PROJECT REPORT

Project Name: SMARTFARMER- IOT ENABLED SMART FARMING APPLICATION

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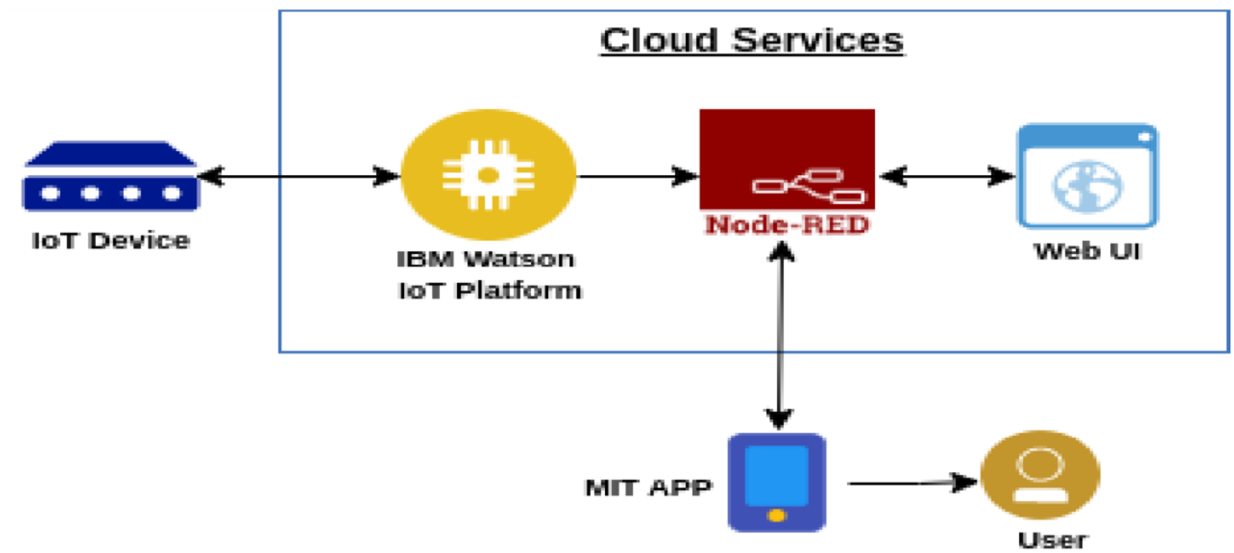
1. INTRODUCTION

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

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

2.LITERATURE SURVEY

2.2 Existing problem

The challenges of a smart agriculture system include the integration of these sensors and tying the sensor data to the analytics driving automation and response activities. An ideal IoT device consists of various interfaces for making connectivity to other devices which can either be wired or wireless.

Any IoT based device consists of following components:

- I/O interface for Sensors.
- Interface for connecting to Internet.
- Interface for Memory and Storage.
- Interface for Audio/Video.

IoT devices can be of various forms like wearable sensors, smart watches, IoT smart home monitoring, IoT intelligent transport systems, IoT smart health devices etc.

- It is not a secure system.
- There is no motion detection for protection of agriculture field.
- Automation is not available.
- Place each work in the context of its contribution to the understanding of the subject under review.
- Describe the relationship of each work to the others under consideration.
- Identify new ways to interpret, and shed light on any gaps in, previous research.

2.2 References

- Elijah, O.; Rahman, T.A.; Orikumhi, I.; Leow, C.Y.; Hindia, M.N. An Overview of Internet of Things (IoT) and Data Analytics in Agriculture: Benefits and Challenges. *IEEE Internet Things J.* **2018**, *5*, 3758–3773. [**Google Scholar**]
- Citoni, B.; Fioranelli, F.; Imran, M.A.; Abbasi, Q.H. Internet of Things and LoRaWAN-Enabled Future Smart Farming. *IEEE Internet Things Mag.* **2019**, *2*, 14–19. [**Google Scholar**]
- Kumar, R.; Mishra, R.; Gupta, H.P.; Dutta, T. Smart Sensing for Agriculture: Applications, Advancements, and Challenges. *IEEE Consum. Electron. Mag.* **2021**, *10*, 51–56. [**Google Scholar**]

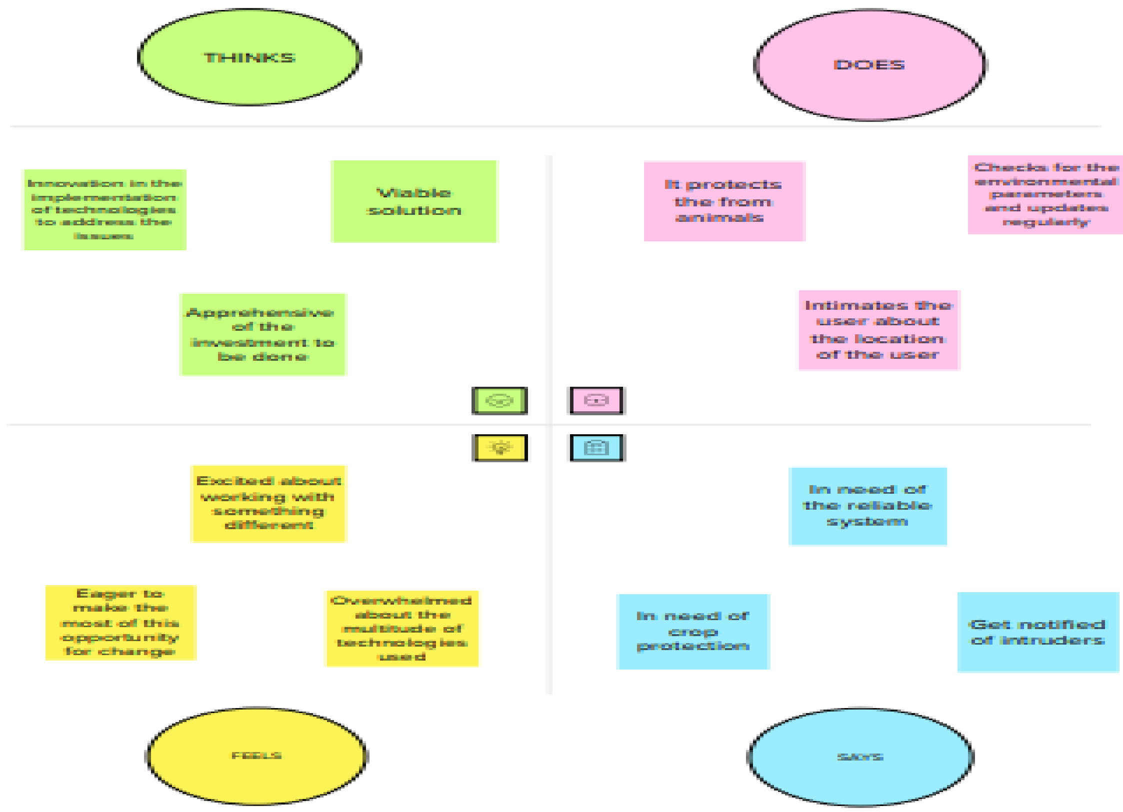
- Yang, X.; Shu, L.; Chen, J.; Ferrag, M.A.; Wu, J.; Nurellari, E.; Huang, K. A Survey on Smart Agriculture: Development Modes, Technologies, and Security and Privacy Challenges. *IEEE/CAA J. Autom. Sin.* **2021**, *8*, 273–302. [**Google Scholar**]
- Ayaz, M.; Ammad-Uddin, M.; Sharif, Z.; Mansour, A.; Aggoune, E.-H.M. Internet-of-Things (IoT)-Based Smart Agriculture: Toward Making the Fields Talk. *IEEE Access* **2019**, *7*, 129551–129583. [**Google Scholar**]

2.3 Problem Statement Definition

The soil moisture sensor measures wetness content in the soil. The Arduino UNO microcontroller used to receive input from a various sensors and it can be controlled automatically. When soil moisture sensor goes low the water pump will be on and it exceeds defined levels of the water motor will turn off automatically. We can constantly monitor the growth of a crop using ultrasonic sensor. PIR sensor detects the motion or unusual movement in the agricultural land. This device his very helpful to the former to monitor and control environmental parameters at their field. The farmers did not go to their field, they can remotely monitor and control using cloud.

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



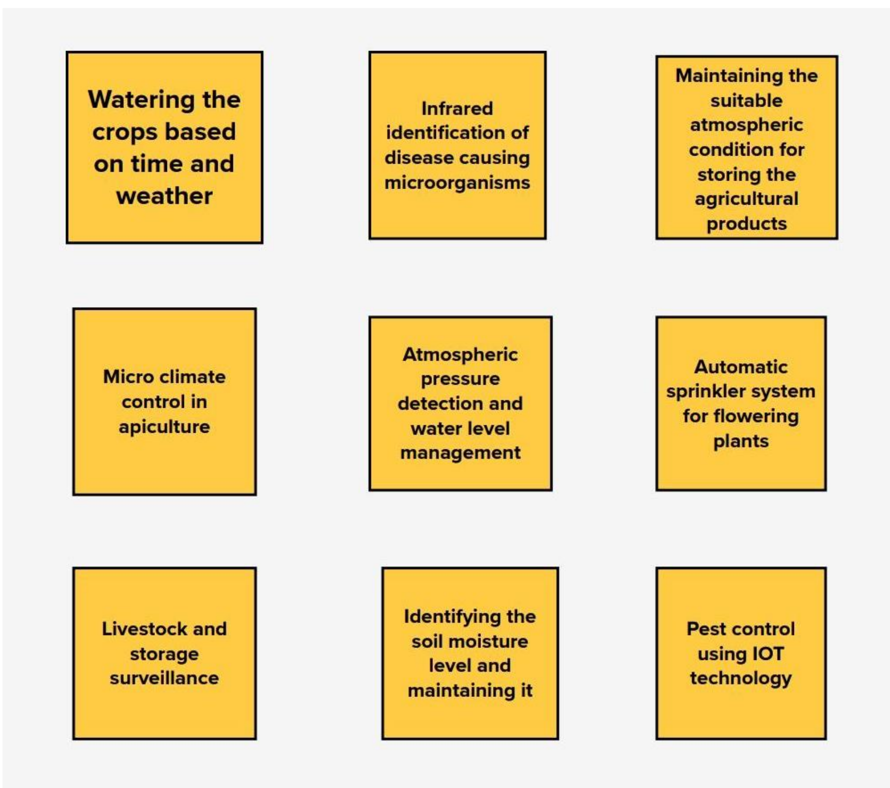
3.2 Ideation and Brainstorming

Introduction on Internet of Things (IoT), application of IoT in agricultural field to improve the yield and quality by reducing the cost is provided. The sensors which are used in the architecture are discussed briefly and the process of transmission of data from the agriculture field to the central system is explained. The proposed system advantages are included. In addition, open research issues, challenges, and future of IoT in agricultural field are highlighted. The concept is basically developed on an idea, where there are numerous things or objects - such as Arduino, sensors, GSM models, LCD display, etc., that are connected with the Internet. Each of the objects has a different address and is able to interact with other items. The things or objects co-operate with each other to reach a common goal.

We are going to construct a smart agricultural monitoring system which can collect crucial agricultural data and send it to an IoT platform called Thingspeak in real time where the data can be logged and analyzed. The logged data on Thingspeak is in graphical format, a botanist or a reasonably knowledged farmer can analyze the data (from anywhere in the world) to make sensible changes in the supplied resources (to crops) to obtain high quality yield.

Smart agriculture monitoring system or simply smart farming is an emerging technology concept where data from several agricultural fields ranging from small to large scale and its surrounding are collected using smart electronic sensors. The collected data are analyzed by experts and local farmers to draw short term and long-term conclusion on weather pattern, soil fertility, current quality of crops, amount of water that will be required for next week to a month etc.

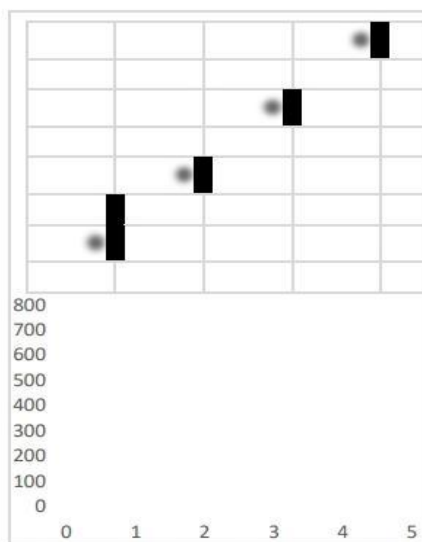
We can take smart farming a step further by automating several parts of farming, for example smart irrigation and water management. We can apply predictive algorithms on microcontrollers or SoC to calculate the amount of water that will be required today for a particular agriculture field. Say, if there was rain yesterday and the quantity of water required today is going to be less. Similarly, if humidity was high the evaporation of water at upper ground level is going to be less, so water required will be less than normal, thus reducing water usage.



3.3 Proposed Solution

Proposed Solution Template:

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	• Watering the field is a difficult process, Farmers have to wait in the field until the water covers the whole farm field. • Power Supply is also one of the problems. In Village Side, the power supply may vary. • The Biggest Challenges Faced by IoT in the Agricultural Sector are Lack of Information, High Adoption, Cost and Security Concerns, etc
2.	Idea / Solution description	• As is the case of precision Agriculture Smart Farming Technique Enables Farmers better to monitor the fields and maintain the humidity level accordingly. • The Data collected by sensors, In terms of humidity, temperature, moisture, and dew detections help in determining the weather pattern in Farms. So cultivation is done for suitable crops.

3.	Novelty / Uniqueness	**ALERT MESSAGE** – IoT sensor nodes collect information from the farming environment, such as soil moisture, air humidity, temperature, nutrient ingredients of soil, pest images, and water quality, then transmit collected data to IoT backhaul devices. **REMOTE ACCESS –** It helps the farmer to operate the motor from anywhere.
4.	Social Impact / Customer Satisfaction	• Reduces the wages for labors who work in the agricultural field. • It saves a lot of time. • IoT can help improve customer relationships by enhancing the customer's overall experience. • Easily identify maintenance needs, build better products, send personalized communications, and more. • IoT can also help e-commerce businesses thrive and increase sales. It make a wealthy society
5.	Business Model (Revenue Model)	Revenue (No. of Users vs Months) User Months 
6.	Scalability of the Solution	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.

3.4 Problem solution fit

Smart Farming Application

Define CS, fit into CC

1. CUSTOMER SEGMENT(S) CS

Who is your customer?
i.e. working parents of 0-5 y.o. kids

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

What constraints prevent your customers from taking action or limit their choices of solutions? i.e. spending power, budget, no cash, network connection, available devices.

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

5. AVAILABLE SOLUTIONS AS

Which solutions are available to the customers when they face the problem or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? i.e. pen and paper

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

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

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

Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.

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

What is the real reason that this problem exists? What is the back story behind the need to do this job?

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

What does your customer do to address the problem and get the job done?
i.e. directly related: find the right solar panel installer, calculate usage and benefits; indirectly associated: customers spend free time on volunteering work (i.e. Greenpeace)

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

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

3. TRIGGERS TR

What triggers customers to act? i.e., seeing their neighbor installing solar panels, reading about a more efficient solution in the news.

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

How do customers feel when they face a problem or a job and afterwards?
i.e. lost, insecure > confident, in control - use it in your communication strategy & design.

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

10. YOUR SOLUTION SL

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality. If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.

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

What kind of actions do customers take online? Extract online channels from #7

8.2 OFFLINE

What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

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	User Registration	Registration through Form Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Sensor Function for framing System	Measure the Temperature and Humidity Measure the Soil Monitoring Check the crop diseases
FR-4	Manage Modules	Manage Roles of User Manage User permission
FR-5	Check whether details	Temperature details Humidity details

4.2 Non-Functional Requirement

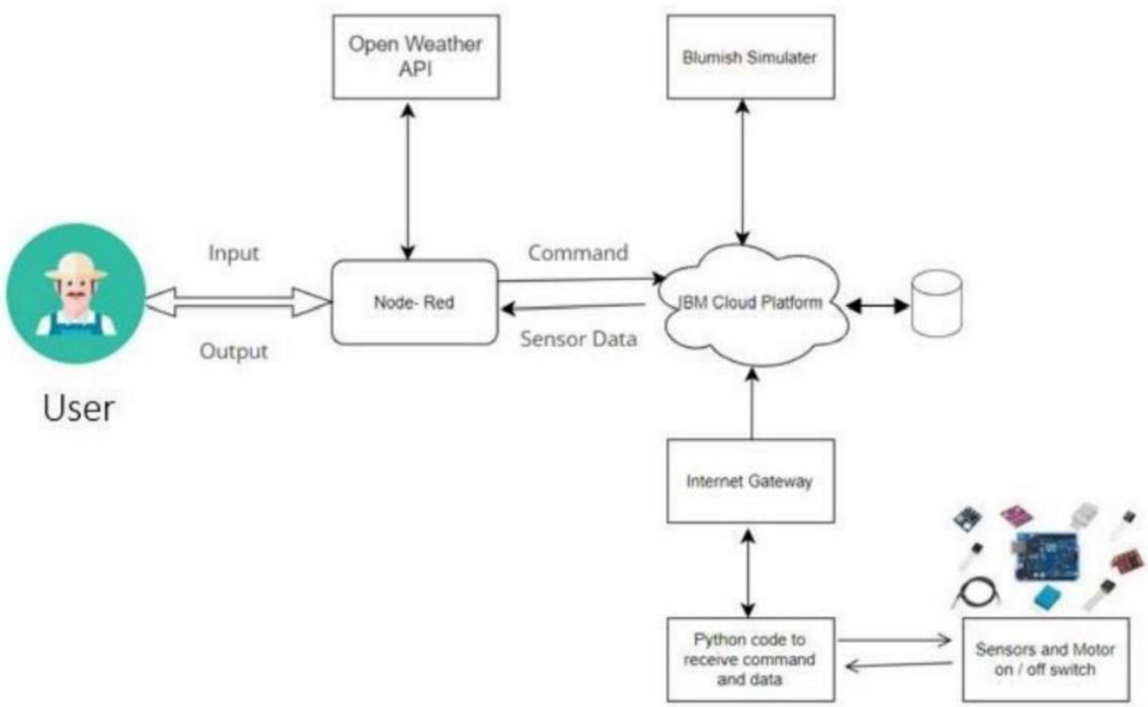
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	User friendly guidelines for users to avail the features. Most simplistic user interface for ease of use.
NFR-2	**Security**	All the details about the user are protected from unauthorized access. Detection and identification of any misfunctions of sensors.
NFR-3	**Reliability**	Implementing Mesh IoT Networks Building a Multi-layered defence for IoT Networks.
NFR-4	**Performance**	The use of modern technology solutions helps to achieve the maximum performances thus resulting in better quality and quantity yields.
NFR-5	**Availability**	This app is available for all platforms

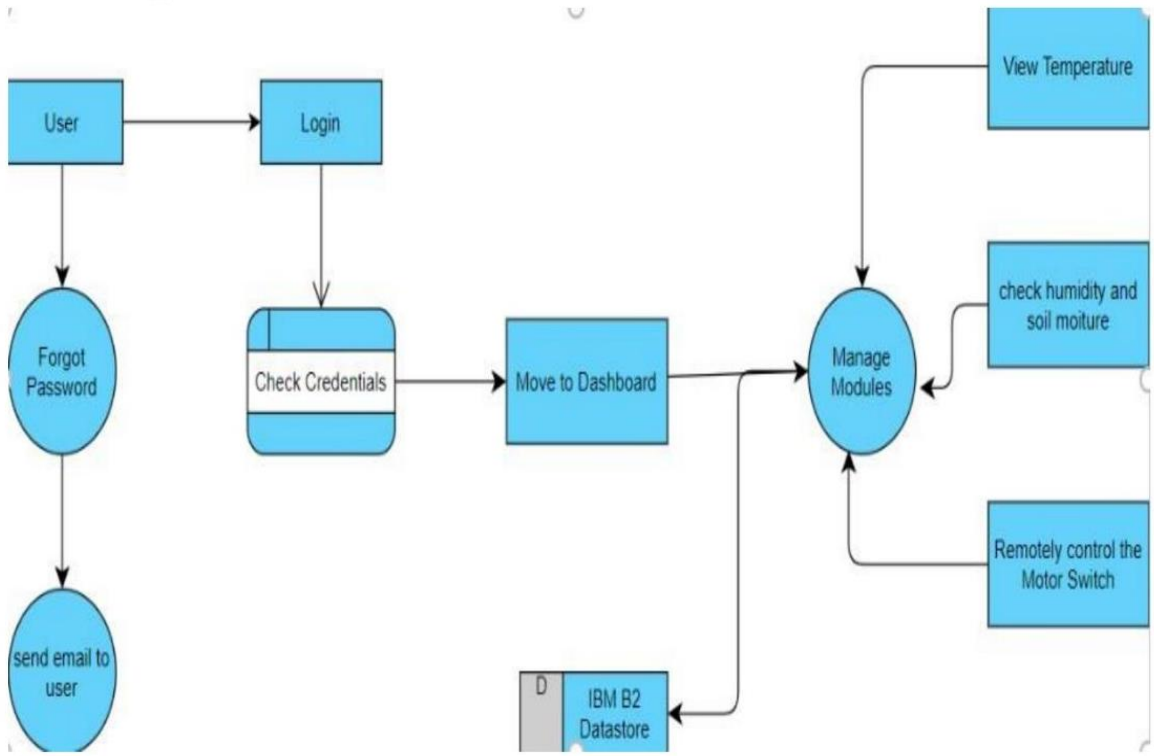
5.PRODUCT DESIGN

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.

- The different soil parameters temperature, soil moistures and then humidity are sensed using different sensors and obtained value is stored in the IBM cloud.
- Arduino UNO is used as a processing Unit that process the data obtained from the sensors and whether data from the weather API.
- NODE-RED is used as a programming tool to write the hardware, software, and APIs. The MQTT protocol is followed for the communication.
- 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 and Technical Architecture

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

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

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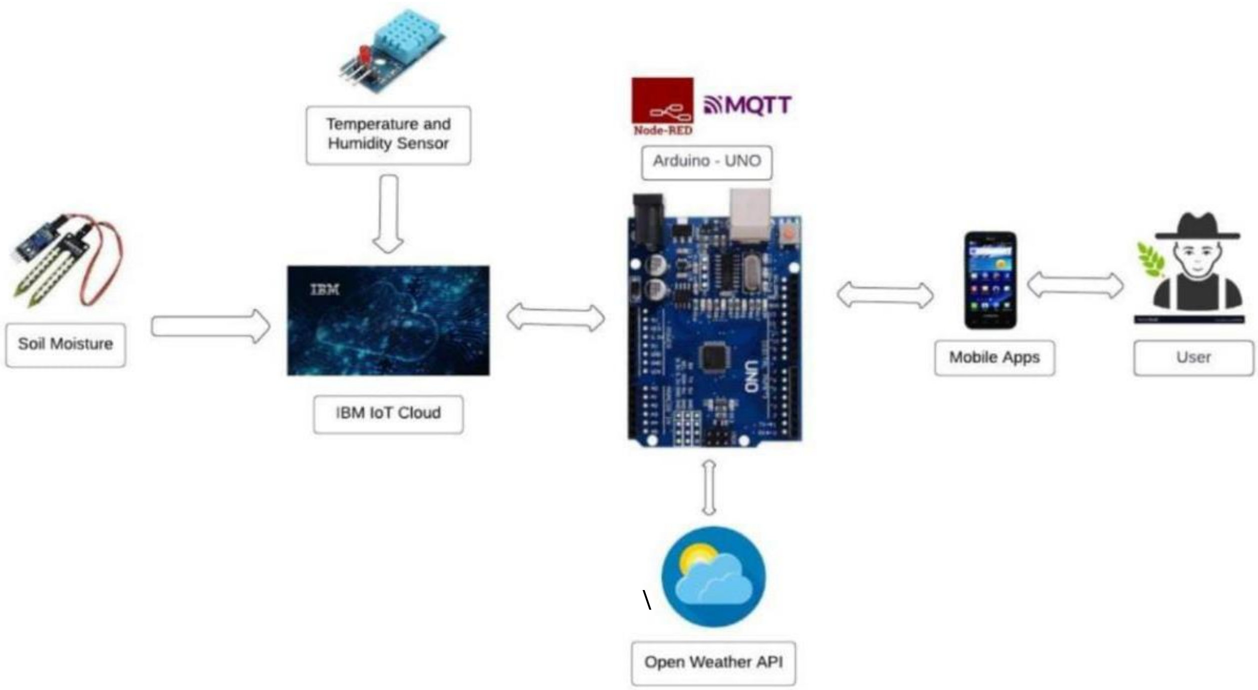


6.PROJECT PLANNING AND SCHEDULING

	Functional Requirement (Epic)	User Story Number		Points		Team Members
Sprint-1	Simulation creation	USN-1	Connect Sensors and Arduino with python code	2	High	Devadharshini, yuvaraj,muthamilarasu,madhumitha
Sprint-2	Software	USN-2	Creating device in the IBM Watson IoT platform, workflow for IoT scenarios using Node-Red	2	High	Devadharshini, yuvaraj, madhumitha, muthamilarasu

Sprint-3	MIT App Inventor	USN-3	Develop an application for the Smart farmer project using MIT App Inventor	2	High	Devadharshini, yuvaraj, madhumitha, muthamilarasu

	Total Story Points	n	Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	Days	Oct 2022	06 Nov 2022	20	Oct 2022
Sprint-2	20	Days	Oct 2022	09 Nov 2022		05 Oct 2022

Sprint			User Story / Task	Story	Priority	
Sprint-3	Dashboard	USN-3	Design the Modules and test the app	2	High	Devadharshini, yuvaraj, madhumitha, muthamilarasu
Sprint-4	Web UI	USN-4	To make the user interact with software.	2	High	Devadharshini, yuvaraj, madhumitha, muthamilarasu

7.CODING AND SOLUTIONING

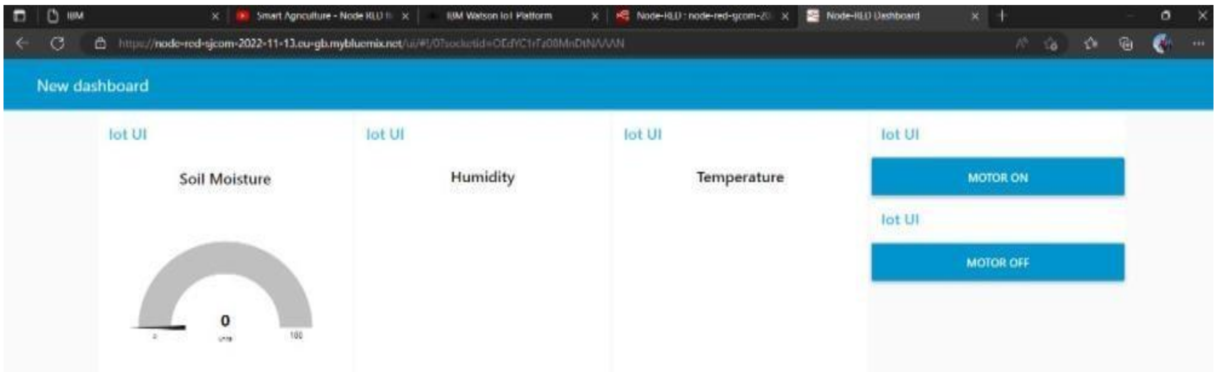
7.1 Feature

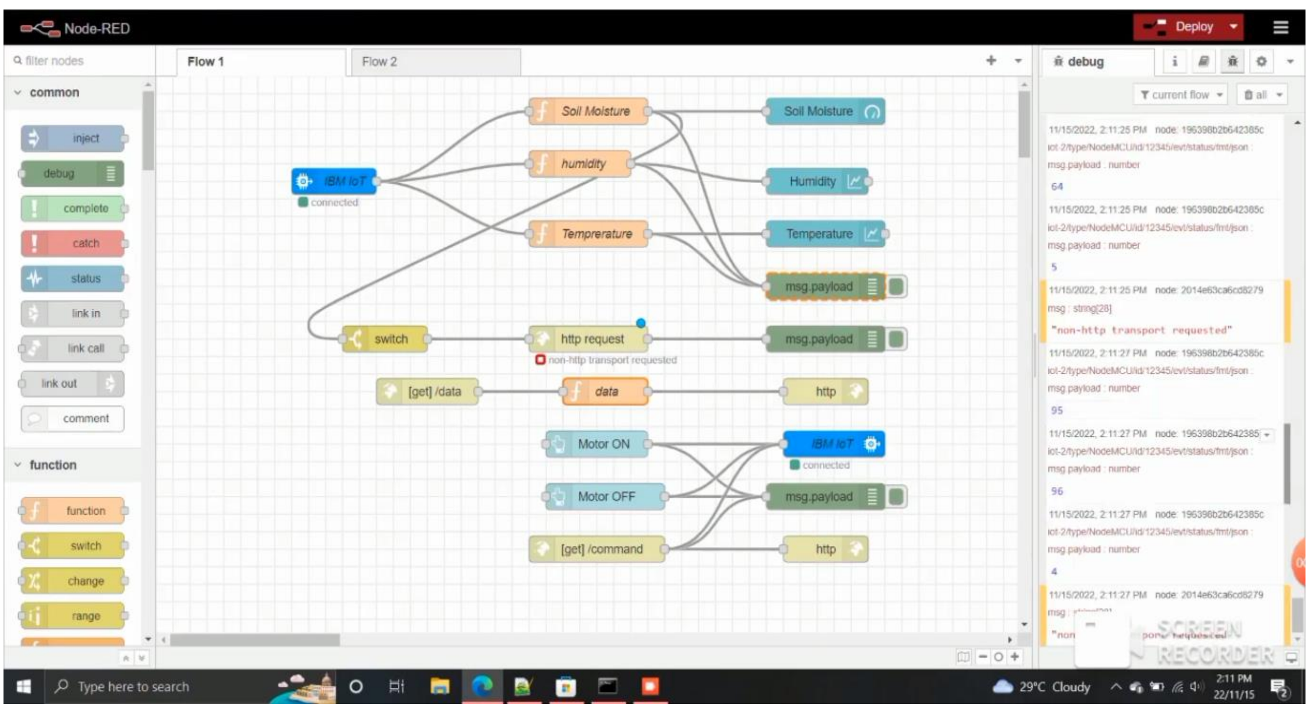
```
import wiotp.sdk.device
import time import os
import datetime import
random myConfig ={
   "identity": {
        "orgId": "0hzydu",
        "typeId": "NodeMCU",
        "deviceId": "12345"
   },
   "auth": {
      "token": "12345678"
   } } client =
wiotp.sdk.device.DeviceClient(config=myConfig,logHandlers=None)
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
()
```

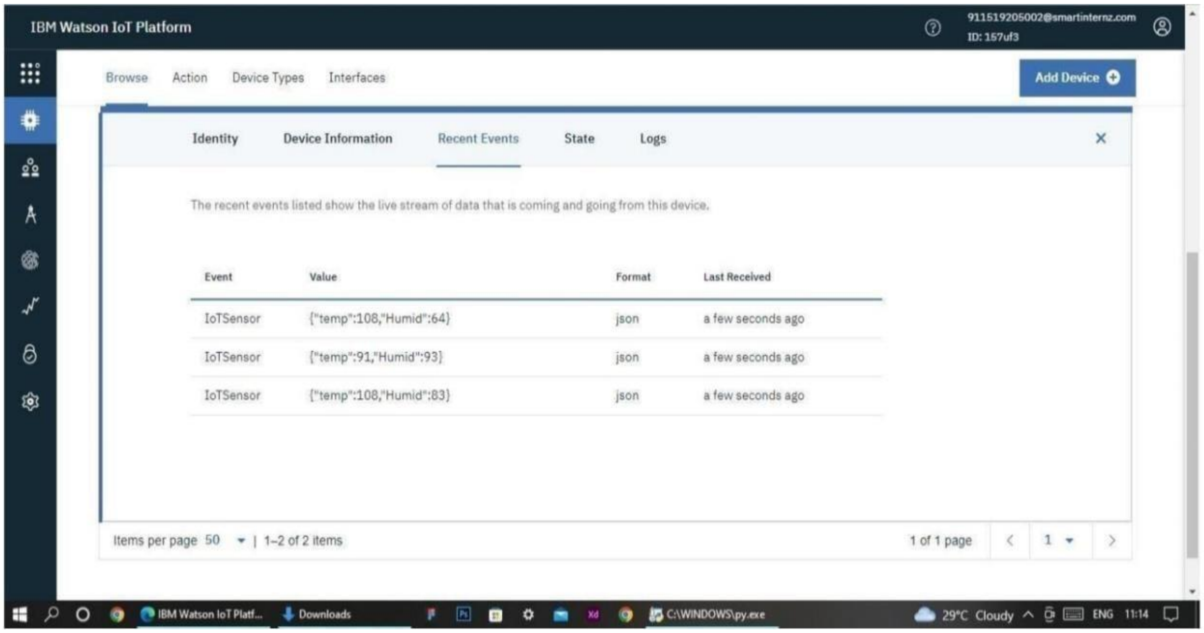
8.TESTING

8.1 Test case

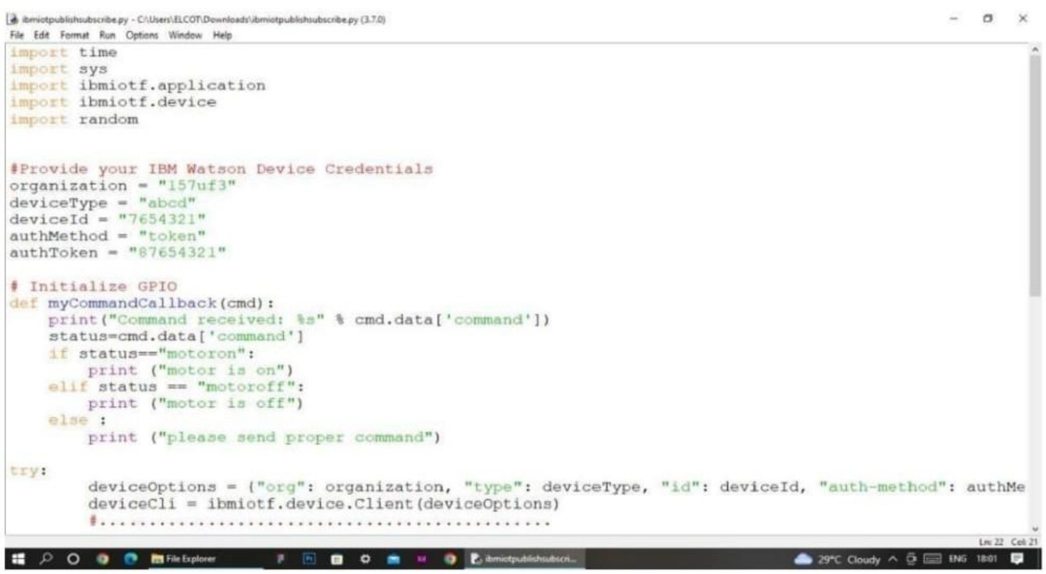
Web application using Node Red



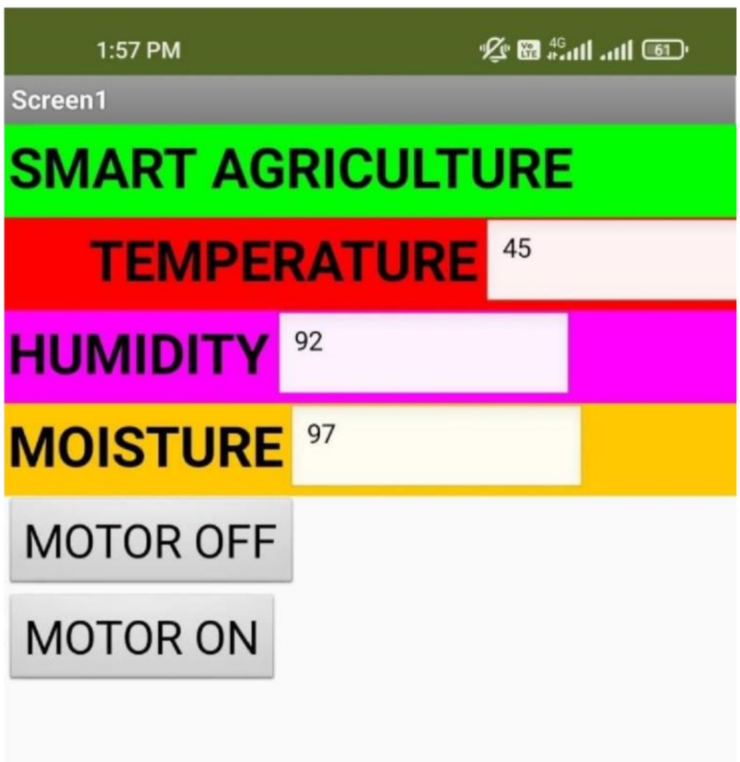



IBM Watson IoT Platform
911519205002@smartinternz.com
ID: 157uf3
Browse
Action
Device Types
Interfaces
Add Device
Identity
Device Information
Recent Events
State
Logs
The recent events listed show the live stream of data that is coming and going from this device.
Event | Value | Format | Last Received
IoTSensor | {"temp":108,"Humid":64} | json | a few seconds ago
IoTSensor | {"temp":91,"Humid":93} | json | a few seconds ago
IoTSensor | {"temp":108,"Humid":83} | json | a few seconds ago
Items per page 50 | 1–2 of 2 items
1 of 1 page
29°C Cloudy
ENG 11:14

Program

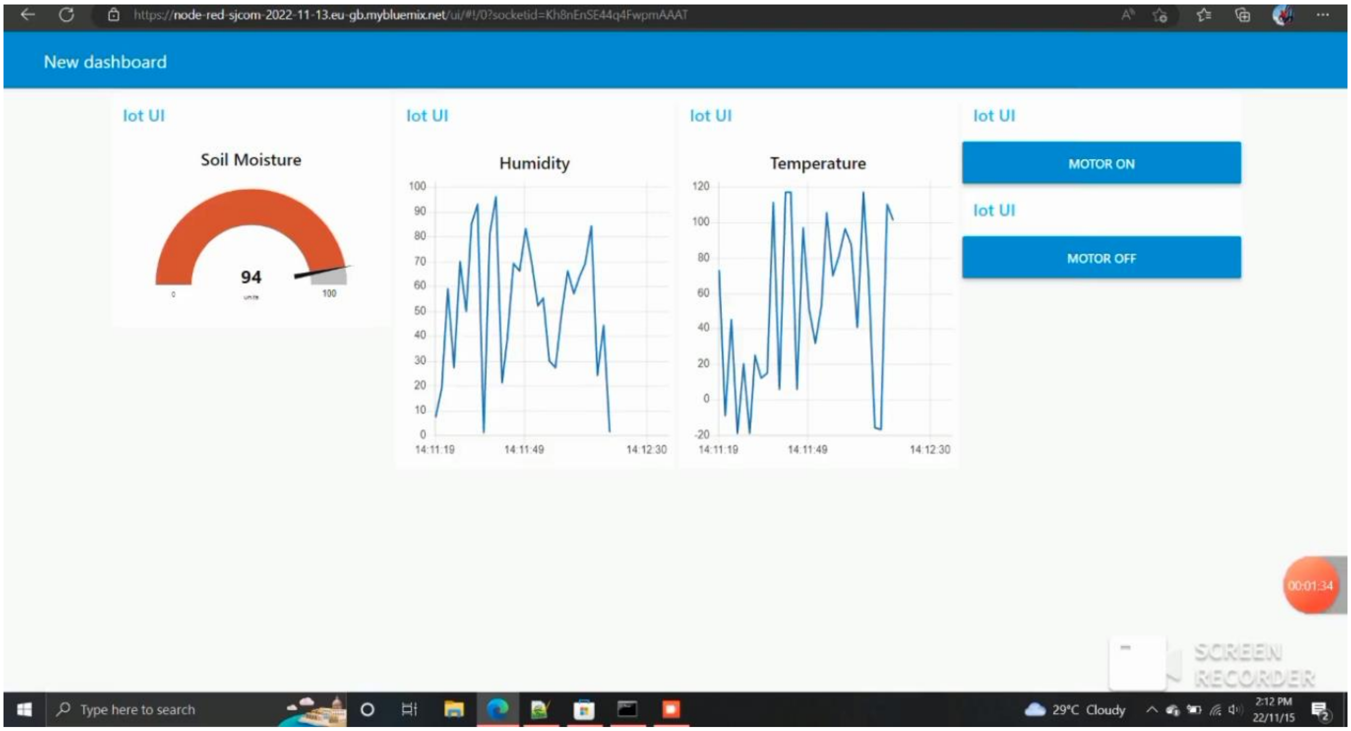

File Edit Format Run Options Window Help
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random
#Provide your IBM Watson Device Credentials
organization = "157uf3"
deviceType = "abcd"
deviceId = "7654321"
authMethod = "token"
authToken = "87654321"
# Initialize GPIO
def myCommandCallback(cmd):
print("Command received: %s" % cmd.data['command'])
status=cmd.data['command']
if status=="motoron":
print ("motor is on")
elif status == "motoroff":
print ("motor is off")
else :
print ("please send proper command")
try:
deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMe
deviceCli = ibmiotf.device.Client(deviceOptions)
#..
29°C Cloudy
ENG 18:01

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 laborintensive. 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 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 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

```
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 ()

Github link: https://github.com/IBM-EPBL/IBM-Project-9477-1659010438

Project Demo link:
https://drive.google.com/file/d/1JrQNUaB8oe5yvimCqPT_rt1WQa1XwOpM/view?usp=drivesdk