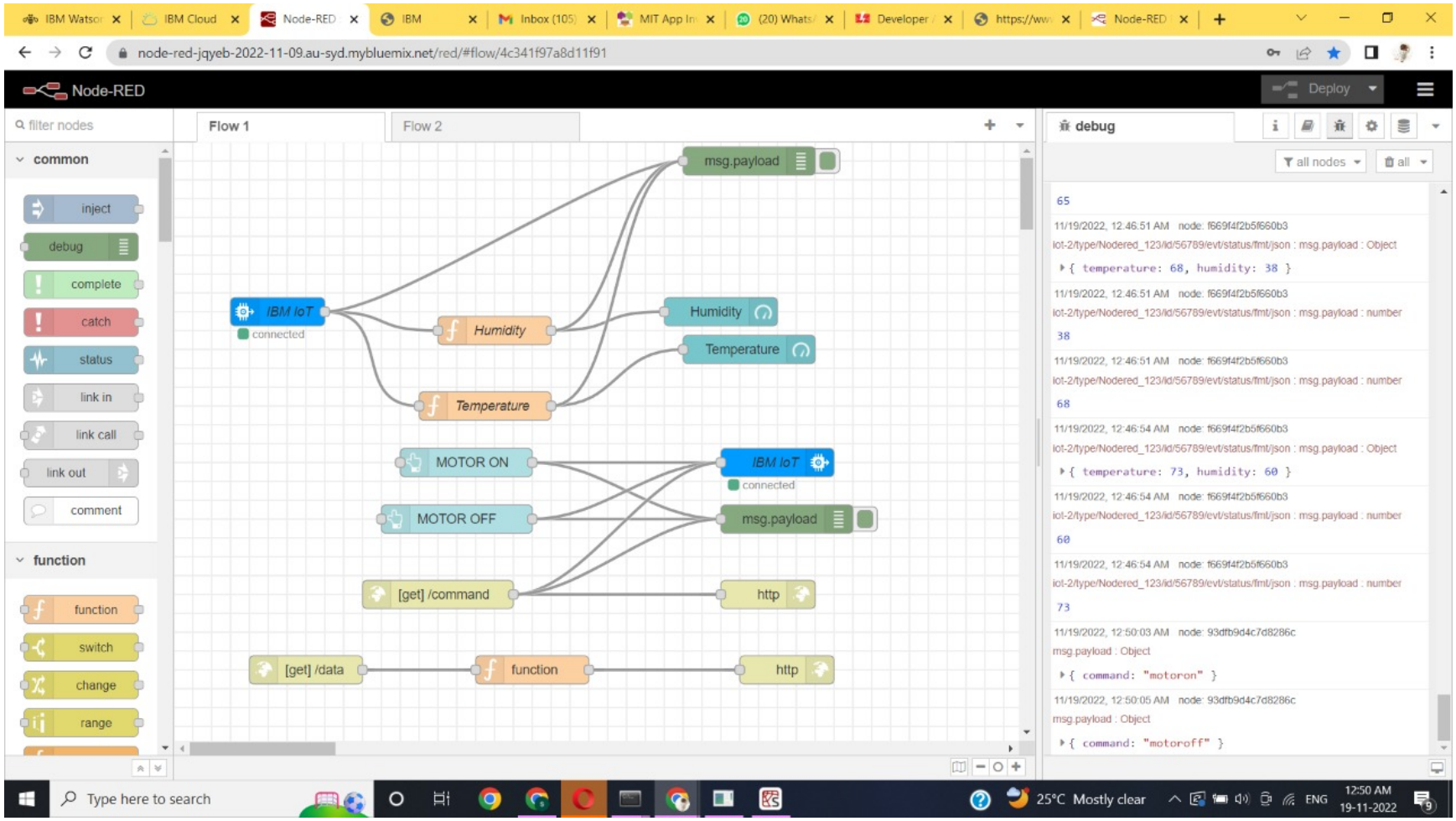
PYTHON CODE TO GET CONNECTED WITH IBM IOT WATSON PLATFORM:

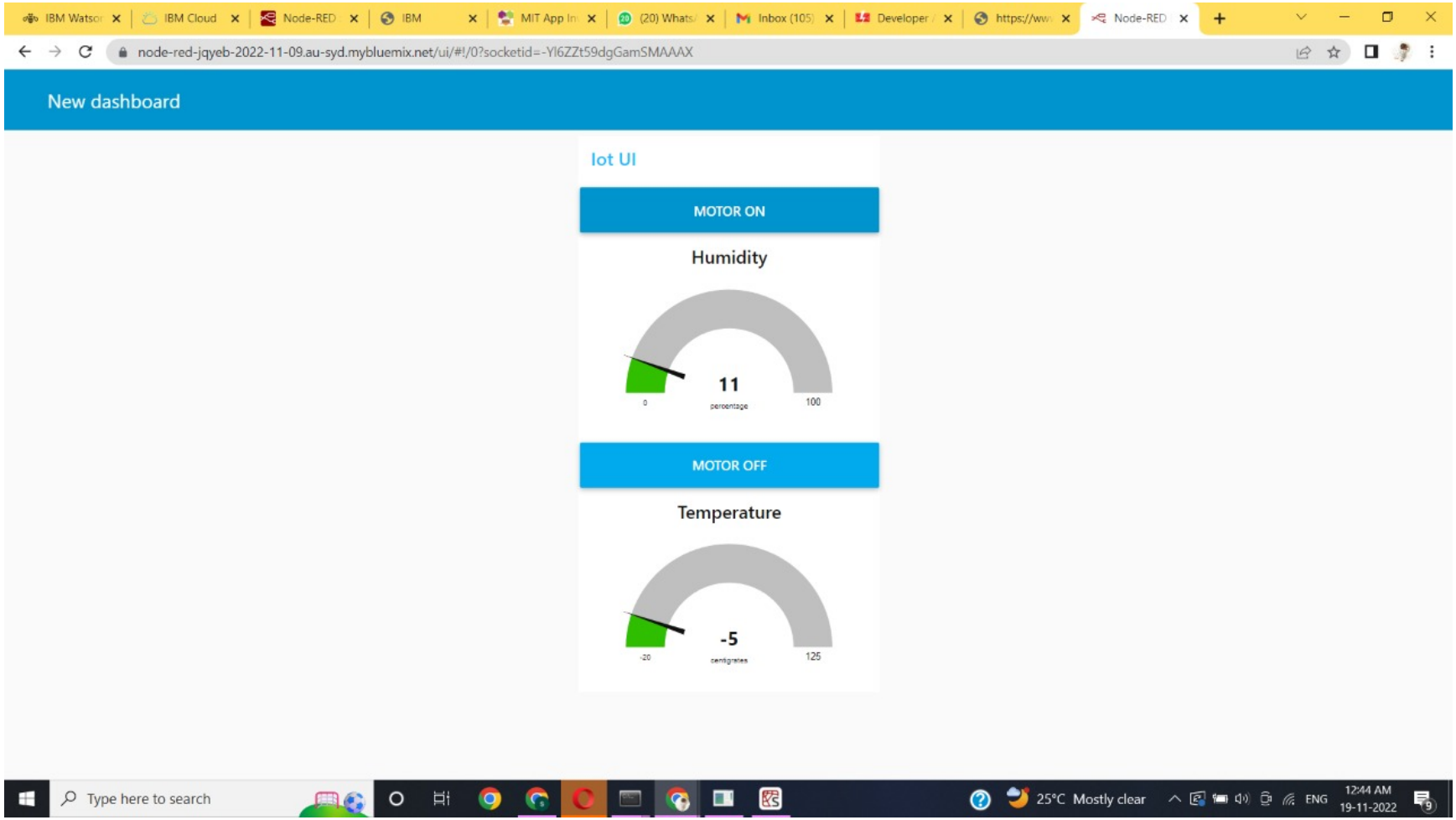



IBM Watson IoT Platform
sowmiyamanickam248@gmail.com
ID: a4peyu
Browse
Action
Device Types
Interfaces
Add Device
Search by Device ID
Device Simulator
Device ID
Status
Device Type
Class ID
Date Added
Descriptive Location
56789
Connected
Nodered_123
Device
Nov 18, 2022 9:32 PM
Identity
Device Information
Recent Events
State
Logs
Device ID
56789
Device Type
Nodered_123
Date Added
Nov 18, 2022 9:32 PM
Added By
sowmiyamanickam248@gmail.com
Connection Status
Connected
Connection Time: Nov 19, 2022 12:22 AM
Client Address: 115.247.148.38 SecureToken
Items per page 50
1–1 of 1 item
1 of 1 page
1
1 Simulation running
Type here to search
25°C Mostly clear
ENG
12:39 AM
19-11-2022

WEB APPLICATION:

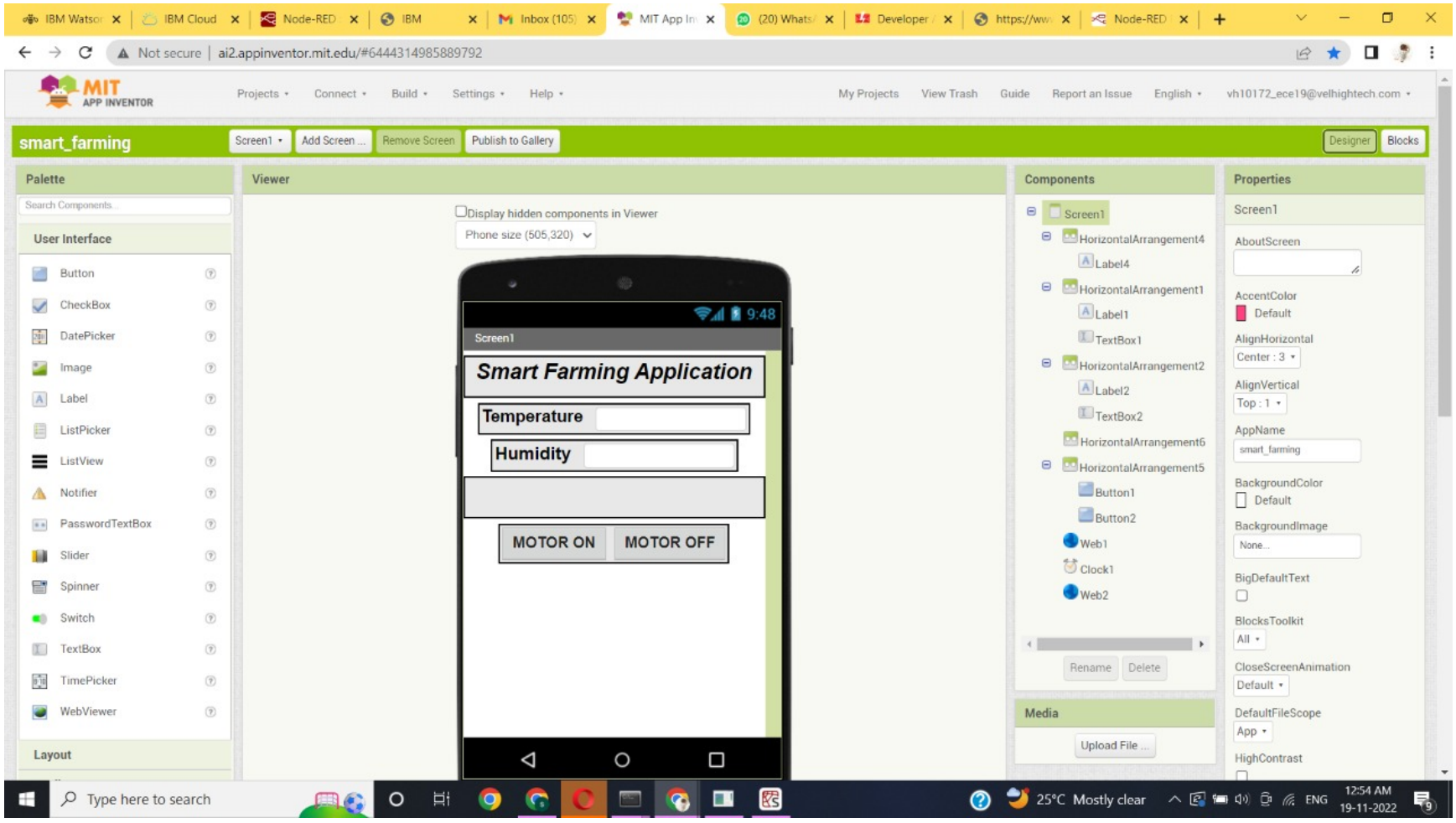
NORERED CONNECTION:



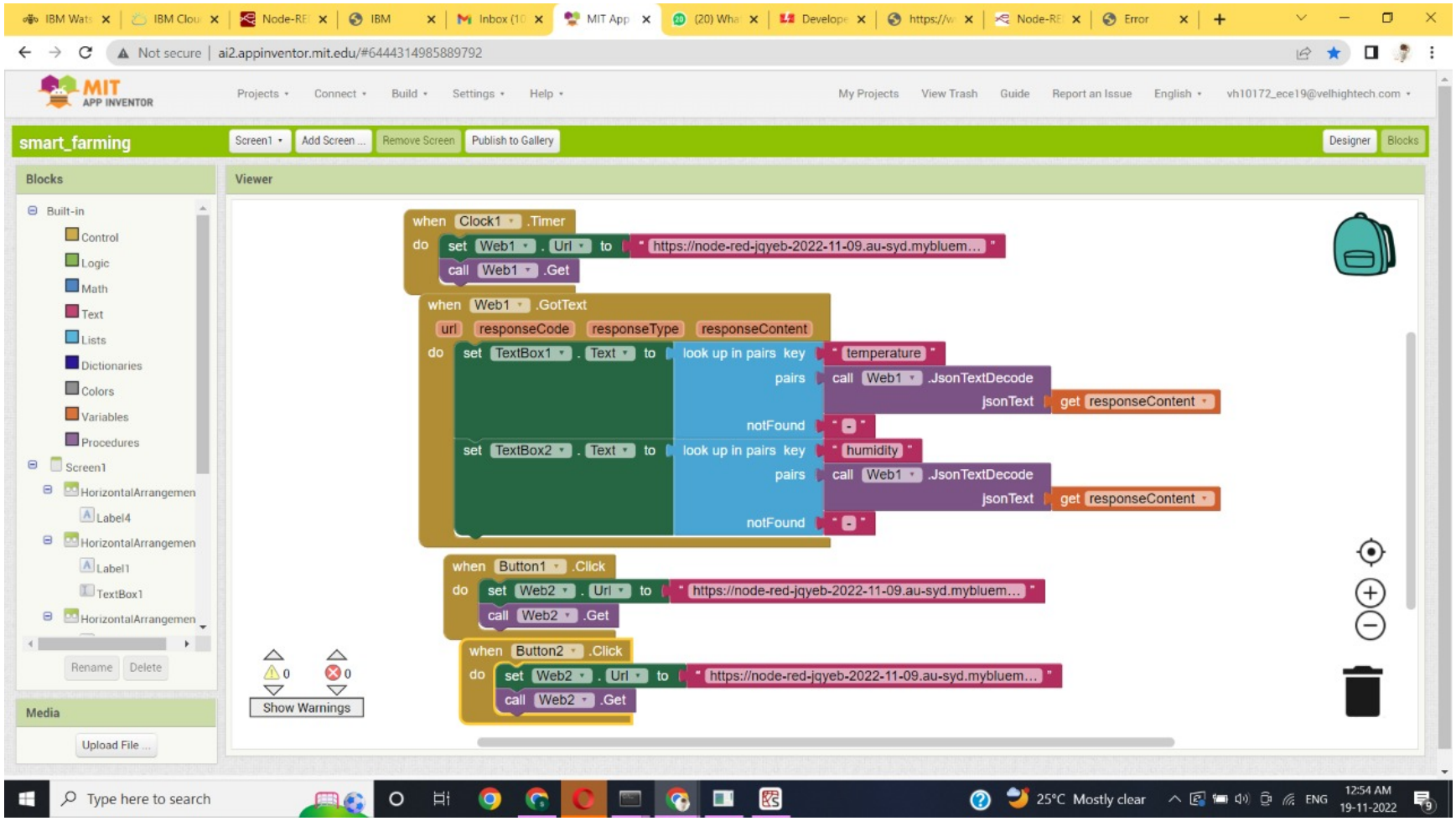

node-red-jqyeb-2022-11-09.au-syd.mybluemix.net/ui/#!/0?socketid=-Yl6ZZt59dgGamSMAAAX
New dashboard
Iot UI
MOTOR ON
Humidity
11
percentage
0
100
MOTOR OFF
Temperature
-5
centigrades
-20
125
Type here to search
25°C Mostly clear
ENG
12:44 AM
19-11-2022

MOBILE APPLICATION:

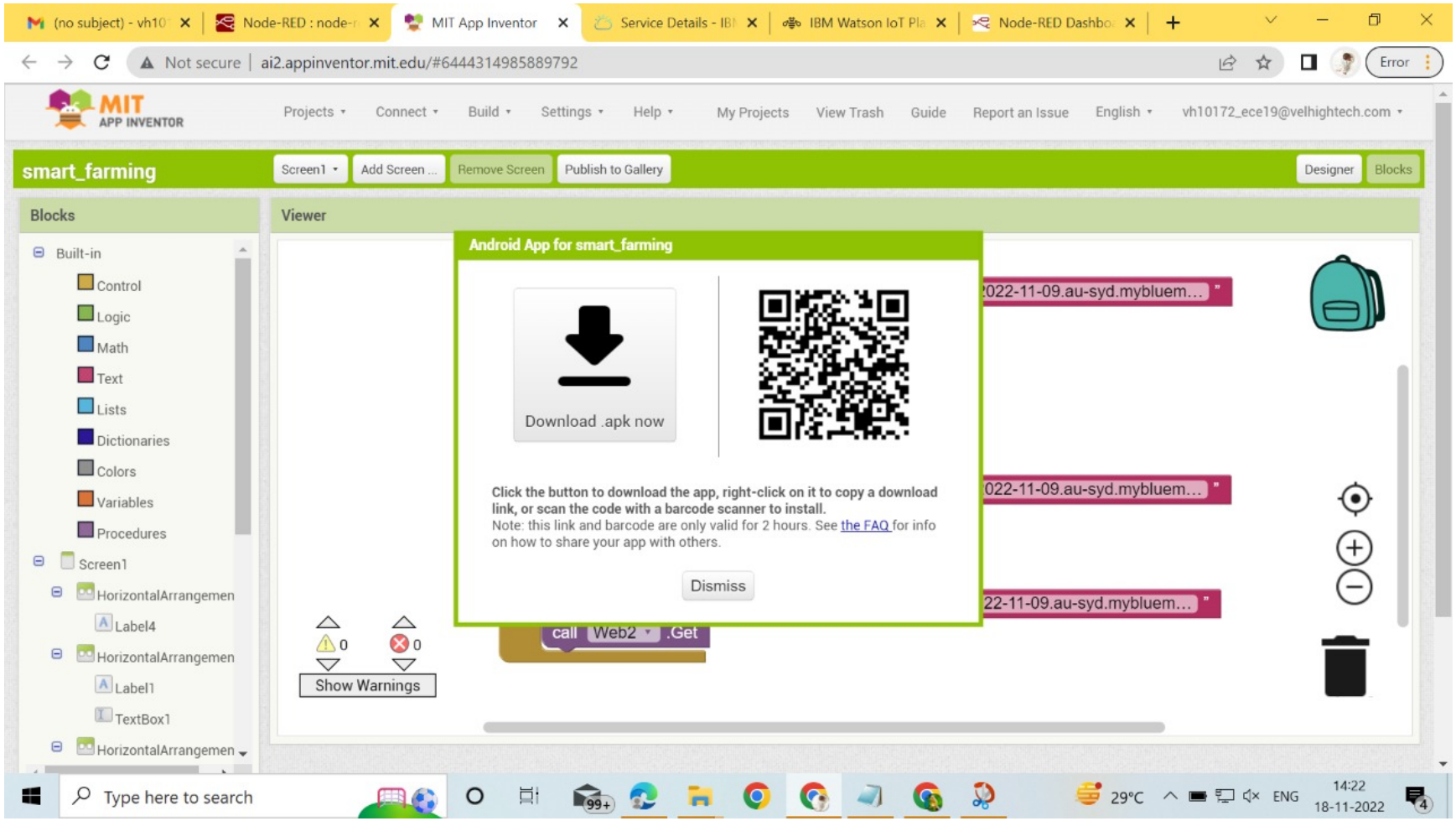
MIT APP INVENTOR FRONT END:



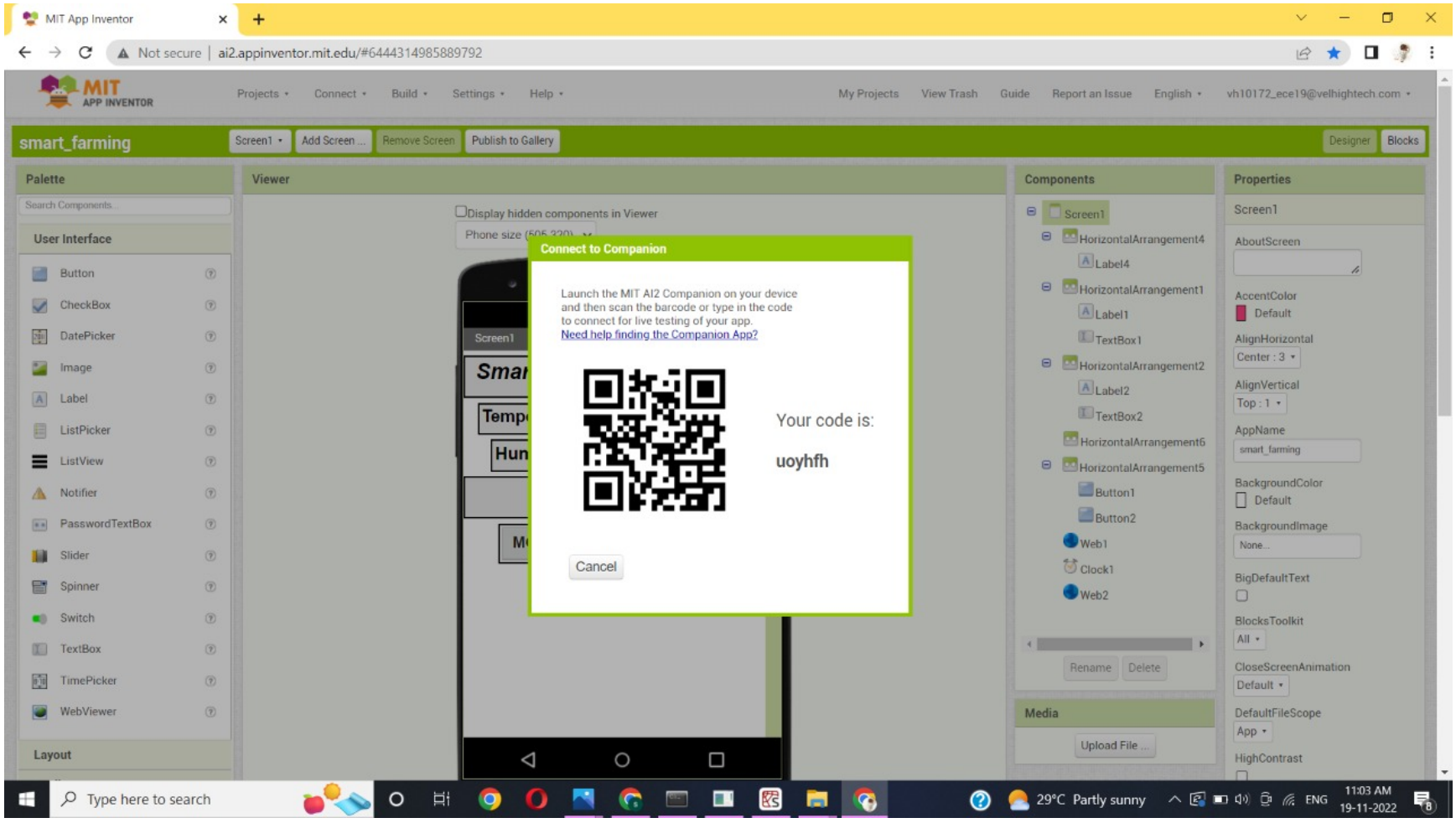
MIT APP INVENTOR BACK END:



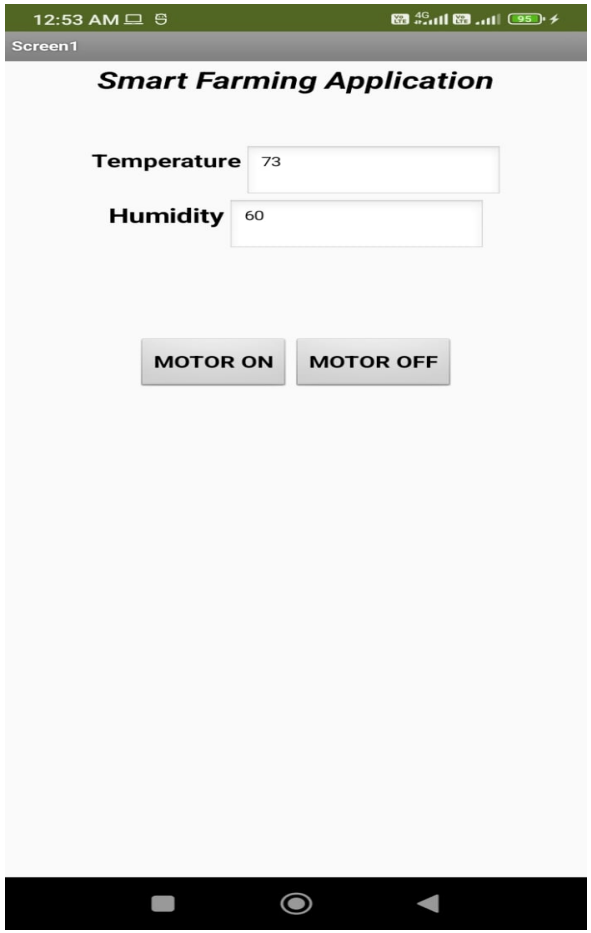
QR CODE FOR APK DOWNLOAD



QR CODE FOR ACCESSING THE APPLICATION:

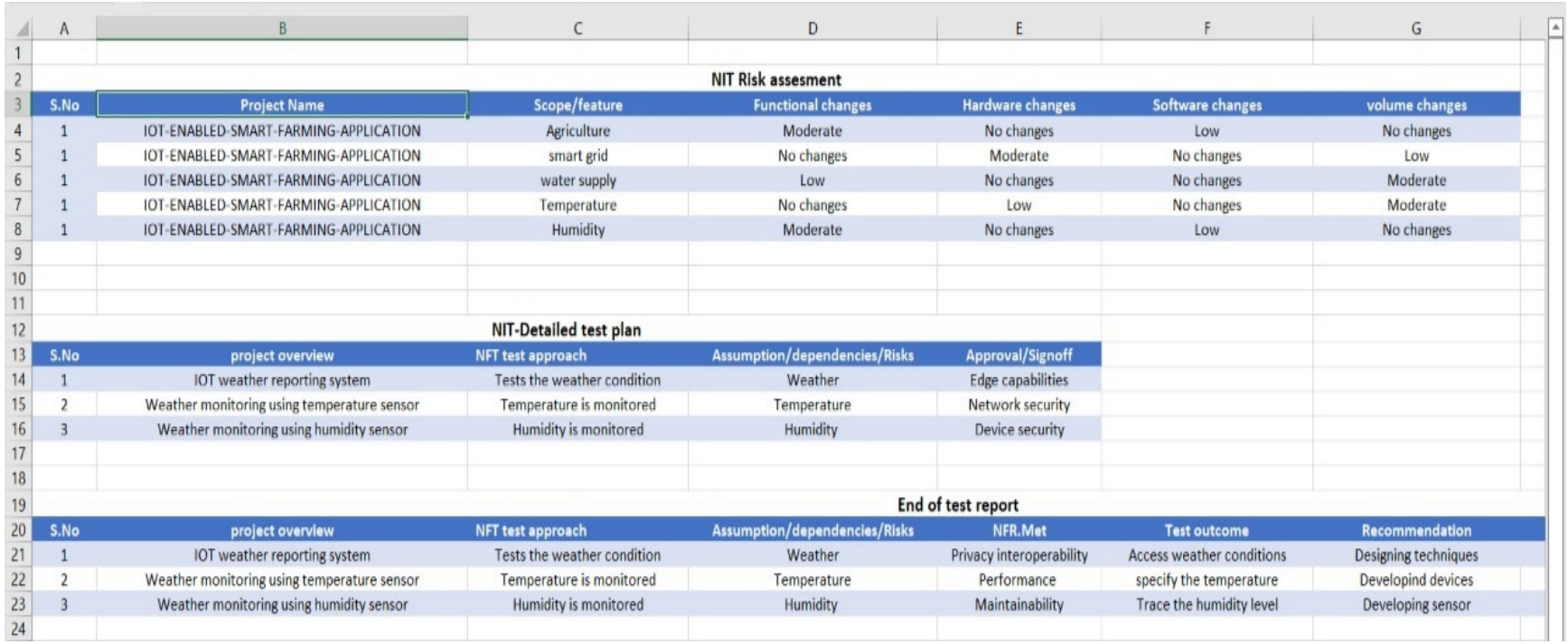


OUTPUT:


12:53 AM
Screen1
Smart Farming Application
Temperature
73
Humidity
60
MOTOR ON
MOTOR OFF

9.RESULT

9.1 PERFORMANCE METRICES



	A	B	C	D	E	F	G
1							
2				NIT Risk assesment			
3	S.No	Project Name	Scope/feature	Functional changes	Hardware changes	Software changes	volume changes
4	1	IOT-ENABLED-SMART-FARMING-APPLICATION	Agriculture	Moderate	No changes	Low	No changes
5	1	IOT-ENABLED-SMART-FARMING-APPLICATION	smart grid	No changes	Moderate	No changes	Low
6	1	IOT-ENABLED-SMART-FARMING-APPLICATION	water supply	Low	No changes	No changes	Moderate
7	1	IOT-ENABLED-SMART-FARMING-APPLICATION	Temperature	No changes	Low	No changes	Moderate
8	1	IOT-ENABLED-SMART-FARMING-APPLICATION	Humidity	Moderate	No changes	Low	No changes
9							
10							
11							
12			NIT-Detailed test plan				
13	S.No	project overview	NFT test approach	Assumption/dependencies/Risks	Approval/Signoff		
14	1	IOT weather reporting system	Tests the weather condition	Weather	Edge capabilities		
15	2	Weather monitoring using temperature sensor	Temperature is monitored	Temperature	Network security		
16	3	Weather monitoring using humidity sensor	Humidity is monitored	Humidity	Device security		
17							
18							
19					End of test report		
20	S.No	project overview	NFT test approach	Assumption/dependencies/Risks	NFR.Met	Test outcome	Recommendation
21	1	IOT weather reporting system	Tests the weather condition	Weather	Privacy interoperability	Access weather conditions	Designing techniques
22	2	Weather monitoring using temperature sensor	Temperature is monitored	Temperature	Performance	specify the temperature	Developind devices
23	3	Weather monitoring using humidity sensor	Humidity is monitored	Humidity	Maintainability	Trace the humidity level	Developing sensor
24							

10.ADVANTAGES:

- Equipped Monitoring:

Farming equipment can be monitored and maintained according to production rated, labor effectiveness and failure prediction.

- Real-Time Data and Production Insight :

Farmers can visualize production levels, soil moisture, sunlight intensity and more in real time and remotely to accelerate decision making.

- Lowered Operation Costs :

Automation processes in planting, treatment and harvesting can reduce resource consumption, human error and overall cost.

- Accurate Farm and Field Evaluation:

Accurately tracking production rates by field over time allows for detailed predicting of future crop yield and value of a farm.

11.CONCLUSION:

For live monitoring of agricultural parameters including temperature, humidity, detection with both the IoT technology by using cloud, the proposed smart farming system is used. The proper use of water is also managed by it.Thus, this system provides high efficiency and accuracy in fetching live data of parameters. This will help farm workers in increasing agricultural yields and take efficient care of food production.Using Node Red and IBM Cloud Platform, an IoT-based smart agriculture system for Live Monitoring of Temperature and Remote Control of Motor has been proposed. The System is highly efficient and accurate in retrieving live temperature and humidity data. The IoT-based smart farming System proposed in this project will assist farmers in increasing agriculture yield and taking efficient care of food production by providing farmers with accurate live feed of environmental temperature and humidity with more than 99% accuracy results. As a result, the project proposes the idea of incorporating the most recent innovation into the agrarian field in order to transform the traditional water system techniques.

12.FUTURE SCOPE:

IoT have the potential to transform agriculture in many aspects and these are the main ones:

- **Data collected by smart agriculture sensors**, in this, a key component are sensors, autonomous vehicles, automated hardware, motion detectors, button camera, and wearable devices. This data can be used to track the state of the business in general as well as staff performance, equipment efficiency.
- **Agricultural Drones** Ground-based and aerial-based drones are being used in agriculture in order to enhance various agricultural practices: crop health assessment, irrigation, crop monitoring, crop spraying, planting, and soil and field analysis**.**
- **Livestock tracking and geofencing Farm** owners can utilize wireless IoT applications to collect data regarding the location, well-being, and health of their cattle.
- **Smart Greenhouses** A smart greenhouse designed with the help of IoT intelligently monitors as well as controls the climate, eliminating the need for manual intervention.
- **Predictive analytics for smart farming** To predict production rate of the crop artificial network use information collected by sensors from the farm. This information includes parameters such as soil, temperature, pressure, rainfall, and humidity. The farmers can get an accurate soil data either by the dashboard or a customized mobile application.

APPENDIX:

Source Code Link: https://github.com/IBM-EPBL/IBM-Project-18900-1659691204/blob/main/Final

Github Link: https://github.com/IBM-EPBL/IBM-Project-18900-1659691204

Nodered Link: https://node-red-jqyeb-2022-11-09.au-syd.mybluemix.net/red/#flow/4c341f97a8d11f91

Demo Link:https://drive.google.com/file/d/1O4vyZxwmin-QaeluhLDF90Tcza_n28pI/view?usp=drivesdk