PROJECT REPORT

Project Name: SMART FARMER- IOT ENABLED SMART FARMINGAPPLICATION

Team ID: PNT2022TMID19210

Team :

Team Leader : Ganasri

Team member : Jayakumar

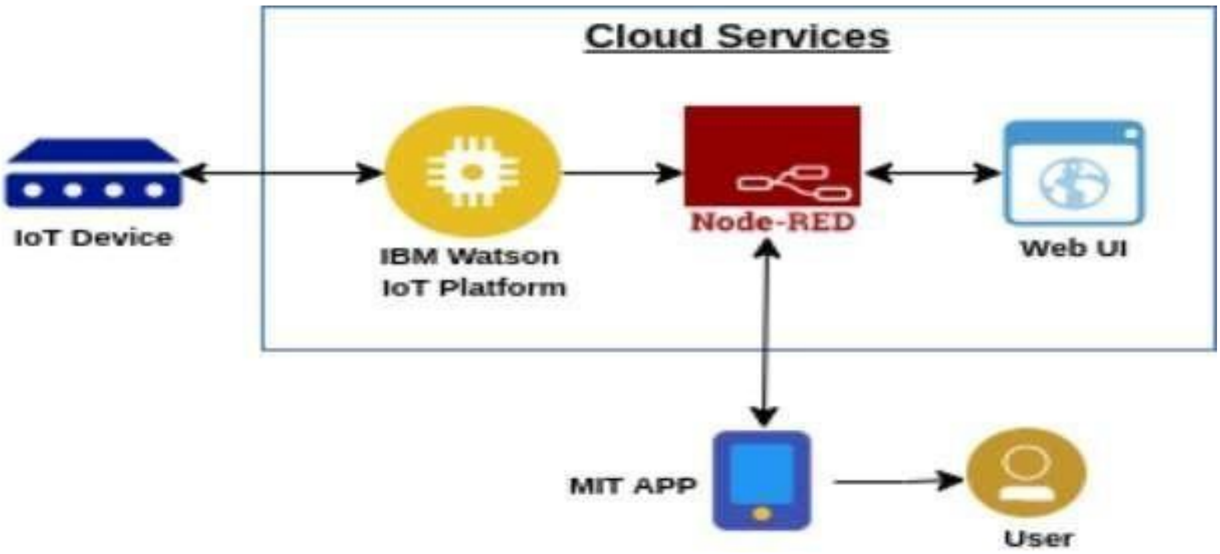
Team member : Shafeeq Ahmed

Team member : Hariharasudan

1. INTRODUCTION

1.1 Project Overview

IoT-based agriculture system helps the farmer in monitoring different parameters of his fieldlike soil moisture, Temperature, humidity using some sensors. Farmers can monitor all the sensorparameters by using a web or mobile application even if the farmer is not near his field. Wateringthe 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

The smart agriculture model main aim to avoid water wastage in the irrigation process. It islow cost and efficient system Is shown below. It includes NodeMCU, Arduino Nano, sensors like soil moisture and Dht11, solenoid valves, relays.

2. LITERATURE SURVEY

2.1 Existing problem

Smart Farming has enabled farmers to reduce waste and enhance productivity with the help of sensors (light, humidity, temperature, soil moisture, etc.) and automation of irrigation systems. Further with the help of these sensors, farmers can monitor the field conditions from anywhere. Internet of Things based Advanced Farming is highly efficient when compared with the conventional approach. The applications of intelligent Agriculture solutions not only targets conventional, large farming. With operations, but could also be new levers to uplift other growing or common trends in agricultural like organic farming, family farming (complex or small spaces, particular cattle and/or cultures, preservation of specific or high-quality varieties, etc.), and enhance highly transparent Farming.

2.2 Technical papers:

[1] Lin Yuanguai. An Intelligent Monitoring System for Agriculture Based on ZigBee Wireless Sensor Network Journal .Advanced Materials Research, Manufacturing Science and Technology, 2011, Vols.383~399:4358~4364

[2] Zhang Chunhong. The Internet of Things Technology and Applications [M].Beijing: Posts & Telecom press, 2011. (In Chinese)

[3] Sachin, Kumar., Prayag, Tiwari., & Mikhail, Zymbler . (2019) Internet of Things is a revolutionary approach for future technology enhancement: a review.Journal of Big Data volume 6, Article number: 111(2019)

[4] Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M.(2013) Internet of things (IoT): a vision, architectural elements, and future directions. Future Gener Comput Syst. 2013;29(7):1645- 60.

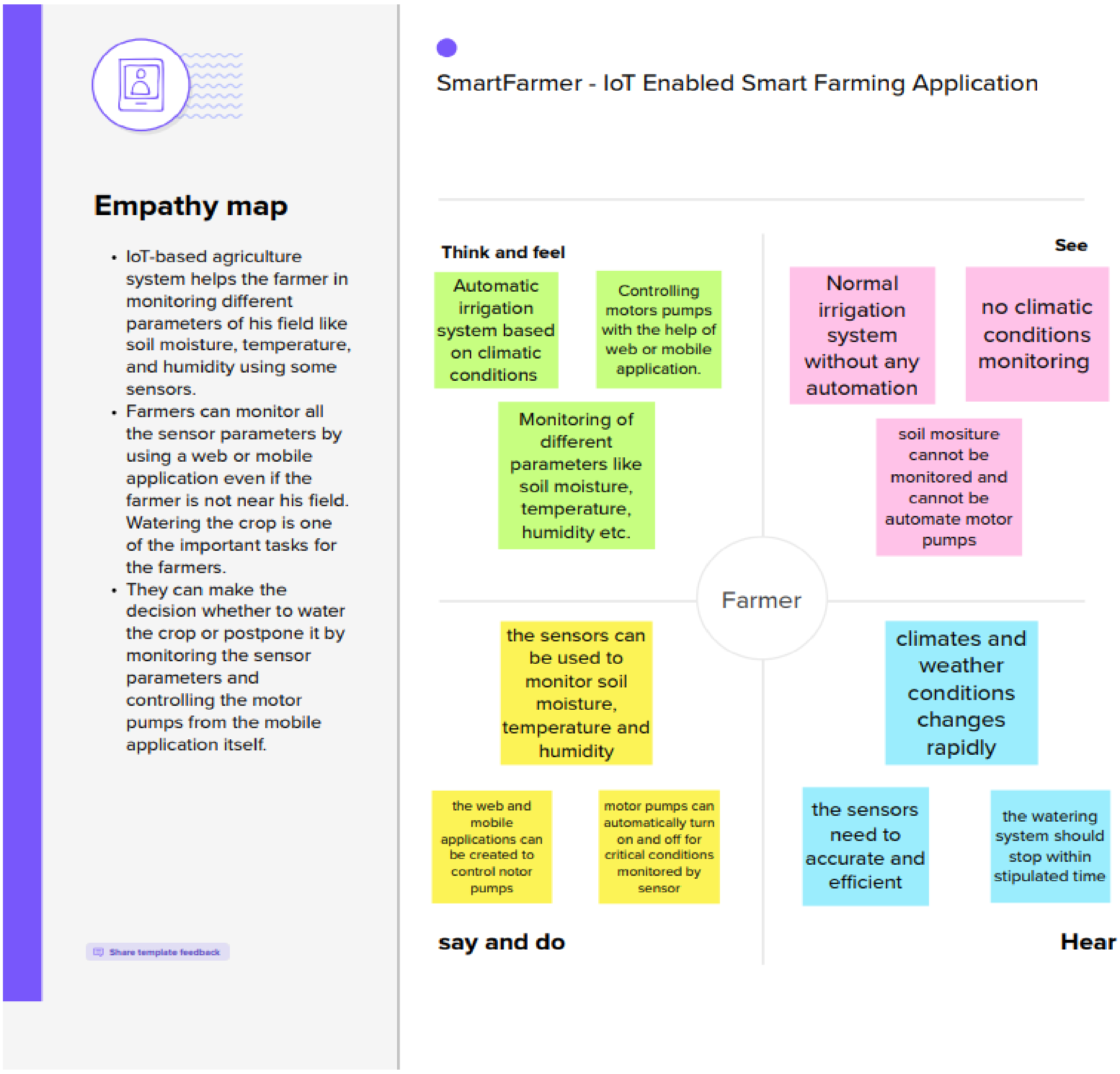
[5] Mohanraj, Kirthika Ashokumar, Naren J., “Field Monitoring and Automation using IOT in Agriculture Domain”, 6th International Conference On Advances In Computing & Communications, ICACC 2016, 6-8 September 2016, Cochin, India.

2.4 Problem statement definition:

- A unified solution which can be integrated with different types of Internet of Things devices.
- The most common challenge for the Internet of Things in agriculture is connectivity. Every area doesn’t have proper internet connectivity.
- The second most common challenge for Internet of Things based Advanced Farming is the lack of awareness among consumers.
- Due to various service providers, it becomes really difficult to maintain interoperability between different IoT systems.
- A scalable solution that can be integrated with thousands of IoT devices for large farms.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



3.2 Ideation & Brainstorming

Existing	Needed	Going to fabfricate
Monitoring of climate conditions	Monitoring of climate conditions with iot	Iot enabled climatic conditions monitoring
Types of irrigation monitoring like sprinkler etc.	Automatic irrigation based on moisture level.	Automatic irrigation based on moisture level and automation using mobile application.

1) Monitoring of climate conditions

Probably the most popular smart agriculture gadgets are weather stations, combining various smart farming sensors. Located across the field, they collect various data from the environment and send it to the cloud. The provided measurements can be used to map the climate conditions, choose the appropriate crops, and take the required measures to improve their capacity.

2) Greenhouse automation

Typically, farmers use manual intervention to control the greenhouse environment. The use of IoT sensors enables them to get accurate real-time information on greenhouse conditions such as lighting, temperature, soil condition, and humidity.

In addition to sourcing environmental data, weather stations can automatically adjust the conditions to match the given parameters. Specifically, greenhouse automation systems use a similar principle.

3) Crop management

One more type of IoT product in agriculture and another element of precision farming arecrop management devices. Just like weather stations, they should be placed in the field tocollect data specific to crop farming; from temperature and precipitation to leaf water potential and overall crop health.

Thus, you can monitor your crop growth and any anomalies to effectively prevent anydiseases or infestations that can harm your yield.

4) Cattle monitoring and management

Just like crop monitoring, there are IoT agriculture sensors that can be attached to the animalson a farm to monitor their health and log performance. Livestock tracking and monitoring help collect data on stock health, well-being, and physical location.

For example, such sensors can identify sick animals so that farmers can separate them fromthe herd and avoid contamination. Using drones for real-time cattle tracking also helps farmers reduce staffing expenses. This works similarly to IoT devices for pet care.

5) Agricultural drones

Perhaps one of the most promising agritech advancements is the use of agricultural drones insmart farming. Also known as UAVs (unmanned aerial vehicles), drones are better equippedthan airplanes and satellites to collect agricultural data. Apart from surveillance capabilities, drones can also perform a vast number of tasks that previously required human labour: planting crops, fighting pests and infections, agriculture spraying, crop monitoring, etc.

6) End-to-end farm management systems

A more complex approach to IoT products in agriculture can be represented by the so-called farm productivity management systems. They usually include a number of agriculture IoT devices and sensors, installed on the premises as well as a powerful dashboard with analyticalcapabilities and in-built accounting/reporting features.

This offers remote farm monitoring capabilities and allows you to streamline most of thebusiness operations. Similar solutions are represented by Farm Logs and Cropio.

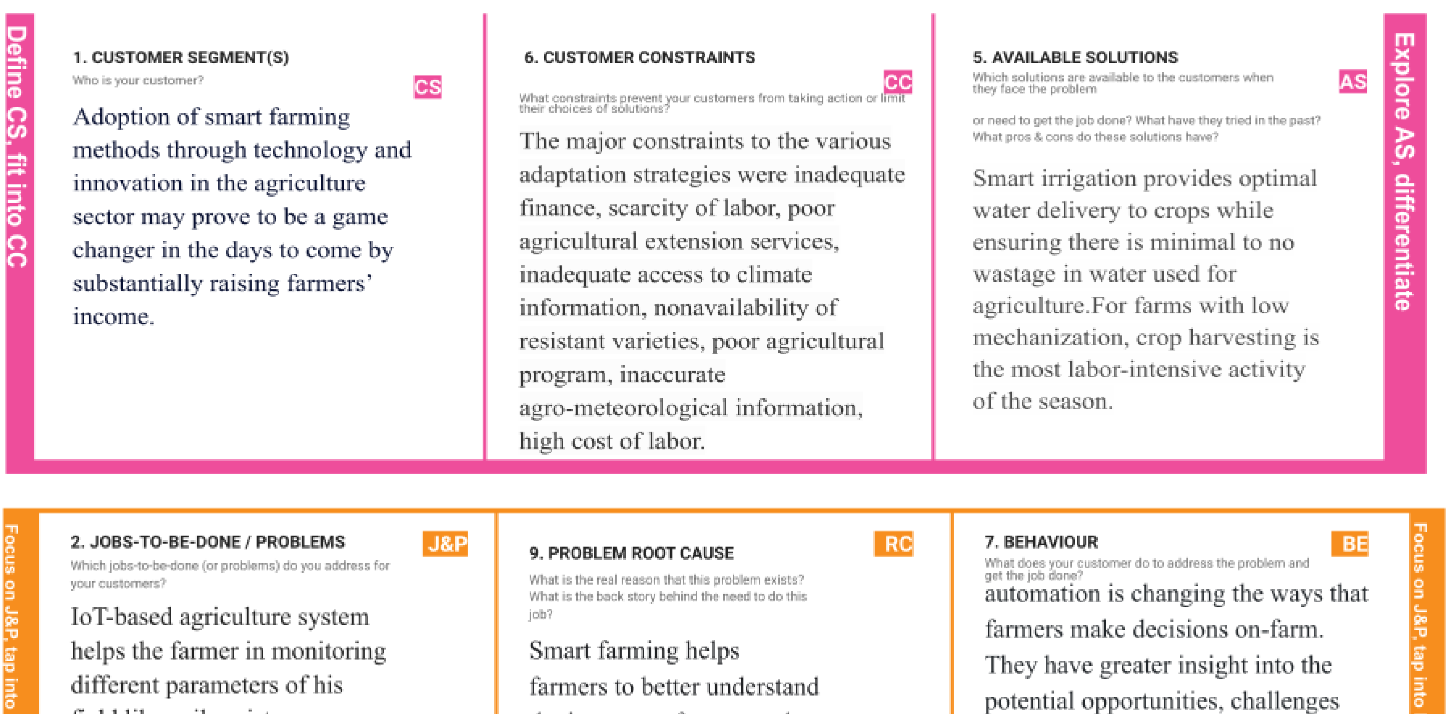
In addition to the listed IoT agriculture use cases, some prominent opportunities includevehicle tracking (or even automation), storage management, logistics, etc.

3.3 Proposed Solution

Smart Farming solutions provide an integrated IOT platform in agriculture that allows farmers toleverage sensor, smart gateways and monitoring systems to collect information, control variousparameters on their farms and analyse real-time data in order to make informed decisions.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To provide efficient decision support system using wireless sensor network which handle different activities of farm and gives useful information related to farm field to farmer
2.	Idea / Solution description	Smart Farming solutions provide an integrated IOT platform in agriculture that allows farmers to leverage sensor , 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.	Novelty / Uniqueness	It is based on four domains namely monitoring ,control ,prediction and logic.
4.	Social Impact / Customer Satisfaction	Conservation of water, better crop yield, Pollution prevention, Time efficiency, accurate diagnosis of nutrient deficiency
5.	Business Model (Revenue Model)	Smart farming which involves the application of sensor and automated irrigation practices can help monitor land, temperature , soil moisture
6.	Scalability of the Solution	Using of number of sensor and the actuators enables us timely analysis.

3.4 Problem Solution fit



3. TRIGGERS	10. YOUR SOLUTION	8. CHANNELS of BEHAVIOUR
TR What triggers customers to act? With smart farming, you can maximize productivity in production.	SL ● 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.	CH 8.1 ONLINE controls motor pumps through online mode,via monitoring weather conditions. 8.2 OFFLINE random checking of fields.
4. EMOTIONS: BEFORE / AFTER EM How do customers feel when they face a problem or a job and afterwards? Smart farming can provide a concerted path out of locked-in technologies and practices characterized by strong polarization and market segmentation.		

4.Requirement Analysis

4.1 Functional requirement

In IOT-based Smart farming system there are some requirements are needed. In that requirements,some of them mentioned below.

Smart farming refers to managing farms using modern Information and communication technologies to increase the quantity and quality of products while optimizing the humanlabor required.

Among the technologies available for present-day farmers are:

- **Sensors**: soil, water, light, humidity, temperature management
- **Software**: specialized software solutions that target specific farm types or applications agnostic IoT platforms
- **Connectivity**: cellular, LoRa
- **Location**: GPS, Satellite

- **Robotics**: Autonomous tractors, processing facilities
- **Data analytics**: standalone analytics solutions, data pipelines for downstream

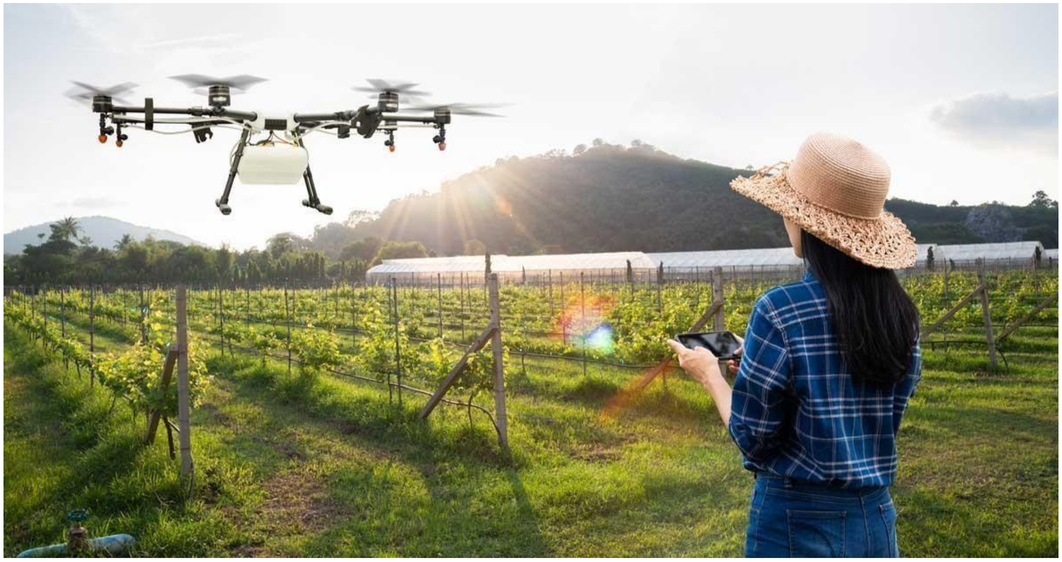
APPLICATION OF SMART FARMING :

1) Precision Farming

Precision agriculture (PA) is **the science of improving crop yields and assisting management decisions using high technology sensor and analysis tools**. PA is a newconcept adopted throughout the world to increase production, reduce labor time, and ensure the effective management of fertilizers and irrigation processes.

Precision agriculture is one of the most famous applications of IoT in the agricultural sectorand numerous organizations are leveraging this technique around the world. CropMetrics isa precision agriculture organization focused on ultra-modern agronomic solutions while specializing in the management of precision irrigation.

2) Agricultural Drones:



Agriculture is one of the major verticals to incorporate both ground-based and aerial drones for crop health assessment, irrigation, crop monitoring, crop spraying, planting, soil and field analysis, and other spheres.

Since drones collect multi spectral, thermal, and visual imagery while flying, the data they gather provide farmers with insights into a whole array of metrics: plant health indices, plant counting and yield prediction, plant height measurement, canopy cover mapping, field water pond mapping, scouting reports, stockpile measuring, chlorophyll measurement, nitrogen content in wheat, drainage mapping, weed pressure mapping, and so on.

3) Livestock Monitoring :

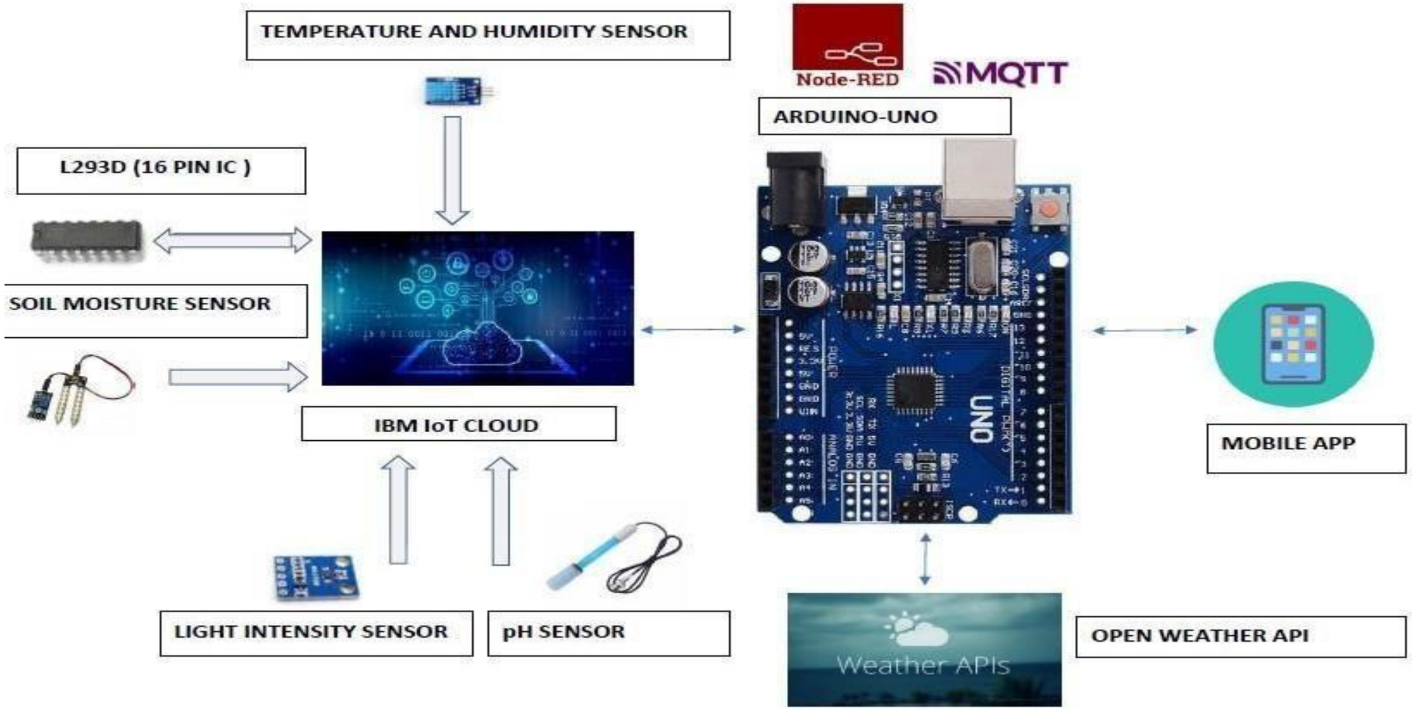
Livestock management, also known as livestock monitoring or precision livestock farming, **uses IoT-enabled devices to track and monitor the health of livestock, mostcommonly cattle**.

Large farm owners can utilize wireless IoT applications to collect data regarding the location, well-being, and health of their cattle. This information helps them in identifyinganimals that are sick so they can be separated from the herd, thereby preventing the spread of disease. It also lowers labor costs as ranchers can locate their cattle with thehelp of IoT based sensors.

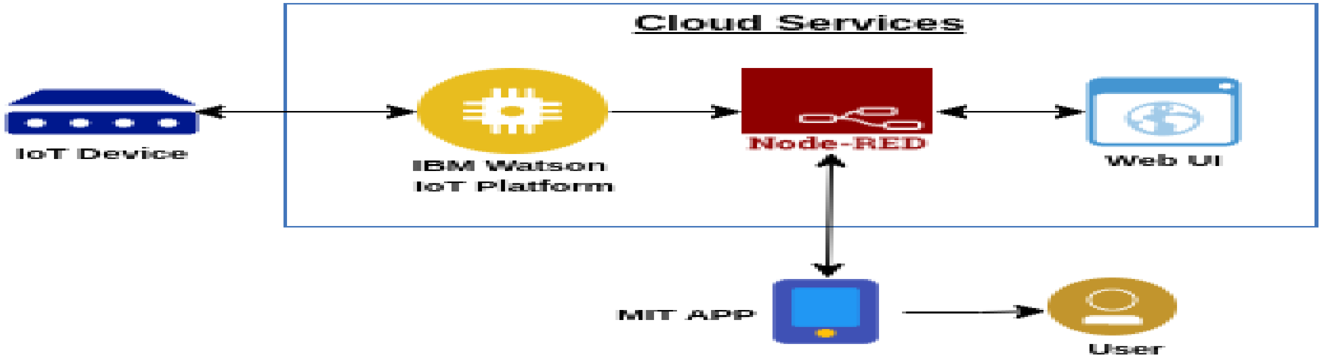
JMB North America is an organization that offers cow monitoring solutions to cattle producers. One of the solutions helps the cattle owners observe cows that are pregnantand about to give birth. From the heifer, a sensor powered by a battery is expelled whenits water breaks. This sends information to the herd manager or the rancher. In the timethat is spent with heifers that are giving birth, the sensor enables farmers to be more focused.

5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture



6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning, Schedule & Estimation

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1		US-1	Create the IBM Cloud services which are being used in this project.	6	High	Ganasri Hariharasudan Jayakumaar shafeeqahmed
Sprint-1		US-2	Configure the IBM Cloud services which are being used in completing this project.	4	Medium	Ganasri Hariharasudan Jayakumaar shafeeqahmed

Sprint-1		US-3	IBM Watson IoT platform acts as the mediator to connect the web application to IoT devices,so create the IBM Watson IoT platform.	5	Medium	Ganasri Hariharasudan Jayakumaar shafeeqahmed
Sprint-1		US-4	In order to connect the IoT device to the IBM cloud, create a device in the IBM Watson IoT platform and get the device credentials.	5	High	Ganasri Hariharasudan Jayakumaar shafeeqahmed
Sprint-2		US-1	Configure the connection security and createAPI keys that are used in the Node-RED service for accessing the IBM IoT Platform.	10	High	Ganasri Hariharasudan Jayakumaar shafeeqahmed

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2		US-2	Create a Node-RED service.	10	High	Ganasri Hariharasudan Jayakumaar shafeeqahmed
Sprint-3		US-1	Develop a python script to publish random sensor data such as temperature, moisture,soil and humidity to the IBM IoT platform	7	High	Ganasri Hariharasudan Jayakumaar shafeeqahmed
Sprint-3		US-2	After developing python code, commands are received just print the statements which represent the control of the devices.	5	Medium	Ganasri Hariharasudan Jayakumaar shafeeqahmed
Sprint-3		US-3	Publish Data to The IBM Cloud	8	High	Ganasri Hariharasudan Jayakumaar shafeeqahmed
Sprint-4		US-1	Create Web UI in Node- Red	10	High	Ganasri Hariharasudan Jayakumaar shafeeqahmed
Sprint-4		US-2	Configure the Node-RED flow to receive datafrom the IBM IoT platform and also use Cloudant DB nodes to store the received sensor data in the cloudant DB	10	High	Ganasri Hariharasudan Jayakumaar shafeeqahmed

Project Tracker, Velocity & Burndown Chart: (4 Marks)

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
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

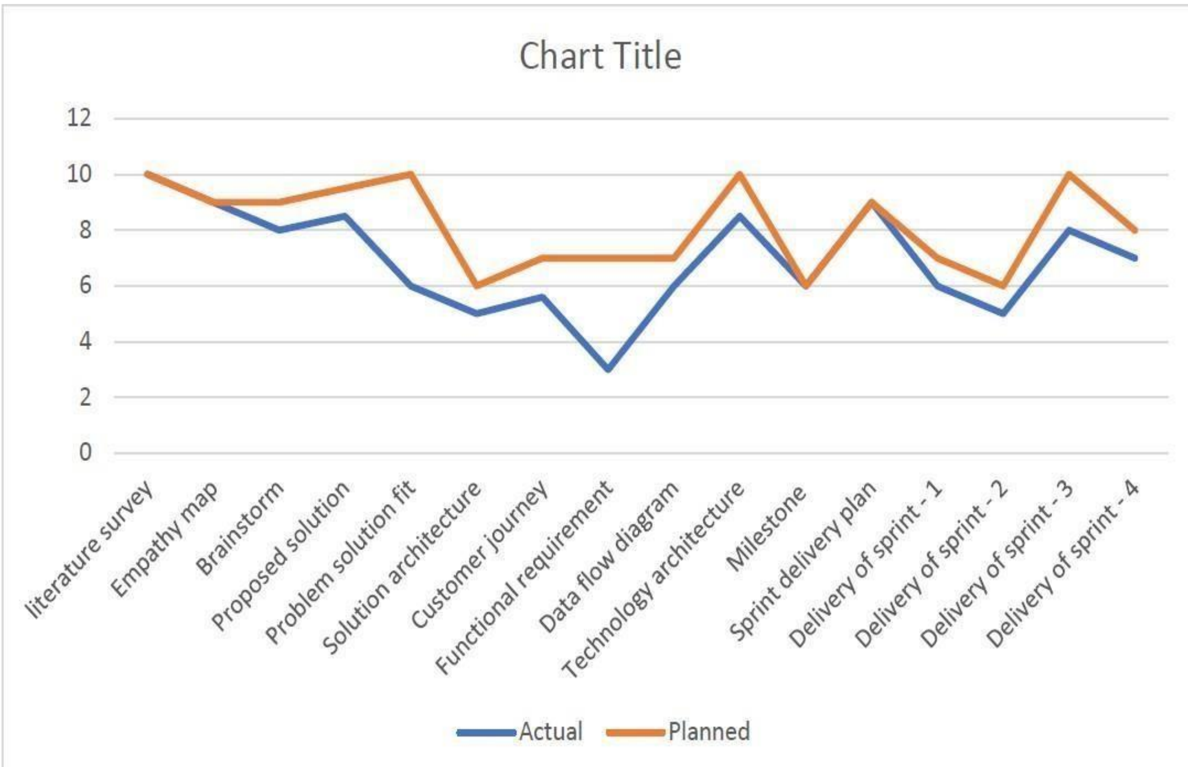
Velocity:

Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let’s calculate the team’s average velocity (AV) periteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

Burndown Chart:

A burndown chart is a graphical representation of work left to do versus time. It is often used in agile software development methodologies such asScrum. However, burndown charts can be applied to any project containing measurable progress overtime.



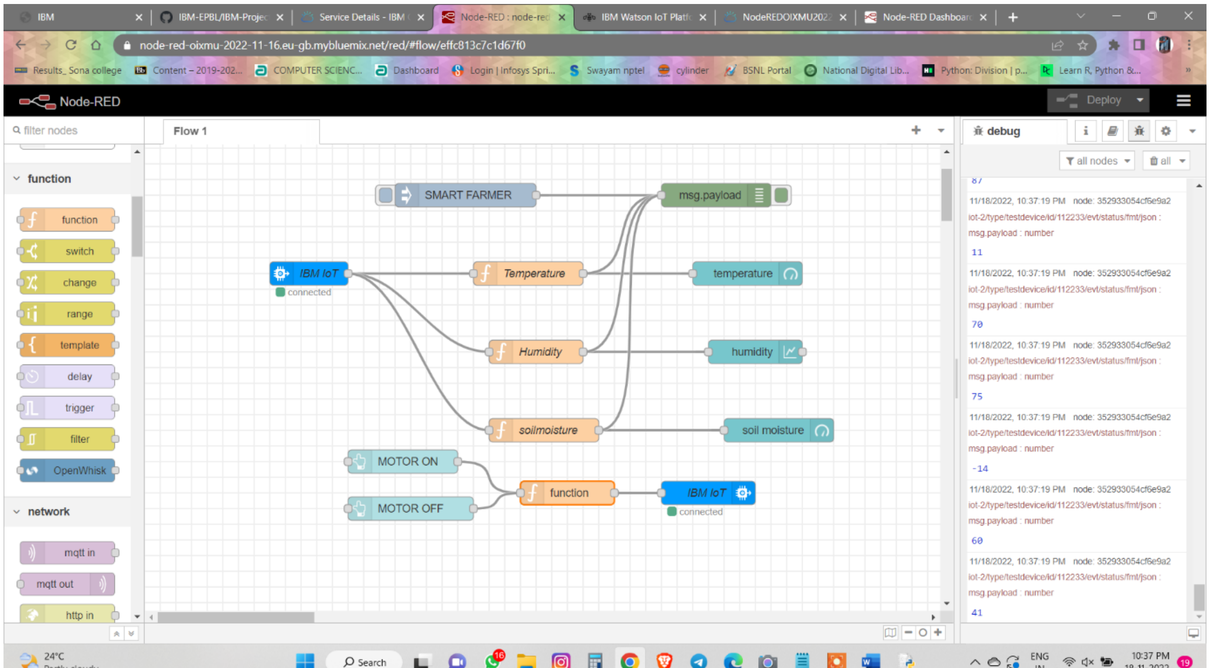
7. **CODING & SOLUTIONING (Explain the features added in the project along with code)**

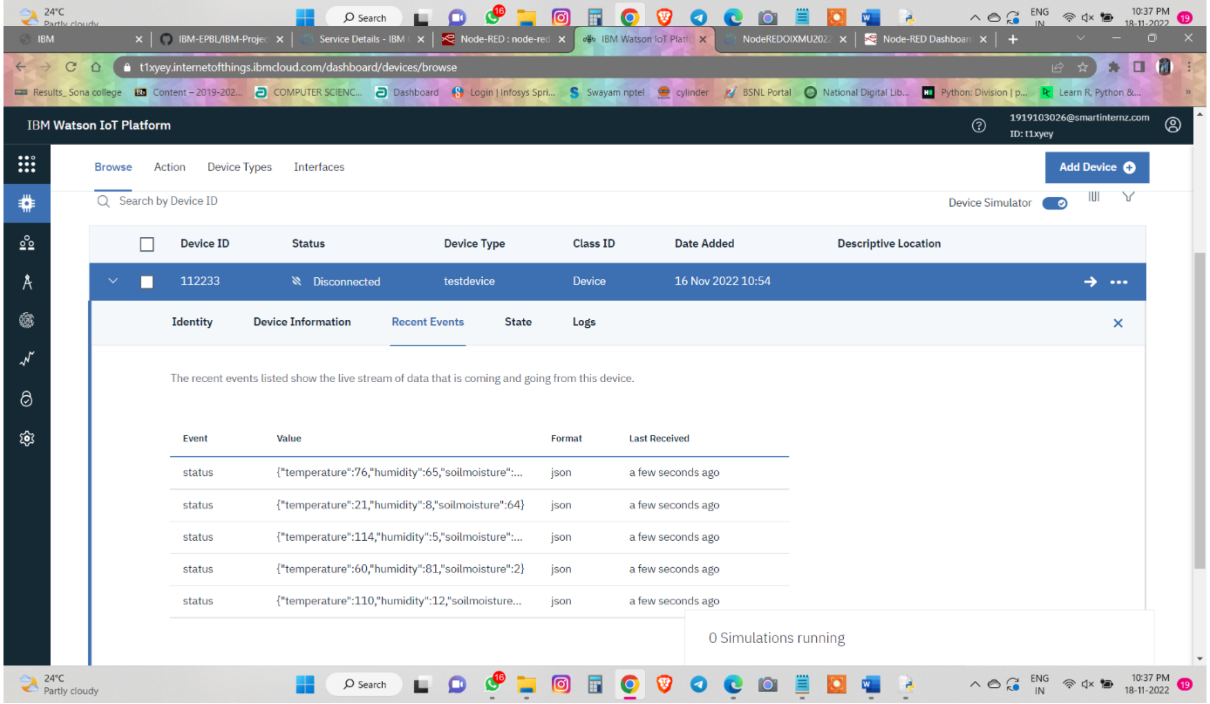
7.1 Feature

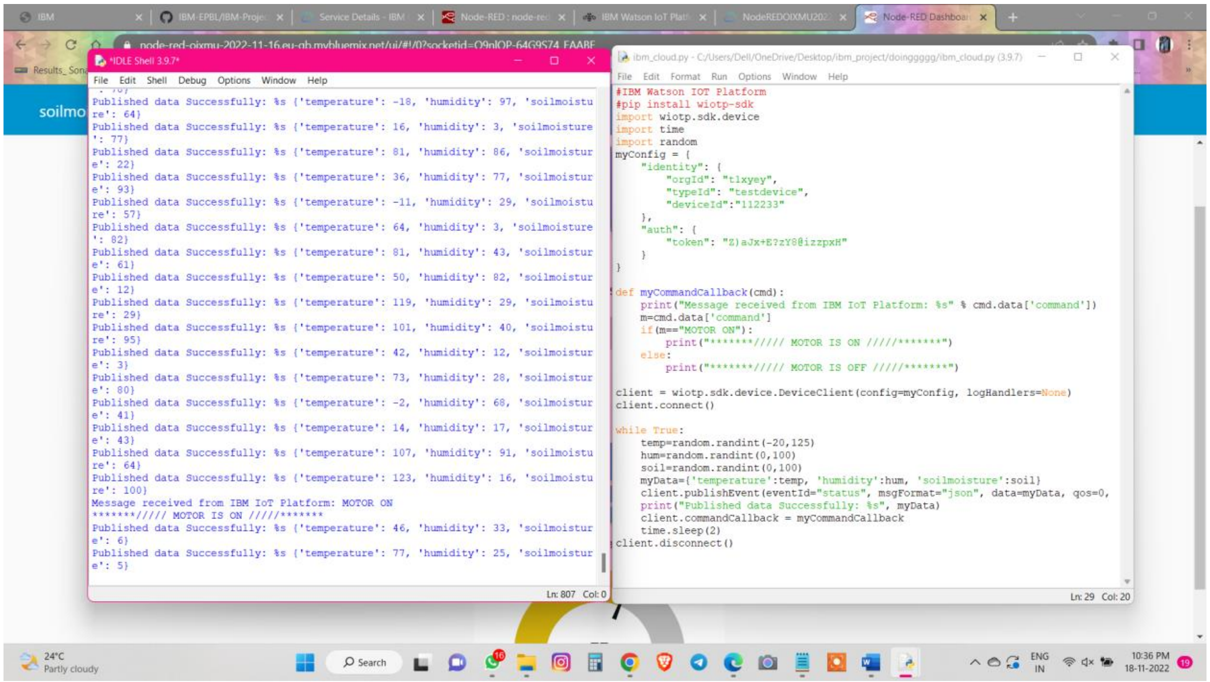
```
#IBM Watson IOT Platform
#pip install wiotp-sdk
import wiotp.sdk.device
import time
import random
myConfig = {
   "identity": {
      "orgId": "t1xyey",
      "typeId": "testdevice",
      "deviceId":"112233"
   },
   "auth": {
```

```
        "token": "Z)aJx+E?zY8@izzpxH"
    }
}

def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    m=cmd.data['command']
    if(m=="MOTOR ON"):
        print("*******///// MOTOR IS ON /////*******")
    else:
        print("*******///// MOTOR IS OFF /////*******")

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

while True:
    temp=random.randint(-20,125)
    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)
    client.commandCallback = myCommandCallback
    time.sleep(2)
client.disconnect()
```

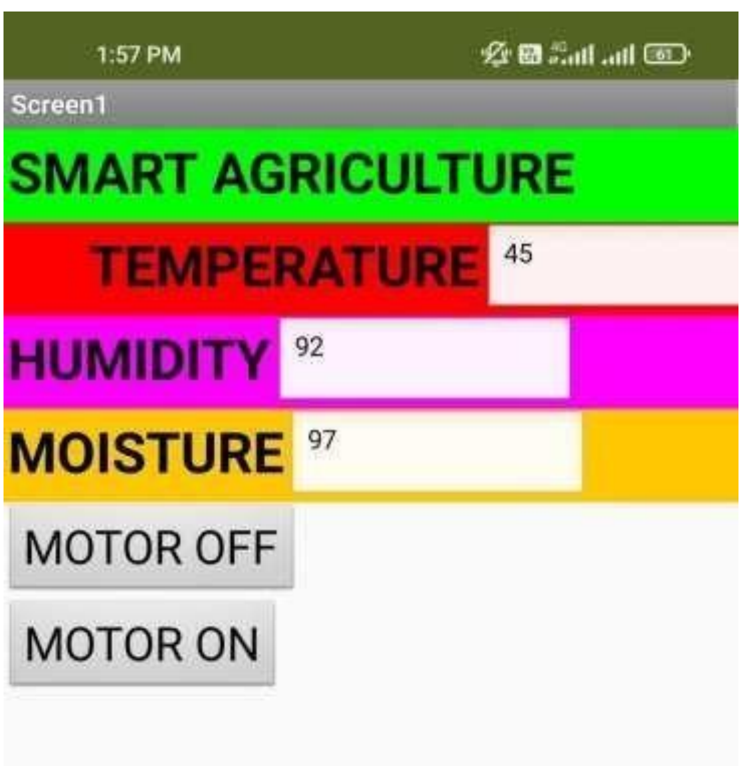
8. TESTING


Node-RED
Flow 1
debug
SMART FARMER
msg.payload
IBM IoT
connected
Temperature
temperature
Humidity
humidity
soilmoisture
soil moisture
MOTOR ON
MOTOR OFF
function
IBM IoT
connected
function
switch
change
range
template
delay
trigger
filter
OpenWhisk
network
mqtt in
mqtt out
http in
11/18/2022, 10:37:19 PM node: 352933054cf6e9a2
msg.payload : number
11
70
75
-14
60
41


IBM Watson IoT Platform
Browse
Action
Device Types
Interfaces
Add Device
Search by Device ID
Device Simulator
Device ID
Status
Device Type
Class ID
Date Added
Descriptive Location
112233
Disconnected
testdevice
Device
16 Nov 2022 10:54
Identity
Device Information
Recent Events
State
Logs
The recent events listed show the live stream of data that is coming and going from this device.
Event
Value
Format
Last Received
status
{"temperature":76,"humidity":65,"soilmoisture":...
json
a few seconds ago
status
{"temperature":21,"humidity":8,"soilmoisture":64}
json
a few seconds ago
status
{"temperature":114,"humidity":5,"soilmoisture":...
json
a few seconds ago
status
{"temperature":60,"humidity":81,"soilmoisture":2}
json
a few seconds ago
status
{"temperature":110,"humidity":12,"soilmoisture...
json
a few seconds ago
0 Simulations running

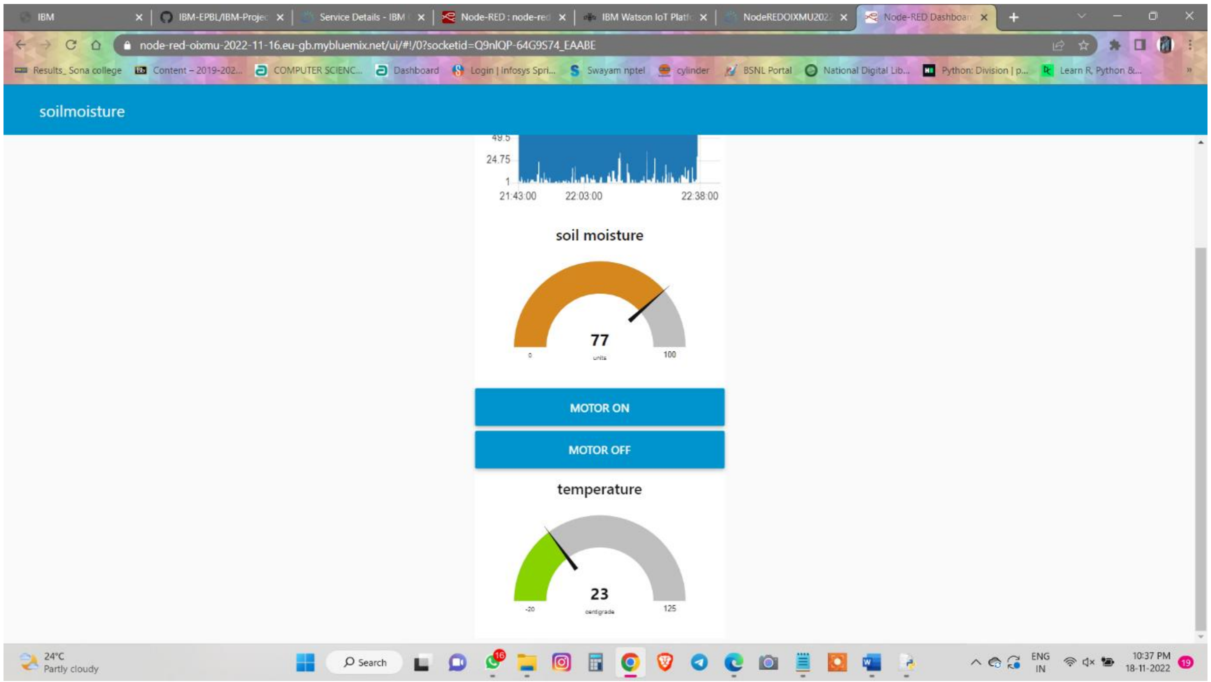


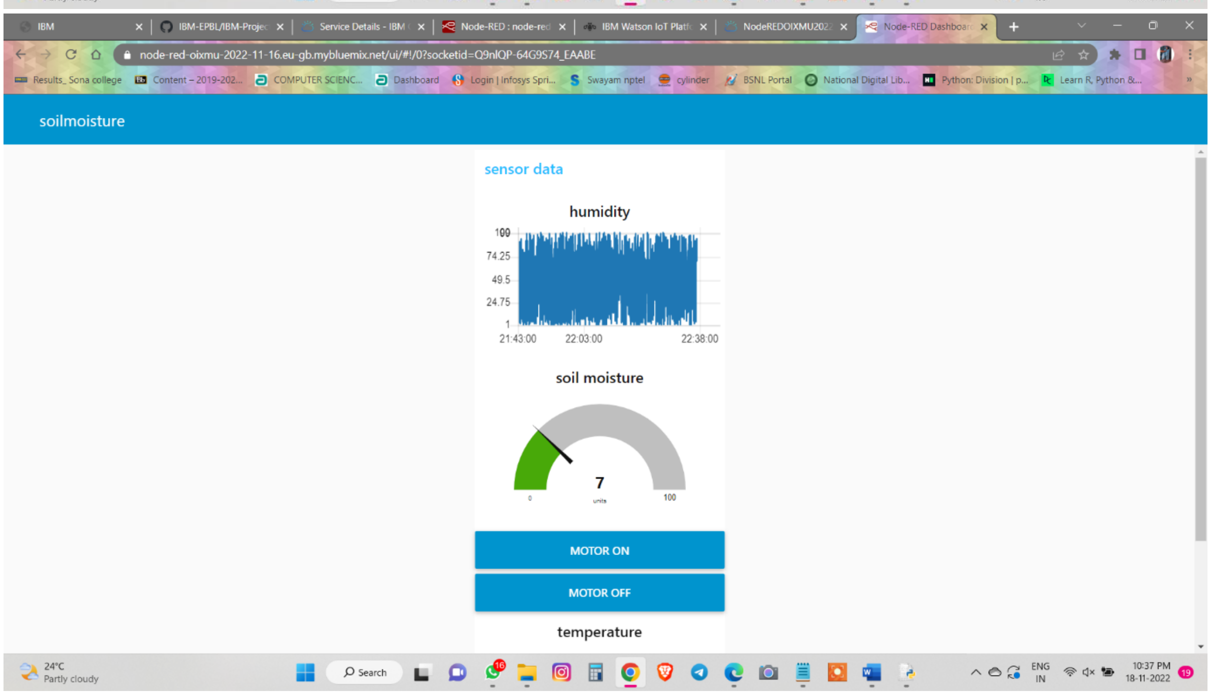
8.2 User Acceptance Testing



9. RESULTS

9.1 Performance Metrics





10. Advantages and 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 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

In the current project we have implemented the project that can protect and maintain thethe 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 a entire.

• We can update the 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 a 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

```
#IBM Watson IOT Platform
#pip install wiotp-sdk
import wiotp.sdk.device
import time
import random
myConfig = {
    "identity": {
        "orgId": "t1xyey",
        "typeId": "testdevice",
        "deviceId":"112233"
    },
    "auth": {
        "token": "Z)aJx+E?zY8@izzpxH"
    }
}

def myCommandCallback(cmd):
    print("Message received from IBM IoT Platform: %s" % cmd.data['command'])
    m=cmd.data['command']
    if(m=="MOTOR ON"):
        print("*******///// MOTOR IS ON /////*******")
    else:
        print("*******///// MOTOR IS OFF /////*******")

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

while True:
    temp=random.randint(-20,125)
    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)
    client.commandCallback = myCommandCallback
    time.sleep(2)
client.disconnect()
```

Github link: **https://github.com/IBM-EPBL/IBM-Project-24916-1659950929**

Project Demo link:
https://drive.google.com/file/d/1rUlfHmN6Ab7ZVcTeiJyGPsxaJ6jpiICF/view?usp=share_link