**SmartFarmer - IoT Enabled Smart Farming Application**

***Submitted by***

***AVINESH J                   2116190701025***

***DEENADHAYALAN K    2116190701031***

***CHARAN V                    2116190701028***

***VISHAL B                     2116190701250***

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**CHAPTER - 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.

**1.2 Purpose :**

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.

**CHAPTER - 2**

**LITERATURE SURVEY**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S.NO&TITLE** | **PROPOSED WORK** | **TOOLS USED(ALGORITHMS)** | **TECHNIQUE & COMMENT** | **ADVANTAGES&**  **DISADVANTAGES** |
| 1.Smart farm and monitoring system for measuring Environmental condition using wireless sensor network -IOT Technology in farming | In this proposed system, it mainly focused on  the soil moisture measuring system in the smart farm environment. Typically with modern generations, most of the people are not interested in working in the farm field. So automated soil moisture measuring system is necessary for the proposed smart farming system. | \*Mobile technology.  \*Wi-Fi  \*Event detection  \*Edge computing | \*Soil moisture measuring system.  \*Wireless sensor network.  \*Temperature monitoring system. | **Advantages:**  \*Real time monitoring system.  \*Field monitoring system.  \*Smart dashboard Mobile    **Disadvantages:**  \*Human interaction.  \*Water wastage.  \*Decision taking issues. |
| 2.Smart Farming-IoT inAgriculture | Traditional Farming & Precision Farming are very different from each other in every way. Traditional Farming uses the old and traditional methods of agriculture and using those old devices for work and growing seasonal crop without any pre assessment of demands in market, rates, weather reports of weather department etc. smart farming uses new technologies like smart connected devices , IoT sensors , Internet , Farmers chatting community , time to time assessment of various factors like best conditions for plant to grow, how much nutrients are needed , soil quality , water quality check. | \*Raw Data Analysis  \*Poly House.  \*Water Volume Sensor. | \*Water volume sensing.  \*Soil pH sensing.  \*Motion detection. | **Advantages:**  \*Use of smart phones and internet.  \*cost reduction using low end sensors.  **Disadvantages:**  \*Sectorial Issue.  \*Technological Issues.  \*Crop Management. |
| 3.Smart farming using IOT | This paper proposes smart farming by the aid of automation and IoT technology by implementing smart GPS based remote controlled vehicle that performs various tasks like monitoring fields to prevent thefts, scaring birds and animals, sensing soil moisture content, spraying fertilizers and pesticides, weeding, sensing soil moisture, etc. | \*zigbee modules  \*interfacing sensors  \*microcontroller  \*GPS module | \*Temperature Sensing  \*Humidity Sensing  \*soil moisture sensing | **Advantages:**  \*single centered control system  \*Real time monitoring system.        **Disadvantages:**  \*Human interaction.  \*high cost  \*Decision taking issues. |
| 4.Implement smart Farm with IOT Technology | In this paper, smart farm system using low power Bluetooth and Low Power Wide Area Networks (LPWAN) communication modules including the wired communication network used in the existing farm was constructed. In addition, the system implements the monitoring and control functions using the MQ Telemetry Transport (MQTT) communication method, which is an IoT dedicated protocol, thereby enhancing the possibility of development. | \*LPWAN  \*Bluetooth  \*RS845 Communication  \*MQTT | \*message using LPWAN | **Advantages:**  \*Low Powered  \*Livestock management    **Disadvantages:**  \*Data loss  \*interference by surroundings |

**2.1 Existing problem :**

The existing system only checks the soil water stress and automates the process of watering. This project is about IOT based smart farming and irrigation system. The ultimate agenda of this project is to automate the process of watering to plants. This work helps us to know the values of various parameters such as humidity, moisture and temperature of plants and water them accordingly.

**2.2 References :**

i) Vijaya Saraswathi R, Sridharani J, Saranya Chowdary P, Nikhil K, Sri Harshitha M, Mahanth Sai K, "Smart Farming: The IoT based Future Agriculture", 2022

ii) S. R. Prathibha, Anupama Hongal, M. P. Jyothi, "IOT Based Monitoring System in Smart Agriculture", 2017

iii) Muhammad Ayaz, Mohammad Ammad-Uddin, Zubair Sharif, Ali Mansour, El-Hadi M. Aggoune, "Internet-of-Things (IoT)-Based Smart Agriculture: Toward Making the Fields Talk", 2020

iv) M.S.D. Abhiram, Jyothsnavi Kuppili, N.Alivelu Manga, "Smart Farming System using IoT for Efficient Crop Growth", 2020

v) C. Mageshkumar, K.R. Sugunamuki, "IOT Based Smart Farming", 2020

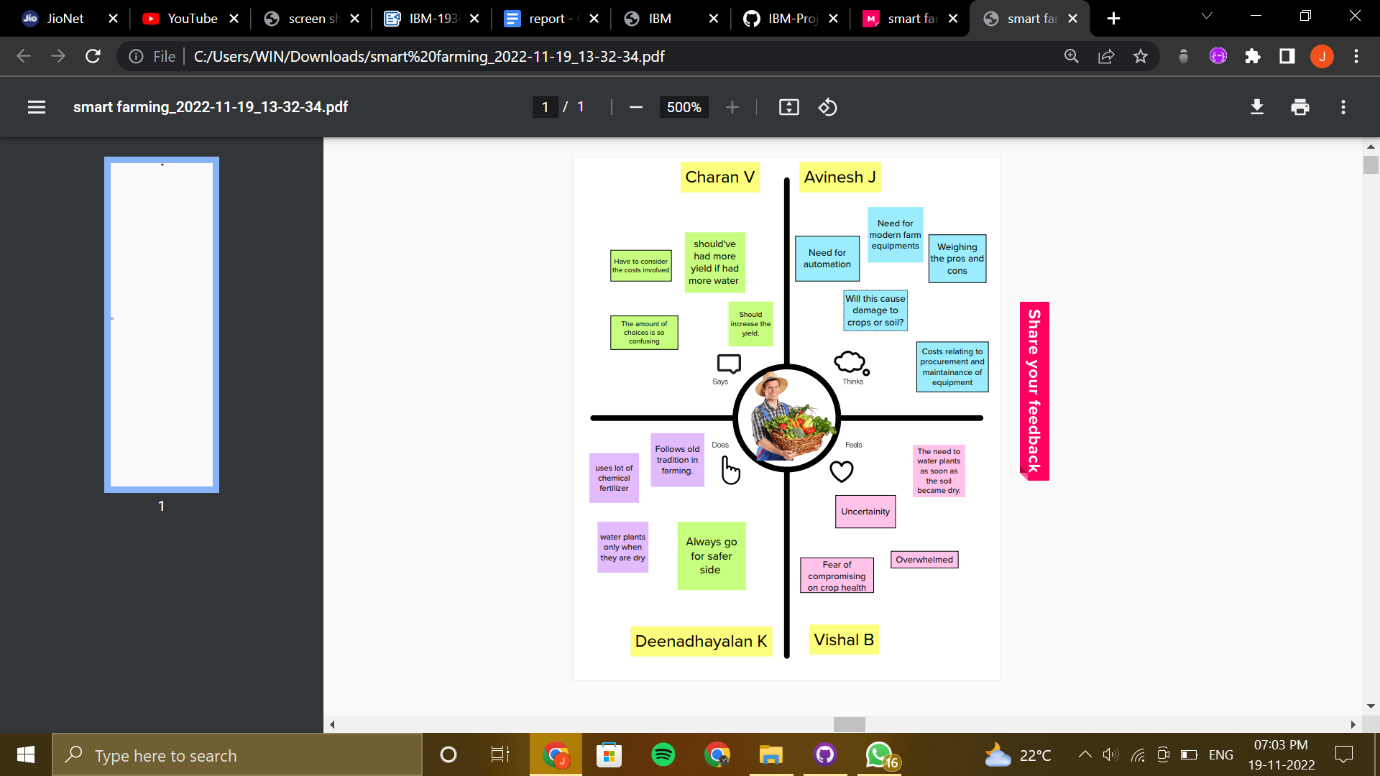
**2.3 Problem statement definition :**

To provide efficient decision web using wireless sensor network which handle different activities of farm and provides useful information associated with farm. Information associated with Soil moisture, Temperature and Humidity content. Due to the atmospheric condition, water level increasing Farmers get lot of distractions which isn't good for Agriculture. Water level is managed by farmers in both Automatic/Manual using that mobile application. it'll make easier to farmers. Performing agriculture is incredibly much time consuming.

**CHAPTER - 3**

**IDEATION AND PROPOSED SOLUTION**

**3.1 Empathy Map Canvas**



**3.2 Ideation and Brainstorming :**

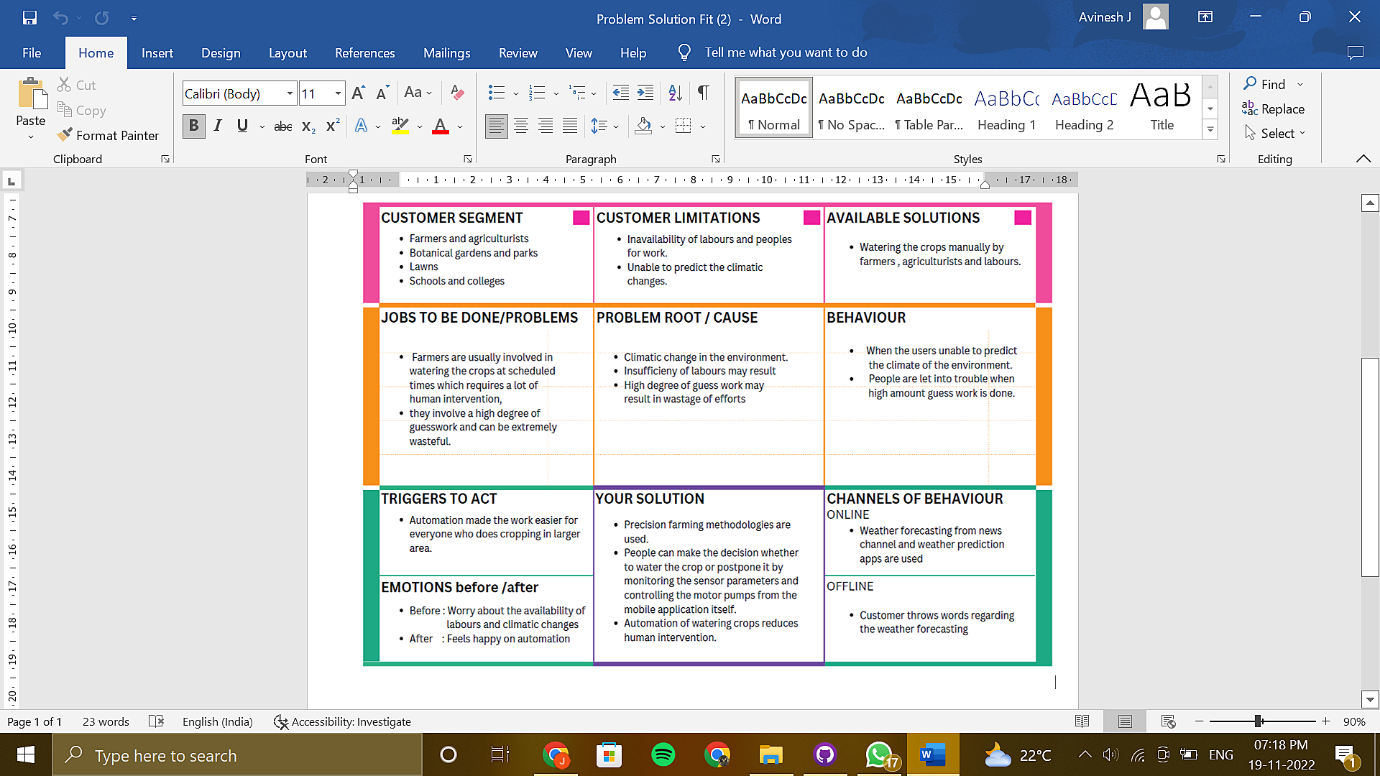
IoT smart agriculture products are designed to help monitor crop fields using sensors and by automating irrigation systems. As a result, farmers and associated brands can easily monitor the field conditions from anywhere without any hassle.



**3.3 Proposed Solution :**

Project team shall fill the followinginformation in proposedsolution template.

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Parameter** | **Description** |
| 1. | Problem Statement (Problem to be  solved) | India is a Global agricultural powerhouse which is considered as the key for Human Progress. Farmers are usually involved in watering the crops at scheduled times which requires a lot of human intervention, they involve a high degree of guesswork and can be extremely wasteful. |
| 2. | Idea / Solution description | We can use precision farming methodologies. 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. Automation of watering crops reduces human intervention. |
| 3. | Novelty / Uniqueness | Smart agriculture farming system is a new idea of farming in agriculture, because which uses IOT technology to monitor the crop 24/7 and sends the information to the cloud. This emerging system increases the quality and quantity of agricultural products. IOT technology provides the information about farming fields and then takes action depending on the farmer input. |
| 4. | Social Impact / Customer Satisfaction | Weather forecasts and sensors that measure soil moisture mean watering only when necessary and for the right length of time. |
| 5. | Business Model (Revenue Model) | IOT in business can instruct systems to autonomously execute transactions in supply chains when certain conditions have been met. Increase productivity and reliability in real time environment |
| 6. | Scalability of the Solution | The ability to increase available resources and system capability without the need to go through a major system redesign . |

**3.4 Problem Solution Fit :**

**CHAPTER - 4**

**REQUIREMENT ANALYSIS**

**4.1 Functional Requirements :**

Following are the functional requirements of the proposed solution.

|  |  |  |
| --- | --- | --- |
| **FR No.** | **Functional Requirement (Epic)** | **Sub Requirement (Story/ Sub-Task)** |
| FR-1 | User Registration | Registration through Form  Registration through Gmail Registration through Linked In |
| FR-2 | User Confirmation | Confirmation via Email  Confirmation via OTP |
| FR-3 | User Profile | Log in  Access the Profile |
| FR-4 | Analyze | Data from smart sensors canbe analyzed for predictive  analysis and automated decision-making. |
| FR-5 | Recommend | Based on the farmingthe software recommends the  automated irrigation practices. |

**4.2  Non-Functional Requirements :**

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

|  |  |  |
| --- | --- | --- |
| **FR No.** | **Non-Functional Requirement** | **Description** |
| NFR-1 | **Usability** | End users can monitor and control their connected farm usingIOT applications on their smartphones or  tablets. |
| NFR-2 | **Security** | Thesoftware keeps the user’s information more  securely. |
| NFR-3 | **Reliability** | The smart farm, embedded with IOT systems, could be called a connected farm, which can support a wide rangeof devices from diverse agricultural  device manufactures. |
| NFR-4 | **Performance** | Itis a user-friendly software and have high  performance. |
| NFR-5 | **Availability** | Available for every user,visible for all users and  farmer. |
| NFR-6 | **Scalability** | The proposed precision farming structure allows the implementation of a flexible methodology that can  be adopted to different typesof crops. |

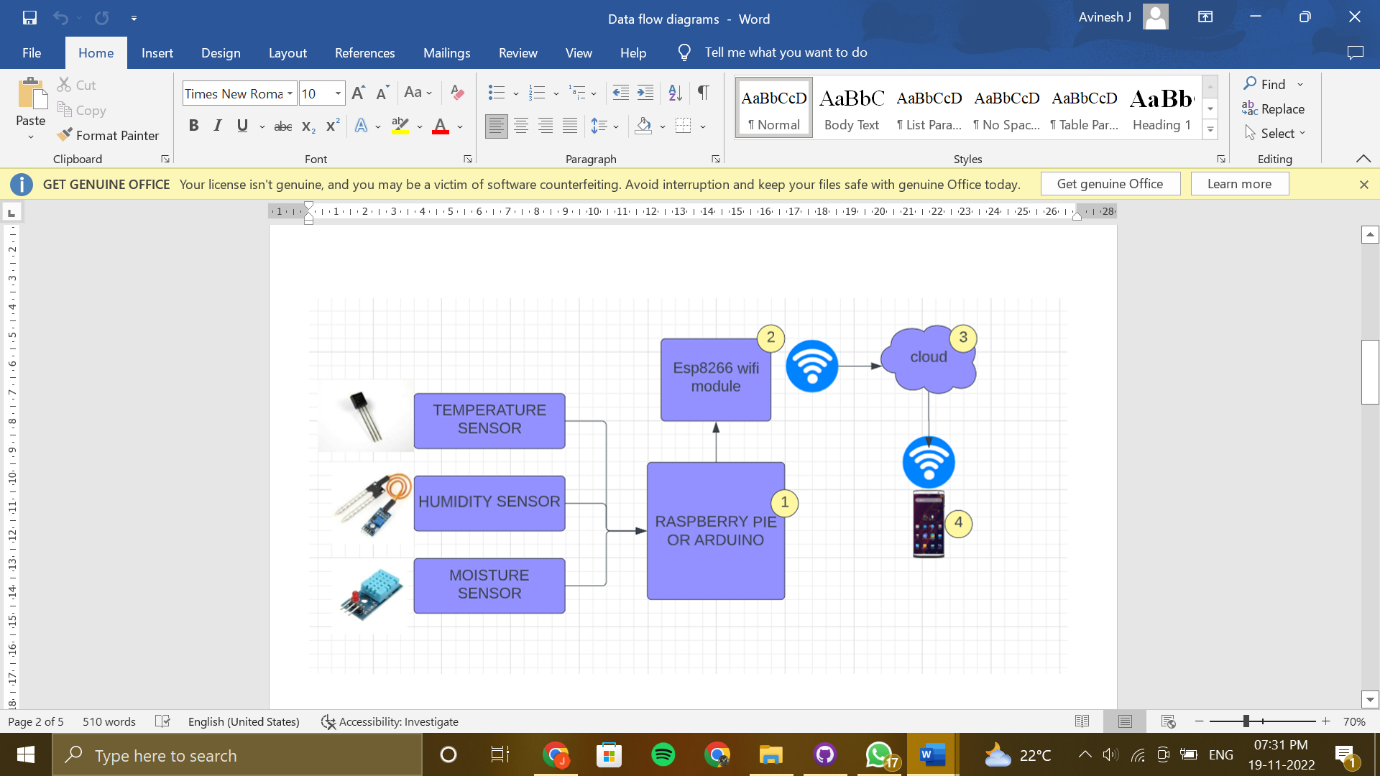
**CHAPTER - 5**

**PROJECT DESIGN**

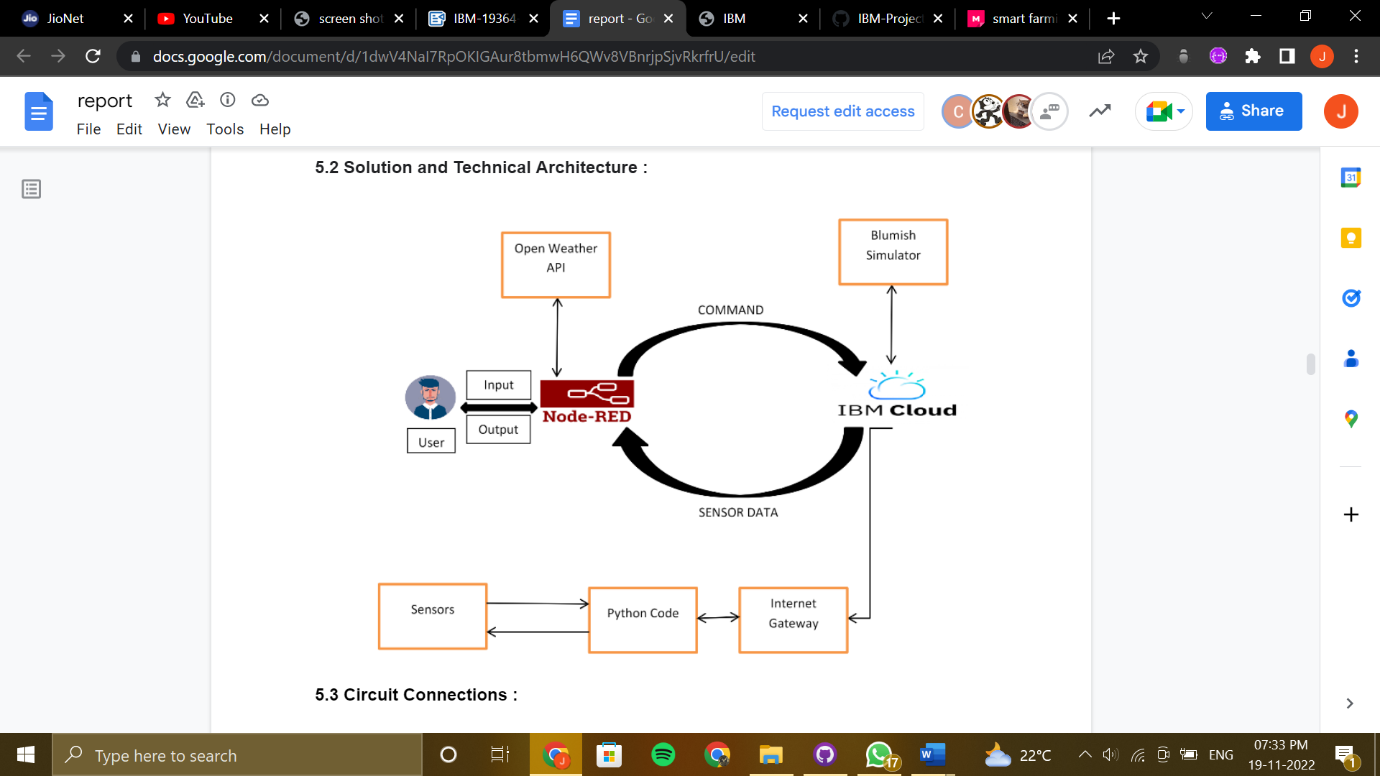
**5.1 Data Flow Diagrams :**

     The classic visual depiction of how information moves through a system is a data flow diagram (DFD). A tidy and understandable DFD may visually represent the appropriate quantity of the system demand. It demonstrates how information enters and exits the system, what modifies the data, and where information is kept.

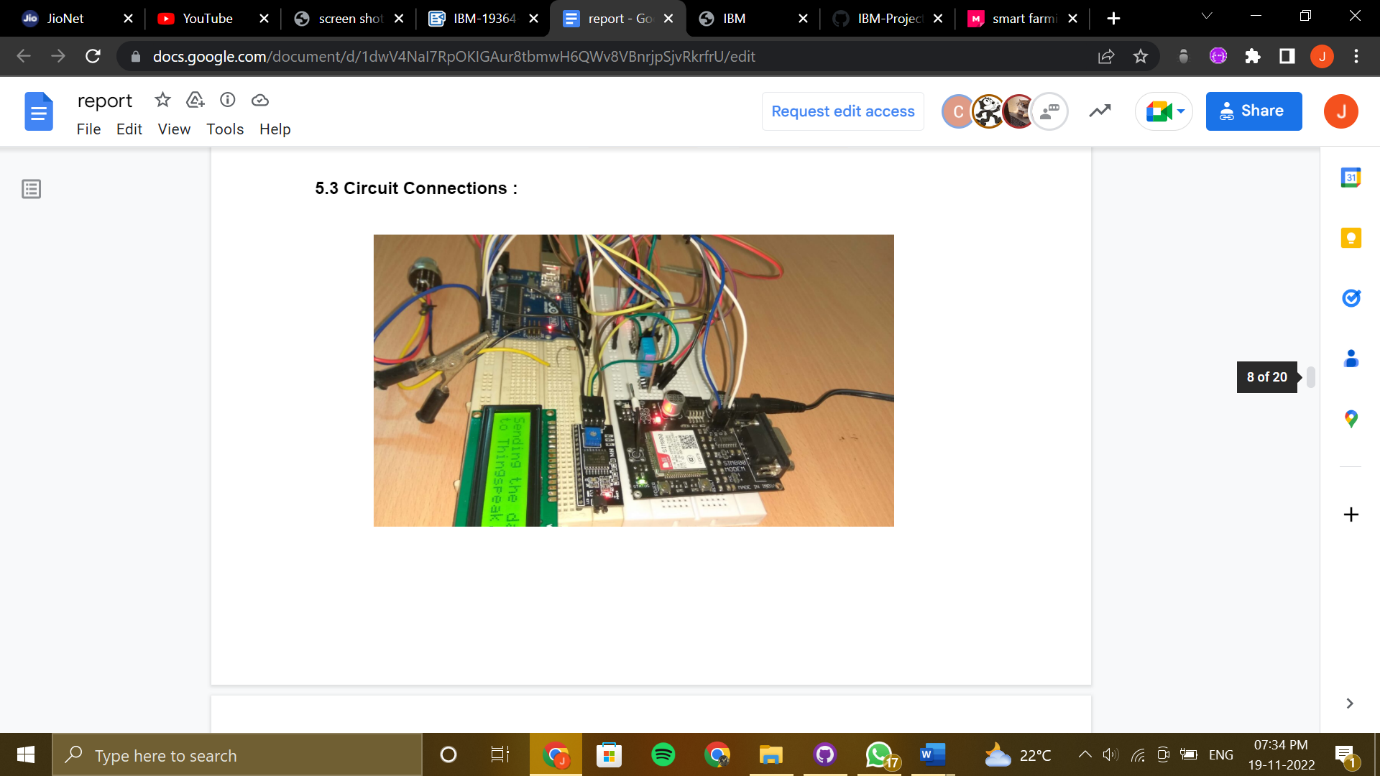
1. Get the inputs from different sensorssuch as Moisture Sensor, HumiditySensor, Temperature Sensor.Data from the sensorsare given as inputs to the microcontroller - Arduino or RaspberryPi
2. Data are feed into the cloud storage using wi-fi module.
3. MQTT-Message QueuingTelemetry Transport Protocol is used to orderdata in FIFO fashion.
4. App is Used to create our own to IOT software according to our specifications where we can able to monitor and control the device.



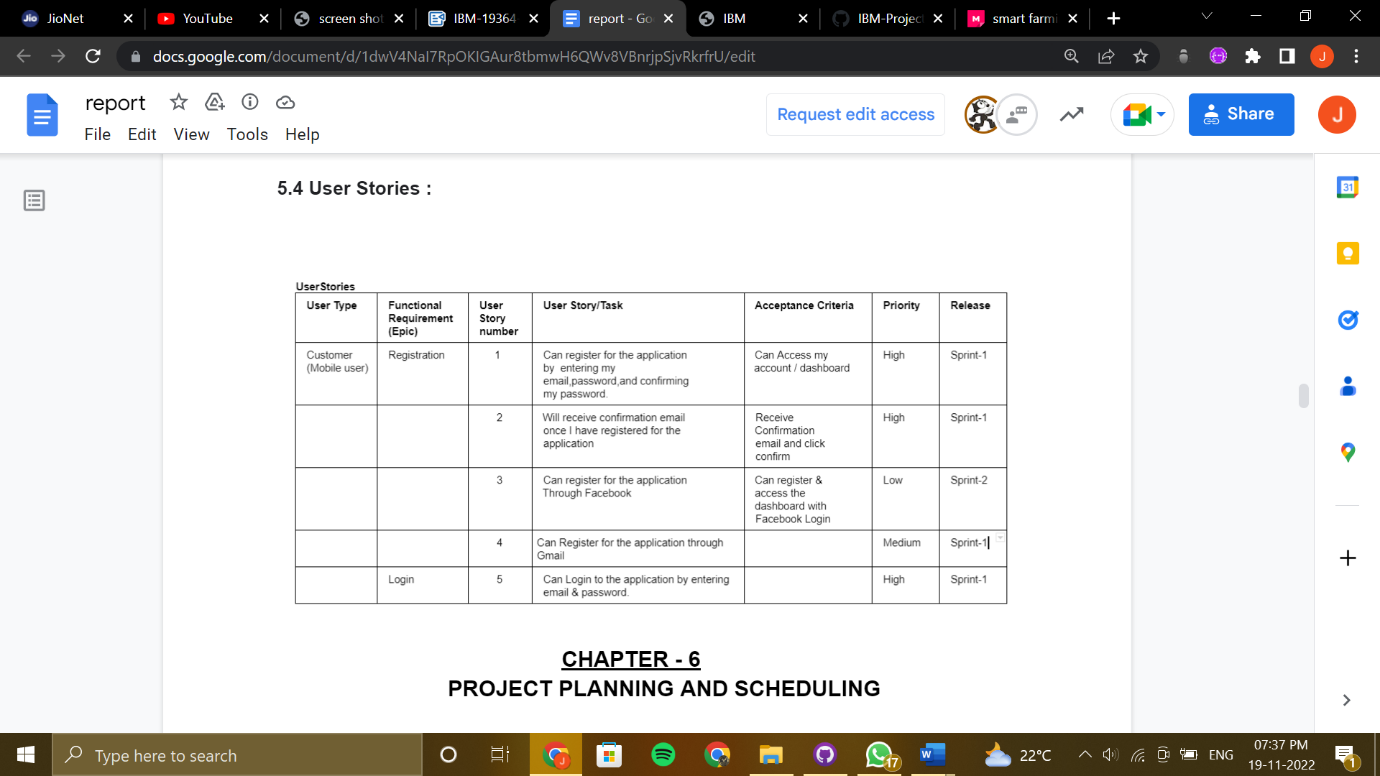
**5.2 Solution and Technical Architecture :**



**5.3 Circuit Connections :**



**5.4 User Stories :**



**CHAPTER - 6**

**PROJECT PLANNING AND SCHEDULING**

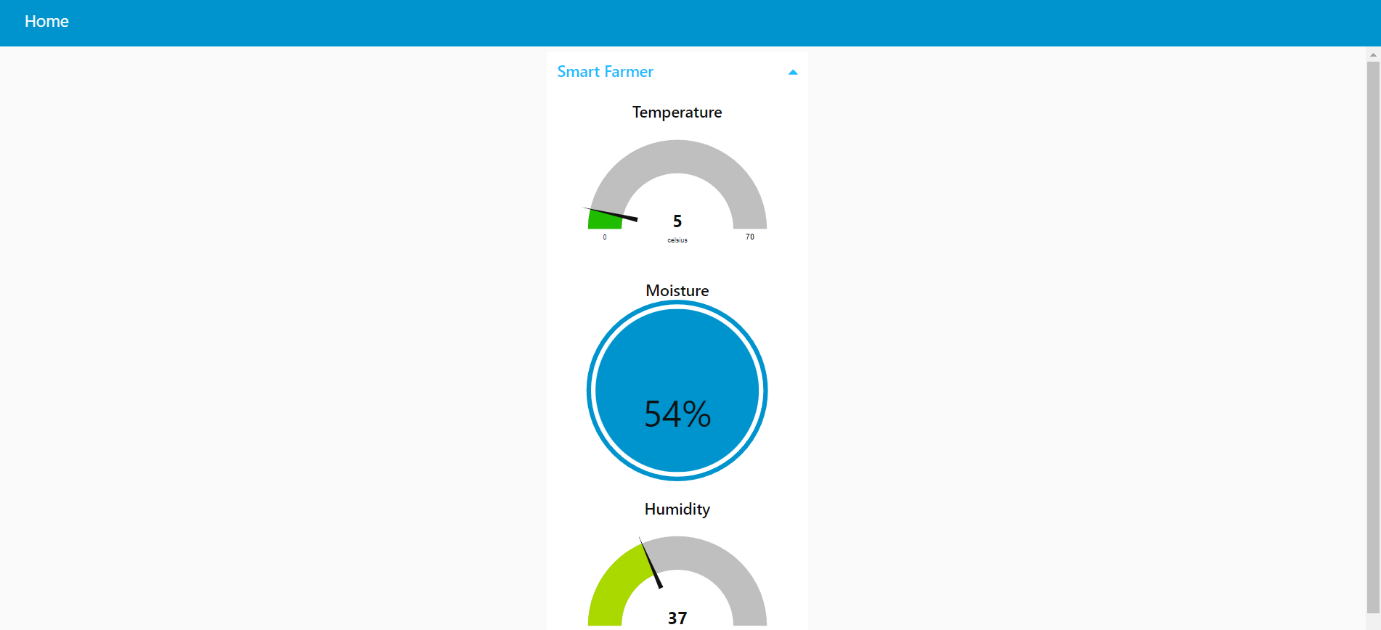
**6.1 Sprint Planning and Estimation :**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sprint** | **Functional Requirement (Epic)** | **User Story Number** | **User Story / Task** | **Story Points** | **Priority** | **Team Members** |
| Sprint-1 | Simulation creation | USN-1 | Connect Sensors and Arduino withpython code | 2 | High | Deenadhayalan, Vishal,  Avinesh |
| Sprint-2 | Software | USN-2 | Creating device in the IBM Watson IOT platform, workflow for IOT scenarios using Node-Red | 2 | High | Avinesh , Vishal, Charan |
| Sprint-3 | MIT App Inventor | USN-3 | Develop an application forthe Smart farmerproject using MIT App Inventor | 2 | High | Deenadhayalan,  Avinesh , Charan |
| Sprint-3 | Dashboard | USN-3 | Design the Modules and test the app | 2 | High | Vishal,  Deenadhayalan, Charan |
| Sprint-4 | Web UI | USN-4 | To make the userto interact withsoftware. | 2 | High | Deenadhayalan, Avinesh , Vishal |

**6.2 Sprint Delivery Schedule :**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **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 | 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 Nov 2022 |
| Sprint-3 | 20 | 6 Days | 07 Nov 2022 | 12 Nov 2022 |  | 12 Nov 2022 |
| Sprint-4 | 20 | 6 Days | 14 Nov 2022 | 19 Nov 2022 |  | 19 Nov 2022 |

**6.3 Reports from JIRA :**



**CHAPTER - 7**

**CODING AND SOLUTIONING**

**7.1 Feature 1 (Arduino - Temperature Sensor) :**

float temp;

int tempPin = 0;

void setup() {

   Serial.begin(9600);

}

void loop() {

   temp = analogRead(tempPin);

   // read analog volt from sensor and save to variable temp

   temp = temp \* 0.48828125;

   // convert the analog volt to its temperature equivalent

   Serial.print("TEMPERATURE = ");

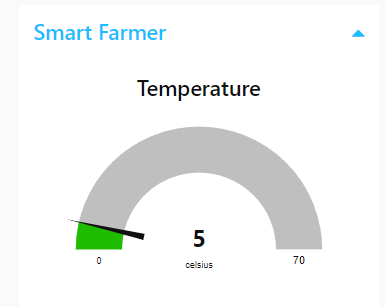
   Serial.print(temp); // display temperature value

   Serial.print("\*C");

   Serial.println();

   delay(1000); // update sensor reading each one second

}



**7.2 Feature 2 (Arduino - Humidity Sensor) :**

DHT dht(DHTPIN, DHTTYPE);

void setup() {

   Serial.begin(9600);

   Serial.println("DHTxx test!");

   dht.begin();

}

void loop() {

   delay(2000); // Wait a few seconds between measurements

   float h = dht.readHumidity();

   // Reading temperature or humidity takes about 250 milliseconds!

   float t = dht.readTemperature();

   // Read temperature as Celsius (the default)

   float f = dht.readTemperature(true);

   // Read temperature as Fahrenheit (isFahrenheit = true)

   // Check if any reads failed and exit early (to try again).

   if (isnan(h) || isnan(t) || isnan(f)) {

      Serial.println("Failed to read from DHT sensor!");

  return;

   }

   // Compute heat index in Fahrenheit (the default)

   float hif = dht.computeHeatIndex(f, h);

   // Compute heat index in Celsius (isFahreheit = false)

   float hic = dht.computeHeatIndex(t, h, false);

   Serial.print ("Humidity: ");

   Serial.print (h);

   Serial.print (" %\t");

   Serial.print ("Temperature: ");

   Serial.print (t);

   Serial.print (" \*C ");

   Serial.print (f);

   Serial.print (" \*F\t");

   Serial.print ("Heat index: ");

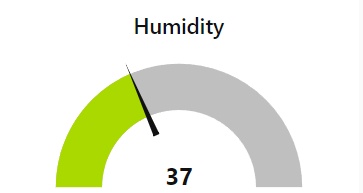
   Serial.print (hic);

   Serial.print (" \*C ");

   Serial.print (hif);

   Serial.println (" \*F");

}



**7.3 Feature 3 (Arduino - Moisture Sensor) :**

int sensorPin = A0;

int sensorValue;

int limit = 300;

void setup() {

Serial.begin(9600);

pinMode(13, OUTPUT);

}

void loop() {

sensorValue = analogRead(sensorPin);

Serial.println("Analog Value : ");

Serial.println(sensorValue);

if (sensorValue<limit) {

digitalWrite(13, HIGH);

}

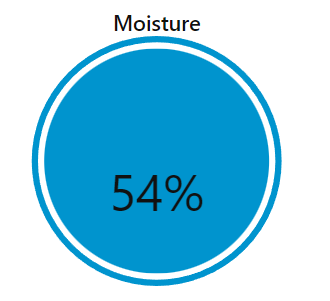
else {

digitalWrite(13, LOW);

}

delay(1000);

}



**CHAPTER - 8**

**TESTING**

**8.1 Test Cases :**

* Check the functioning condition of **Temperature** sensor
* Verify the proper functioning of **Humidity** sensor
* Check the working condition of **soil moisture** sensor
* Check the [**Performance**](https://www.testrigtechnologies.com/service/performance-testing/) **of the app** on the various internet networks
* Check whether the application is working for **real-time updates**
* Detect **response** when a Login Button is pressed

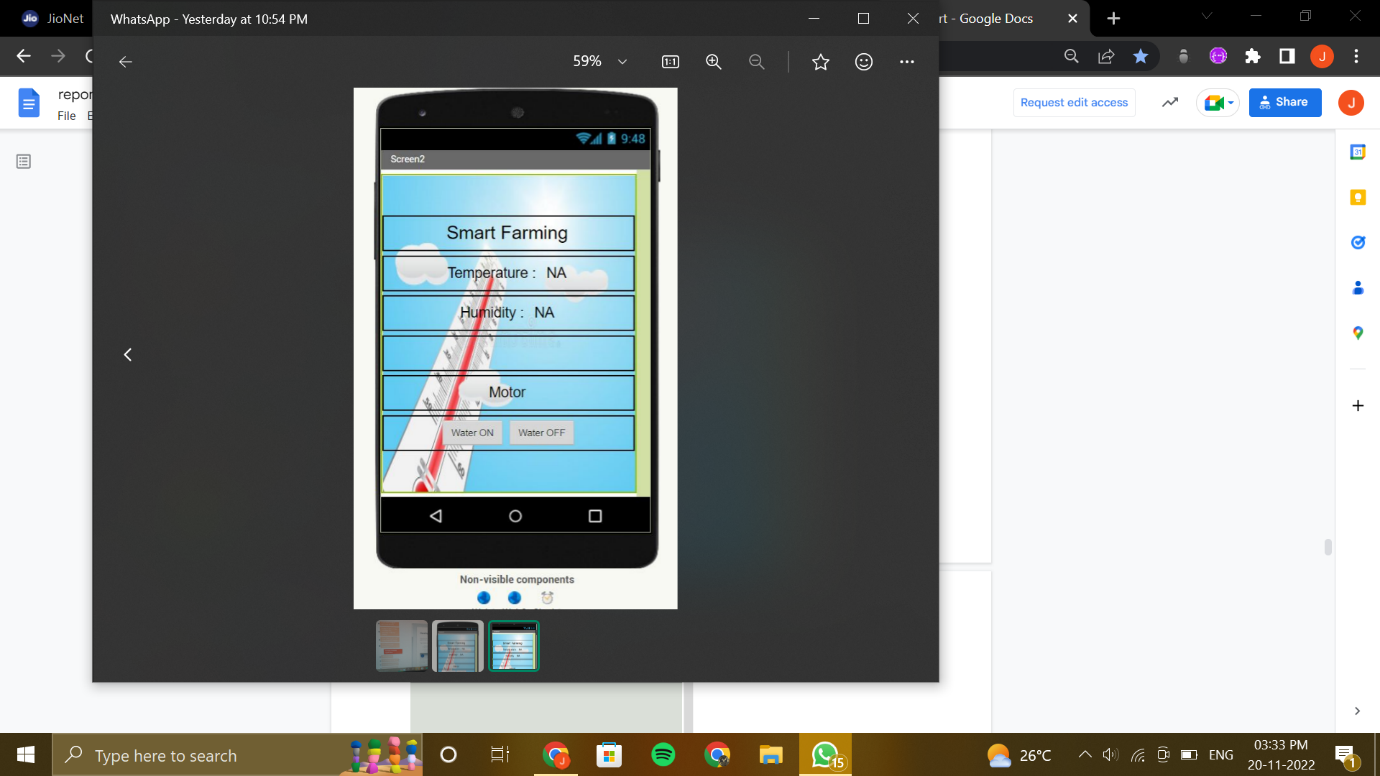
**8.2 User Acceptance Testing :**

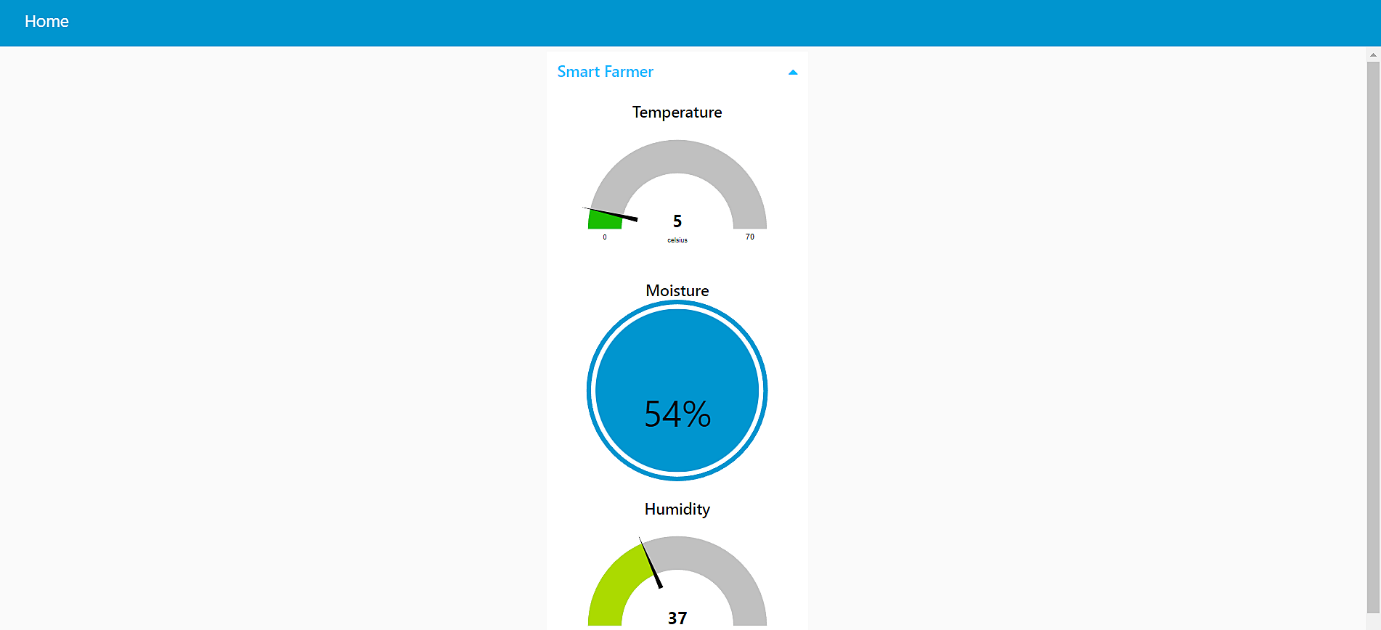
This smart farming using IoT system powered by NodeMCU consists of a DHT11 sensor, Moisture sensor, DS18B20 Sensor Probe, LDR, Water Pump, and 12V led strip. When the IoT-based agriculture monitoring system starts, it checks the Soil moisture, temperature, humidity, and soil temperature. It then sends this data to the IoT cloud for live monitoring and the farmers can monitor the information through this mobile application.If the soil moisture goes below a certain level, it automatically starts the water pump. We already know [Automatic Plant Irrigation System](https://circuitdigest.com/microcontroller-projects/arduino-automatic-plant-watering-system)which sends alerts on mobile but doesn’t monitor other parameters. Apart from this, [Rain alarm](https://circuitdigest.com/electronic-circuits/rain-alarm-project) and [soil moisture detector circuit](https://circuitdigest.com/electronic-circuits/soil-moisture-sensor-circuit-diagram) can also be helpful in building Smart faming System.

**CHAPTER - 9**

**RESULTS**

**9.1 Performance Metrices :**





**CHAPTER - 10**

**ADVANTAGES AND DISADVANTAGES**

**Advantages :**

* Farms can be monitored and controlled remotely.
* Increase in convenience to farmers.
* Less labor cost.
* Better standards of living.

**Disadvantages :**

* Lack of internet/connectivity issues.
* Added cost of internet and internet gateway infrastructure.
* Farmers wanted to adapt the use of Mobile App.

**CHAPTER - 11**

**CONCLUSION**

IoT will help to enhance smart farming. Using IoT the system can predict the soil moisture level and humidity so that the irrigation system can be monitored and controlled. IoT works in different domains of farming to improve time efficiency, water management, crop monitoring, soil management and control of insecticides and pesticides. This system also minimizes human efforts, simplifies techniques of farming and helps to gain smart farming. Besides the advantages provided by this system, smart farming can also help to grow the market for farmers with single touch and minimum effort.

**CHAPTER - 12**

**FUTURE SCOPE**

The project has vast scope in developing the system and making it more user friendly and the additional features of the system like:

* By installing a webcam in the system, photos of the crops can be captured and the data can be sent to database.
* Speech based option can be implemented in the system for the people who are less literate.
* GPS (Global Positioning System) can be integrated to provide specific location of the farmer and more accurate weather reports of agriculture field and garden.
* Regional language feature can be implemented to make it easy for the farmers who are aware of only their regional language.

**CHAPTER - 13**

**APPENDIX**

**Source code**

import time

import sys

import ibmiotf.application

import ibmiotf.device

import random

# Provide your IBM Watson Device Credentials

"orgId": "ck2tfo",

"typeId": "NodeMLIC",

"deviceId": "1234"

"token" : "87654321"

# Initialize GPIO

def myCommandCallback(cmd): print("Command

received: %s" % cmd.data['command'])

status=cmd.data['command'] if status=="motoron":

print ("motor is on") elif status == "motoroff": print

("motor 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" into the cloud as an event of type "greeting" 10 times deviceCli.connect()

while True:

#Get Sensor Data from

DHT11

temp=random.randint(90,110)

Humid=random.randint(60,100)

Mois=random. Randint(20,120)

data = { 'temp' : temp, 'Humid': Humid , ‘Mois’: Mois}

#print data def

myOnPublishCallback(

):

print ("Published Temperature = %s C" % temp, "Humidity = %s %%" %Humid, “Moisture =%s deg c” % Mois “to IBM Watson")

success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,on\_publish=myOnPublishCallback) if not success: print("Not connected to IoTF")

time.sleep(10)

deviceCli.commandCallback = myCommandCallback #

Disconnect the device and application from the cloud

deviceCli.disconnect()

**Github Link:**

<https://github.com/IBM-EPBL/IBM-Project-19364-1659696642>

**Demo Link:**

https://drive.google.com/file/d/1QPGSF-ShIo8OEY7LH86XZG1CdnbEUtK7/view