SMART FARMER-IOT ENABLED SMART FARMING APPLICATION

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Submitted By

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INTRODUCTION

PROJECT OVERVIEW

Agriculture is the primary occupation in developing countries like India. 47% of the people are involved in the agriculture sector. 18% of the total GDP of India is contributed by agricultural sector in 2022.The main objective of the project is to monitor the field and control the irrigation from the remote location. In this project user can monitor and manage the system remotely with the help of a Mobile application. The IoT Based Smart Agriculture Monitoring System improves various features such as sensitivity to humidity, soil moisture and temperature.

In this project Smart Farming System will use concept of IOT, WSN, node red and MIT app inventor. IOT based smart Farming system can be very helpful for farmers to prevent from delayed irrigation of absence of farmer near the field. This project senses real time data from field. On the basis of Live Data Monitoring the farmers may access the updates of motor as per the requirements. The farmer can view every information about the field in mobile application at any time from any remote location. This system is accurate and efficient in fetching these live data. This system helps the farmers to increase the crop production by taking proper care on crops. This project can allow the farmers to irrigate in right time and prevent from excessive watering to the crops by automated irrigation system.

PURPOSE

The purpose of this project is to maintain the ideal environment for the growth of crops. This project enables to check the parameters of the field for the growth of the crops in field and with these project farmers are able to solve irrigation problems.

In automated irrigation system, the crops are irrigated whenever the moisture of the soil falls low but certain times the corps should not be irrigated but the automated irrigation system only follows the conditions given.

When this proposed solution is set to work, the problem in automated irrigation can be reduced. As the farmer, user can control the irrigation system, Irrigation can be kept within the control of the former with the help of IOT.

This solution can ultimately help the farmer and prevent from crops from dying due to Over-irrigation and Deficit irrigation.

CHAPTER - 2

LITERATURE SURVEY

EXISTING PROBLEM

Smart farming describes an automated irrigation system that uses IoT. Internet of things and cloud computing together do a system that effectively regulates the agricultural sector. This program will hear all the environmental parameters and send data to user by cloud. The user will take control action depending on whether this will be done using an actuator. This property allows the farmer to develop the crop in the way that the crop needs and protects from over irrigation. It leads to higher, longer crop yields production time, better quality and less use of human labour.

Table 2.1. Literature survey

Author and Year	Technique/ Methodology	Limitations/ Drawback	Advantages	Applications
Raj Aryan, 2022	IOT	Costly	Automation of Irrigation System	Farmer land
Divy Mehta, 2020	IOT	Need stable internet	Live Monitoring	Farming, House plant
CH Nishanthi, 2021	IOT	Need stable internet	Data Storage	Smart farming, Nursery garden
Akshay Atole, 2017	IOT	Costly	Weather Monitoring	Farmer land
Adithya Vadapalli, 2020	IOT	Need stable internet	Temperature Monitoring	Smart farming

REFERENCES

1. Raj Aryan, Ankur Mishra, Sachin Kumar, Ms. Sonia Kumari. A Smart Farming and "Crop Monitoring Technology" Using IOT in Agriculture.Volume 10 Issue V May 2022.DOI 10.22214/ijraset.2022.42409

2. Divy Mehta Pooja Bhatt, Shivang Thakker, Gaurang Dalvadi, M.V. Patel. IoT Based Process Control which will assist the farmers in getting Live data from field by integrating different sensors. Volume 7, Issue 10, October 2020. DOI 10.17148/IARJSET.2020.71008

3. CH Nishanthi, Dekonda Naveen, Chiramdasu Sai Ram, Kommineni Divya, Rachuri Ajay Kumar.n IoT-based smart farming, a system Is built for monitoring the crop field with the help of Sensors.Volume 8,Issue 1, June 2022

4. Akshay Atole, Apurva Asmar, Amar Biradar,Nikhil Kothawade, Sambhaji Sarode, Rajendra G .IoT based smart farming system is used to generate decisions regarding irrigation using real time data. Volume 4, Issue 04, April 2017.

5. Adithya Vadapalli, Swapna Peravali, Venkata Rao Dadi. Smart Agriculture project incorporated with the Wireless sensor networks and IoT systems. Volume 09, Issue 09, April 2013.

PROBLEM STATEMENT DEFINITION

Creating a problem statement to understand your customer's point of view. The Customer Problem Statement template helps you focus on what matters to create experiences people will love.

Our main aim is to make a Smart farming application for those farmers who wants to monitor the field regularly and wants to irrigate the field in right time from the remote locations.

Figure 2.1. Problem Statement

CHAPTER - 3

IDEATION AND PROPOSED SOLUTION

EMPATHY MAP CANVAS

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviors 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.

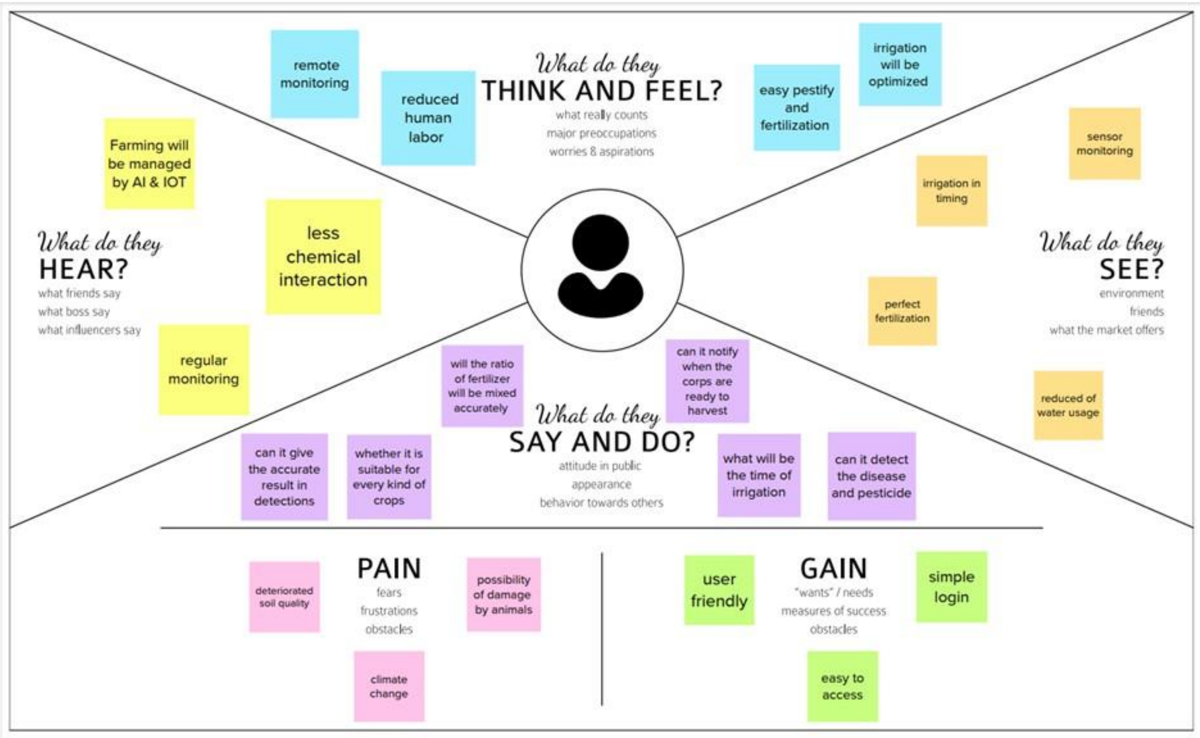


Figure 3.1. Empathy Map

IDEATION & 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 number of creative solutions.

STEP-1 TEAM GATHERING, COLLABORATION AND SELECTING THE PROBLEM STATEMENT

This step includes the formation of a team, collaborating with the team by collecting the problems of the domain we have taken and consolidating the collected information into a single problem statement.

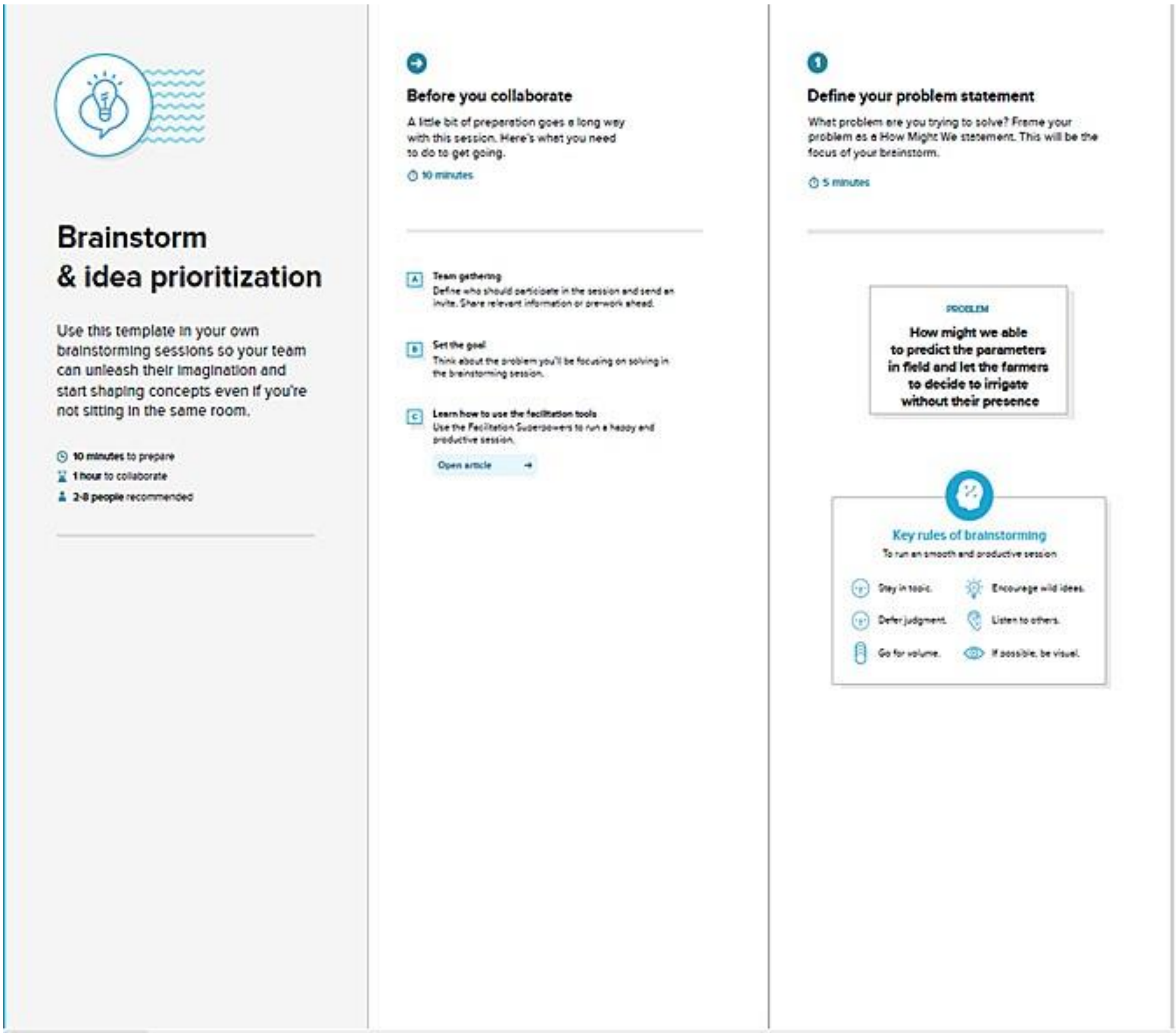


Figure 3.2. Ideation And Brainstorming

STEP 2 BRAINSTORM, IDEA LISTING AND GROUPING

This step of ideation includes the listing of individual ideas by teammates to help with the problem statement framed. All the individual ideas have been valued and made individual clusters.

Then discussed as a team and finally made an ideation using IOT, Cloud and concluded with the most voted ideas from all the clusters together and Cluster web Application with the needed ideas for application.

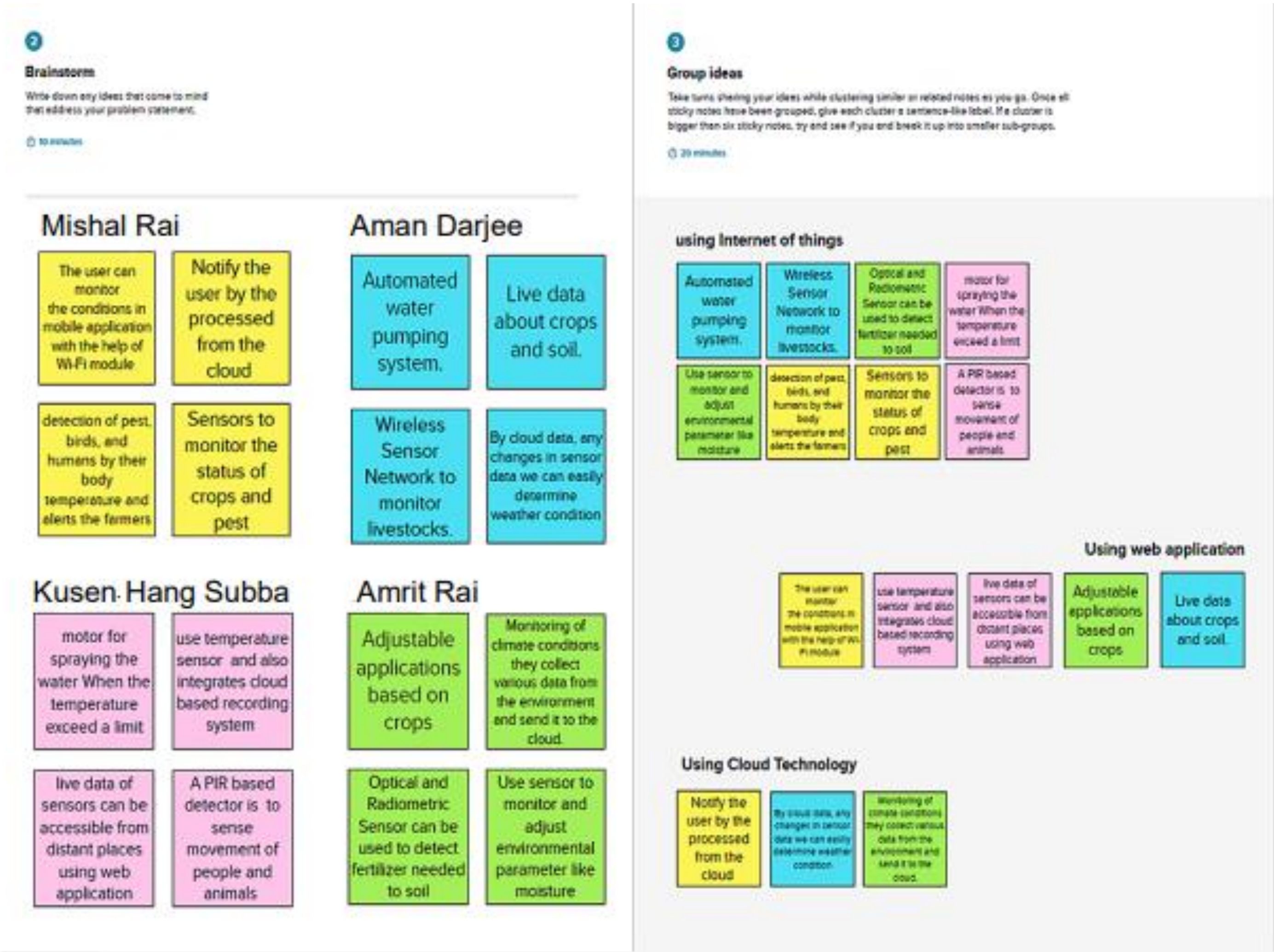


Figure 3.3. Brainstorm, Idea Listing and Grouping

STEP 3 IDEA PRIORITIZATION

This step includes the process of listing necessary components to come up with the working solution and making a hierarchy chart by prioritizing the components based on importance, say from the higher being backend and lower being the user interfacing components.

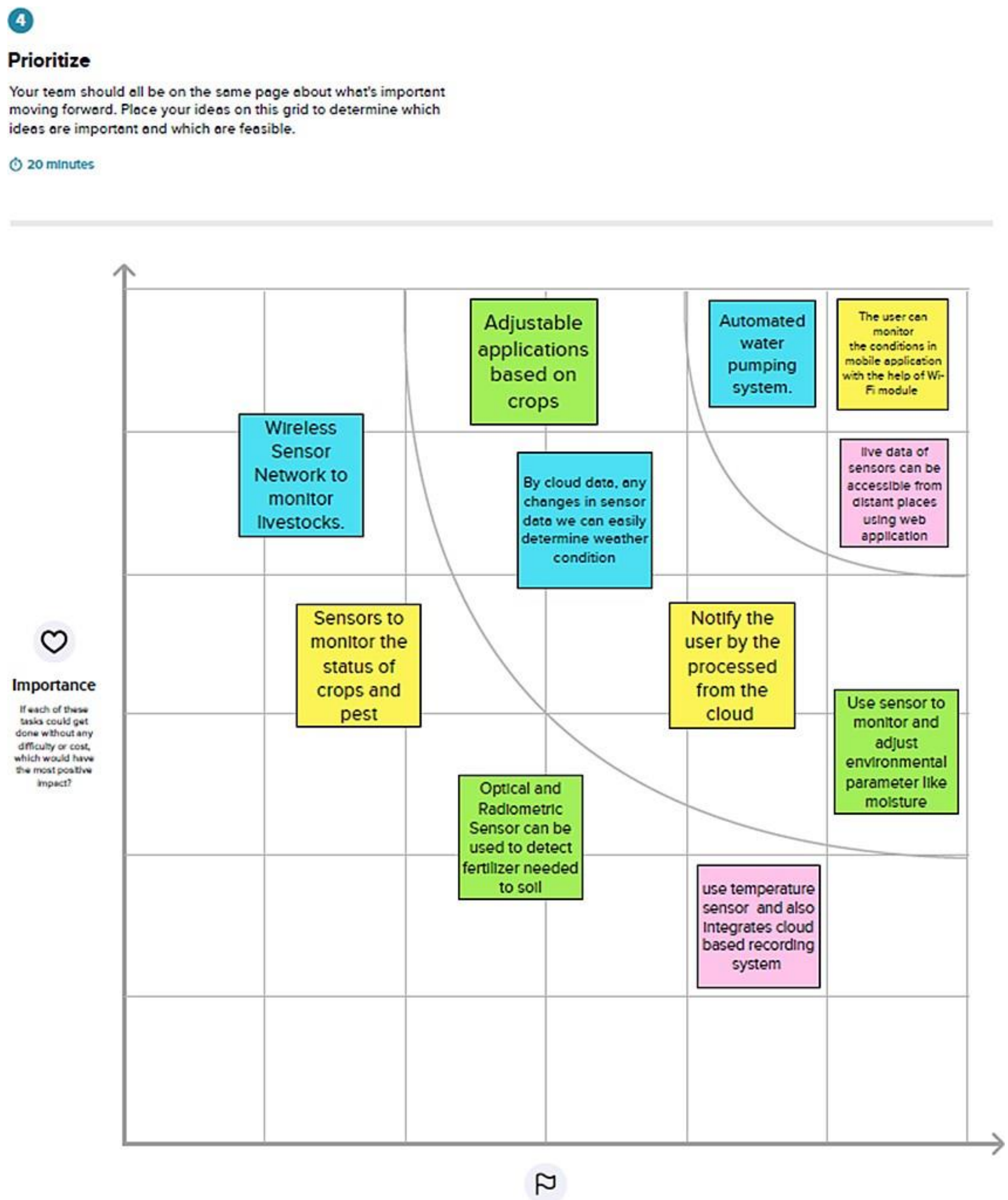


Figure 3.4. Idea Prioritization

PROPOSED SOLUTION

Problem statement (problem to be solved)

Our project's main aim is to make an application for the farmer to irrigate the field, for the farmers who need to irrigate the field but they are not available near the field.

Idea / Solution description

A Smart Farming Application which allows the farmers to control the irrigating motors through the mobile and web application easily. This Smart farming Application allows the farmers to monitor the field regularly from any remote locations.

Novelty / Uniqueness

A user-friendly application which can be used easily to control the motors and monitor the field from anywhere.

Social Impact / Customer Satisfaction

farmers can get an alert when the field is dry and can control the water pump from remote location. For over irrigating issue of automated pump, the farmers can make a decision of irrigation before the automation process begins.

PROBLEM-SOLUTION FIT

The Problem-Solution Fit simply means that you have found a problem with your customer and that the solution you have realized for it solves the customer's problem. It helps entrepreneurs, marketers and corporate innovators identify behavioral patterns and recognize what would work and why

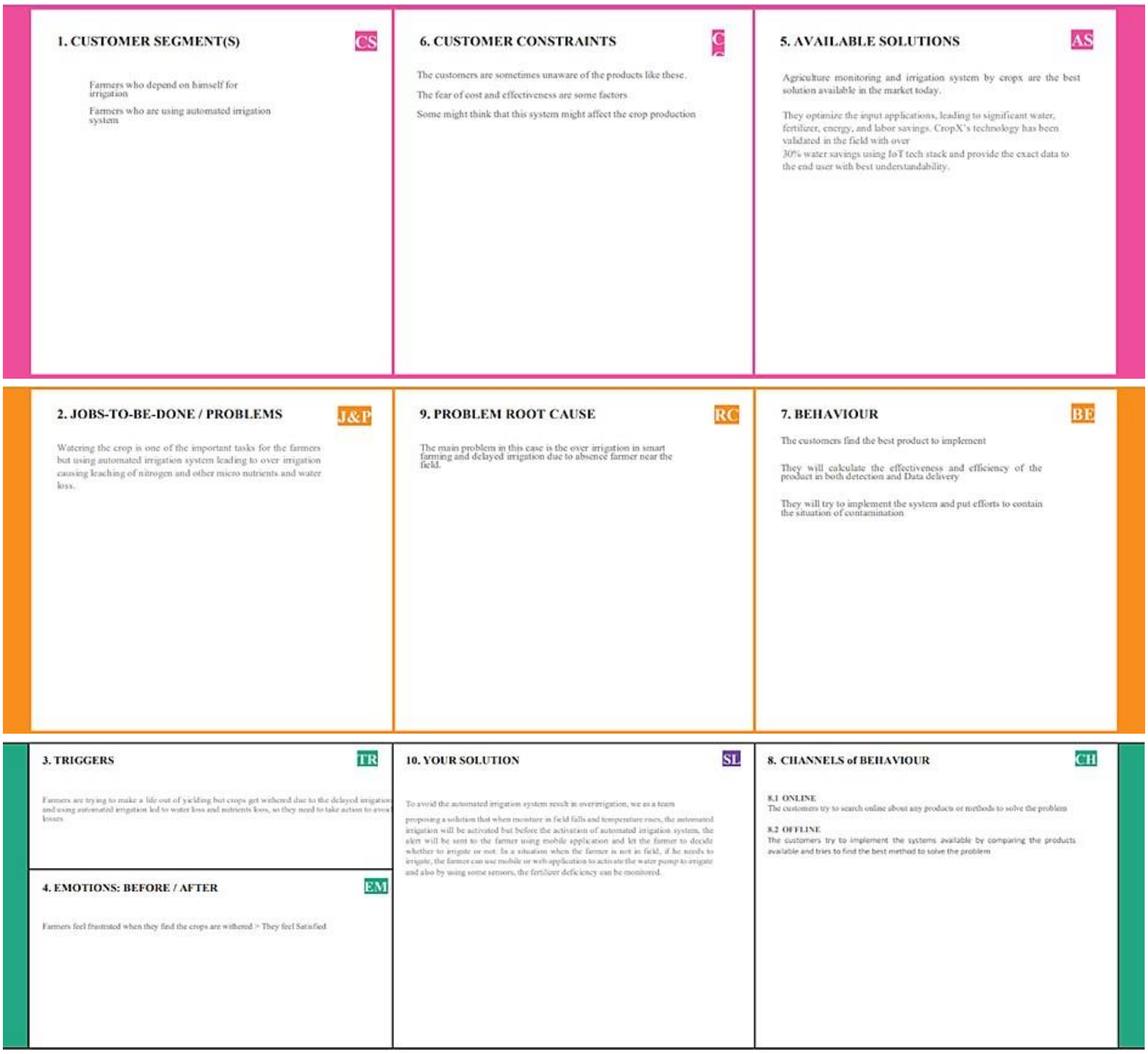


Figure 3.5. Solution Fit

CHAPTER - 4

REQUIREMENT ANALYSIS

Functional Requirements

- Gardener - Regular monitoring of field parameters
- Farmer - Control of irrigating motors

Non-Functional Requirements

Usability

User-friendly Interface to facilitate the user with easy processing. Model provides visual representation of parameters and controls over the irrigating motors.

Security

Smart Farming Application, like other computer systems, can be vulnerable to security breaches, potentially impacting the safety and effectiveness of the device

Reliability

This application will allow farmers to monitor and control the irrigation system from remote location anytime.

Performance

The process of the usage is easy and simple which allows to monitor and control with application's stability and accuracy.

Availability

The Application can used to control and monitor from anywhere at any time according to the comfortability of the farmer.

Scalability

In future upgrade of the Smart farming Application allows to be used for various types of crops in field.

CHAPTER - 5

PROJECT DESIGN

DATA FLOW DIAGRAMS

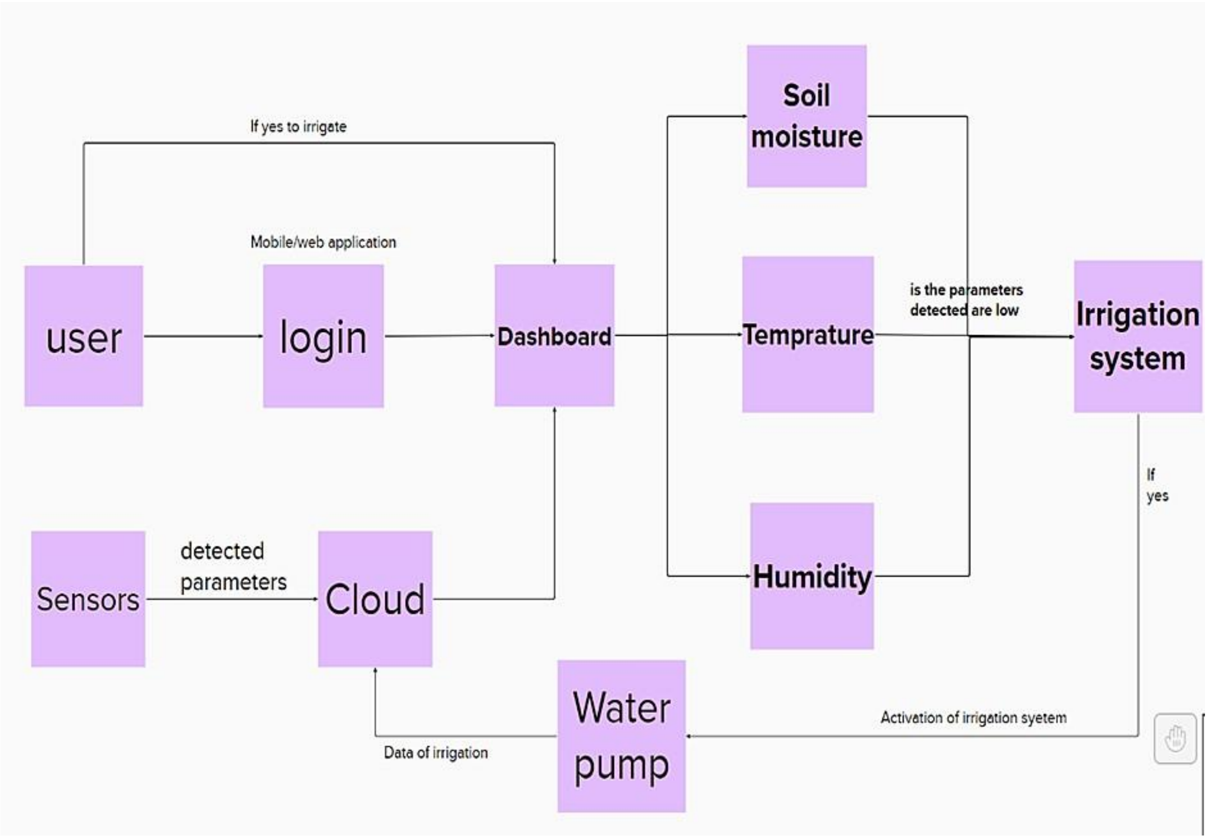


Figure 5.1. Data flow Diagram

SOLUTION AND TECHNICAL ARCHITECTURE

The solution architecture includes the components and the flow we have designed to deliver the solution.

Here, the application is planned to be designed, where the farmers can monitor the parameters of the field and the irrigating motors can controlled the help of python and API calls. By monitoring the parameter information in the application, irrigation can be done in right time from remote locations.

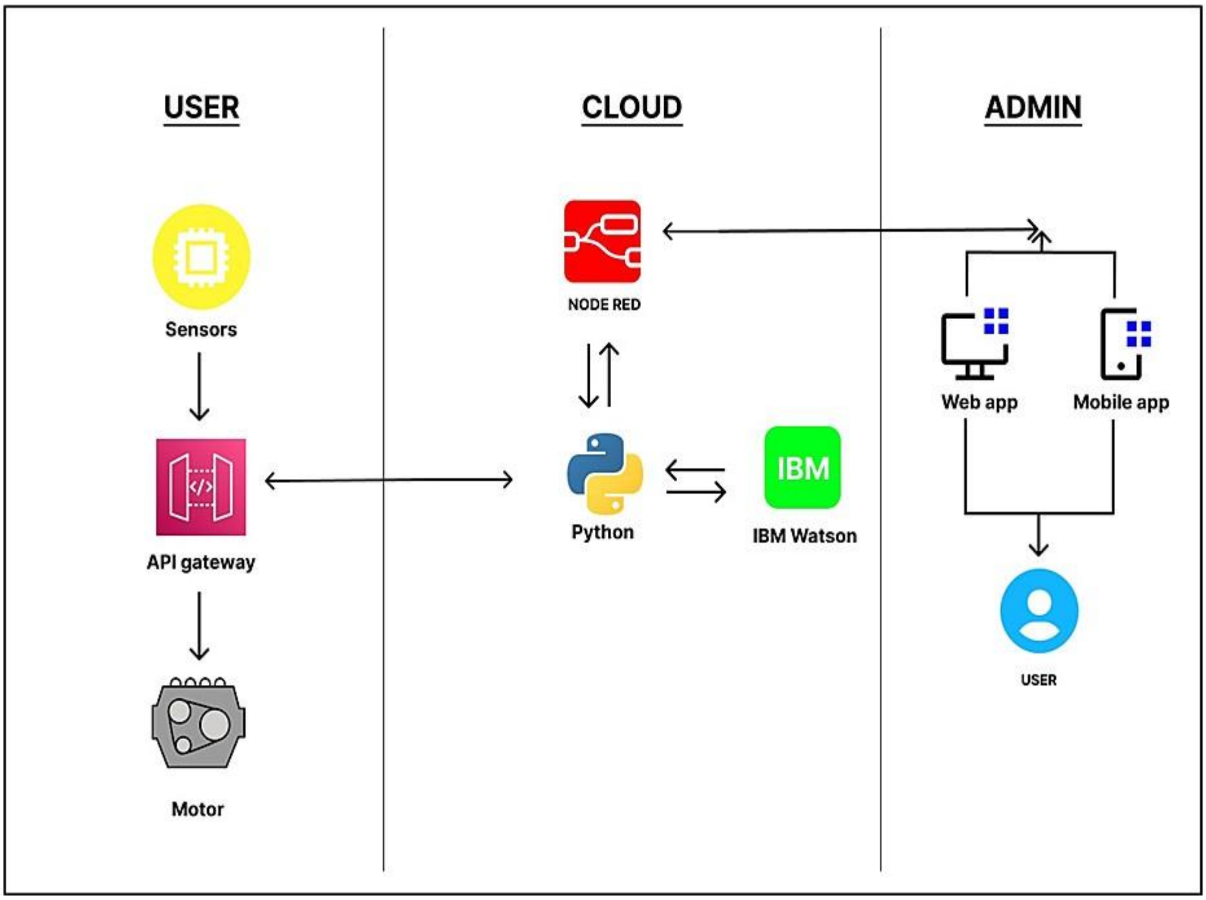


Figure 5.2. Technology Architecture

USER STORIES

Table 5.1. User Stories

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Farmer	Sensor interface	USN-1	As a user, I will receive the detected data from the field	Receiving the detected data(data generated using python random function)	Medium	Sprint-1
Nursery garden	Dashboard	USN-2	As a user, I could monitor the parameters data	Monitoring the data of the parameters in dashboard	High	Sprint-2
Houseplant	API call for controlling	USN-3	As a user, I can give a permission for the activation of the automated irrigation system	Controlling automated irrigation system	High	Sprint-3

Farmer	Mobile/web application	USN-4	As a user, I can monitor and control the field from remote location	Monitoring and control of field	Medium	Sprint-4

CHAPTER - 6

PROJECT PLANNING AND SCHEDULING

SPRINT PLANNING &

ESTIMATIONSPRINT 1

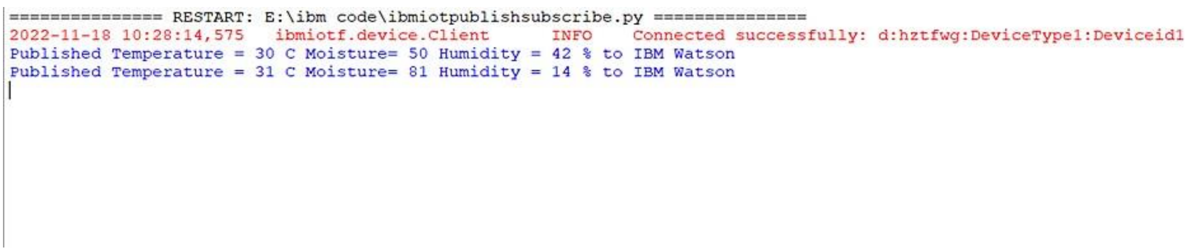
The first sprint involves the setting up of IBM IoT Watson Platform to generate the sensor data in field (Internet of Things). After that a device must be created and registered in the Watson IoT Platform. Then the device is switched on and then the senor data is fetched.

Organization ID: hztfwg

Device Type: DeviceType1

Device ID: Deviceid1

Authentication Token: X4C_j!VzrEFM3Qt43L



```
=============== RESTART: E:\ibm code\ibmiotpublishsubscribe.py ===============
2022-11-18 10:28:14,575   ibmiotf.device.Client      INFO    Connected successfully: d:hztfwg:DeviceType1:Deviceid1
Published Temperature = 30 C Moisture= 50 Humidity = 42 % to IBM Watson
Published Temperature = 31 C Moisture= 81 Humidity = 14 % to IBM Watson
```

Figure 6.1.1. python random data

SPRINT 2

In this sprint, an organization is created and registered. Then an API key is generated for the registered device. In node-red, the IBM Watson IoT Platform is connected using the API key, Device Type and Device ID. Then a msg.payload node is connected to receive the sensor data. Then the function node (soil moisture, Temperature , humidity) in Node-RED is connected with the IBM Watson platform and then the sent data is connected to the gauge in dashboard of Web UI and Mobile Application.

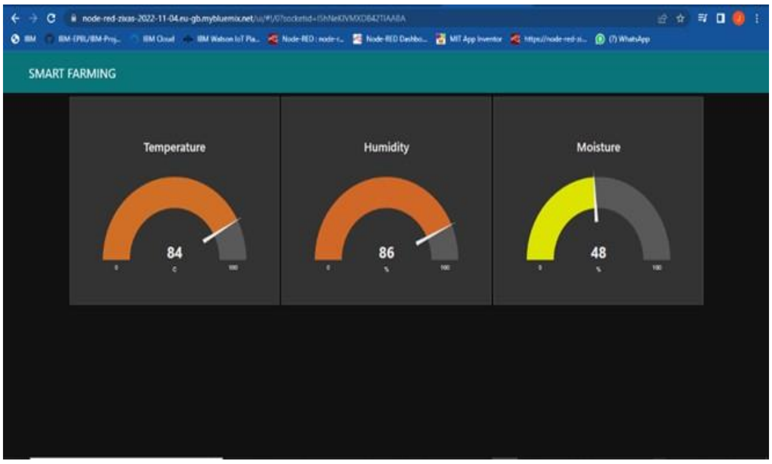


Figure 6.1.2 web dashboard

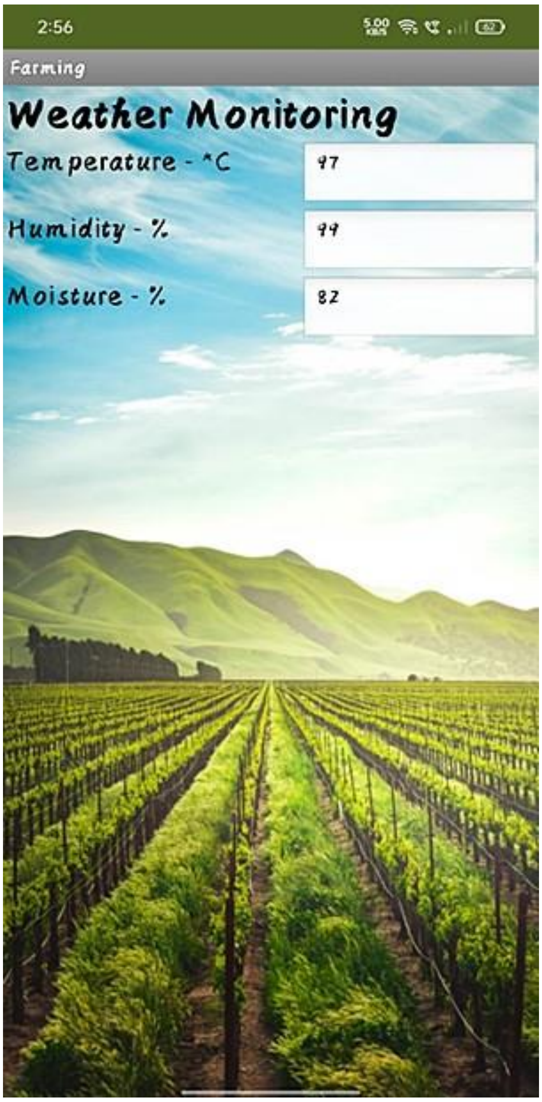


Figure 6.1.3 mobile dashboard

SPRINT 3

In Sprint 3, once the connection of gauge dashboard node is done with the function node, Then the control buttons are created to control the irrigation motors in the field.

Then the http function node and command function nodes are created and connected with cloud to get the command from the web UI and Mobile Application to control the irrigating motors.

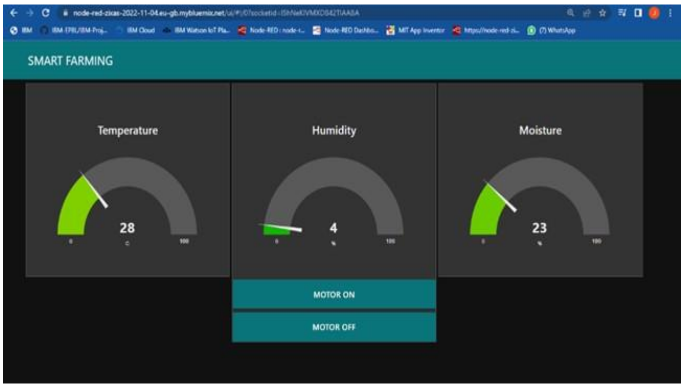


Figure 6.1.4 web dashboard

Figure 6.1.5 mobile dashboard

SPRINT 4

In this Sprint a mobile application is created using the MITAPP Inventor. In the frontend designer block, the mobile screen in which able to view the data created. Labels are created as Temperature, Humidity, Moisture. The control buttons are created to control the motors. Web 1 and a clock is created for the backend process. In the backend process: web 1 is connected with the clock1 and a url is attached (https://node-red-zixas-2022-11-04.eu-gb.mybluemix.net/ui/#!/0?socketid=C8cNlCoGvWIE4cAuAAAB).

Then web1.GotText block is created and Set.textbox.Text to is connected with lookup in tab from the list. Then a empty text boxes were created for the parameters. To get the value from the Watson a Call web1.jsonText. Decode is connected. And a get responseContent is attached. Likewise for all parameters connections are established. Then a QR code is generated, by scanning the code user can download the apk of an mobile from Mobile Application. The status of the motors can also monitored through dashboard.

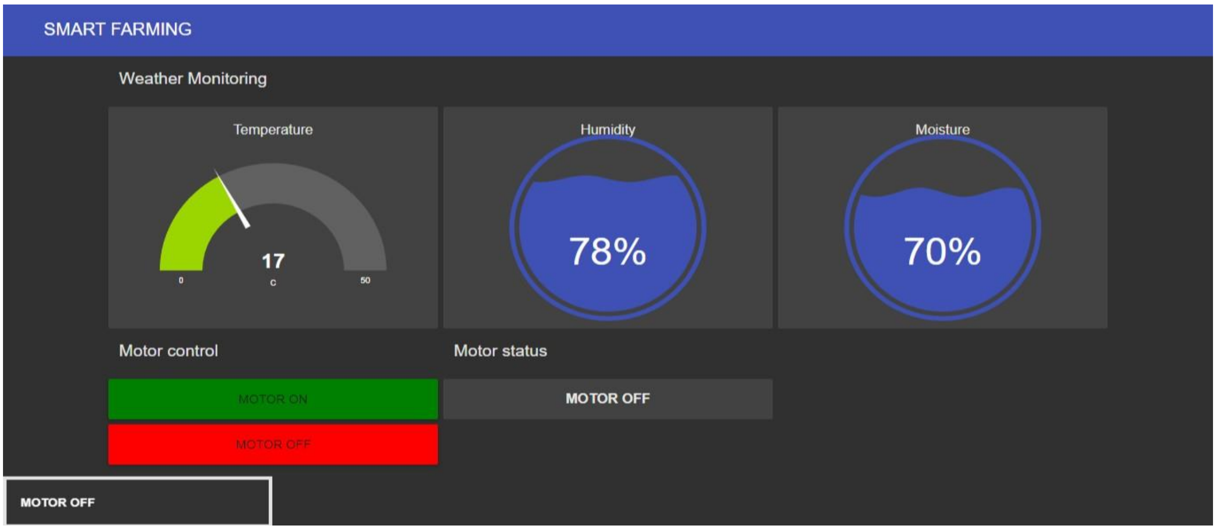


Figure 6.1.6 web dashboard(Motor Off)

Figure 6.1.7 Web dashboard(Motor On)

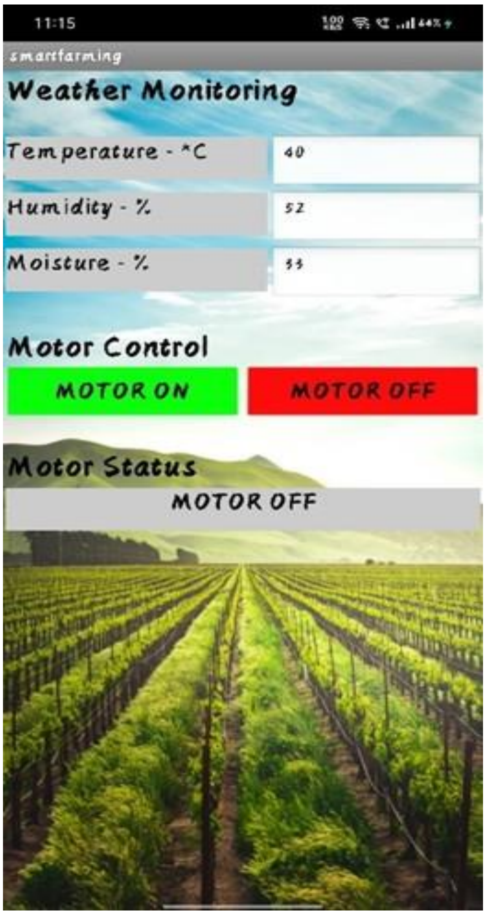


Figure 6.1.8 Mobile dashboard

SPRINT DELIVERY SCHEDULE

Table 6.1. Sprint Delivery Schedule

Sprint	Functional Requirement (Epic)	Sprint Start Date	Sprint End Date	Story Points	Team Members
Sprint- 1	Sensor data generated using Random in python	24 Oct 2022	29 Oct 2022	8	Aman Darjee
Sprint- 2	Data interface with web UI and mobile app	31 Oct 2022	05 Nov 2022	8	Mishal Rai
Sprint- 3	API for controlling	07 Nov 2022	12 Nov 2022	5	Kusen Hang Subba
Sprint- 4	Mobile and web application development	14 Nov 2022	19 Nov 2022	5	Amrit Rai

REPORTS FROM JIRA

Burndown chart

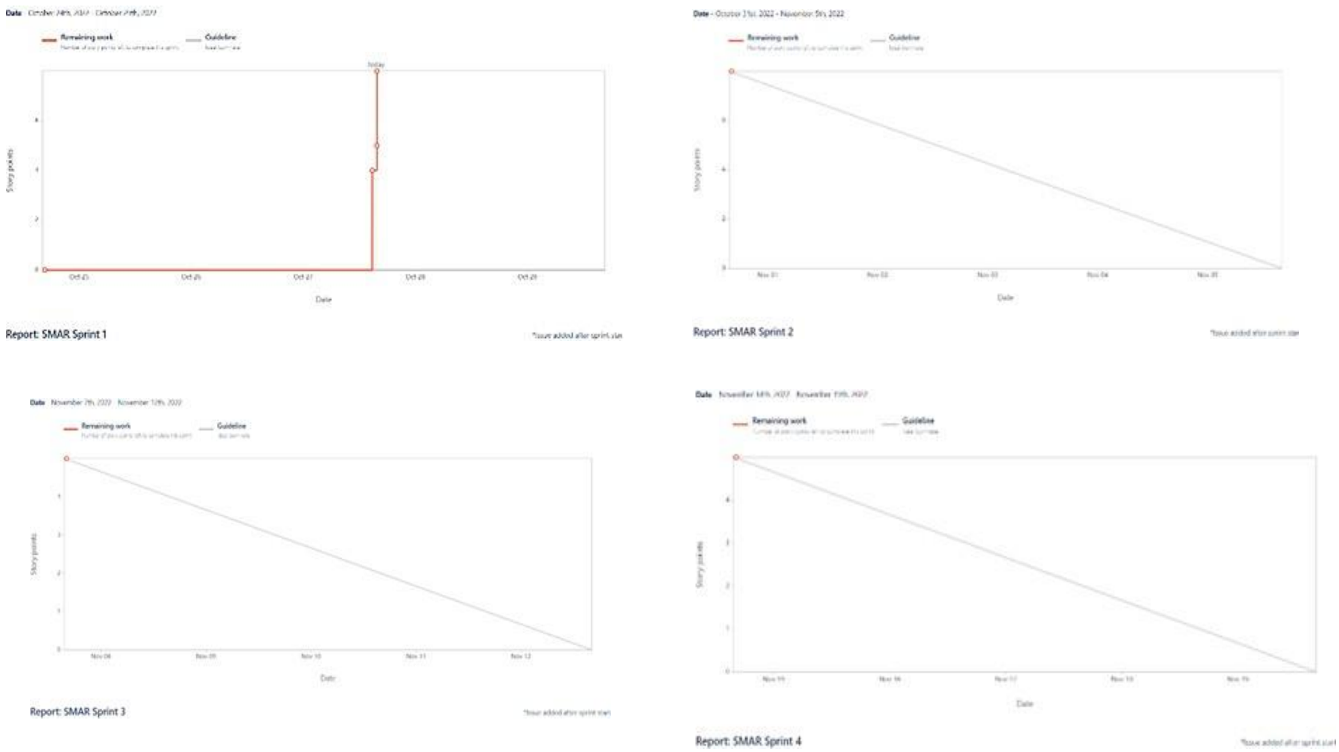


Figure 6.1. Burndown Chart

Road map

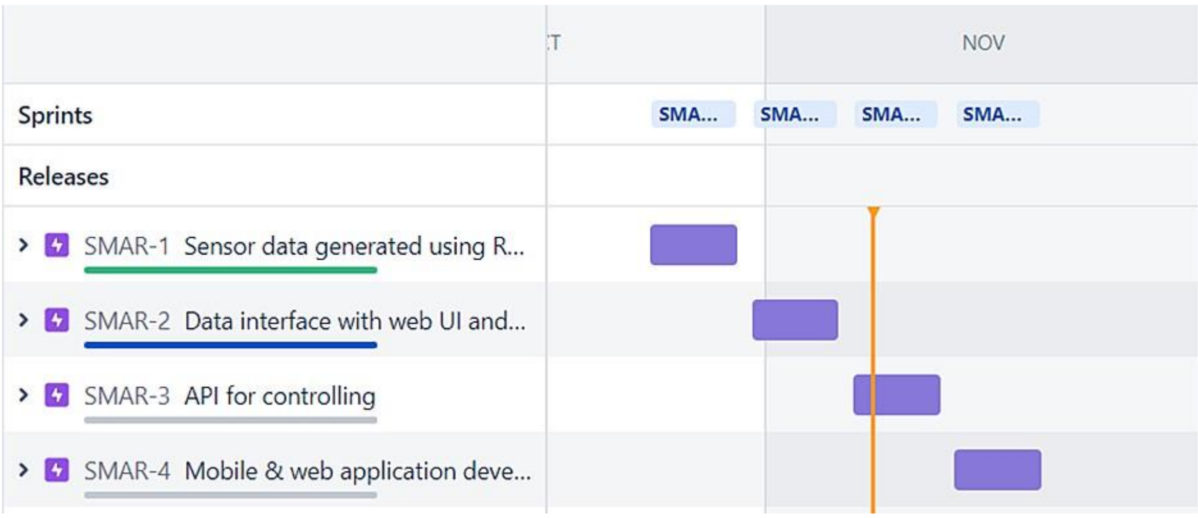


Figure 6.2. Road Map

CHAPTER - 7

CODING AND SOLUTIONS

FEATURE 1

Node-RED Supports browser-based flow editing making it user friendly, accessible and visual. It is built on Node.js, which is a none-blocking, lightweight I/O model, making it lightweight and efficient. Flows created in Node-RED are stored using JSON, and can imported and exported and shared with ease.

Features of Node-RED

Ability to run in cloud environments

Simple user interface creation

FEATURE 2

In the mobile application, the farmers shall able to monitor the parameters in the field such as Soil temperature, moisture and humidity from any locations at any time. By using this application, the farmers would be able to control the irrigation motors from anywhere so there won't be any delayed irrigation or Over-irrigation.

CHAPTER - 8

TESTING

TEST CASES

A test case might be created as an automated script to verify the functionality per the original acceptance criteria. After doing manual exploratory testing, QA testers might suggest other functionality be added to the application as well as updated test cases be incorporated in the automated test suite.

Table 8.1. Test Case

Test case ID	Feature Type	Component	Test Scenario
Watson IOT platform_TC_OO1	Random data to cloud	Python 3.7.0	Sensor data generated and sent to Watson IOT platform
Frontend_TC_OO2	Dashboard UI	Node.RED	The data should be sent from cloud to NODE and data needed to be displayed
Backend_TC_OO3	API for motor control	Node.RED	When motor controls are clicked, the controls has to be sent to cloud and from cloud to python code

Table.8.2. Test Report

Steps To Execute	Test Data	Expected Result	Status	Executed By
1.write the python code foe connection 2. enter the credentials 3.Run the code to connect with Watson platform	https://hztfwg.internetofthings.ibmcloud.com/dashboard/	Watson IOT platform receives the data generated	Pass	MIshal Rai
1.cloud configuration 2.Node-red Configuration 3. APP Route	https://node-redzixas-2022-11-04.eugb.mybluemix.net/ui/#!/0?socketid=C8cNlCoGvWIE4cAuAAAB	Data is received in Node-red and displayed in web UI and Mobile application	Pass	Aman Darjee Amrit Rai
1.Login to the dashboard 2.Click the controls	https://node-redzixas-2022-11-04.eugb.mybluemix.net/ui/#!/0?socketid=C8cNlCoGvWIE4cAuAAAB	User command has to be sent to the python from cloud by Node-RED	Pass	Kusen Hang Subba

USER ACCEPTANCE TESTING

The purpose of this document is to briefly explain the test coverage and open issues of the irrigation reminder project at the time of the release to User Acceptance Testing (UAT).

Defect Analysis

Table 8.1. Defect Analysis

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	9	3	4	1	16
Duplicate	0	0	1	2	3
External	3	3	0	1	7
Fixed	7	1	4	14	26
Not Reproduced	0	0	1	0	1
Skipped	0	0	0	1	1
Won't Fix	0	0	0	1	1
Totals	19	7	10	20	55

Test Case Analysis

Table 8.2. Test Case Analysis

Section	Total Cases	Not Tested	Fail	Pass
Sensor data generation	3	0	0	3
Watson platform connection	4	0	0	4
Node-RED	5	0	0	5
Sensor Interface	4	0	0	4
API for control	6	0	0	6
Motor status	6	0	0	6

CHAPTER - 9

RESULTS

Performance

MetricsNFT -

Detailed Test Plan

Table 9.1. NFT - Detailed Test Plan

S.No	Project Overview	NFT Test approach	Assumptions/Dependencies/Risks	Approvals/Sign Off
1	Smart farming Web -UI	Stress	App Crash/ Developer team/ Site Down	Approved
2	Smart farming mobile application	Load	Server Crash/ Developer team/ Server Down	Approved

End Of Test Report

Table 9.2. End Of Test Report

Project Overview	NFT Test approach	NFR - Met	GO/NO-GO decision	Identified Defects	Approvals/ Sign Off
Smart farming Web -UI	Stress	Performance	GO	Closed	Approved
Smart farming mobile application	Load	Scalability	NO-GO	Closed	Approved

CHAPTER - 10

ADVANTAGES AND DISADVANTAGES

ADVANTAGES

1. IOT makes it possible to avoid challenges and removes all issues that may arise during the farming process thus the quantity of the product is growing and customers get a good product of High quality.

2. IOT system helps to continuously monitor land so that precautions can be taken at an early stage it increases productivity, reduces manual work, and farming efficient.

3. By using IOT crop maintenance can be easily done to observe the growth of the crop.

4. Increase in agricultural productivity.

5. These sensors are equipped with wireless chips so that they can be controlled remotely.

6. They are easy to operate and use and easy to maintain.

DISADVANTAGES

7. IOT smart crop needs availability on the Internet continuously, the rural part of the developing countries did not fulfill these requirements and the Internet is slower.

8. 2. The IOT-based equipment required the farmer to understand and learn the use of technology. This is the main challenge in adopting smart agriculture framing at a large scale across the continues.

CHAPTER - 11

CONCLUSION

With the incorporation of the WSN&IOT, we can upgrade the agriculture farm. These systems enable to check the quality of the soil and the growth of the crop in soil and with these system farmers are able to solve irrigation problems, temperature problems, humidity problems, etc. The availability of sensors for the agricultural parameters and micro-controllers can be easily interfaced with each other and with the help of Internet of Things, wireless sensor networks communication the challenges encountered by the farmers can also be reduced and a better communication path for the transfer of useful data can be achieved between various nodes. Farmers are able to control various equipment's related to agricultural and monitor their crop on Smartphone or on computers. These systems offer a high application area to the users to improve their skill and output of the crops in better way. Using these system helps to increase the Rice, wheat and maize and other agricultural production . IOT capable to control the condition of the yield and growth, it can also able to check soil, temperature, humidity, etc. with help of IoT.

CHAPTER - 12

FUTURE SCOPE

In the future, there will be a large scope for this system. Various sensors used to collect the information from field and transmitted it through GSM. This project can be further enhanced by a wireless sensor network.

We can use various type of sensors like finding the moisture, Humidity and Temperature of the soil. These sensors gather information that is useful to the farmers and can be conscious of the farmland from any place in the world.

This project can be enhanced by using data of individual crops to adopt the monitoring system based on the type of crop planted in field.

CHAPTER - 13

APPENDIX

SOURCE CODE

```
import time
 import os
import datetime
 import wiotp.sdk.device
import random

organization = "hztfwg" deviceType =
"DeviceType1" deviceId =
"Deviceid1" authMethod = "token"
authToken = "12345678"

deviceOptions = {"org": organization, "type": deviceType, "id": deviceId,
"auth-method": authMethod, "auth-token": authToken}
deviceCli = ibmiotf.device.Client(deviceOptions)
deviceCli.connect()


def myCommandCallback(cmd):
        print("Message  received      from  Ibm    IOT   Platform:    %s"    %
cmd.data['command'])
        m=cmd.data['command']
    if(m=="motor on"):
```

```
        print("motor is Switched
on")     elif(m=="motor off"):
print("motor is off")     print(" ")

while True:
          soil =random.randint(5,100)
          temp =random.randint(15,50)
          hum =random.randint(10,100)
           myData={'soil_moisture': soil,'temperature':
temp,'humidity':hum}

def myOnPublishCallback():
          print ("Published Temperature = %s C" % temp,"Moisture= %s" % soil
"Humidity = %s %%" % hum, "to IBM Watson")
          success    =    deviceCli.publishEvent("event_1",    "json",    data=myData,
qos=0, on_publish=myOnPublishCallback)
          if not success:
                    print("Not connected to IoTF")
                    time.sleep(10)
                    deviceCli.commandCallback = myCommandCallback
deviceCli.disconnect()
```

SCREENSHOTS

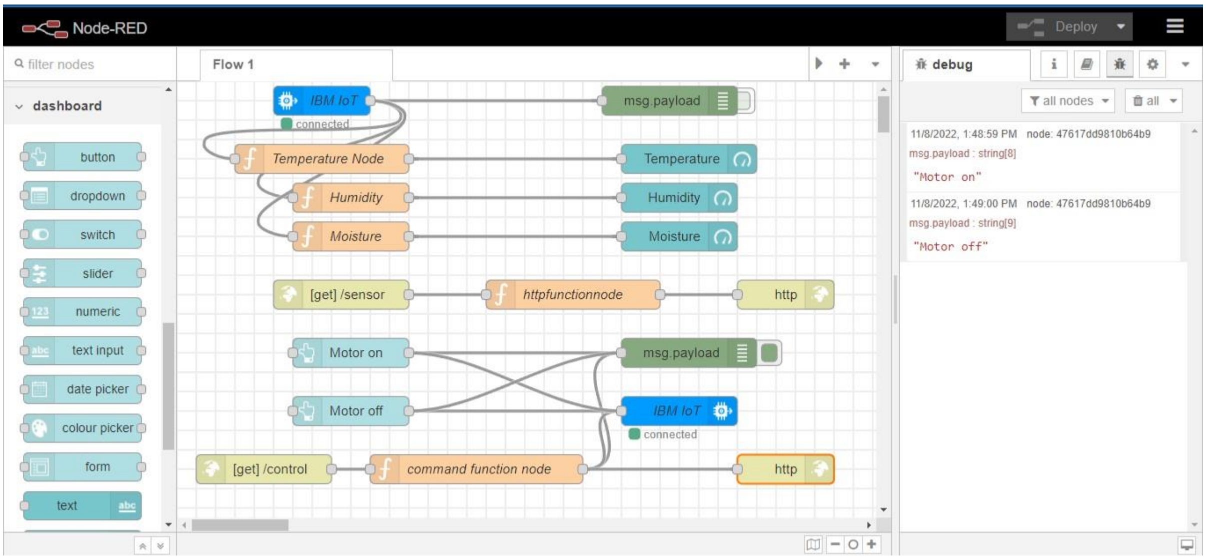


Figure.13.2.1. Node red

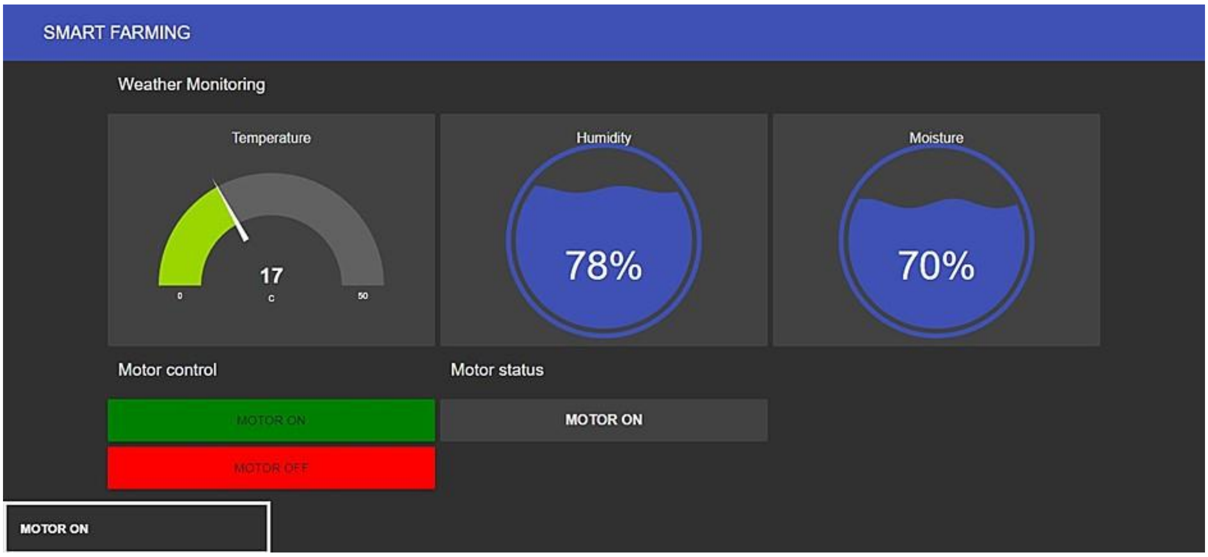


Figure.13.2.2. Dashboard UI (motor on)

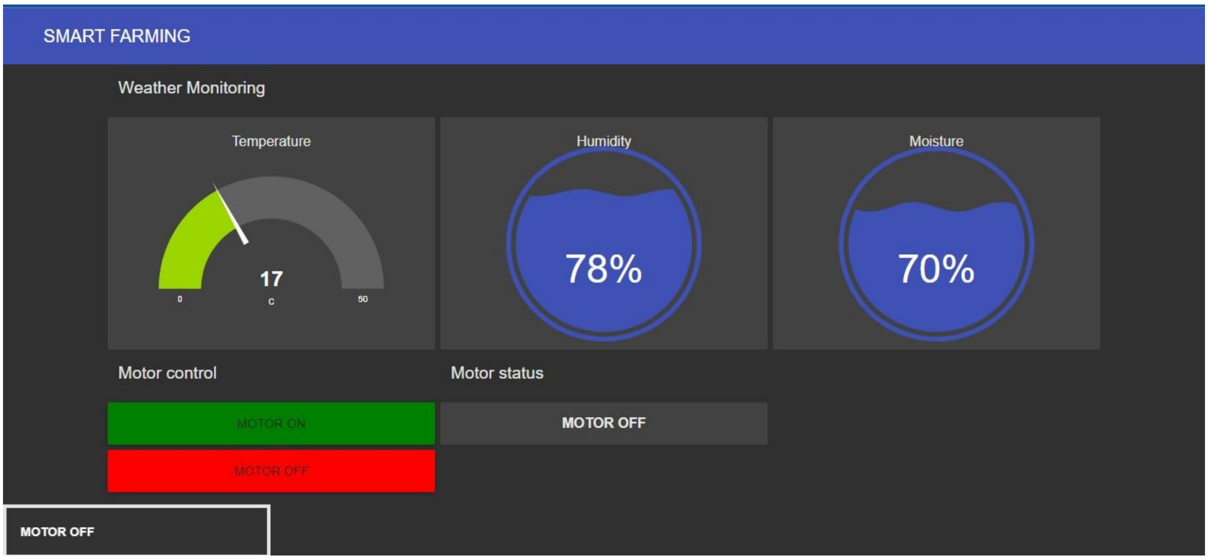


Figure.13.2.3. Dashboard UI(motor off)

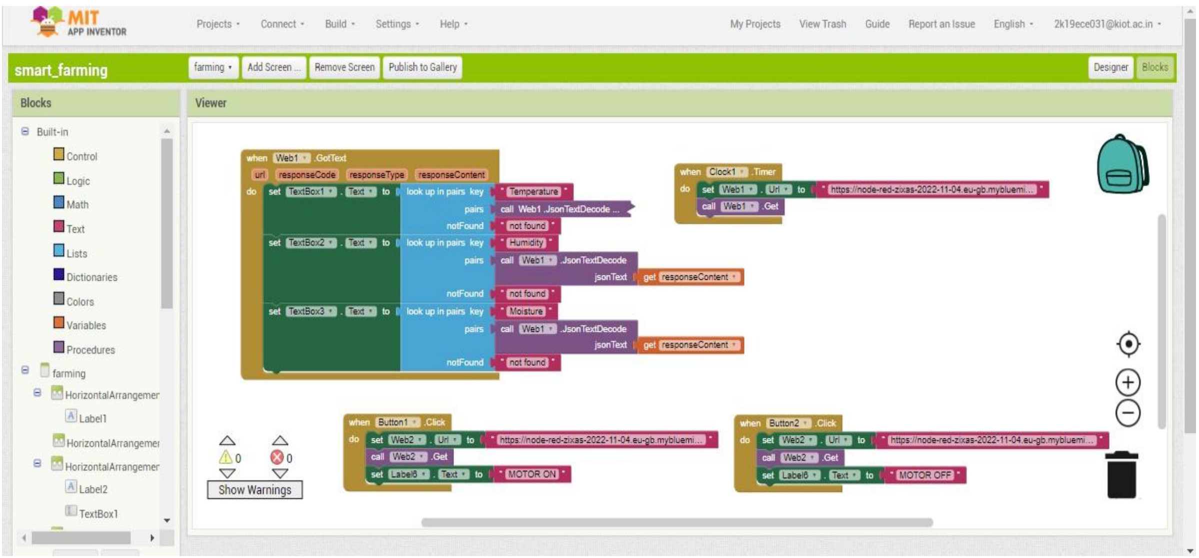


Figure.13.2.3. Mobile application's backend

GITHUB AND PROJECT DEMO LINK

1.	GITHUB	" https://github.com/IBM-EPBL/IBM-Project-5699-1658813239"
2.	PROJECT DEMONSTRATION LINK	" https://youtu.be/z2diIoGIRm0"