SMART FARMER-IOT ENABLED SMART FARMING APPLICATION

PNT2022TMID43020

IBM PROJECT REPORT

Submitted by

NITHISHKUMAR B (713119104012)

PUSHPANATHAN U (713119104014)

SOWNTHAR RAJAN T (713119104018)

MADHUHASAN L (713119205004)

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COIMBATORE - 641 109

ANNA UNIVERSITY :: CHENNAI 600 025

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ABSTRACT

The growth of the global population coupled with a decline in natural resources, farmland, and the increase in unpredictable environmental conditions leads to food security is becoming amajor concern for all nations worldwide. These problems are motivators that are driving the agricultural industry to transition to smart agriculture with the application of the Internet of Things (IoT) and big data solutions to improve operational efficiency and productivity. The IoT integrates a series of existing state-of-the-art solutions and technologies, such as wireless sensor networks, cognitive radio ad hoc networks, cloud computing, big data, and end-user applications. This study presents a survey of IoT solutions emon strates how IoT can be integrated into the smart agriculture sector. Tachieve this objective, we discuss the vision of IoT-enabled smart agriculture ecosystems by evaluating their architecture (IoT devices, communication technologies , big data storage, and processing), their applications, and research timeline. In addition, we discuss trends and opportunities of IoT applications for smart agriculture and also indicate the open issues and challenges of IoT application in smart agriculture. We hope that the findings of this study will constitute important guidelines in research and promotion of IoT solutions aiming to improve the productivity and quality of the agriculture sector as well as facilitating the transition towards a future sustainable environment with an agroecological approach.

1.INTRODUCTION

1.1 Project overview

The objectives of this report is to proposed IoT based Smart Farming System which will enable farmers to have live data of soil moisture environment temperature at very low cost so that live monitoring can be done. The structure of the report is as follows: chapter I will cover over of overview of IoT Technology and agriculture-concepts and definition, IOT enabling technologies, IOT application in agriculture, benefits of IOT in agriculture and IOT and agriculture current scenario and future forecasts. Chapter II will cover definition of IOT based smart farming system , the components and modules used in it and working principal of it. Chapter III will cover algorithm and flowchart of the overall process carried out in the system and its final graphical output .chapter IV consist of conclusion, future scope and references.

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

2.1 Existing problem:

Farmers need to deal with many problems, including how to:

- Cope with climate change, soil erosion and biodiversity loss
- Satisfy consumers' changing tastes and expectations
- Meet rising demand for more food of higher quality
- Invest in farm productivity
- Adopt and learn new technologies
- Stay resilient against global economic factors
- Inspire young people to stay in rural areas and become future farmers

2.2 References

1.Wheeler T, von Braun J (2013) Climate change impacts on global food security. Science34180):508513(tps//doi.org/10.1126/science.1239402)

2. Fountas S, Carli G, Sørensen CG, Tsiropoulos Z, Cavalaris C, Vatsanidou A, Liakos B, Canavari M, Wiebensohn J, Tisserye B (2015) Farm management information systems: current situation and future perspectives. https://doi.org/10.1016/J.COMPAG. 2015.05.011

3. Pivoto D, Waquil PD, Talamini E, Finocchio CPS, Dalla Corte VF, de Vargas Mores G (2018) Scientific development of smart farming technologies and their

application in Brazil. Inf Process Agric 5:21–32. https:/ /doi.org/10.1016/ J.INPA.2017.12.002

4. Supreetha MA, /Mundada MR, Pooja JN (2019) Design of a smart water-saving irrigation system for agriculture based on a wireless sensor network for better crop yield.93104 https: //doi.org/101007/978-98.1-13-0212-1 11

5. Prabakar C, Devi KS, Selvam S (2011) Labour scarcity—its immensity and impact on agriculture. Agric Econ ResZ:373-380

6. Autonomous technology is steering a new agricultural revolution|ASI [WWW Document] (n.d.). URL https://www.asirobots.com/autonomous -technology-steering-new-agricultural-revolution/2019 Jan 2019

2.3 Problem Statement Definition:

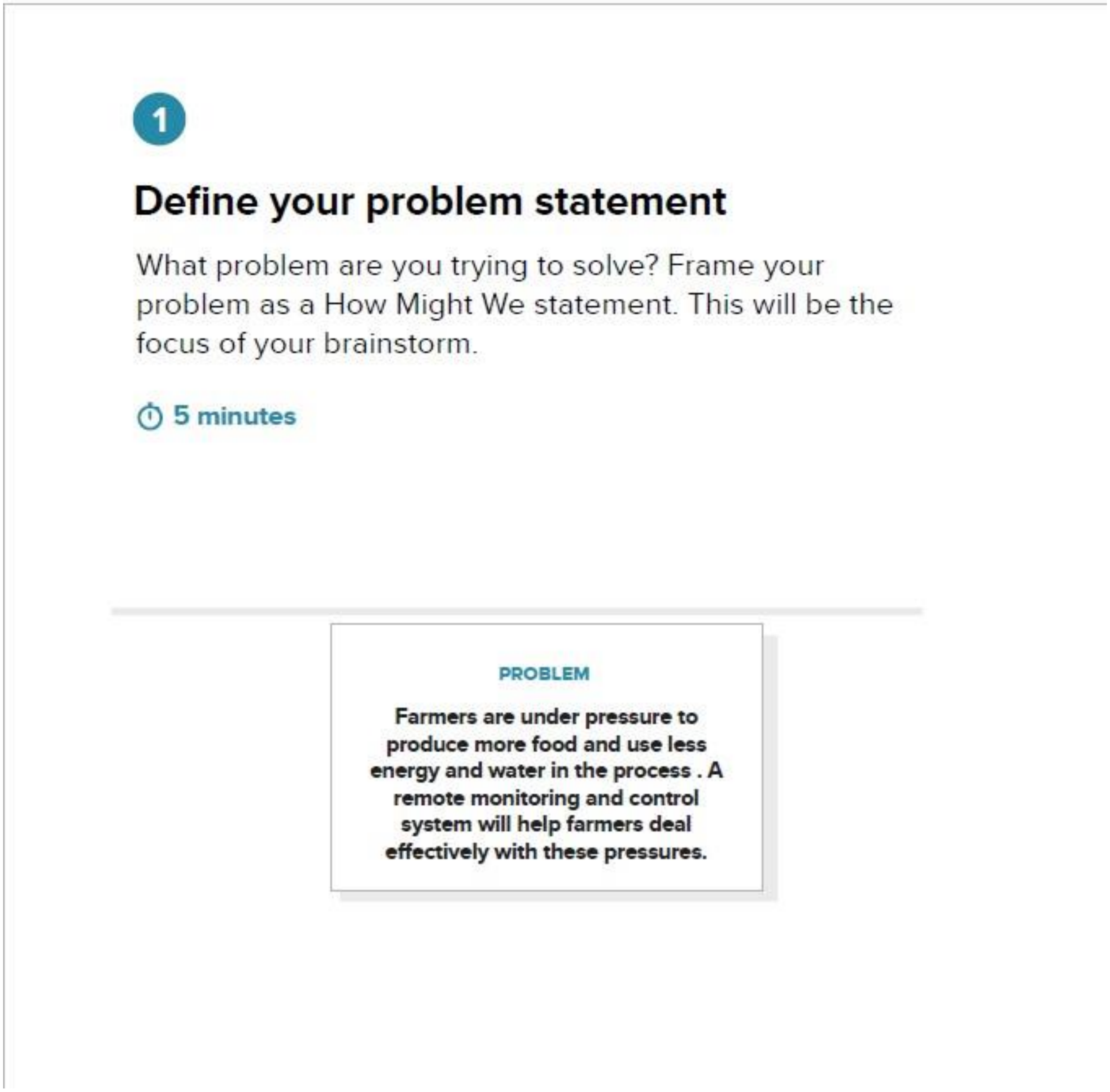
Customer Problem Statement :

3.IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas:

An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment.

3.2 Ideation & Brainstorming:



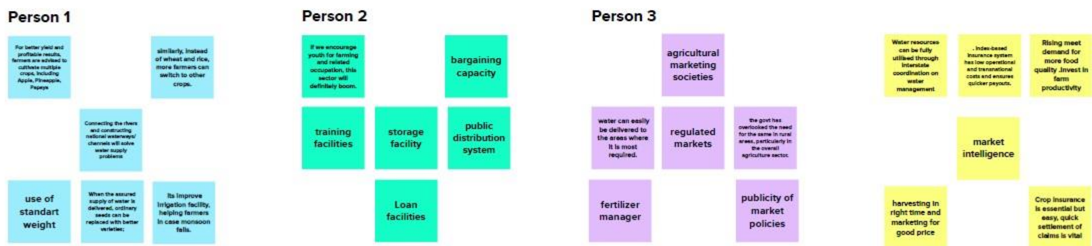
2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

⏱ 10 minutes

> **TIP**
> You can select a sticky note and hit the pencil [switch to sketch] icon to start drawing!



3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

⏱ 20 minutes

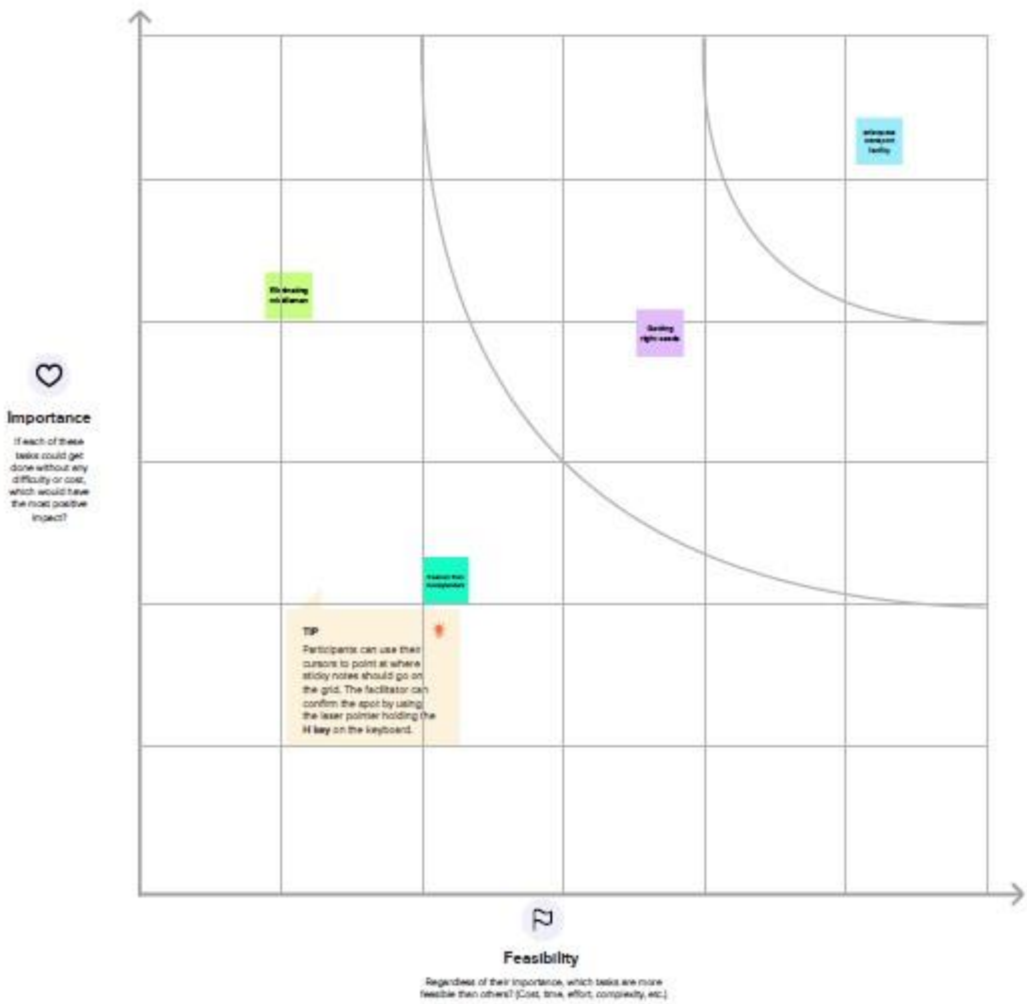
> **TIP**
> Add customizable tags to sticky notes to make it easier to find, browse, organize, and categorize important ideas as themes within your mural.

4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

20 minutes

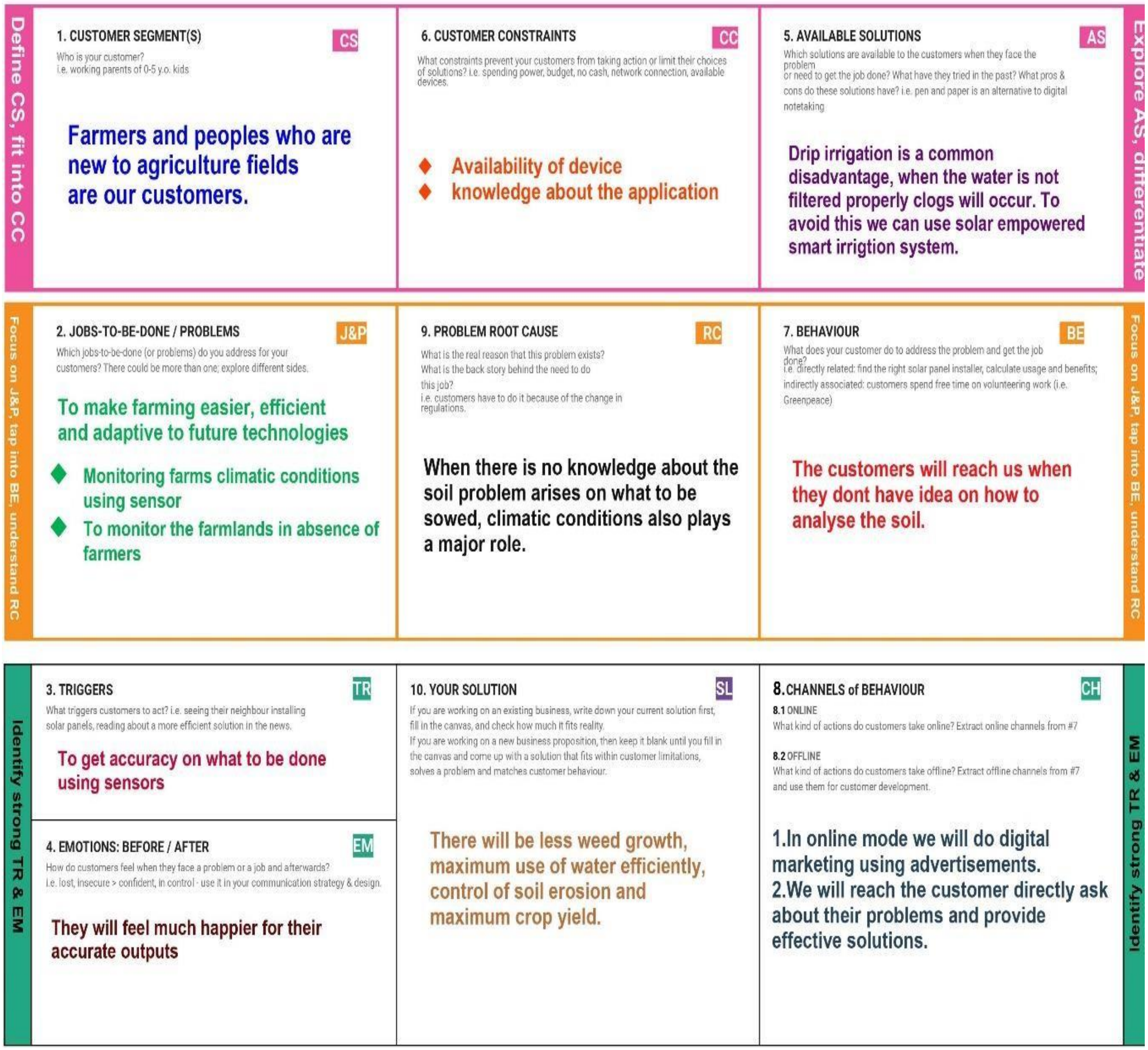


3.3Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	**Problem:** Farmers are under pressure to produce more food AND use less energy and water in the process.
2.	Idea / Solution description	**Idea:** "Smart farming" is an emerging concept that refers to **managing farms using technologies like IoT, robotics, drones and AI to increase the quantity and quality of products while optimizing the human labor required by production**. The Internet of Things (IoT) has provided ways to improve nearly every industry imaginable.
3.	Novelty / Uniqueness	**Uniqueness**: Remote Management. With farms being located in far-off areas and distant lands, farmers are seeking a better solution to their management issues. ... • Real-Time Crop Monitoring. ... • Crop Protection. ... • Soil Testing & its Quality. ... • Real-time Analysis of Soil Demand. ... • Smart Greenhouses.
4.	Social Impact / Customer Satisfaction	**Customer Satisfaction :** Recognize the dimensions Of Customer service that are critical for improving customer satisfaction. According to Pennsylvania State University agricultural marketing educator John Berry, these dimensions are activities, such as order processing and billing; performance indicators, such as order-processing times; and a strategic focus on customer service

		throughout the company.
5.	Business Model (Revenue Model)	○ Grow Microgreens ○ Agricultural farm ○ Sod farm ○ Organic farm ○ Herb farm
6.	Scalability of the Solution	**scalability :** 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 **Solution:** Smart Farming solutions provide an integrated IoT platform in agriculture that allows farmers to leverage sensors, smart gateways and monitoring systems to collect information, control various parameters on their farms and analyse real-time data in order to make informed decisions.

3.4 Problem Solution fit:



4.REQUIREMENT ANALYSIS

4.1 Functional Requirements:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Install the app. Signing up with Gmail or phone number Creating a profile. Understand the guidelines.
FR-2	User Confirmation	Email or phone number verification required via OTP.
FR-3	Accessing datasets	Data's are obtained by cloudant DB.
FR-4	Interface sensor	Connect the sensor and the application When animals enter the field , the alarm is generated.
FR-5	Mobile application	It is used to control motors and field sprinklers.

4.2 Non-functional Requirements:

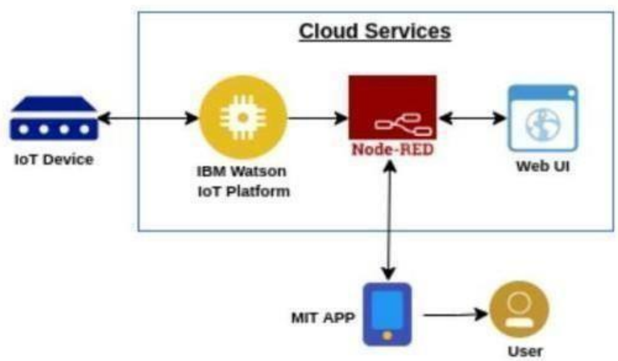
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	This project's contributes the farm protection through the smart protection system.
NFR-2	**Security**	It was created to protect the crops from animals.
NFR-3	**Reliability**	Farmers are able to safeguard their lands by help of this technology. They will also benefits from higher crop yields, which will improve our economic situation.
NFR-4	**Performance**	When animals attempt to enter the field, IOT devices and sensors alert the farmer via message.
NFR-5	**Availability**	We can defend the crops against wild animals by creating and implementing resilient hardware and software.
NFR-6	**Scalability**	This system's integration of computer vision algorithms with IBM cloudant services makes it more efficient to retrieve photos at scale, enhancing scalability.

5.PROJECT DESIGN

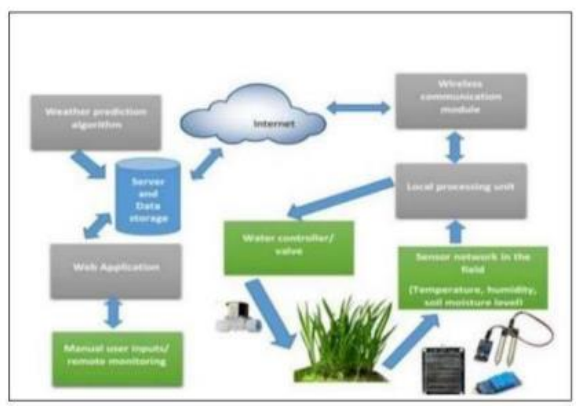
5.1Data Flow Diagrams:

A Data flow diagram (DFD) is a common visual representation of how information moves through a system. A clean and understandable DFD can graphically represent the appropriate quantity of the system need. It displays how information enters and exits the system, what modifies the data, and where information is kept.

Example: (Simplified)

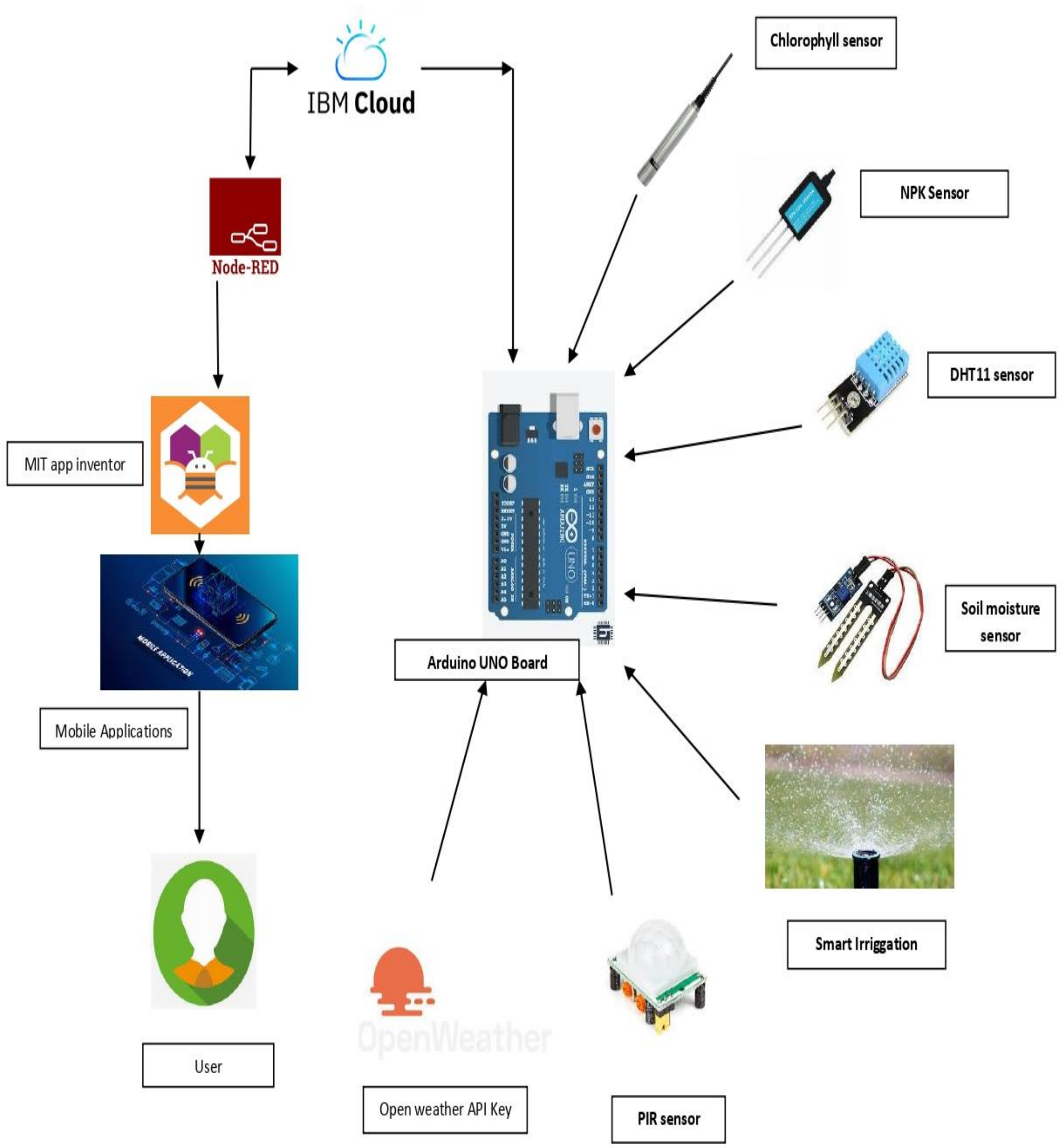


Example: DFD Level 0 (Industry Standard)

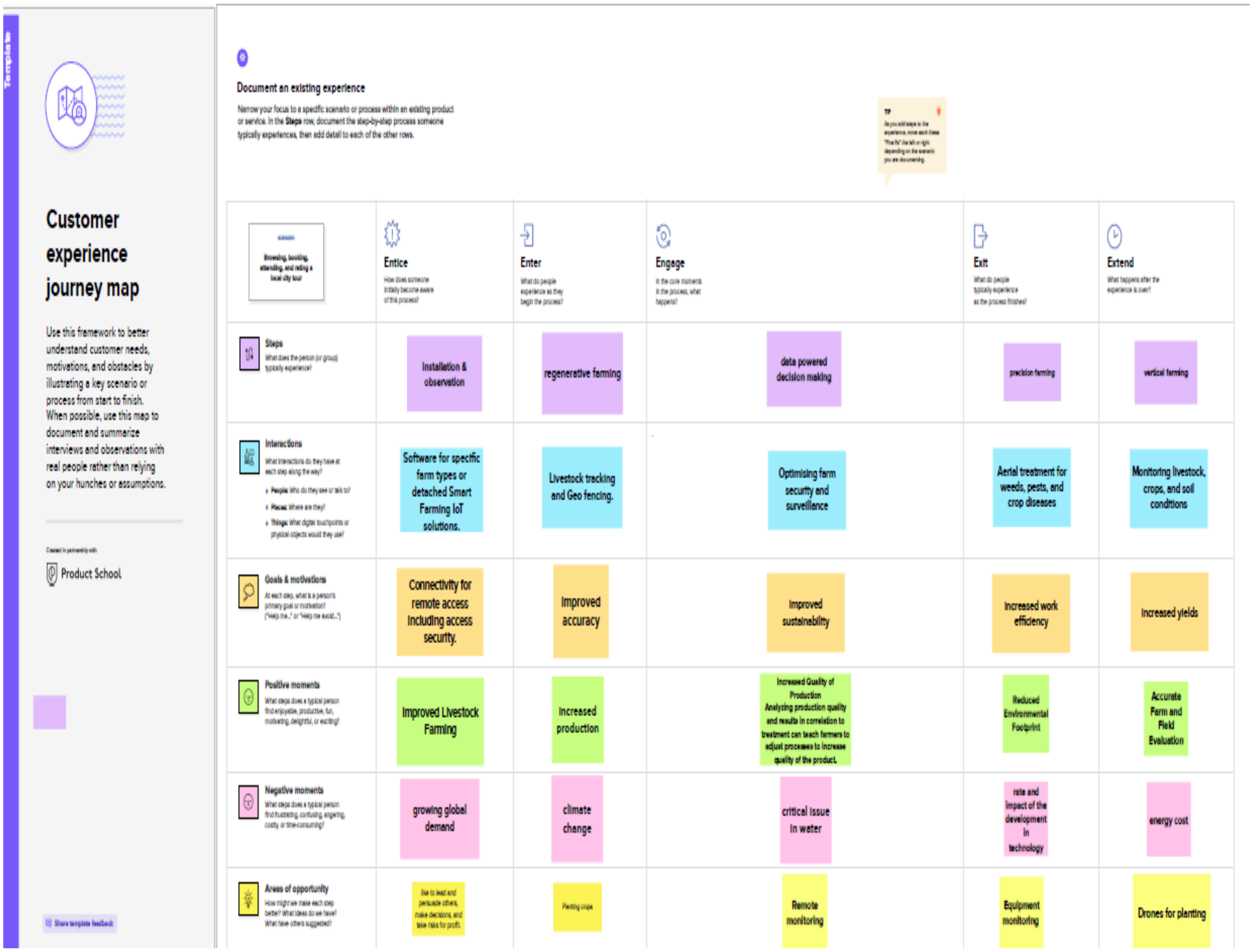


- Using various sensors, the various soil parameters, including temperature, moisture content and humidity are measured. The results are then stored in the IBM cloud.
- The Arduino UNO is utilised as a processing unit to process the data from the sensors and weather API.
- To write the hardware, software, and APIs. NODE-RED is employed as a programming tool. In order to communicate, the MQTT protocol is used.
- A mobile application created with MIT App Inventor makes all the collected data available to the user. Depending on the sensor results, the user might decide whether or not to irrigate the crop using an app. They can control the motor switch remotely by utilising the app.

5.2 Solution & Technical Architecture



5.3 User Stories



6. PROJECT PLANNING & SCHEDULING

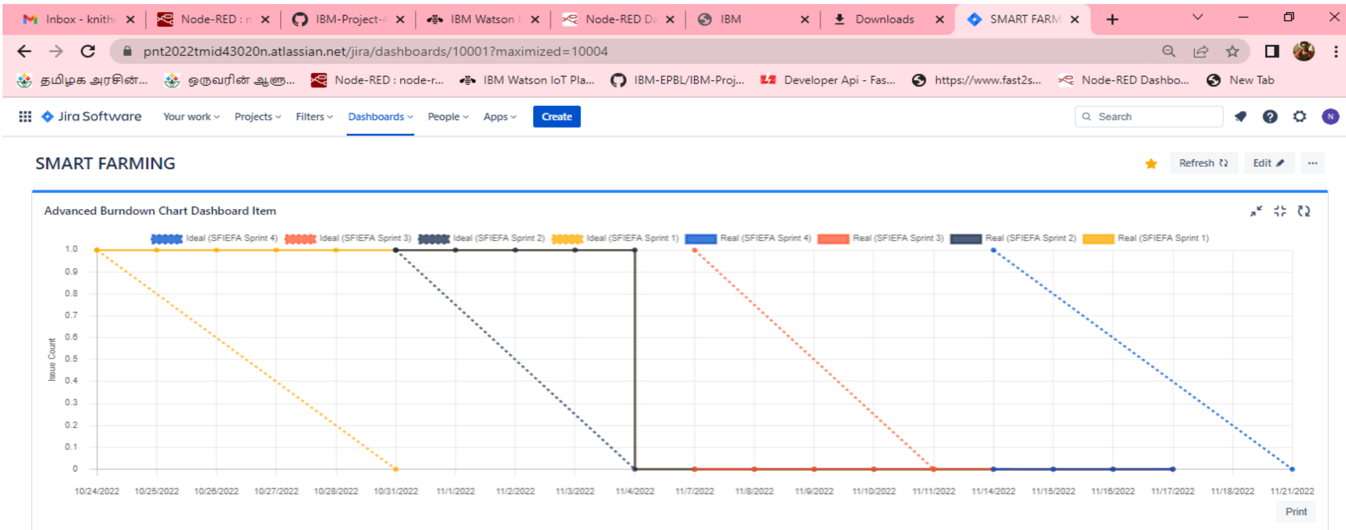
6.1Sprint Planning & Estimation:

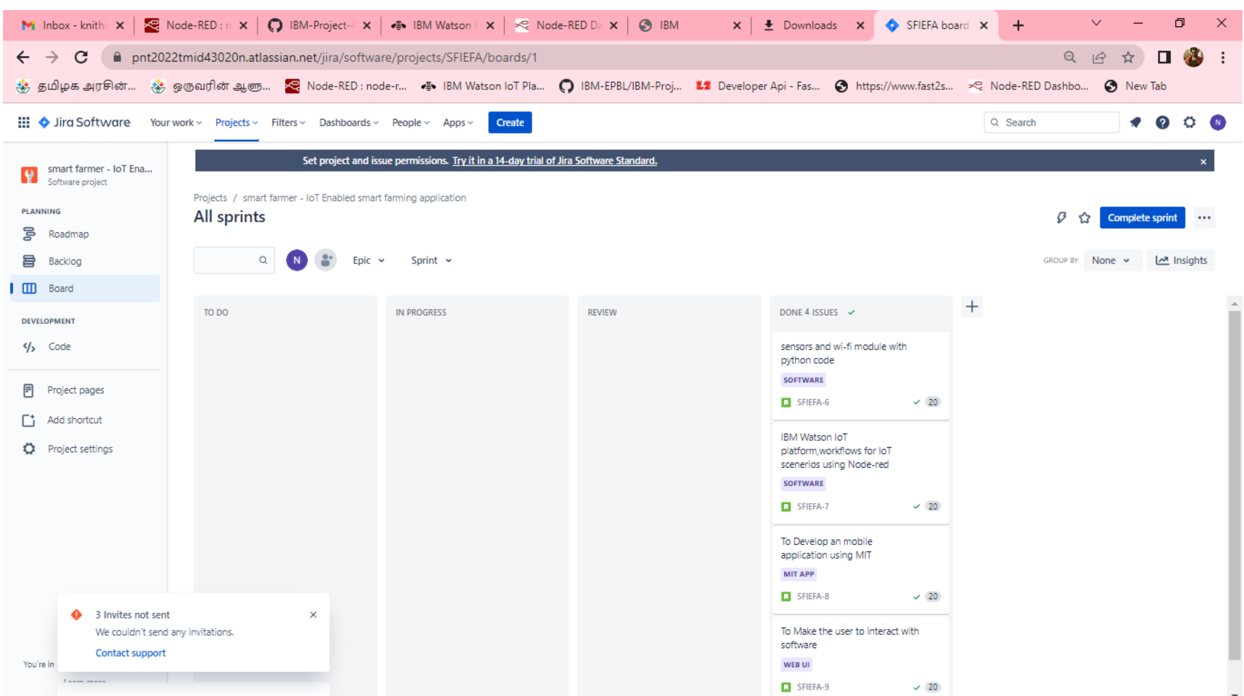
Sprint	Functional requirement (EPIC)	User Story Number	User Story/Task	Story points	Priority	Team members
Sprint-1	Software	USN-1	Sensors and wi-fi module with python code	2	High	Nithish, Maadhu, Sownthar, Pushpanathan
Sprint-2	Software	USN-2	IBM Watson IoT platform, Workflows for IoT scenarios using Node-red	2	High	Nithish, Maadhu, Sownthar, Pushpanathan
Sprint-3	MIT App	USN-3	To develop an mobile application using MIT	2	High	Nithish, Maadhu, Sownthar, Pushpanathan
Sprint-4	Web UI	USN-4	To make the user to interact with software.	2	High	Nithish, Maadhu, Sownthar, Pushpanathan

6.2 Sprint Delivery Schedule

Sprint	Total story ints	Duration	Sprint End date	Sprint End (planned)	Story points complete (as on planned End Date)	Sprint release data
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	20	5thNOV 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12thNOV 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	14thNOV 2022

6.3 Reports from JIRA





7. CODING & SOLUTIONING (Explain the features added in the project along with code)

7.1 Feature 1

```
#IBM Watson IOT Platform
#pip install wiotp-sdk
import wiotp.sdk.device
import time
import random
myConfig = {
  "identity": {
    "orgId": "jjbd71",
    "typeId": "Maadhu",
    "deviceId":"9500569875"
  },
  "auth": {
    "token": "9361475232"
  }
}
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(" ")
client=wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()

while True:
  temp=random.randint(0,100)
  hum=random.randint(0,100)
  soil=random.randint(0,100)
  myData={'Temperature':temp,
```

```
            'Humidity':hum,
           'SoilMoisture':soil}
 client.publishEvent(eventId="status",msgFormat="json",data=myData,qos=0,
onPublish=None)
        print("Published data Successfully: %s", myData)
        if(soil<20):
            print("Less moisture is detected")
        else:
            print("Moisture is sufficient")
        time.sleep(2)
        client.commandCallback = myCommandCallback
    client.disconnect()
```

8. TESTING

8.1 Test Cases

Date	17-Nov-22
Team ID	PNT2022TMID48483
Project Name	Smart Farmer-IoT enabled smart farming application
Maximum Marks	4 marks

Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	Commnets	TC for Automation(Y/N)	BUG ID	Executed By
LoginPage_TC_OO1	Functional	Home Page	Verify user is able to see the Login/Signup popup when user clicked on Start button	MIT App Inventor	1.Open MIT application 2.Home page will appear. 3.Click on Start button.	http://ai2.appinventor.mit.edu/#6734083678666752	Login/Signup screen should display	Working as expected	Pass	Got the Exact Results	Yes	Nil	User
Database_TC_OO2	Functional	Firebase	Verify the Firebase	Firebase Account creation	1.Open Chrome 2.Search firebase 3.Create new form login project a.create account (if already not existed) and create realtime database. b.Create a program to store the credentials. 2.Publish the program to execute.	https://formlogin-283db-default-rtdb.firebaseio.com/	To Store and Get the value of username and password	Working as expected	Pass	Got the exact results	Yes	Nil	Developer
LoginPage_TC_OO3	Functional	Login/Signup Buttons	Verify user is able to log into application with Valid credentials	MIT App Inventor	1.Enter UserName and Password in the respected boxes. 2.Click on sign up to store the values. 3.Now click login to view the parameters. 4.If invalid password entered in password text box 5.Click on login button	Username and Password Text boxes. Username: device password: 123	User should able to view the parameters	working as expected	Pass	got the exact results	Yes	Nil	User
LoginPage_TC_OO4	Functional	Login page	Verify user is able to log into application with InValid credentials		1.Enter URL(https://shopenzer.com/) and click go 2.Click on My Account dropdown button 3.Enter Valid username/email in Email text box 4.Enter Invalid password in password text box 5.Click on login button	Username: dev password: 123	Application should show 'Incorrect email or password ' validation message.	working as expected	pass	Got the exact results	yes	nil	User
TC-005	UI	Home Page	Verify whether the expected measurement sections are present and with default values	IBM cloud, Python IDLE,Node-Red,Fast2SMS	1.Navigate to the Soil Moisture UI 2.User should see the measurement fields for Temperature, Pressure, Humidity and SoilMoisture 3. All those fields should initially points to null value	Arduino board, ESP8266, Soil Moisture Sensor	Desired output.	Working as expected	Pass	Executed successfully	Yes	Nil	User
TC-006	Functional	Home Page	Verify the smoke sensor is detecting with good accuracy even with all kinds of gas leakage	IBM cloud, Python IDLE,Node-Red,Fast2SMS	1.Navigate to the Soil Moisture UI 2. Check for the measurement accuracy	Arduino board, ESP8266, Soil Moisture Sensor	Desired output	Working as expected	Pass	Successful	No	Nil	User

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 Smart Farmer IoT enabled smart farming application 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
Improper network connectivity	10	6	4	2	22
Humidity alone is detected.	12	10	6	4	32

Continuous Battery Consumption	20	9	5	2	36
Detection Coverage Area	14	6	2	2	24
Altering the Calibration Curve	20	9	7	6	42
Maintenance	11	3	2	1	17
Accuracy detection of parameters	17	9	6	3	35
Totals	104	52	32	20	208

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
Improper network connectivity	6	2	1	1
Humidity alone is detected.	15	0	0	15
Continuous Battery Consumption	12	0	0	12
Detection Coverage Area	5	0	1	4
Altering the Calibration Curve	4	0	0	4
Maintenance	5	0	0	5
Accuracy detection of parameters	1	0	0	1

9. RESULTS

9.1 Performance Metrics

Date	17-Nov-22
Team ID	PNT2022TMID43020
Project Nmae	Smart Farmer IoT Enabled Smart Farmeing Application

NFT - Risk Assessment

S.No	Scenario Name	Scope/feature	Functional Changes	Hardware Changes	Software Changes	Impact of Downtime	Load/Volume Changes	Risk Score
1	Detection accuracy - Response	New	New	Low	Moderate	Moderate	No Changes	Orange
2	Soil Moisture below threshold limit	New	Moderate	No	NO	Low	No Changes	Green

NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	Assumptions/Dependencies/Risks	Approvals/SignOff
1	Detection Accuracy and response	Using python and Node Red	Dependency- Cloud client / Risk- Moderate	
2	Soil Moisture below threshold limit	Using python and Node Red	Dependency- Cloud client / Risk- Low	
3	User Mobile Application	Using MIT App Inventor	Dependency- Cloud client / Risk- Low	

End Of Test Report

S.No	Project Overview	FT Test approac	NFR - Met	Test Outcome	GO/NO GO decision	Identified Defects (Detected/Closed/Open)	Approvals/SignOff
.	Detection accuracy - Response	Using Python and NodeRed	No	Expectaions partially met	No-Go	Observed intermittent performance issue sometimes . Bug is open	.
2	Soil Moisture below threshold limit	Using Python and NodeRed	Yes	Expectations met	Go	Oberved response for the leakage detection in the UI and its accuracy is as expected.	

10. ADVANTAGES & DISADVANTAGES

ADVANTAGES AND APPLICATIONS

Advantages:

• Increased production and its quality.
• Water is used effectively.
• Remote monitoring.
• Automatic controlling of irrigation.
• Cost Effective.
• IOT technologies enables growers and farmers to reduce waste and enhance productivity.

Applications:

- System can be used in various farm lands.
- System can be used in green house farming.
- System can also be used in gardening.
- It can be used in Precision farming.

DISADVANTAGES

- Lack of Infrastructure
- High Cost
- Lack of Security

11. CONCLUSION

Agriculture monitoring system is needed to reduce the need for human intervention in farming. This process is aimed to educate the farmer on the use of an integrated technology system to monitor the farm land to increase the quantity of the production of the crops. This project helps in efficient usage of water. This project can also be used in various farm lands. It can be used in gardening, greenhouse farming, horticulture etc. In this project intruder can be detected by pir sensor farmer now no need to be afraid of theft of his crops and destruction of his crops by animals.

12. FUTURE SCOPE

For the future improvements we can implement the smart farming system with the use of AI, IoT, Machine learning and implement of cloud for the further improvement in the better analyses and getting more harvest in the agriculture field. The machine learning can be used to analyze the field and determine the harvest amount and quality. The AI technology, IoT and cloud computing technologies can be used to improvise the farming harvest and technologies. Cloud computing and technology is used to store the data and collect it and analyze it using machine learning. With more research and advancement in technology we can improvise the agriculture field so that we can minimize the wastage as much as much as possible and get maximum output to fulfill the demands of the growing population. Additional sensors like NPK sensor, humidity sensor and cameras can be used for better analysis and growth in the field of farming.

For future enhancement, we would like to attain more data so that we can run training and testing of the data. We will also validate the data with different subset. The fuzzy systems itself will be adjusted to be applicable for all types of crops. Different kinds of sensors such as pH sensors, carbon dioxide sensors, and light sensors can be installed .

13. APPENDIX

Source Code

```
#IBM Watson IOT Platform
#pip install wiotp-sdk
import wiotp.sdk.device
import time
import random
myConfig = {
    "identity": {
        "orgId": "jjbd71",
        "typeId": "Maadhu",
        "deviceId":"9500569875"
    },
    "auth": {
        "token": "9361475232"
    }
}
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(" ")
```

```
client=wiotp.sdk.device.DeviceClient(config=myConfig, logHandlers=None)
client.connect()

while True:
    temp=random.randint(0,100)
    hum=random.randint(0,100)
    soil=random.randint(0,100)
    myData={'Temperature':temp,
        'Humidity':hum,
     'SoilMoisture':soil}
 client.publishEvent(eventId="status",msgFormat="json",data=myData,qos=0,
onPublish=None)
    print("Published data Successfully: %s", myData)
    if(soil<20):
        print("Less moisture is detected")
    else:
        print("Moisture is sufficient")
    time.sleep(2)
    client.commandCallback = myCommandCallback
client.disconnect()
```

GitHub & Project Demo Link

Github link: https://github.com/IBM-EPBL/IBM-Project-49908-1660884419

Project Demo link: https://drive.google.com/file/d/1k3Oi6lLYHH-hJ8BpMV7dWuJjl-xTqA2f/view?usp=drivesdk

MIT App link: http://ai2.appinventor.mit.edu/#6179065170886656