PROJECT REPORT

PROJECT NAME: SMART FARMER- IOT ENABLED SMART FARMING APPLICATION

TEAM ID: PNT2022TMID31496

TEAM:

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KOKILA C

ABSTRACT

From farm to fork, information and communication technology sector is being enhanced to facilitate the farmers, croppers and related users of intelligent services. Technological revolution integrates the development of smart devices and IoT services. To feed the ever growing global population, the agriculture industry needs to be extended.

Internet of Things opens the door wide for smart farming solution to increase the agricultural production. IoT technologies helps the farmers as a service by providing historical and real time data for predicting soil quality, weather conditions and crop’s health. Smart farming provides the enhanced facility for process automation and evaluation and waste reduction. As a result, all these factors drastically increase the quality and quantity of the food products and decrease the production cost. This paper outlines the promising solutions applied in the sphere of agriculture.

Keywords: Smart Farming, Internet of Things, Green House, IoT agriculture.

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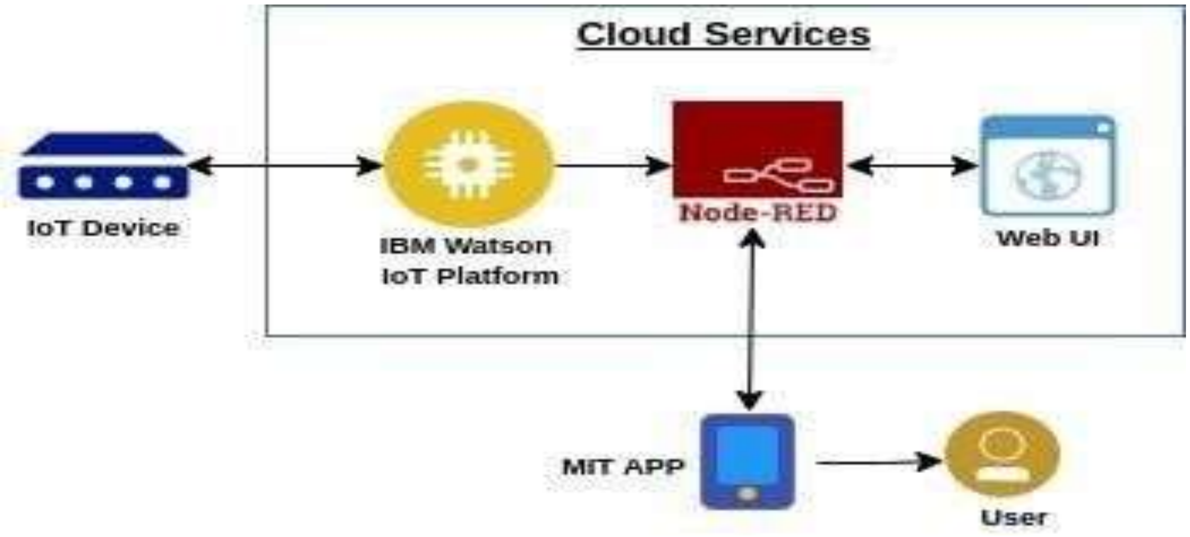
LIST OF ABBREVIATIONS

ABBREVATION	DESCRIPTION
IOT	Internet Of Things
ISP	Internet Service Provider
HTML	Hypertext Markup Language
CSS	Cascade Style Sheet

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 motor pumps from the mobile application itself.



1.2 PURPOSE

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.

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.

Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc.

In large farmland, Internet of Things equipped drone helps to receive the current state of crops and send the live pictures of farmland.

2. LITERATURE SURVEY

2.1 EXISTING SYSTEM

The biggest challenges faced by IoT in the agricultural sector are lack of information, high adoption costs, and security concerns, etc. Most of the farmers are not aware of the implementation.

2.2 REFERENCE

[1] ISSN No:-2456-2165 Volume 4, Issue 2 Feb – 2019: "Solars' Energy: - A safe and reliable, eco-friendly and sustainable Clean Energy Option for Future India: - A Review."

[2] Universal Paper of advanced science and science and exploration technology. [2] GRD Journals- Global Research and Development Journal for Engineering | Volume 4 | Issue 3 | February (2019) ISSN: 2455-5703 “Design and Implementation of an Advanced Security System for Farm Protection from Wild Animals”.

[3] International Journal of Innovations in Engineering and Science, Impact Factor Value 4.046 e-ISSN: 2456-3463 Vol.4, No. 5, 2019 “Solar Powered Smart Fencing System for Agriculture Protection using GSM & Wireless Camera”.

[4] International Journal of Management, Technology and Engineering ISSN NO: 2249-7455

Volume 8, Issue VII, JULY/2018”Protecting Crops from Birds, Using Sound Technology In

Agriculture" [5] American Journal of Engineering Research (AJER) 2018 eISSN: 2320-0847 pISSN: 2320- 0936 Volume-7, Issue-7, pp-326-330 "Moisture Sensing Automatic Plant Watering System Using Arduino Uno".

2.3 PROBLEM STATEMENT DIFINITION

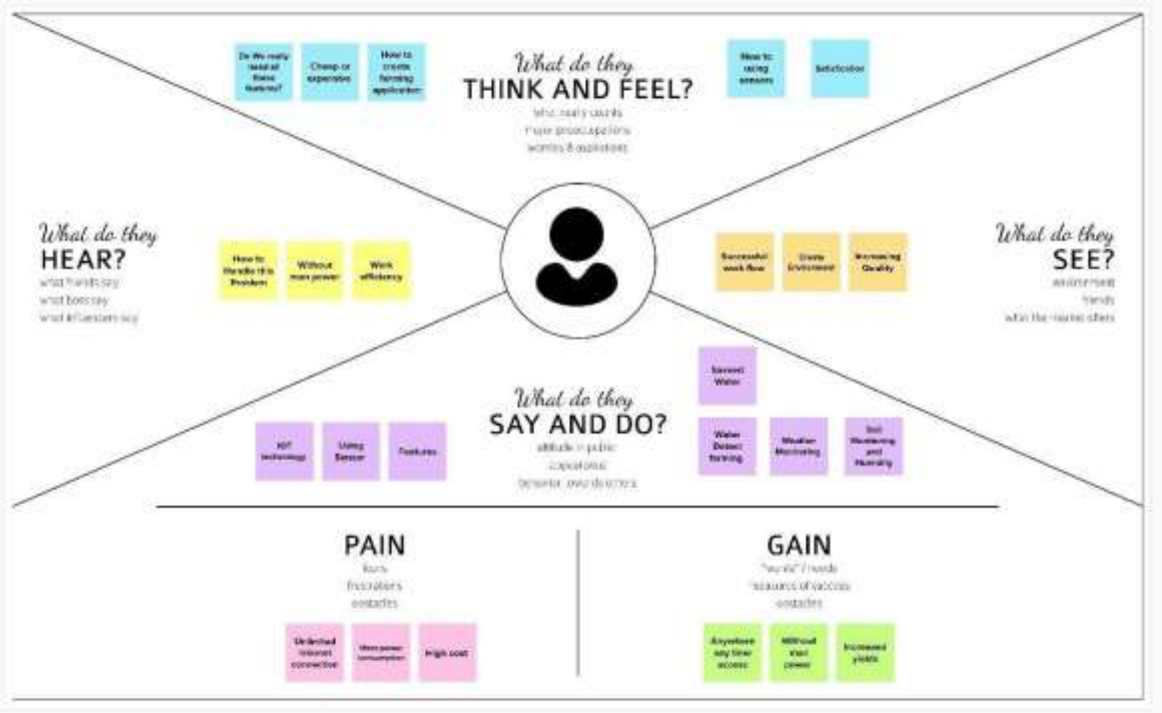
A strong customer problem statement should provide a detailed description of your customer's current situation. Consider how they feel, the financial and emotional impact of their current situation, and any other important details about their thoughts or feelings.

Creating a customer problem statement is easy with Miro. Using our collaborative online whiteboard, you can create an online problem statement that's easy to follow and shareable with your team. All you have to do is sign up for free, select this template, and follow your template.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user’s behaviors and attitudes. It is a useful tool to helps teams better understand their users. Creating an effective solution requires understanding the true problem ant the person who is experiencing it The exercise of creating the map helps participants consider things from the user’s perspective along with his or her goals and challenges.



3.2 Ideation & Brainstorming

TEAM IDEAS:

V MANOJ KARTHIK:

- Automate irrigation process using temperature of soil.
- Automate irrigation using measurement of moisture of soil.

JEEVETH P:

- We can use sensors on sensing.
- We can sense and program the moisture level.

JINI SS:

- We can simplify the drip irrigation into time controlled irrigation.
- Automate irrigation using any Robots.

KOKILA C:

- We can automate and design Audino for programming.
- We can make good design and programming of soil moisture and temperature.

Best Three Ideas:-

- Automate irrigation using measurement of moisture of soil.
- We can sense and program the moisture level.
- We can automate and design Audino for programming.

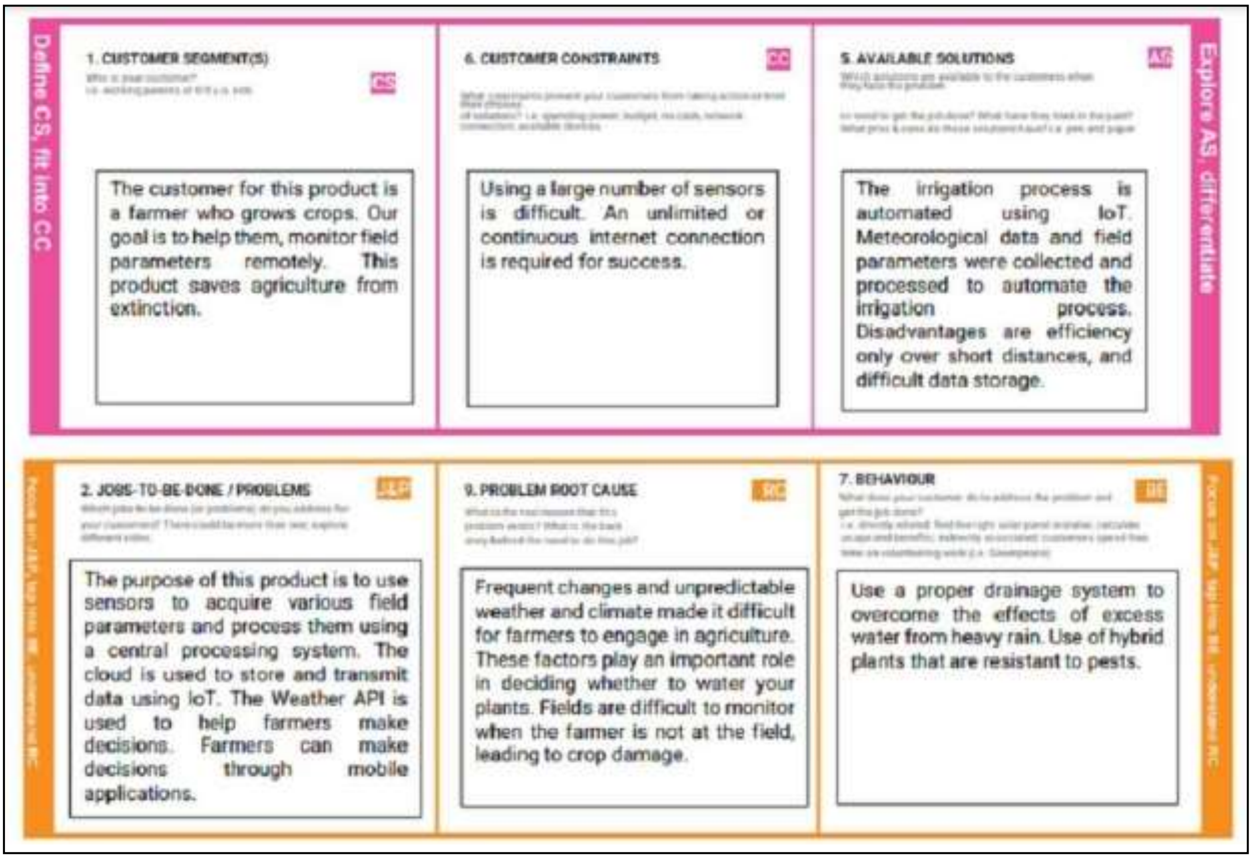
3.3 Proposed Solution

Proposed Solution Template:

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to besolved)	To incorporate the process of working andalso elevate the smart farming using IOT enabled smart Farming technique since the traditional Farming technique I very Complex one.
2.	Idea / Solution description	To automate irrigation in accordance to theamount of moisture present in soil
3.	Novelty / Uniqueness	Automation of irrigation to amount of moisture
4.	Social Impact / Customer Satisfaction	The problems faced by the farmers in the process of irrigation gets solved and this full fillsand saves their crops from over irrigation
5.	Business Model (Revenue Model)	The process of fulfilling this process brings revolution in drip irrigation systems also makesa revolutionary change in market
6.	Scalability of the Solution	The design scale of solution has been plannedin a compact manner

3.4 Problem Solution fit



Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Who is your customer? [illegible]

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.

6. CUSTOMER CONSTRAINTS CC

[illegible]

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

5. AVAILABLE SOLUTIONS AS

[illegible]

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.

Explore AS, differentiate

2. JOBS-TO-BE-DONE / PROBLEMS J&P

[illegible]

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 decisions. Farmers can make decisions through mobile applications.

9. PROBLEM ROOT CAUSE RC

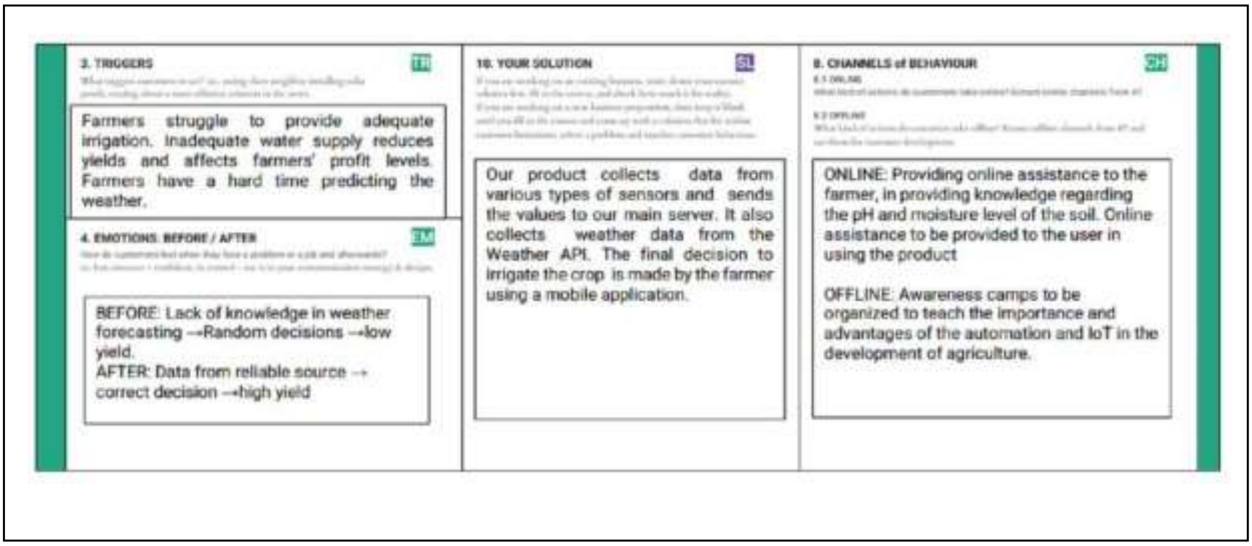
[illegible]

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.

7. BEHAVIOUR BE

[illegible]

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



3. TRIGGERS TR

[illegible]

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

4. EMOTIONS: BEFORE / AFTER EM

[illegible]

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

10. YOUR SOLUTION SL

[illegible]

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.

8. CHANNELS of BEHAVIOUR CH

8.1 ONLINE [illegible]

8.2 OFFLINE [illegible]

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 user 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	Measure Temperature	Soil thermometers are the most common Tool for measuring soil temperature. Thevoltage across the diode terminals
FR-2	Measure soil moister	Sensor for soil scanning and water, light, humidity and temperature management
FR-3	Calculating the date and time	Time of day : Between 1 and 2 p.m. Depth :4 inches below the soil surface Soil Location: Same area of field, soil type weather and precipitation
FR-4	Irrigating the soil if needed	A moisture supply for plant growth whichalso transports essential nutrients. A flow of water to leach or dilute salts in the soil

4.2 NON-FUNCTIONAL REQUIREMENT

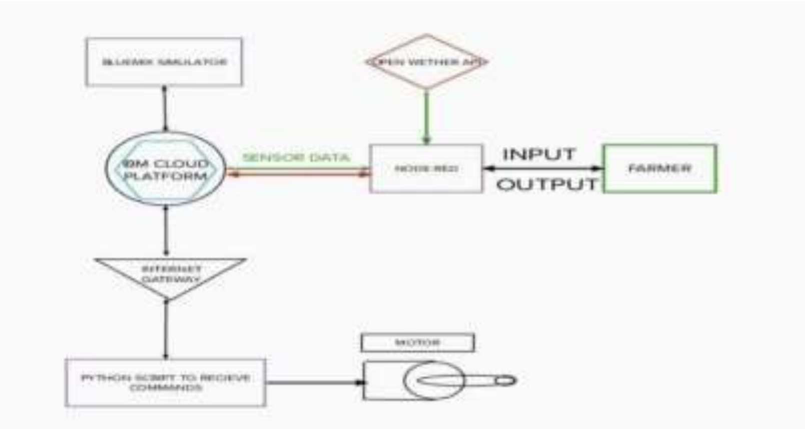
Following are the non-functional requirements of the proposed solution.

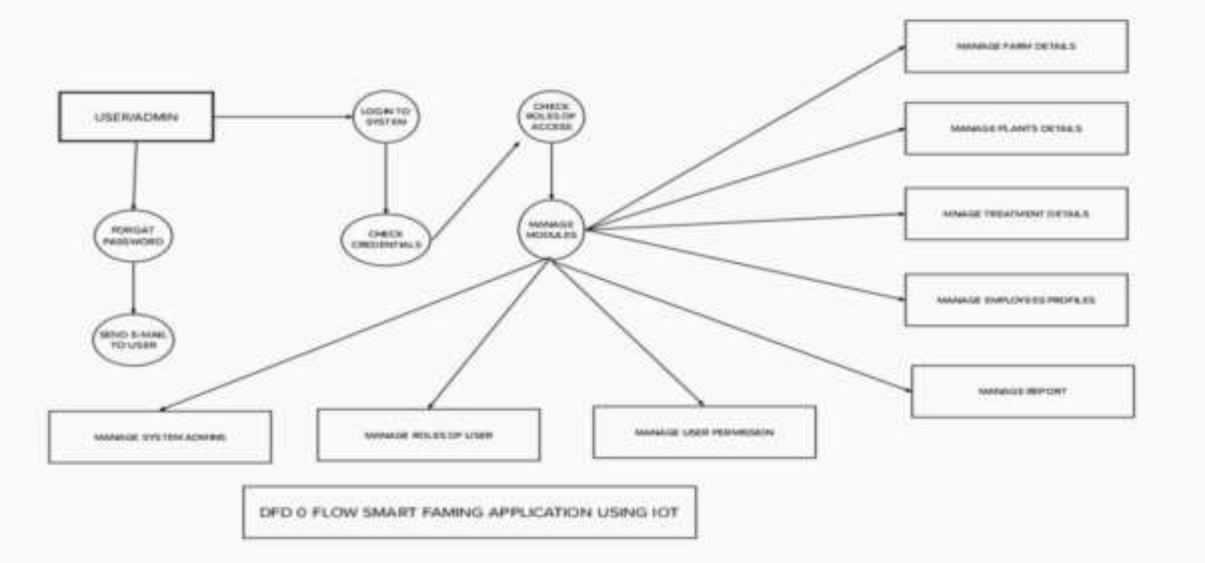
FR.No	Non-Functional Requirement	Description
NFR-1	**Usability**	Indicates how effectively and easy users can learnand use a system

NFR-2	**Security**	Assures all data inside the system or its part will be protected against malware attacks or unauthorized access.
NFR-3	**Reliability**	The system provides an accurate measurement ofdata, and it can have a longer lifespan
NFR-4	**Performance**	The present system can be improved easily by integrating new components with enhanced features
NFR-5	**Availability**	The proposed product can be available and operable successfully all the time
NFR-6	**Scalability**	The proposed system is user friendly .The usage ofproduct doesn’t require any prior learning

5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS





A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows how data enters and leaves the system, what changes the information, and where data is stored.

1. The different soil parameters temperature, soil moistures and then humidity are sense during different sensors and obtained value is stored in the IBMcloud.

2. Arduino UNO is used as a processing Unit that process the data obtained from the sensors and whether data from the weatherAPI.

3. NODE-RED is used as a programming tool to write the hardware, software, and APIs. The MQTT protocol is followed forth communication.

4. All the collected data are provided to the user through a mobile application that was developed using the MIT app inventor. The user could plan through an app, weather to water the crop or not depending upon the sensor values. By using the app they can remotely operate to the motor switch.

5.2 Solution & Technical Architecture

The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2 Guidelines:

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

2. Arduino UNO is used as a processing Unit that process the data obtained from the sensors and whether data from the weather API.

3. NODE-RED is used as a programming tool to write the hardware, software, and APIs. The MQTT protocol is followed for the communication.

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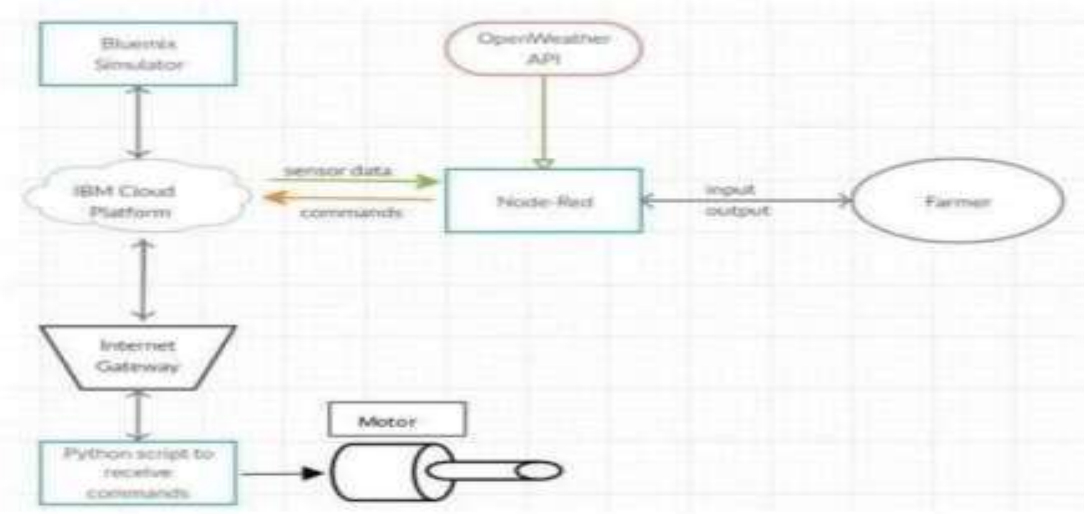


Table-1:

Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chabot etc.	MIT app
2.	Application Logic-1	Logic for a process in the application	Node red/IBM Watson/MIT app
3.	Application Logic-2	Logic for a process in the application	Node red/IBM Watson/MIT app
4.	Application Logic-3	Logic for a process in the application	Node red/IBM Watson/MIT app
5.	Database	Data Type, Configurationsetc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM cloud.
7.	Temperature sensor	Monitors the temperature of the crop	
8.	Humidity sensor	Monitors the humidity	
9.	Soil moisture sensor (Torsiometer’s)	Monitors the soil temperature	

10.	Weather sensor	Monitors the weather	.
11.	Solar panel		.
12.	RTC module	Date and time configuration	
13.	Relay	To get the soil moisturedata	

Table-2:

Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	MIT app, Node-Red	Software
2.	Scalable Architecture	Drone technology, pesticide monitoring, Mineral identification in soil.	Hardware

5.3 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	I can access my account / dashboard	High	Sprint-1

			confirming my password.			
		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 Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard					
Customer (Web user)						
CustomerCare Executi						

ve						
Administrator						

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	Hardware	USN-1	Sensors and Wi-Fi module with python code.	2	High	V Manoj Karthik Jeeveth p Jini SS Kokila C
Sprint-2	Software	USN-2	IBM Watson IoT platform, Workflows for IoT scenarios using Node-red	2	High	V Manoj Karthik Jeeveth p Jini SS Kokila C
Sprint-3	MIT app	USN-3	To develop an mobile application using MIT	2	High	V Manoj Karthik Jeeveth p Jini SS Kokila C
Sprint-4	Web UI	USN-4	To make the user to interact with software.	2	High	V Manoj Karthik Jeeveth p Jini SS Kokila C

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	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022

7. CODING & SOLUTIONING

7.1 Feature 1

```
import wiotp.sdk.device

import time

import os

import datetime

import random myConfig ={

   "identity": {

        "orgId": "0hzydu",

        "typeId": "NodeMCU",

        "deviceId": "12345"

   },

   "auth": {

      "token": "12345678"

   }          }          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 switchedon")   elif (m=="motoroff"):

      print ("Motor is switchedOFF")    print (" ") while True:    moist
=random.randint   (0,100)          temp=random.randint   (-20,   125)
hum=random.randint (0, 100)
```

```
    myData={'moisture':moist,'temperature':temp,'humidity':hum}

    client.publishEvent (eventId="status", msgFormat="json", data=myData, qos=0 , onPublish=None)

    print ("Published data Successfully: %s",myData)      time.sleep (2)

    client.commandCallback =myCommandCallback client.disconnect ()
```

7.1 Feature 2

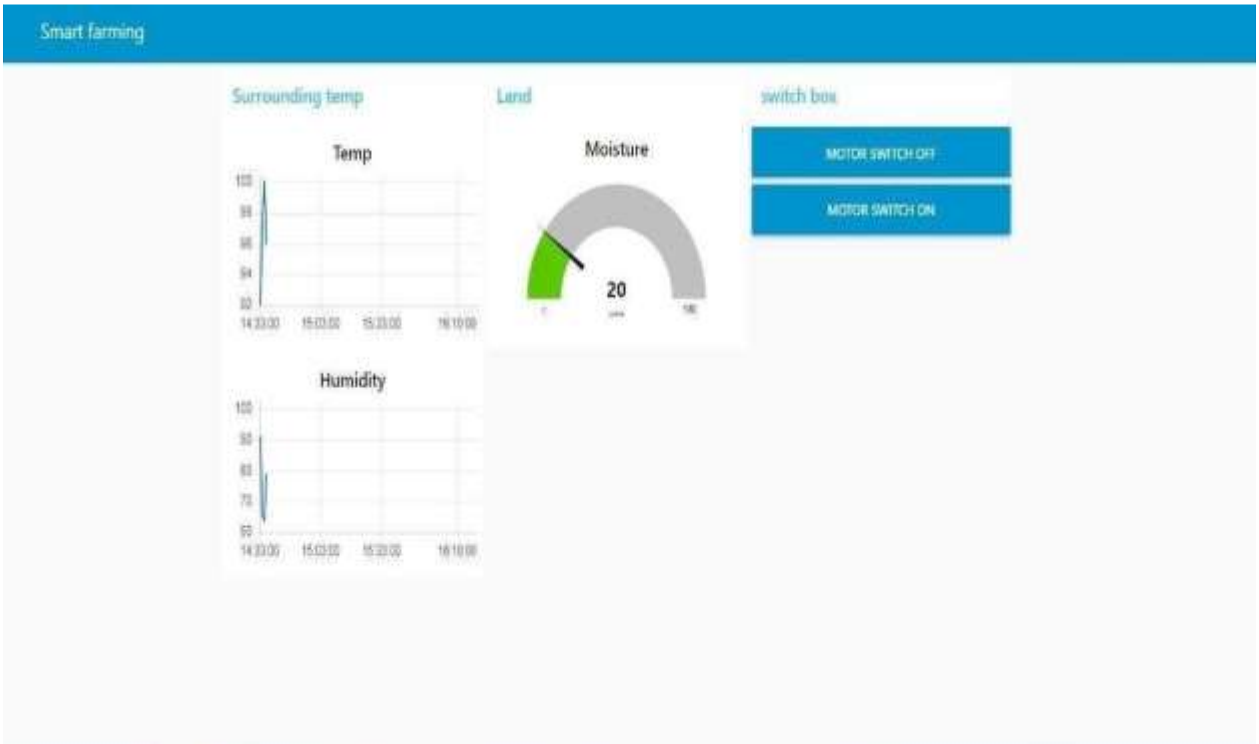
```
/*

Plant Watering System


The circuit:

-         Water pump

Power supply: 4.5~12V DC Interface: Brown +; Blue -

-         Temperature/moisture sensor Power supply: 3.3-5v

-         Moisture sensor Power supply: 3.3-5v

*/


#include "DHT.h"

#define DHTPIN 2// what digital pin we're connected to #define DHTTYPE DHT22 // DHT 22 (AM2302), AM2321


DHT dht(DHTPIN, DHTTYPE);
```

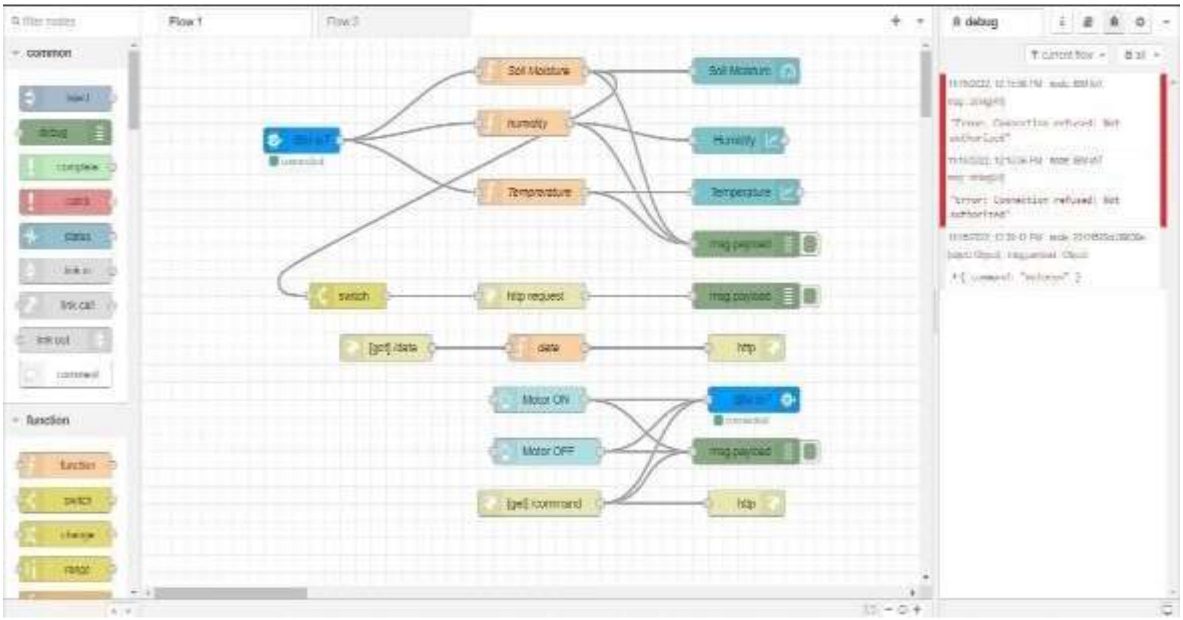
```
const int SOIL_MOISTURE_SENSOR_PIN = A0; const int
WATER_PUMP_PIN = 4;


const int dry = 520; const int wet = 270;

const int moistureLevels = (dry - wet) / 3;


// TODO: Should we have a counter so if it waters for X times, then take a break?

// OPTIMIZE: how dry to start watering and for how long. const int
soilMoistureSartWatering = 400;

const int soilMoistureStopWatering = 300;

// 60 seconds

const long waterDuration = 1000L * 60L;

// 60 seconds

const long sensorReadIntervals = 1000L * 60L;

// 2 hr

const long waterIntervals = 1000L * 60L * 60L * 2; long lastWaterTime = -
waterIntervals - 1;

boolean isWatering = false;


void setup()

{ Serial.begin(9600); pinMode(WATER_PUMP_PIN, OUTPUT);
waterPumpOff(); dht.begin();


}


void loop()
{ mainLoop ();
}


void mainLoop() {
float temperature = getTemperature(); float humidity = getHumidity();
long soilMoisture = analogRead(SOIL_MOISTURE_SENSOR_PIN);
Serial.println("Soil Moisture: " + readableSoilMoisture(soilMoisture) + ", " +
soilMoisture);
Serial.println("Temperature: " + String(temperature) + "
*F");Serial.println("Humidity: " + String(humidity) + " %");


if (millis() - lastWaterTime > waterIntervals)
{waterPlants(soilMoisture); lastWaterTime = millis();
}


delay(sensorReadIntervals);
}
```

```
void waterPlants(int soilMoisture) {

// Should this take a moving avg of the soilMoisture?

// Can get outliers on the right after watering. if (soilMoisture >
soilMoistureSartWatering)

{ isWatering = true
```

8. TESTING

8.1 Test Cases





"Error: Connection refused: Not authorized"

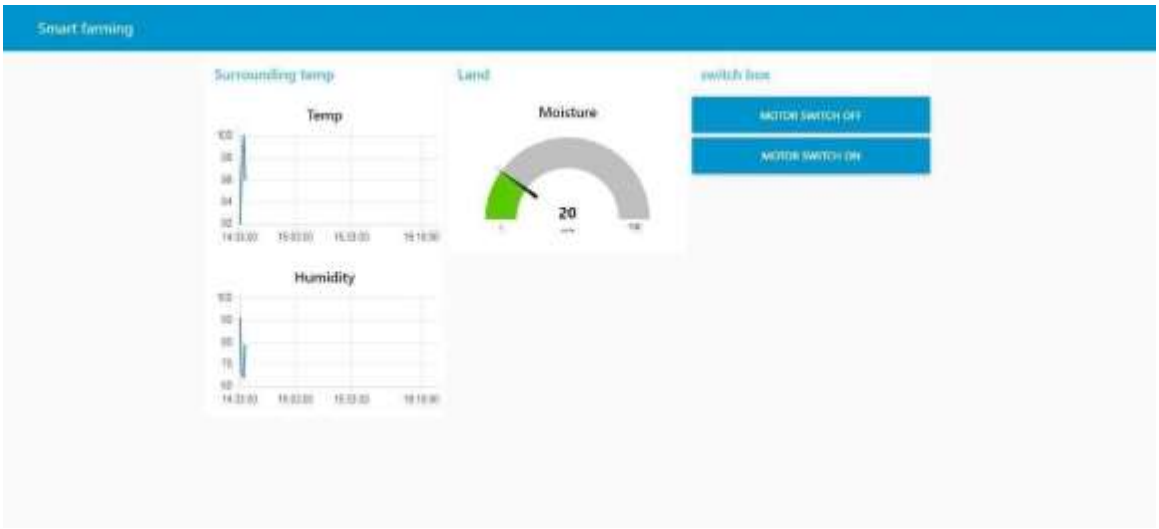
"Error: Connection refused: Not authorized"

▸{ command: "motoron" }

8.2 User Acceptance Testing

9. RESULTS

9.1 PERFORMANCE METRICS



10. ADVANTAGES & DISADVANTAGES

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.

DISADVANTAGES:

- The smart agriculture needs availability of internet continuously. Rural part of most of the developing countries do not fulfil this requirement. Moreover 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.

11. 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.

12. 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 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.

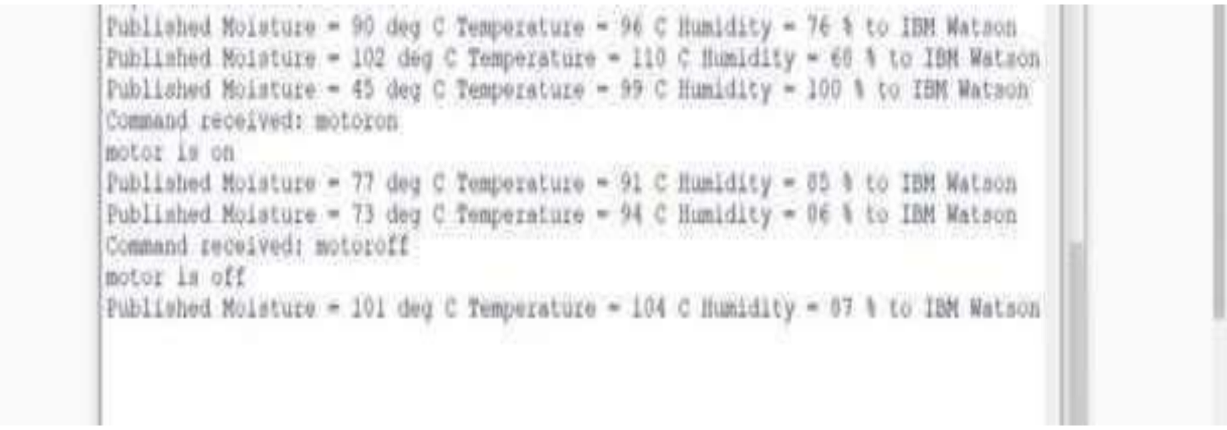
13. APPENDIX

SOURCE CODE

```
import wiotp.sdk.device

import time

import os

import datetime

import random myConfig ={

  "identity": {

     "orgId": "0hzydu",

     "typeId": "NodeMCU",

     "deviceId": "12345"

  },

  "auth": {

    "token": "12345678"

  }

} 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 switchedon")   elif (m=="motoroff"):

    print ("Motor is switchedOFF")   print (" ") while True:
```

```
    moist =random.randint (0,100)     temp=random.randint (-20, 125)
hum=random.randint (0, 100)
myData={'moisture':moist,'temperature':temp,'humidity':hum}
client.publishEvent (eventId="status", msgFormat="json", data=myData, qos=0
, onPublish=None)     print ("Published data Successfully: %s",myData)
time.sleep (2)

    client.commandCallback =myCommandCallback client.disconnect ()
```

OUTPUT:



```
Published Moisture = 90 deg C Temperature = 96 C Humidity = 76 % to IBM Watson
Published Moisture = 102 deg C Temperature = 110 C Humidity = 60 % to IBM Watson
Published Moisture = 45 deg C Temperature = 99 C Humidity = 100 % to IBM Watson
Command received: motoron
motor is on
Published Moisture = 77 deg C Temperature = 91 C Humidity = 85 % to IBM Watson
Published Moisture = 73 deg C Temperature = 94 C Humidity = 86 % to IBM Watson
Command received: motoroff
motor is off
Published Moisture = 101 deg C Temperature = 104 C Humidity = 87 % to IBM Watson
```

GitHub link: https://github.com/IBM-EPBL/IBM-Project-39484-1660451134

Demo link: https://github.com/IBM-EPBL/IBM-Project-39484-1660451134/tree/main/Manoj%20Karthik/Demo%20Link