Smart Farmer-IOT Enabled Smart Farming Application

A NAALAIYA THIRAN PROJECT REPORT

Submitted by

TAMILARASAN S	(610519104104)
TAMIL SELVAN S	(610519104106)
MOHANA PRIYAN M	(610519104064)
SYEDABUTHAHIR M	(610519104102)

TEAM ID: PNT2022TMID29852

FACULTY MENTOR

MRS P VIMALA

INDUSTRY MENTOR

MR BHARADWAJ

Department Of Computer Science And Engineering

DHIRAJLAL GANDHI COLLEGE OF TECHNOLOGY

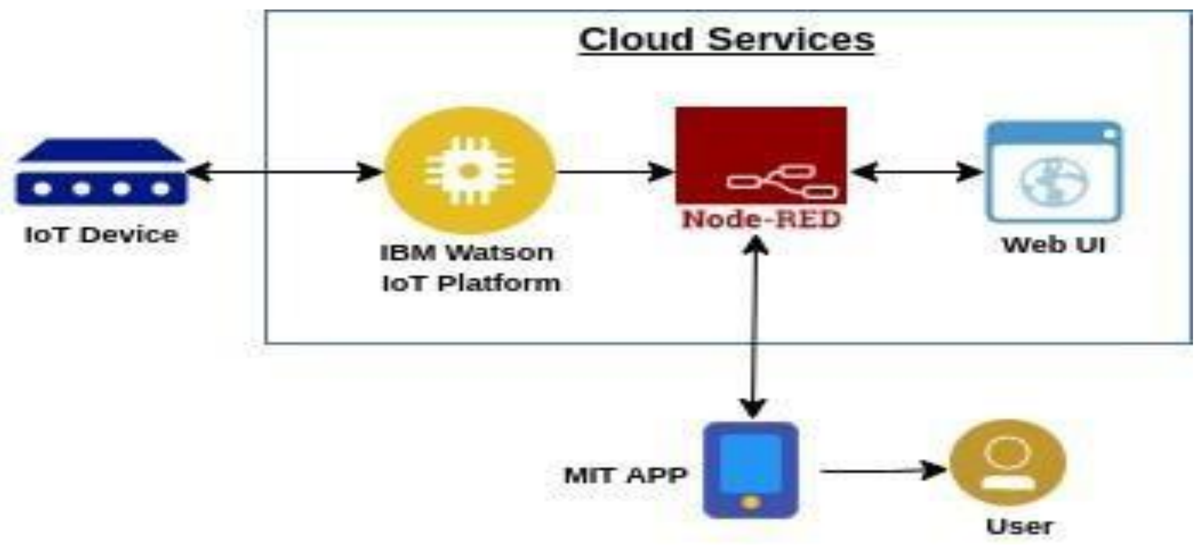
SALEM

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Project Overview:

IoT-based agriculture system helps the farmer in monitoring different parameters of his field like soil moisture, Temperature, 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 motorpumps from the mobile application itself.



1.2 Purpose:

By making farming more connected and intelligent, precision agriculture helps reduce overall costs and improve the quality and quantity of products, the sustainability of agriculture and the experience for the consumer. Increasing control over production leads to better cost management and waste reduction. The ability to trace anomalies in crop growth or livestock health, for instance, helps eliminate the risk of losing yields. Additionally, automation boosts efficiency. With smart devices, multiple processes can be activated at the same time, and automated services enhance product quality and volume by better controlling production processes.

Smart farming systems also enable careful management of the demand forecast and delivery of goods to market just in time to reduce waste. Precision agriculture is focused on managing the supply of land and, based on its condition, concentrating on the right growing parameters – for example, moisture, fertilizer or material content – to provide production for the right crop that is in demand. The types of precision farming systems implemented depend on the use of software for the management of the business. Control systems manage sensor input, delivering remote information for supply and decision support, in addition to the automation of machines and equipment for responding to emerging issues and production support.

2. LITERATURE SURVEY

REFERNCE PAPER:
SMART FARMING USING IOT

REFERNCE LINK:
https://www.academia.edu/36664759/Literature_Review_on_IOT_Based_Smart_Security_and_Monitoring_Devices_for_Agriculture

DESCRIPTION:

Joaquín Gutiérrez et al. (2014), The paper aims at optimizing water use for agricultural crops. An algorithm was developed with threshold values of temperature and soil moisture that was programmed into a microcontroller-based gateway to control water quantity. The system was powered by photovoltaic panel sand had a duplex communication link based on a cellular-Internet interface that allowed for data inspection and irrigation scheduling to be programmed through a web page. The issue is that the investment in electric power supply would be expensive.

Shakthi priya N et al. (2014), As mentioned it reviews the state of art wireless sensor technology in agriculture. Based on the value of soil moisture sensor the water sprinkler works during the period of water scarcity. Once the field is sprinkled with adequate water, the water sprinkler is switched off. Here by water can be conserved. Also, the value of soil pH sensor is sent to the farmer via SMS using GSM modem. The issue is that it provides only precision values that is not accurate and is not cost efficient.

G.MeenaKumari et al. (2014) , The approach proposes technological development in Wireless Sensor Networks made it possible to use in monitoring and control of greenhouse parameter in precision agriculture In the Field bus concept, the data transfer is mainly controlled by hybrid system(wired and wireless) to automate the system performance and throughput .ZigBee protocols based on IEEE 802.15.4 for wireless system are used. The atmospheric conditions are monitored and controlled online by using Ethernet IEEE 802.3. Partial Root Zone Drying Process is implemented to save water. Also, Controller Area Network (CAN) and Hybrid networks are used. It uses traditional communication system is used. The future research can be focused on Optical communication System with wavelength routing networks and can also be implemented using advanced ARM Controllers and core processors and also in energy saving data fusion and other directions.

BezaNegashGetu et al. (2015), It investigate the design and simulation of an electronic system for automatic controlling of water pumps that are used for agricultural fields or plant watering based on the level of soil moisture sensing. The speed of the motor is varied according to the level of the soil moisture content; the motor is OFF during maximum wet and is running with HIGH speed during dry soil conditions respectively. The duration of water pumping is controlled by a timer circuit. The system is tested using NI MULTISM simulation software. DIAC and TRIAC techniques are used. The issue is that it does not support several water levels and uses old techniques.

2.1 Problem Statement:

Internet of Things (IoT) technology has brought revolution to each and every field of common man's life by making everything smart and intelligent. IoT refers to a network of things which make a self-configuring network.

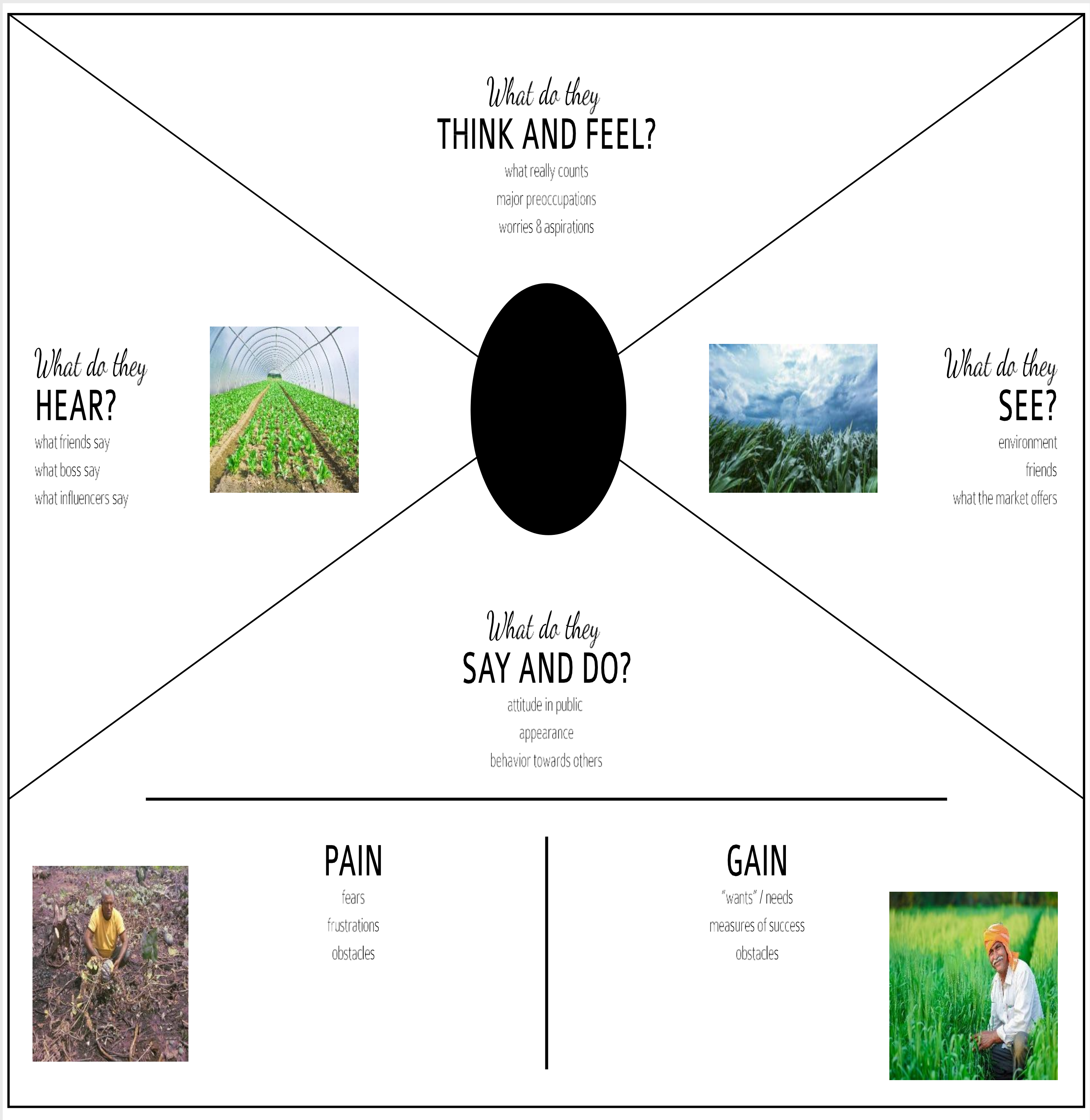
The development of Intelligent Smart Farming IoT based devices is day by day turning the face of agriculture production by not only enhancing it but also making it cost-effective and reducing wastage.

The aim / objective of this paper is to propose a Novel Smart IoT based Agriculture Stick assisting farmers in getting Live Data (Temperature, Soil Moisture, Weather, Irrigation) for efficient environment monitoring which will enable them to do smart farming and increase their overall yield and quality of products.

The agriculture stick being proposed via this paper is integrated with Arduino Technology, Breadboard mixed with various sensors and live data feed can be obtained. The product being proposed is tested on Live Agriculture Fields giving high accuracy over 98% in data feeds.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:



3.2 Ideation:

Sensor Technology in Agriculture:

Vast variety of sensors are used in agricultural products such as soil moisture sensors, water-level sensors, equipment used to sample the state of the atmosphere at a given time meteorological sensors (monitors the current state of atmosphere), heavy metal detection sensors, biosensors (detection of an Analyte), gas sensors (detects presence of gas).

Intelligent irrigation Technology:

Based on satellite positioning network and “shallow wells underground cables + field + automatic irrigation system pipe” technology, it can accumulate irrigation water, irrigation, electricity, and time data to accomplish automation of farmland irrigation and through a complete analysis of information technology software to monitor irrigation.

Radio Transmission Technology in Agriculture:

Self-organizing wireless data transmission can be achieved with ZigBee wireless sensor networks. In large-scale farming, it has been widely used for data transmission.

3.3 Proposed Solution:

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	IoT-based agriculture system helps the farmer in monitoring different parameters of his field like soil moisture, temperature, and humidity using some sensors.
2.	Idea / Solution description	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.
3.	Novelty / Uniqueness	Configuring APIs using Node-RED for communicating with a mobile application.
4.	Social Impact / Customer Satisfaction	Doubles the farmer income, higher production, food security.
5.	Business Model (Revenue Model)	Government driven models, community/contract farming models.
6.	Scalability of the Solution	If we are not near the field, using sensors we can water to the crop and controlling the motor pumps from the mobile application.

3.4 Problem Solution Fit:

1.Customer Segment(S) CS

Who is your customer?
i.e. working parents

The customer for this product is a farmer who grows crops. Our goal is to help them, monitor field parameters remotely. This product saves agriculture from extinction

2. Customer Constraints CC

What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.

Using a large number of sensors is difficult. An unlimited of continuous Internet connection is required for success.

3. Available Solutions AS

Which solutions are available to the customers when they face the problem

Or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen

The irrigation process is automated using IoT. Meteorological data and field parameters were collected and processed to automate the irrigation process. Disadvantages are efficiency only over short distances, and difficult data storage.

4. Jobs-To-Be-Done / Problems J&P

Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.

The purpose of this product is to use sensors to acquire various field parameters and process them using a central processing system. The cloud is used to store and transmit data using IoT. The Weather API is used to help farmers make decision.

5. Problem Root Cause RC

What is the real reason that this problem exists? What is the backstory behind the need to do this job?

Frequent changes and unpredictable weather and climate made it difficult for farmers to engage in agriculture. These factors play an important role in deciding whether to water your plants. Fields are difficult to monitor when the farmer is not at the field, leading to crop damage.

6. Behavior BE

What does your customer do to address the problem and
Get the job done?
i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)

Use a proper drainage system to overcome the effects of excess water from heavy rain. Use of hybrid plants that are resistant to pests.

7.Trigger TR

What triggers customers to act? i.e., seeing their neighbor installing Solar panels, reading about a more efficient solution in the news.

Farmers struggle to provide adequate irrigation. Inadequate water supply reduces yields and affects farmers' profit levels. Farmers have a hard time predicting the weather.

8. Emotion Before / After EM

How do customers feel when they face a problem of a job and afterwards?
I .e. lost, insecure confident, in control – use it in your communication strategy & design.

BEFORE: Lack of knowledge in weather forecasting →Random decisions →low yield.
After: Data from reliable source → correct decision →high yield

9.Your Solutions SL

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.

If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behavior.

Our product collects data from various types of sensors and sends the values to our main server. It also collects weather data from the Weather API. The final decision to irrigate the crop is made by the farmer using a mobile application.

10.Channels of Behavior CH

8.1 ONLINE
What kind of actions do customers take online?
Extract online channels from #7
8.2 ONLINE
What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development

ONLINE: Providing online assistance to the farmer, in providing knowledge regarding the pH and moisture level of the soil. Online assistance to be provided to the sensor in using the product

OFFLINE: Awareness camps to be organized to teach the importance and advantages of the automation and IoT in the development of agriculture.

4. REQUIREMENT ANALYSIS

4.1 Functional Requirement:

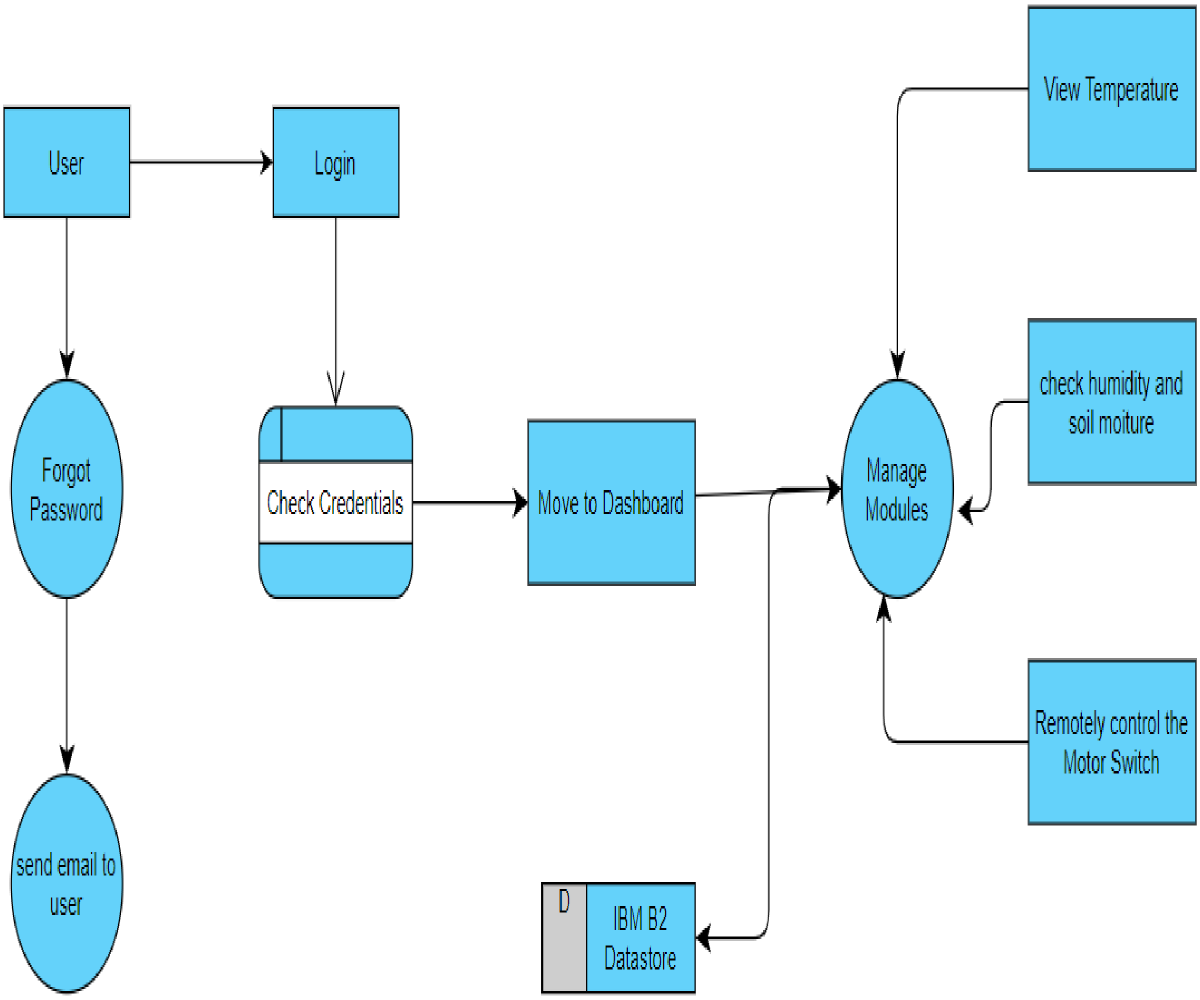
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Sensor Function for framing System	Measure the Temperature and Humidity Measure the Soil Monitoring Check the crop diseases
FR-4	Manage Modules	Manage Roles of User Manage User permission
FR-5	Check whether details	Temperature details Humidity details
FR-6	Data Management	Manage the data of weather conditions Manage the data of crop conditions Manage the data of live stock conditions

4.2 Non-Functional Requirement:

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	User friendly guidelines for users to avail the features. Most simplistic user interface for ease of use.
NFR-2	**Security**	All the details about the user are protected from unauthorized access. Detection and identification of any misfunctions of sensors.
NFR-3	**Reliability**	Implementing Mesh IoT Networks Building a Multi-layered distance for IoT Networks.
NFR-4	**Performance**	The use of modern technology solutions helps to achieve the maximum performances thus resulting in better quality and quantity yields.
NFR-5	**Availability**	This app is available for all platforms
NFR-6	**Scalability**	Scalability refers to the ability to increase available resources and system capability without the need to go through a major system redesign or implementation.

5. PROJECT DESIGN

5.1 Data Flow Diagaram:



5.2 User Stories:

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-4	As a user, I can log into the application byentering email & password		High	Sprint-1
Customer (Web user)	Dashboard	USN-5	As a User can view the dashboard, and this dashboard include the check roles of accessand then move to the manage modules.	I can view the dashboard in this smart farming application system.	High	Sprint 2
		USN-6	User can remotely access the motor switch	In the smart farming app	High	Sprint 3
Administrator			As a user once view the manage modules this describes the Manage system Admins and Manage Roles of User and etc.			Sprint 2

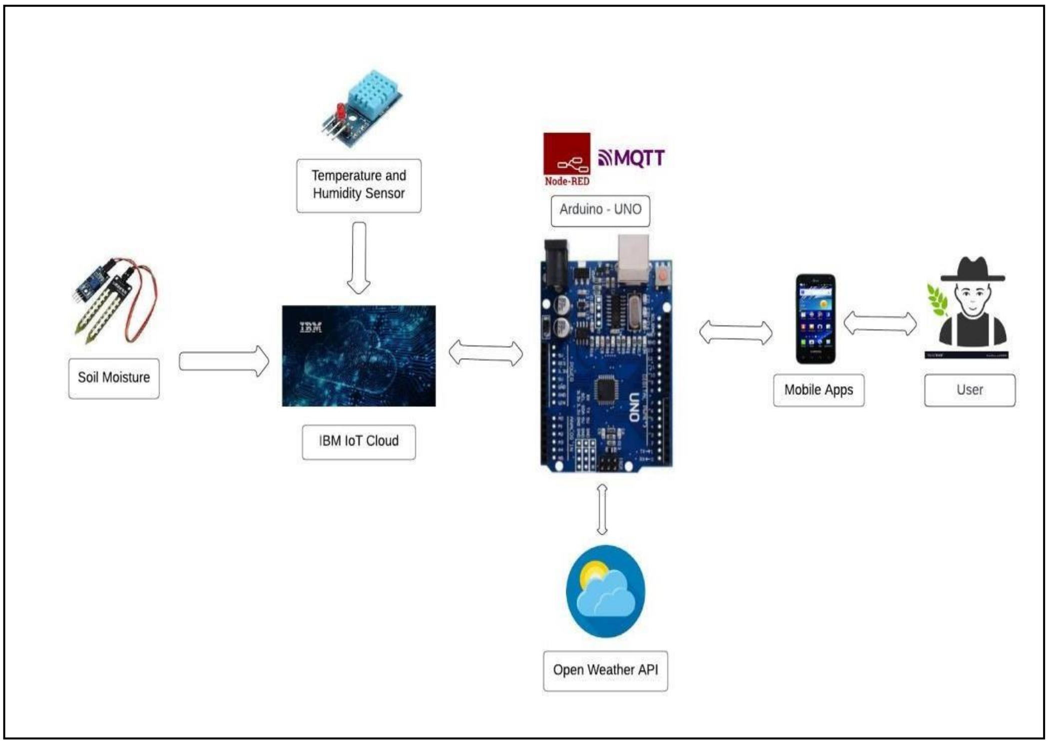
5.3 Solution Architecture:

The different soil parameters (temperature, humidity, Soil Moisture) are sensed using different sensors, and the obtained value is stored in the IBM cloud.

Arduino UNO is used as a processing unit that processes the data obtained from sensors and weather data from weather API.

Node-red is used as a programming tool to wire the hardware, software, and APIs. The MQTT protocol is followed for 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, whether to water the crop or not depending upon the sensor values. By using the app they can remotely operate the motor switch.



5.4 Technology Stack (Architecture & Stack):

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.

Application Characteristics:

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frame works used	Technology of Opensource framework
2.	Security Implementations	Sensitive and private datamust 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 platformsaffect system scalability and that automatic real time decision-making is feasiblein an environmentcomposed of dozens of thousand.	Technology used

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 withpython code	2	High	Tamilarasan S , Syedabuthahir M
Sprint-2	Software	USN-2	Creating device in the IBM WatsonIoT platform, workflow for IoT scenarios using Node-Red	2	High	Tamilarasan S , Syedabuthahir M
Sprint-3	MIT App Inventor	USN-3	Develop an application for the Smart farmer project using MIT App Inventor	2	High	Mohana Priyan M
Sprint-3	Dashboard	USN-3	Design the Modules and test the app	2	High	Tamil Selvan S
Sprint-4	Web UI	USN-4	To make the user to interact with software.	2	High	Tamilarasan S , Syedabuthahir M , Mohana Priyan M , Tamil Selvan S

6.2 Sprint Delivery Schedule:

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned EndDate)	Sprint Release Date(Actual)
Sprint-1	20	7 Days	24 Oct 2022	01 Nov 2022	20	01 Nov 2022
Sprint-2	20	5 Days	02 Nov 2022	07 Nov 2022	20	07 Nov 2022
Sprint-3	20	10 Days	08 Nov 2022	18 Nov 2022	20	18 Nov 2022
Sprint-4	20	9 Days	19 Nov 2022	28 Nov 2022	20	28 Nov 2022

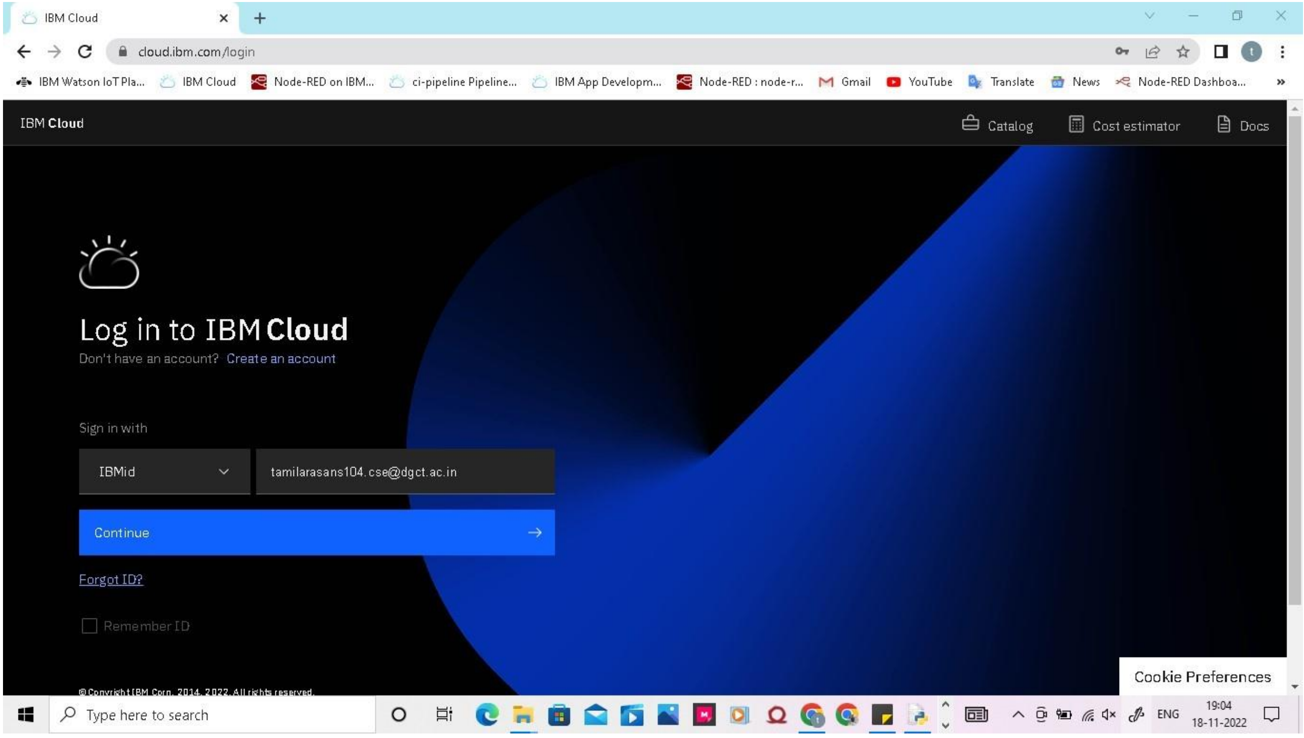
7. CODING

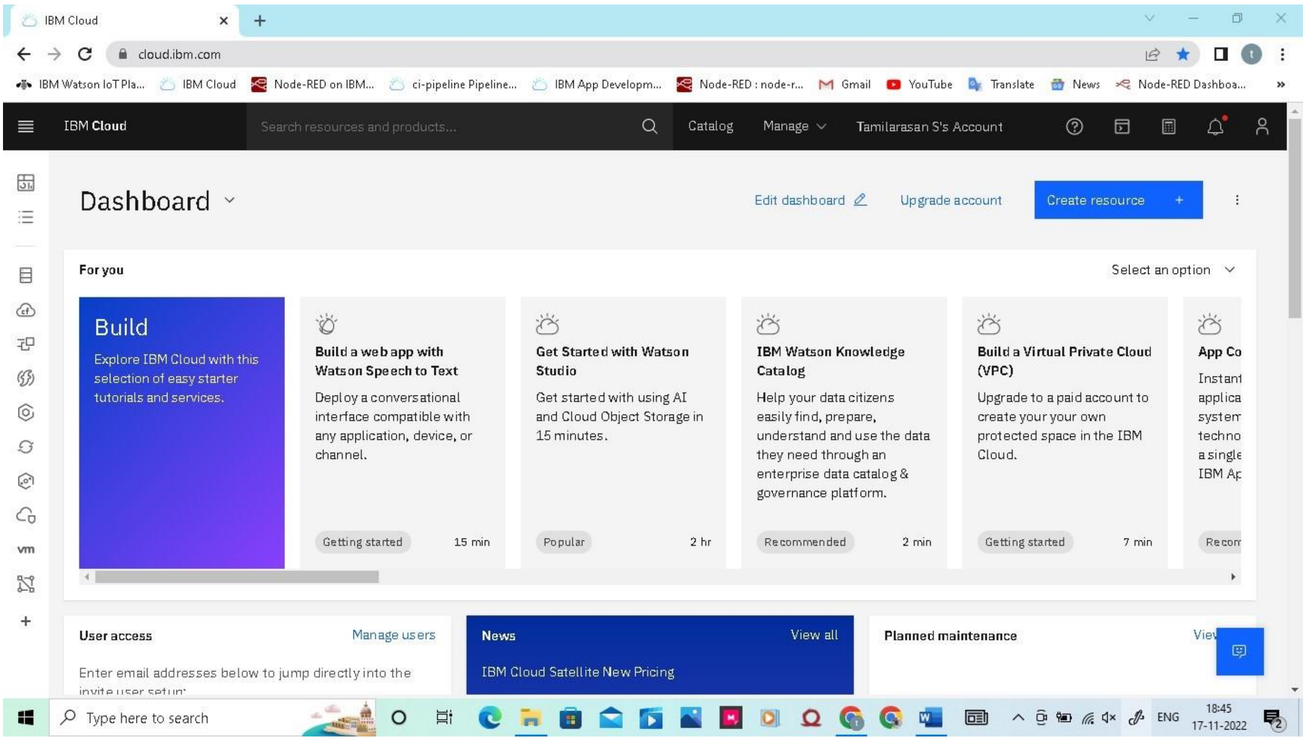
```
import random
import sys
import time
import ibmiotf.application
import ibmiotf.device

#provide Your IBM Watson Device Credentials
organization = "9te1u1"
deviceType = "SFTTMS00"
deviceID = "SFTTMS11"
authMethod = "token"
authToken = "PNTIBMSb18"


#Initialize GPIO
def myCommandCallback(cmd):
    print ("command received: %s" %cmd.data['command'])
    status=cmd.data['command']
    if status=="lighton":
        print  ("led is on")
    elif status == "lightoff":
       print ("led is off")
    else:
      print ("please send proper command")
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" info the cloud as an
event of type"greetings"10 times
```

```
deviceCli.connect()

while True:
        #Get sensor Data from DHT11

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

        data = { 'temp' : temp, 'Humid': Humid, 'soilmoisture':soilmoisture}
        #print data
        def myOnPublishCallback():
           print ("published Temperature = %s C" %  temp, "Humidity = is %s
%%" % Humid, "soilmoisture= is %s %%" % soilmoisture,"to IBM Watson")


        success = deviceCli.publishEvent("IOTSensor",
"json",data,qos=0,on_publish=myOnPublishCallback)
        if not success:
           print("Not connected to IOTF")
        time.sleep(5)


        deviceCli.commandCallback = myCommandCallback

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

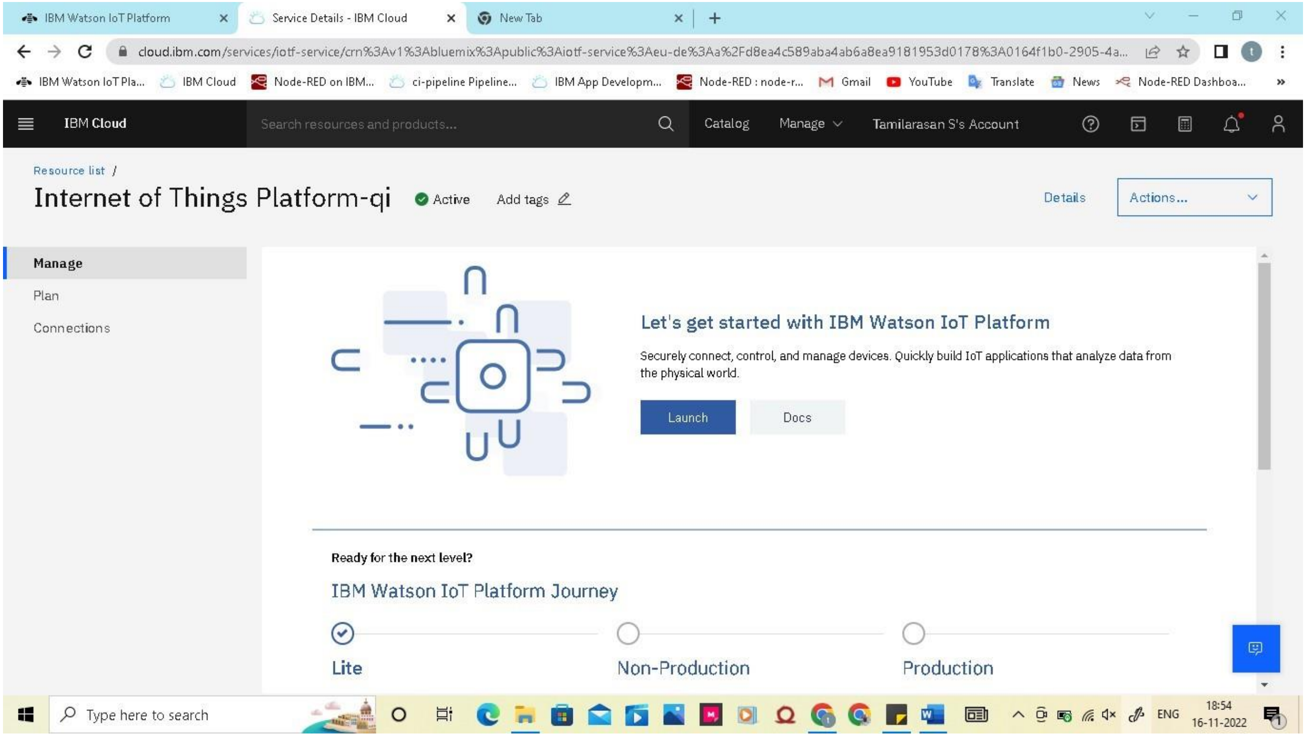
8. IBM CLOUD AND WATSON

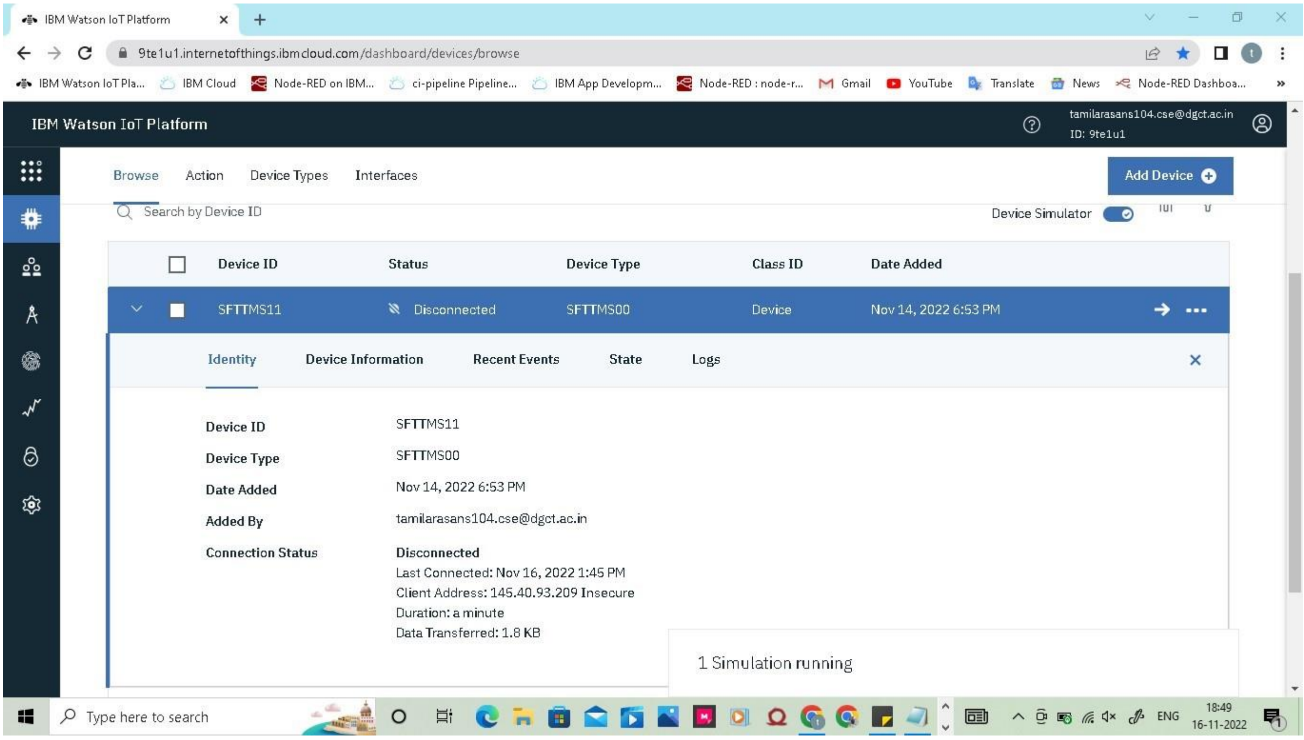
8.1 IBM Cloud:





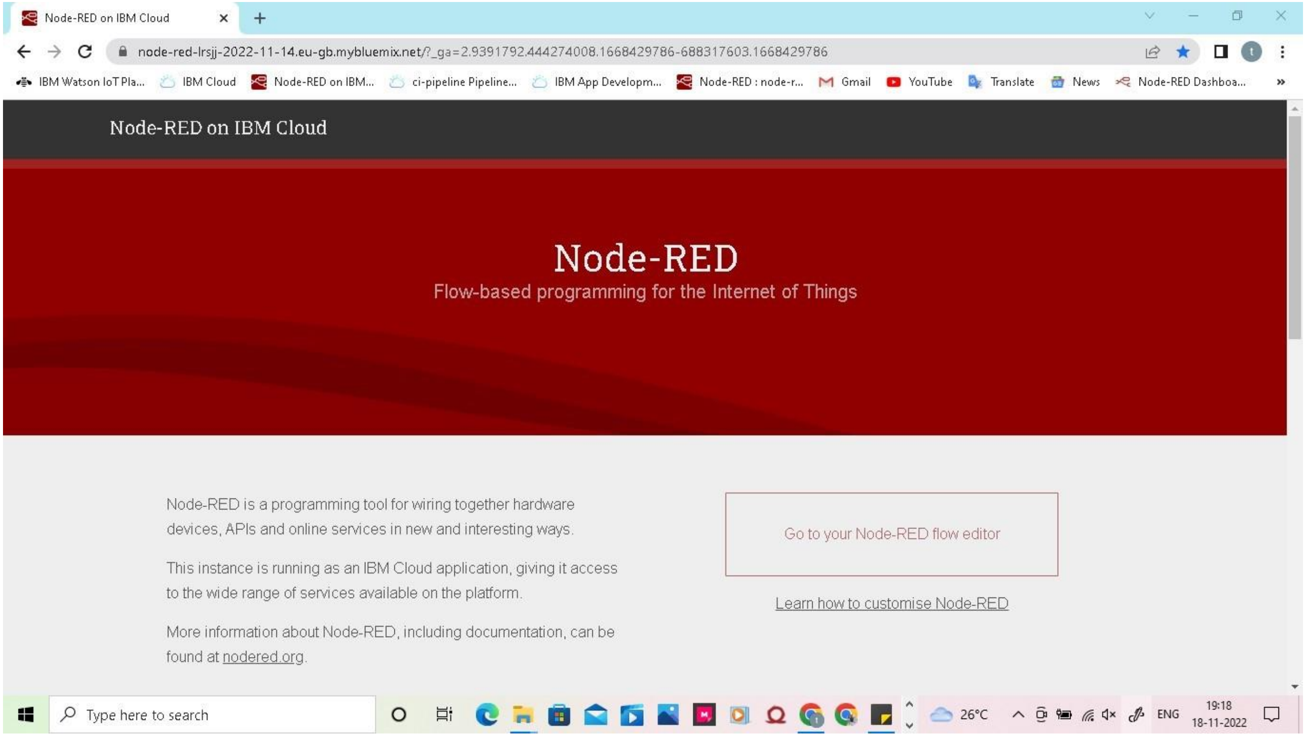
8.2 IBM Watson:



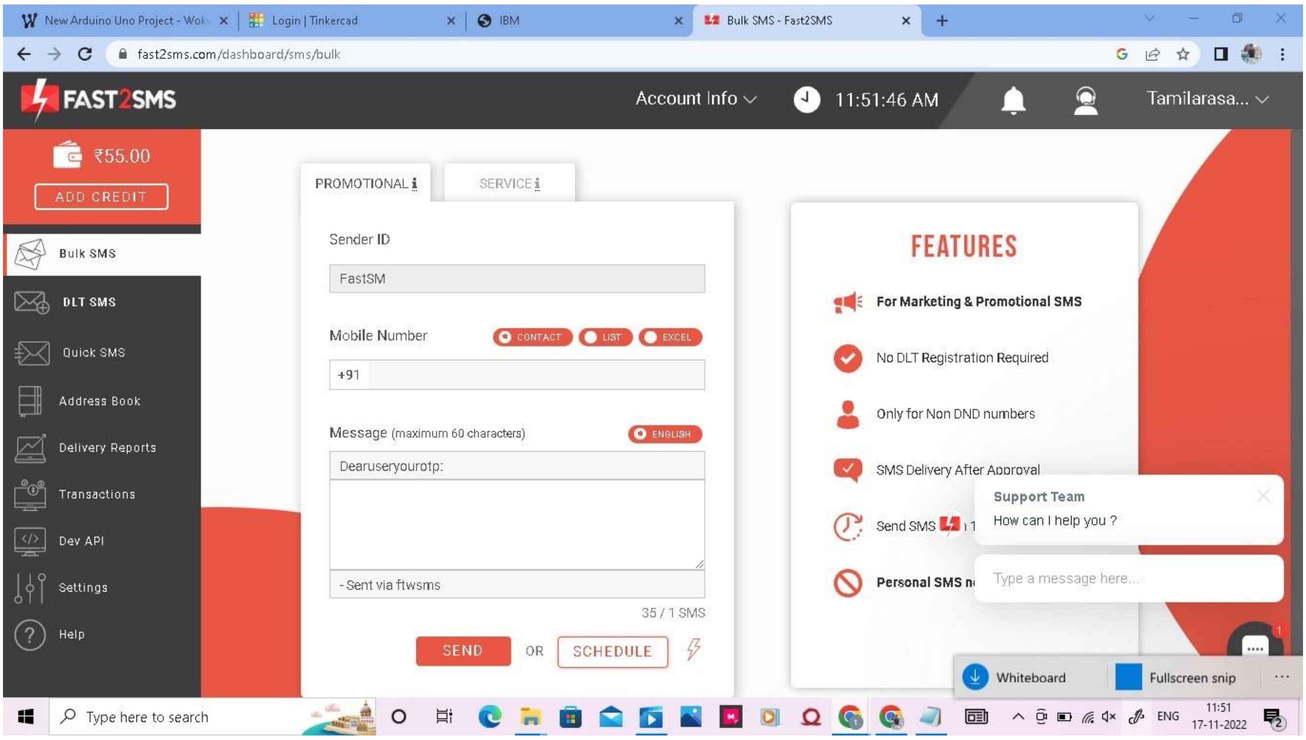


9. NODE RED AND FAST2SMS

9.1 Node Red:

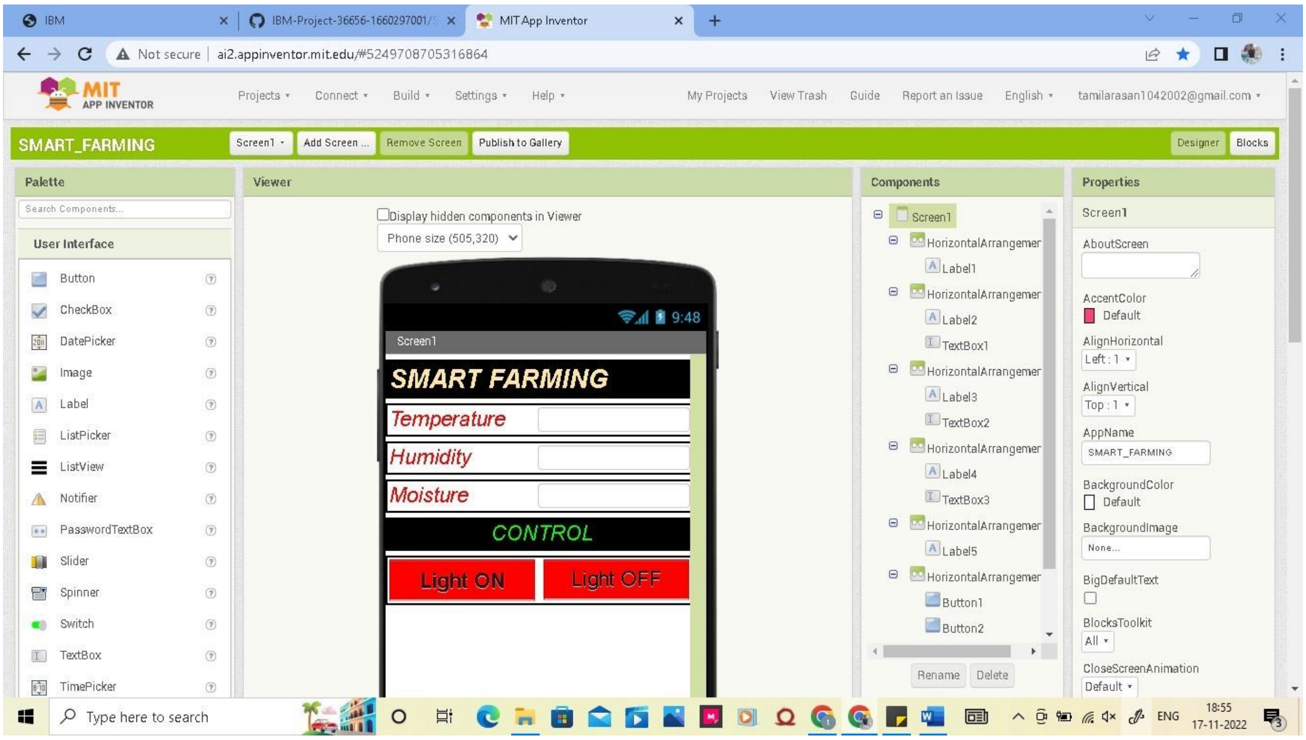


9.2 Fast2Sms:

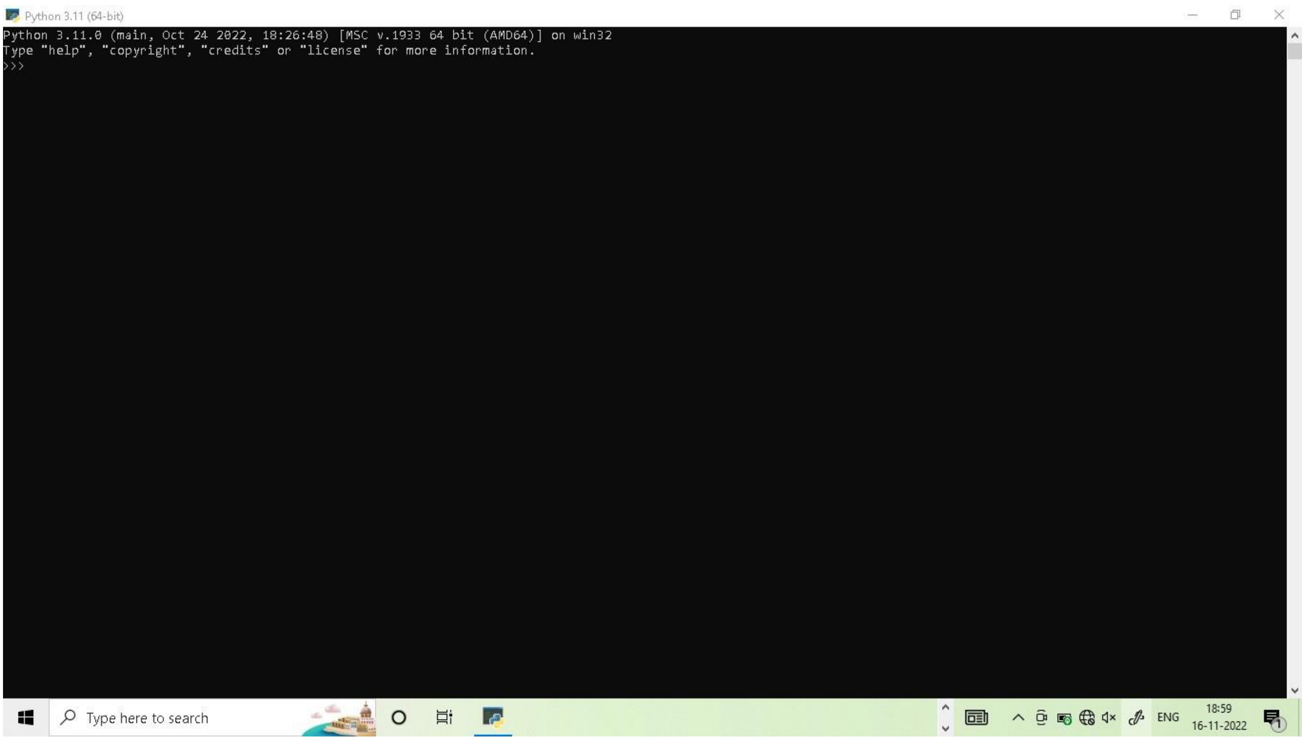


10. MIT APP AND PYTHON

10.1 MIT App:

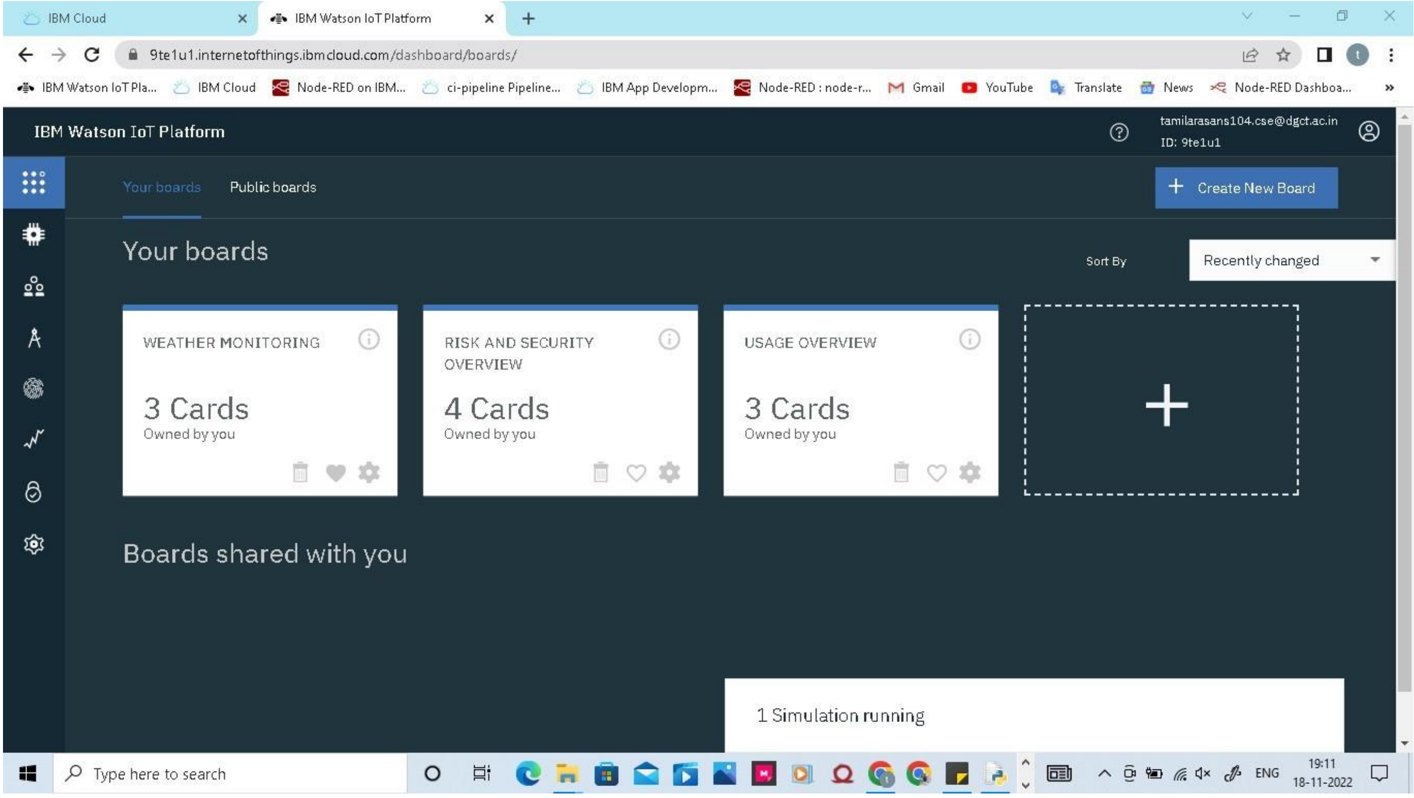


10.2 Python:

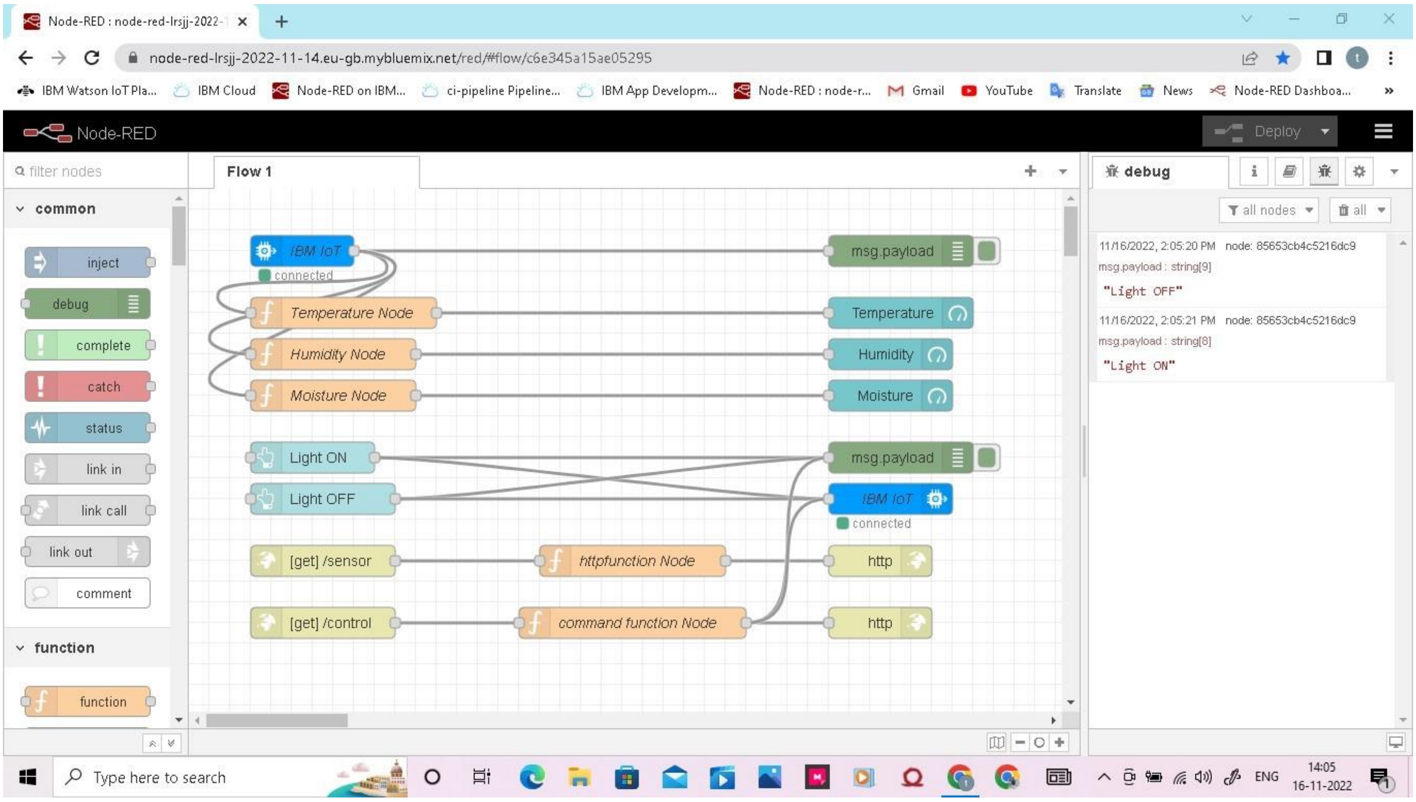


11. TESTING

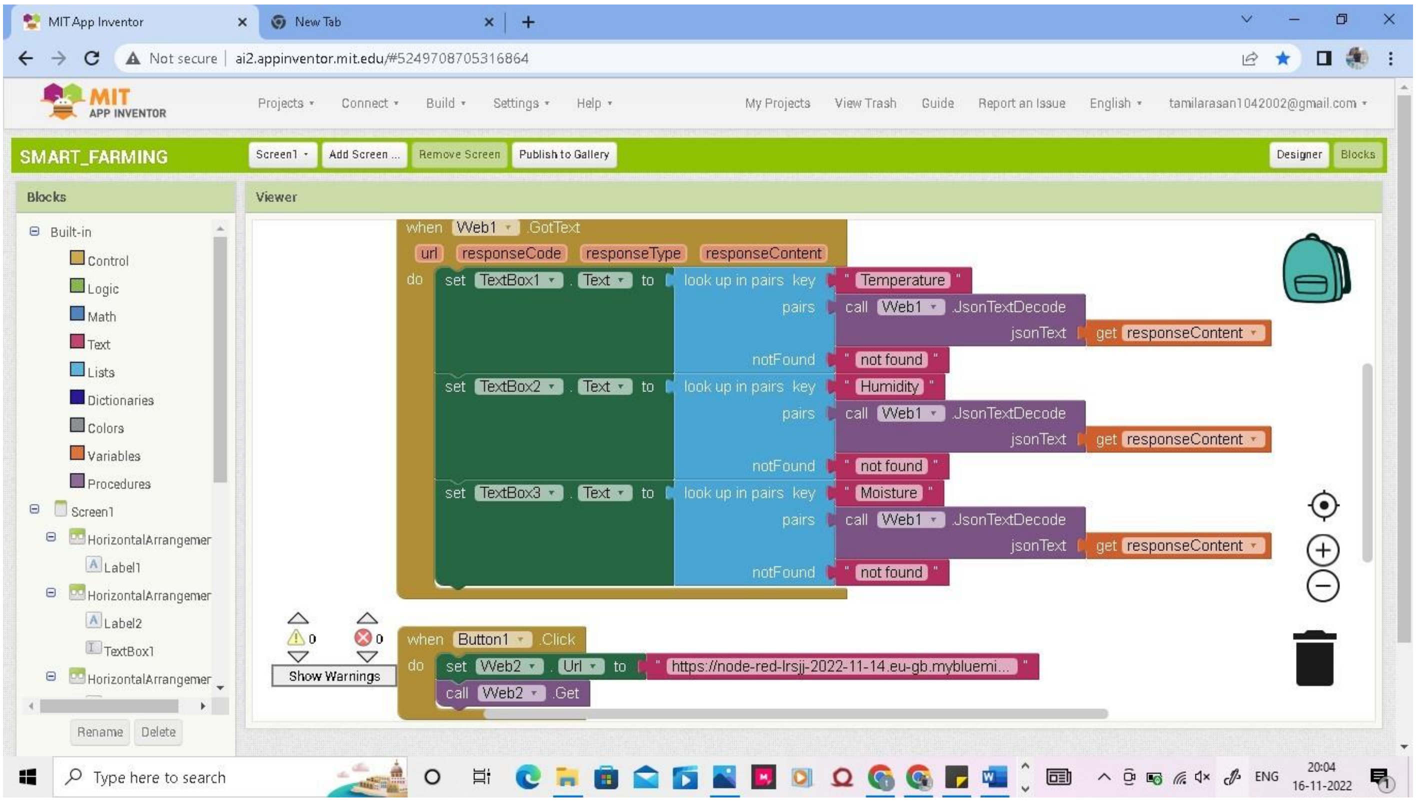
11.1 Watson:



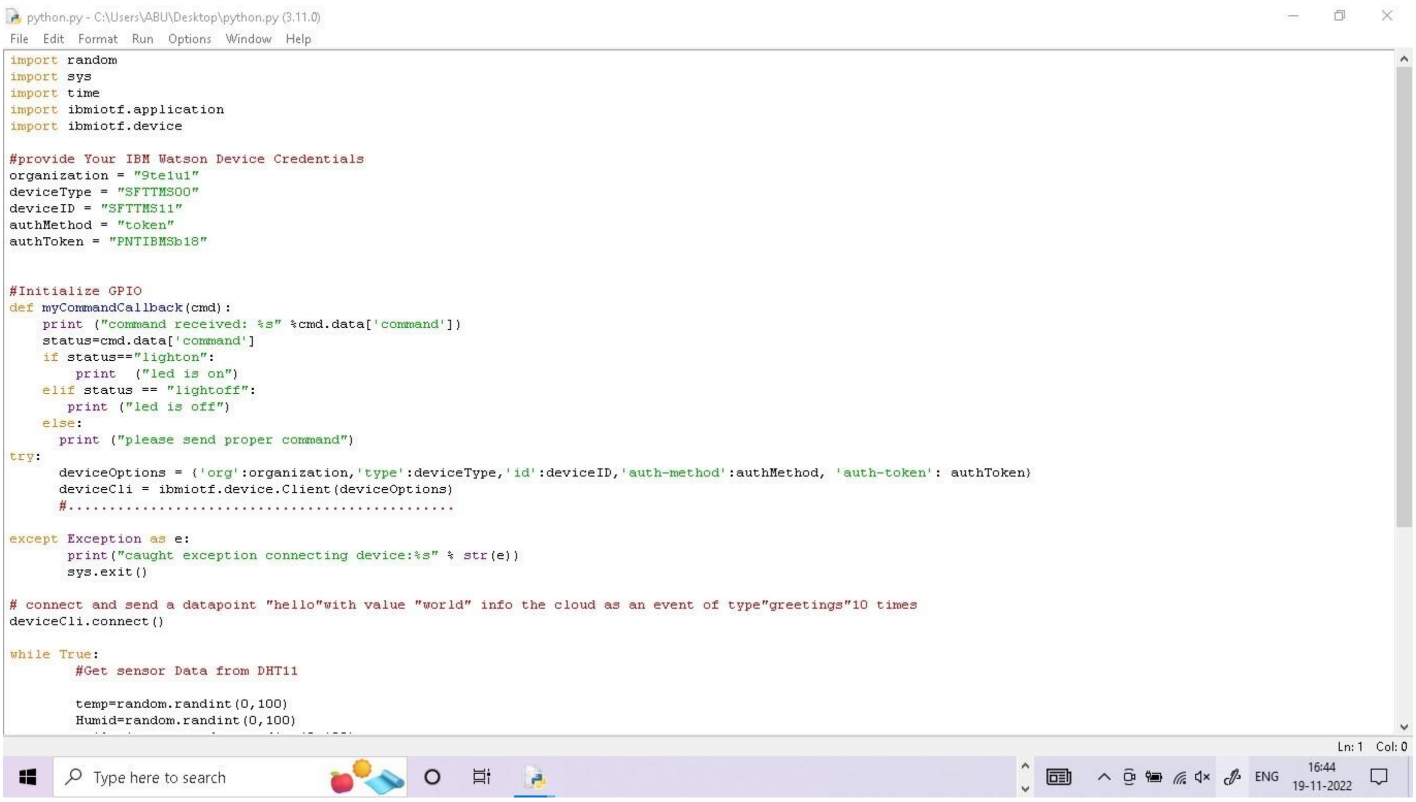
11.2 Node Red:



11.3 MIT App:



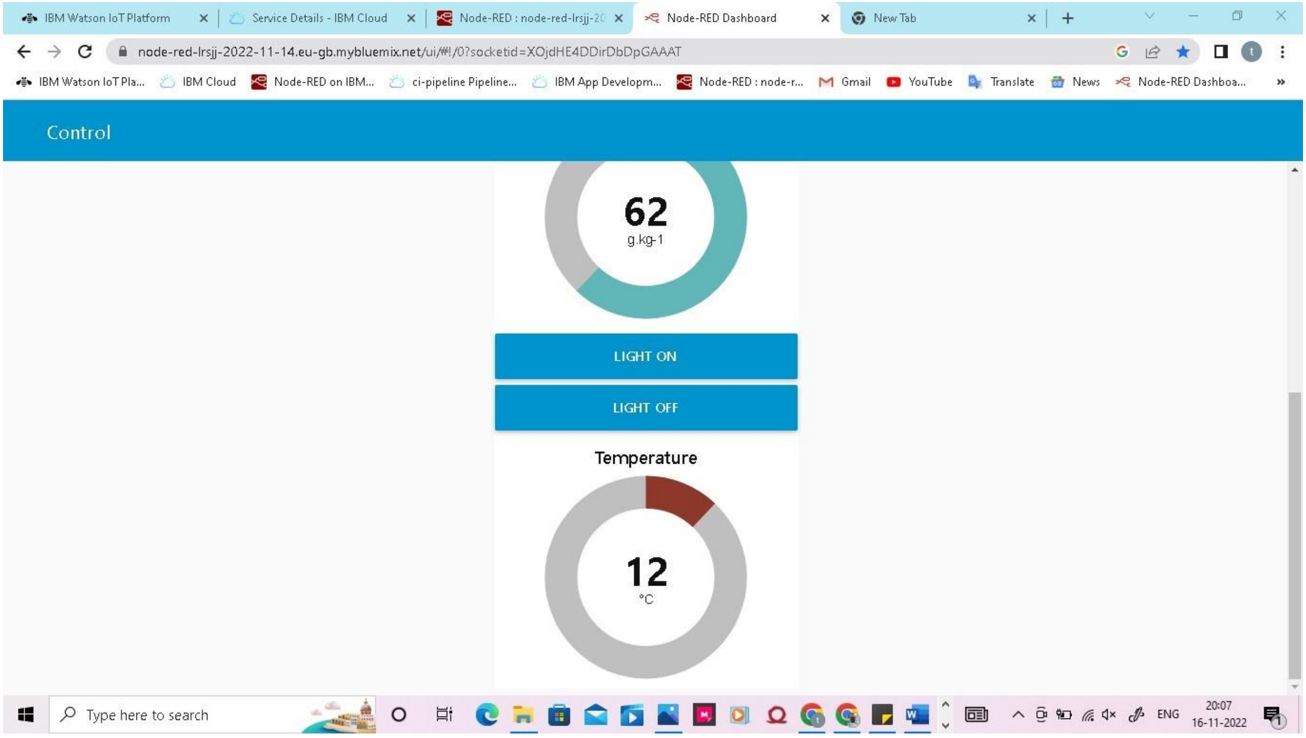
11.4 Python:



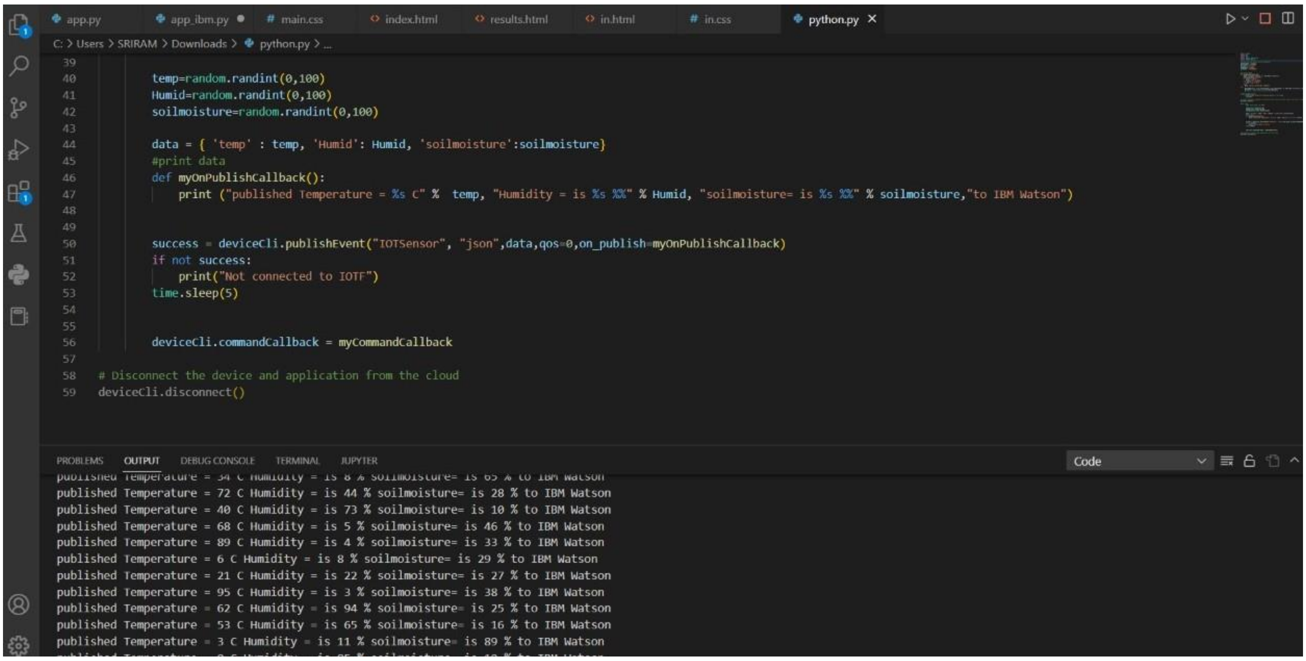
```python
import random
import sys
import time
import ibmiotf.application
import ibmiotf.device

#provide Your IBM Watson Device Credentials
organization = "9te1u1"
deviceType = "SFTTMS00"
deviceID = "SFTTMS11"
authMethod = "token"
authToken = "PNTIBMSb18"


#Initialize GPIO
def myCommandCallback(cmd):
    print ("command received: %s" %cmd.data['command'])
    status=cmd.data['command']
    if status=="lighton":
        print  ("led is on")
    elif status == "lightoff":
       print ("led is off")
    else:
      print ("please send proper command")
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" info the cloud as an event of type"greetings"10 times
deviceCli.connect()

while True:
        #Get sensor Data from DHT11

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

12. OUTCOME

12.1 Node Red:



12.2 Python:



12.3 MIT App:

2:05
33%
Screen1
SMART FARMING
Temperature
3
Humidity
12
Moisture
45
CONTROL
Light ON
Light OFF

13. ADVANTAGES & DISADVANTAGES

13.1 Advantages:

- A remote control system can help in working irrigation system valves dependent on schedule. Irrigating remote farm properties can be exceptionally troublesome and labor-intensive. It gets hard to comprehend when the valves were started and whether the ideal measure of water was distributed.

- For situations where a quick reaction is required, manual valve actuation may not be conceivable constantly. Thus, remote observing and control of irrigation systems, generators or wind machines or some other motor-driven hardware become the next logical step.

- Various solutions are available to monitor engine statistics and starting or stopping the engine. When the client chooses to begin or stop the motor, the program transmits a sign to the unit within seconds by means of a mobile phone system.

- Submersible weight sensors or ultrasonic sensors can screen the degree of tanks, lakes, wells and different kinds of fluid stockpiling like fuel and compost. The product figures volume dependent on the tank or lake geometry after some time. It conveys alarms dependent on various conditions.

13.2 Disadvantages:

- The smart agriculture needs availability of internet continuously. Rural part of most of the developing countries do not fulfil this requirement. More over internet connection is slower.

- The smart farming based equipment require farmers to understand and learn the use of technology. This is major challenge in adopting smart agriculture farming at large scale across the countries.

CONCLUSION

Farmers can benefit greatly from an IoT-based smart agriculture system. As a result of the lack of Farming irrigation, agriculture suffers. Climate factors such as humidity, temperature, and moisture can be adjusted dependent on the local environmental variables. This technology also detects animal invasions, which are a major cause of crop loss. This technology aids in the scheduling of irrigation based on present data from the field and records from a climate source. It helps in deciding the farmer to whether to do Smart farming irrigation or not to do. Continuous internet connectivity is required for continuous monitoring of data from sensors. This also can be overcome by using GSM unit as an alternative of mobile app. By GSM, SMS can be sent to farmer's phone.

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.

- In the current project we have implemented the project that can protect and maintain the crop. In this project the farmer monitor and control the field remotely. In future we can add or update few more things to this project.

- We can create few more models of the same project, so that the farmer can have information of an entire.

- We can update this project by using solar power mechanism. So that the power supply from electric poles can be replaced with solar panels. It reduces the power line cost. It will be a one-time investment. We can add solar fencing technology to this project.

- We can use GSM technology to this project so that the farmers can get the information directly to his home through SMS. This helps the farmer to get information if there is an internet issues.

- We can add camera feature so that the farmer can monitor his field in real time. This helps in avoiding thefts.

GITHUB LINK:

https://github.com/IBM-EPBL/IBM-Project-36656-1660297001