IOT BASED SMART CROP PROTECTION SYSTEM

TEAM ID: PNT2022TMID11064

1. INTRODUCTION

Agriculture is a pillar of India's economy and deserves security. Security and protection are required at the very initial stage, like protection from attacks of rodents or insects in the fields and as well as grain stores.Those challenges also need to be taken into account. The security systems that are used today are not smart enough to deliver real-time notification after detecting the problem. Climate change, soil erosion and loss of biodiversity also increases the pressure of farmers and a drastic decrease in the crop production.

Project Overview

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. The device will detect the animals and birds using the Clarified 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.

Purpose

The Main motive of this project is to protect the various agriculture field from factors such as birds,animals,insects and other climatic conditions.This system helps the crops to protect from ravaging animals also birds feeding into newly growing crops ,This system can also find the increase in water in level during extreme rain .With this system the surrounding temperature ,humidity, moisture content etc… can also be detected.

2. LITERATURE SURVEY

Existing problem

As new technologies has been introduced and utilized in modern world, there is a need to bring advancement in the sector of agriculture also. Various Researches have been undergone to enhance crop cultivation and are widely used. So as to enhance the crop productivity efficiently, it is necessary to monitor the environmental conditions in and around the field. The parameters that has to be exact monitored to enhance the yield are soil characteristics, weather conditions, moisture, temperature, etc., Internet of Things (IOT) is being utilized in a number of real time applications. The introduction of Internet of thing (IOT) along with the sensor network in framre furbishes the traditional way of farming. Online crop monitoring the use of IOT helps the farmers to stay related to his subject from somewhere and anytime. Various sensors are used to screen and collect records about the area conditions. Collectively the about the farm circumstance is disbursed to the farmer thru GSM technology.

References

[1] Official webpage of the European Smart crop protection System at:
http://effis.jrc.ec.europa.eu/
[2] Official webpage of the Copernicus Earth Observation Programme at:
http://www.copernicus.eu
[3] Forest Fires in Europe, Middle East and North Africa 2016, JRC Science for policy report,
BN 978-92-79-71292-0, ISSN 1831-9424, doi:10.2760/17690, availabe at:
http://effis.jrc.ec.europa.eu/media/cms_page_media/40/Smart_Crop_i
n_Europe_Middle_east_and_North_Africa_2016_final_pdf_JZU7He L.pdf
[4] The 2018 Attica wildfires Wikipedia webpage available at
https://en.wikipedia.org/wiki/2018_Attica_wildfires

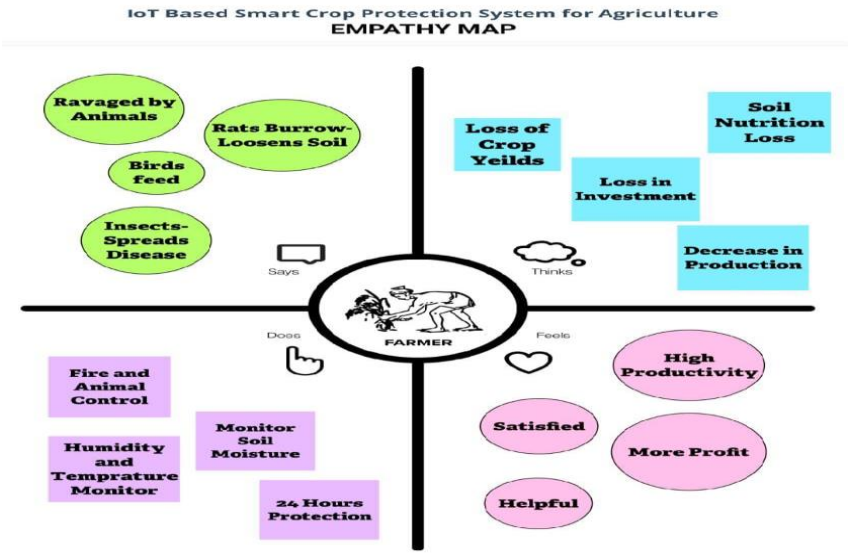
Problem Statement Definition

The problem of wild life attack on crops i.e., Animals,Birds cause a lot of damage to crops by running over them, eating and completely vandalizing them. This lead to poor yield of crops and significant financial loss to the owners of the farmland.

3. IDEATION AND PROPOSED SOLUTION

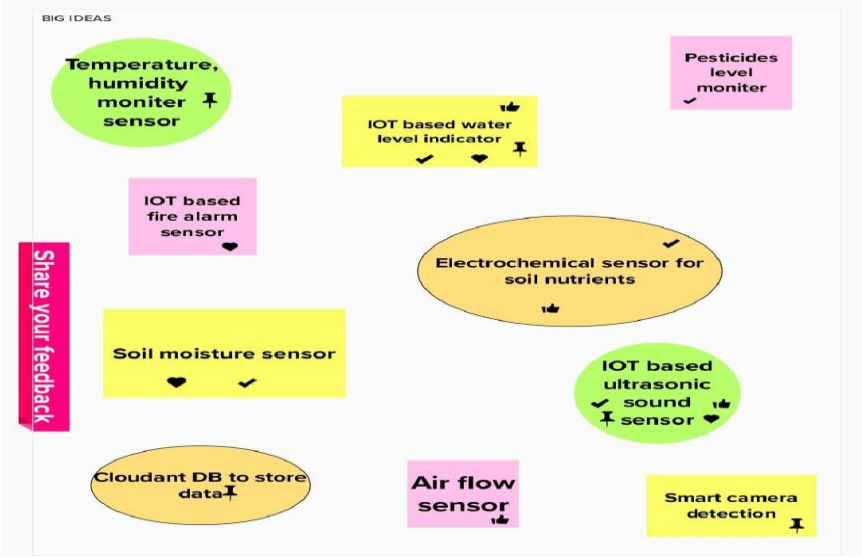
Empathy Map Canvas

An empathy map canvas is a more in-depth version of the original empathy map, which helps identify and describe the user's needs and pain points.



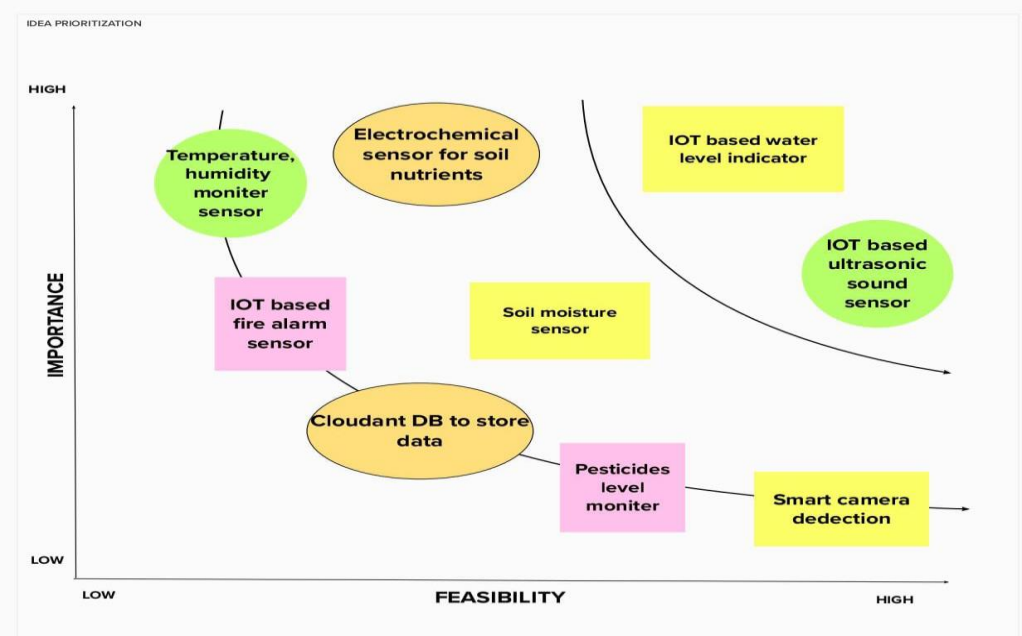
Big Ideas

It consists of all the ideas of instruments and equipments that we are going to implement in this project.

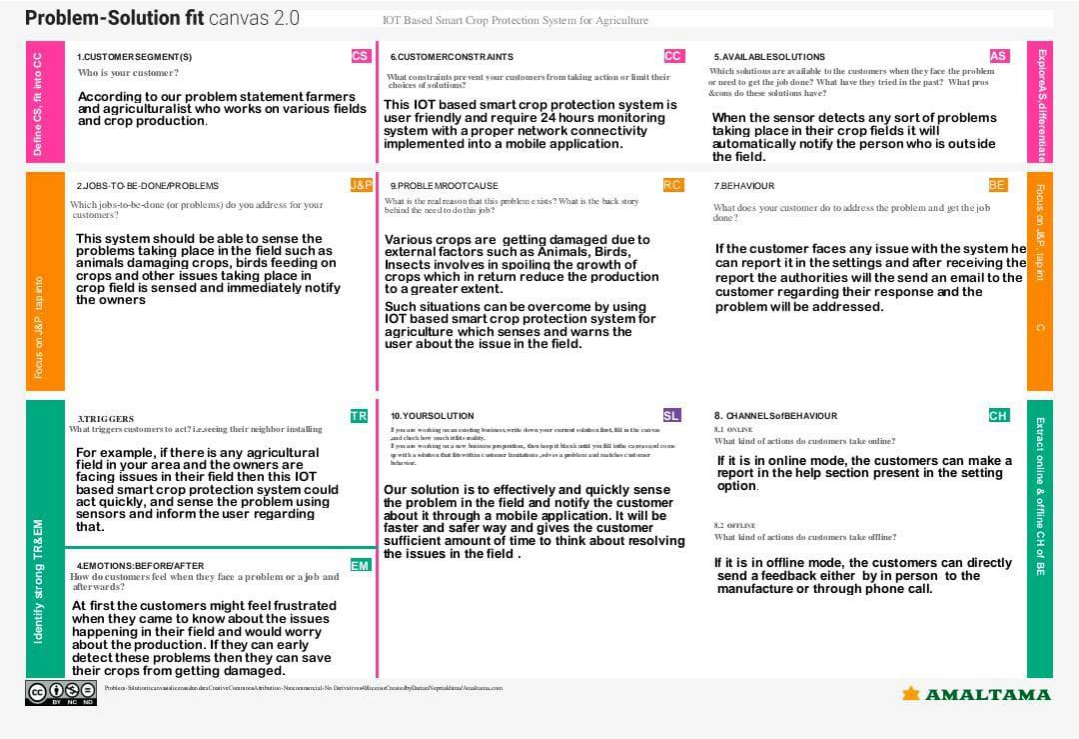


Idea Prioritization

It deals with the prioritizing of the big ideas in order of highest to lowest likes.



Problem Solution Fit



Proposed Solution

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	The aim is to Find the Emerging methods for Early Detection of Forest Fires (Using Artificial Intelligence).
2.	Idea / Solution description	**IDEA:** The idea is to create a system that can detect the forest fire and to give an alert message using twilio numbers and give an alert alarm sound using playsound. **SOLUTION:** The model using the pretrained image is constructed using Deep Learning technologies by CNN 2dconv networks to make detection more accurate and then this model is connected with the Open CV2 to make detection in video and images that was being captured then when the presence of fire an immediate alert message was sent to registered twilio account and following that an alert sound is played on the device.
3.	Novelty / Uniqueness	The system developed was very accurate as it can accurately detect and it is unique as idea was not yet developed.
4.	Social Impact / Customer Satisfaction	As forest fire was an important social impact that can cause many effects in living surroundings almost every living matters are affected by forest fire ,So our developed model can used for prior information about the forest fire to avoid it or to take safety prevention and to make alert of the peoples in the affected area.
5.	Business Model (Revenue Model)	This model is an economical model it can used in the place where the problems arises due to fire so that our model can detect perfectly to make prior warnings.

4. REQUIREMENT ANALYSIS

Functional Requirements

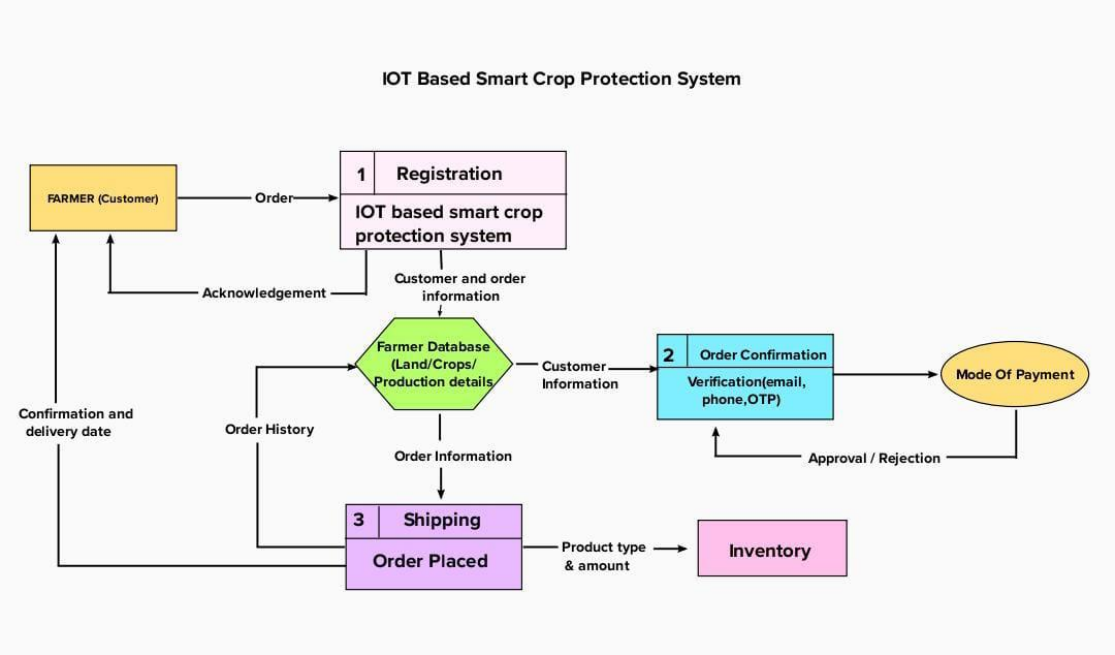
FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	**User Requirements**	Crop Protection Automatic Sprinkler System Monitors Soil Moisture ,Humidity and Temperature
FR-2	**User Registration**	Manual Registration Registration through webpage Registration through Form Registration through Gmail
FR-3	**User Confirmation**	Confirmation via Phone Confirmation via Email Confirmation via OTP
FR-4	**Payment Options**	Cash on Delivery Net Banking/UPI Credit/Debit/ATM Card
FR-5	**Product Delivery and Installation**	Door Step delivery Take away Free Installation and 1 year Warranty
FR-6	**Product Feedback**	Through Webpage Through Phone calls Through Google forms

Non Functional Requirements

FR No.	Non-Functional Requirement	Description
NFR-1	**Usability**	Have a clear and self-explanatory manual. Easier to use Even an illiterate farmer have to use the product without any difficulties
NFR-2	**Security**	Application has to be secured with 2 step authorisation Passwords and passkeys will be assigned as per the users need.
NFR-3	**Reliability**	Hardware requires a regular checking and service Software may be updated periodically Immediate alert is provided in case of any system failure
NFR-4	**Performance**	The application must have a good user interface It should have a minimal energy requirement It has to save water and energy
NFR-5	**Availability**	All the features will be available when the user requires. It depends on the need of the farmer and the customization the user has done.
NFR-6	**Scalability**	The product has to cover all the space of land irrespective of the size or area of a farm field.

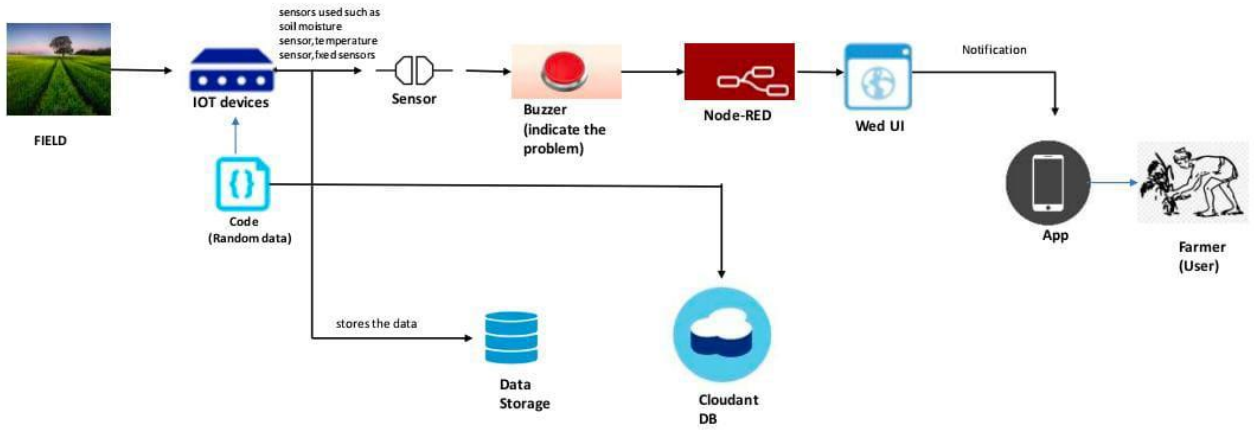
5. PROJECT DESIGN

Data Flow Diagram



Solution Architecture

Solution Architecture Diagram:



Architecture and data flow of the IoT Based Smart Crop Protection System For Agriculture

Customer Journey Map

IoT Based Smart Crop Protection System For Agriculture

Phases	Phase 1 Motivation	Phase 2 Information gathering	Phase 3 Analyzes various products	Phase 4 Chooses the most efficient product	Phase 5 Product Evaluation	Phase 6 Payment
Activities Performed	Wants to protect the crops and to improve the productivity.	Wants to buy an efficient product and hence searches on various websites.	Categorize and prioritize products according to their need and depends on various factors like scalability and quality .	Finalise the product that comes under all the mandatory categories.	Checks for previous customers feedbacks and also tests the product manually.	Credits the payment for the chosen product.
Emotions	Motivated and Enthusiastic as they are going to find a solution for their problem.	Interested and Excited as they are learning about new things.	Confused as they are going through various similar models.	Happy as they finalised one among many.	Satisfaction as the product works good.	Relief as they completes the payment procedure.
Overall Experiences						
Customer Expectations	Easy availability of resources in better cost and quality.	Best and trusted source of informations.	Availability of various products with better specifiactions.	Have to be perfect in all the required aspects.	User friendly product with top notch quality and efficiency.	Various Payment options and a waranty assurance.

6. PROJECT PLANNING PHASE

Product Backlog, Sprint Schedule, and Estimation

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 confirming my password.	2	High	NANDHINI N
Sprint-1	Confirmation	USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	NANDHINI N
Sprint-1	Registration	USN-3	As a user, I can register for the application through Facebook	2	Low	NANDHINI N
Sprint-1	Registration	USN-4	As a user, I can register for the application through Gmail	2	Medium	ROSHANA S
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	ROSHANA S
Sprint-1	Dashboard	USN-6	As a user, I can log into the application by entering email & password and access all the resources and services available	2	High	ROSHANA S
Sprint-2	Login	USN-1	As a smart crop protection user, I log into my profileand start monitoring the crop status	3	High	NANDHINI N
Sprint-2	Dashboard	USN-2	I receive all the information about crop, temperature and soil moistur.	2	Medium	PRIYANKA E
Sprint-3	Login	USN-1	As a data controller, I keep note of all the data received from various areas in the field anddetect the problems in the crops.	3	High	NEHA MOHANAN
Sprint-3	Dashboard	USN-2	With the help of sensor it allows farmers to monitor the crops and protect the crops from various factors such as animals birds and then it also notice the appearance of dangerous weeds, pests or diseases timely.	2	Medium	NEHA MOHANAN
Sprint-4	Login	USN-1	As a zonal officer, I ensure the fields periodically by checking the devices and sensors and limit the evolution of pesticides .	3	High	PRIYANKA E
Sprint-4	Login	USN-1	As an administrator, I ensure that all departments work co-ordinated and ensure the accuracy and efficiency.	2	Medium	ROSHANA S

Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart: (4 Marks)

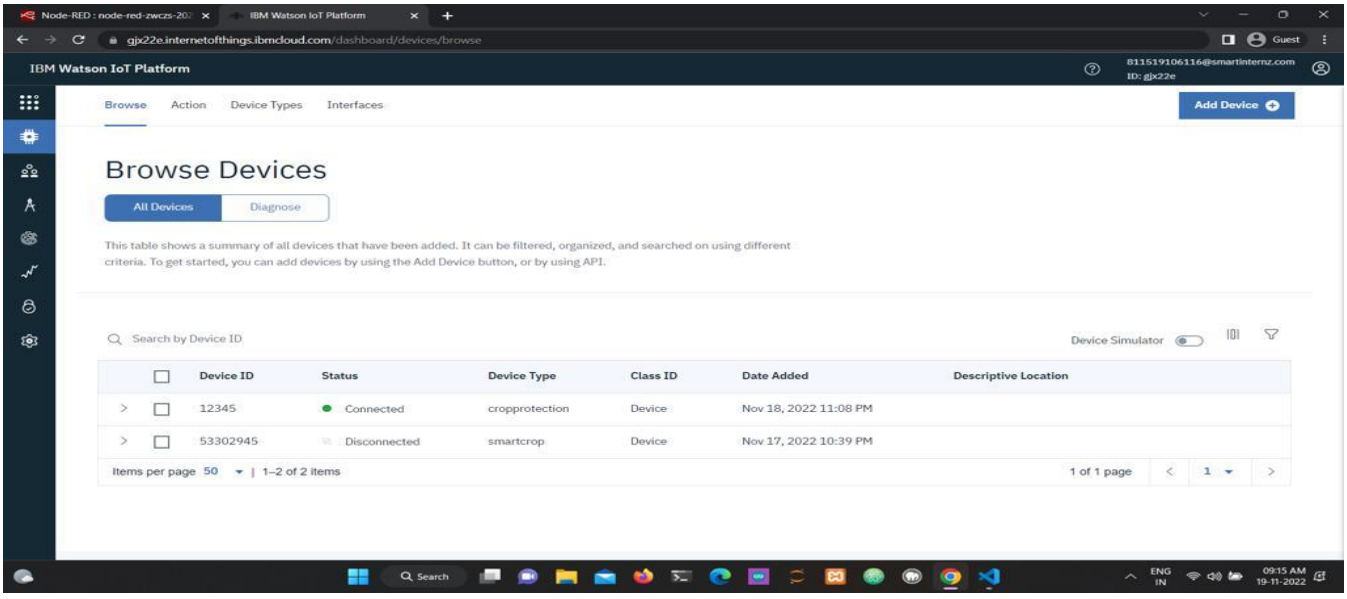
Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	24 Oct 2022	29 Oct 2022	20	29 Oct 2022
Sprint-2	20	6 Days	31 Oct 2022	05 Nov 2022	20	5 Nov 2022
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022		
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022		

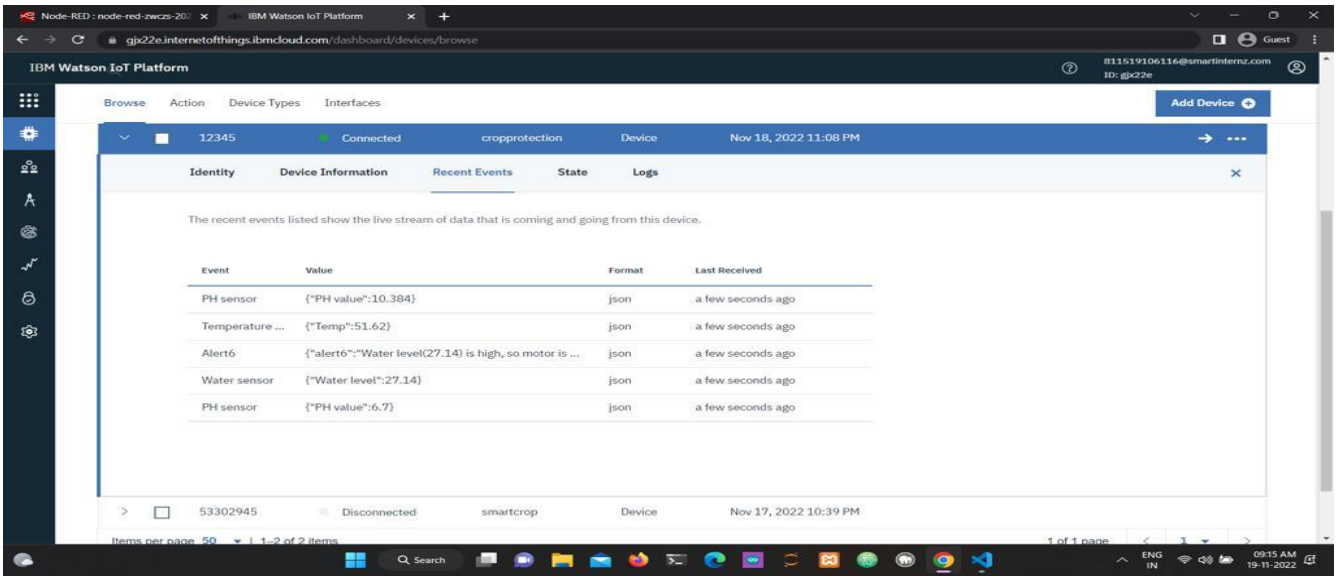
7. CODING AND SOLUTION

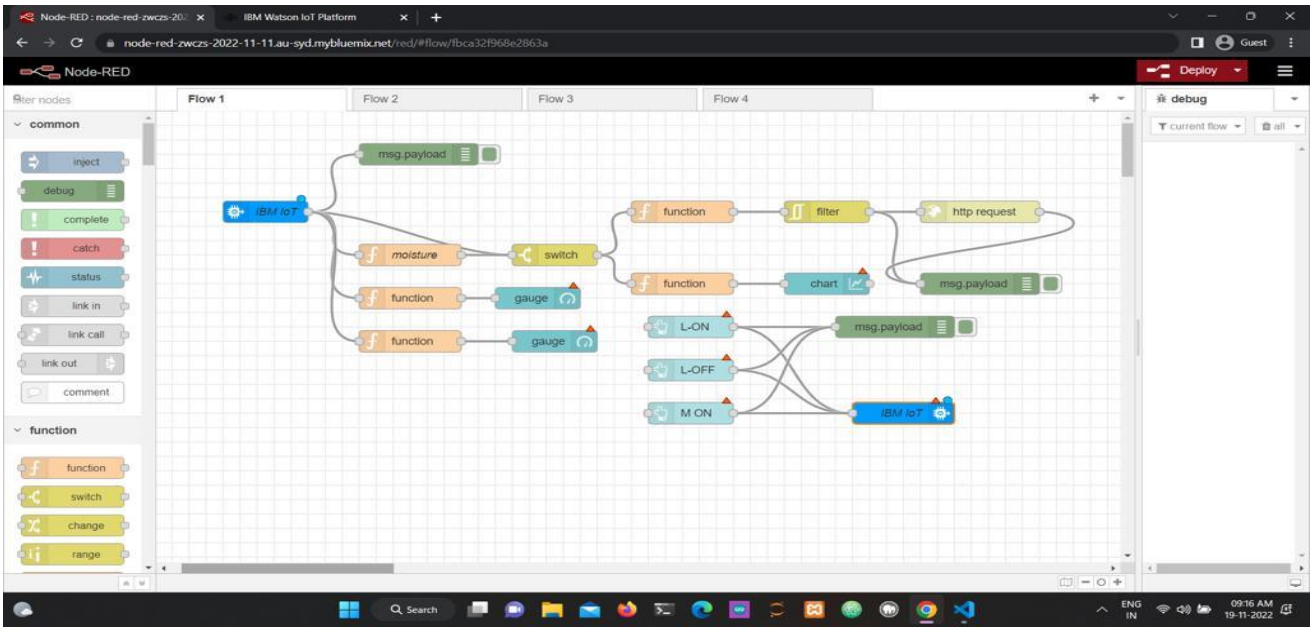
```
import random
import ibmiotf.application
import ibmiotf.device
from time import sleep
import sys

organization = "gjx22e"
deviceType = "cropprotection"
deviceId = "12345"
authMethod = "token"
authToken = "987654321"
def myCommandCallback(cmd):
    print("Command received: %s" % cmd.data['command'])
    status=cmd.data['command']
    if status=="sprinkler_on":
        print ("sprinkler is turning ON")
    else :
        print ("sprinkler is turning OFF")
try:
    deviceOptions = {"org": organization, "type": deviceType, "id": deviceId, "auth-method": authMethod, "auth-
token": authToken}
    deviceCli = ibmiotf.device.Client(deviceOptions)
except Exception as e:
        print("Exception detected in connecting device: %s" % str(e))
        sys.exit()
deviceCli.connect()
while True:
#Getting values from sensors...
    temp_sensor = round( random.uniform(0,80),2)
    PH_sensor = round(random.uniform(1,14),3)
    moist_level = round(random.uniform(0,100),2)
    water_level = round(random.uniform(0,30),2)

    temp_data = { 'Temp' : temp_sensor }
    PH_data = { 'PH value' : PH_sensor }

    moist_data = { 'Moisture level' : moist_level}
    water_data = { 'Water level' : water_level}
```

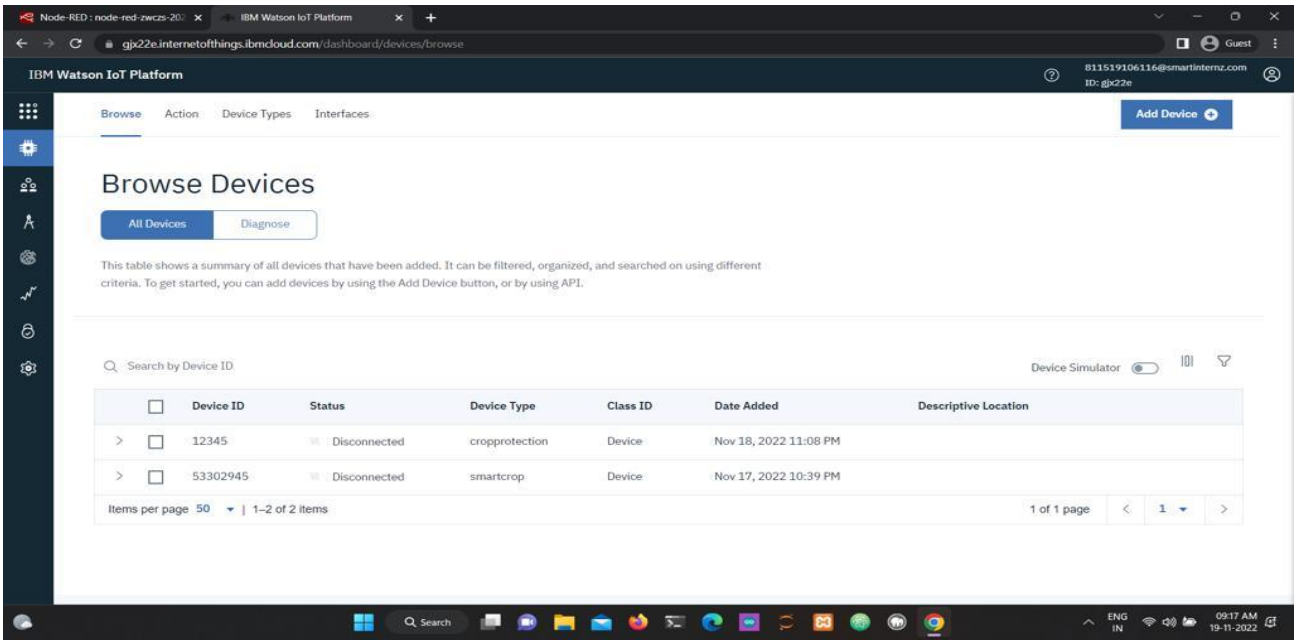
```
    success = deviceCli.publishEvent("Temperature sensor", "json", temp_data, qos=0)
    sleep(1)
    if success:
        print ("... ...publish ok... ... ...")
        print ("Published Temp = %s C" % temp_sensor, "to IBM Watson")
        success = deviceCli.publishEvent("PH sensor", "json", PH_data, qos=0)
        sleep(1)
    if success:
        print ("Published Moisture level = %s " % moist_level, "to IBM Watson")
        success = deviceCli.publishEvent("Water sensor", "json", water_data, qos=0)
        sleep(1)
    if success:
        print ("Published Water level = %s cm" % water_level, "to IBM Watson")
        print ("")

    if (temp_sensor > 35):
        print("sprinkler-1 is ON")
        success = deviceCli.publishEvent("Alert1", "json",{ 'alert1' : "Temperature(%s) is high, sprinkerlers are turned
ON" %temp_sensor }, qos=0)
        sleep(1)
    if success:
        print( 'Published Alert1 : ', "Temperature(%s) is high, sprinkerlers are turned ON" %temp_sensor,"to IBM
Watson")
        print("")
    else:
        print("sprinkler-1 is OFF")
        print("")

    if (PH_sensor > 7.5 or PH_sensor < 5.5):
        success = deviceCli.publishEvent("Alert2", "json",{ 'alert2' : "Fertilizer PH level(%s) is not safe,use other
fertilizer" %PH_sensor } , qos=0)
        sleep(1)
    if success:
        print('Published Alert2 : ' , "Fertilizer PH level(%s) is not safe,use other fertilizer" %PH_sensor,"to IBM
Watson")
        print("")
    else:
        print("sprinkler-2 is OFF")
        print("")
    if (moist_level < 20):
        print("Motor-1 is ON")
        success = deviceCli.publishEvent("Alert5", "json", { 'alert5' : "Moisture level(%s) is low, Irrigation started"
%moist_level }, qos=0)
        sleep(1)
    if success:
        print('Published Alert5 : ' , "Moisture level(%s) is low, Irrigation started" %moist_level,"to IBM Watson" )
        print("")
    else:
        print("Motor-1 is OFF")
        print("")
    if (water_level > 20):
        print("Motor-2 is turning ON")
        success = deviceCli.publishEvent("Alert6", "json", { 'alert6' : "Water level(%s) is high, so motor is ON to take
water out " %water_level }, qos=0)
        sleep(1)
```

```
    if success:
        print('Published Alert6 : ' , "water level(%s) is high, so motor is ON to take water out " %water_level,"to IBM
Watson" )
        print("")
    else:
        print("Motor-2 is turning OFF")
        print("")
deviceCli.commandCallback = myCommandCallback
deviceCli.disconnect()
```

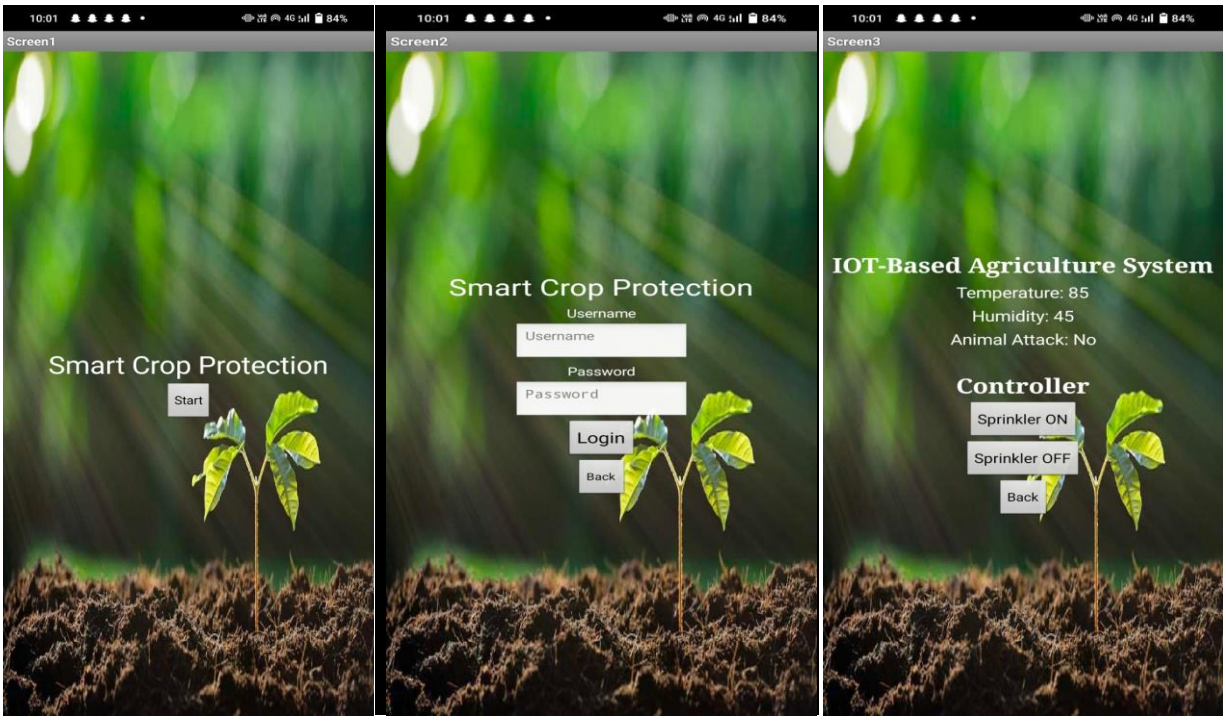





Node-RED : node-red-zwczs-20
IBM Watson IoT Platform
node-red-zwczs-2022-11-11.au-syd.mybluemix.net/red/#flow/fbca32f968e2863a
Guest
Node-RED
Deploy
Flow 1
Flow 2
Flow 3
Flow 4
debug
common
inject
debug
complete
catch
status
link in
link call
link out
comment
function
function
switch
change
range
msg.payload
IBM IoT
moisture
switch
function
gauge
function
gauge
function
filter
http request
function
chart
msg.payload
L-ON
L-OFF
M ON
msg.payload
IBM IoT
Search
ENG
IN
09:16 AM
19-11-2022


Node-RED : node-red-zwczs-20
IBM Watson IoT Platform
gjx22e.internetofthings.ibmcloud.com/dashboard/devices/browse
Guest
IBM Watson IoT Platform
811519106116@smartinternz.com
ID: gjx22e
Browse
Action
Device Types
Interfaces
Add Device
Browse Devices
All Devices
Diagnose
This table shows a summary of all devices that have been added. It can be filtered, organized, and searched on using different criteria. To get started, you can add devices by using the Add Device button, or by using API.
Search by Device ID
Device Simulator
Device ID
Status
Device Type
Class ID
Date Added
Descriptive Location
12345
Disconnected
cropprotection
Device
Nov 18, 2022 11:08 PM
53302945
Disconnected
smartcrop
Device
Nov 17, 2022 10:39 PM
Items per page 50
1–2 of 2 items
1 of 1 page
1
Search
ENG
IN
09:17 AM
19-11-2022

8. OUTPUT IN MOBILE APP



9. ADVANTAGES AND DISADVANTAGES

Advantages :

- Easily detect the problems in the field.
- Most Accurate
- Flexible Model which can give maximized outcome
- No Specific Requirements needed to implement the model

Disadvantages :

- Wind can wreak havoc on sprinklers, directing water in the wrong direction.
- The cost of maintenance becomes high whether there is a repair or not.
- If there are faulty data processing equipment or sensors then it will lead to the situation where the wrong decisions are taken.

10. CONCLUSION

In this paper, we proposed a method for efficient crop monitoring for agricultural field. With the application of IOT the datas can be stored and retrieved from anywhere. In this proposed work, the sensor part is limited only for monitoring of crop. hence in future it can be automated for irrigation and the system can be enhanced with security of farm land under video surveillence which prevents it from obtrude intrusion.

11. FUTURE SCOPE

- It can be developed as a web or Android application.
- In future alternative advanced technology can be implemented.
- Identification and tracking system can be implemented if possible.

12. APPENDIX

GitHub Link: IBM-EPBL/IBM-Project-6403-1658828028

Demo Link: https://youtu.be/qSQ_AbxfA4o