SMARTFARMER- IOT ENABLED SMART FARMING APPLICATION

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NALAIYA THIRAN PROJECT BASED LEARNING ON PROFESSIONAL READINESS FOR INNOVATION, EMPLOYNMENT AND ENTERPRENEURSHIP

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A PROJECT REPORT
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12. FUTURE SCOPE

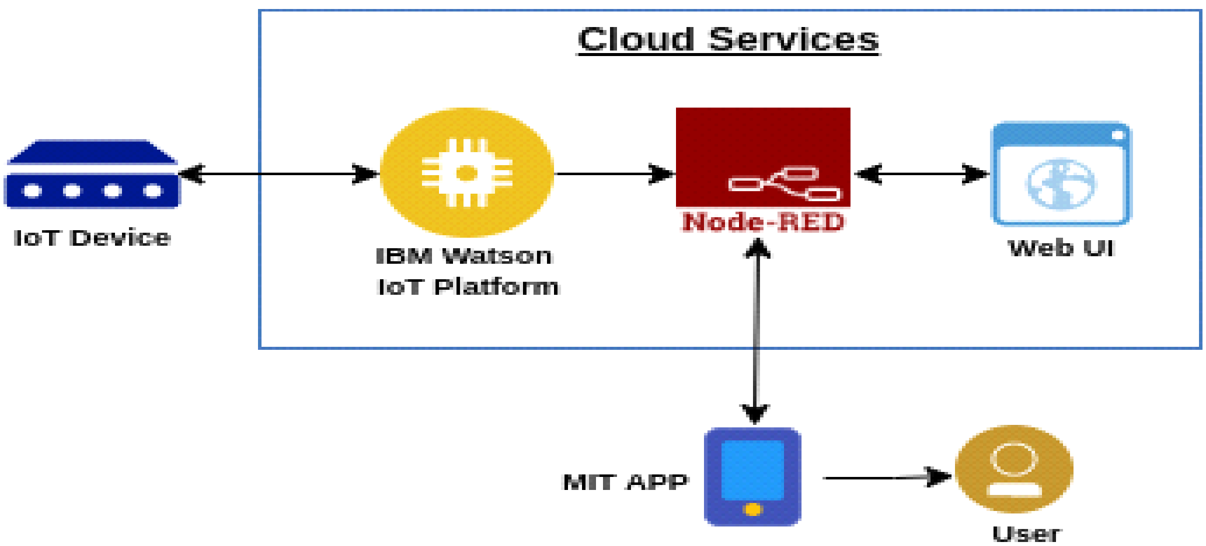
13. APPENDIX

- Source Code
- Demo video link

1. INTRODUCTION

- Project Overview

The farmer may monitor several field characteristics, such as soil moisture, temperature, and humidity, using an IoT-based agriculture system. Even when the farmer is far from his field, he or she can use a web or mobile application to monitor all the sensor parameters. One of the crucial tasks for farmers is to water the crops. By keeping an eye on the sensor parameters and managing the motor pumps from the mobile application itself, they may decide whether to water the crop or delay it.



- PURPOSE

The primary goal of the smart agriculture model is to reduce water waste during the irrigation process. It is an economical and effective system. is depicted below. It comprises NodeMCU, Arduino Nano, solenoid valves, relays, and sensors like soil moisture and DHT11.

2. LITERATURE SURVEY

Existing Problem

The integration of these sensors and connecting the sensor data to the analytics powering automation and response actions are two challenges of a smart agriculture system. When properly integrated, data analytics can lower total agricultural costs and help increase yield from the same amount of land by precisely controlling water, fertiliser, and light. Smart techniques, whether indoor or outdoor, enable farming on smaller and more dispersed acreage through remote monitoring.

Consider establishing a communications network that can connect a small number of sensors over a sizable farmland in order to successfully implement a smart agricultural system. Setting up a private network with access points and uplinks to a private network or using third-party network provisioning will be necessary to do this.

- It is not a secure system.
- There is no motion detection for protection of agriculture field.
- Automation is not available.

References

- Muhammad Shoaib Farooq, Shamyla Riaz, Adnan Abid, Kamran Abid and Muhammad Azhar Naeem (2019) have proposed a paper titled “A survey on the Role of IoT in Agriculture for the Implementation of Smart Farming”. This paper includes a discussion on network topologies used in IoT based agriculture which involves network architecture and layers, network topologies used and protocols. Furthermore, the connection of IoT based agriculture system with technologies like cloud computing, big data storage and analytics has also been included. The security issues in IoT agriculture have also been discussed. A list of smart phone and sensor based applications developed for various aspects of farm management have also been included. In the end, some open research issues and challenges in IoT agriculture have been presented.
- Anand Nayyar, Er. Vikram Puri (2016) have proposed a paper titled “IoT Based Smart Sensors Agriculture Stick For Live Temperature and Moisture Monitoring using Arduino, Cloud Computing and Solar Technology”. The main objective of this paper is to provide a Novel Smart IoT based Agriculture Stick which would help the farmers in getting Live Data

(Temperature, Soil and Moisture) for efficient environment monitoring enabling the farmers to do smart farming and increase their overall yield and quality of products. The agriculture stick proposed in this paper is integrated with Arduino technology. Breadboard mixed with various sensors and live data feed can be obtained online from Thinngsspeak.com. This method of designing agriculture stick provides an accuracy of over 98% in data feeds.

- Gaia Codeluppi, Antonio Cilfone, Luca Davoli and Gianluigi Ferrari (2020) have proposed a paper titled “LoRaFarM: A LoRaWAN Based Smart Farming Modular IoT Architecture. This method includes a low-cost, modular, and Long-Range Wide-Area Network (LoRaWAN) based IoT platform denoted as LoRaFarM aimed at improving the management of generic farms in a highly customizable way. The platform is built around a core middleware and is easily extensible with ad-hoc low-level modules. This has been evaluated in a real farm in Italy, collecting environmental data like air/soil temperature and humidity related to the growth of farm products over a period of three months.
- Nurzaman Ahmed, Debashis De, Iftekhar Hussain have presented a paper titled “Internet of Things (IoT) for Smart Precision Agriculture and Farming in Rural Areas”. This paper focuses on providing a scalable network architecture for monitoring and controlling agriculture and farms in rural areas. Compared to the existing IoT based agriculture and farming solutions, the proposed method reduces network latency up to a certain extent. The network structure is analyzed based on coverage range, throughput and latency.
- Muhammad Ayaz,Mohammad Ammad-Uddin,Zubair Sharif,Ali Mansour,El-Hadi M.Aggoune(2019) have presented a paper titled “Internet of Things (IoT) -Based Smart Agriculture Towards Making the Fields Talk”.This paper discusses the benefits of wireless sensor networks and the Internet of Things (IoT) in agriculture.Throughout analysis is performed on IoT devices and communication methods related to wireless sensors used in agriculture applications.It includes a list of the sensors that are suitable for various crop monitoring, such as soil preparation, crop condition, irrigation, and insect and pest detection. It is described how this technology assists farmers in all crop-related processes, including planting, growing, harvesting, packing, and transportation. This article also takes into consideration the usage of unmanned aerial vehicles for crop surveillance and other advantageous purposes like increasing crop output.
- Shubo Liu,Liqing Guo,Heather Webb,Xiao Ya,Xiao Chang(2017) have presented a paper titled “Internet of Things Monitoring System of Modern Eco-Agriculture Based on Cloud Computing”.Challenges such as quality and safety of agricultural products and the pollution of the environment from agricultural operations

need to be solved in order to improve the efficiency and safety of production and management of modern agriculture in China. An integrated framework system platform including the Internet of Things (IoT), cloud computing, data mining, and other technologies is analyzed based on the new generation of information technology (IT), and a new concept for its implementation in modern agriculture is proposed. The experimental framework and simulation design imply that it is possible to implement the essential features of the IoT monitoring system for agriculture. Additionally, the innovation created by merging several technologies is key to its success reducing system costs.

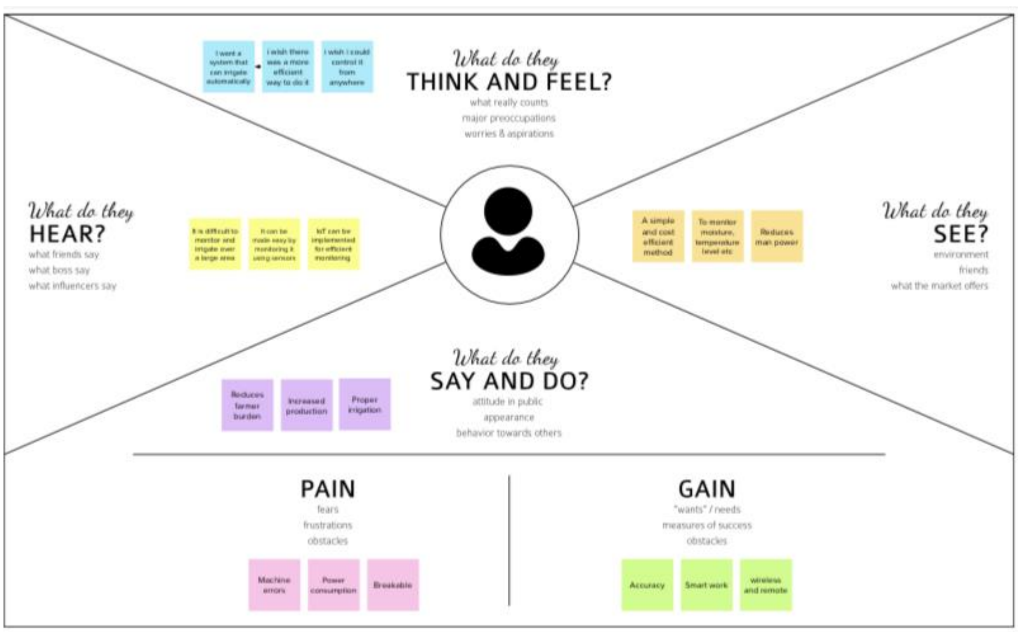
- Othmane Friha,Mohamed Amine Ferrag,Lei Shu,Leandros Maglaras,Xiaochan Wang (2021) have presented a paper titled “Internet of Things for the Future of Smart Agriculture: A Comprehensive Survey of Emerging Technologies”.These study provides a thorough analysis of splitting technologies for IoT-based smart agriculture. We start by describing the existing studies and defining innovative technologies for the agricultural IoT, such as drones, wireless technologies, open- source IoT platforms, software defined networking (SDN), network function virtualization (NFV), cloud/fog computing, and middleware platforms. Additionally, we offer a seven-category classification of IoT applications for smart agriculture, including smart monitoring, smart water management, agrochemical applications, disease control, smart harvesting, supply chain management, and smart agricultural practices. Additionally, we offer a taxonomy and a side-by-side comparison of the most advanced approaches to supply chain management for agricultural IoTs that are based on blockchain technology.
- Abdul Salam,Syed Shah (2019) have presented a paper titled”Internet of Things in Smart Agriculture: Enabling Technologies”.This article presents a research and innovation agenda for IoT technologies in precision agriculture (PA). The difficulties and numerous current practical trends have been emphasised. There are a few key goals for precision agriculture technology research and education highlighted. Precision agriculture difficulties are addressed with efficient IoT-based communications and sensing methods.

Problem Statement Definition

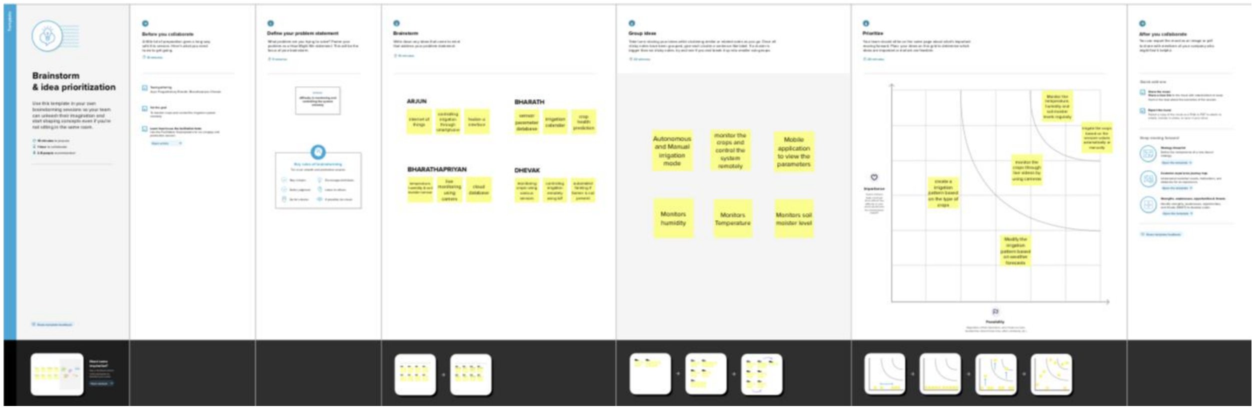
The soil moisture sensor determines how moist the soil is. The Arduino UNO microcontroller may be automatically controlled and is used to take input from a variety of sensors. When the soil moisture sensor detects a low level, the water pump will turn on, and when it surpasses certain values, the motor will automatically shut off. Ultrasonic sensors enable continuous crop growth monitoring. PIR sensors in agricultural land can detect motion or unusual movement. The former can monitor and regulate environmental conditions at their field with the help of this equipment. The farmers did not go to their fields since they could watch and control them from a distance utilising the cloud.

3. IDEATION & PROPOSED SOLUTION

- Empathy Map Canvas



- Ideation and Brainstorming



An introduction to the Internet of Things (IoT) and its use in agriculture to increase production and quality while lowering costs are given. A brief discussion of the sensors utilised in the architecture is included, along with an explanation of how data is transmitted from the agriculture field to the central system. The benefits of the suggested system are included. Open research questions, difficulties, and the potential for IoT in agriculture are also discussed. The idea behind the notion primarily centres around the premise that there are many different devices or objects—such as Arduino, sensors, GSM models, LCD displays, etc.—that are linked to the Internet. Each object has a unique address and can communicate with other objects. The things or things work together.

We will build a smart agricultural monitoring system that can gather essential agricultural data and transmit it in real time to Thingspeak, an IoT platform where the data can be logged and examined. A botanist or a farmer with average understanding can study the Thingspeak data (from any location in the world) and make wise adjustments to the resources supplied to crops in order to produce high-quality yield.

A new technology concept known as "smart farming" collects information from various agricultural fields, ranging in size from tiny to vast, and their surroundings utilising sophisticated electronic sensors. Experts and local farmers examine the data obtained to provide short- and long-term predictions about weather patterns, soil fertility, the quality of the crops currently being grown, the amount of water that will be needed in the coming week to month, and other factors.

By automating some farming processes, such as smart irrigation and water management, we can advance the concept of smart farming. Predictive algorithms can be used on SoC or microcontrollers to determine how much water will be needed right now for a certain agricultural sector. Consider the scenario where there was rain yesterday and less water is needed today. Similar to this, high humidity will result in decreased evaporation of water at upper ground level, resulting in less water being used than usual and reduced water usage.

- Proposed Solution

S. No.	Parameters	Description
1.	Problem Statement (Problem to be solved)	Farmers experience several distractions as a result of the weather and rising water levels, which is bad for agriculture. Utilizing a wireless sensor network to develop an effective decision support system that manages various farm activities and provides useful information related to the content of soil moisture, temperature, and humidity.
2.	Idea / Solution description	It is a network of various devices that work together to form a self-configuring network. The new developments of Smart Farming with the use of IoT are changing the face of traditional agriculture methods by not only making them optimal but also cost efficient for farmers and improved crop growth
3.	Novelty / Uniqueness	Smart farming based on IoT improves the entire agricultural system by monitoring the field in real time. The Internet of Things in Agriculture, with the help of sensors and interconnectivity, has not only saved farmers' time but has also reduced costs. Irrigation can be done on a scheduled basis.
4.	Social Impact / Customer Satisfaction	With smart farming, the reliance on manual labor has been significantly reduced. Pest control, fertilization, and irrigation are all becoming more automated, and farmers can control them remotely. The use of smart IoT sensors can help to keep these processes going and increase crop production.
5.	Business Model (Revenue Model)	Crop based irrigation method and tips for the improved growth of the crop can be available if the user purchases the monthly subscription
6.	Scalability of the Solution	Scalability refers to the ability to develop from prototype to production in seamless way. The given solution can be implemented to build a smart farming application.

- Problem solution fit

Define CS, Fit into CC

1. CUSTOMER SEGMENT (CS)

Farmers who grow crops are the target market for this product. Our goal is to help them remotely monitor the field parameters and maintain a record of the parameters.

6.CUSTOMER CONSTRAINT (CC)

It is challenging to deploy a large number of sensors. For it to be effective, a limitless or ongoing internet connection is necessary.

5. AVAILABLE SOLUTIONS (AS)

Cameras can be used to monitor the live field 24/7. But the disadvantage is that it is difficult to send and organize all the recordings.

Explore AS, Differentiate

Focus on J&P, tap into BE, understand RC

2. JOBS-TO-BE-DONE/PROBLEM (J&P)

The goal of this product is to collect various field parameters using sensors and process them using a central processing system. The cloud is used to store and transmit data via IoT. Weather APIs are used to help farmers make decisions. A farmer could make a decision using a mobile

9. PROBLEM ROOT CAUSE (RC)

The farmers found it challenging to practice agriculture because of the frequently changing or unpredictable weather and climate. These elements are crucial in deciding whether or not to water the plant. When the farmer is away from the farm, it is difficult to monitor the field, which can result in crop damage.

7. BEHAVIOUR (BE)

utilizing a suitable drainage system to combat the effects of too much water from a heavy downpour. utilizing crop hybrids with pest-resistant tr

Focus on J&P, tap into BE, understand RC

Identify strong TR & EM

3. TRIGGERS (TR)

Farmers are having difficulty providing adequate irrigation. Water scarcity leads to decreased production, which reduces the farmer's profit margin.

4. EMOTIONS: BEFORE / AFTER (EM)

BEFORE: cannot monitor the field all the time.

AFTER: can monitor the field all the time and can irrigate the crops remotely.

10. YOUR SOLUTION (SL)

Our product collects data from various types of sensors and sends it to the main server. It also gets weather data from OpenWeather API. The farmer makes the final decision on whether or not to water the crop using a mobile application.

8.CHANNELS of BEHAVIOUR (CH)

1.ONLINE

Providing online assistance to farmers by providing information about the pH and moisture level of the soil. The user will receive online assistance in using the product.

2.OFFLINE

Awareness camps will be held to teach the importance and benefits of automation and IoT in agricultural development.

Identify strong TR & EM

4. Requirement Analysis

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 Gmail Create a new username and password
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User login	Login using the credentials we have used during registration
FR-4	User permission	Get permission from user to access their location, camera, storage, wifi, audio and contacts.
FR-5	User Details	Get user details like name, mobile number, email, types of crops etc.

PRODUCT DESIGN

Data flow diagrams

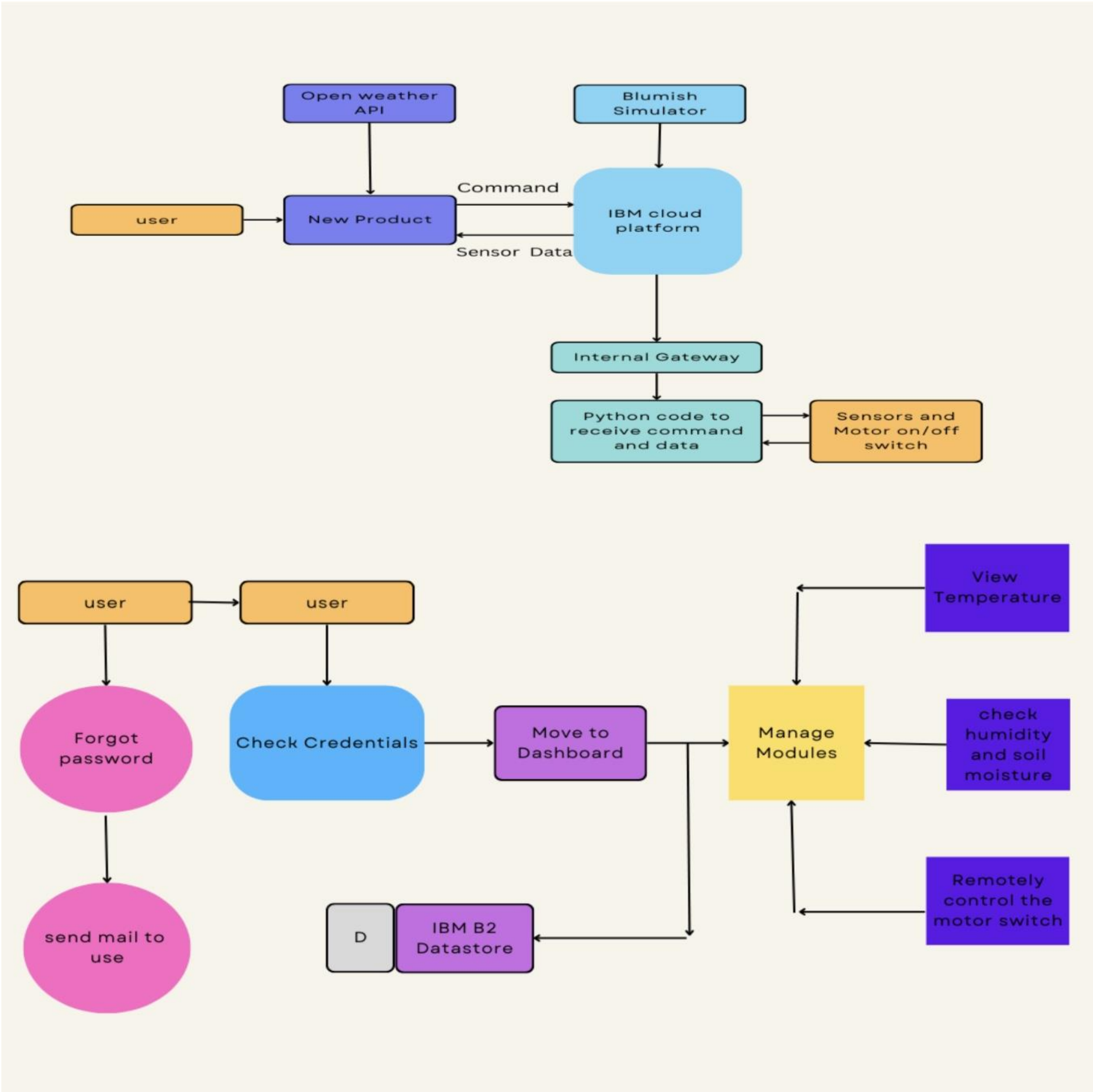
The classic visual representation of how information moves through a system is a data flow diagram (DFD). A tidy and understandable DFD can graphically represent the appropriate quantity of the system demand. It demonstrates how information enters and exits the system, what modifies the data, and where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

• Using various sensors, the various soil parameters—including temperature, moisture content, and humidity—are measured, and the results are saved in the IBM cloud.

• The Arduino UNO is utilised as a processing unit to process the data from the sensors and weather API.

NODE-RED is a programming language that is used to create the hardware, software, and APIs. The communication adheres to the MQTT protocol.

• All of the gathered information is offered



Solution and Technical Architecture

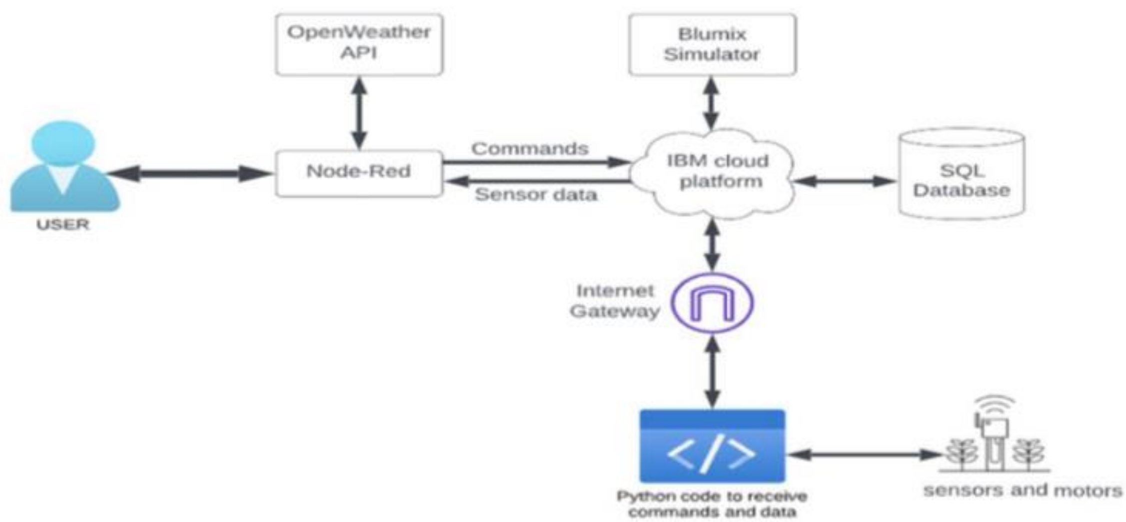
The Deliverable shall include the architectural diagram as below and the information as per the table1 & table 2 Guidelines:

• Using various sensors, the various soil parameters—including temperature, moisture content, and humidity—are measured, and the results are saved in the IBM cloud.

• The Arduino UNO is utilised as a processing unit to process the data from the sensors and weather API.

• NODE-RED is a programming language that is used to create the hardware, software, and APIs. The communication adheres to the MQTT protocol.

• A mobile application that was created utilising the MIT app inventor gives the user access to all the collected data. Depending on the sensor results, the user might choose through an app whether to irrigate the crop or not. They are able to remotely control the motor switch by utilising the app.



6. PROJECT PLANNING AND SCHEDULING

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	Arjun Pragadhishraj, Bharath, Dhevak, Bharathapriyan
Sprint-2	Software	USN-2	IBM Watson IoT platform, Workflows for IoT scenarios using Node-red	2	High	Arjun Pragadhishraj, Bharath, Dhevak, Bharathapriyan
Sprint-3	MIT app	USN-3	To develop an mobile application using MIT	2	High	Arjun Pragadhishraj, Bharath, Dhevak, Bharathapriyan
Sprint-4	Web UI	USN-4	To make the user to interact with software.	2	High	Arjun Pragadhishraj, Bharath, Dhevak, Bharathapriyan

7. CODING AND SOLUTIONING

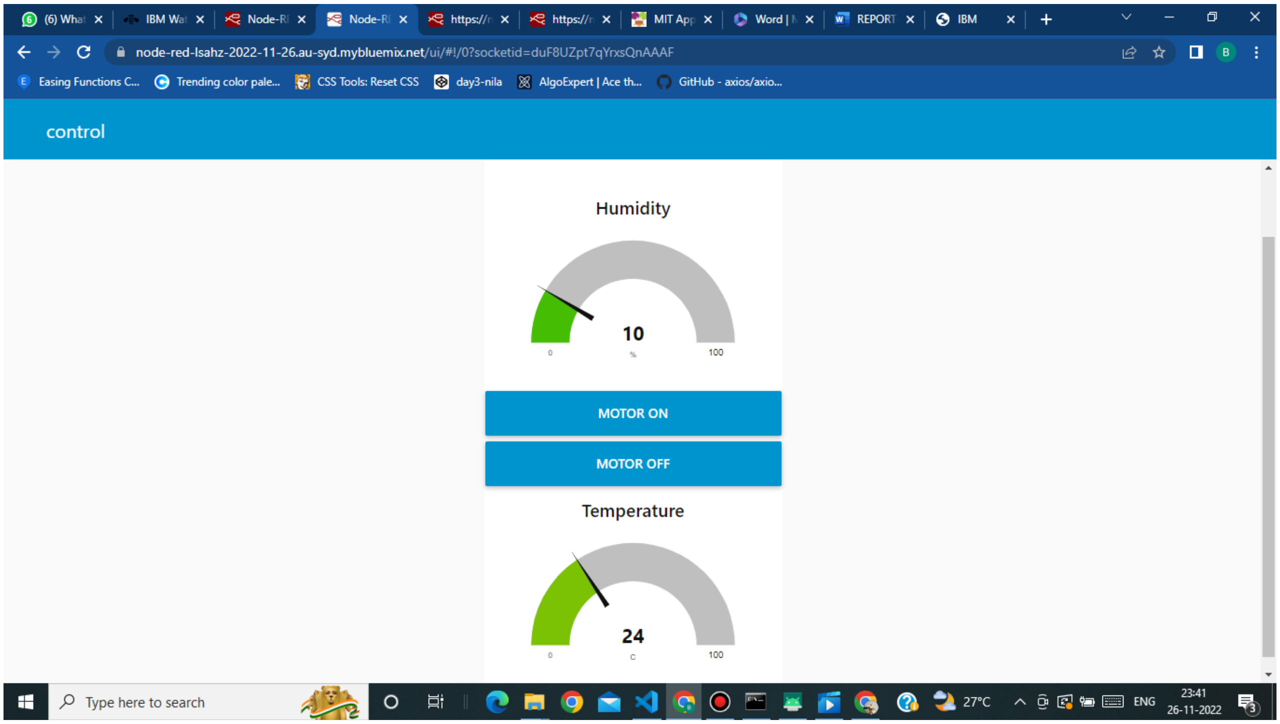
```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

organization = "jfyut1"
deviceType = "iotSensor"
deviceId = "12345"
authMethod = "token"
authToken = "12345678"

def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])

    status=cmd.data['command']

    if status=="motoron":
        print ("motor is on")

    else :
        print ("motor is off")


try:
```

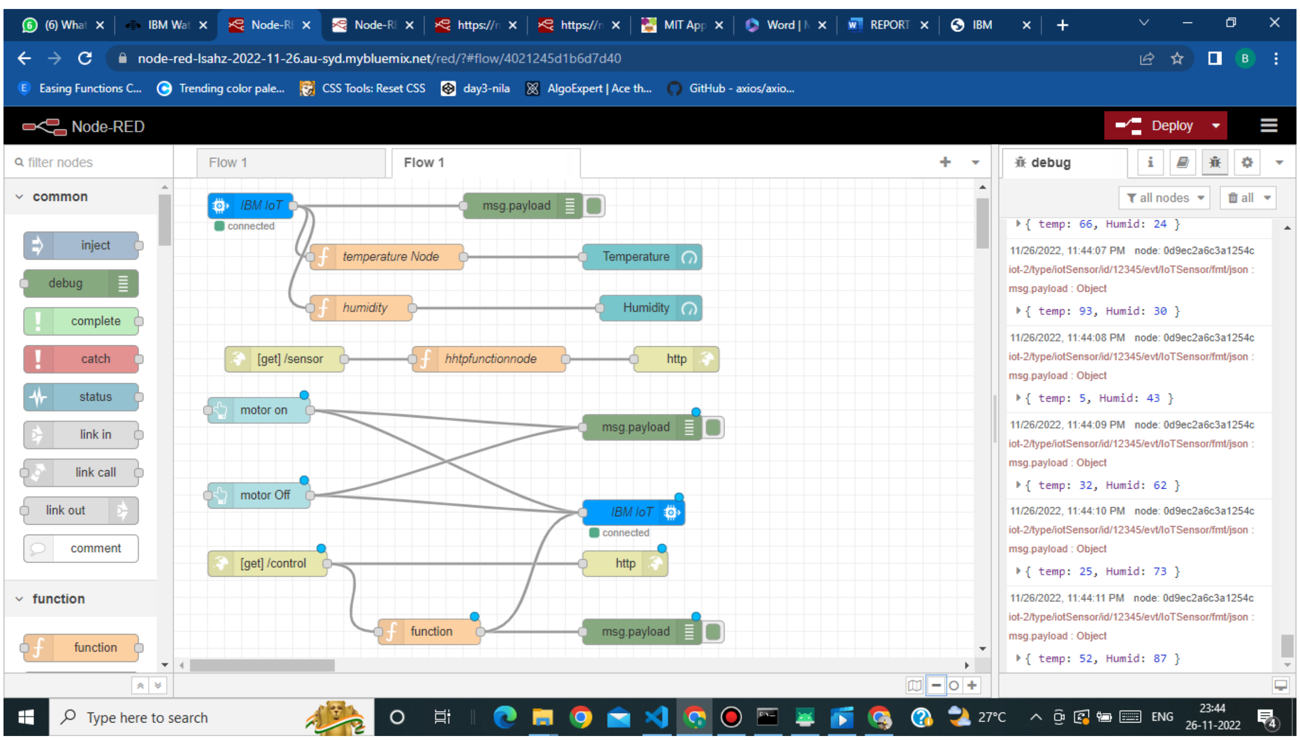
```
    deviceOptions = {"org": organization, "type": deviceType, "id": deviceId,
"auth-method": authMethod, "auth-token": authToken}
    deviceCli = ibmiotf.device.Client(deviceOptions)


except Exception as e:
    print("Caught exception connecting device: %s" % str(e))
    sys.exit()

deviceCli.connect()

while True:
        temp=random.randint(0,100)
        Humid=random.randint(0,100)

        data = { 'temp' : temp, 'Humid': Humid }

        def myOnPublishCallback():
            print ("Published Temperature = %s C" % temp, "Humidity = %s %%" %
Humid, "to IBM Watson")

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0,
on_publish=myOnPublishCallback)

        if not success:
            print("Not connected to IoTF")
        time.sleep(1)

        deviceCli.commandCallback = myCommandCallback

deviceCli.disconnect()
```

8.TESTING

Test case

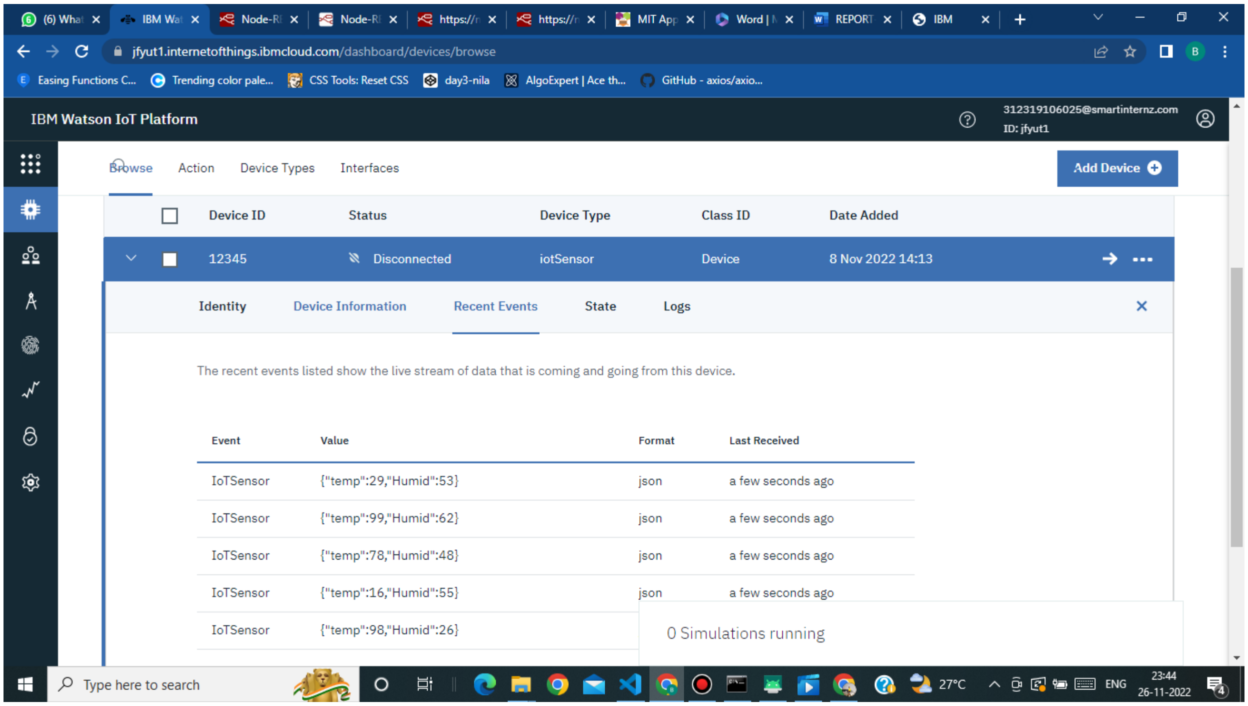
Web application using Node Red



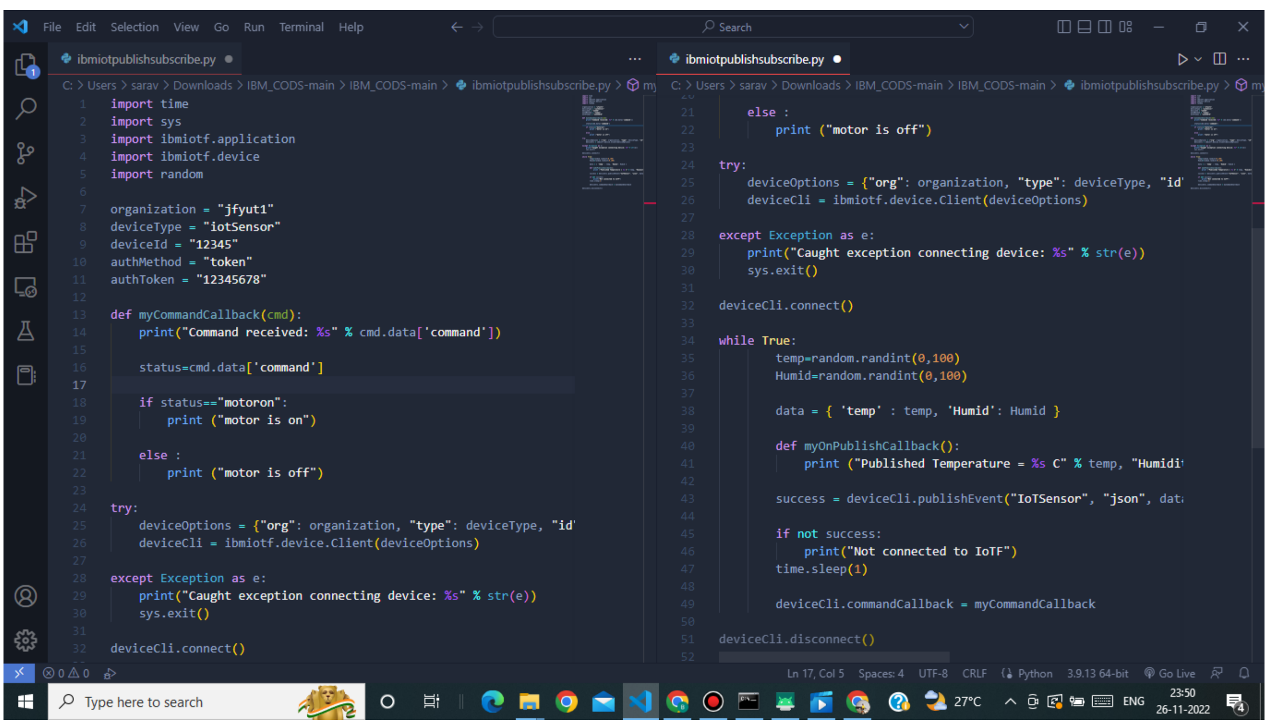


Iot Watson Platform

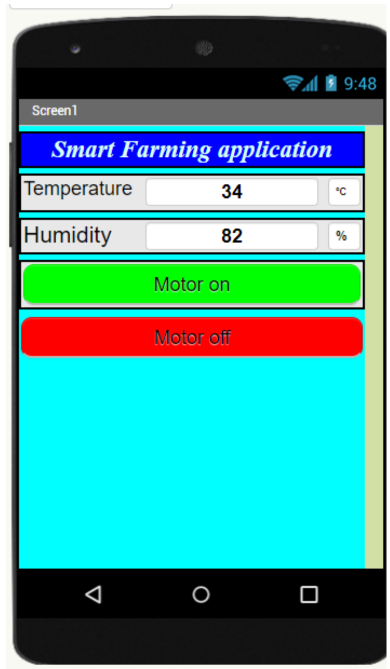
Device creation and connection to node-red



Python code connected to Iot watson platform

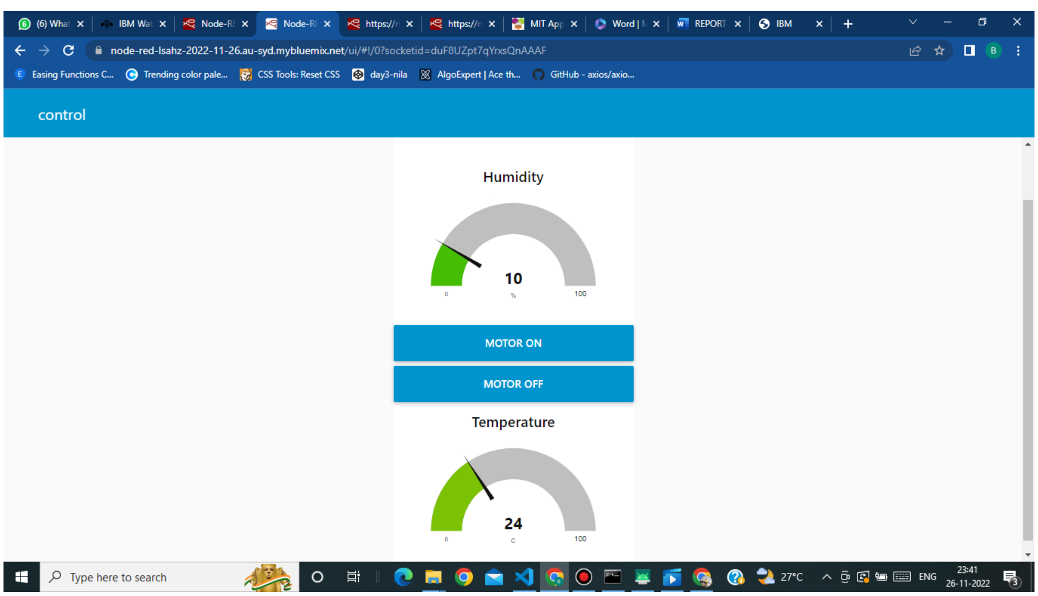


- **User Acceptance Testing**



9.RESULTS

9.1 Performance Metrics



10. Advantages and disadvantages

Advantages:

• A remote control system can assist in timing the operation of irrigation system valves. Remote farm holdings can be extremely difficult and labor-intensive to irrigate. Understanding when the valves were opened and whether the proper amount of water was released becomes difficult.

• Manual valve actuation might not always be feasible for conditions that call for a speedy response. The logical next step is to remotely monitor and control motorised gear such as irrigation systems, generators, wind turbines, and other similar devices.

• There are numerous options for keeping track of engine statistics and starting or halting the engine. The application instantly sends a signal to the device via a mobile phone system when the client decides to start or stop the motor.

• Submersible weight sensors or ultrasonic sensors can check the level of fluid storage in tanks, lakes, wells, and other types of fluids like compost and gasoline. After some time, the product calculates volume based on the geometry of the tank or lake. It transmits alarms based on a variety of situations.

Disadvantages:

• Constant internet access is necessary for smart agriculture. Most developing countries' rural areas do not meet this condition. Additionally, internet speed is slower.

• Farmers that utilise smart farming equipment must comprehend and learn how to use technology. This is a significant obstacle to the widespread adoption of smart agriculture farming across nations.

11. CONCLUSION

Farmers can benefit greatly from an IoT-based smart agriculture system. As a result of the lack of 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 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 farmers phone.

12. Future scope

We have built a project that can preserve and protect the crop in the current project. In this initiative, the farmer operates and remotely monitors the field. Future updates and additions to this project are possible. • We can make a few additional replicas of the same project so that the farmer has access to comprehensive information.

• We are able to update this project by using solar electricity. in order to replace the electric poles' source of power with solar panels. It lowers the cost of the electricity lines. It will only be spent once. We can upgrade this project with solar fence technology.

• For this project, we can use GSM technology so that the farmers can receive the information directly.

13. Appendix

Source Code:

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


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deviceType = "iotSensor"
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    status=cmd.data['command']
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```

DEMO VIDEO LINK :

https://drive.google.com/file/d/10fnz-FXoAvlQKcCJ9Z4lrxkaQjpqO04l/view?usp=drivesdk