SmartFarmer - IoT Enabled Smart Farming Application

IBM PROJECT REPORT
Submitted by

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ABSTRACT:

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 sensorparameters and controlling the motor pumps from the mobile application itself.

1. CHAPTER

INTRODUCTION

1.1 OVERVIEW

The objectives of this report is to proposed IoT based Smart Farming System which will enable farmers to have live data of soil moisture environment temperature at very low cost so that live monitoring can be done. The structure of the report is as follows: chapter I will cover over of overview of IoT Technology and agriculture-concepts and definition, IOT enabling technologies, IOT application in agriculture, benefits of IOT in agriculture and IOT and agriculture current scenario and future forecasts. Chapter II will cover definition of IOT based smart farming system , the components and modules used in it and working principal of it. Chapter III will cover algorithm and flowchart of theoverall process carried out in the system and its final graphical output .chapter IV consist of conclusion, future scope and references.

PURPOSE

:

1. IoT enables easy collection and management of tons of data collected from sensors and with integration of cloud computing services like Agriculture fields maps, cloud storage etc., data can be accessed live from anywhere and everywhere enabling live monitoring and end to end connectivity among all the parties concerned.
2. IoT is regarded as key component for Smart Farming as with accurate sensors and smart equipment's, farmers can increase the food production by 70% till year 2050 as depicted by experts.
3. With IoT productions costs can be reduced to a remarkable level which will in turn increase profitability and sustainability.
4. With IoT, efficiency level would be increased in terms of usage of Soil, Water, Fertilizers, Pesticides etc.
5. With IoT, various factors would also lead to the protection of environment.

2. CHAPTER LITERATURE SURVEY

EXISTING PROBLEM :

Farmers are under pressure to produce more food AND use less energy and water in the process. A remote monitoring and control system will help farmers deal effectively with these pressures.

Irrigated farms typically deploy a single pump to irrigate 80 to 100 acres of land. Many large farms, therefore, require 40 to 80 or more irrigation pumps spread over hundreds of square miles. Most are pumping ground water for irrigation purposes, most operate in remote fields, and trucks must roll to tend to them.

Ideally, each field should get just the right amount of water at just the right time. Under-watering causes crop stress and yield reduction. Overwatering can also cause yield reduction and consumes more water and fuel than necessary and leads to soil erosion and fertilizer, herbicide, and pesticide runoff.

Agricultural operations waste 60% of water consumed each year. Now more than ever, new technologies for water conservation must be adopted. According to U.S. government statistics, however, only 10% of irrigated farms use advanced water management decision tools, including precision irrigation controls and soil moisture/water level sensing devices. There are both state and federal incentive plans now in place to help increase those percentages, and we were recently awarded an Arkansas Conservation Stewardship Grant to do advanced research in soil and water level monitoring.

REFERENCES :

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Young, A. Is there really spare land? A critique of estimates of available cultivable land in developing countries. Environ. Dev.

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PROBLEM STATEMENT DEFINITION

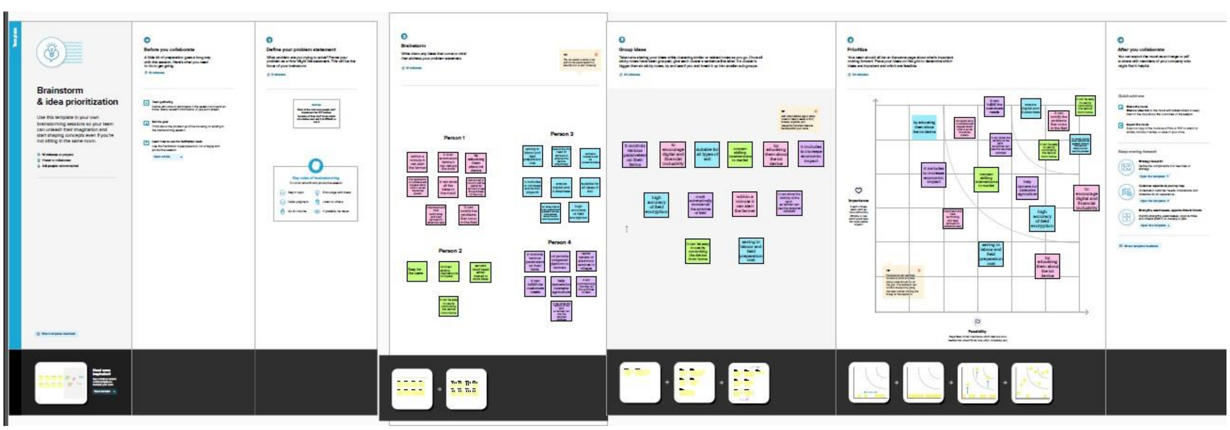
Smart Farming has enabled farmers to reduce waste and enhance productivity with the help of sensors (light, humidity, temperature, soil moisture, etc.) and automation of irrigation systems. Further with the help of these sensors, farmers can monitor the field conditions from anywhere. Internet of Things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

CHAPTER 3

IDEATION AND PROPOSED SOLUTION

EMPATHY MAP

IDEATION & BRAINSTORMING



PROPOSED SOLUTION :

S. No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	To provide efficient decision support system using wireless sensor network which handle different activities of farm and gives useful information related to farm. Information related to Soil moisture, Temperature and Humidity content. Due to the weather condition, water level increasing Farmers get lot of distractions which is not good for Agriculture.
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 parameters on 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 in the 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 the irrigation 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 increase the capacity, for example, the number of technology devices such as sensors and actuators, while enabling timely analysis.

PROBLEM SOLUTION FIT :

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.

CHAPTER 4

REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

FUNCTIONALREQUIREMENTS:

FR No.	Functional Requirement	Sub Requirement (Story / Sub-Task)
1	❖ ❖ User Registration	✓ ✓ Registration through Gmail ✓ ✓ Registration through phone

		number
2	❖ ❖ User Confirmation	✓ ✓ Confirmation via Email ✓ ✓ Confirmation via OTP ✓ ✓ Confirmation via verification link sent to registered mail id
3	❖ ❖ Roles and service	✓ ✓ Choose roles (ex: farmer, student etc.) ✓ ✓ Enter the personal details. ✓ ✓ Choose the type of service or options (ex: irrigation, pest management, crop management etc.)
4	❖ ❖ Details of farm and plans	✓ ✓ Enter the details of farming land and vegetation.

		✓ ✓ Choose the crop you want to plant ✓ ✓ Choose the types of plans (ex: regular and premium)
5	❖ ❖ Details according to farm information	✓ ✓ Check the weather information ✓ ✓ Enter the soil nutrient and pH value ✓ ✓ click SAVE ✓ ✓ Soon the details will share to registered mail ✓ ✓ EXIT

Non-functional Requirements:

NFR No.	Non-Functional Requirement	Description
1	❖ ❖ Usability	✓ ✓ A system is built for monitoring the crop field with the help of sensors and automating the irrigation system and helps the farmer to understand the important aspects.
	❖ ❖ Security	✓ ✓ Applications must be designed with the security of their use in mind.

2		This includes personal data and their user’s well-being.
3	❖ ❖ Reliability	✓ ✓ It allows farmers to maximize yields using minimum resources such as water, fertilizers, seeds etc.
4	❖ ❖ Performance	✓ ✓ It increases efficiency and reduce the environmental impacts and to implement technology properly to minimize cost.
5	❖ ❖ Availability	✓ ✓ This concept focused on providing the agricultural industry with the infrastructure to leverage advanced technology.

6	❖ ❖ Scalability	✓ It provides the recognition of each object that makes up a solution and ensure communication. The system must remain operational regardless.

CHAPTER 5

PROJECT DESIGN

Data Flow Diagram :

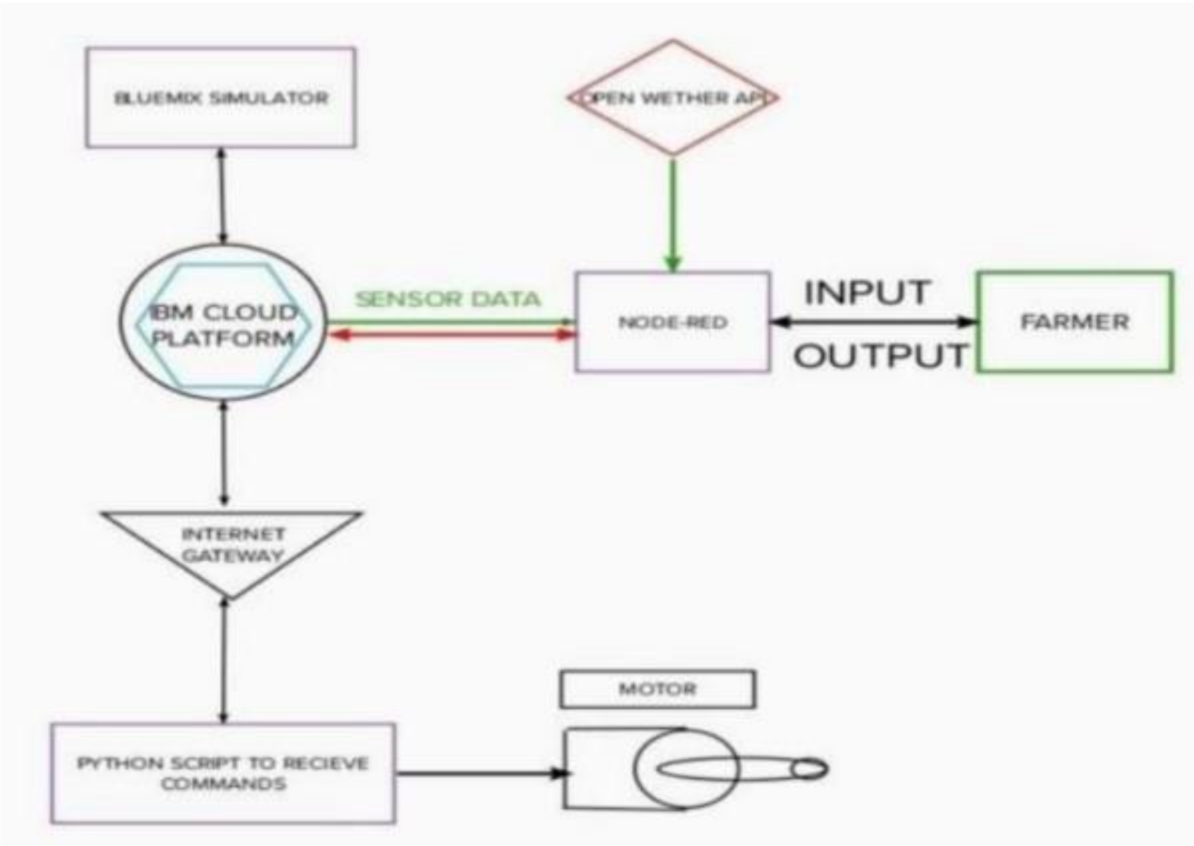
A Data Flow Diagram (DFD) is a traditional visual representation of the information flowswithin a system. A neat and clear DFD can depict the right amount of the system requirementgraphically. It shows how data enters and leaves the system, what changes the information,and where data is stored.

• The different soil parameters temperature, soil moistures and then humidity are sensedusing 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 & TECHNICAL ARCHITECTURE

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CHAPTER 6
CODING & SOLUTIONING

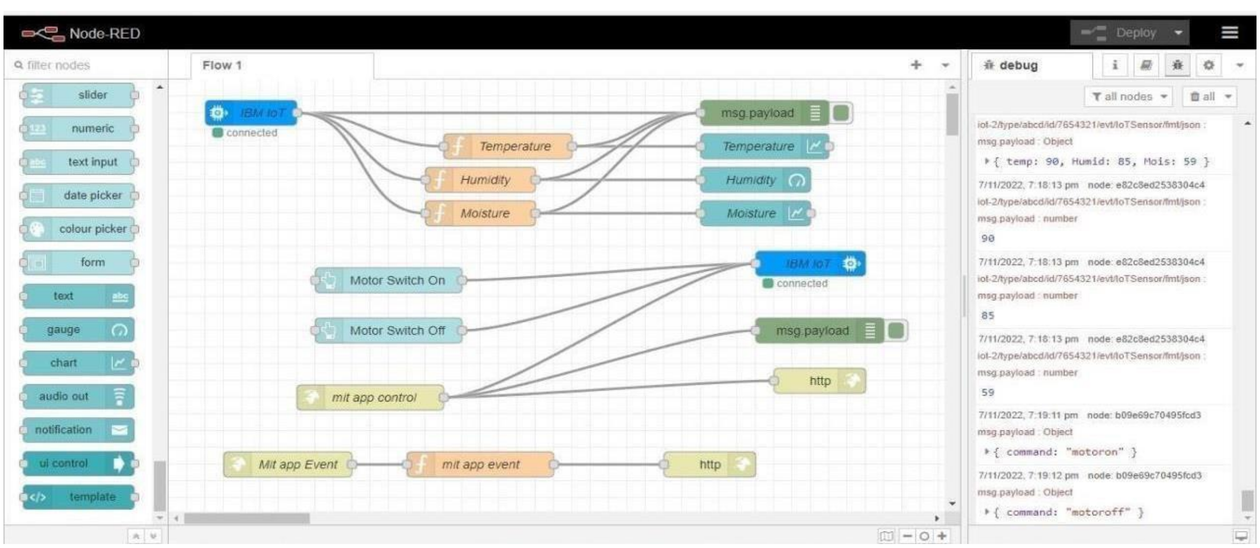
CODE:

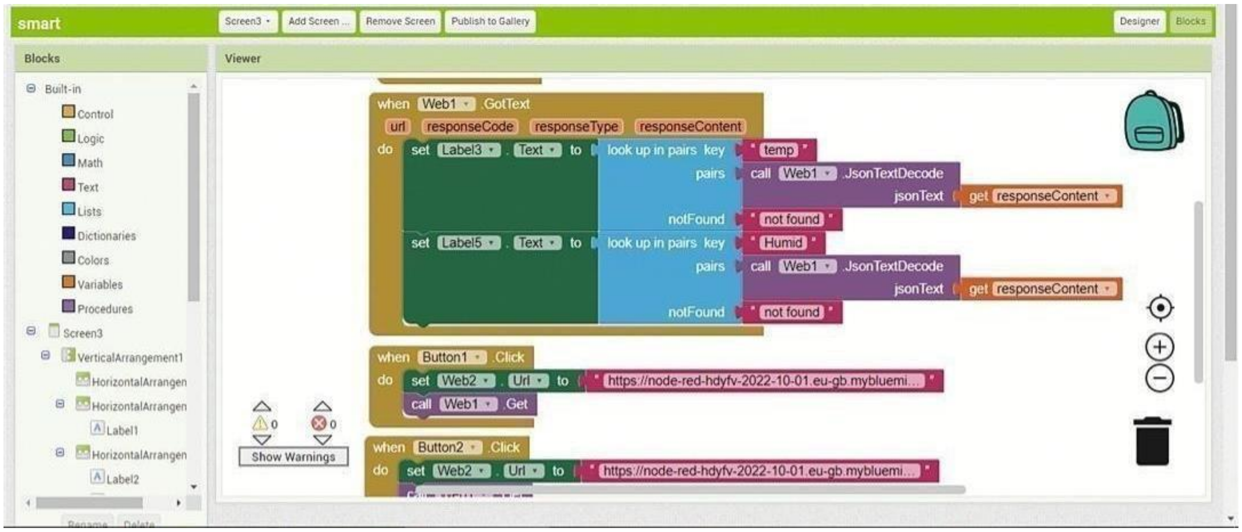
```
Import  wiotp.sdk.device

import   time

import   os

import   datetime

import   random

myConfig = {

         "identity":{

               "orgId": "ck2tfo",

              "typeId": "NodeMLIC",

              "deviceId": "1234"
},
"auth" : {

        "token": "87654321"
      }
}

Client  =   wiotp.sdk.device.DeviceClient (config=myconfig, logHandlers=None)

cilent, 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 switched on")
        elif (m=="motoroff"):
            print ("motor is switched OFF")
        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)
         print("published data sucessfully:%s", myData)
         time.sleep(2)
         client.commandCallback = myCommandCallback
client.disconnect()
```

CHAPTER 7
TESTING

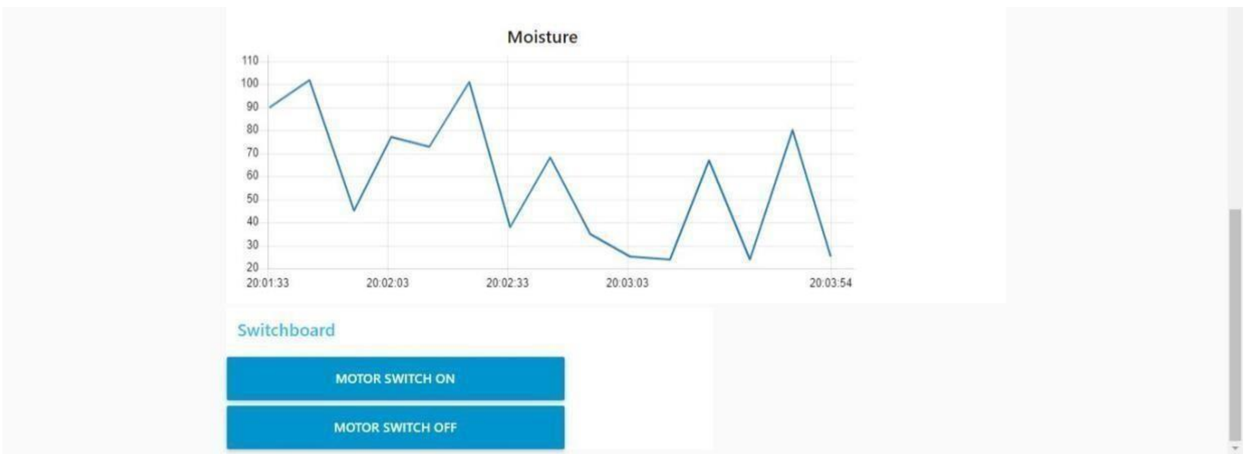
Web Application Using Node Red

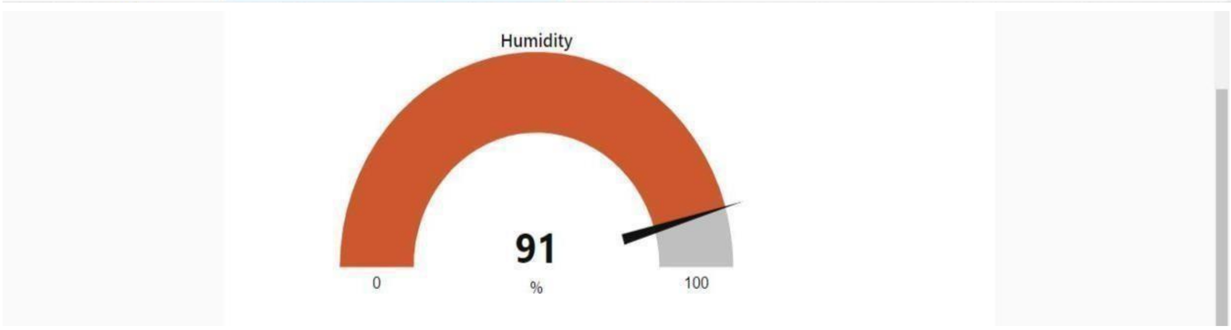




smart
Screen3
Add Screen ...
Remove Screen
Publish to Gallery
Designer
Blocks
Viewer
Built-in
Control
Logic
Math
Text
Lists
Dictionaries
Colors
Variables
Procedures
Screen3
VerticalArrangement1
HorizontalArrangen
HorizontalArrangen
Label1
HorizontalArrangen
Label2
when Web1 .GotText
url responseCode responseType responseContent
do set Label3 . Text to look up in pairs key "temp"
pairs call Web1 .JsonTextDecode
jsonText get responseContent
notFound "not found"
set Label5 . Text to look up in pairs key "Humid"
pairs call Web1 .JsonTextDecode
jsonText get responseContent
notFound "not found"
when Button1 .Click
do set Web2 . Url to "https://node-red-hdyfv-2022-10-01.eu-gb.mybluemi..."
call Web1 .Get
when Button2 .Click
do set Web2 . Url to "https://node-red-hdyfv-2022-10-01.eu-gb.mybluemi..."
Show Warnings

User Acceptance Testing :





Advantages & Disadvantages :

Advantages:

- Farms can be monitored and controlled remotely.
- Increase in convenience to farmers.
- Less labor cost.
- Better standards of living

Disadvantages:

- Lack of internet/connectivity issues.
- Added cost of internet and internet gateway infrastructure.
- Farmers wanted to adapt the use of Mobile App.

CHAPTER-8

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.