IOT BASED SMART CROP PROTECTION SYSTEM FOR AGRICULTURE

Team ID: PNT2022TMID46736

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Team Member 2 : R. SOUNDHARYA

Team Member 3 : C. SURIYA

INTRODUCTION

Project Overview:

An IoT based smart crop protection system helps the farmers in protecting the crop from the animals and birds which destroy the crop. Crops in farms are many times ravaged by local animals like buffaloes, cows, goats, birds, etc. This leads to huge losses for the farmers. It is not possible for farmers to barricade entire fields 24 hours and guard it. So here we propose automatic crop protection system from animals. Animal detection system is designed to detect the presence of animal and offer a warning. 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 applications.

Project Purpose:

An intelligent smart 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. 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. Users can also control the motor the motors through the web application.

LITERATURE SURVEY

IoT Based Smart Crop Protection System for Agriculture

Existing Problem:

Crop damage caused by animal's attacks is one of the major threats in reducing the crop yield. Due to the expansion of cultivated land into previous wildlife habitat, crop raiding is becoming one of the most conflicts antagonizing human-wildlife relationships. Farmers in India face serious threats from pests, natural calamities and damage by animals resulting in lower yields. Traditional methods followed by farmers are not that effective and it is not feasible to keep an eye on crops and prevent wild animals. Since safety of both human and animal is equally important. It is important to protect the crops from damage caused by animal as well as divert the animal without any harm. In order to overcome above problems and to reach our aim, we use machine to detect animals, entering into our farm by using neural network concept, a division in computer vision. In this project, we will monitor entire farm at regular intervals through a camera which will be recording. With the help of deep learning model, we detect the entry of animals and we play appropriate sounds to drive the animal away. In our project, we use various libraries and concepts of convolutional neural networks used to create the model.

References:

[1] Krunal Mahajan and Riya Parate, "IoT Based Smart Crop Protection System" in this paper published in 2021.

[2] Ipseeta nanda and sahithi chadalavada, "Implementation of IIoT Based smart crop protection and irrigation system" journal of physics conference and series, published in 2021.

[3] Mohit Korche and Sarthak Tokse, "Smart Crop Protection System" International Journal of Latest Engineering Science (IJLES), published in August 2021.

[4] Jayesh Redij and Pranav Shitap, "Smart Crop Protection System From Animals", International journal of creative research thoughts, published in April 2022.

[5] D. Pavithra and P. Bhargavi, "Smart Irrigation and Crop Protection From Wild Animals", published in April 2020.

Problem Statement Definition:

Crop protection combines strategies, tools and products that protect against various wild animals. There are various ways to crop loss from wild animals, in some areas farmers burn elephant dung or other materials that smolder and create heavy smoke, that repels rabbits and deer. Develop smart and affordable solution to protect crops from wild animals is an ultimate objective of this work. With the help of remote sensing technologies we can develop crop protection solution from wild animal attacks. Provide alerts on any crop damage in case animals destroy crops. The wild animals are like elephant, deer, wolf, chimpanzee, cheetah, Monkey are the major animals that damage crops.

I am	a Farmer	Crop protection combines strategies, tools and products that protect against various wild animals. There are various ways to crop loss from wild animals including for smoke, in some areas farmers burn elephant dung or other materials that smolder and create heavy smoke, that repels rabbits and deer.
I'm trying to	Protect crop from wild animals	Electronic Repellents is an effective long-lasting and eco-friendly method for crop protection that repels animals without harming them. Farmers use one of the following two types of electronic repellent; Ultrasonic electronic repellent; silent to humans, high-frequency sound waves repels wild animals.
But	They damage their crops field	They can damage the plants by feeding on plant parts or simply by running over the field and trampling over the crop fields. Therefore, wild animals may easily cause significant yield losses and provoke additional financial problems.
Because	The animal running and trampling over the crop field	This leads to poor yield of crops and significant financial loss to the owners of the farmland. This problem is so pronounced that sometimes the farmers decide to leave the areas barren due to such frequent wild animal attacks.
Which makes me feel	Unprofitable from crop field	Farmers experience significant losses to their crops due to raiding by wild species such as elephants; predation of livestock by wild carnivores.

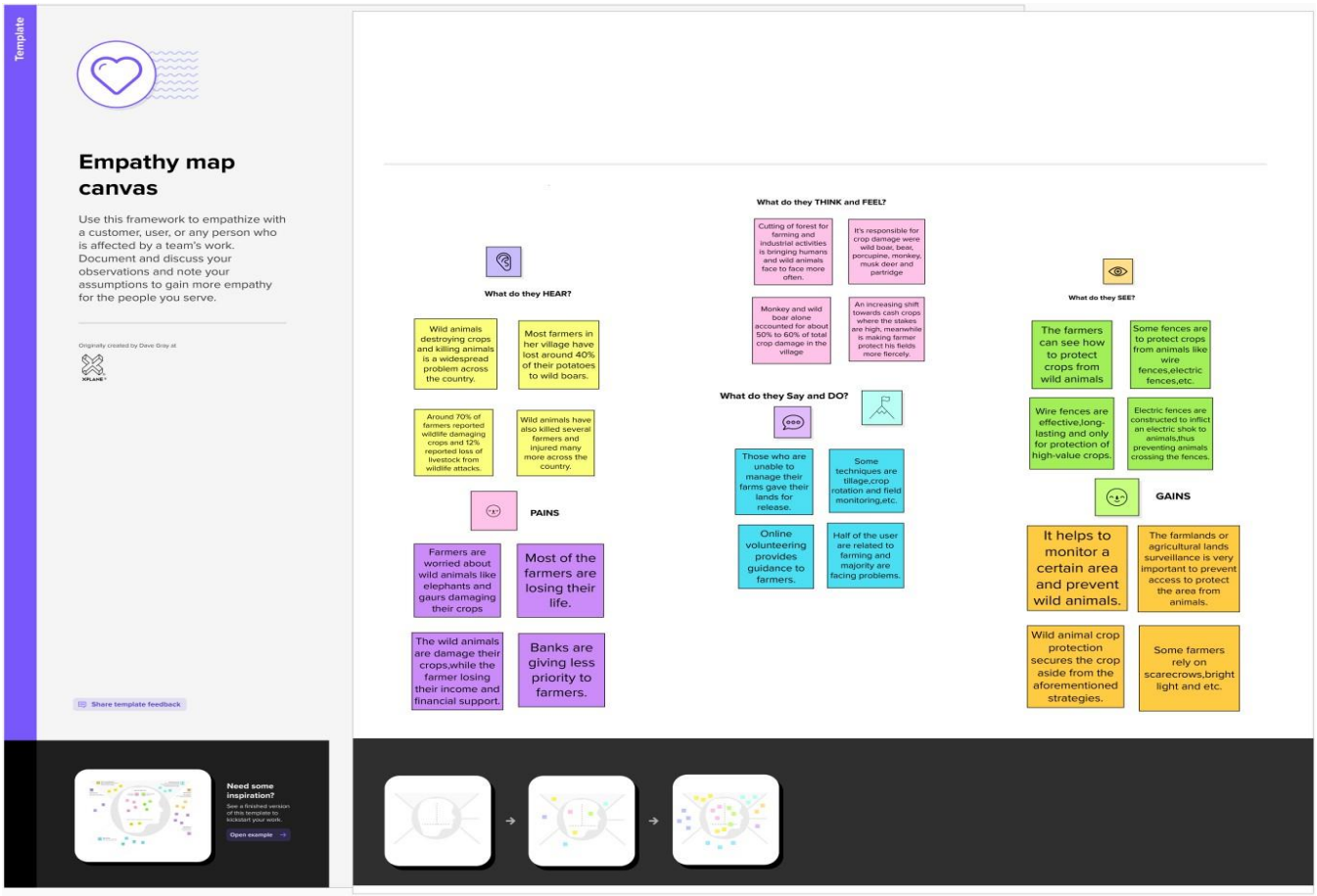
Problem Solution Template:

IDEATION & PROPOSED SOLUTION

Empathy Map Canvas:

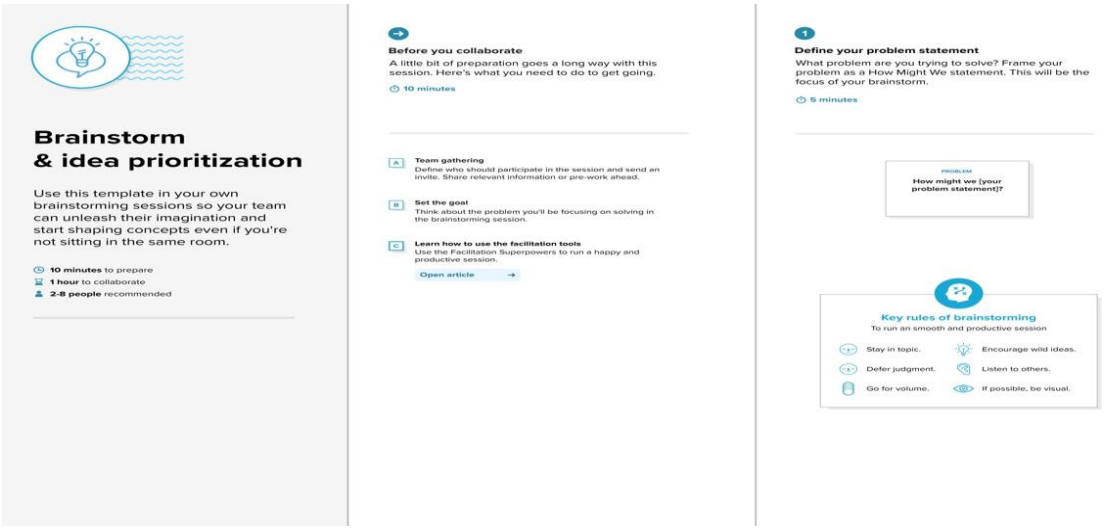
Wild animals destroying crops and killing animals is a wide spread problem across the country. Around 70% of farmers reported wildlife damaging crops and 12% reported loss of livestock from wildlife attacks. Wild animals have also killed several farmers and injured many more across the country. Monkey and wild boar alone accounted for about 50% to 60% of total crop damage in the village. The farmers can see how to protect crops from wild animals. Some fences are to protect crops from animals like wire fences and electric fences. The wild animals are damaged their crops, while the farmer losing their income and financial support. It helps to monitor a certain area and prevent wild animals. The farmlands or agricultural lands surveillance to prevent access to protect the area from animals. Wild animals crop protection secures the crop aside from the aforementioned strategies. Some farmers rely on scarecrows, bright light and etc.

Empathy Map

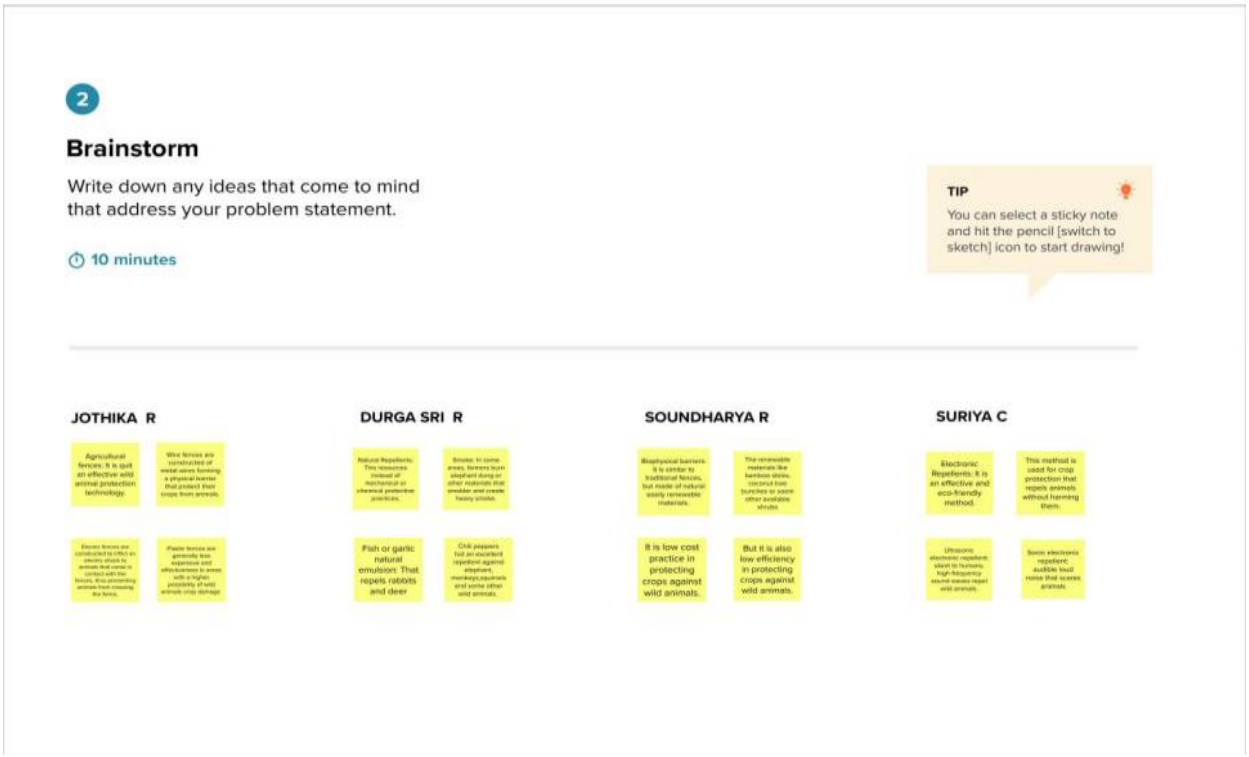


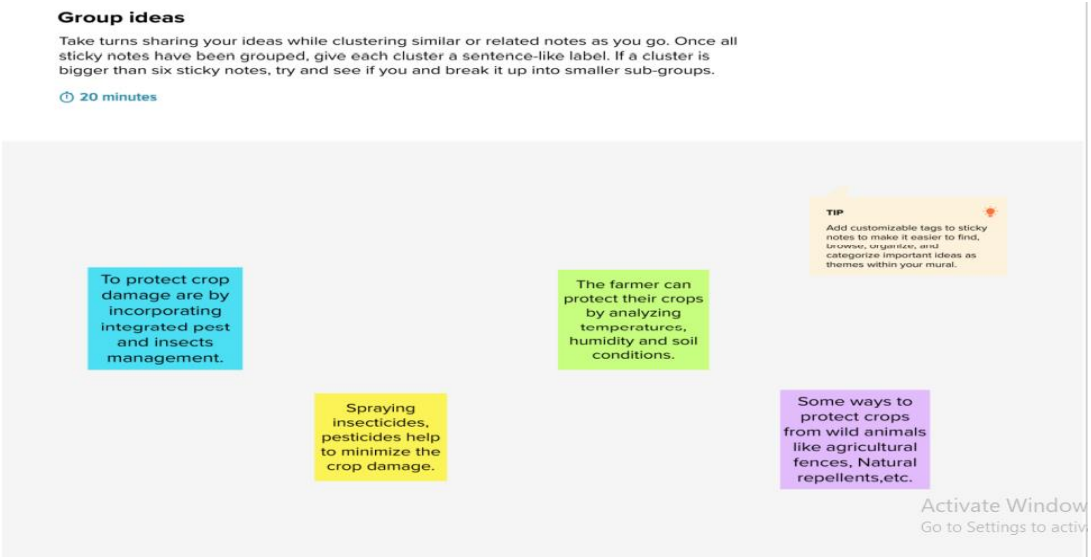
Ideation & Brainstorming:

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

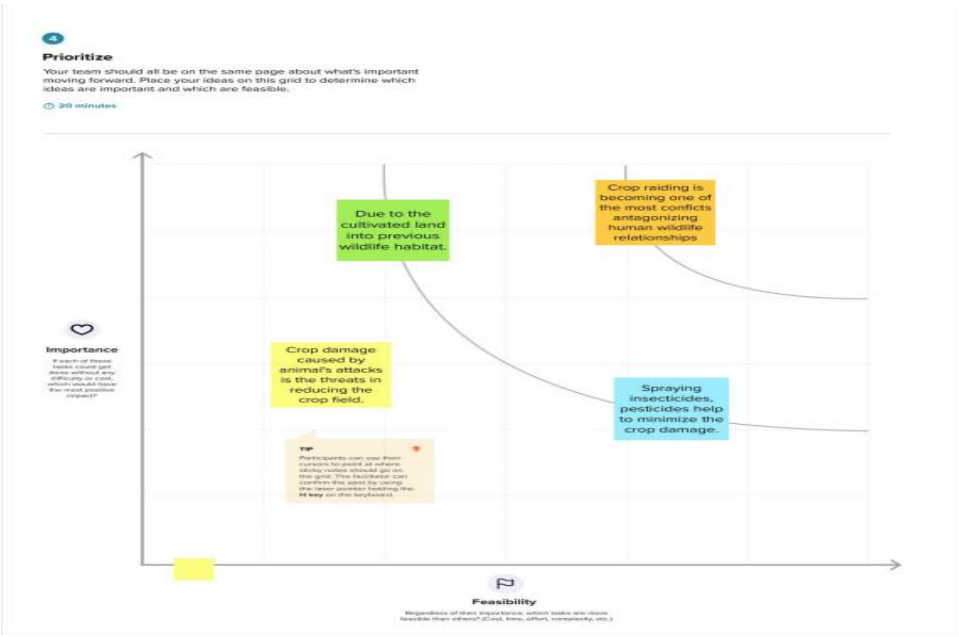


Step-2: Brainstorm, Idea Listing and Grouping





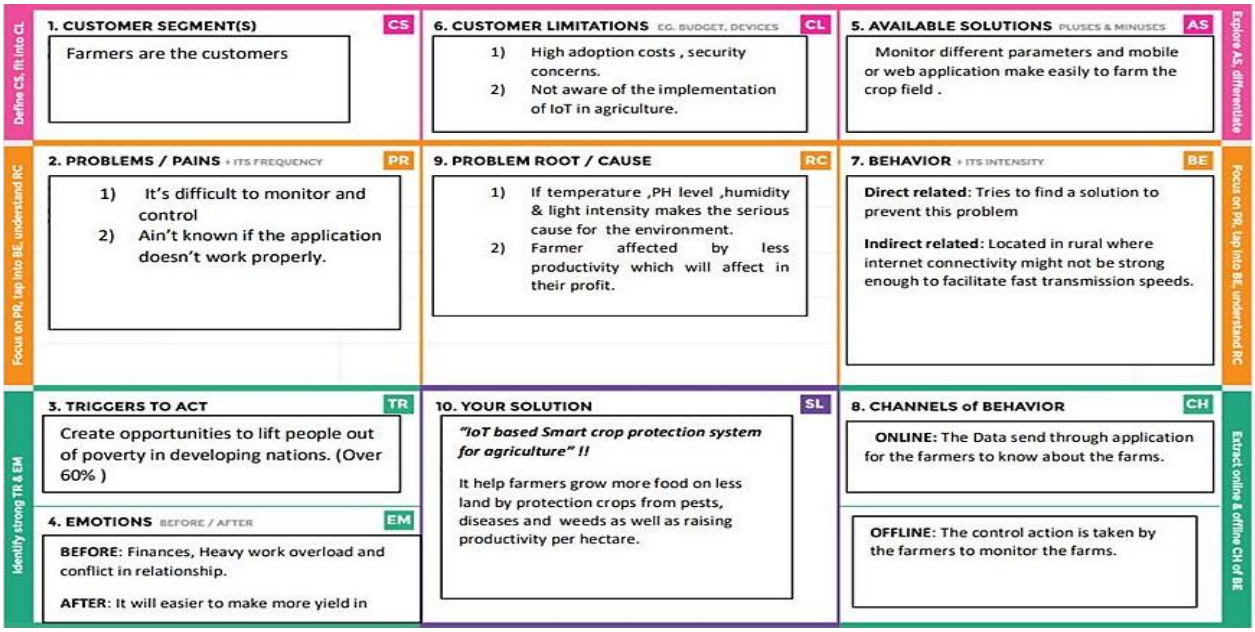
Step-3: Idea Prioritization



Proposed Solution:

S.No.	Parameter	Description
1.	Problem Statement(Problem To Be Solved)	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.
2.	Idea/Solution Description	This system uses a motion sensor to detect wild animals approaching near the field and smoke sensor to detect the fire. In such a case the sensor signals are given to the microcontroller to take action.
3.	Novelty/Uniqueness	Agriculture is the backbone of the economy but, because of animal interference in agricultural lands, there will be huge loss of crops.
4.	Social Impact/Customer Satisfaction	The correct use of pesticides can deliver significant social economic and environmental benefits in the form of safe, healthy, affordable food and enable sustainable farm management by improving the efficiency with which we use natural resources such as soil, water and overall land use.
5.	Business Model(Revenue Model)	The proposition that alternative business models for crop protection can address these problems by incentivizing and benefiting from efficiency of pesticide use.
6.	Scalability Of The Solution	➢ Monitoring of climate conditions. ➢ Greenhouse automation ➢ Crop management and Cattle monitoring management. ➢ Precision farming and agricultural drones. ➢ Predictive analytics for smart farming. ➢ End-to-end farm management systems.

Problem Solution Fit:



REQUIREMENT ANALYSIS

Functional Requirement:

FR.No	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration is done through Gmail which is available in the playstore .
FR-2	User Confirmation	Confirmation via Email as a invitation Confirmation via OTP through user's mobile number.
FR-3	User Login	It is necessary to Login through website or App using the respective username and password givenby the user.
FR-4	User Access	User might allow all the requirements for better experience.
FR-5	User Guide	Guides the basic steps of using the application.
FR-6	User Upload	User should be able to send the data
FR-7	User Solution	Data report should be generated and delivered to user for per every 24 hours
FR-8	User Data Sync	API interface to increase to invoice system

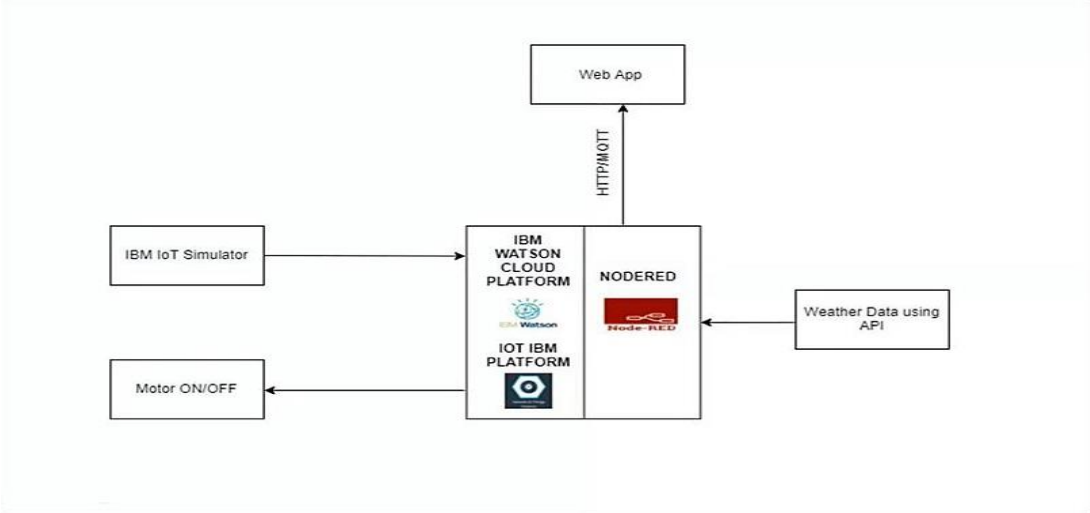
Non-Functional Requirement:

NFR. No	Non-Functional Requirement	Description
NFR-1	**Usability**	Monitoring crops, surveying, and mapping the fields and providing data to farmers for rational farm management plans to save both time and money.
NFR-2	**Security**	A network typically designed with sensors (Light, Humidity, Temp, Soil Moisture, etc.) To monitor the crop field and automate farming activities.
NFR-3	**Reliability**	The Reduction of risks, Mechanization of industry, Enhancement of production, Inspection of livestock, Monitoring of environment conditions, Roboticization of green houses, and crop monitoring nearly every sector, like smart agriculture modified by Internet-Of-Things based technology.
NFR-4	**Performance**	It performs surveillance which is mainly for human intruders, but we tend to forget that the main enemies ofsuch farmers are the animals which destroy the crops.
NFR-5	**Availability**	Protection of crop yield is one of the most challenging concerns faced by farmers. Some of the factors that challenge crop protection are changingweather conditions, unplanned seed sowing, unpredicted locus attacks, and irregular irrigation.
NFR-6	**Scalability**	➢ Monitoring of climate conditions. ➢ Greenhouse automation ➢ Crop management and Cattle monitoring management. ➢ Precision farming and agricultural drones. ➢ Predictive analytics for smart farming. ➢ End-to-end farm management systems.

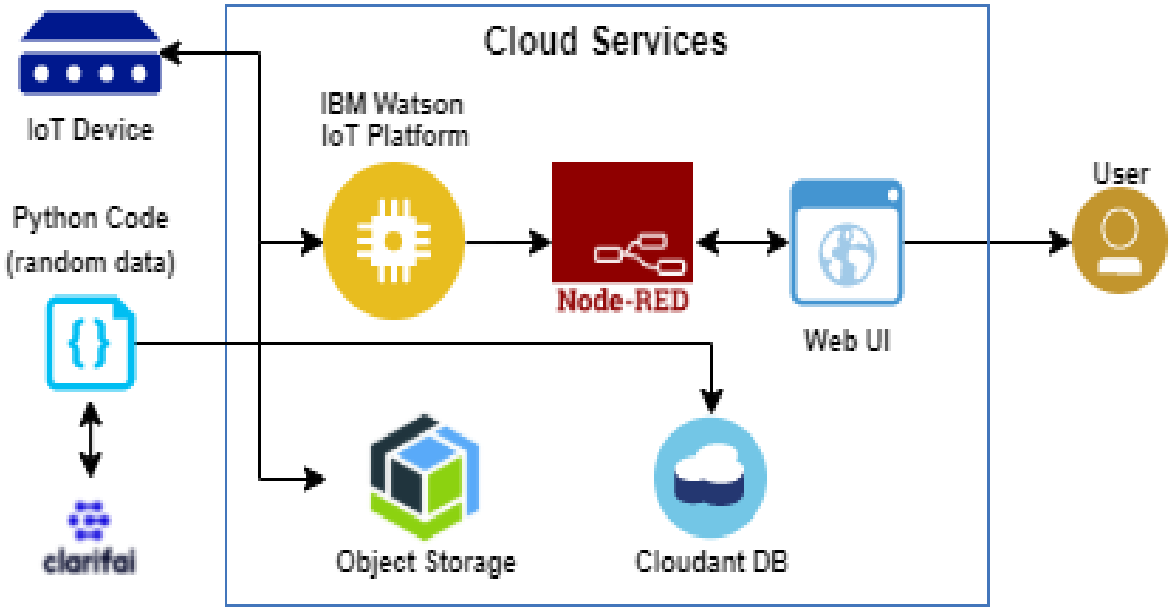
PROJECT DESIGN

Data Flow Diagram:

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



Solution & Technical Architecture:



User Stories:

User Type	Functional requirement	User story number	User story/task	Acceptance criteria	Priority	Release
Customer (Mobile user, Web user, Care executive, Administrator)	Registration	USN-1	As a user, I can register for the application by entering my mail, password, and confirming my password	I can access my account/ Dashboard	High	Sprint-1
		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	Sprint-1
	Dashboard	USN-3	As a user, I can register for the application through internet	I can register & access the Dashboard with Internet Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail	I can confirm The registration in Gmail	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password	I can login with my ID and password	High	Sprint-1

PROJECT PLANNING & SCHEDULING

Sprint Planning & Estimation:

TITLE	DESCRIPTION	DATE
Literature Survey& Information Gathering	Literature survey on the selected project & gathering information by referring the, technical papers, research publications etc.	28 SEPTEMBER 2022
Prepare Empathy Map	Prepare Empathy Map Canvas to capture the user Pains & Gains, Prepare list ofproblem statements	24 SEPTEMBER 2022
Ideation	List by organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.	25 SEPTEMBER 2022
Proposed Solution	Prepare the proposed solution document, which includes the novelty, feasibility of idea, business model, social impact, scalability of solution, etc.	23 SEPTEMBER 2022
Problem Solution Fit	Prepare problem - solutionfit document.	30 SEPTEMBER 2022
Solution Architecture	Prepare solution architecture document.	28 SEPTEMBER 2022

Customer Journey	Prepare the customer journey maps to understand the user interactions & experiences with the application (entry toexit).	20 OCTOBER 2022
Functional Requirement	Prepare the functional requirement document.	8 OCTOBER 2022
Data Flow Diagrams	Draw the data flow diagrams and submit for review.	9 OCTOBER 2022
Technology Architecture	Prepare the technology architecture diagram.	10 OCTOBER 2022
Prepare Milestone & Activity List	Prepare the milestones & activity list of the project.	22 OCTOBER 2022
Project Development - Delivery of Sprint-1, 2, 3 & 4	Develop & submit the developed code by testing it.	IN PROGRESS..

Sprint Delivery Schedule:

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirmingmy password.	3	High	R. Jothika
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	2	High	R. Durga Sri
Sprint-2	Cloud Service	USN-3	As a user, I can register for the applicationthrough Facebook or any social media	1	Low	C. Suriya
Sprint-4		USN-4	As a user, I can register for the application through Gmail / web service	2	Medium	R. Durga Sri
Sprint-3	Login	USN-5	As a user, I can log into the application by entering email & password	4	High	R. Soundharya
Sprint-2	Pre processing	USN-6	As a farmer, the user must be able to find the system easy to access so the Prep-processes and other task must be perfect	3	High	C. Suriya
Sprint-1	Collecting Dataset	USN-7	To collect various sources of animal threats and keep developing a dataset using Clarifai.	3	Medium	R. Jothika

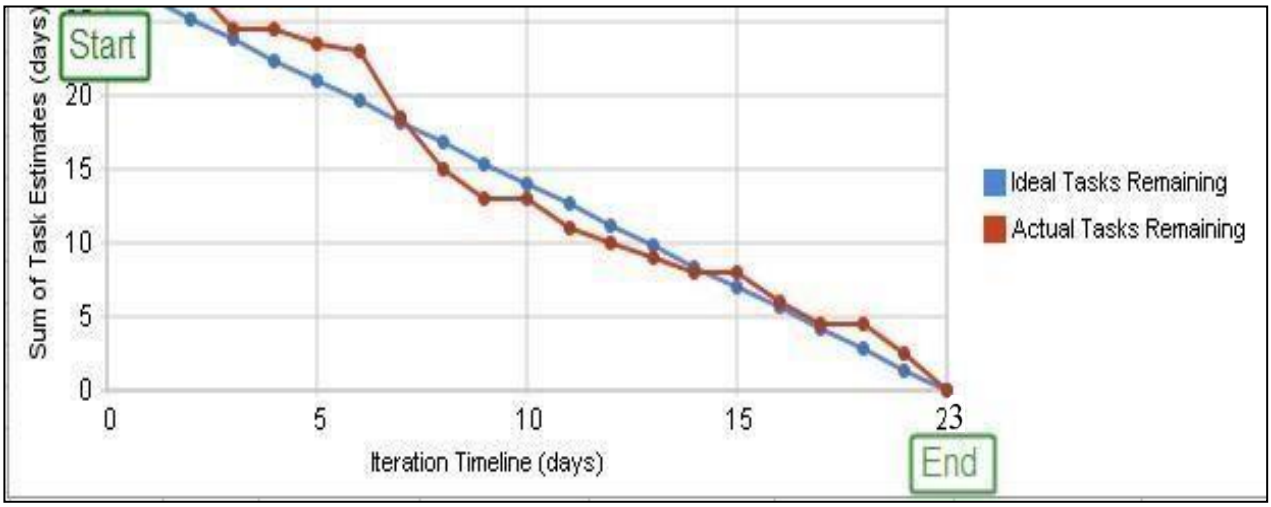
Sprint-4	Integrating	USN-8	To integrate the available dataset and keepimproving the accuracy of finding animals	2	Medium	C. Suriya
Sprint-3		USN-9	To find and use appropriate compiler to run and test the data so that we can implement our program	1	Low	R. Durga Sri
Sprint-2		USN-10	Request AVS Engineering College to deploythe project in our campus and test	1	Low	C. Suriya

Project Tracker, Velocity & Burndown Chart:

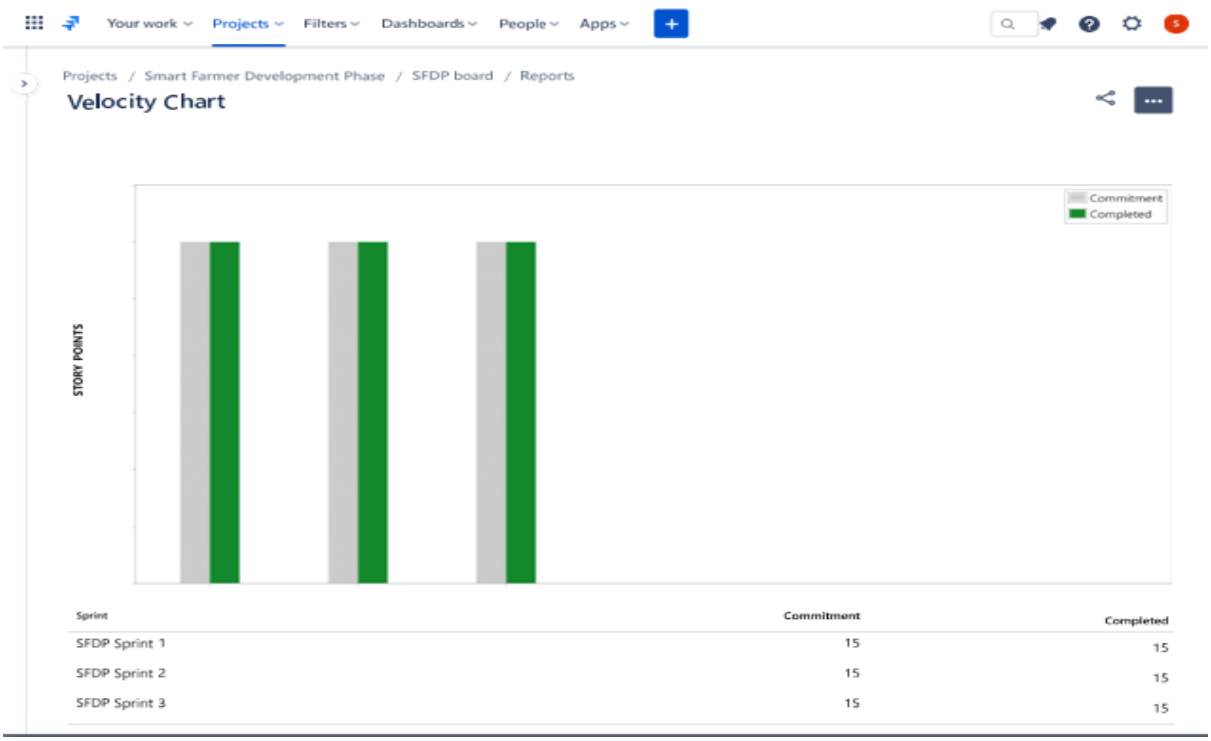
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	20Oct 2022	24 Oct 2022	20	21 Oct 2022
Sprint-2	20	6 Days	25 Oct 2022	29 Oct 2022	20	27 Oct 2022
Sprint-3	20	6 Days	31 Oct 2022	4 Nov 2022	20	2 Nov 2022
Sprint-4	20	6 Days	5 Nov 2022	11 Nov 2022	20	8 Nov 2022

Velocity:

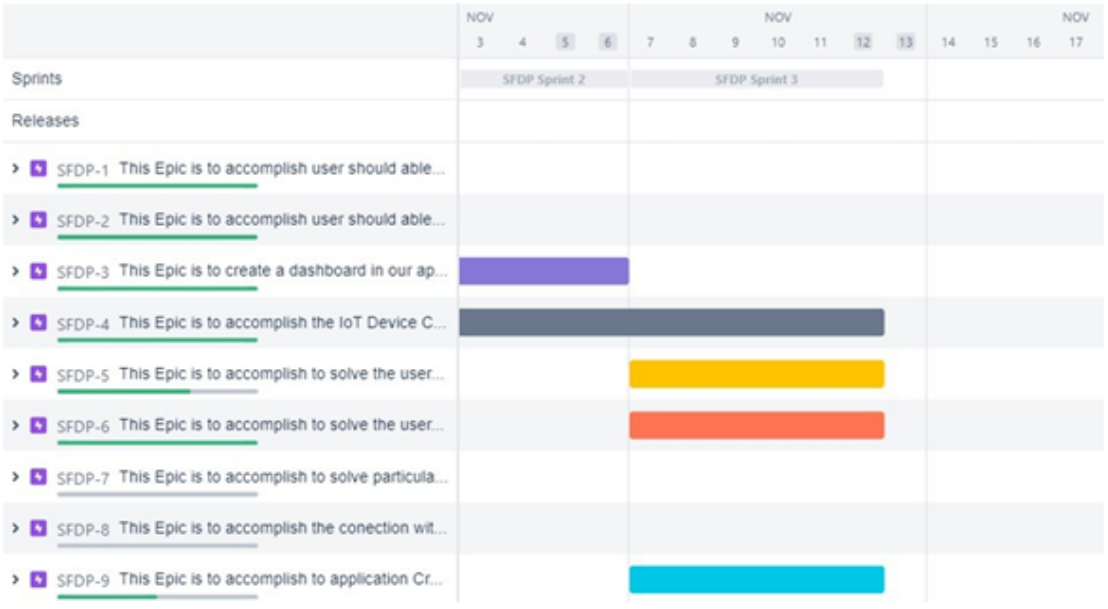
Imagine we have a 23-day sprint duration and the velocity of the team is 20 (points per sprint). Let's calculate the team's average velocity(AV) per iteration unit(story points per day)



Reports from JIRA:



Sprint	Commitment	Completed
SFDP Sprint 1	15	15
SFDP Sprint 2	15	15
SFDP Sprint 3	15	15



Activate Windows
Go to Settings to activate Windows.

CODING & SOLUTIONING

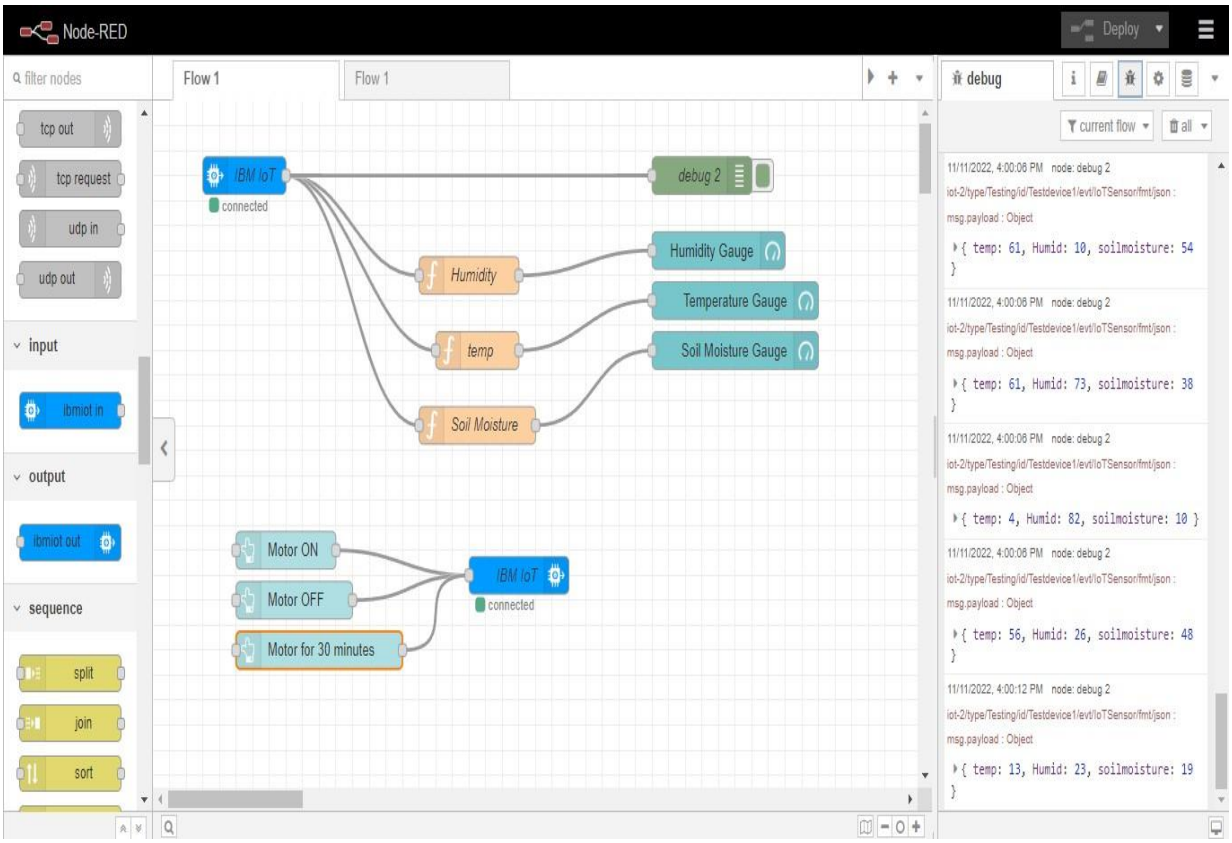
Feature 1:

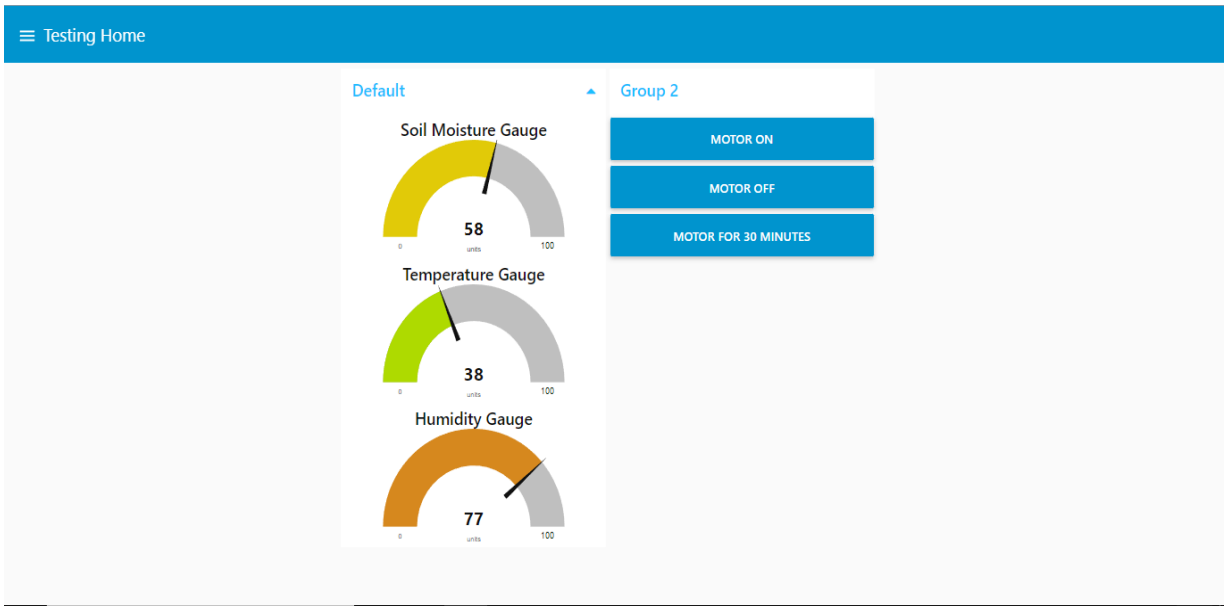
```
import time
import sys
import ibmiotf.application
import ibmiotf.device
import random

#Provide your IBM Watson Device Credentials
organization = "x0fxss" #replace the ORG ID
deviceType = "Testing"#replace the Device type wi
deviceId = "Testdevice1"#replace Device ID
authMethod = "token"
authToken = "123456789" #Replace the authtoken
# Initialize GPIO

#Receives Command from Node-red
def myCommandCallback(cmd):
    print ("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="motoron":
        print ("motor is on")
    elif status == "motoroff" :
        print ("motor is off")
    elif status == "motor30" :
        print ("motor is on for 30 minutes")

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

```
except Exception as e:
    print("Caught exception connecting device: %s" % str(e))
    sys.exit()

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

while True:
        #Get Sensor Data from DHT11

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

        data = { 'temp' : temp, 'Humid': Humid, 'soilmoisture': soilmoisture }
        #print data
        def myOnPublishCallback():
            print ("Published Temperature = %s C" % temp, "Humidity = %s %%" % Humid, "soilmoisture = %s %%"
%soilmoisture, "to IBM Watson")

        success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on_publish=myOnPublishCallback)
        if not success:
            print("Not connected to IoTF")
        time.sleep(5)

        deviceCli.commandCallback = myCommandCallback

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

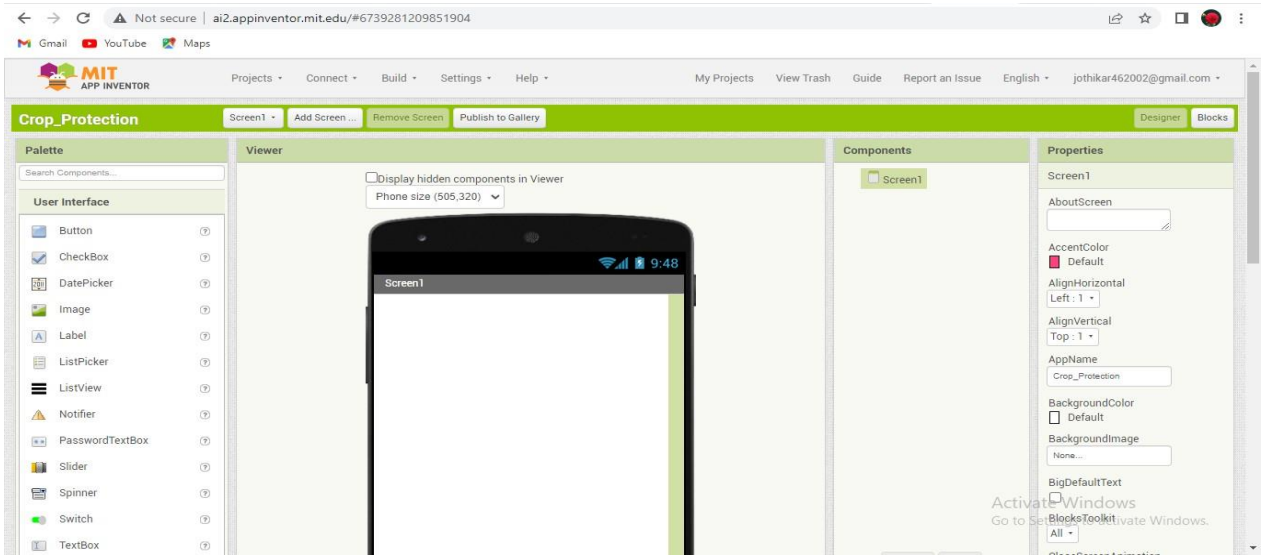
```
*Python 3.7.0 Shell*
File  Edit  Shell  Debug  Options  Window  Help
Python 3.7.0 (v3.7.0:1bf9cc5093, Jun 27 2018, 04:59:51) [MSC v.1914 64 bit (AMD64)] on win32
Type "copyright", "credits" or "license()" for more information.
>>>
======== RESTART: C:\Users\charu\Downloads\ibmiotpublishsubscribe.py ========
2022-11-11 15:56:49,907   ibmiotf.device.Client      INFO    Connected successfully: d:x0fxss:Testing:Testdevice1
Published Temperature = 8 C Humidity = 44 % soilmoisture = 3 % to IBM Watson
Published Temperature = 13 C Humidity = 95 % soilmoisture = 43 % to IBM Watson
Published Temperature = 78 C Humidity = 83 % soilmoisture = 83 % to IBM Watson
Published Temperature = 100 C Humidity = 52 % soilmoisture = 60 % to IBM Watson
Published Temperature = 45 C Humidity = 93 % soilmoisture = 16 % to IBM Watson
Published Temperature = 53 C Humidity = 12 % soilmoisture = 59 % to IBM Watson
Published Temperature = 15 C Humidity = 49 % soilmoisture = 32 % to IBM Watson
Published Temperature = 37 C Humidity = 73 % soilmoisture = 25 % to IBM Watson
```

Node-RED:

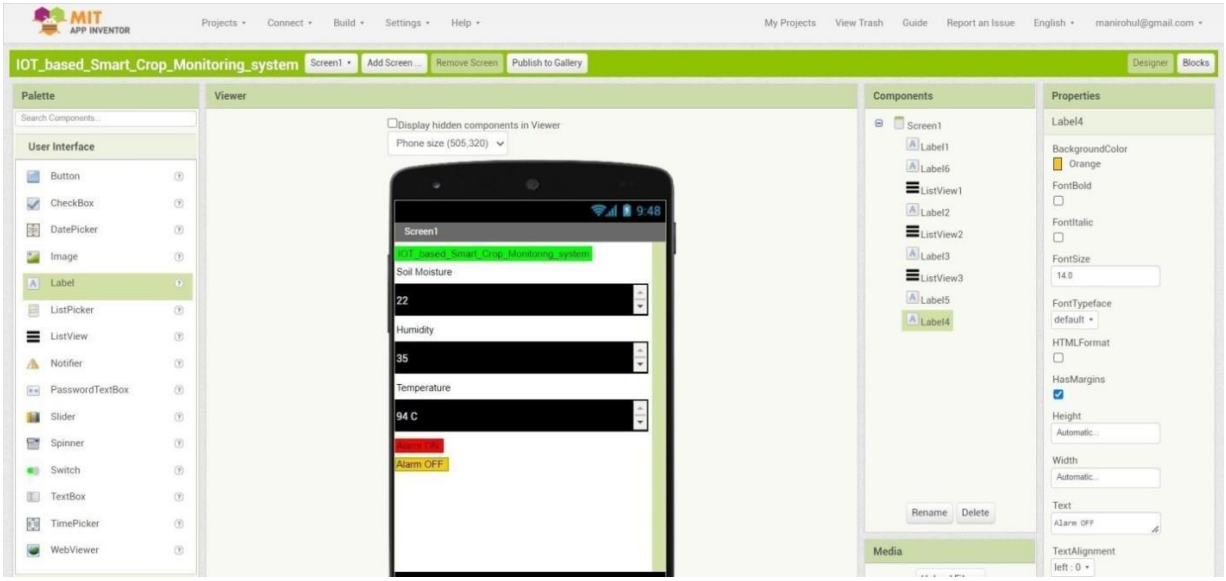



Testing Home
Default
Soil Moisture Gauge
58
Temperature Gauge
38
Humidity Gauge
77
Group 2
MOTOR ON
MOTOR OFF
MOTOR FOR 30 MINUTES

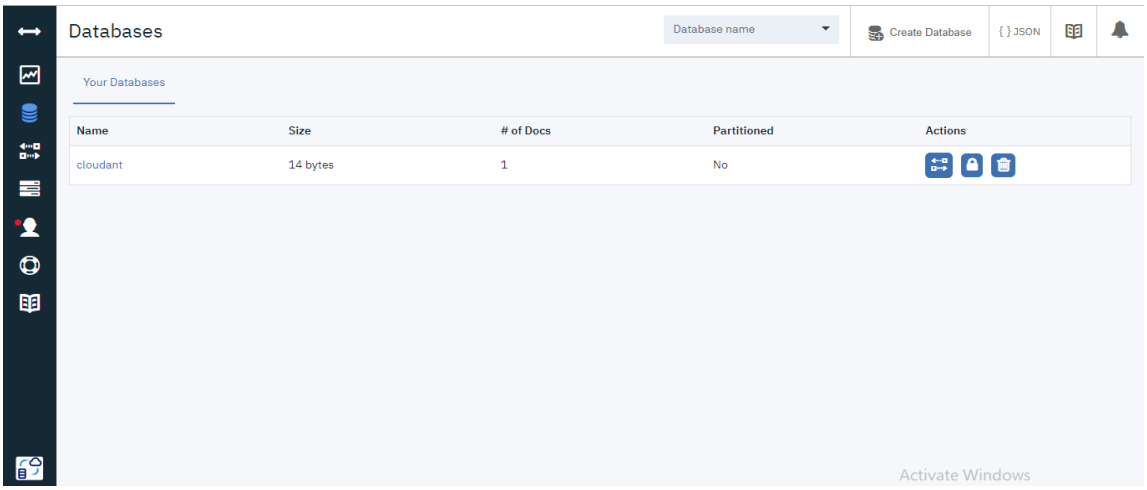
Feature 2

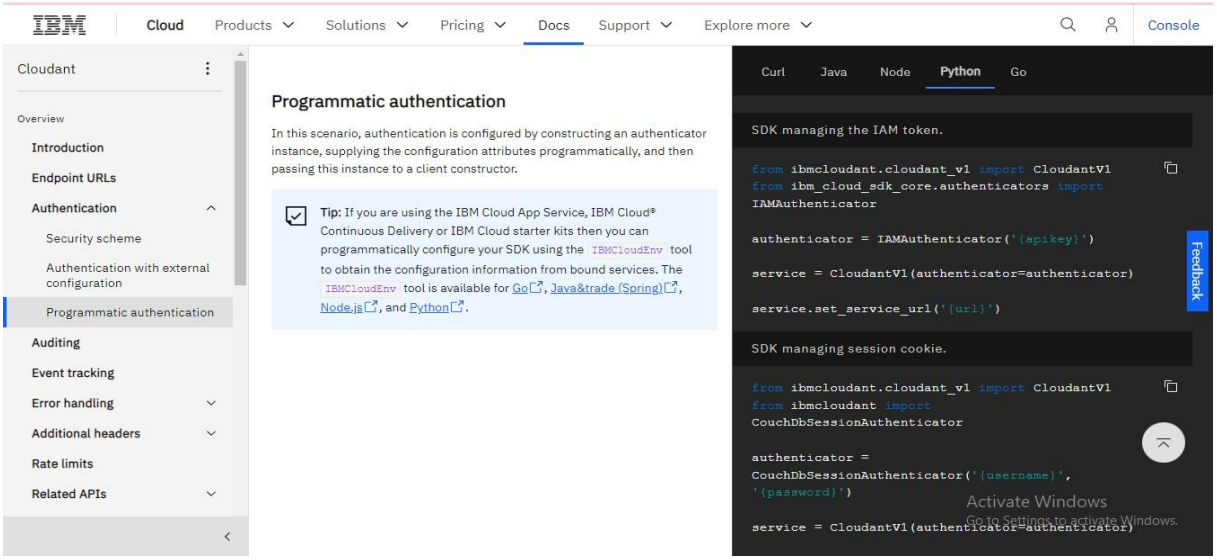

Crop_Protection
Palette
Viewer
Components
Properties
Screen1
Display hidden components in Viewer
Phone size (505,320)
User Interface
Button
CheckBox
DatePicker
Image
Label
ListPicker
ListView
Notifier
PasswordTextBox
Slider
Spinner
Switch
TextBox


User Interface
Layout
HorizontalArrangement
HorizontalScrollArrangement
TableArrangement
VerticalArrangement
VerticalScrollArrangement
Media
Drawing and Animation
Maps
Charts
Sensors
Social
Storage
Connectivity
LEGO® MINDSTORMS®
Experimental
Extension
Phone size (505,320)
HALl AC
Temerature: NA
Humidity: NA
Switch Board
Light ON
Light OFF



Database Scheme:





TESTING

Defect Analysis

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

Resolution	Severity 1	Severity 2	Severity 3	Severity 4	Subtotal
By Design	11	4	2	2	19
Duplicate	1	1	2	0	4
External	2	3	0	1	6
Fixed	10	2	3	20	35
Not Reproduced	0	0	2	0	2
Skipped	0	0	2	1	3
Won't Fix	0	5	2	1	8
Totals	24	15	13	25	77

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	5	0	1	4
Client Application	47	0	2	45
Security	3	0	0	3
Outsource Shipping	2	0	0	2
Exception Reporting	11	0	2	9
Final Report Output	5	0	0	5
Version Control	3	0	1	2

RESULT:

We have successfully built an **" IOT Based Smart Crop Protection System for Agriculture"** and integrated all the services using Node-RED.

ADVANTAGES & DISADVANTAGES

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.
- Many difficult challenges can be avoided making the process automated and the quality of crops can be maintained.
- The process included in farming can be controlled using the web application from anywhere and anytime.

Disadvantages:

- Smart Crop Protection requires internet connectivity continuously, but rural parts can't fulfilled this requirement.

1. Any faults in the sensors can cause great loss in the agriculture, due to wrong records and the actions of automated processes.
2. IoT Devices need more cost to implement.

CONCLUSION

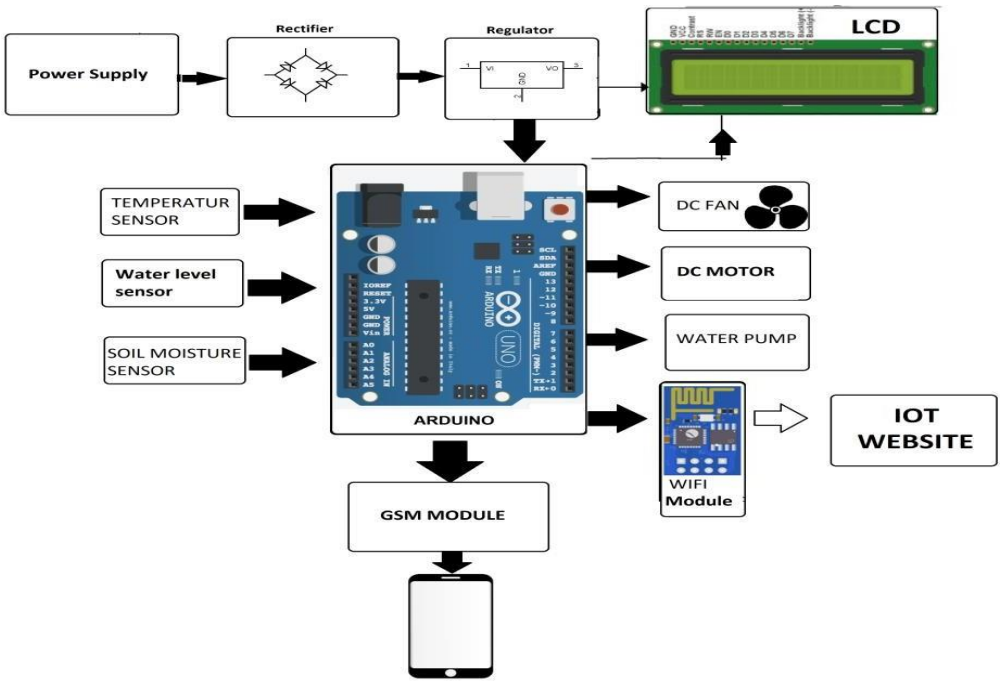
IoT based Smart Crop Protection System for Agriculture for Live monitoring of temperature and soil moisture and to control motor and light remotely has been proposed using Node-RED and IBM Cloud Platform. The system has high efficiency and accuracy in fetching the live data of temperature and soil moisture. The IoT based smart farming system being proposed via this project will assist farmers in increasing the agriculture yield and take efficient care of food production as the system will always provide to help farmer for getting accurate live feed of environmental temperature and soil moisture with more than 99% accurate results. Therefore, the project propose a thought of consolidating the most recent innovation into the agrarian field to turn the customary techniques for water system to current strategies in this way making simple profitable and temperate trimming.

FUTURE SCOPE

In future due to demand of good and more farming in less time, for betterment of the crops and reducing the usage of extravagant resources like electricity and water IoT can be implemented in most of the places.

APPENDIX

Solution Architecture Diagram



GitHub Link: https://github.com/IBM-EPBL/IBM-Project-44769-1660726627