Project Report Format

Team ID	PNT2022TMID46404
Project Name	Smart Farmer – IoT Enabled Smart Farming Application

1. INTRODUCTION

1.1 Project Overview

Smart Farming System is an emerging concept which utilizes sensors in the field enabled through IoT to get live data from the farm. 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

Smart farming is a management concept focused on providing the agricultural industry with the infrastructure to leverage advanced technology – including cloud and the internet of things (IoT) – for tracking, monitoring, automating and analysing operations.

IoT based Smart Farming improves the entire Agriculture system by monitoring the field in real-time. With the help of sensors and interconnectivity, the Internet of Things in Agriculture has not only saved the time of the farmers but has also reduced the extravagant use of resources such as Water and Electricity.

2. LITERATURE SURVEY

2.1 Existing problem

1. He is a farmer who is trying to know what kind of fertilizer he has to use but he can’t able to predict the appropriate fertilizer because of the soil condition which makes him worry.

2. Another farmer is trying to monitor the crop anywhere and anytime but he can’t able to spend full time in the land because he has to do the daily routine which makes him unclear.

3. A new farmer is trying to monitor to cultivate a new crop in his land but he doesn’t know the soil condition because he don’t have a clear knowledge

about cultivation which makes him doubtful.

2.2 References

1. Harika Pendyala, Ganesh Kumar Rodda, Anooja Mamidi, Madhavi Vangala - International journal of Scientific Engineering and Research (IJSR) - Iot Smart Agriculture Monitoring System.

2. M.Manoi Venkata sai, K.Subba Rao - Iconic Research and Engineering journals(IRE) - Iot Based smart agriculture.

3. Dr.Sanjay, N.Patil, MadhuriB.jadha v - International Journal of Advanced Research in Computer and Communication Engineering (IJARCCE) - Smart Agriculture Monitoring System using IoT.

4. Priyadharsnee.K, Dr.S.Rathi - International Journal of scientific and Engineering Research - An Iot Based Smart Irrigation System.

5. Muthunoori Naresh, P Munaswamy - International Journal of Recent Technology and Engineering (IJRTE) - Agriculture System using IoT Technology.

6. S. Nalini Durga, M Ramakrishna - International Research Journal of Engineering Technology (IRJET) - Smart Irrigation System Based on Soil Moisture using IoT.

7. Wafa Difallah, Khelifa Benahmed, Fateh Bounama, Belka cem, Ahmed Saaidi - International Journal of Advanced Computer Science and Application - Intelligent Irrigation Manage System.

8. Tigist Hilemariam senbetu,Kishore Kumar K,G.M.Karpura Dheepan - International Journal of Innovative Technology and Exploring Engineering (IJITEE) - IoT Based Irrigation Remote Real-Time Monitoring And Controlling Systems.

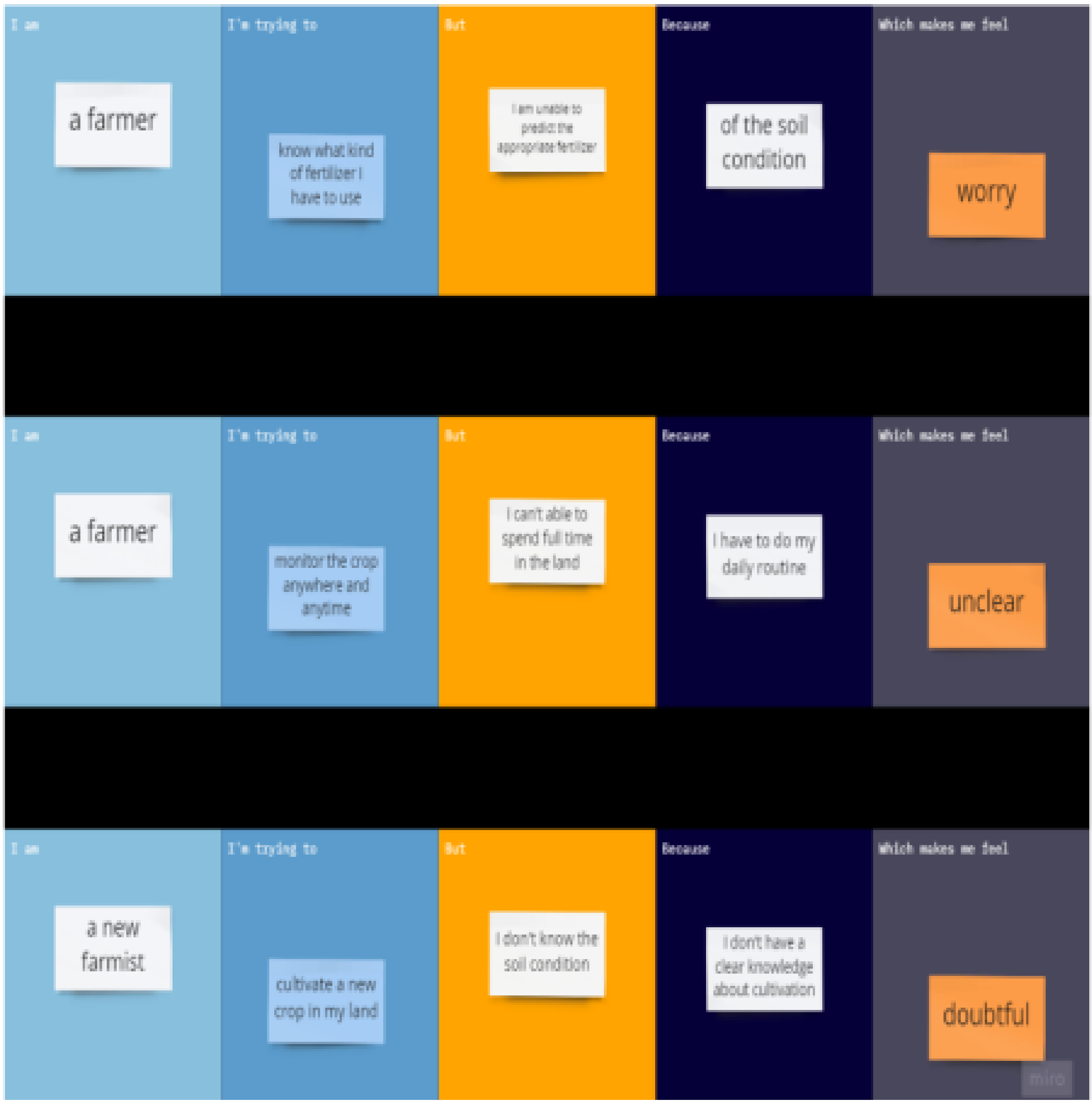
9. Adithya Vadapalli, Swapna Peravali and Venkata Rao Dadi - International Journal of advance Research in science and Engineering - Smart Agriculture System using IoT Technology.

10. Ritika Srivastava, Vandana Sharma, Vishal Jaiswal, Sumit Raj - International Research Journal of Engineering and Technology - A Research paper on Smart Agriculture using IoT.

https://www.wipro.com/analytics/smart-farming-powered-by-analytics/
https://www.ibm.com/case-studies/ifarming-watson-cloud

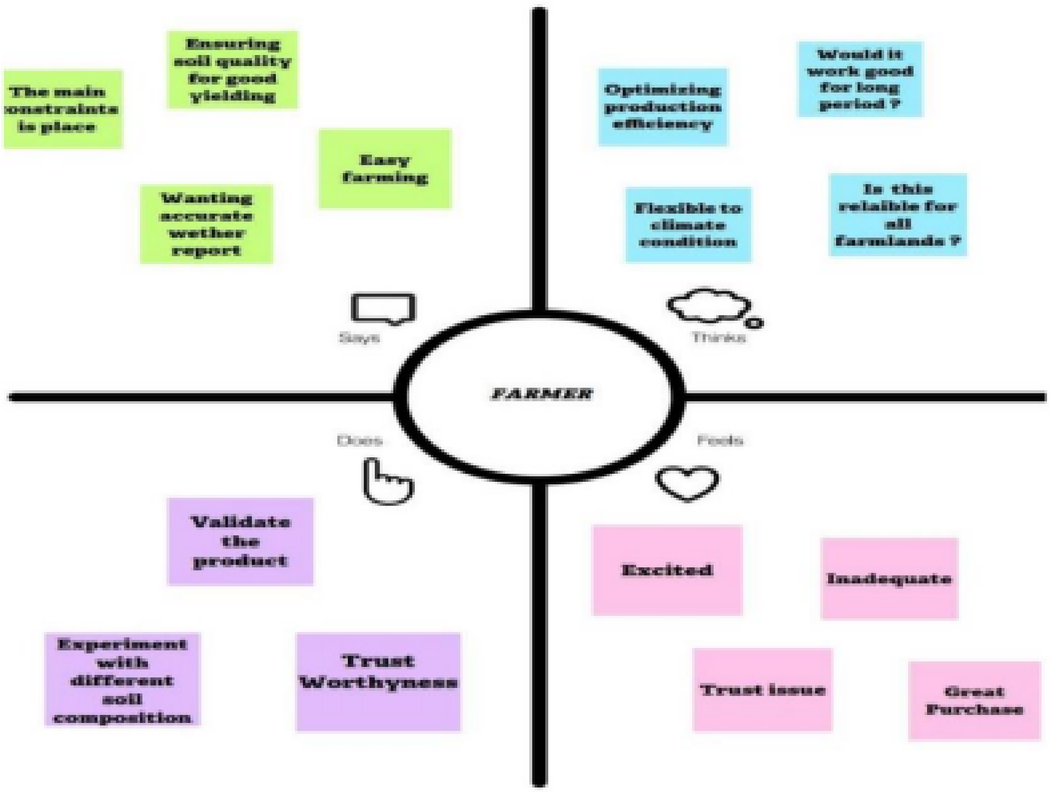
2.3 Problem Statement Definition

Farmers are to be present at farm for its maintenance irrespective of the weather conditions. They have to ensure that the crops are well watered and the farm status is monitored by them physically. Farmer have to stay most of the time in field in order to get a good yield. In difficult times like in the presence of pandemic also they have to work hard in their fields risking their lives to provide food for the country.



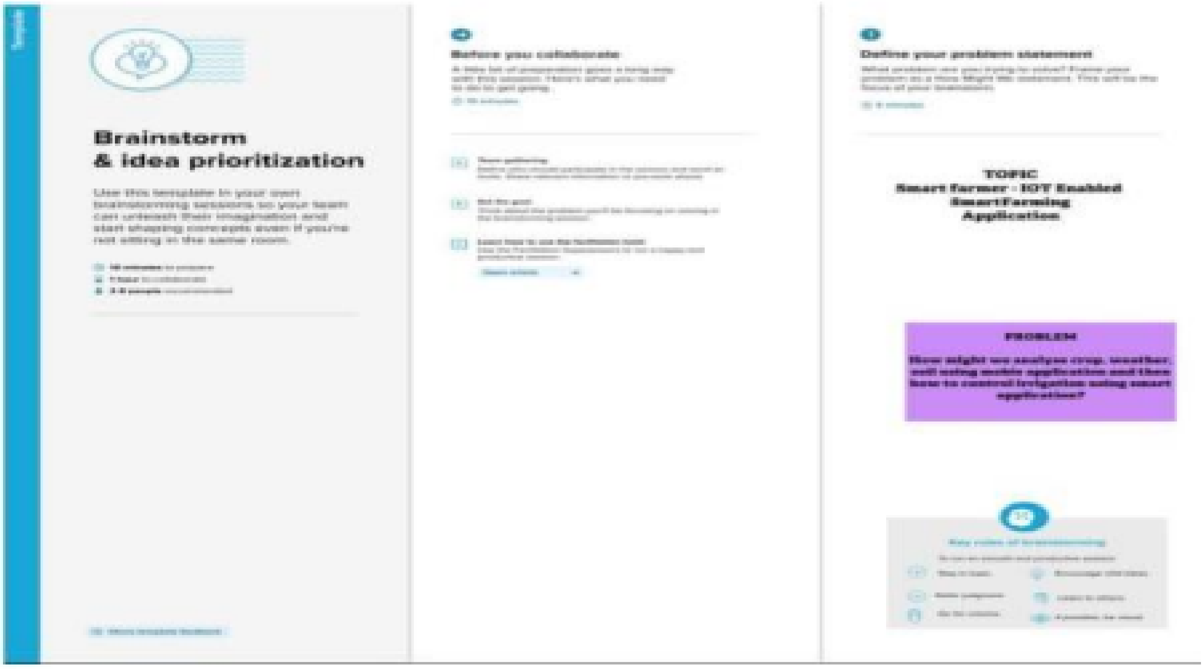
3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas

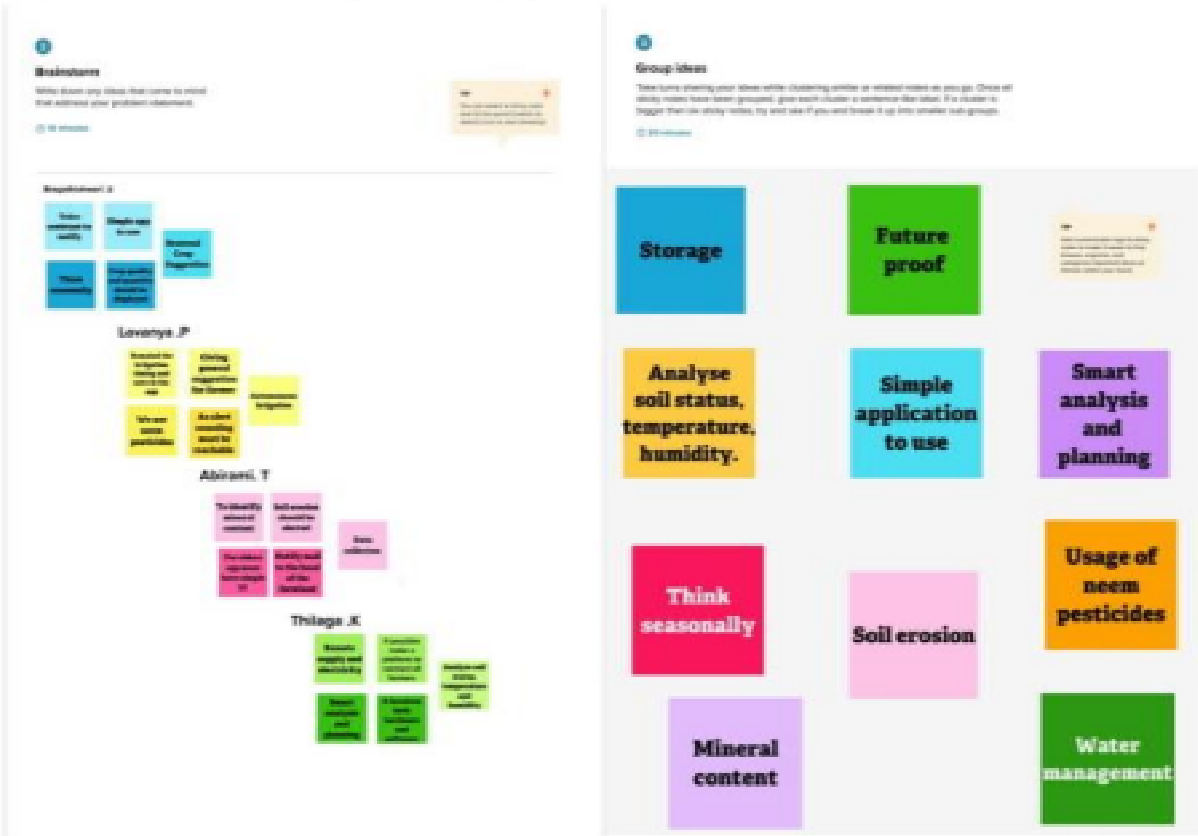


3.2 Ideation & Brainstorming

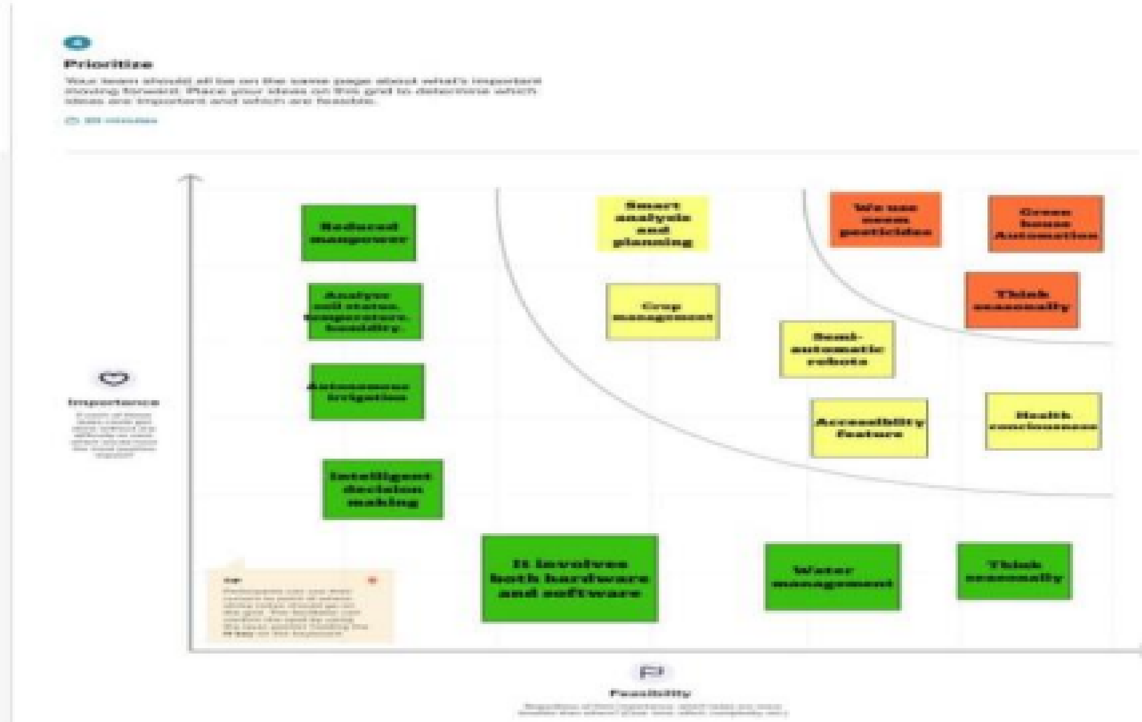
Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step-2: Brainstorm, Idea Listing and Grouping



Step-3: Idea Prioritization



3.3 Proposed Solution

Project team shall fill the following information in proposed solution template.

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	❖ Smart faming solves the monitoring problem by enabling the remote monitoring feature that enables to increase yield and quality of product. ❖ Smart irrigation help to remotely control irrigation that pumps according to the crop water requirements.
2.	Idea / Solution description	❖ Farmers can monitor all the sensor parameters by using a web or mobile applications to get data about condition of crop, soil, climate. ❖ Warn the farmer regarding any undesirable change in the weather condition and suggest pre-emptive measures.
3.	Novelty / Uniqueness	❖ Low cost system. ❖ Improving crop quality of regulating the parameters to the optimum levels. ❖ Alert message. ❖ Remote access.
4.	Social Impact / Customer Satisfaction	❖ Doubles the farmer income. ❖ Higher production. ❖ Food security.
5.	Business Model (Revenue Model)	❖ Government Driven Models. ❖ Community / Contract farming Models. ❖ Health services.
6.	Scalability of the Solution	❖ Smart farming uses modern technology to increase the quality and quantity of agricultural products. ❖ Sensors are relatively in expensive and the installation of set up is very easy. ❖ Improve internet connectivity in rural areas.

Problem Statement:

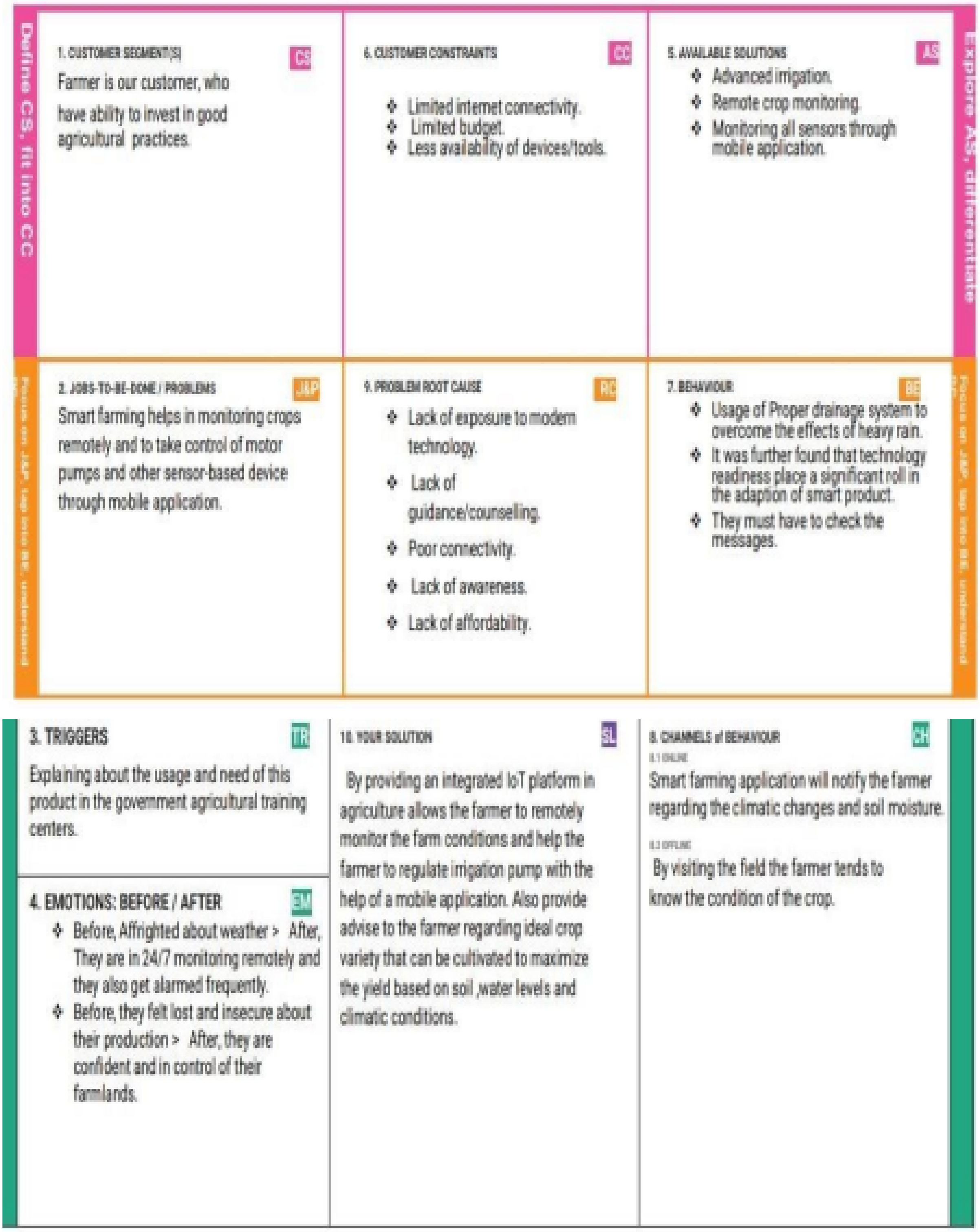
This is the project from the motivation of the farmers working in the farm lands are solely dependent on the rains and bore wells for irrigation of their land. In recent times, the farmers have been using irrigation technique through the manual control in which the farmers irrigate the land at regular intervals by turning the water-pump ON/OFF when required. Moreover, for the power indication they are glowing a single bulb between any one of phase and neutral, meanwhile when there is any phase deduction occurs in other phases, the farmer cannot know their supply is low. If they Switch ON any of the motor, there will be the sudden defuse in motor circuit. They may have to travel so far for SWITCHING ON/OFF the motor. They may be suffering from hot Sun, rain and night time too. After reaching their farm, they found that there is no power, so they quietly disappointed to it!! Is there any solution for it??? Let's check our solution.

Idea / Solution description:

This project presents proposed model for Smart Agriculture to develop real time monitoring system for soil properties like Temperature, Humidity and moisture. It will also be possible to control various operations of the field remotely from anywhere, anytime by mobile as well as web application. The IOT based agricultural monitoring system has been used to maximize the yield of crop by monitoring the environmental parameters and thus providing the required information to farmer remotely.

This system can be implemented in any type of agricultural field with varying soils. The proposed system is developed for the goodwill of farmers. The system greatly reduces the human interaction, labour cost and wastage of water. Threshold values for climatic conditions like humidity, temperature, moisture can be fixed based on the environmental conditions of that particular region. This system generates irrigation schedule based on the sensed real time data from field and data from the weather repository.

3.4 Problem Solution fit



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 E-MAIL: Enter email address PASSWORD: Enter password
FR-2	User Confirmation	❖ Confirmation via Email ❖ Confirmation via OTP
FR-3	IBM Cloud services configuration	❖ Create IBM Watson IoT platform. ❖ Create a device &configure the IBM IoT platform. ❖ Crete node-RED service. ❖ Create a database in cloudant DB to store all the sensor parameters.
FR-4	Manage Modules	❖ Manage roles of user. ❖ Manage user permission.
FR-5	Data Management	❖ Manage the data of weather condition. ❖ Manage the data of crop condition.
FR-6	Mobile Application Requirements	❖ The mobile app should have the following features ❖ Display the sensor parameters ❖ Should communicate with the IBM cloud using API to get the sensor data and send the commands.

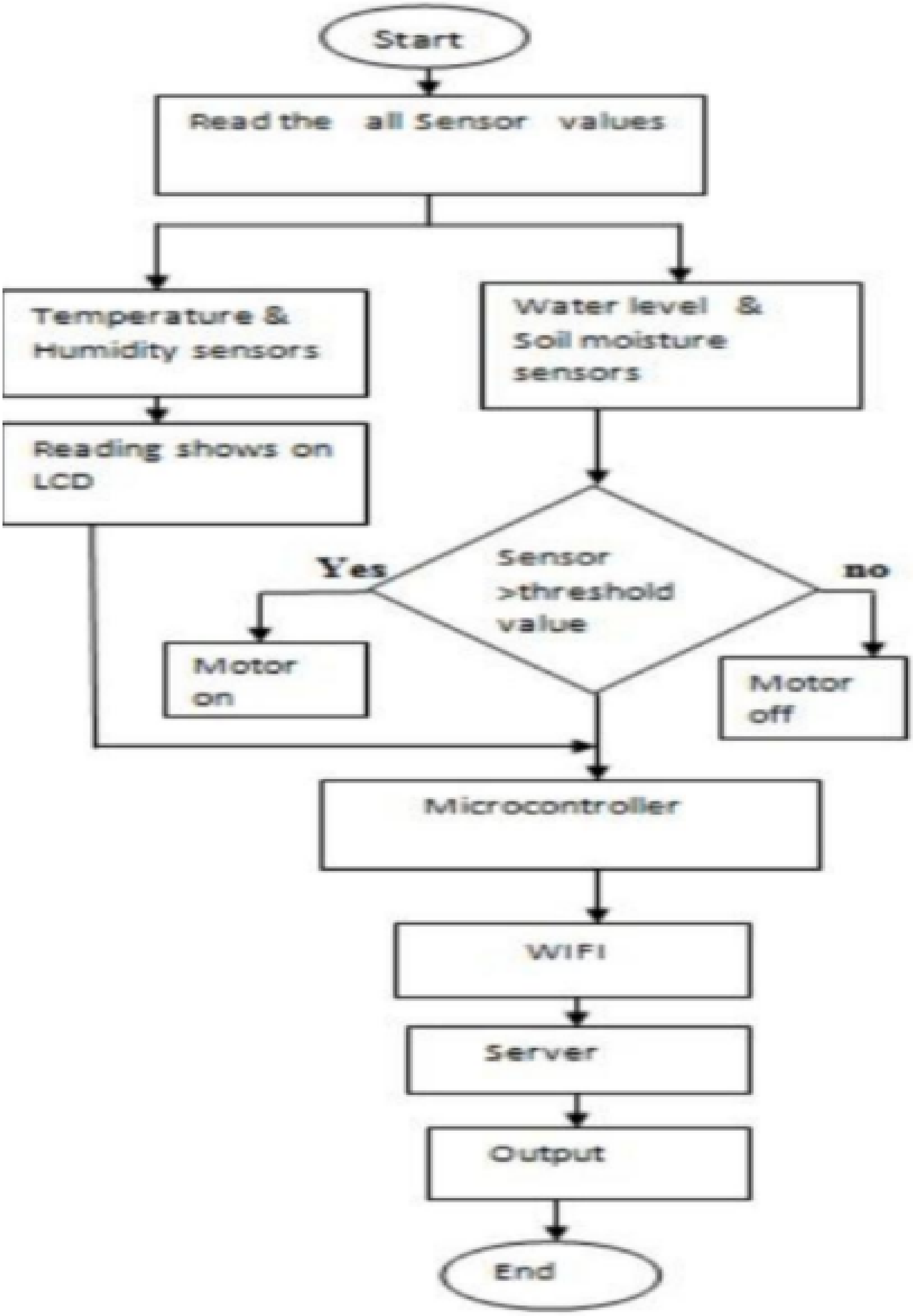
4.2 Non-Functional requirements

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

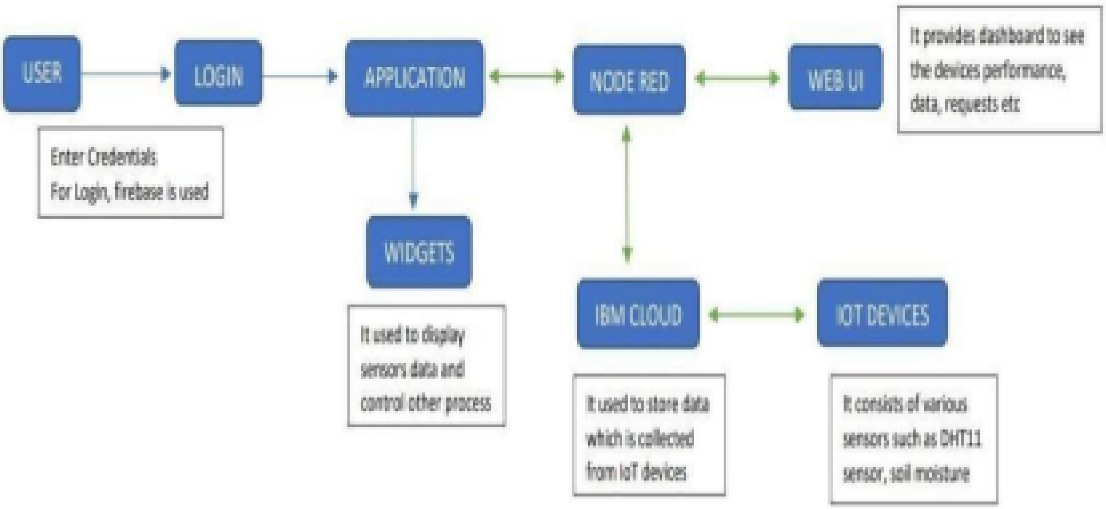
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	❖ User friendly guidelines for users to avail the features. ❖ Most simplistic user interface for ease of use.
NFR-2	**Security**	❖ All the details about the user are protected from unauthorized access. ❖ Detection and identification of any malfunction of sensors.
NFR-3	**Reliability**	❖ It is used for remote monitoring, It can be used in cases where a single farmer is managing the entire farm. ❖ Data should be more accurate and should not be misleading.
NFR-4	**Performance**	❖ The use of modern technology solutions helps to achieve the maximum performances thus resulting in better quality and quantity yields.
NFR-5	**Availability**	❖ It should monitor water level, temperature, humidity and soil moisture. ❖ This app is available for all platforms
NFR-6	**Scalability**	❖ Scalability refers to the ability to increase available resources and system. ❖ It should be made used in remote areas where technological advancements have not even been raised and should deliver a more productive and sustainable form of agriculture.

5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2 Solution & Technical Architecture



5.3 User Stories

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority
Customer (Mobile user)	Download the database	USN-1	As a user, I can register for the application by entering my email, mobile, password and conforming my password.	I can access my account / dashboard.	High
	Acknowledgement	USN-2	As a user, I will receive confirmation email once I have registered for the application.	I can receive confirmation email & click confirm.	High
	Register	USN-3	As a user, I can register for the application through email, password and conforming the password.	I can register & access the dashboard with Facebook Login.	Low
	Login	USN-4	As a user, I can log into the application by entering email & password.	I can login by using the credentials which I used above while registering.	High
	Dashboard	USN-5	As a user, I can open the dashboard and monitor the activity in the farm land.	I can login by using the credentials.	High
Customer (Web user)	The functional requirements are same as mobile user	USN-6	Web user provides the user friendly platform to access and monitor the functionalities in the farm.	I can login by using the credentials.	High
Customer Care Executive	The functional requirements are user friendly.	USN-7	As a user, if we face any technical issue we can receive the details and can log to monitor the farm.	I can login by any device.	Low

6. PROJECT PLANNING & SCHEDULING

6.1 Sprint Planning & Estimation

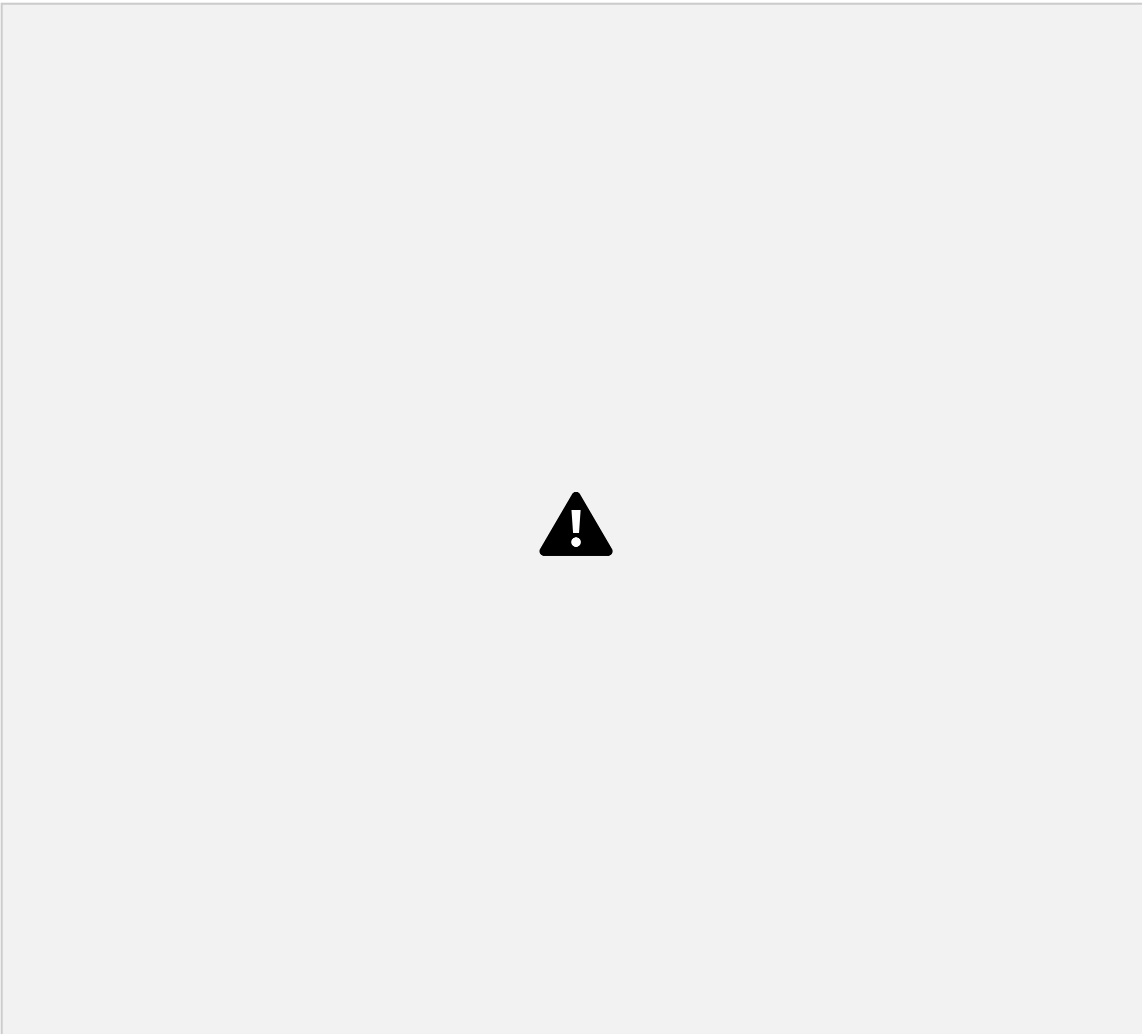
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	05 Oct 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022	20	12 Oct 2022
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022	20	15 Oct 2022

Velocity:

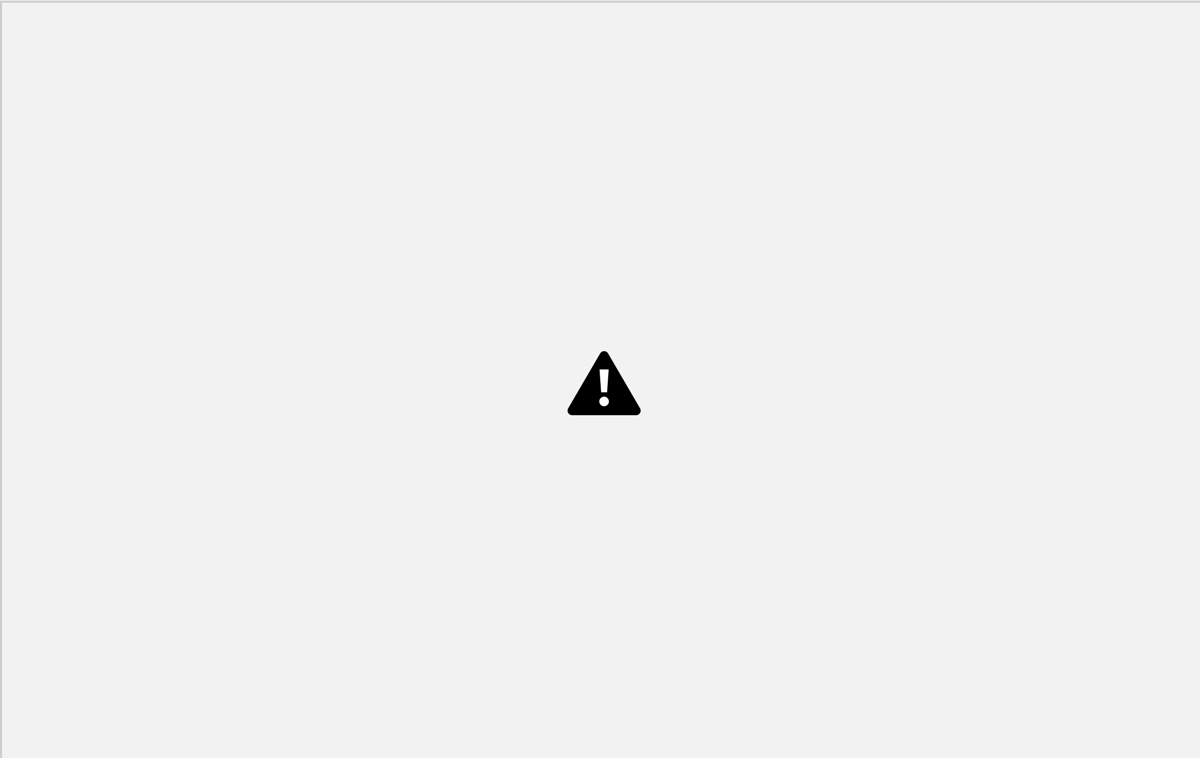
Imagine we have a 10-day sprint duration, and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity (AV) per iteration unit (story points per day)

$$AV = \frac{sprint\ duration}{velocity} = \frac{20}{10} = 2$$

6.2 Sprint Delivery Schedule



6.3 Reports from JIRA



7. CODING & SOLUTIONING

7.1 Feature 1

```
#include <WiFi.h>//library for wifi
#include <PubSubClient.h>//library for MQtt
#include "DHT.h"// Library for dht11
#define DHTPIN 15 // what pin we're connected to
#define DHTTYPE DHT22 // define type of sensor DHT 11
#define LED 2

DHT dht (DHTPIN, DHTTYPE);// creating the instance by passing pin and typr of
dht connected

void callback(char* subscribetopic, byte* payload, unsigned int
payloadLength);

//-------credentials of IBM Accounts------

#define ORG "4tot8b"//IBM ORGANITION ID
#define DEVICE_TYPE "smart_farming"//Device type mentioned in ibm watson IOT
Platform
#define DEVICE_ID "farm_today"//Device ID mentioned in ibm watson IOT
Platform #define TOKEN "oiJYpRYqYNUC" //Token
String data3;
float h, t;
//-------- Customise the above values --------
char server[] = ORG ".messaging.internetofthings.ibmcloud.com";// Server
Name char publishTopic[] = "iot-2/evt/Data/fmt/json";// topic name and type
of  event perform and format in which data to be send
char subscribetopic[] = "iot-2/cmd/command/fmt/String";// cmd REPRESENT
command type AND COMMAND IS TEST OF FORMAT STRING
char authMethod[] = "use-token-auth";// authentication
```

```
method char token[] = TOKEN;
char clientId[] = "d:" ORG ":" DEVICE_TYPE ":" DEVICE_ID;//client id


//-----------------------------------------
WiFiClient wifiClient; // creating the instance for wificlient
PubSubClient client(server, 1883, callback ,wifiClient); //calling the
predefined client id by passing parameter like server id,portand
wificredential


void setup()// configureing the ESP32
{
  Serial.begin(115200);
  dht.begin();
  pinMode(LED,OUTPUT);
  delay(10);
  Serial.println();
  wificonnect();
  mqttconnect();
}

void loop()// Recursive Function
{

  h = dht.readHumidity();
  t = dht.readTemperature();
  Serial.print("temp:");
  Serial.println(t);
  Serial.print("Humid:");
  Serial.println(h);

  PublishData(t, h);
  delay(1000);
  if (!client.loop()) {
    mqttconnect();
  }
}
/*.....................................retrieving to
Cloud...............................*/

void PublishData(float temp, float humid) {
  mqttconnect();//function call for connecting to ibm
  /*
     creating the String in in form JSon to update the data to ibm cloud
  */
  String payload = "{\"temp\":";
  payload += temp;
  payload += "," "\"Humid\":";
  payload += humid;
  payload += "}";


  Serial.print("Sending payload: ");
```

```
  Serial.println(payload);


  if (client.publish(publishTopic, (char*) payload.c_str())) {
Serial.println("Publish ok");// if it sucessfully upload data on the cloud
then it will print publish ok in Serial monitor or else it will print publish
failed
  } else {
    Serial.println("Publish failed");
  }

}


void mqttconnect() {
  if (!client.connected()) {
    Serial.print("Reconnecting client to ");
    Serial.println(server);
    while (!!!client.connect(clientId, authMethod, token)) {
      Serial.print(".");
      delay(500);
    }

     initManagedDevice();
     Serial.println();
  }
}
void wificonnect() //function defination for wificonnect
{
  Serial.println();
  Serial.print("Connecting to ");
  WiFi.begin("Wokwi-GUEST", "", 6);//passing the wifi credentials to establish
the connection
  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address: ");
  Serial.println(WiFi.localIP());
}

void initManagedDevice() {
  if (client.subscribe(subscribetopic)) {
    Serial.println((subscribetopic));
    Serial.println("subscribe to cmd OK");
  } else {
    Serial.println("subscribe to cmd FAILED");
  }
}

void callback(char* subscribetopic, byte* payload, unsigned int payloadLength)
```

```
{

  Serial.print("callback invoked for topic: ");
  Serial.println(subscribetopic);
  for (int i = 0; i < payloadLength; i++) {
    //Serial.print((char)payload[i]);
    data3 += (char)payload[i];
  }
  Serial.println("data: "+ data3);
  if(data3=="lighton")
  {
Serial.println(data3);
digitalWrite(LED,HIGH);
  }
  else
  {
Serial.println(data3);
digitalWrite(LED,LOW);
  }
data3="";
}
```

7.2 Feature 2

Now with the help of MIT App Inventor and the data's from NODE - RED Device we have created the mobile app using which the Farmer can know the same field conditions (Humidity, Moisture and Temperature) and also the MOTOR ON and MOTOR OFF Buttons. It is more feasible than web application as the values will be directly displayed instead of charts.

8. TESTING

8.1 Test Cases

Although smart agriculture IoT, as well as industrial IoT in general, aren't as popular as consumer connected devices; yet the market is still very dynamic. The adoption of IoT solutions for agriculture is constantly growing. Namely, COVID-19 has had a positive impact on IoT in the agriculture market share. There are many types of IoT sensors for agriculture as well as IoT applications in agriculture in general:

1.Monitoring of climate conditions

Probably the most popular smart 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 conditions, choose the appropriate crops, and take the required measures to improve their capacity (i.e., precision farming).

2.End-to-end farm management systems

This offers remote farm monitoring capabilities and allows you to streamline most of the business operations. Similar solutions are represented by Farm Logs. In addition to the listed IoT agriculture use cases, some prominent opportunities include vehicle tracking (or even automation), storage management, logistics, etc.

3. Greenhouse automation

Typically, farmers use manual intervention to control the greenhouse environment. The use of IoT sensors enables them to get accurate real-time information on greenhouse conditions such as lighting, temperature, soil condition, and humidity.

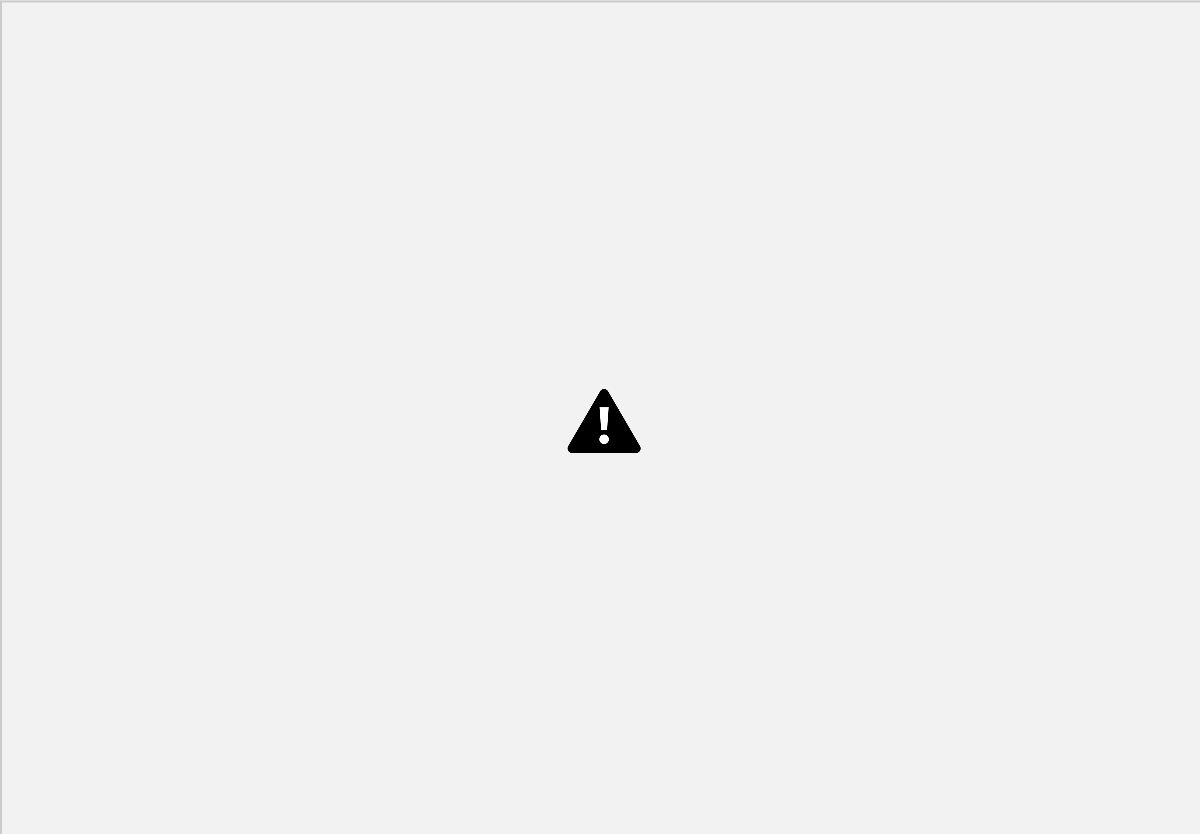
4.Crop management

One more type of IoT product in agriculture and another element of precision farming are 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. Thus, you can monitor your crop growth and any anomalies to effectively prevent any diseases or infestations that can harm your yield.

5. Precision farming

Precision farming is all about efficiency and making accurate data-driven decisions. It’s also one of the most widespread and effective applications of IoT in agriculture. By using IoT sensors, farmers can collect a vast array of metrics on every fact of the field microclimate and ecosystem: lighting, temperature, soil condition, humidity, CO_2 levels, and pest infections. This data enables farmers to estimate optimal amounts of water, fertilizers, and pesticides that their crops need, reduce expenses, and raise better and healthier crops.

8.2 User Acceptance Testing



9. RESULTS

9.1 Performance Metrics

There are many ways smart devices can help you increase your farm's performance and revenue. However, agriculture IoT apps development is no easy task. Smart farming application needs some software websites and MIT app inventor to control the motor of humidity, temperature.

S.NO	Name of the phase	Tasks performed	Performance Metrics
1.	Development of problem statement	The underlying problem analysed and a rough idea of the solution was planned	The Problem statement was developed.
2.	Ideation phase	Extracting use and test cases	Empathy map, Ideation and Literature survey were formulated.

3.	Project Design Phase I	Solution for the problem is formulated and architecture is designed	Problem solution fit was designed and the Proposed solution is finalized with the help of solution architecture.
4.	Project Design Phase II	In depths of analysis of the solution is performed including requirements, tech stack, etc.	Solution Requirements, Technology Stack, Data flow diagrams, User stories were formulated.
5.	Project Planning Phase	Various sprints were designed as individual progressive steps.	Project Milestone and Sprint delivery plans were developed.
6.	Project Development Phase	Final project of the sprints was verified	Sprint1, Sprint2, Sprint3, Sprint4 were developed.

Human interface cut down; Reduction of wastage gives good condition of output.

Economic efficiency gives better condition of output.

Reliability in real time gives excellent of the output.

10. ADVANTAGES & DISADVANTAGES

Advantages:

- Waste reduction
- Improve sustainability
- Water conservation
- Save energy and time

Disadvantages:

- Lack of Infrastructure
- Lack of internet/ Connectivity issues
- Farmers afraid of using smart farming
- Very complicated plan

11. CONCLUSION

Smart farming helps the farmer to reduce the foot print of farming and helps them to save time to do some other works a day. The development of the agriculture sector will always be a priority especially given the dynamics of the world today. Therefore, using IoT in agriculture has a big promising future as a driving force of efficiency, sustainability, and scalability in this industry. Smart farming reduces the ecological footprint of farming. Minimized or site specific application of inputs, such as fertilizers and pesticides, in precision agriculture systems will mitigate leaching problems as well as the emission of greenhouse gases. A system to monitor temperature, humidity, moisture levels in the soil was designed and the project provides an opportunity to study the existing systems, along with their features and drawbacks. Agriculture is one of the most water consuming activities. The proposed system can be used to switch the motor (on/off) depending on the favourable condition of plants i.e., sensor values, thereby automating the process of irrigation, which is one of the most time efficient activities in farming, which helps to prevent over-irrigation or under irrigation of soil thereby avoiding crop damage. The farm owner can monitor the process online through an Android App. Though this project can be concluded that there can be considerable development in farming with the use of IOT and automation.

12. FUTURE SCOPE

Future work would be focused more on increasing sensor on this system to fetch more data especially with regard to Pest Control and by also integrating GPS modules in this system to enhance this Agriculture IoT Technology to full fledged Agriculture Precision ready product

Smart farming is certainly a leading enabler in producing more food with less for an increasing world population. Through collecting data from sensors using IoT devices, you will learn about the real-time state of your crops. The future of IoT in agriculture allows predictive analytics to help you make better harvesting decisions.

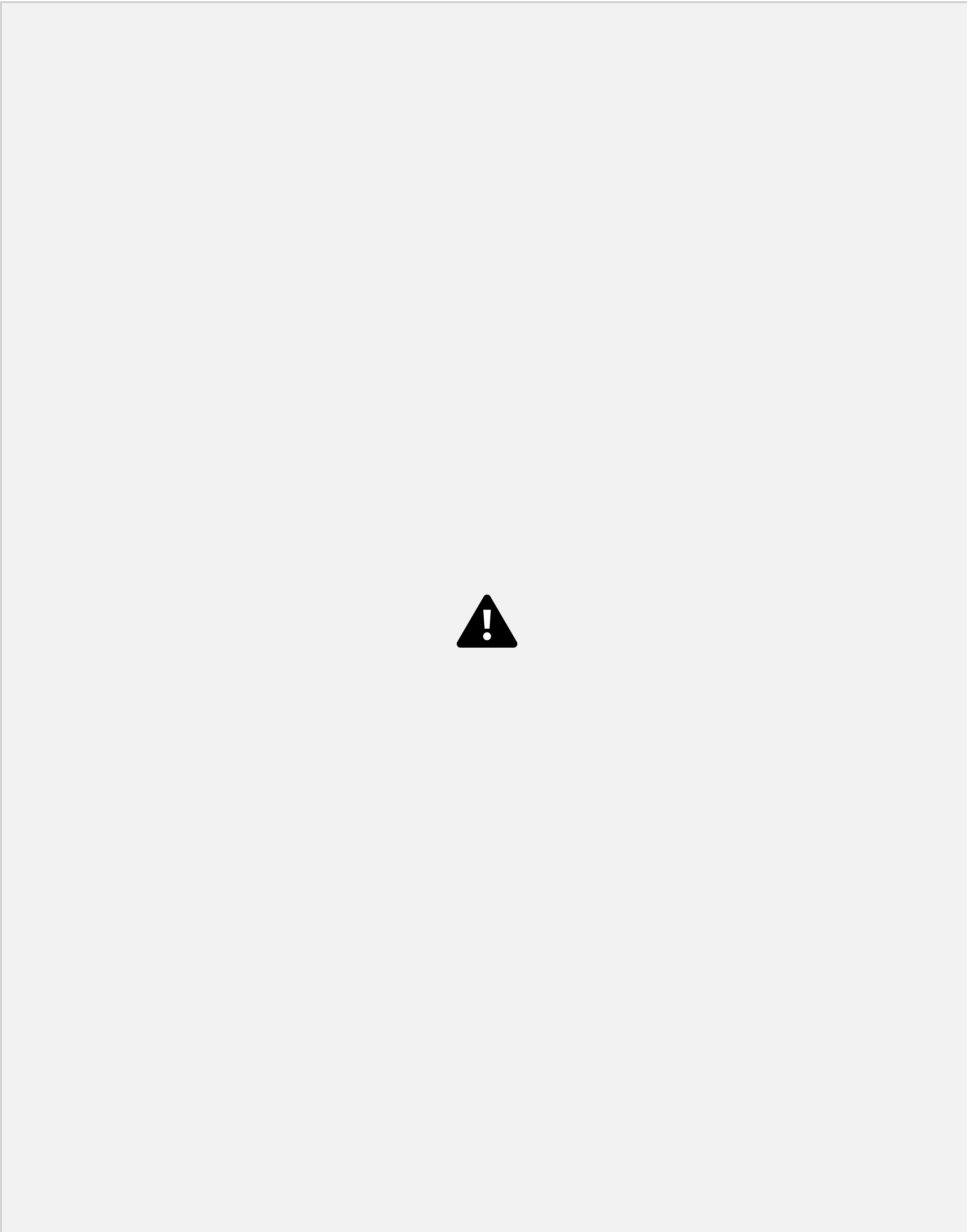
● IoT helps us meet our food needs by reducing environmental hazards, such as extreme weather and climatic transitions.

● The harvesters and tractors were both mechanical inventions that work in agriculture since the 20th century. The agriculture industry is heavily dependent on innovative ideas because of the increasing demand for food.

● The Industrial IoT has aided increased agricultural productivity with a lower cost, so, over the next few years, smart systems based on IoT will be more common in agricultural operations.

13. APPENDIX

Source Code



GitHub Link

https://github.com/IBM-EPBL/IBM-Project-50089-1660892068