SMARTFARMER-IOT ENABLED SMART FARMING APPLICATION

NALAIYATHIRAN IBM PROJECT

TEAM ID:PNT2022TMID41338

REPORT

Submitted by

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ANNA UNIVERSITY, CHENNAI::600 025

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BONAFIDE CERTIFICATE

Certificate that this project titled **"SMARTFARMER-IOT ENABLED SMART FARMING APPLICATION"** the bonafide work of **DHIVYA S (620319104006), BHUVANESHWARI M(620319104004), PRIYADHARSHINI S(620319104030), SARANYA M(620319104036)**who carried out the project work under my supervision. Certified further that to the best of knowledge the work reported here in does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

Staff-In charge	Evaluator
MRS.K.SARANYA,ME.,	**MR.BHARADWAJ**

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ABSTRACT

The growth of the global population coupled with a decline in natural resources, farmland, and the increase in unpredictable environmental conditions leads to food security is becoming a major concern for all nations worldwide. These problems are motivators that are driving the agricultural industry to transition to smart agriculture with the application of the Internet of Things (IoT) and the big data solutions to improve operational efficiency and productivity. The IoT is a integrates a series of existing state-of-the-art solutions and technologies, such as wireless of sensor networks, cognitive radio ad hoc networks, cloud computing, big data, and end-user applications. This study presents a survey of IoT solutions and demonstrates how IoT can be integrated into the smart agriculture sector. To achieve this objective, we discuss the vision of IoT-enabled smart agriculture ecosystems by evaluating their architecture (IoT devices, connect Communication technologies, big data storage, and processing), their applications, and the research timeline. In addition, we discuss trends and opportunities of IoT applications for smart agriculture and also indicate the open issues and challenges of IoT application in smart agriculture. We hope that the findings of this study will constitute important guidelines in research and promotion of IoT solutions aiming to improve the productivity and quality of the agriculture sector as well as facilitating the transition towards a future sustainable environment with an agroecological approach.

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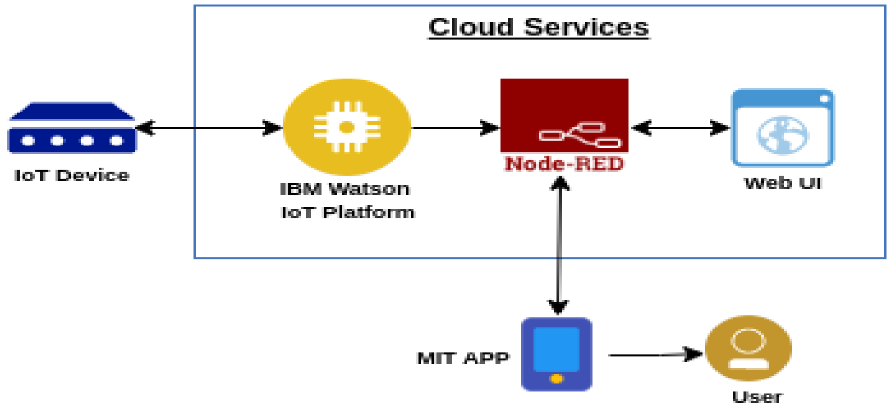
CHAPTER 1
INTRODUCTION

Agriculture is the basic source of livelihood of people in India. In the past decade, it is observed that there is not much crop development in agriculture sector. Food prices are continuously increasing because crop rate is declined. Some of the factors which are responsible for this may be wastage of water, low soil fertility, fertilizer abuse, climate change, diseases, etc.

There are number of factors which are responsible for this, it may be due to water waste, low soil fertility, Monitoring systems are used in the field to collect information on farming conditions (e.g., light intensity, humidity, and temperature) with the aim of enhancing crop productivity. Internet of things (IoT) technology is a recent trend in numerous fields, including monitoring systems for agriculture. In conventional farming, farmers need manual labor to handle crops and livestock, often leading to inefficient resource use. This downside can be addressed through the concept of smart farming, whereby farmers receive training in the use of IoT, access to the global positioning system (GPS), and data management capabilities to increase the quantity and quality of their products.

1.1 Project Overview

- IoT-based agriculture system helps the farmer in monitoring different parameters of his field like soil moisture, temperature, and 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

By making farming more connected and intelligent, precision agriculture helps reduce overall costs and improve the quality and quantity of products, the sustainability of agriculture and the experience for the consumer. Increasing control over production leads to better cost management and waste reduction. The ability to trace anomalies in crop growth or livestock health, for instance, helps eliminate the risk of losing yields. Additionally, automation boosts efficiency. With smart devices, multiple processes can be activated at the same time, and automated services enhance product quality and volume by better controlling production processes.

Smart farming systems also enable careful management of the demand forecast and delivery of goods to market just in time to reduce waste. Precision agriculture is focused on managing the supply of land and, based on its condition, concentrating on the right growing parameters – for example, moisture, fertilizer or material content – to provide production for the right crop that is in demand. The types of precision farming systems implemented depend on the use of software for the management of the business. Control systems manage sensor input, delivering remote information for supply and decision support, in addition to the automation of machines and equipment for responding to emerging issues and production support.

CHAPTER 2
LITERATURE SURVEY

Zuraida Muhammad, Muhammad Azri Asyraf Mohd Hafez, Nor Adni MatLeh, Zakiah Mohd Yusoff , Shabinar Abd Hamid [1] The term "Internet of Things" refers to the connection of objects, equipment, vehicles, and other electronic devices to a network for the purpose of data exchange (IoT). The Internet of Things (IoT) is increasingly being utilised to connect objects and collect data. As a result, the Internet of Things' use in agriculture is crucial. The idea behind the project is to create a smart agriculture system that is connected to the internet of things. The technology is combined with an irrigation system to deal with Malaysia's variable weather. This system's microcontroller is a Raspberry Pi 4 Model B. The temperature and humidity in the surrounding region, as well as the moisture level of the soil, are monitored using the DHT22 and soil moisture sensor. The data will be available on both a smartphone and a computer. As a result, Internet of Things (IoT) and Raspberry Pi-based Smart Agriculture Systems have a significant impact on how farmers work. It will have a good impact on agricultural productivity as well. In Malaysia, employing IoT-based irrigation systems saves roughly 24.44 percent per year when compared to traditional irrigation systems. This would save money on labour expenditures while also preventing water waste in daily needs.

Divya J., Divya M.,Janani V. [2] Agriculture is essential to India's economy and people's survival. The purpose of this project is to create an embedded-based soil monitoring and irrigation system that will reduce manual field monitoring and provide information via a mobile app. The method is intended to help farmers increase their agricultural output. A pH sensor, a temperature sensor, and a humidity sensor are among the tools used to examine the soil. Based on the findings, farmers may plant the best crop for the land. The sensor data is sent to the field manager through Wi-Fi, and the crop advice is created with the help of the mobile app. When the soil temperature is high, an automatic watering system is used. The crop image is gathered and forwarded to the field manager for pesticide advice.

2.1 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

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

2.2 References

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

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

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

[4] International Journal of Management, Technology And Engineering ISSN NO : 2249-7455Volume 8, Issue VII, JULY/2018”Protecting Crops From Birds, Using Sound Technology In Agriculture”

[5] American Journal of Engineering Research (AJER)2018 e ISSN: 2320-0847 p ISSN : 2320- 0936 Volume-7, Issue-7, pp-326-330 “Moisture Sensing Automatic Plant Watering System Using Arduino Uno”.

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.

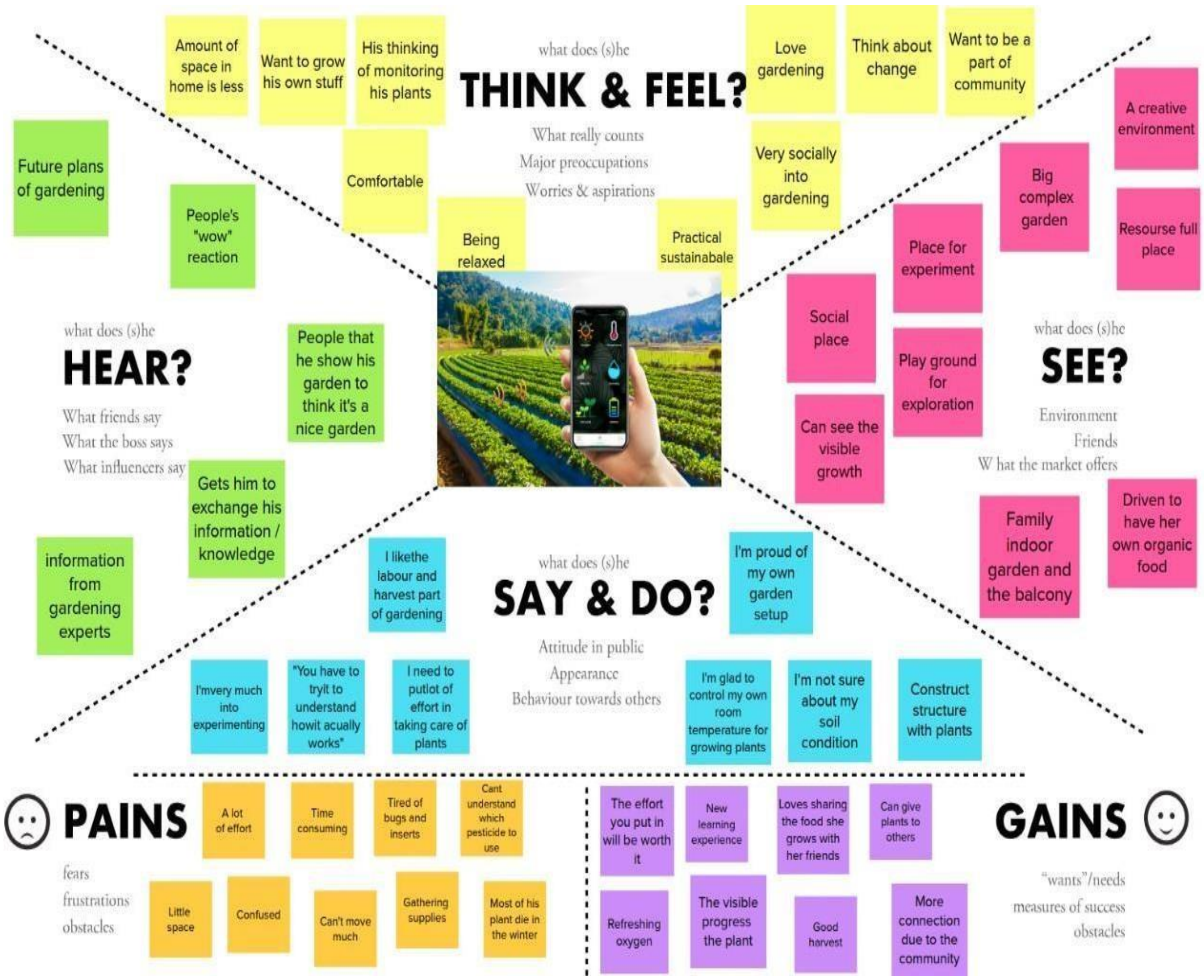
Who does the problem affect?	Persons who do Agriculture.
What are the boundaries of the problem?	People who Grow Crops and facingIssues in monitoring and watering plants.
When does the issue occur?	When the weather condition is uncertain, it is difficult to decide whether to water the crop or not.
What is the issue?	In agricultural aspects, if the plant is not provided with sufficient water, the production of the crop will be affected to a great extent. Providing correct amount of water is a challenge for the farmers.
Where does the issue occur?	The issue occurs in agriculture practicing areas, particularly in rural regions.
Why is it important that we fix theproblem?	It is required for the growth of better quality food products. It is important to maximize the cropyield.

What solution to solve this issue?	This could be solved by monitoring the soil parameters, weather and climatic conditions and helping the farmer to make the correct decision.
What methodology used to solvethe issue?	Sensors, Weather API and mobile application could be used. The sensor values and weather data areused for the computation and the final decision whether to water the crop or not is taken using mobile application.

CHAPTER 3

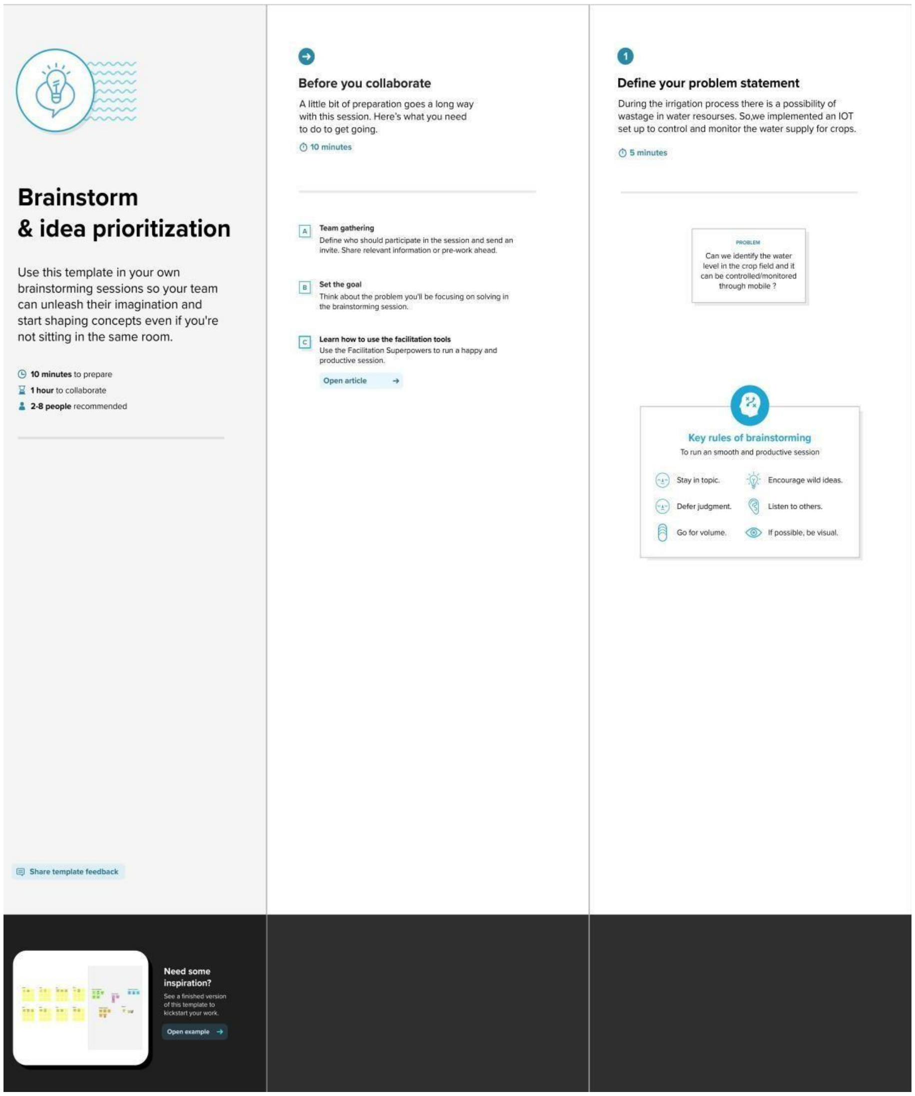
IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

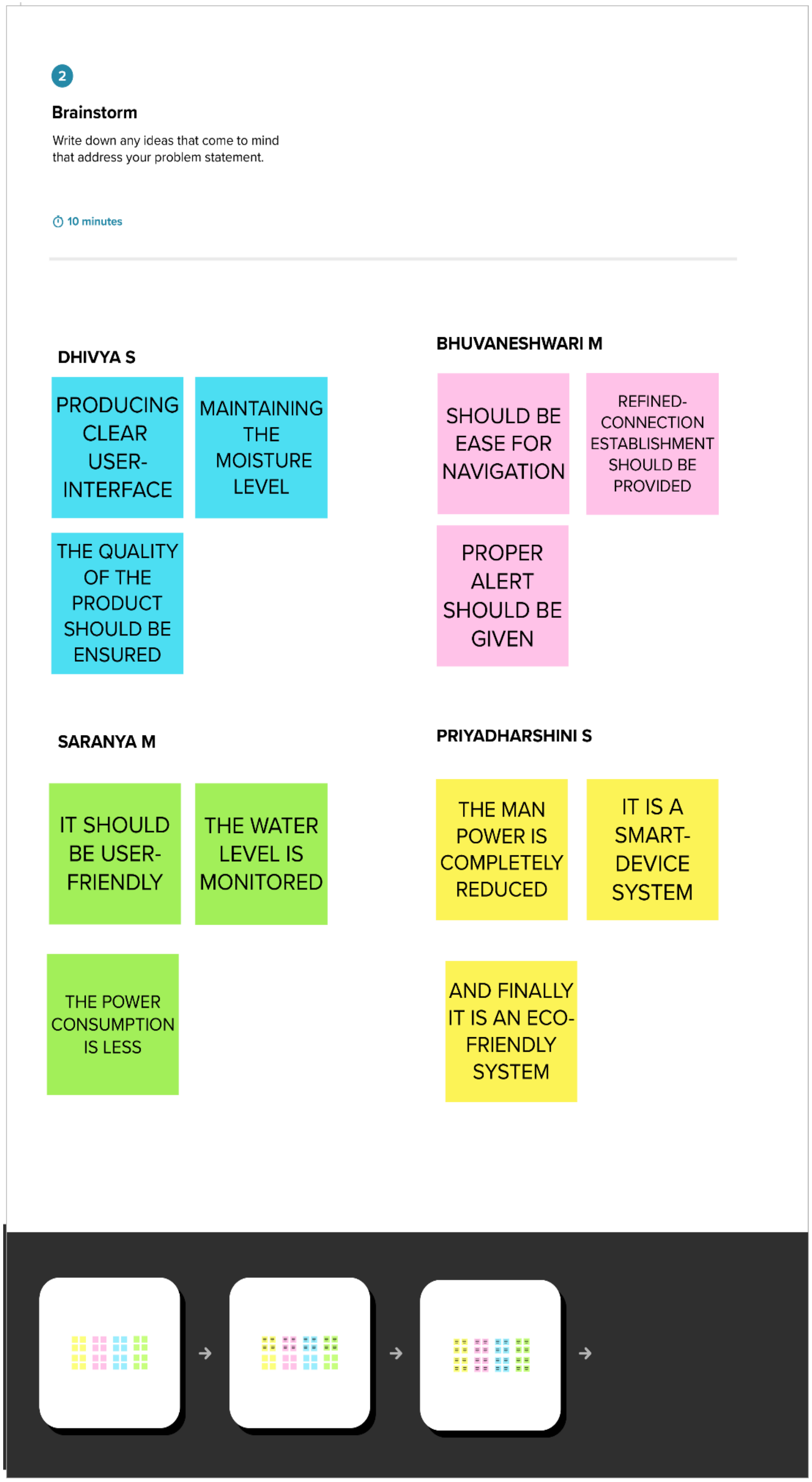


3.2 Ideation & Brainstorming

Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping



3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

20 minutes

DEVELOPING THE MOBILE APPLICATION

CAN BE USED IN RURAL AREAS

INDICATION SYSTEM SHOULD WORK PROPERLY

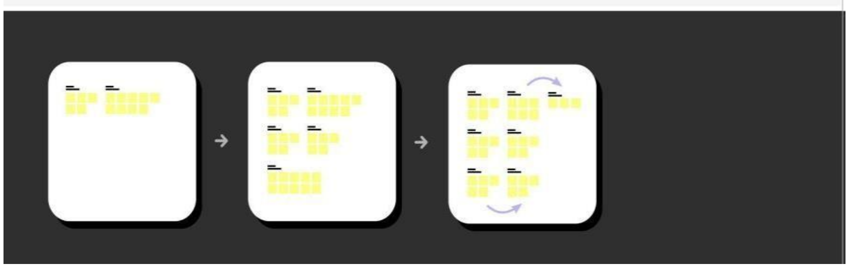
FARMERS SHOULD SEE THEIR OWN FIELD VIRTUALLY

THE POWER-SUPPLY IS NECESSARY FOR THE INDICATION PURPOSE

CROPS ARE MONITORED REGULARLY

RESULTS SHOULD BE ACCURATE

OUTPUTS SHOULD BE CATEGORISED AS PER RATIO



Step-3: Idea Prioritization

3.3 Proposed Solution

S.NO	Parameters	DESCRIPTION
1.	Problem Statement (Problem tobe solved)	To provide efficient decision support systemusing wireless sensor network which handle different activities of farm and gives useful information related to farm. Information related to Soil moisture, Temperature and Humidity content. Due to the weathercondition, water level increasing Farmers get lot of distractions which is not good forAgriculture.
2.	Idea / Solution description	Smart Agricultural System solutions provide an integrated IoT platform in agriculture that allows farmers to leverage sensors, smart gateways and monitoring systems to collect information, control various parameterson their farms and analyze real-time data in order to make informed decisions.
3.	Novelty / Uniqueness	Various eminent researchers have been making efforts for smart farming by using IoT concepts in agriculture. But, a bouquet of unfolded challenges is still in a queue for their effective solution. This study makes some efforts to discuss past research and open challenges in IoT based agriculture.
4.	Social Impact / Customer Satisfaction	Reduces the wages for labors who work inthe agricultural field. It saves a lot of time.IoT can help improve customer relationships by enhancing the customer's overall experience.
5.	Business Model (Revenue Model)	A monthly subscription is charged to farmers for prediction and suggesting theirrigation timing based on sensors parameters like temperature, humidity, Soil moisture.
6.	Scalability of the Solution	Scalability in smart farming refers to the adaptability of a system to increasethe capacity, for example, the numberof technology devices such as sensors and actuators, while enabling timely analysis.

3.4 Problem Solution fit

Define CS, fit into CC

1. CUSTOMER SEGMENTS CS

Who is your customer?

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 C

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

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

5. AVAILABLE SOLUTIONS AS

Which solutions are available to the customers when theyface the problem

of need to get the job done? What have they tied 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 (of 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 ROOF CAUSE

What is the real season that this problem exists? What is the back story behind

Frequent changes and unpredictable weather and climate made it difficult for farmers to engage in agriculture. Phase 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

What does your customer do to address the problem andget the job done?
i.e., directly related: find the light solar panel installer, calculate usage and benefits; indirectly associated: customers spend foretime 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 hand time predicting the weather.

4. EMOTIONS: BEFORE / AFTER EM

How do customers feel when they face a problem of 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 → collects 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 blankuntil you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behavior.

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 OÏÏLINE
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 used 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.

CHAPTER 4
REQUIREMENT ANALYSIS

4.1 Functional requirement

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 EmailConfirmation via OTP
FR-3	Log in to system	Check Credentials Check Roles of Access.
FR-4	Manage Modules	Manage System Admins Manage Roles of User Manage User permission
FR-5	Check whether details	Temperature details Humidity details
FR-6	Log out	Exit

4.2 Non-Functional requirements

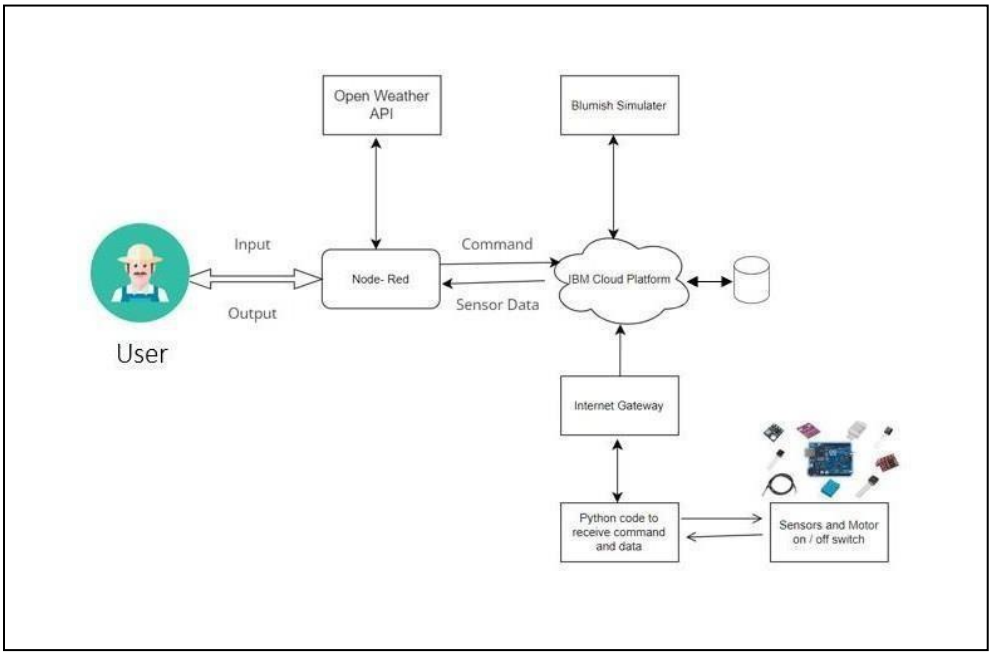
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Usability includes easy learn ability, efficiency in use, remember ability, lack of errors in operation and subjective pleasure.
NFR-2	**Security**	Sensitive and private data must be protected from their production until the decision-making and storage stages.
NFR-3	**Reliability**	The shared protection achieves a better trade-offbetween costs and reliability. The model uses dedicated and shared protectionschemes to avoid farm service outages.
NFR-4	**Performance**	The idea of implementing integrated sensors with sensing soil and environmental or ambient parameters in farming will be more efficient for overall monitoring.
NFR-5	**Availability**	Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc.
NFR-6	**Scalability**	Scalability is a major concern for IoT platforms. It has shown that different architectural choices of IoT platforms affect system scalability and that automatic real time decision-making is feasible in an environment composed of dozens of thousand.

CHAPTER 5
PROJECT DESIGN

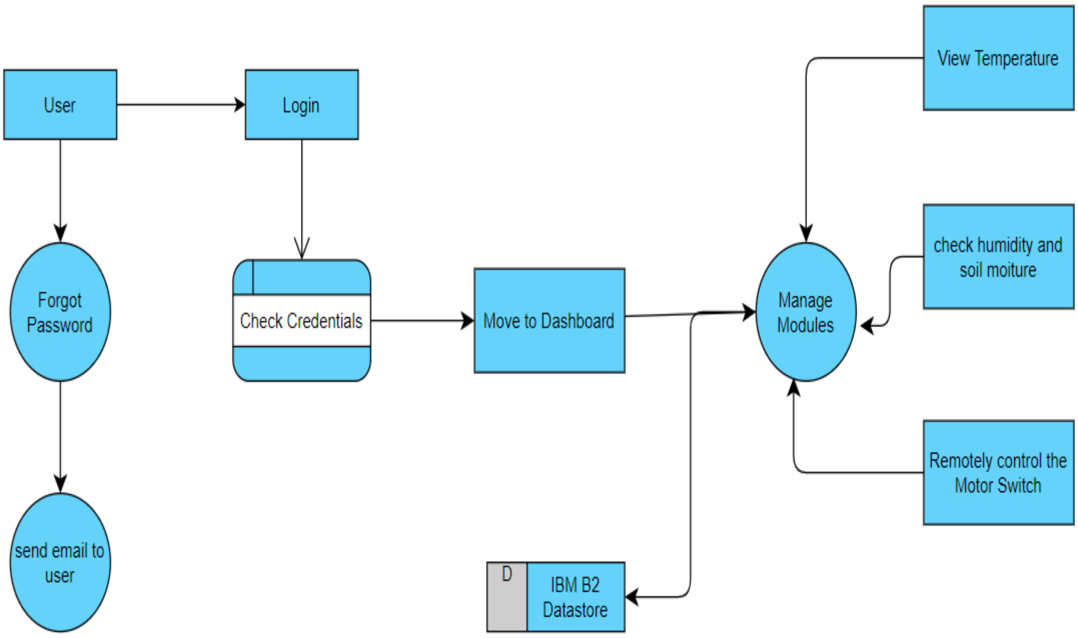
5.1 Data Flow Diagrams

Smart Farming Application Flow Diagram:



Data Flow Diagrams:

DFD Level 0 (Industry Standard)

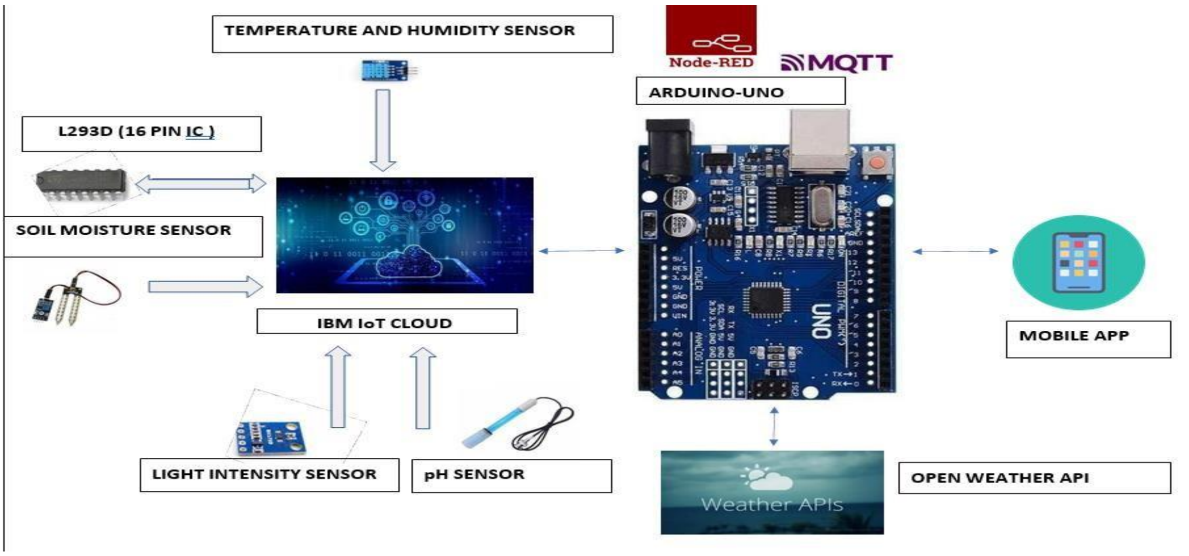


5.2 Solution & Technical Architecture

5.2.1 Solution Architecture:

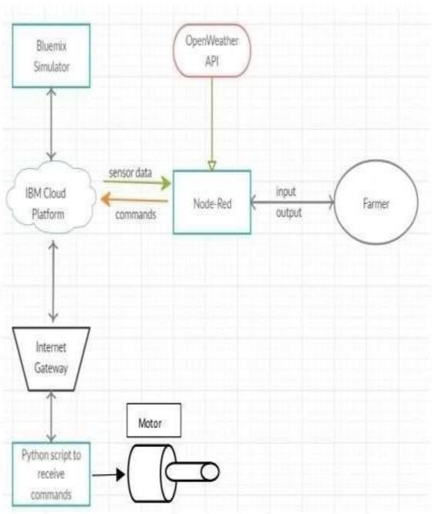
- ➢ The different soil parameters (temperature, humidity, light intensity, pH level) are sensed using different sensors and the obtained value is stored in IBM cloud.
- ➢ Arduino uno is used as a processing unit which processes the data obtained from sensors and weather data from weather API.
- ➢ Node red is used as a programming tool to wire the hardware, software and APIs. The MQTT protocol is followed for communication.
- ➢ All the collected data are provided to the user through a mobile application which was developed using MIT app inventor. The user could make decision through an app, whether to water the crop or not depending upon the sensor values.

Solution Architecture Diagram:



5.2.2 Technical Architecture:

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



Guidelines

1. Include all the processes (As an application logic / Technology Block)
2. Provide infrastructural demarcation (Local / Cloud)
3. Indicate external interfaces (third party API's etc.)
4. Indicate Data Storage components / services
5. Indicate interface to machine learning models (if applicable)

- 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 decide through an app, weather to water the crop or not depending upon the sensor values. By using the app, they can remotely operate the motor switch.

Technical Architecture Diagram:

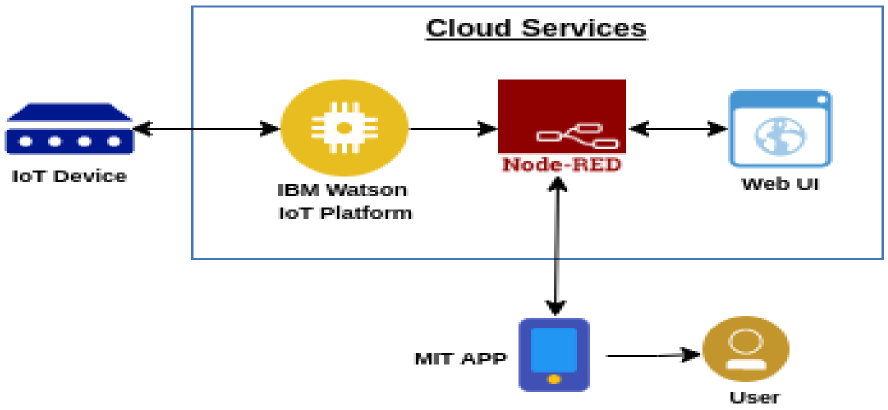


Table - 1: Components & Technologies:

S. No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson IOT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
6.	Cloud Database	Database Service on Cloud	IBM Cloud
7.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
9.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, etc.

Table-2: Application Characteristics:

S. No	Characteristics	Description	Technology
1.	Open-Source Frameworks	List the open-source frameworks used	Technology of Opensource framework
2.	Security Implementations	Sensitive and private data must be protected fromtheir production until the decision-making and storage stages.	e.g. Node-Red, Open weather App API,MIT App Inventor, etc.
3.	Scalable Architecture	scalability is a major concern for IoT platforms. It has been shown that different architectural choices of IoT platforms affect system scalabilityand that automatic real time decision-making is feasible in an environment composed of dozens of thousand.	Technology used
4.	Availability	Automatic adjustment of farming equipment made possible by linking information like crops/weather and equipment to auto-adjust temperature, humidity, etc.	Technology used
5.	Performance	The idea of implementing integrated sensors withsensing soil and environmental or ambient parameters in farming will be more efficient for overall monitoring.	Technology used

5.3 User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirmingmy password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation emailonce I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the applicationthrough Gmail		Medium	Sprint-1
	Login	USN-4	As a user, I can log into the application byentering email & password		High	Sprint-1
Customer (Web user)	Dashboard	USN-5	As a User can view the dashboard, and this dashboard include the check roles of access and then move to the manage modules.	I can view the dashboard in this smart farming application system.	High	Sprint 2
		USN-6	User can remotely access the motor switch	In the smart farming app	High	Sprint 3
Administrator			As a user once view the manage modules this describes the Manage system Admins and Manage Roles of User and etc.			Sprint 2

CHAPTER 6
PROJECT PLANNING & SCHEDULING

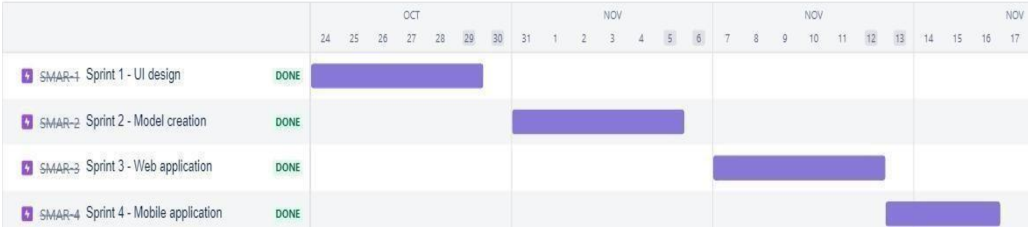
6.1 Sprint Planning & Estimation

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Simulation Creation	USN-1	Connect Sensors and Arduino with python code	2	High	Dhivya, Bhuvaneshwari, Saranya
Sprint-2	Software	USN-2	Creating device in the IBM Watson IoT platform, workflow for IoT scenarios using Node-Red	2	High	Dhivya, Bhuvaneshwari, Priyadharshini
Sprint-3	MIT App Inventor	USN-3	Develop an application for the Smart farmer project using MIT App Inventor	2	High	Dhivya, Bhuvaneshwari, Priyadharshini, Saranya
Sprint-3	Dashboard	USN-3	Design the Modules and test the app	2	High	Dhivya, Bhuvaneshwari, Saranya
Sprint-4	Web UI	USN-4	To make the user to interact with software	2	High	Dhivya, Bhuvaneshwari, Priyadharshini

6.2 Sprint Delivery Schedule

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	19 Nov 2022

6.3 Reports from JIRA



CHAPTER 7
CODING & SOLUTIONING

7.1 Feature 1

->Connecting the python code to the IBM Watson Cloud Platform

->Setting the organization id and token to make the connection with cloud

#Providing the IBM Watson Device Credentials

```
organization = "1xl08d "
deviceType = " abcd "
deviceId = "12"
authMethod = "token"
authToken = "12345678"
```

7.2 Feature 2

Python Code

1. Its for "Light ON and OFF"
2. Identifying Soil Moisture Temperature and Humidity

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

#Provide your IBM Watson Device Credentials
organization = "1xl08d"
deviceType = "abcd"
deviceId = "12"
authMethod = "token"
authToken = "12345678"

# Initialize GPIO

def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="lighton":
        print ("led is on")
    else :
        print ("led is off")

    #print(cmd)

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()

# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type
"greeting" 10 times
deviceCli.connect()
```

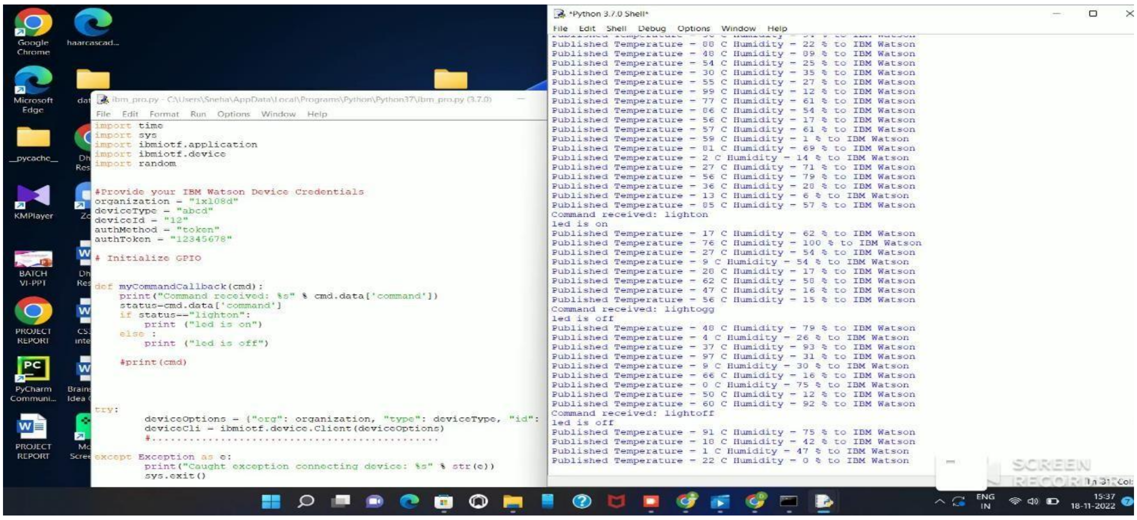
```
while True:
    #Get Sensor Data from DHT11

    temp=random.randint(0,100)
    Humid=random.randint(0,100)

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

# Disconnect the device and application from the cloud
deviceCli.disconnect()
```

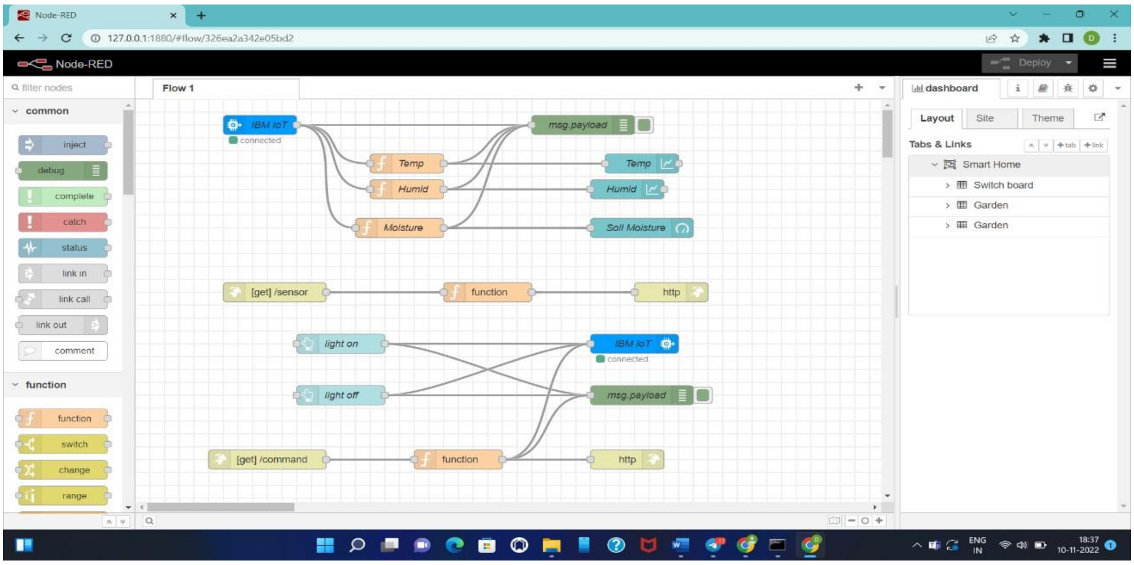
CHAPTER 8
TESTING

8.1 Test Cases

Testcases	Test Scenarios
Testcase 1	Verify user is able to see the Login/Signup popup when user logged on to the app.
Testcase 2	Verify the UI elements in Signup popup
Testcase 3	Verify user is able to log into application with Valid credentials
Testcase 4	Verify user is able to log into application with InValid credentials
Testcase 5	Verify user is able to log into application with InValid credentials

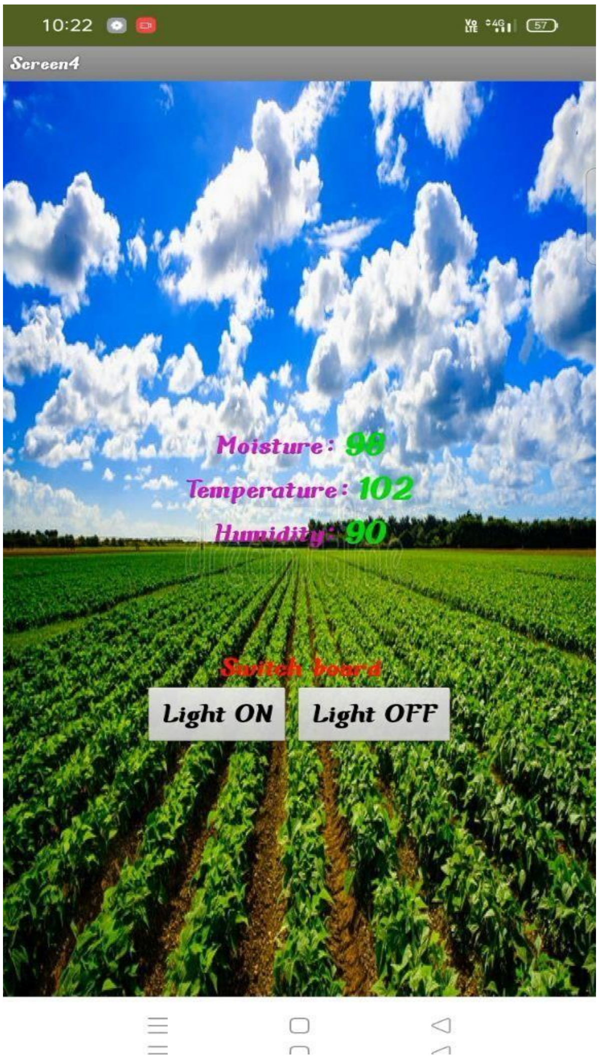
Command received from Node-Red:





8.2 User Acceptance Testing:

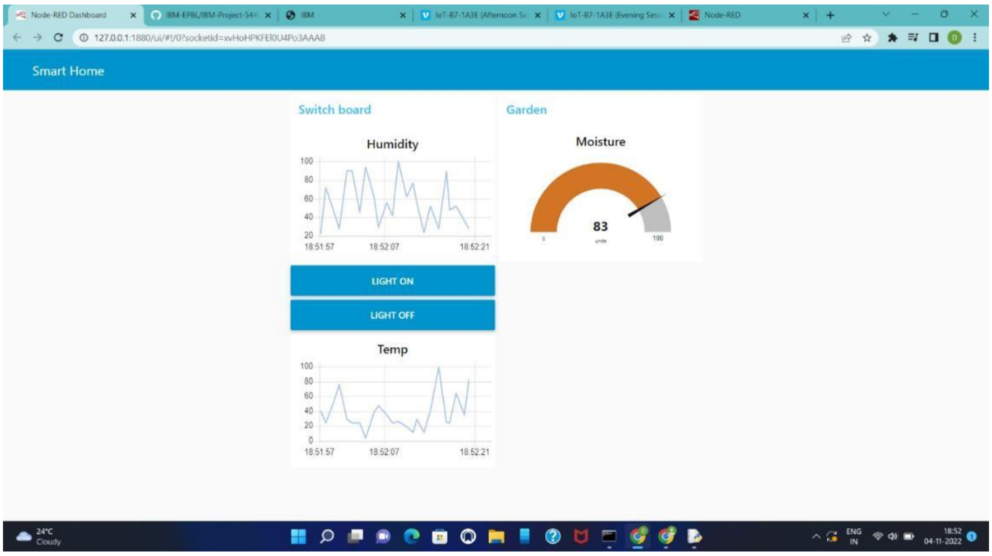
Using the App:

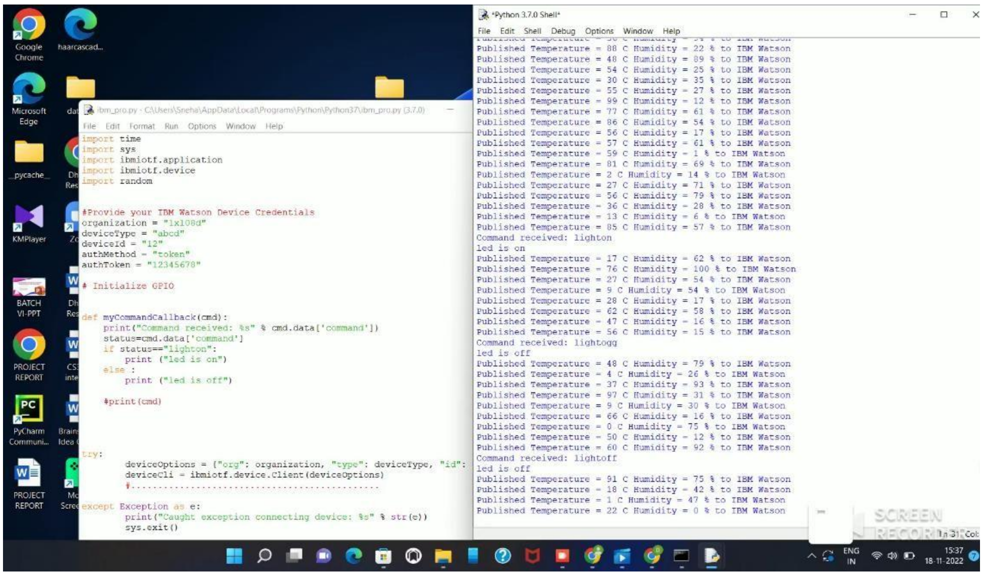


CHAPTER 9
RESULTS

9.1 Performance Metrics

From this we getting the values of Soil Moisture , Temperature , Humidity





CHAPTER 10
ADVANTAGES & DISADVANTAGES

10.1 ADVANTAGES

Internet of things (IoT) facilitates the several advantages in day-to-day life in the business sector (for example in agriculture). Some of its benefits are given below:

Minimum Resources: It allows farmers to maximize yields using minimum resources such as water, fertilizers, seeds etc.

Wireless Monitoring: Smart agriculture use drones and robots which helps in many ways. These improves data collection process and helps in wireless monitoring and control.

Efficient resource utilization: If we know the functionality and the way that how each device work we definitely increase the efficient resource utilization as well as monitor natural resources.

Minimize human effort: As the devices of IoT interact and communicate with each other and do lot of task for us, then they minimize the human effort.

Save time: As it reduces the human effort then it definitely saves out time. Time is the primary factor which can save through IoT platform.

10.2 DISADVANTAGES

As the Internet of things facilitates a set of benefits, it also creates a significant set of challenges. Some of the IoT challenges are given below:

Availability: 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.

Challenges: 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.

Privacy: Even without the active participation on the user, the IoT system provides substantial personal data in maximum detail.

Complexity: The designing, developing, and maintaining and enabling the large technology to IoT system is quite complicated.

CHAPTER 11

CONCLUSION

IoT will help to enhance smart farming. Using IoT the system can predict the soil moisture level and humidity so that the irrigation system can be monitored and controlled. IoT works in different domains of farming to improve time efficiency, water management, crop monitoring, soil management and control of insecticides and pesticides. This system also minimizes human efforts, simplifies techniques of farming and helps to gain smart farming. Besides the advantages provided by this system, smart farming can also help to grow the market for farmer with single touch and minimum effort.

CHAPTER 12

FUTURE SCOPE

The project has vast scope in developing the system and making it more user friendly and the additional features of the system like:

- By installing a webcam in the system, photos of the crops can be captured and the data can be sent to database.
- Speech based option can be implemented in the system for the people who are less literate.
- GPS (Global Positioning System) can be integrated to provide specific location of the farmer and more accurate weather reports of agriculture field and garden.
- Regional language feature can be implemented to make it easy for the farmers who are aware of only their regional language.

CHAPTER 13
APPENDIX

13.1 Source Code

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

#Provide your IBM Watson Device Credentials
organization = "1xl08d"
deviceType = "abcd"
deviceId = "12"
authMethod = "token"
authToken = "12345678"

# Initialize GPIO

def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="lighton":
        print ("led is on")
    else :
        print ("led is off")

  #print(cmd)

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()

# Connect and send a datapoint "hello" with value "world" into the cloud as an event of type
"greeting" 10 times
deviceCli.connect()

while True:
    #Get Sensor Data from DHT11

    temp=random.randint(0,100)
    Humid=random.randint(0,100)

    data = { 'temp' : temp, 'Humid': Humid }
    #print data
    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
```

 # Disconnect the device and application from the cloud

```
deviceCli.disconnect()
```

13.2 GitHub & Project Demo Link

GITHUB LINK: https://github.com/IBM-EPBL/IBM-Project-54407-1661958753

Project Demo Link: https://github.com/IBM-EPBL/IBM-Project-54407-1661958753/blob/main/Final%20Deliverables/Demo%20Link.mp4