SMART FARMER - IOT ENABLED SMART FARMING APPLICATION

NALAIYA THIRAN PROJECT BASED LEARNING

SUBMITTED BY

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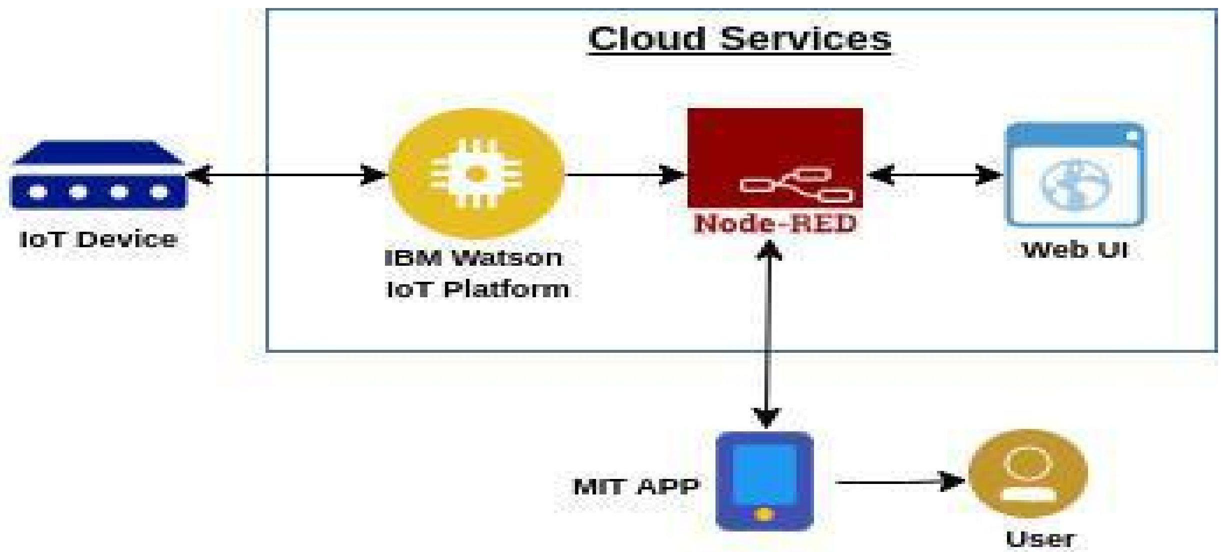
1. INTRODUCTION

1.1 Project Overview

Agriculture is done in every country from ages. As the world is trending into new technologies and implementations it is a necessary goal to trend up with agriculture also which reduces the conflicts that are made manually. IoT plays a very important role in smart agriculture. IOT sensors are capable of providing information about agriculture fields. This IOT based Agriculture monitoring system makes use of wireless sensor networks that collects data from different sensors deployed at various nodes and sends it through the wireless protocol. This smart agriculture using IOT system consists of Temperature sensor, Moisture sensor, water level sensor etc. When the IOT based agriculture monitoring system starts it checks the water level, humidity and moisture level with the most accurate percentage.

Farmers can monitor all the sensor parameters by using a web or mobile application even if the farmer is not near the field. Watering the crop is one of the important tasks for the farmers. It depends upon the moisture content present in the soil.They can make the decision whether to water the crop or postpone it by monitoring the sensor using the moisture sensor parameters and controlling the motor pumps from the mobile application itself.



1.2 PURPOSE

The incorporation of IoT in the field of agriculture makes increase in yield with many inovative technologies on monitoring the crops using sensors so that farmers may not mannually monitors every corners. The main motto of this model is also to make aware of the farmers and to educate them on how to use them. The smart agriculture model mainly aims to avoid water wastage in irrigation methods. Also it is a low cost and efficient system. It includes the Node MCU, ARduino Nano, sensors like moisture and Dht11, solenoid valves, relays etc.

This model is suitable for all types of soil with high accurarcy of field encryption. WIthin a minute the farmer can be alerted . This also connects the skilling intervention into the market and by educating the experienced farmers and the farmer who is new to agriculture enhance the crop production twice. It reduces the work of the farmer. The smart agriculture using IoT includes the increasing economic impact on the market. The main purpose of this project is to save the labour field preparation cost which also ensures digital and its awarness between farmers.

It also improves the entire agriculture system by monitoring the field in real time. With the help of these sensors and interconnectivity, the Internet of Things in agriculture has not only saved the time of the farmers but also has reduced the extravagant use of resources such as Water and electricity.

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. When integrated, the use of data analytics can reduce the overall cost of agriculture and contribute to higher production from the same amount of area through precise control of water, fertilizer and light. Smart methods allow for farming on smaller and more distributed lands through remote monitoring, whether indoor or outdoor.

To successfully deploy a smart agriculture system, consider setting up a communications network that can integrate a limited number of sensors across a large area of farmland. This will require third-party network provisioning or setting up a private network consisting of access points and uplinks to a private backhaul network, which channels all the data traffic to centralized monitoring software or an analytics head-end system

The author [1] proposed an idea on Farming as a major input sector for economic development of any country. Livelihood of the majority of the population of countries like India depends on agriculture. In this project, it is proposed to develop a Smart Farming System that uses the advantages of cutting edge technologies such as IoT, Wireless Sensor Network and Cloud computing to help farmers enhance the way farming is done. Using sensors like temperature, humidity, moisture etc. are used to get information about the field and help farmers to make precise decisions on insights and recommendations based on the collected data.

The author[2] discusses various models employed in Farming and proposes Smart Digi-farming models which focus on farming using IoT (Internet of Things), Mobile application for the dissemination of farming and commercial information and online sale of produce. Training on the latest fertilizers, farming tools and digitization in agriculture will attract youth towards farming and making India self-sufficient in food grains. Happiness Index of farmers is measured and improved through this model which drives the farmers away from suicidal tendencies and ushers in confidence, productivity and changes the lifestyle of the farmer.

The author [3] proposed The Internet of Things (IoT) has changed the definition of smart farming and enhanced its capabilities to monitor and assess crop and soil quality; to plan planting locations to optimise resources and land area.

The Low-Power Wide-Area Network (LPWAN) technologies have enhanced these capabilities by increasing the wireless communication range, by eliminating the dependency of Backhaul networks and by reducing power consumption. In this paper, we have presented an experimental analysis of LPWAN literature with the support of simulation and actual implementation of a Long Range Wide Area Network (LoRaWAN) based IoT network for smart farming.

The author[4] describes that Rural and urban areas in India face a variety of comparable problems within the domain of agriculture, which calls for certainly comparative answers for being coordinated towards finding these issues. The purpose of this concept is to analyse the ability of IoT techniques in relation to impoverishment in these areas, besides the requirements known in these commodities and with stress on farming. This work analyses samples of an internet of things to modify the farming desires of the commodities for the region to maximise the yield production.

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

2.2 References

[1] Akshay Atole at el.(2012) Internet-of-Things (IoT) based smart farming system Journal of Emerging Technologies and Innovative Research.

[2] Harshkumar Prakashbhai Thakor et al.(2019) Development and Analysis of Smart Digi-farming Robust Model for Production Optimization in Agriculture.IEEE 2019.

[3] Nahina Islam et al. (2020)IoT Based Smart Farming: Are the LPWAN Technologies Suitable for Remote Communication?.IEEE 2020

[4] Kamlesh Chandra purohit et al. (2019)Smart farming Using IoT IEEE Access, *10*, 9483-9505

2.3 Problem Statement Definition

Incorporation of technology into farming to reduce work and labour, increase productivity and to improve the soil and plant the next crop. Many experienced and young farmers face issues in incorporating the technologies in agriculture. The major issues faced are labour cost, coping with climate change, soil erosion and biodiversity losses. This may lead to loss of agricultural land and the decrease in the varieties of crops and livestock produced. These issues mainly occur due to increasing pressure from climatic changes, soil erosion which mostly starts from the first day of farming. It is important to fix these issues as it is required for the growth of better-quality food products. It is important to maximise the crop yield and to maintain soil richness.

The soil moisture sensor measures wetness content in the soil. The Arduino UNO microcontroller used to receive input from various sensors and it can be controlled automatically. When the 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 sensors. PIR sensor detects the motion or unusual movement in the agricultural land. This device is very helpful to the former to monitor and control environmental parameters in their field. The farmers did not go to their field, they can remotely monitor and control using the cloud.

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 behaviours and attitudes. It is a useful tool to help teams better understand their users. Creating an effective solution requires understanding the true problem and 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 and Brainstorming

Brainstorming provides a free and open environment that encourages everyone within a team to participate in the creative thinking process that leads to problem solving. Prioritizing volume over value, out-of-the-box ideas are welcome and built upon, and all participants are encouraged to collaborate, helping each other develop a rich amount of creative solutions. Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

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 the future of IoT in the 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 cooperate 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 analysed. The logged data on Thingspeak is in graphical format, a botanist or a reasonably knowledgeable farmer can analyse 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 surroundings are collected using smart electronic sensors. The collected data are analysed by experts and local farmers to draw short term and long-term conclusions on weather patterns, 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

Watering the field is a difficult process, Farmers have to monitor the field for moisture content and supply water according to it. Some other challenges are Lack of knowledge, Cost , Security Concerns, etc. Smart farming techniques enable farmers to better 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 water can be provided accordingly and cultivation can be done for suitable crops. IoT sensor nodes collect information from the farming environment, such as soil moisture, air humidity, temperature and water quality, then transmit collected data to IoT backhaul devices. REMOTE ACCESS – It helps the farmer to operate the motor from anywhereScalability 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.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	• Watering the field is a difficult process, Farmers have to monitor the field for moisture content and supply water according to it. •Some other challenges are Lack of knowledge, Cost , Security Concerns, etc.,
2.	Idea / Solution description	•Smart farming techniques enable 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 water can be provided accordingly and cultivation can be 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 and water quality, then transmit collected data to IoT backhaul devices. REMOTE ACCESS – It helps the farmer to operate the motor from anywhere

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4.	Social Impact / Customer Satisfaction	• IoT can help improve customer relationships by enhancing the customer's overall experience • Reduces the wages for labours who work in the agricultural field. • It saves a lot of time. • Easily identify maintenance needs, build better products, send personalized communications, and more • It make a wealthy society
5.	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

1.Customer segments:- Types of Customers who are going to this project are • Large Scale Farmers • Remote Farmers	**6.Customer constrains:-** The customer needs a solution which will solve the problems in farming when he is in a remote location and that solution should fulfil the following needs. • Cost efficient • Low power consumption • Time efficient	**5. Available solutions :-** We can give solutions to this problem by using the Smart Farming Application which collects the Moisture level data from the field and operate in the basis of that moisture level.
2. Jobs to be done :- The Customers want to automate the irrigation process, reduce cost of manual workers and minimize the power consumption	**9. Problem route cause:-** The route cause for Smart farming Applica	**7. Behavior:-** The customer needs to make a revolutionary change in farming by means of modern technologies.
3. Triggers:- Farmers are facing many problems while farming in traditional manner. This triggers the Smart Farming Applications. **4. Emotions:-** Farmers feel very relaxed and feel stressless while working in field.	**10. Solution:-** Our solution for this project is to give environment sustainable Product for the farming in modern era with reduced cost and with best efficiency	**8.Channels of behaviour:-** The channels of behavior recombines the ration of the following • Online • Offline

4.Requirement Analysis

4.1 Functional Requirements

Following are the functional requirements of the proposed solution.

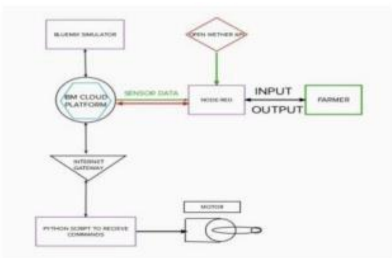
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through Gmail
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Login to system	Check credentials Check roles of access
FR-4	Manage Modules	Manage admins Manage User roles Manage User permission
FR-5	Checking details	Temperature details Humidity details Moisture details
FR-6	Log out	Exit

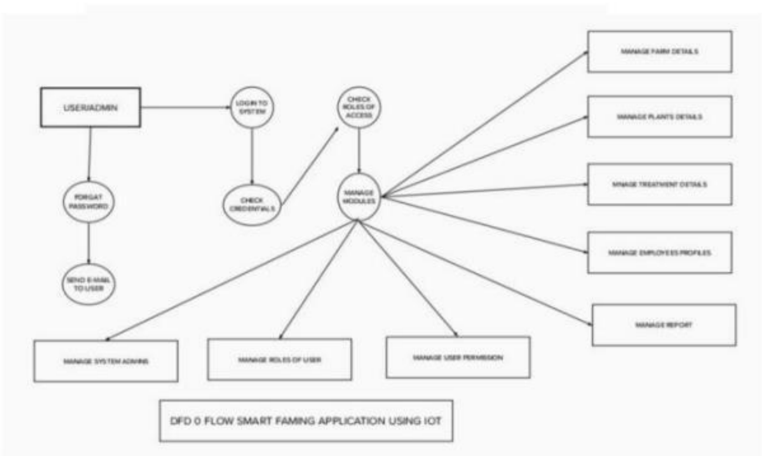
5.PRODUCT DESIGN

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.

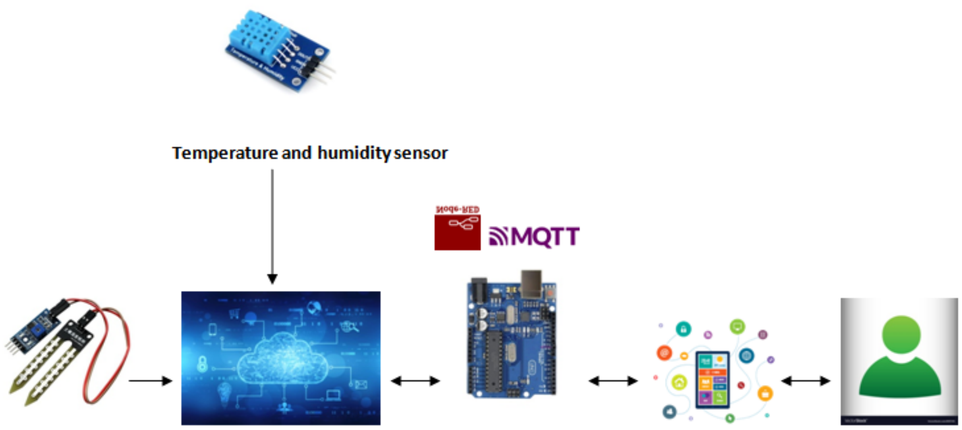
- The different soil parameters temperature, soil moistures and then humidity are sensed using different sensors and obtained value is stored in the IBM cloud.
- Arduino UNO is used as a processing Unit that processes the data obtained from the sensors and weather data from the weather API.
- NODE-RED 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, whether 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

- Various soil characteristics, including temperature, humidity, and soil moisture, are measured using various sensors, and the results are saved in the IBM cloud.
- The processing unit, Arduino UNO, is utilised to process weather data from weather API as well as input from sensors.
- Hardware, software, and APIs are wired using Node-red as a programming tool. For communication, the MQTT protocol is used.
- Through a smart phone application created with the help of MIT App Inventor, the user is given access to all the collected data. Depending on the sensor results, the user may decide whether to irrigate the crop or not using an app. They can control the motor switch from a distance using the app



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	Rubini, Rajkaviya, Sanjai, Nitharsan
Sprint-2	Software	USN-2	Creating device in the IBM Watson IoT platform, workflow for IoT scenarios using Node-Red	2	High	Rubini, Rajkaviya, Sanjai, Nitharsan
Sprint-3	MIT App Inventor	USN-3	Develop an application for the Smart farmer project using MIT App Inventor	2	High	Rubini, Rajkaviya, Sanjai, Nitharsan
Sprint		**User Story / Task**	**Story**	**Priority**		
Sprint-3	Dashboard	USN-3	Design the Modules and test the app	2	High	Rubini, Rajkaviya, Sanjai, Nitharsan
Sprint-4	Web UI	USN-4	To make the user interact with software.	2	High	Rubini, Rajkaviya, Sanjai, Nitharsan

7.CODING AND SOLUTIONING

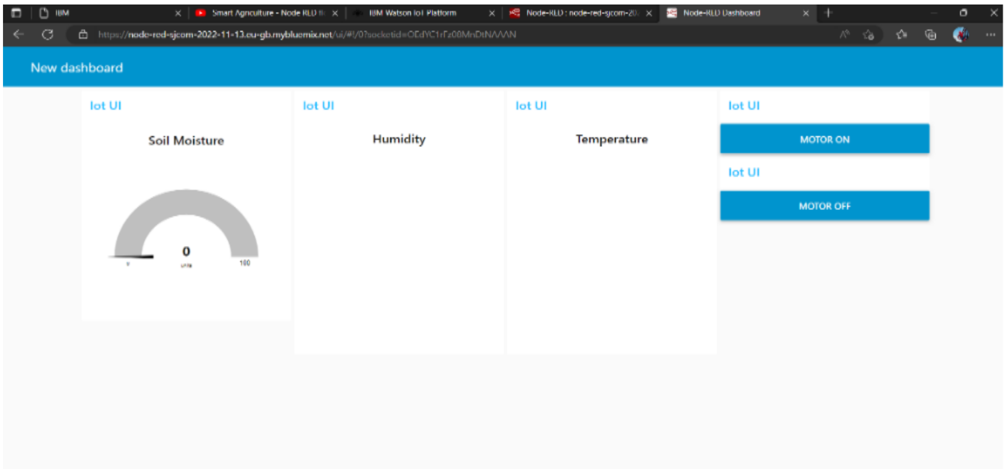
7.1 Feature

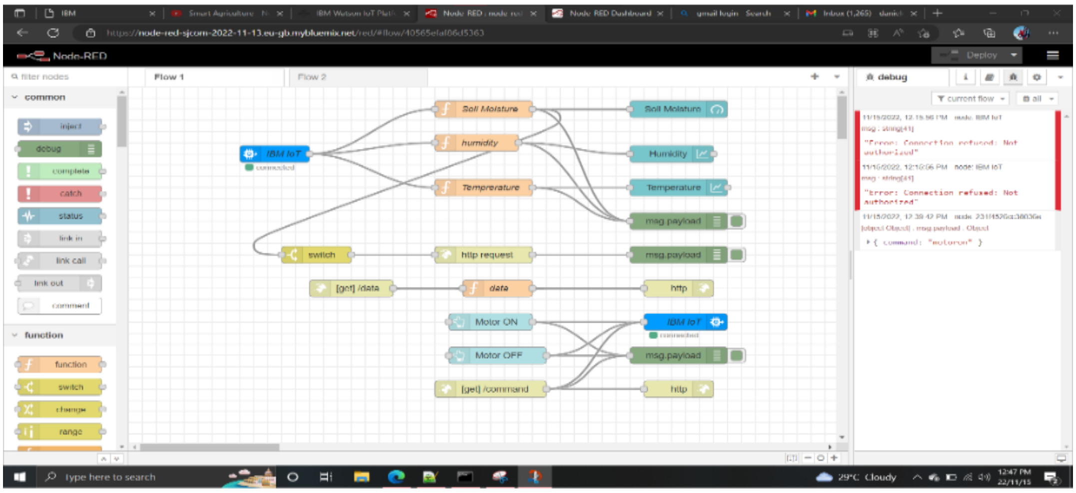
```
import wiotp.sdk.device
import time
import os
import datetime
import random
myConfig ={
   "identity": {
        "orgId": "0hzydu",
        "typeId": "NodeMCU",
        "deviceId": "12345"
   },
   "auth": {
      "token": "12345678"
   }
}
client = wiotp.sdk.device.DeviceClient(config=myConfig,logHandlers=None)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

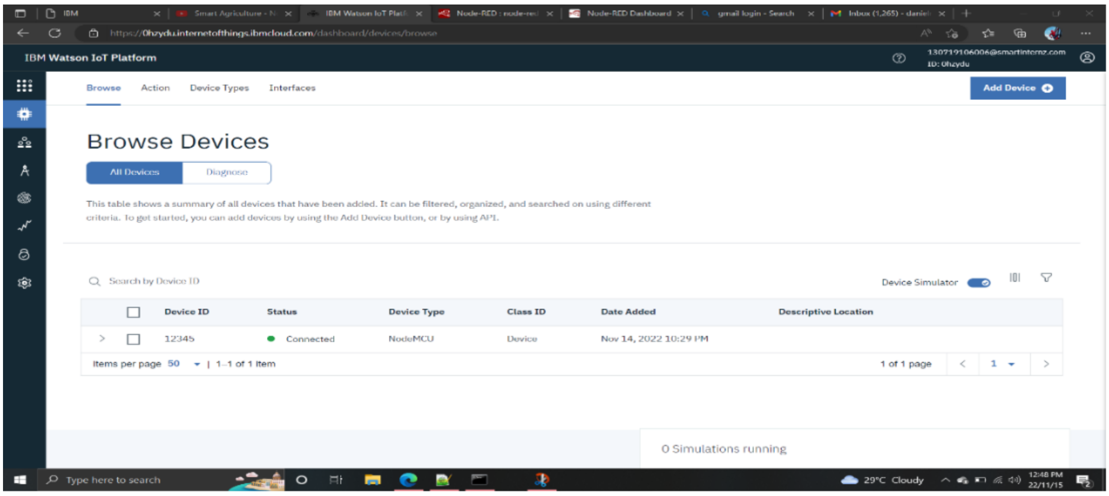
8.TESTING

8.1 Test case

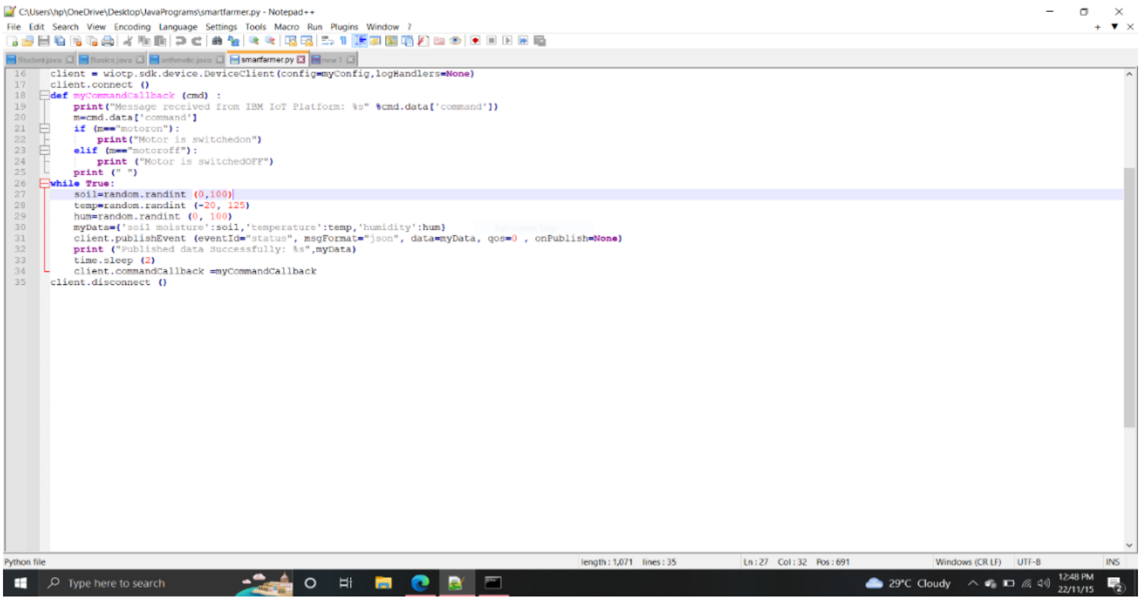
Web application using Node Red





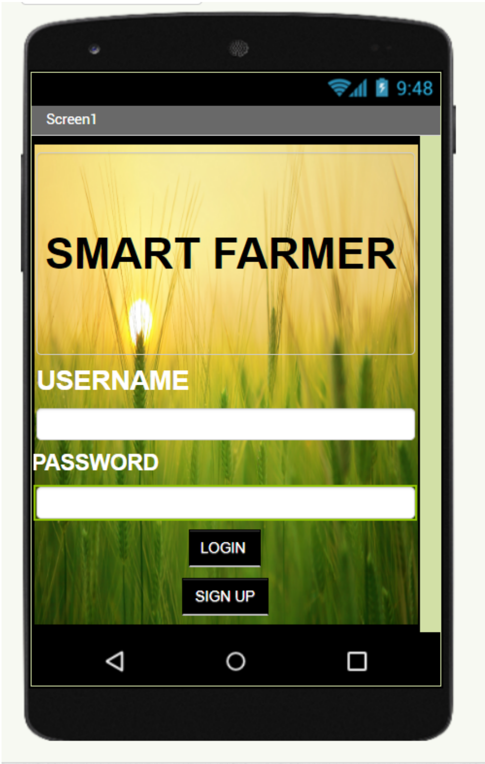


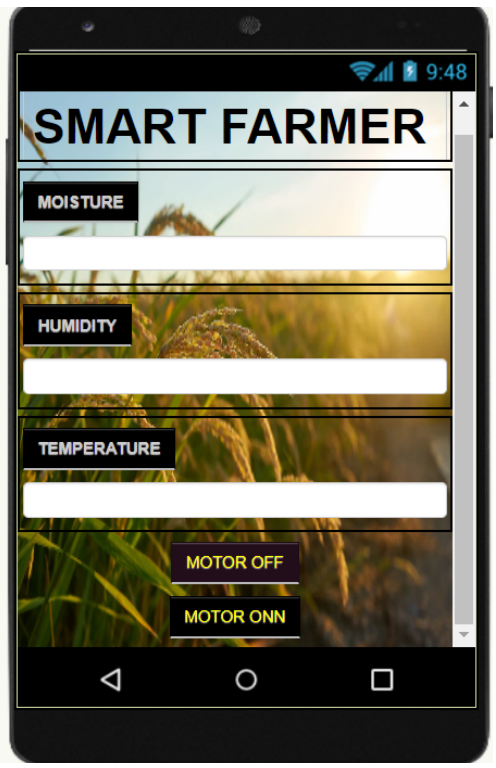
IBM Watson IoT Platform
Browse
Action
Device Types
Interfaces
Add Device
Browse Devices
All Devices
Diagnose
This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add devices by using the Add Device button, or by using API.
Search by Device ID
Device Simulator
Device ID
Status
Device Type
Class ID
Date Added
Descriptive Location
12345
Connected
NodeMCU
Device
Nov 14, 2022 10:29 PM
Items per page 50
1–1 of 1 item
1 of 1 page
0 Simulations running
Type here to search
29°C Cloudy
12:48 PM
22/11/15



C:\Users\hp\OneDrive\Desktop\JavaPrograms\smartfarmer.py - Notepad++
File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
smartfarmer.py
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:
soil=random.randint (0,100)
temp=random.randint (-20, 125)
hum=random.randint (0, 100)
myData={'soil moisture':soil,'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 ()
Python file
length : 1,071 lines : 35
Ln : 27 Col : 32 Pos : 691
Windows (CR LF) UTF-8 INS
Type here to search
29°C Cloudy
12:48 PM
22/11/15

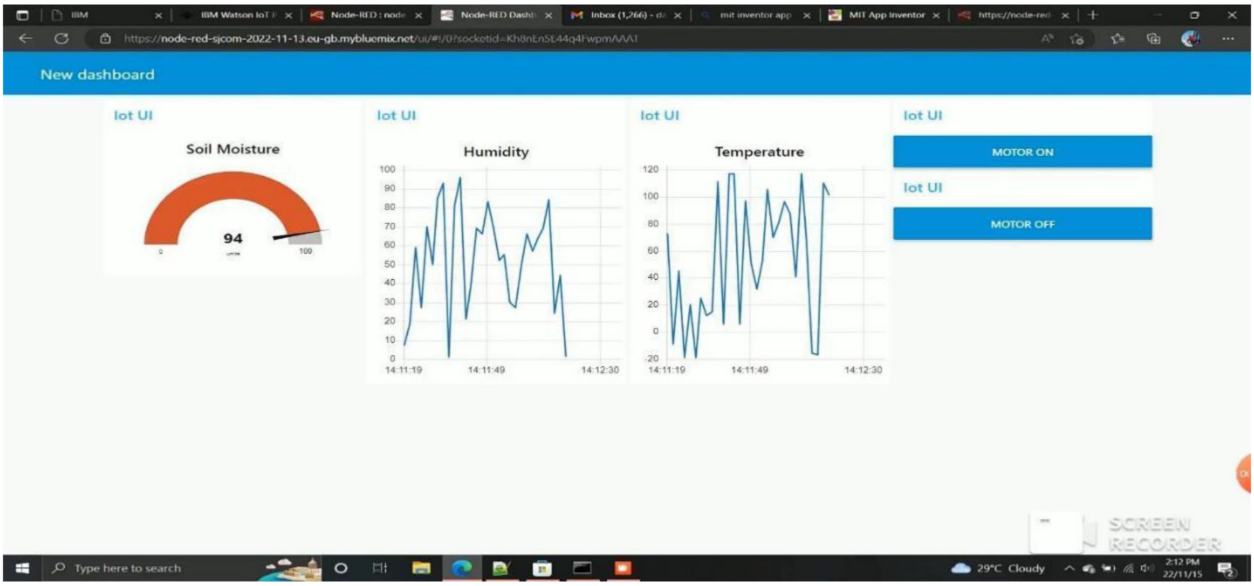
8.2 User Acceptance Testing





9.RESULTS

9.1 Performance Metrics



10.ADVANTAGES AND DISADVANTAGES

Advantages:

- The irrigation system valves can be operated according to a schedule with the aid of a remote control system. Remote farm holdings can be extremely difficult and labour-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 in circumstances when a speedy response is required. The logical next step is to remotely monitor and control motorised gear such as irrigation systems, generators, wind turbines, and other similar devices.
- 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 programme transmits a sign to the unit within seconds by means of a mobile phone system.
- 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 fuel. 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:

- The continuous availability of the internet is essential for smart agriculture. Most developing countries' rural areas do not meet this condition. Additionally, internet speed is slower
- Farmers must comprehend and become computer savvy in order to use the smart farming equipment. This is a significant obstacle to the widespread adoption of smart agriculture farming across the nations.

Applications:

Monitoring of CLimate Conditions - Probably The smartest 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, choose crops appropriately and take required measures to achieve higher capacity and precision in farming.

Crop Management - One more type of Iot product in agriculture and other elements of precision farming is crop farming is crop management devices. Just like weather stations, they should be placed in the field to collect data specific to crop farming; from temperature and precipitation to leaf water potential and overall crop health, these can all be used to readily collect data and information for improved farming practices.

11.CONCLUSION

A smart agriculture system based on the IoT can be very advantageous for farmers. Agriculture suffers from the lack of irrigation. Depending on the local environmental elements, climate characteristics like humidity, temperature, and wetness can be changed. Animal incursions, a significant contributor to crop loss, are also discovered by this method. This technique helps with irrigation scheduling based on current field data and records from a climate source. It aids in the farmer's decision of whether or not to perform irrigation. For continuous monitoring of sensor data, internet access must always be present. Using GSM devices as an alternative to mobile apps can potentially solve this problem. SMS can be sent to farmers' phones via GSM.

12.FUTURE SCOPE

In the current project we have implemented a project that can protect and maintain the crop. In this project the farmer monitors and controls the field remotely. In future we can add or update few more things to this project

. • We can make a few additional replicas of the same project so that the farmer has access to comprehensive information.

• By including solar power systems, we can modernise this project. 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 employ GSM technology so that the farmers can receive the information via SMS at their homes. If there are any internet problems, this enables the farmer to obtain information.

• A camera capability might be added to allow the farmer to view his land in real time. This aids in preventing theft.

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 ()
```