FINAL DELIVERABLES

PROJECT REPORT

Date	25 November 2022
Team ID	PNT2022TMID32468
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:

- **Title:** IOT IN AGRICULTURE CROP PROTECTION AND POWER GENERATION (2020)

  Author: Anjana M, Charan Kumar A, Monisha R, Sahana R H

- **Title:** IOT BASED CROP PROTECTION SYSTEM AGAINST AND WILD ANIMAL ATTACKS (2020)

  Author: Navaneetha P, RamiyaDevi R, Vennila S, Manikandan P, Dr. Saravanan S

- **Title:** SMART CROP PROTECTION SYSTEM (2021)

  Author: Krunal Mahajan, Riya Parate, Ekta Zade, Shubham Khante, Shishir Bagal

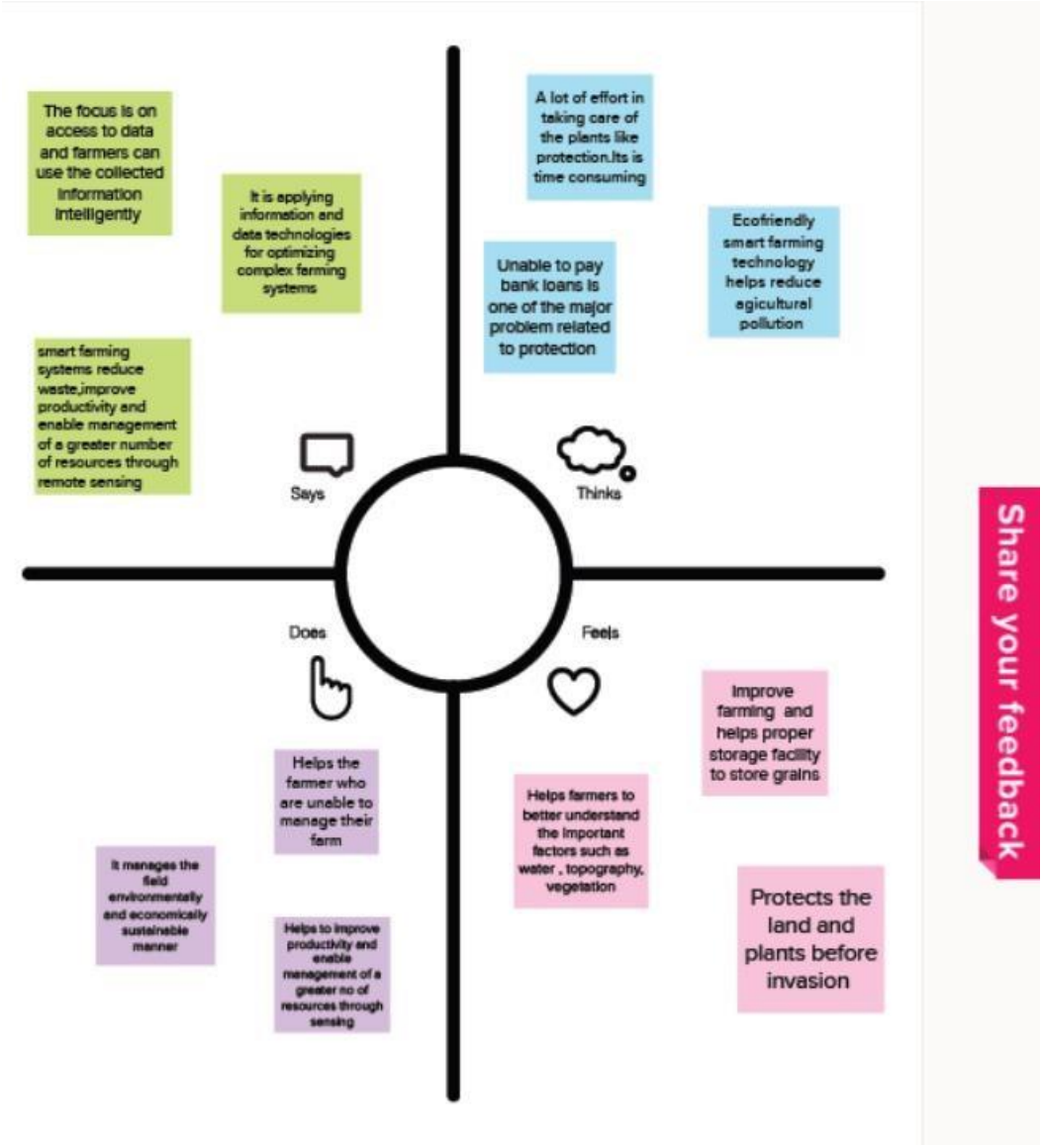
3. Problem statement:

The Farmers (User characteristics) who needs to water their plants on time and to prevent their plants from animals (User need)

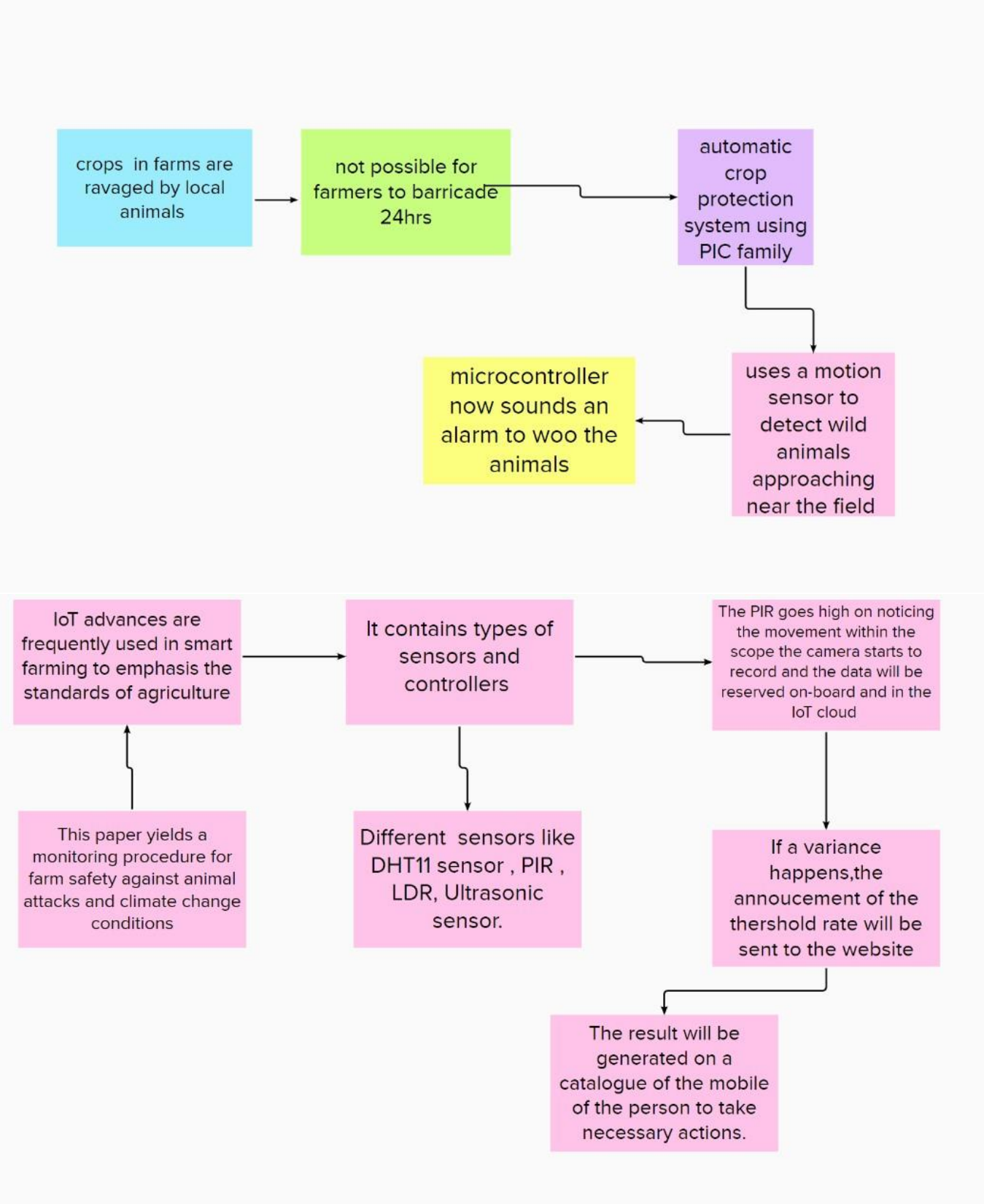
because the plants became dry when watering is improper and animals and birds often affects the field. (Insight)

III.IDEATION & PROPOSED SOLUTION

1. Empathy Map:



2. Ideation & Brainstorming:



3.Proposed Solution:

S.NO	PARAMETER	DESCRIPTION
1.	Problem Statement (Problem to be solved)	Our aim is to detect the animal and birds invasion in the field.
2.	Idea / Solution description	we will use PIR sensor for motion detection ,therefore Buzzer is on to scar away the animals and an alert message is send to the Farmers mobile by GSM module .
3.	Novelty / Uniqueness	The uniqueness of the project is to avoid the expenditure of the labour wages. This system is used to detect the presence of animal.
4.	Social Impact / Customer Satisfaction	In order to help the farmers this IoT technology helps customers to alert the farmers and scare animals an birds which satisfies the customers by increasing the productivity.
5.	Business Model (Revenue Model)	By using this technology and ideation of our projects ,Farmers will not affected by the yield. So they are benefitted financially.
6.	Scalability of the Solution	40 % of the farmers are literates, they can use modern technology which has a understandable architecture. we can implement this software to a greater extended

Proposed Solution Template:

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

S.NO	PARAMETER	DESCRIPTION
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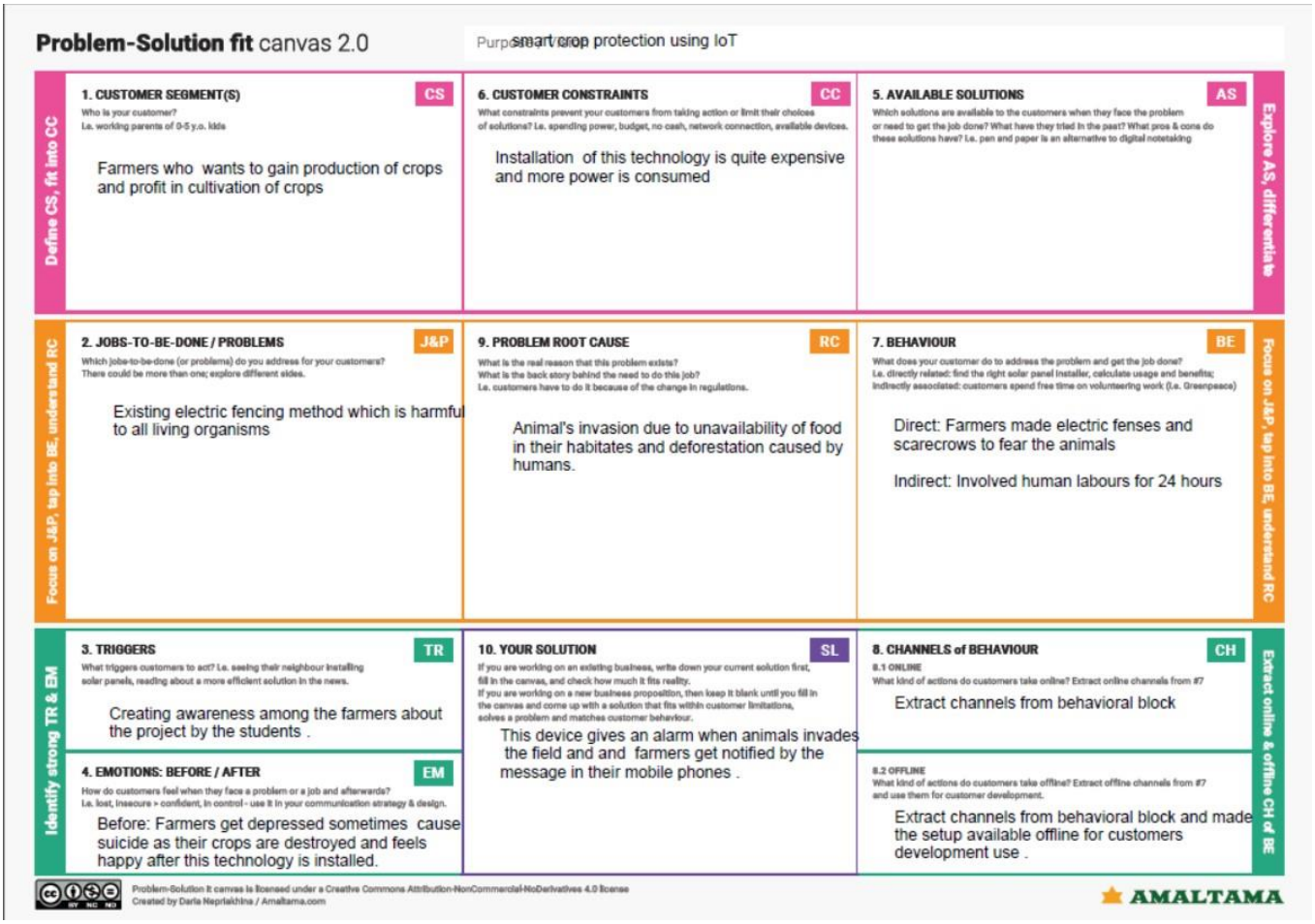
3. Problem Solution fit:



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	Download the app Registration through Gmail Create an account Follow the instructions
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Interface sensor	Interface sensor and the application so if animals enter the field it gives alarm.
FR-4	Accessing datasets	Datasets are retrieved from Cloudant DB
FR-5	Mobile application	Motos and sprinklers in the field can be controlled by mobile application.

2.Non –functional requirements

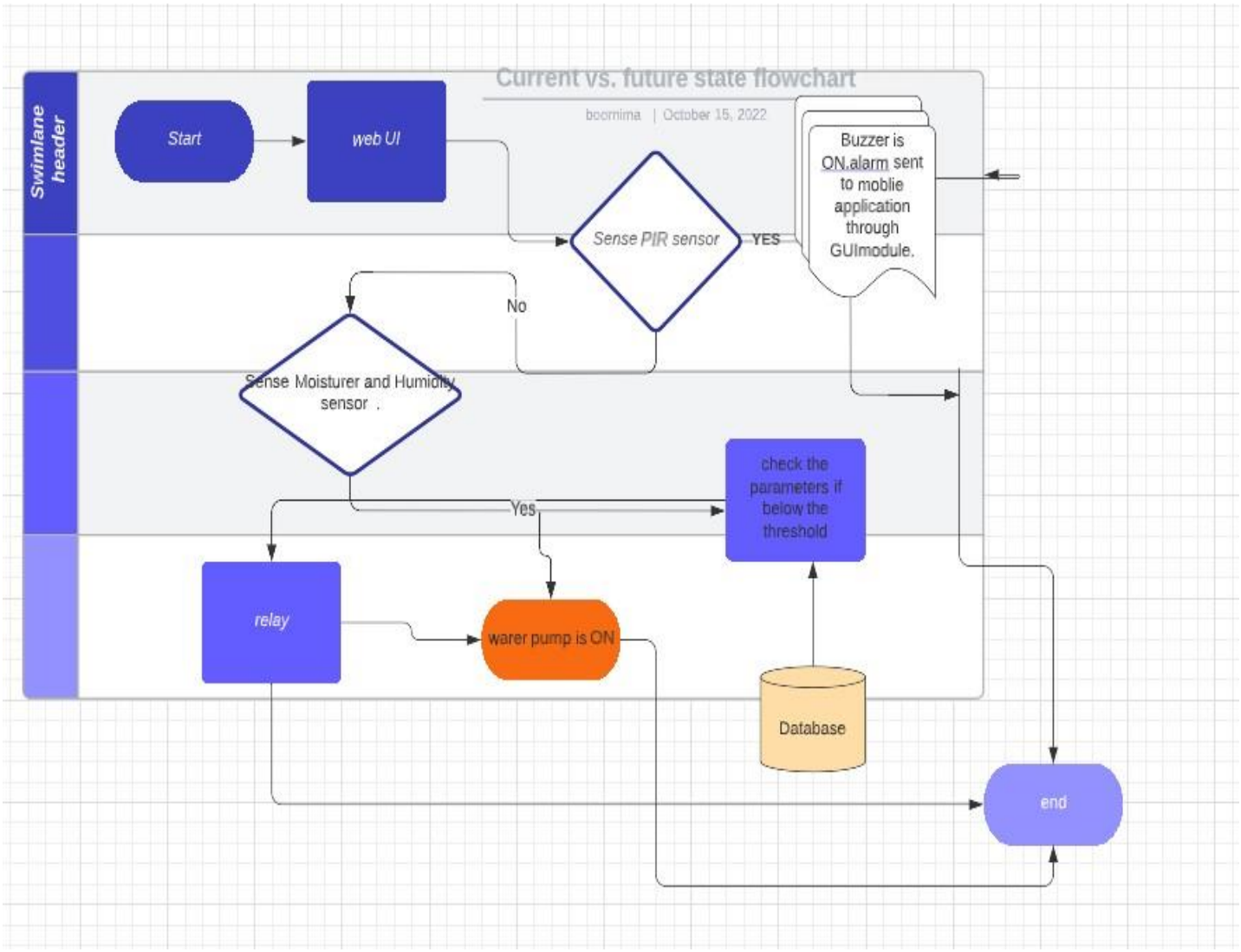
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	The smart protection system defines that this project helps farmers to protect the farm.
NFR-2	Security	We have designed this project to secure the crops from animals.

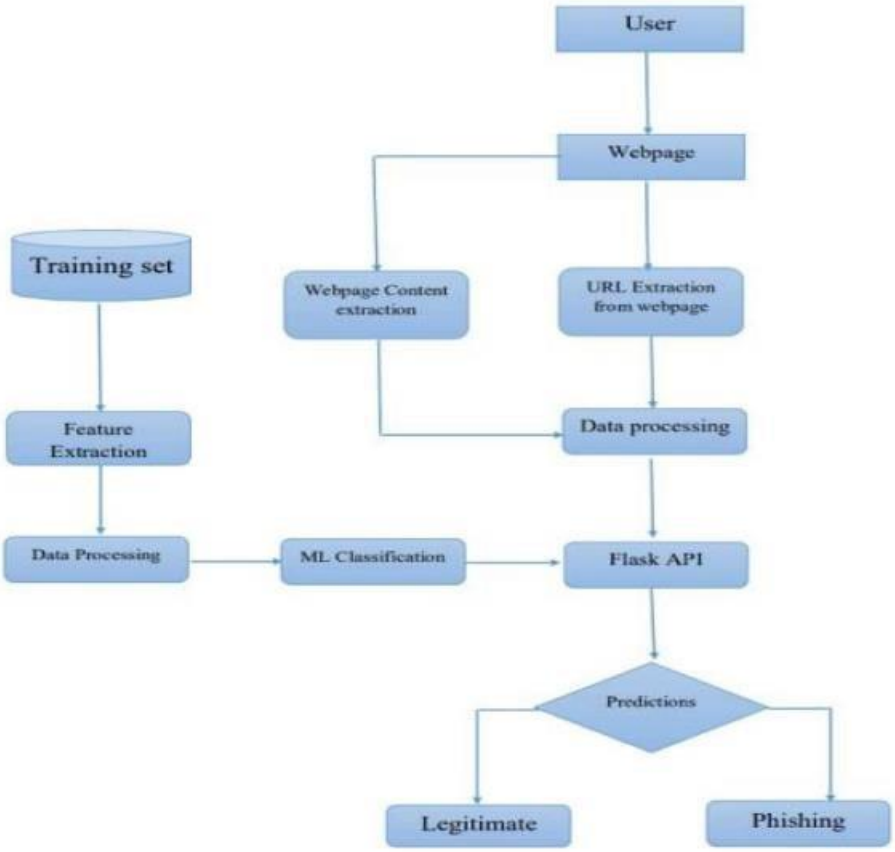
NFR-3	Reliability	This project will help farmers in protecting their fields and save them from significant financial losses. This will also help them in achieving better crop yields thus leading to their economic well being.
NFR-4	Performance	IOT devices and sensors are used to indicate the farmer by a message when animals try to enter into the field and also we use an SD card module that helps to store a specified sound to scare the animals.
NFR-5	Availability	By developing and deploying resilient hardware and software we can protect the crops from wild animals.
NFR-6	**Scalability**	Since this system uses computer vision techniques integrated with IBM cloudant services helps efficiently to retrieve images in large scale thus improving scalability

V. PROJECT DESIGN:

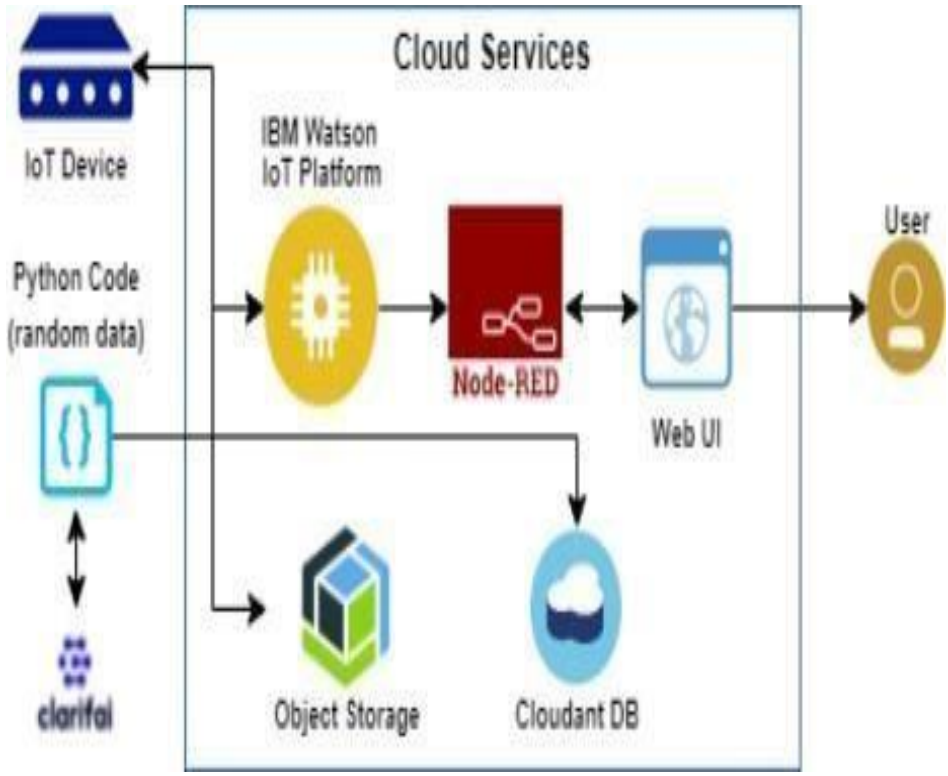
1. Data Flow Diagrams:



2. Solution Architecture:



3.Technology Architecture:



4.**Components & technologies**:

S.No	Component	Description	Technology
1.	User Interface	How user interacts with application e.g., Mobile Application	HTML, CSS, JavaScript / Angular JS / Node Red.
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 STT service
4.	Application Logic-3	Logic for a process in the application	IBM Watson Assistant
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 Other Storage 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 is 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.

3. User Stories:

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 (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, 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
		USN-3	As a user, I can register for the application through Facebook	I can register & access the dashboard with Facebook Login	Low	Sprint-2
		USN-4	As a user, I can register for the application through Gmail		Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering email & password		High	Sprint-1
	Dashboard					
Customer (Web user)	User input	USN-1	As a user i can input the particular URL in the required field and waiting for validation.	I can go access the website without any problem	High	Sprint-1
Customer Care Executive	Feature extraction	USN-1	After i compare in case if none found on comparison then we can extract feature using heuristic and visual similarity approach.	As a User i can have comparison between websites for security.	High	Sprint-1
Administrator	Prediction	USN-1	Here the Model will predict the URL websites using Machine Learning algorithms such as Logistic Regression, KNN	In this i can have correct prediction on the particular algorithms	High	Sprint-1
	Classifier	USN-2	Here i will send all the model output to classifier in order to produce final result.	I this i will find the correct classifier for producing the result	Medium	Sprint-2

VI. PROJECT PLANNING & SCHEDULING:

1. Sprint Planning & 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	BOORNIMA.S
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	1	High	SRUTHI.S
Sprint-1		USN-3	As a user, I can register for the application through Facebook	2	Low	SUSITHRA.N
Sprint-1		USN-4	As a user, I can register for the application through Gmail	2	Medium	SOWMIYA.R
Sprint-1	Login	USN-5	As a user, I can log into the application by entering email & password	1	High	SOWMIYA.R
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	BOORNIMA.S

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-2	Login	USN-1	As a weather data controller, I log into my profile and start monitoring the weatherupdates	3	High	SRUTHI.S
Sprint-2	Dashboard	USN-2	I receive all the information about weather from web from weather API. Whenever there is change in weather, corresponding updates are made on sign boards.	2	Medium	SUSITHRA.N
Sprint-3	Login	USN-1	As a image controller, I keep note of all the images received from various areas and detect traffic in that particular area.	3	High	SOWMIYA.R
Sprint-3	Dashboard	USN-2	With the traffic, updates I change the status of sign board as "take diversion".	2	Medium	BOORNIMA.S
Sprint-4	Login	USN-1	With the traffic, updates I change the status of sign board as "take diversion With the traffic, updates I change the status of sign board as "take diversion	3	High	SUSITHRA.N
Sprint-4	Login	USN-1	As an administrator, I ensure that all departments work co-ordinated and ensure the accuracy and efficiency.	2	Medium	SRUTHI.S

2. Sprint Delivery Schedule:

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		
Sprint-3	20	6 Days	07 Nov 2022	12 Nov 2022		
Sprint-4	20	6 Days	14 Nov 2022	19 Nov 2022		

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

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 :**

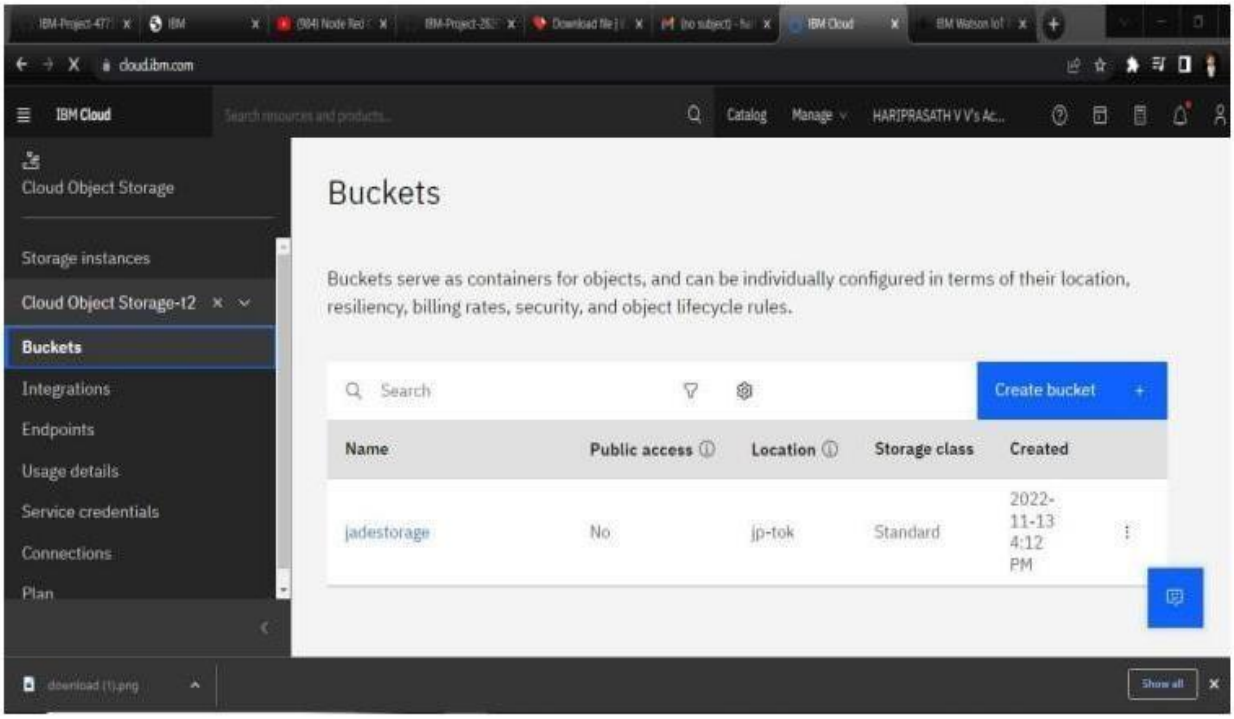
This is the cloud storage area where we can store the images of the detected animal.

VIII. TESTING

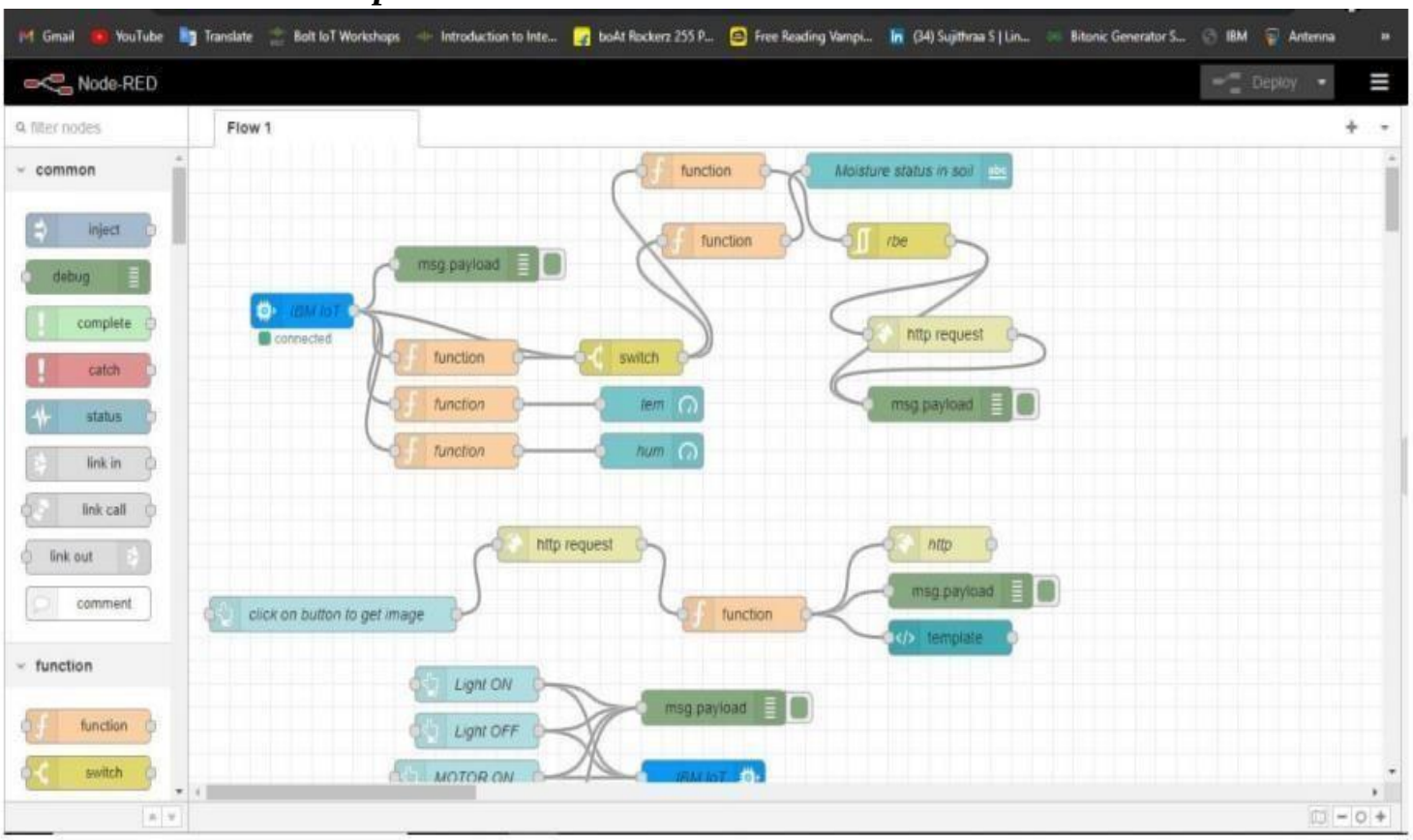
➢ Python code testing:

```
sprinkler-1 is ON
Published Alert1 :  Temperature(41.42) is high, sprinkerlers are turned ON to IBM Watson

Published Alert2 :  Fertilizer PH level(7.063) 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(97.48) is low, Irrigation started to IBM Watson

Published Alert6 :  water level(14.02) is high, so motor is ON to take water out  to IBM Watson

... ...publish ok... ... ...
Published Temp = 37.64 C to IBM Watson
Published PH value = 7.008 to IBM Watson
Published Animal attack Not Detected  to IBM Watson
Published Flame Not Detected  to IBM Watson
Published Moisture level = 59.12  to IBM Watson
Published Water level = 22.61 cm to IBM Watson

sprinkler-1 is ON
Published Alert1 :  Temperature(37.64) is high, sprinkerlers are turned ON to IBM Watson

Published Alert2 :  Fertilizer PH level(7.008) 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(59.12) is low, Irrigation started to IBM Watson

Motor-2 is turning ON
Published Alert6 :  water level(22.61) is high, so motor is ON to take water out  to IBM Watson

... ...publish ok... ... ...
Published Temp = 19.07 C to IBM Watson
```

➢ Node-red



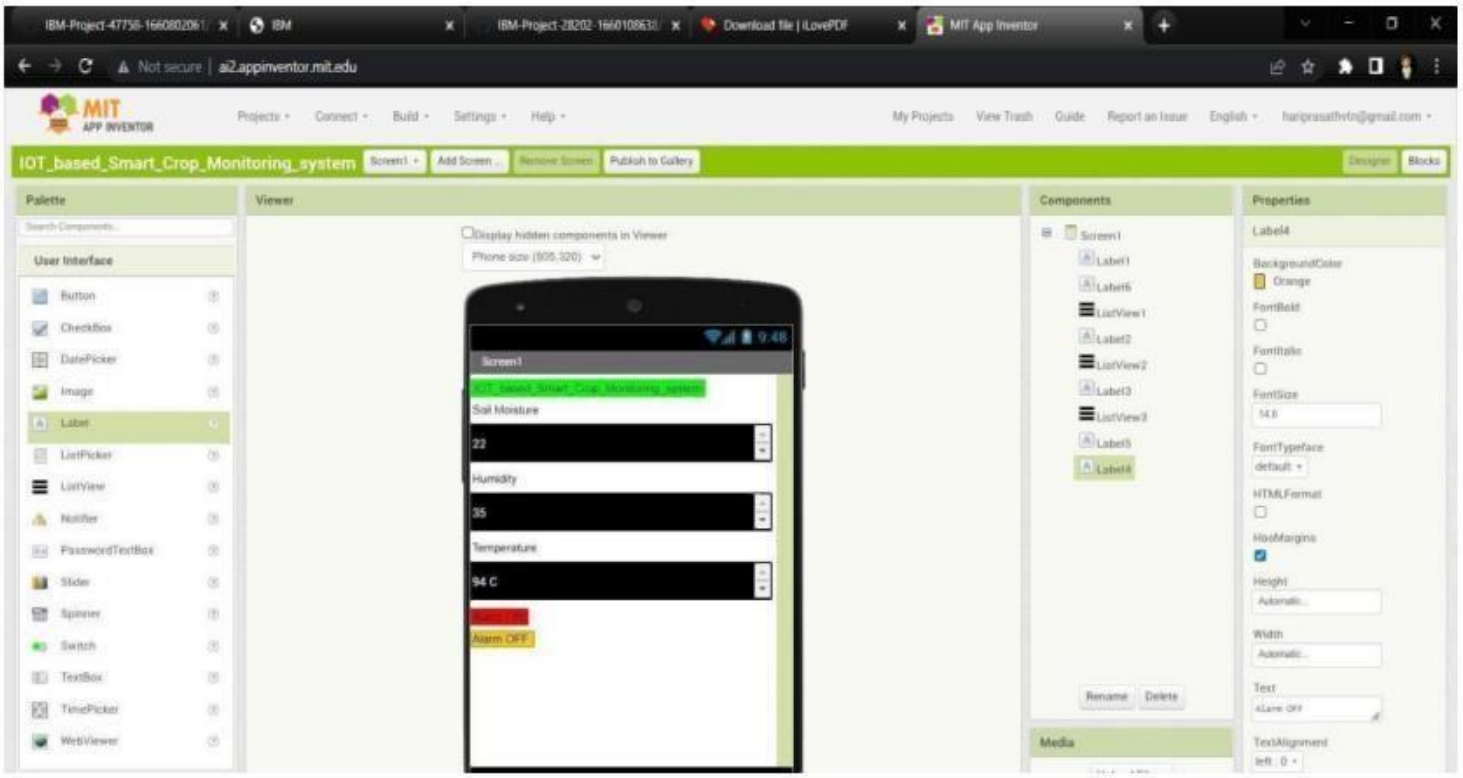
Connection and output:



Web applicationtesting:

➤ Mobile Application testing:

Mobile application creation :



IX. ADVANTAGES & DISADVANTAGES:

1. ADVANTAGES:

•Farmers canmonitorthe health of farmanimalsclosely, 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 farmerneeds to have access to crop data reliably at any time fromany 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 cv2 import
numpy as np import
wiotp.sdk.device import
playsound import random
import time
importdatetime import
ibm_boto3
from ibm_botocore.client import Config, ClientError
#CloudantDB from cloudant.client import
Cloudant from cloudant.error import
CloudantException from cloudant.result
import Result, ResultByKey
from clarifai_grpc.channel.clarifai_channel import ClarifaiChannel from
clarifai_grpc.grpc.api import service_pb2_grpc stub =
service_pb2_grpc.V2Stub(ClarifaiChannel.get_grpc_channel()) from
clarifai_grpc.grpc.api import service_pb2, resources_pb2 from
clarifai_grpc.grpc.api.status import status_code_pb2


#This is how you authenticate
metadata = (('authorization', 'key 83ddcfb774c54cfd81d7a67ba69a0678'),)
COS_ENDPOINT = "https://s3.jp-tok.cloud-object-storage.appdomain.cloud"
COS_API_KEY_ID = "kn05el2QeCyawCFMRytUXLFirKVxw8v5HAIRvDKsIHmu"
COS_AUTH_ENDPOINT = "https://iam.cloud.ibm.com/identity/token"
COS_RESOURCE_CRN="crn:v1:bluemix:public:cloudantnosqldb:eugb:a/98d92dfd0c
c f4f32a116d3d0fe24e15c:02d1fcad-1310-4403-93a6a0eabc4c768b::"
Clientdb=Cloudant("apikey-v2-
d8mn8ful7bxv3pw2cq0o1p1d8z3icznh8qu8y2xsv5",
"400eef0a90d31fd7fa41c9dd0a2baa4b", url="https://cbf0b64e-c2d3-4404-be21-
```

```
36565dc150b9-
bluemix.cloudantnosqldb.appdomain.cloud")
clientdb.connect()          #Create      resource      cos      =
ibm_boto3.resource("s3",
   ibm_api_key_id=COS_API_KEY_ID,
   ibm_service_instance_id=COS_RESOURCE_CRN,
   ibm_auth_endpoint=COS_AUTH_ENDPOINT,
   config=Config(signature_version="oauth"),
   endpoint_url=COS_ENDPOINT
)
def multi_part_upload(bucket_name, item_name, file_path): try:
print("Starting file transfer for {0} to bucket:          {1}\n".format(item_name,
bucket_name))
      #set 5 MB chunks part_size
      = 1024 * 1024 * 5 #set
      threadhold to 15 MB
      file_threshold = 1024 *
      1024 * 15
      #set the transfer threshold and chunk size
      transfer_config = ibm_boto3.s3.transfer.TransferConfig(
      multipart_threshold=file_threshold, multipart_chunksize=part_size
      )
      #the upload_fileobj method will automatically execute a multi-part upload
      #in 5 MB chunks size with
      open(file_path, "rb") as file_data:
         cos.Object(bucket_name, item_name).upload_fileobj(
         Fileobj=file_data,
          Config=transfer_config
         )
```

```
        print("Transfer for {0} Complete!\n".format(item_name))  except
    ClientError as be: print("CLIENT
        ERROR: {0}\n".format(be))
    except Exception as e:
        print("Unable to complete multi-part upload: {0}".format(e))
  def myCommandCallback(cmd):
        print("Command received: %s" % cmd.data) command=cmd.data['command']
        #print(command)
         if(command=="lighton"):
         print('lighton')
        elif(command=="lightoff"):
             print('lightoff')
        elif(command=="motoron"): print('motoron')
        elif(command=="motoroff"):
            print('motoroff')
myConfig = {
    "identity": {
        "orgId":"tw9ckq",
        "typeId": "node",
        "deviceId":"6020"
    },
    "auth": {
        "token": "27102001"
    }
}
client =       wiotp.sdk.device.DeviceClient(config=myConfig,  logHandlers=None)
client.connect()

database_name = "sample1"
my_database = clientdb.create_database(database_name) if my_database.exists():
```

```
        print(f"'{database_name}' successfully created.")
        cap=cv2.VideoCapture("garden.mp4")


    if(cap.isOpened()==True):

       print('File        opened')

    else:

       print('File not found')

    while(cap.isOpened()): ret, frame = cap.read() gray =

       cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY) imS=

       cv2.resize(frame, (960,540))

       cv2.imwrite('ex.jpg',imS) with open("ex.jpg", "rb")

       as f:

       file_bytes = f.read()

       detect=False

       t=random.randint(-1,1)

       if(t==0):

            detect=True print("Alert! Alert!

           animal detected")

           #playsound.playsound('alert.mp3')

           picname=datetime.datetime.now().strftime("%y-%m-%d-%H-%M")

             cv2.imwrite(picname+'.jpg',frame)

multi_part_upload('jadestorage', picname+'.jpg',   picname+'.jpg') json_document=
    {"link":COS_ENDPOINT+'/'+'jadestorage'+'/'+picname+'.jpg'}
    new_document = my_database.create_document(json_document)

    if new_document.exists():

            print(f"Document successfully created.") time.sleep(5)


       moist=random.randint(0,100) humidity=random.randint(0,200)

       temperature=random.randint(0,100)

       myData={'Animal':detect,'moisture':moist,'hum':humidity,'temp':temperatur e}

       print(myData) if(humidity!=None):
```

```
client.publishEvent(eventId="status",msgFormat="json", data=myData, qos=0,
    onPublish=None) print("Publish Ok..")

    client.commandCallback =
    myCommandCallback cv2.imshow('frame',imS)
    if cv2.waitKey(1) & 0xFF == ord('q'):  break
client.disconnect() cap.release()
cv2.destroyAllWindows()
    )
```

GITHUB LINK:

https://github.com/IBM-EPBL/IBM-Project-14309-1659574524 or IBM-EPBL / IBM-Project-14309-1659574524