MEENAKSHI SUNDARARAJAN ENGINEERING COLLEGE

IOT BASED SMART CROP PROTECTION SYSTEM FOR AGRICULTURE

TEAM ID: PNT2022TMID27944

TEAM MEMBERS

SNEKA S (Team Lead)

MAHALAKSHMI D

NITHYA S K

YOGALAKSHMI S

1. **INTRODUCTION**
    1. Project Overview
    2. Purpose
2. **LITERATURE SURVEY**
    1. Existing problem
    2. References
    3. Problem Statement Definition
3. **IDEATION & PROPOSED SOLUTION**
    1. Empathy Map Canvas
    2. Ideation & Brainstorming
    3. Proposed Solution
    4. Problem Solution fit
4. **REQUIREMENT ANALYSIS**
    1. Functional requirement
    2. Non-Functional requirements
5. **PROJECT DESIGN**
    1. Data Flow Diagrams
    2. Solution & Technical Architecture
    3. User Stories
6. **PROJECT PLANNING & SCHEDULING**
    1. Sprint Planning & Estimation
    2. Sprint Delivery Schedule
    3. Reports from JIRA
7. **CODING & SOLUTIONING (Explain the features added in the project along with code)**
    1. Feature 1
    2. Feature 2
    3. Database Schema (if Applicable)
8. **TESTING**
    1. Test Cases
    2. User Acceptance Testing
9. **RESULTS**
    1. Performance Metrics
10. **ADVANTAGES & DISADVANTAGES**
11. **CONCLUSION**
12. **FUTURE SCOPE**
13. **APPENDIX**

Source Code

GitHub & Project Demo Link

1.INTRODUCTION

1.1Project Overview

• The device will detect the animals and birds using the Clarifai service.

• If any animal or bird is detected the image will be captured and stored in the IBM Cloud object storage.

• It also generates an alarm and avoid animals from destroying the crop .

• The image URL will be stored in the IBM Cloudant DB service.

• The device will also monitor the soil moisture levels, temperature, and humidity values and send them to the IBM IoT Platform.

• The image will be retrieved from Object storage and displayed in the web application.

• A web application is developed to visualize the soil moisture, temperature, and humidity values .

• Users can also control the motors through web application.

1.2 PURPOSE

An intelligent crop protection system helps the farmers in protecting the crop from the animals and birds which destroy the crop. This system also helps farmers to monitor the soil moisture levels in the field and also the temperature and humidity values near the field. The motors and sprinklers in the field can be controlled using the mobile application.

2. LITERATURE SURVEY

2.1 Existing Problem

Agriculture is a field which forms the basis of our economy. Yet it faces a lot of problems in terms of availability of resources, Irrigation, increasing rate of Pesticides, Climatic disasters, insects which ruin the crops and makes huge loss in this sector. In agriculture water is needed for the crops for their growth. If the soil gets dry it is necessary to supply water. But sometime if the farmer doesn't visit the field it is not possible to know the condition of soil. Sometimes over supply of water or less supply of water affects the growth of crops. Sometimes if the weather or temperature changes suddenly it is necessary to take certain actions. The crop protection is majorly dependent on the moisture content of the soil , temperature and humidity of the surrounding environment.

2.2 References

i. Mr.Pranav shitap, Mr.Jayesh redij, Mr.Shikhar Singh, Mr.Durvesh Zagade, Dr. Sharada Chougule. Department of ELECTRONICS AND TELECOMMUNICATION ENGINEERING, Finolex Academy of Management and technology, ratangiri, India.

ii. N.Penchalaiah, D.Pavithra, B.Bhargavi, D.P.Madhurai, K.EliyasShaik,S.Md.sohaib.Assitant Professor, Department of CSE,AITS, Rajampet,India UG Student, Department of CSE,AITS,Rajampet, India.

iii. Mohit Korche ,Sarthak Tokse, Shubham Shirbhate, Vaibhav Thakre,S. P. Jolhe(HOD). Students , Final Year ,Dept.of Electrical engineering, Government

College of engineering, Nagpur head of dept., Electrical engineering, Government College of engineering, Nagpur

2.3 Problem Statement Definition

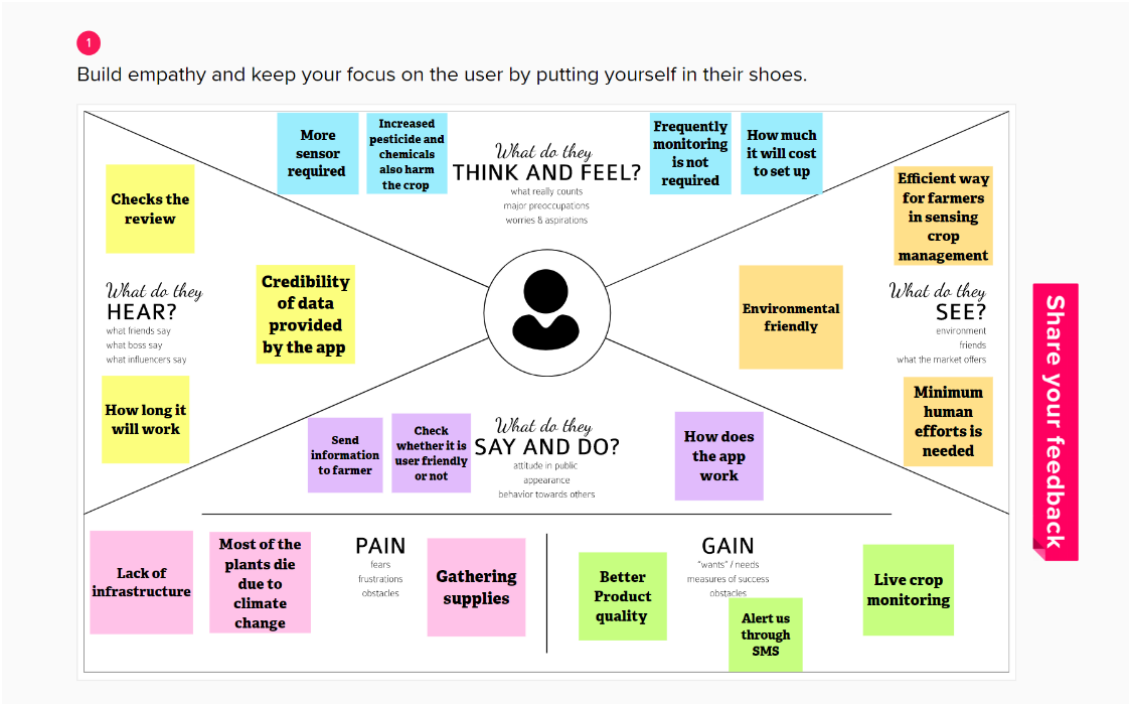
As a worker:

As an industrialist:

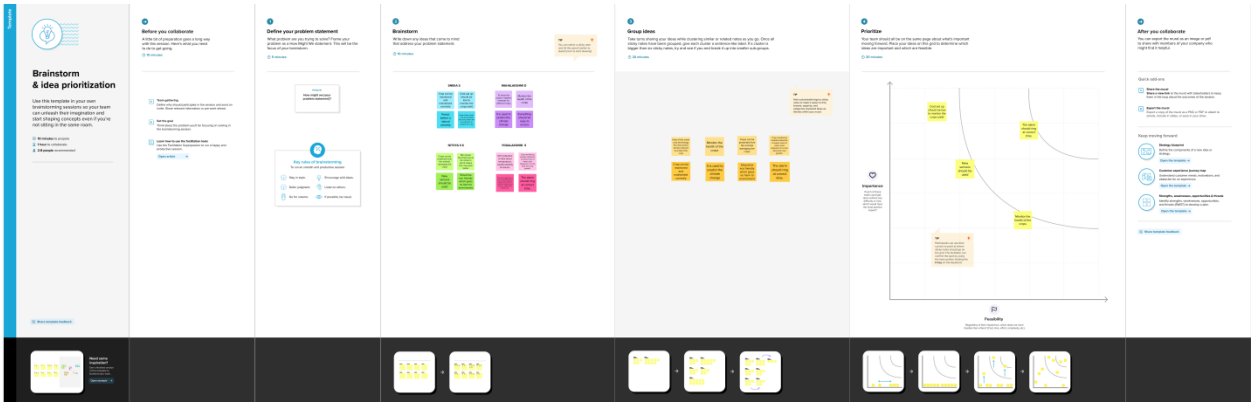
Problem Statement (PS)	I am	I'm trying to	But	Because	Which makes me feel
Identify the chemical explosion and fire in industry	A worker	Handle fire explosion issues in my industry	Manually its difficult	Its is hard to find the exact location and move towards it	Scared of loosing my life and co workers life.
To reduce the fire accidents in my industry	An industrialist	To reduce fire accidents in my industry	Its not possible to control large fires	Fire should cause huge loss it should be found at the begining	Bad that huge loss of life of precious workers and drastic loss in property

3. IDEATION & PROPOSED SOLUTION

3.1 Empathy Map Canvas



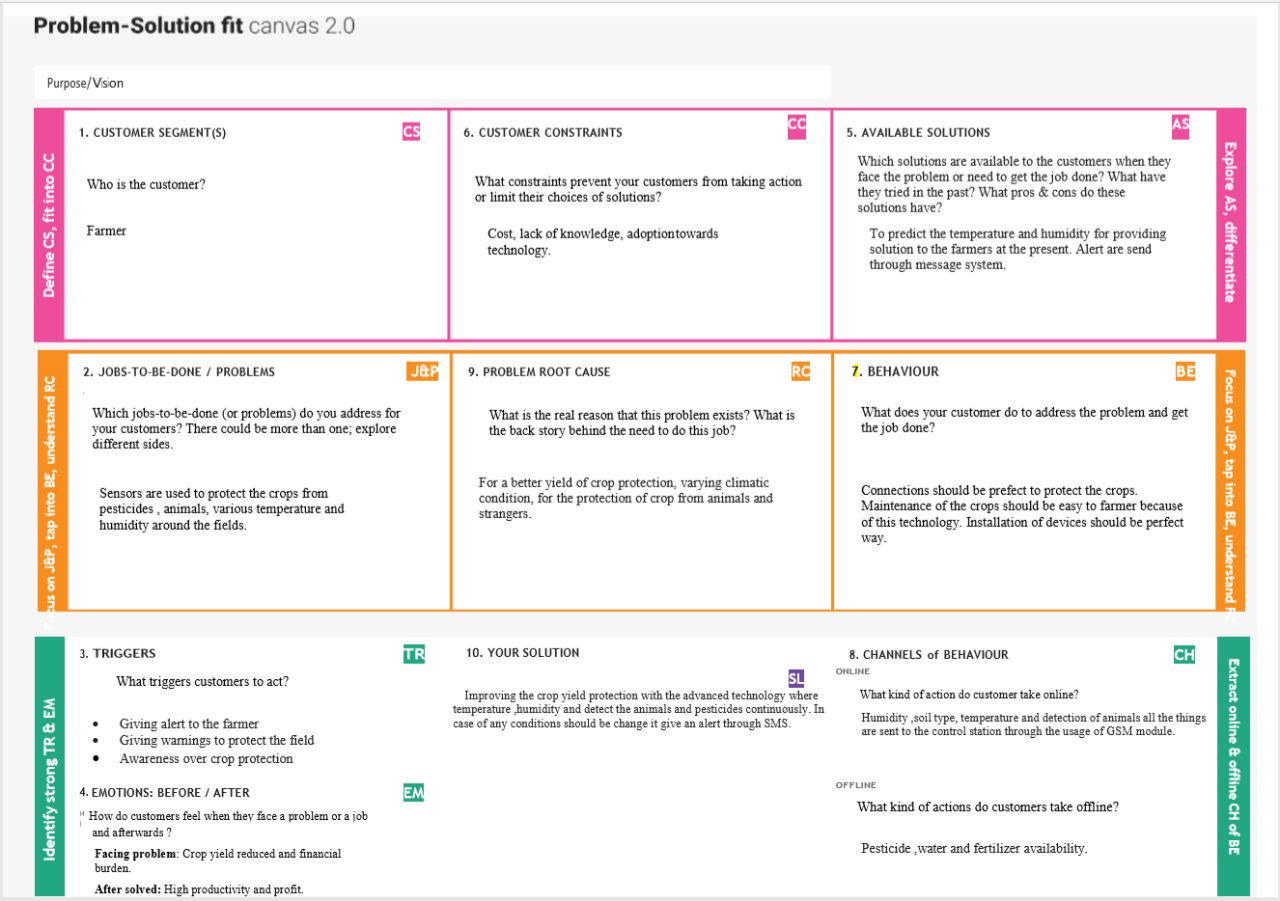
3.2Ideation & Brainstorming



3.3 Proposed Solution

Sl.No	Parameter	Description
1.	Problem statement (Problem to be solved)	The farmer who needs to water their plants on a desired time and to prevent their plants from the wild animals then the proper maintaining of the crop field.
2.	Solution description/Idea	The Smart crop device will detect the animals and birds from the fields.When it comes nearer to the fields it generate an alarm to avoid animals from destroying the crops.
3.	Novelty / Uniqueness	The uniqueness of project is to monitor the soil moisture level , temperature and humidity.
4.	Customer satisfaction / Social Impact	It can be used to protect the field from the animals and yielding more profits for the farmer.
5.	Business model(Revenue Model)	Farmers and co-operatives(minimize costs). Farming as a service(Faas). Commerce and Government. Pay per use. Performance based model. Additional sharing model.
6.	Scalability of the solution	In the field of IOT we proposed to deal with brilliant sensors and other electrical equipments to achieve an "**Smart Crop Protection System**" which is more beneficial for farmers.

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	Install the app. Signing up with Gmail or phone number Creating a profile. Understand the guidelines.
FR-2	User Confirmation	Confirmation via Email Confirmation via phone number verification required via OTP.
FR-3	Accessing datasets	Data's are obtained by cloudant DB.
FR-4	Interface sensor	Connect the sensor and the application When animals enter the field , the alert is generated.

FR-5	Mobile application	It is used to predict the temperature,humidity which makes the crop yield better.

4. 2 Non-functional Requirements:

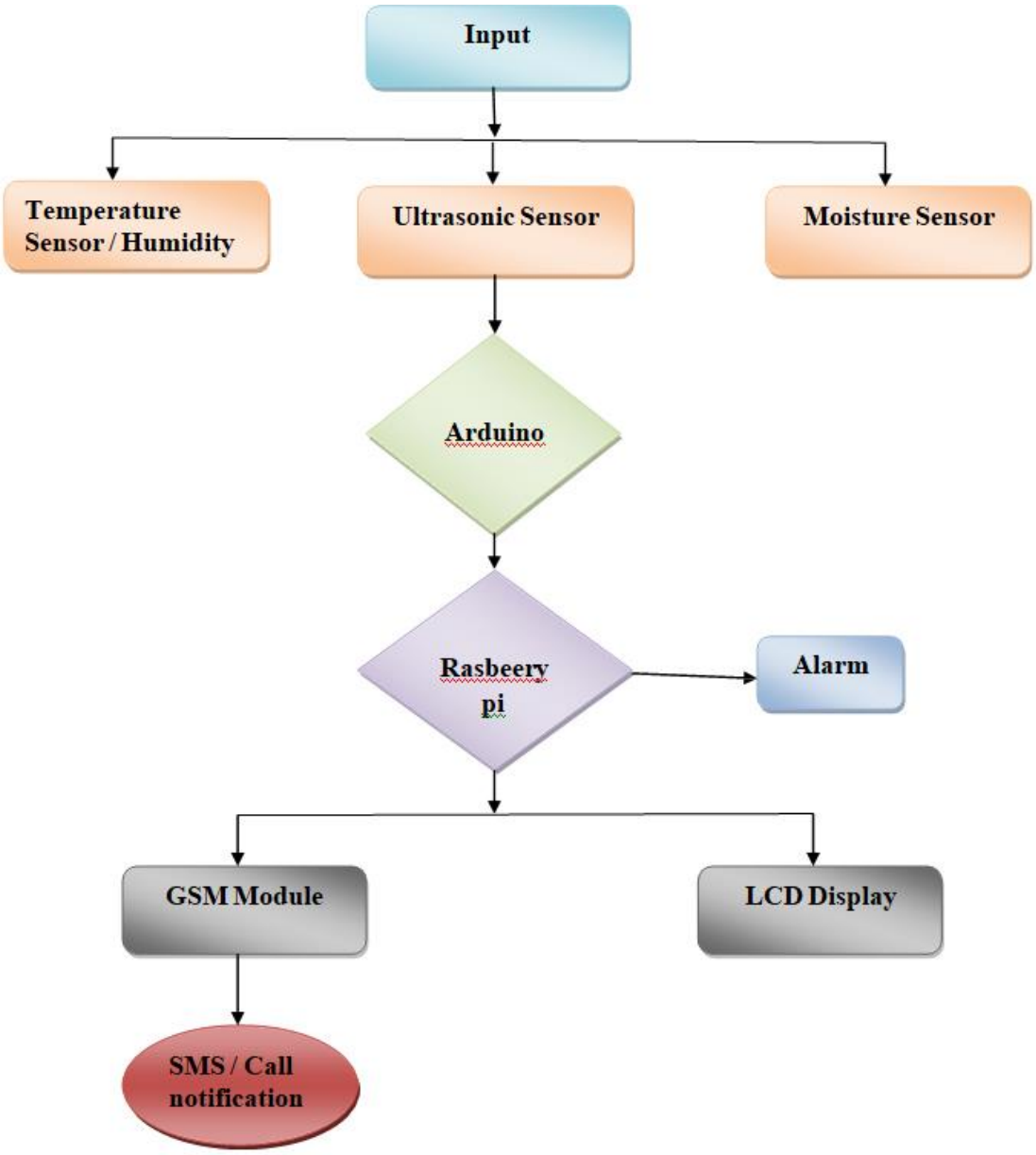
Non-functional Requirements:

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

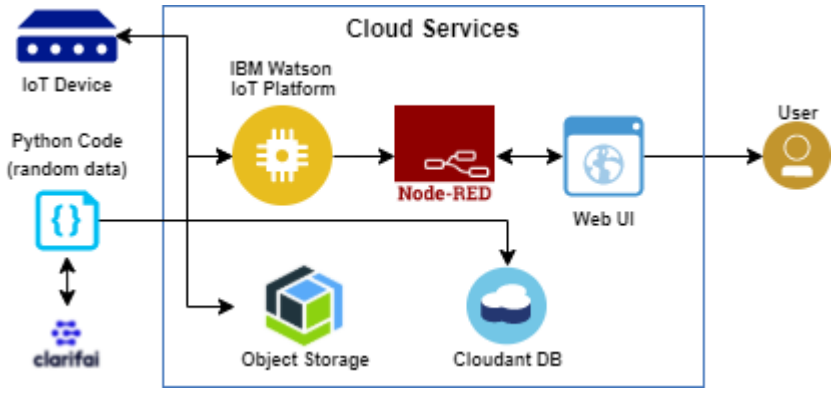
FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	This project's contributes the farm protection through the smart protection system.
NFR-2	**Security**	It was created to protect the crops from animals,climate change.
NFR-3	**Reliability**	Farmers are able to safeguard their lands withthe help of this technology. They will also benefits from higher crop yields, which will improve our economic situation.
NFR-4	**Performance**	When animals attempt to enter the field, IOT devices and sensors alert the farmer also when the climatic condition changes this also gives an
		alert by the indication of message.
NFR-5	**Availability**	We can defend the crops against wild animals by devloping and deploying resilient hardware and software.
NFR-6	**Scalability**	The ibm cloud service is involved which uses computer vision techniques integrated at cloudant service. It helps efficiently to retrieve images in large scale.

5. PROJECT DESIGN

5.1 Data Flow Diagrams



5.2. Solution &Technical Architecture



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)

Table-1 : Components & Technologies:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / Node-red etc.
2.	Application Logic-1	Logic for a process in the Application	Java / Python
3.	Application Logic-2	Logic for a process in the Application	IBM Watson /Node red
4.	Application Logic-3	Logic for a process in the Application	IBM Watson/Node red
5.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.

6.	Cloud Database	Database Service on Cloud	IBM DB2
7.	File Storage	File storage requirements	IBM Block Storage or OtherStorage Service or Local Filesystem
8.	External API-1	Purpose of External API used in the application	IBM Weather API, etc.
9.	IoT Model	Purpose of IoT model for integrating the sensors with a user interface	IBM IoT Platform
10.	Infrastructure (Server / Cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration :	Local, Cloud Foundry, Kubernetes, etc.

Table-2: Application Characteristics:

S.No	Characteristics	Description	Technology
1.	Open-Source Frameworks	Open source is a source code that is available for modification and redistribution	MIT License
2.	Security Implementations	Monitors and filters the incoming and outgoing network traffic	Encryptions, IBM Controls
3.	Scalable Architecture	Sensors- IoT Cloud based architecture	Cloud computing/AI
4.	Availability	The sensors are widely used to detect the temperature, humidity and moisture level	Sensors
5.	Performance	The ideas of implementing integrated sensors to detect the above characteristic and to indicate the parameters to farmer will be more efficient for overall monitoring.	Software

5.3 User Stories

User type	Functional requirement	User story	User story/Task	Acceptance criteria	Priority	Release
1.Customer (Mobile user, Web user) 2.Customer Care 3.Executive Administrator	Registration	USN-1	User can register for the application through e mail, password and confirming my password	Access account /dashboard	High	Sprint-1
		USN-2	User will receive a confirmation email once , registered for the application	User receive a confirmation email & click confirm	High	Sprint-1
		USN-3	User can register forthe application through Facebook	User can register &access the dashboard with login	Low	Sprint -2
		USN-4	User can register forthe application through Gmail		Medium	Sprint-1
	Login	USN-5	User can log into theapplication by entering email & password		High	Sprint-1

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		US-1	Create the IBM Cloud services which are being used in this project.	6	High	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S
Sprint-1		US-2	Configure the IBM Cloud services which are being used in completing this project.	4	Medium	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S
Sprint-2		US-3	IBM Watson IoT platform acts as the mediator to connect the web application to IoT devices, so create the IBM Watson IoT platform.	5	Medium	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S
Sprint-2		US-4	In order to connect the IoT device to the IBM cloud ,create a device in the IBM Watson IoT platform and get The device credentials.	5	High	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S
Sprint-3		US-1	Configure the connection security and create API keys that are used in the Node-RED service for accessing the IBM IoT Platform.	10	High	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S
Sprint-3		US-2	Create a Node-RED service.	10	High	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S
Sprint-3		US-1	Develop a python script to publish random sensor data such as temperature, moisture, soil and humidity to The IBM IoT platform	7	High	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S

Sprint-3		US-2	After developing python code, commands are received just print the statements which represent the control of the devices.	5	Medium	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S
Sprint-4		US-3	Publish Data to The IBM Cloud	8	High	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S
Sprint-4		US-1	Create web UI inordered	10	High	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S
Sprint-4		US-2	Configure the Node-RED flow to receive data from the IBM IoT platform and also use Cloudant DB nodes to store the received sensor data in the cloudant DB	10	High	Sneka S Mahalakshmi.D Nithya S K Yogalakshmi S

6.2 Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart

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	12	6Days	24Oct2022	29Oct2022	12	29Oct2022
Sprint-2	12	6Days	31Oct2022	05Nov2022	12	31Oct2022
Sprint-3	18	6Days	07Nov2022	12Nov2022	18	12Nov2022
Sprint-4	12	6Days	14Nov2022	19Nov2022	12	19Nov2022

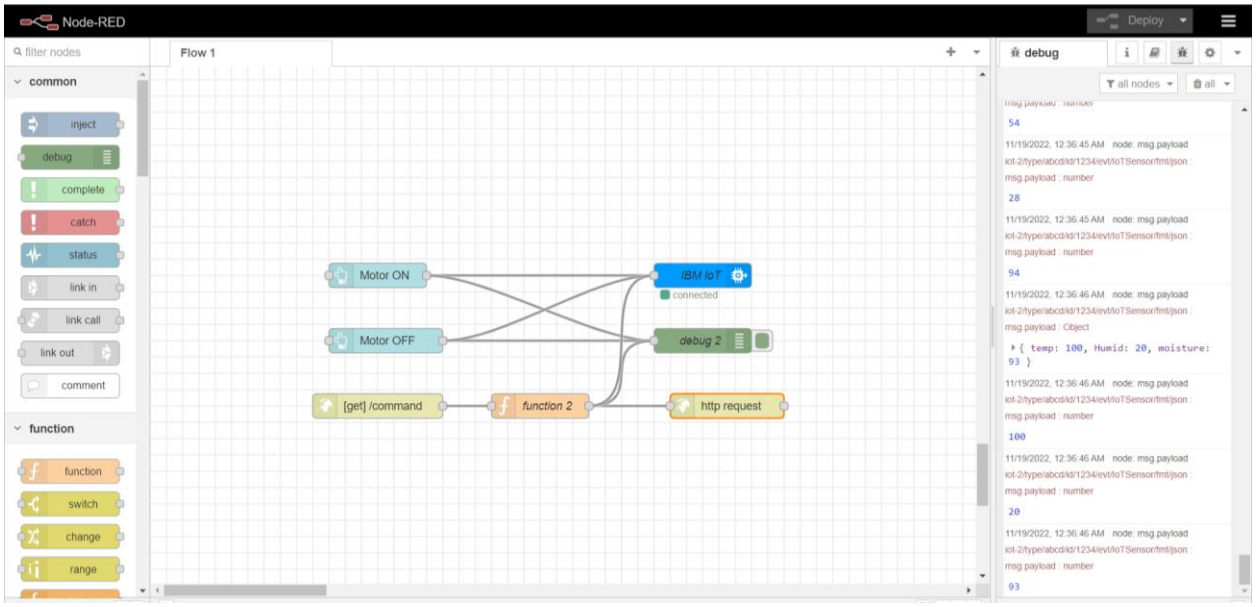
Velocity:

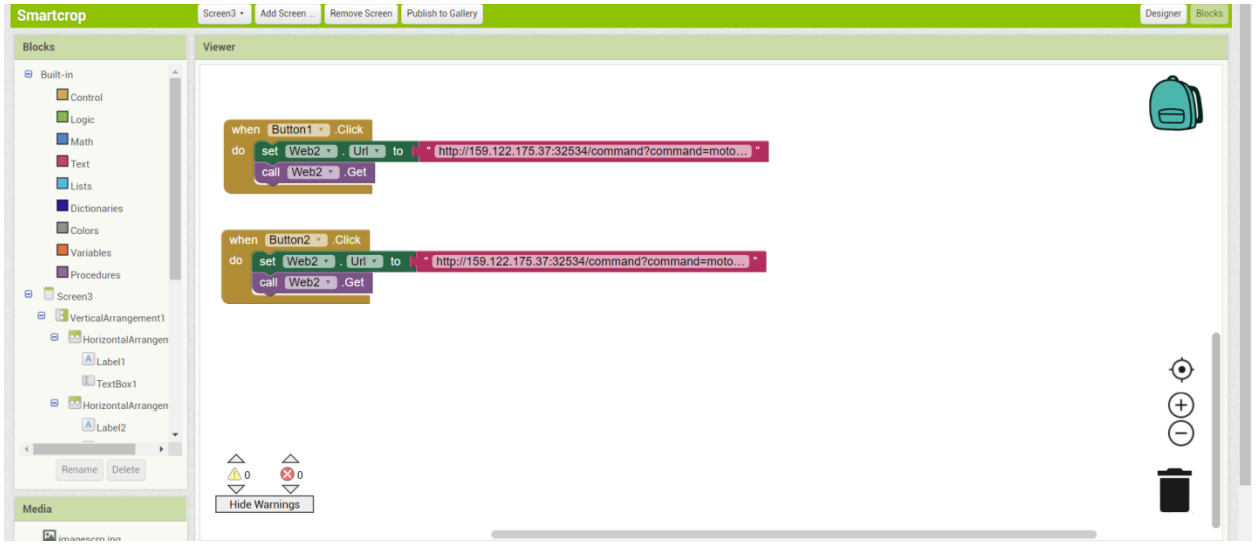
AVforsprint-1=12/6=2points
AV for sprint-2 = 12/6 = 2 points
AV for sprint-3 = 18/6 = 3 points
AVforsprint-4=12/6=2points

7 .CODING & SOLUTIONING

7.1 Feature 1

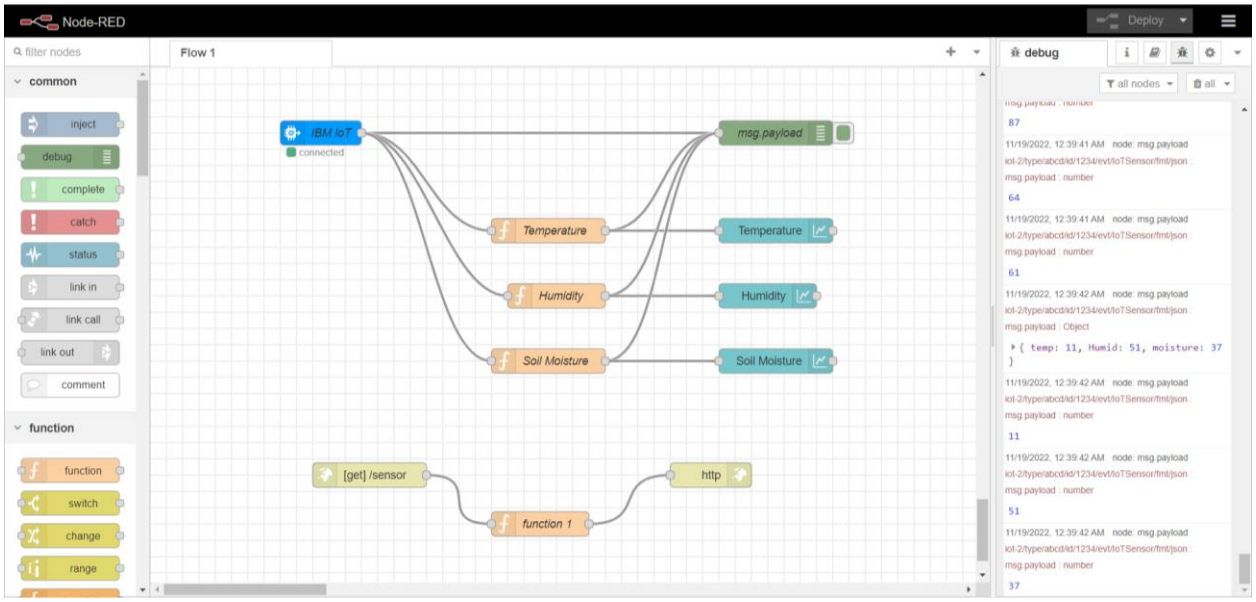
To indicate the less moisture level in the field, so that the user can switch on motor to reach the sufficient water level for plants.





7.2 Feature 2

To detect the temperature and humidity near the field and to measure the moisture level present in the soil. We can use it in mobile application to monitor at any time and also able to control the motors



7.3 Feature 3

PYTHON CODE TO IBM:

```
import time

import sys

import ibmiotf.application

import ibmiotf.device

import random

#Provide your IBM Watson Device Credentials

organization = "bx1po5"

deviceType = "abcd"

deviceId = "1234"

authMethod = "token"
```

```
authToken = "12345678"
# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="motoron":
        print ("motor is on")
    else :
        print ("motor 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 DHT1
    temp=random.randint(0,100)
    Humid=random.randint(0,100)
    moisture=random.randint(0,100)
```

```
        data = { 'temp' : temp, 'Humid': Humid, 'moisture': moisture }
        #print data
        def myOnPublishCallback():
            print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid,
"moisture = %s %%" % moisture,"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()
```

NODE RED CODE:

```
msg.payload = { "temp": global.get("t"),
                "Humid": global.get("h"),
                "moisture": global.get("m")}
return msg;
```

For Temperature:

```
msg.payload = msg.payload.temp
global.set("t",msg.payload)
return msg;
```

For Humidity:

```
msg.payload = msg.payload.Humid
global.set("h", msg.payload)
return msg;
```

For Moisture:

msg.payload = msg.payload.moisture

global.set("m", msg.payload)

return msg;

8. TESTING

8.1 TESTING:

- Python code to Ibm
- Iot sensor output
- Ibm cloud to node Red output

8.2 USER ACCEPTANCE TESTING:

8.2.1Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of the[Product Name] project at the time of there lease to User Acceptance Testing(UAT).

8.2.2. Defect analysis

This report shows the number of resolved or closed bugs at each severity level, and how they were resolve

Resolution	Severity1	Severity2	Severity3	Severity4	Subtotal
By Design	10	4	2	3	20
Duplicate	1	0	3	0	4
External	2	3	0	1	6
Fixed	11	2	4	20	37

Not Reproduced	0	0	1	0	1
Skipped	0	0	1	1	2
Won't Fix	0	5	2	1	8
Totals	24	14	13	26	77

8.2.3 Test Case Analysis

This report shows the number of test cases that have passed, failed, and untested

Section	Total Cases	Not Tested	Fail	Pass
Print Engine	7	0	0	7
Client Application	51	0	0	51
Security	2	0	0	2
Out source Shipping	3	0	0	3
Exception Reporting	9	0	0	9
Final Report Output	4	0	0	4
Version Control	2	0	0	2

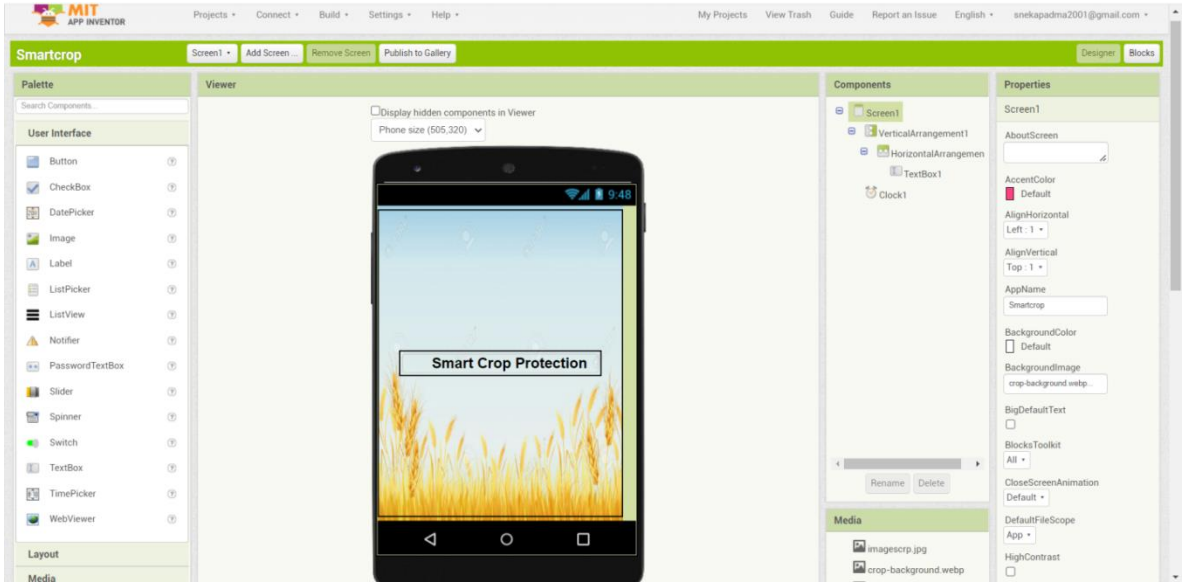
9. RESULTS

9.1 Performance Metrics

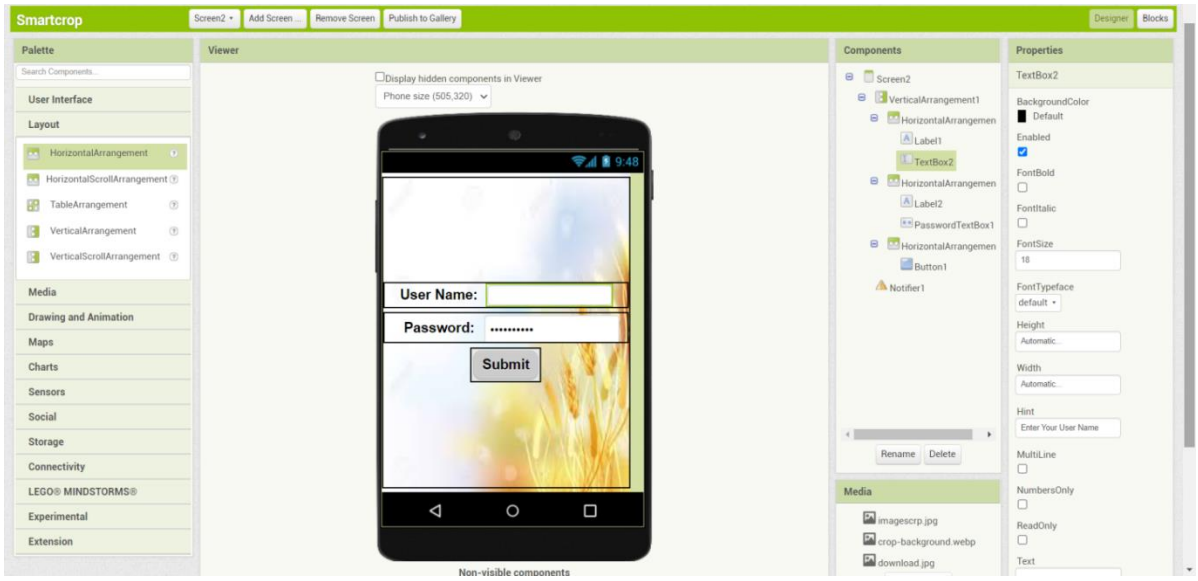
Mit Application Designer:

(FRONTEND)

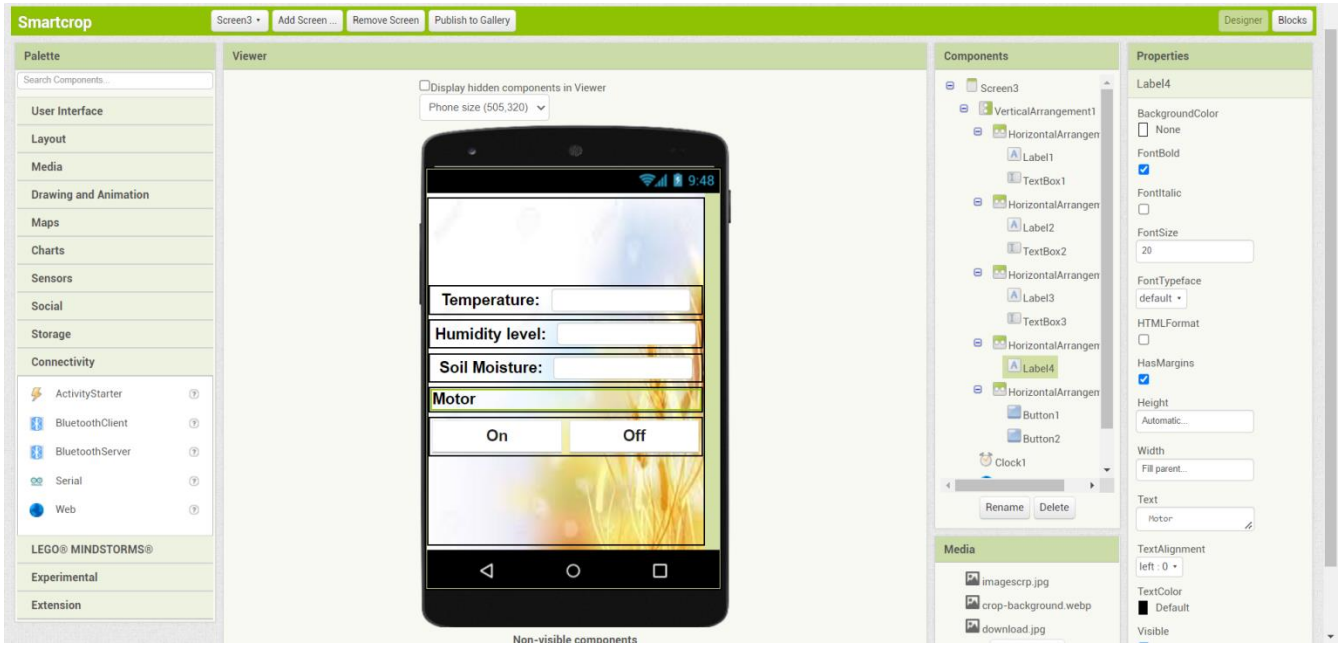
Screen-1:



Screen-2:



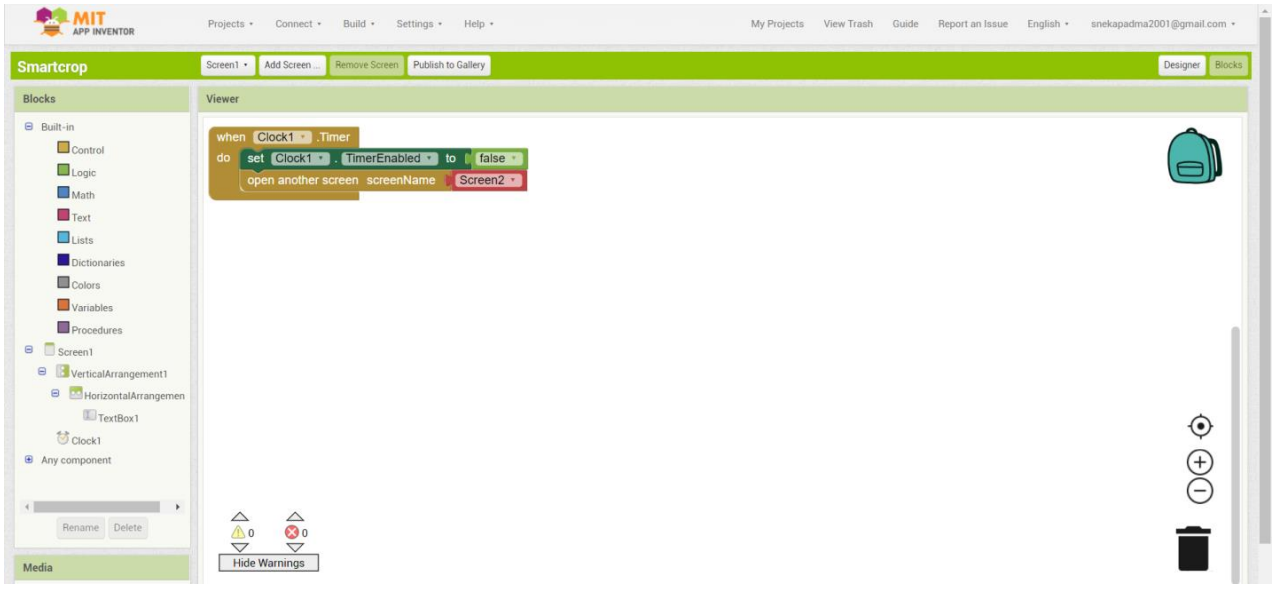
Screen-3:



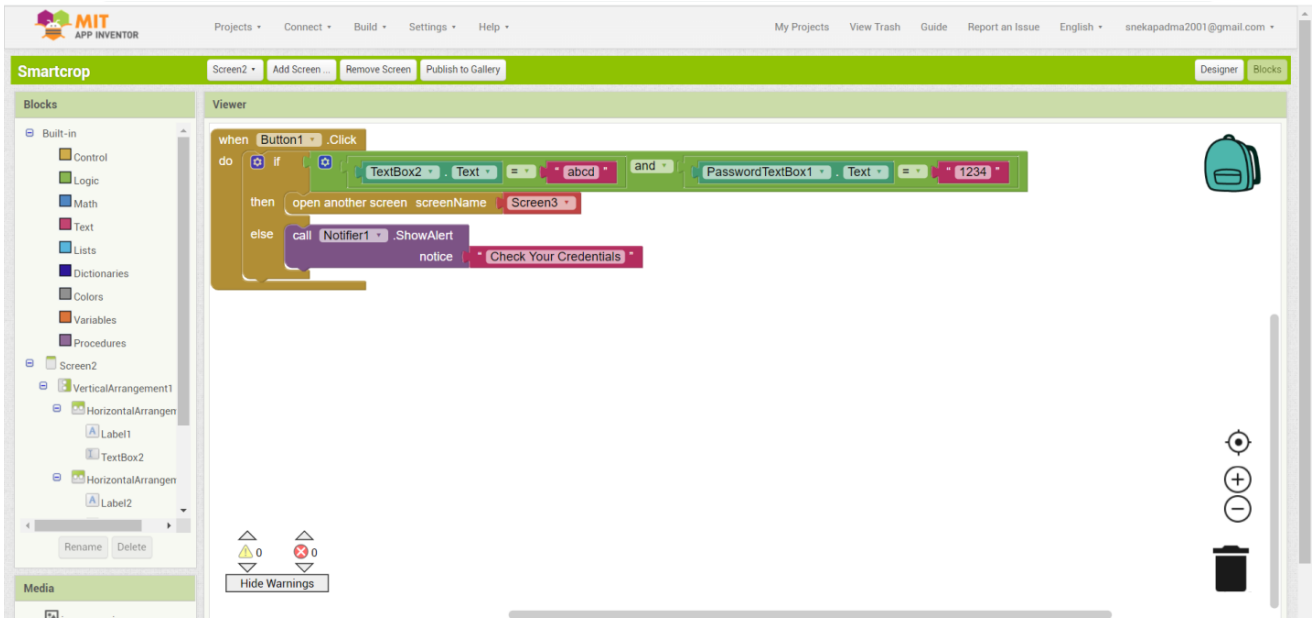
Customize the APP interface to display the values:

Blocks(BACKEND)

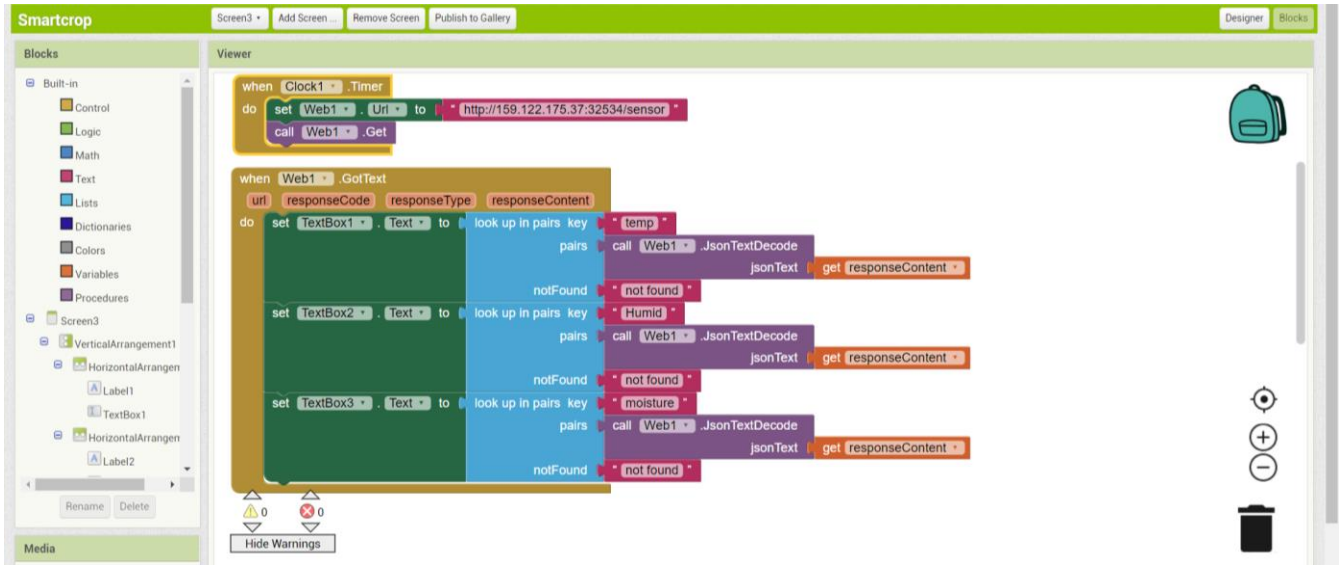
Screen-1:



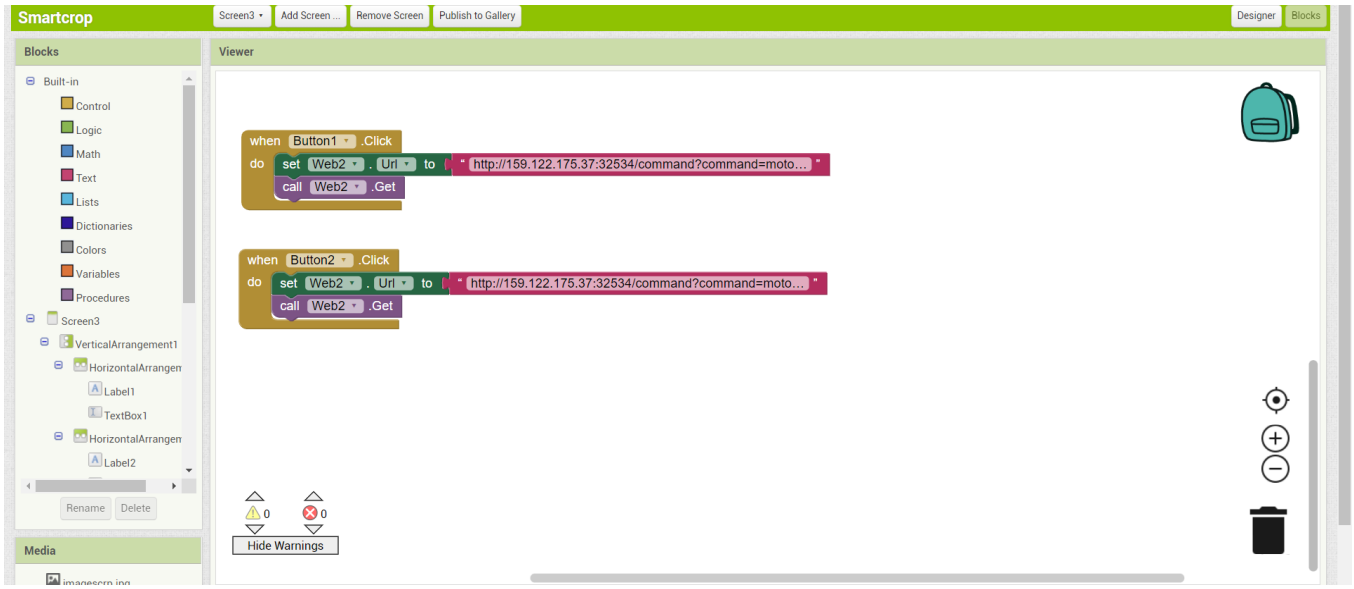
Screen-2:



Screen-3 :

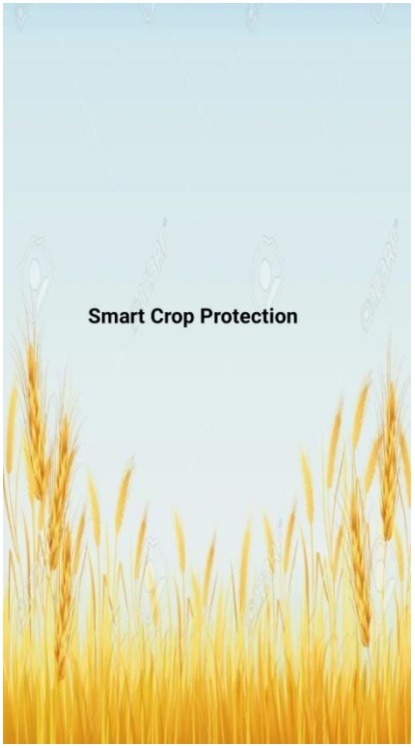


Screen-3 Blocks Button:



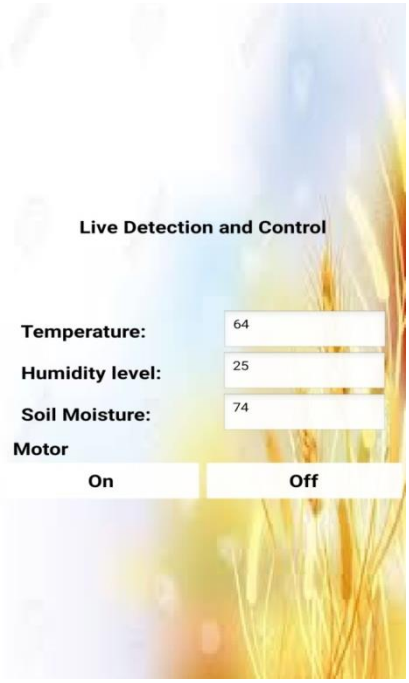
MIT App Invertor Output-Mobile Phone:

Screen-1:



Screen-2:

Screen-3:



10. ADVANTAGES & DISADVANTAGE

10.1 Advantages

- All the data like climatic conditions and changes in them, soil or
- Crop conditions everything can be easily monitored.
- Risk of crop damage can be lowered to a greater extent.
- The process included in farming can be controlled using the web
- Applications from anywhere, anytime.
- Farmers can monitor the health of farm animals closely, even if they are physically distant.
- Smart farming systems reduce waste, improve productivity and enable management of a greater number of resources through remote sensing.

10.2 Disadvantages

- Smart Crop Protection requires internet connectivity continuously, but
- rural part scan not fulfill this requirement.
- Any faults in the sensors can cause great loss in the agriculture, due to
- wrong records and the actions of automated processes.

- IoT devices need much money to implement.

11. CONCLUSION

Iot based smart crop protection system for agriculture reduces the ecological footprint of farming and man power. 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.The dependency on manual labor has reduced significantly. The processes like pest control, fertilizing, and irrigation are increasingly becoming automated, and farmers can control them remotely. The use of smart IoT sensors can maintain these processes, increasing crop production

12. FUTURE SCOPE

IoT smart agriculture products are designed to help monitor crop fields using sensors and by automating irrigation systems. As a result of this smart crop protection, farmers and associated brands can easily monitor the field conditions from anywhere without any hassle the future scope makes the farmers to monitor the crops and produce a good yield of crop production.

13. APPENDIX

13.1 SOURCE CODE:

https://wokwi.com/projects/348825091983802964

13.2 GITHUB & PROJECT DEMO LINK:

GITHUB:

https://github.com/IBM-EPBL/IBM-Project-18523-1659686346

PROJECT DEMO LINK:

https://drive.google.com/file/d/19GnZtYm6CsEsdG5tAazybRqGn_AXrTcX/view?usp=drivesdk