

FINAL DELIVERABLES

PROJECT REPORT

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Team ID

PNT2022TMID33206

Project Name

IoT Based Smart Crop Protection System for Agriculture.

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IOT BASED SMART CROP PROTECTION SYSTEM FOR AGRICULTURE

I. Introduction:

1. Project Objectives:

- 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.

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

.II.

Literature Survey:

1. Existing problem:

Crops in the farms are many times devastated by the wild as well as domestic animals and low productivity of crops is one of the reasons for this. It is not possible

to stay 24 hours in the farm to guard the crops.

2. References:

[1] Dr.M. Chandra ,Mohan Reddy,
KeerthiRajuKamakshiKodi,
BabithaAnapalliMounikaPulla, "SMART CROP
PROTECTION SYSTEM FROM LIVING
OBJECTS AND FIRE USING ARDUINO",
Science, Technology and Development,
Volume IX Issue IX ,pg.no 261-265,Sept 2020.

[2] Anjana ,Sowmya , Charan Kumar , Monisha ,
Sahana, " Review on IoT in Agricultural Crop
Protection and Power Generation",
International Research Journal of Engineering
and Technology (IRJET) , Volume 06, Issue 11
,Nov 2019.

[3] G. NaveenB

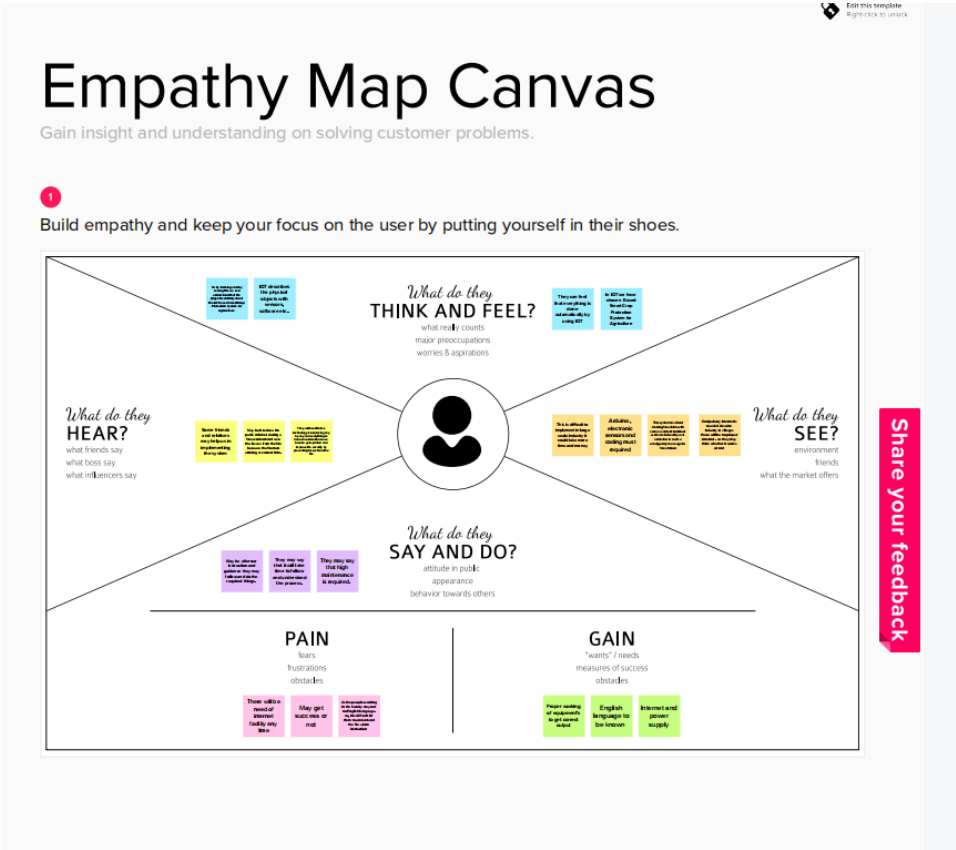
3. Problem statement:

Problem Statement (PS)	I am (Customer)	I am trying to	But	Because	Which makes me feel
PS-1	Farmer	Checking the developing condition	It includes chance on related gear and get it the utilize of innovation	Requires more information and abilities	Chafed
PS-2	Farmer	Keen and exactness water system	Climates changes to expanded support of	Acquiring and introducing costs tall	Appropriate for mass trim assurance

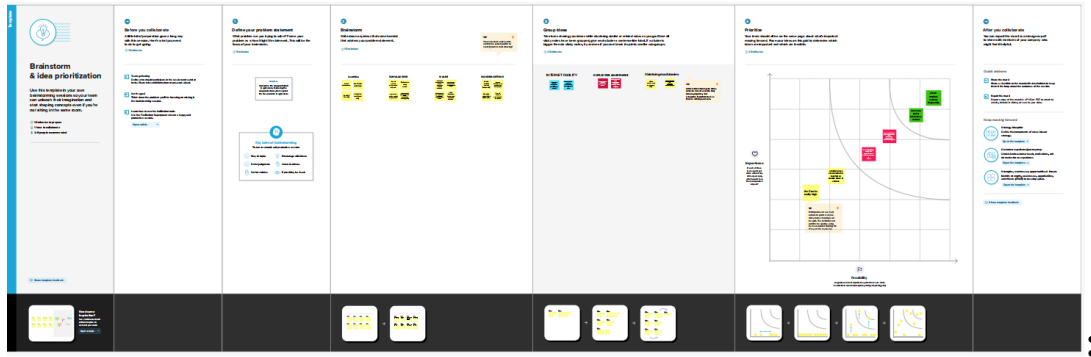
			channels		
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III. IDEATION & PROPOSED SOLUTION

1. Empathy Map



2. Ideation & Brainstorming



3. Proposed Solution:

S. No	Parameter	Description
1	Problem Statement (Problem to be solved)	Low productiveness is due to crop ruined by means of untamed weather conditions untamed animal attacks, small types of species, insects, some hazardous snakes and weather circumstances.
2	Idea/Solution description	To implement crop protection in agriculture based on IOT using Arduino board with DHT 11 Humidity & Temperature Sensor, PIR sensor, LDR sensor, HC-SR04 Ultrasonic. All the sensors and camera are link-up with ARM Cortex-A.
3	Novelty/Uniqueness	A message shall be produced robotically to the recorded cellular quantity making use of a SIM900A to the admin.
4	Social Impact/Customer Satisfaction	It early prevents the crop and field from animal attacks, small types of species, insects, some hazardous snakes and weather circumstances.

5	Business Model (Revenue Model)	This product can be utilized by farmers and is a productive and helpful item in agriculture for preventing crop from animal attacks, small types of species, insects, some hazardous snakes and weather circumstances.
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6.	Scalability of the Solution	It is trying to execute this technique as we need to introduce on Arduino gadget which was modified with an Arduino that takes received signals from sensors. Easy maintenance. Cost is very low
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4. Problem Solution fit:

Define CS, fit into CL	1. CUSTOMER SEGMENT(S) CS Farmers ! Who's not close to his or her field	6. CUSTOMER LIMITATIONS CL <small>EG. BUDGET, DEVICES</small> 1) High appropriation costs , security concerns. 2) Not mindful of the usage of IOT in horticulture	5. AVAILABLE SOLUTIONS AS <small>PLUSES & MINUSES</small> Screen distinctive parameters and versatile or web application make effectively to cultivate the trim field .	Explore AS, differentiate
	2. PROBLEMS / PAINS PR <small>+ ITS FREQUENCY</small> It's troublesome to screen and control. Ain't known the application doesn't work appropriately.	9. PROBLEM ROOT / CAUSE RC 1) If temperature ,PH level ,stickiness & light escalated makes the genuine cause for the environment. 2) Farmer influenced by less efficiency which is able influence in their benefit.	7. BEHAVIOR BE <small>+ ITS INTENSITY</small> Coordinate related: Tries to discover a arrangement to anticipate this issue Indirect related: Found in provincial where web network might not be solid sufficient to encourage quick transmission speeds	
Identify strong TR & EM	3. TRIGGERS TO ACT TR Make openings to lift individuals out of destitution in creating countries.	10. YOUR SOLUTION SL <i>"IOT based Keen trim security framework for agriculture" !!</i> It offer assistance agriculturists develop more nourishment on less arrive by security crops from bugs, illnesses and weeds as well as raising efficiency per hectare.	8. CHANNELS of BEHAVIOR CH ONLINE: The Information send through application for the ranchers to know approximately the ranches. OFFLINE: The control activity is taken by the ranchers to screen the ranches.	Extract online & offline CH of BE
	4. EMOTIONS EM <small>BEFORE / AFTER</small> BEFORE: Funds, Overwhelming work over-burden and strife in relationship. AFTER: It'll simpler to form more Abdicate in field.			

IV. REQUIREMENT ANALYSIS:

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 website google mail
FR-2	User Confirmation	Confirmation by means of Email or phone number OTP
FR-3	User Login	Login through site or App using respective username and password
FR-4	User Access	Get to the app prerequisites
FR-5	User Upload	Client got to be able to transfer the data
FR-6	User Solution	Information report ought to be produced and conveyed to client for per each 24 hours
FR-7	User Data Sync	API interface to extend to receipt framework

Non-functional Requirements:

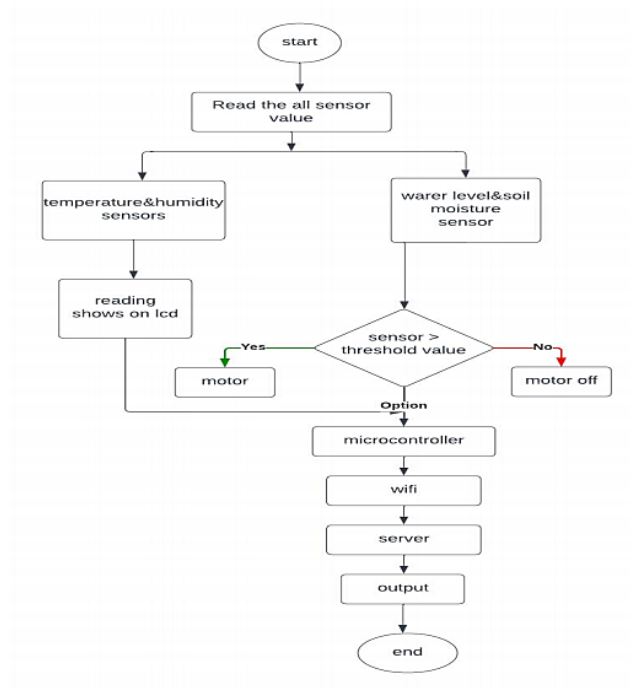
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Ease of use necessities can consider languagebarriers and localization assignments. Ease ofuse can be assessed from the underneath capacities. Productivity of use. Low seen workload. Simple and straightforward UI.
NFR-2	Security	Access permissions for the particular systeminformation may only be changed by the system's data administrator.

NFR-3	Reliability	The database update process must roll back all related updates when any update fails.
NFR-4	Performance	The front-page stack time must be no more than 2 seconds for clients that get to the site utilizing an VoLTE versatile connection.
NFR-5	Availability	Modern module arrangement mustn't affect front page, item pages, and check out pages availability and mustn't take longer than one hour. The rest of the pages that will experience problems must show a notice with a timer showing when the framework is attending to be up once more
NFR-6	Scalability	Ready to increment adaptability by including memory, servers, or disk space. On the other hand, we can compress information, utilize optimizing calculations. The website participation restrain must be adaptable enough to bolster 500,000 clients at a time

V. PROJECT DESIGN:

1. Data Flow Diagrams:



2. Solution & Technical Architecture:

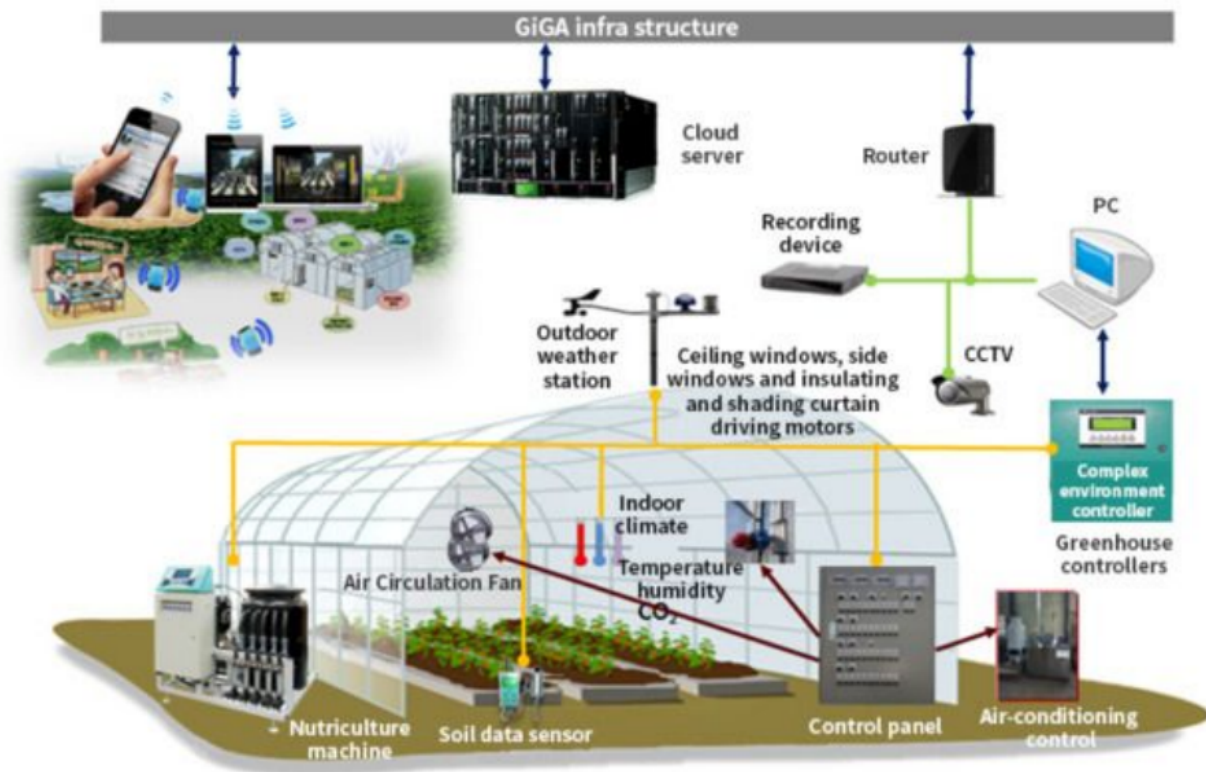


Table-1 : Components & Technologies:

S.No	Component	Description	Technology

1.	User Interface	User interacts with application and websites e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript / Angular Js / React Js etc.
2.	Application Logic-1	Logic for a process in the application	Python
3.	Application Logic-2	Logic for a process in the application	IBM Watson STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
5.	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
6.	Cloud Database	Database Service on Cloud	IBM DB2, IBM Cloudant etc.
7.	Database	Data Type, Configurations etc.	MySQL, NoSQL, etc.
8.	External API-1	Purpose of External API used in the application	Node-RED API ,IBM Weather API, etc.
9.	External API-2	Purpose of External API used in the application	Bot API, Third party API ,etc.
10.	Machine Learning Model	Purpose of Machine Learning Model	Object Recognition Model, ML ,etc.
11.	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
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1.	Open-Source Frameworks	List the open-source frameworks used	Python of Opensource framework
2.	Security Implementations	List all the security /access controls implemented, use offirewalls etc.	eg. SHA-256, Encryptions, IAM Controls, OWASP etc.
3.	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	AIT echnology used
4.	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	IBM DB2Technologyused
5.	Performance	Design consideration for the performance of the application (number of requests per sec, use of Cache, use of CDN's) etc.	CWMP/USP Technology used

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	Release
Customer	Installation	USN-1	As a user, I can install the crop protection device in every agriculture field	I can do it by myself	High	Sprint-1
Customer	Power connection	USN-2	As a user, I want ensure power supply for all devices	I will ensure it	High	Sprint-2
Customer	Safety	USN-3	As a user, I want to ensure that the devices should not be in contact with water	I will ensure that	High	Sprint-3
Customer	Battery Status	USN-4	As a user, I want check the battery status monthly once	I can assure that	Medium	Sprint-4
Customer	Internet Connectivity	USN-5	As a user, I want to check the internet connectivity	I will ensure that	High	Sprint-5

VI. PROJECT PLANNING & SCHEDULING:

1. Sprint Planning & Estimation:

Product Backlog, Sprint Schedule, and Estimation (4 Marks)

Use the below template to create product backlog and sprint schedule

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	US-1	Make the IBM Cloud administrations which are being utilized in this extend.	6	High	Keerthika, Mahalakshmi

Sprint-1	Registration	US-2	Arrange the IBM Cloud administrations which are being utilized in completing this extend.	4	Medium	Malini, Manoranjitham
Sprint-2	Login	US-3	IBM Watson IoT stage acts as the arbiter to put through the net application to IoT gadgets, so make the IBM Watson IoT stage.	5	Medium	Keerthika
Sprint-2	View	US-4	In arrange to associate the IoT gadget to the IBM cloud, makea gadget within the IBM Watson	5	High	Mahalakshmi

			IoT stage and get the gadget qualifications.			
Sprint-3	Actions	US-1	Arrange the association security and make API keys that are utilized within the Node-RED benefit for getting to the IBM IoT Stage.	10	High	Malini
Sprint-3	Actions	US-2	Make a Node-RED service.	10	High	Manoranjitham

Sprint-3	Actions	US-1	Create a python script to distribute irregular sensor information such as temperature, dampness, soil and stickiness to the IBM IoT stage	7	High	Keerthika
Sprint-3	Management	US-2	After creating python code, commands are gotten fair print the articulations which speak to the control of the gadgets.	5	Medium	Mahalakshmi
Sprint-4	Testing	US-3	Distribute Information to The IBM Cloud	8	High	Malini
Sprint-4	Testing	US-1	make Web UI in Node- Red	10	High	Manoranjitham
Sprint-4	Testing	US-2	Arrange the Node- information from th conjointly utilize C to store the gotten within the cloudant	10	High	Keerthika

Project Planning Phase

Milestone & Activity List

TITLE	DESCRIPTION	DATE
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Literature Survey on TheSelected Project and Information Gathering	A Writing Overview could be a compilation rundown of investigate done already within the given point. Writing overview can be taken from books, term paper online or from any source.	7 October 2022
Prepare Empathy Map	Compassion Outline may be a visualization tool which can be utilized to urge distant better;a muchbetter ,a higher ,a stronger ,an improved a distant better knowledge of the client	8 October 2022
Ideation-Brainstorming	Conceptualizing could be a gather issue tackling session where thoughtsare shared, talked about and organized among the group individuals.	9 October 2022
Define Problem Statement	A Issue Explanation could be a brief portrayal of the issue or issues a extend looks for to address. The problem articulation distinguishes thecurrent state, the required future state and any holes between the two.	2 NOV 2022
Problem Solution Fit	This makes a difference us to get it the contemplations of the client their likes, behavior, feelings etc.	9 October 2022
Proposed Solution	Proposed arrangement appears thecurrent arrangement and it makes adifference is going towards the required result until it is accomplished.	10 October 2022

Solution Architecture	Arrangement Design could be a exceptionally complex prepare I.e it features a part of sub-processes and branches. It makes a difference in understanding the components and highlights to total our extend.	11 October 2022
Customer Journey	It makes a difference us to analyze from the point of view of a client, who employments our venture.	17 October 2022
Solution Requirement	Here utilitarian and nonfunctional prerequisites are briefed. It has particular highlights like ease of use, security, unwavering quality, execution, accessibility and adaptability.	
Data Flow Diagrams	Information Stream Chart could be a graphical or visual representation employing a standardized set of images and documentations to portray a business's operations through information development.	18 October 2022
Technology Architecture	Innovation Engineering may be a more well characterized adaptation of arrangement engineering. It makes a difference us analyze and get it various technologies that has to be executed within the venture.	19 October 2022
Prepare Milestone & Activity List	It makes a difference us to get it and assess our possess advance and exactness so distant.	2 NOV 2022

Spring Delivery Plan	Sprint arranging is an occasion in scrum that kicks off the sprint. The reason of sprint arranging is to characterize what can be conveyed within the sprint and how that work will be accomplished.	In Progress
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VII. CODING & SOLUTIONING:

1. Feature 1:

IoT based smart crop protection system was implemented using traditional farming concepts and it has a user interfacing system to monitor the temperature humidity and moisture level of the soil. It enables smart farming through that the farmer can access the environmental parameters. The Random module used to generate the values for moisture, temperature and humidity. These values are further sent to the Watson platform.

2. Feature 2:

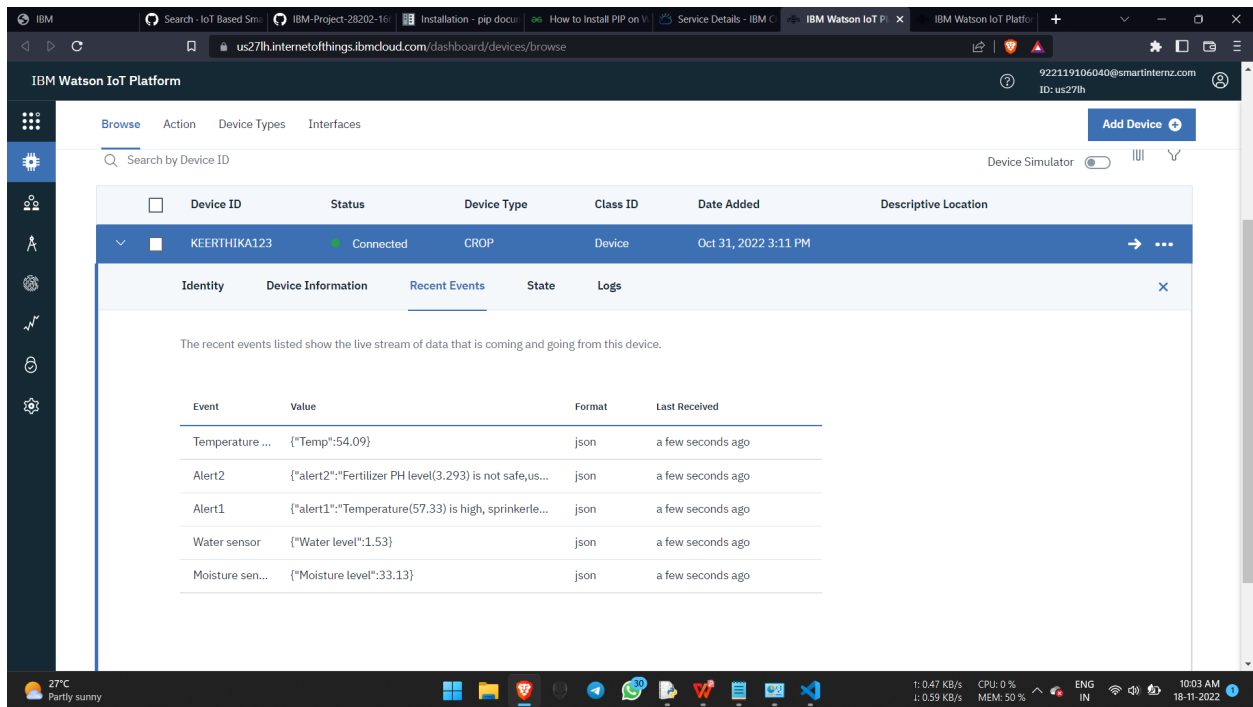
Further the smart crop protection system was enhanced by creating the user interface. Node red web user interface and MIT app inventor were used to create the user interface. The data from the python script were stored in Watson and the animal detected information were uploaded in the object storage. The opencv2 module is used to capture the animal picture in the field and alter message will be sent to the farmer through the web user interface and mobile application.

3. Database Schema:



IBM Watson IoT platform:

Random temperature, humidity, and moisture values are generated using the python code and the values are sent to the IBM cloud. IBM cloud sends those values to the node red and shown in the node red dashboard



► Cloud object storage :

This is the cloud storage area where we can store the images of the detected animal.

VIII. TESTING

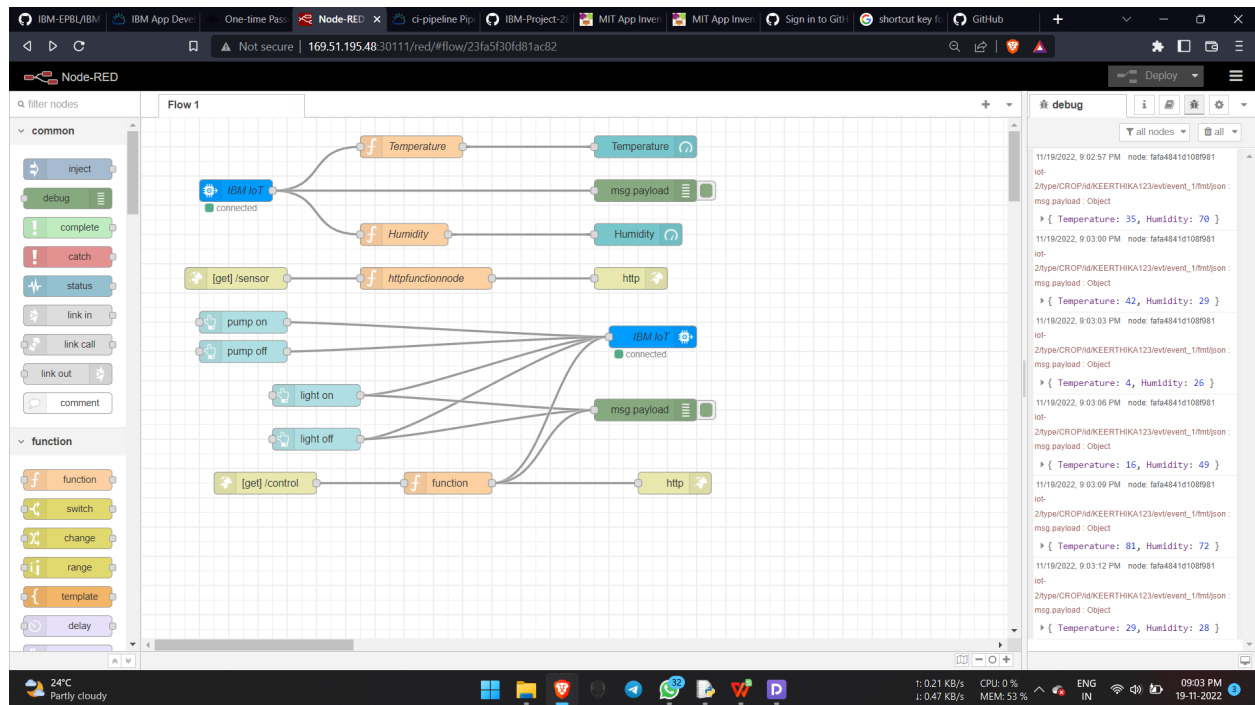
► Python code testing:

```
Python 3.7.0 Shell
File Edit Shell Debug Options Window Help
.....publish ok.....
Published Temp = 32.94 C to IBM Watson
Published PH value = 5.134 to IBM Watson
Published Animal attack NOT Detected to IBM Watson
Published Flame Detected to IBM Watson
Published Moisture level = 95.19 to IBM Watson
Published Water level = 11.94 cm to IBM Watson

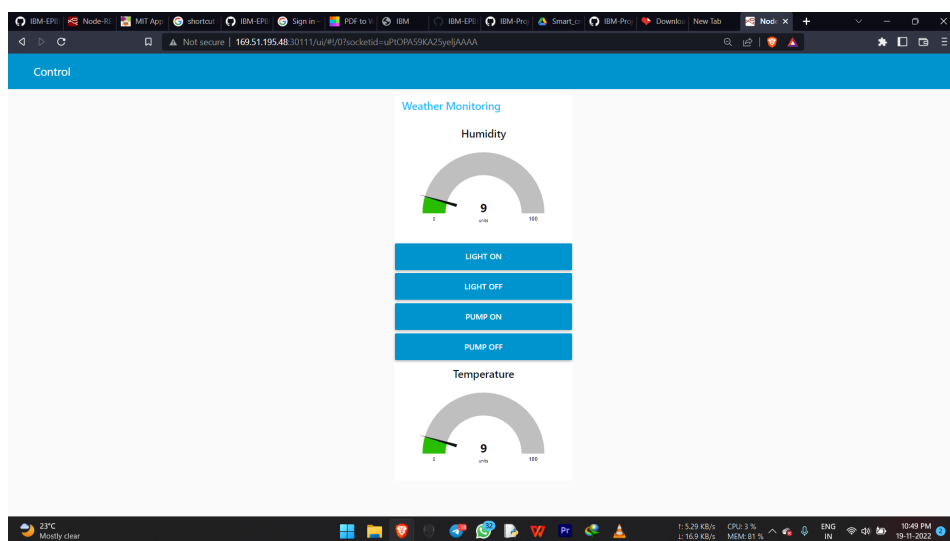
Published Alert1 : Temperature(32.94) is high, sprinklers are turned ON to IBM Watson
Published Alert2 : Fertilizer PH level(5.134) is not safe,use other fertilizer to IBM Watson
Published Alert3 : Animal attack on crops detected to IBM Watson to IBM Watson
sprinkler-1 is ON
Published Alert4 : Flame is detected crops are in danger,sprinklers turned ON to IBM Watson
Published Alert5 : Moisture level(95.19) is low, Irrigation started to IBM Watson
Published Alert6 : water level(11.94) is high, so motor is ON to take water out to IBM Watson
.....publish ok.....
Published Temp = 49.52 C to IBM Watson
Published PH value = 6.618 to IBM Watson
Published Animal attack NOT Detected to IBM Watson
Published Flame NOT Detected to IBM Watson
Published Moisture level = 91.51 to IBM Watson
Published Water level = 4.95 cm to IBM Watson

sprinkler-2 is ON
Published Alert1 : Temperature(49.52) is high, sprinklers are turned ON to IBM Watson
Published Alert2 : Fertilizer PH level(6.618) is not safe,use other fertilizer to IBM Watson
Published Alert3 : Animal attack on crops detected to IBM Watson to IBM Watson
Published Alert4 : Flame is detected crops are in danger,sprinklers turned ON to IBM Watson
Published Alert5 : Moisture level(91.51) is low, Irrigation started to IBM Watson
Published Alert6 : water level(4.95) is high, so motor is ON to take water out to IBM Watson
.....publish ok.....
Published Temp = 72.51 C to IBM Watson
Published PH value = 13.042 to IBM Watson
Published Animal attack NOT Detected to IBM Watson
```

► Node-red testing: *Connection and output,*

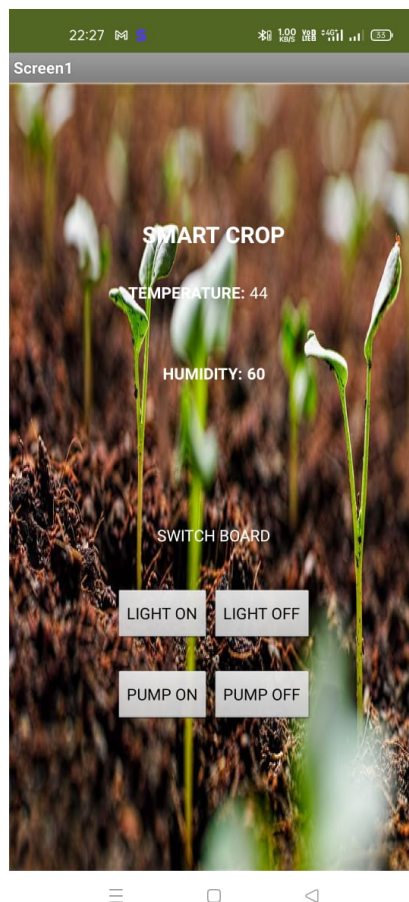


Web application testing:



[illegible]

Dashboard Page:



IX. ADVANTAGES & DISADVANTAGES:

1. ADVANTAGES:

- 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.
- High reliance.
- Enhanced Security

2. DISADVANTAGES:

- Farms are located in remote areas and are far from access to the internet.
- A farmer needs to have access to crop data reliably at any time from any location, so connection issues would cause an advanced monitoring system to be useless.
- High Cost
- Equipment needed to implement IoT in agriculture is expensive

X. CONCLUSION

As a result of this system, we can detect the changes in the field easily and intimate the farmers about it and also, we can take precautions and do remedies accordingly. Here we use very low power consuming highly efficient components that give us accurate results and also, they perform at low data rate conditions without any lag and help in finding the remedies. This crop protection system helps

in detection of all kinds of external dangers and it saves time and money to the farmers before any loss that may occur. With the help of this system the farmers can be in a peaceful environment at ease without any pressure.

XI. FUTURE SCOPE:

Study and analysis of the developed Crop protection systems for its cost effectiveness with the development of Arduino based variable frequency Ultrasonic bird deterrent circuit. outline of the crop damage caused by a particular Wild animal if the behavioural features of the with the reduced cost in the smart phones.

XII. APPENDIX:

1. Source code:

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

#Provide your IBM Watson Device Credentials
organization = "us27lh"
deviceType = "CROP"
deviceId = "KEERTHIKA123"
authMethod = "token"
authToken = "keekkee123"

# Initialize GPIO
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="lighton":
        print ("led is on")
    elif status == "lightoff":
        print ("led is off")
    else :
        print ("please send proper command")
    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(90,110)
        Humid=random.randint(60,100)
        data = { 'temp' : temp, 'Humid': Humid }
        #print data
```



```
def myOnPublishCallback():
    print ("Published Temperature = %s C" % temp, "Humidity = %s %" % Humid, "to IBM Watson")
    success = deviceCli.publishEvent("IoTSensor", "json", data, qos=0, on_publish=myOnPublishCallback)
    if not success:
        print("Not connected to IoT")
        time.sleep(10)
    deviceCli.commandCallback = myCommandCallback
    # Disconnect the device and application from the cloud
    deviceCli.disconnect()
```

➤ GITHUB LINK:

<https://github.com/IBM-EPBL/IBM-Project-2322-1658469743>

➤ PROJECT DEMO: