IOT Based smart crop protection for agriculture

A PROJECT REPORT

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1. INTRODUCTION :

In the agriculture field, the crop yielding is acquiring minimized by the wild animal attacks. The necessary factor is to stop the animals that pass out of the forest into the agricultural land, hasbecomeoneinalltheincreasingissuethatinfluence agriculture. The farmers ache heaps by the animal barrage. Generally, individuals additionally lost their lives whereas they struggle to banish the animals out of their place. The animals set foot into the agricultural land due to the shortage of water supplies within the forest areas and deforestation.To enhance agriculture because of the endurance of the fittest,wild animals that a set foot in to the Agricultural land is often viewed and a repelled device is employed to supply the ultrasound thatannoystheanimalsanddirectsthem.Togetherwithahearth detector is superimposed to avoid the spreading of fireside from the biological science areas to the agriculture. With the assistance of IoT,an alert are often given relating to the animal foot in and also the forestfire.

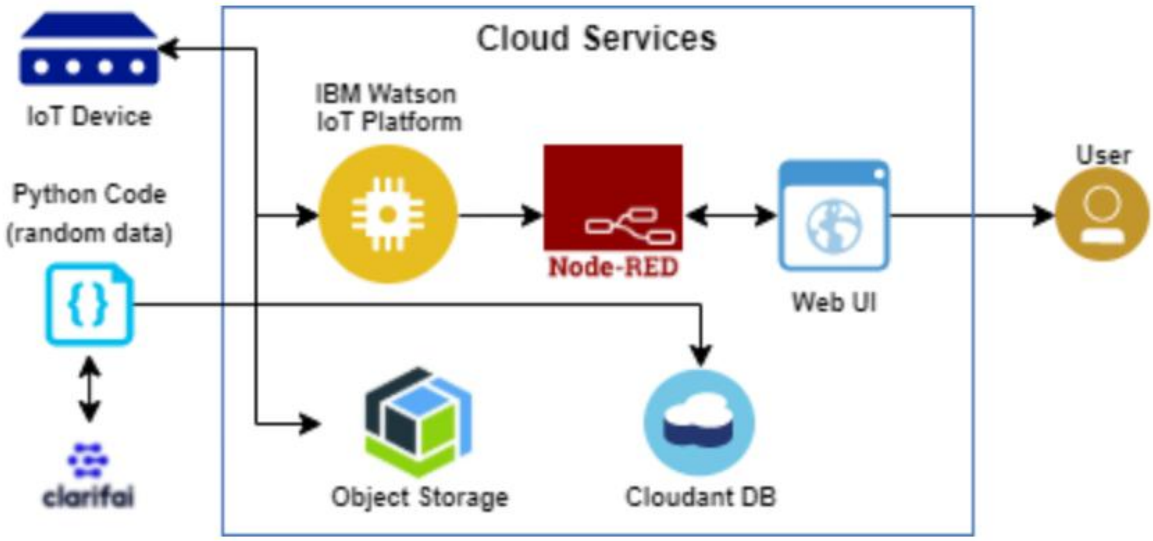
The problem of wild animal attacks on crop fields i.e. crop vandalization is becoming a very common phenomenon in the state of Himachal Pradesh, Punjab, Haryana and many other states. Wild animals like monkeys, estray animals especially cows and buffaloes wild dogs, nilgais, bisons, elephants deer, wild pigs and even birds like parakeets cause a lot of damage to crops either by running over them or eating them and vandalizing them completely. This leads to poor yield of crops. These animals attack on fruit orchards and destroy the flowerings and fruits. In both cases, this leads to significant financial loss to the farmers and orchard owners. The problem is so pronounced that sometimes farmers decide to leave the area barren due to these animal attacks.

1.1.PROJECT OVERVIWE :

elucidates our method of addressing this problem i.e. how this project can solve this problem. The main aim of this project is to provide an effective solution to this problem, so that the economic losses incurred by our farmers are minimized and they have a good crop yield.

MODULES USED: Raspberry pi, PIR sensor, LAN, Camera

Arduino is an associate open provide element and code company, project, and user community that designs and constructs single-board microcontrollers and microcontroller kits for form digital devices and interactive body which will sense and management body inside the physical world. Arduino board devices utilize a ramification of microprocessors and controllers. The boards provide sets of digital and analog entry/exit (I/O) pins which can be interfaced to varied enlargement boards (shields) and different circuits. The board's characteristic sequential communications links, moreover as Universal Serial Bus (USB) on a few of patterns that are utilized for charge programs out of distinctive computers. The Internet ofthings (IoT) is that the network of the human body, motors, domestic materials, and various things implant with natural ideology, software, sensing parts, actuators, and network belongings that permit this stuff to connect and swap data. Each issue is unambiguously identifiable through its implant ADPS but is prepared to between process at intervals the triumph webconfiguration.



1.2. PURPOSE :

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 or stay on field 24 hours and guard it. So here we propose automatic crop protection system from animals.

This is a microcontroller based system using PIC family microcontroller. This system uses a motion sensor to detect wild animals approaching near the field. In such a case the sensor signals the microcontroller to take action.

The microcontroller now sounds an alarm to woo the animals away from the field as well as sends sms to the farmer so that he may know about the issue and come to the spot in case the animals don't turn away by the alarm. This ensures complete safety of crops from animals thus protecting the farmers loss.

2.LITERATURE SURVEY

2.1.EXISTING PROBLEM

This project describes a security alarm system that can monitor an industry and home. This is a simple and useful security system and easy to install. This vibration detector is realized using readily available, low cost components. One of its many applications is in a rolling shutter guard for offices and shops. The detector will sense vibration caused by activities like drilling and switch on the connected load (bulb, piezo buzzer, etc) to alert you. The use of data mining techniques in agriculture, particularly on soils, can boost cultivation yields and change the status of pledge making. Soil analysis is critical for resolving a variety of challenges in the agricultural area. This paper discusses the role of data mining in the context of soil analysis in agriculture, as well as many data mining approaches and their associated work by several authors in the context of soil analysis. The purpose of data mining is to extract knowledge from an existing data set and transform it into a unique human-readable format for future usage. Crop management in a particular agricultural region is influenced by local climatic circumstances, as climate has a significant impact on crop productivity. Real-time weather data can aid in effective crop management. The use of information and communications technology allows for the automation of extracting significant data in order to obtain knowledge and trends

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PROBLEM STATEMENT DEFINITION :

Essential parameter for agriculture analysis is nature of soil. Diverse varieties of soil are available in this India. Crops are cultivated depending on the type of soil in the land. The role of soil in improving crop cultivation is discussed [3]. Data mining techniques are applied to analyze the soil parameter.

JRip, J48 and Naive Bayes techniques are applied [4] which produces more reliable results in analyzing red and Black soil. Impact of parameters of agriculture in crop management is studied to improve productivity [5]. Neural networks, soft computing, big data and fuzzy logic methods are being used to examine the agricultural factors.

Pritam Bose [6] developed a SNN model to have a spatiotemporal analysis with crop estimation. An automatic system to gather the information about soil nature, weather conditions was developed [7] with clustering techniques to extract the knowledge and use it by farmers in crop cultivation.

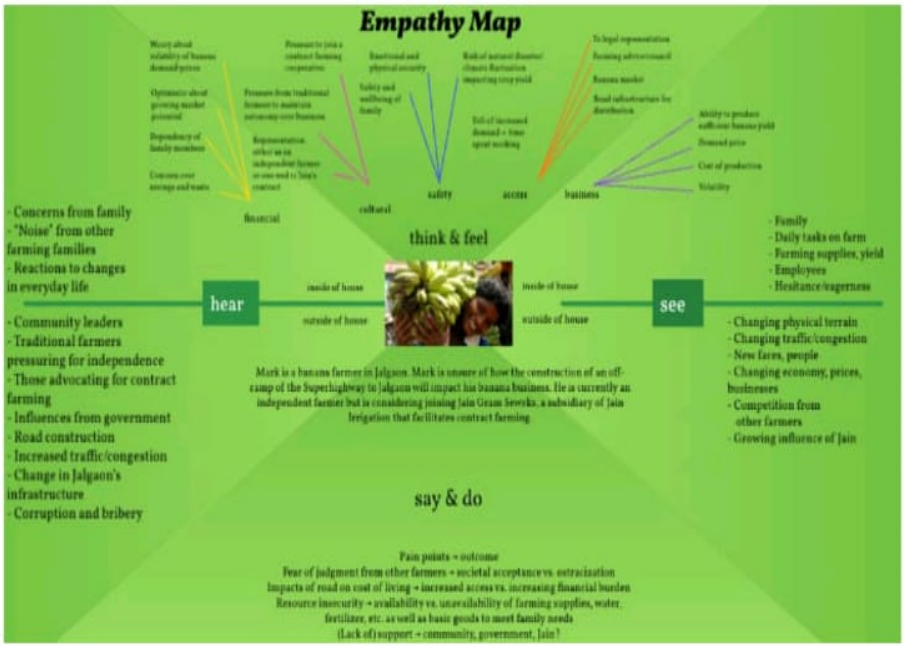
3.IDEATION & PROPOSED SOLUTION

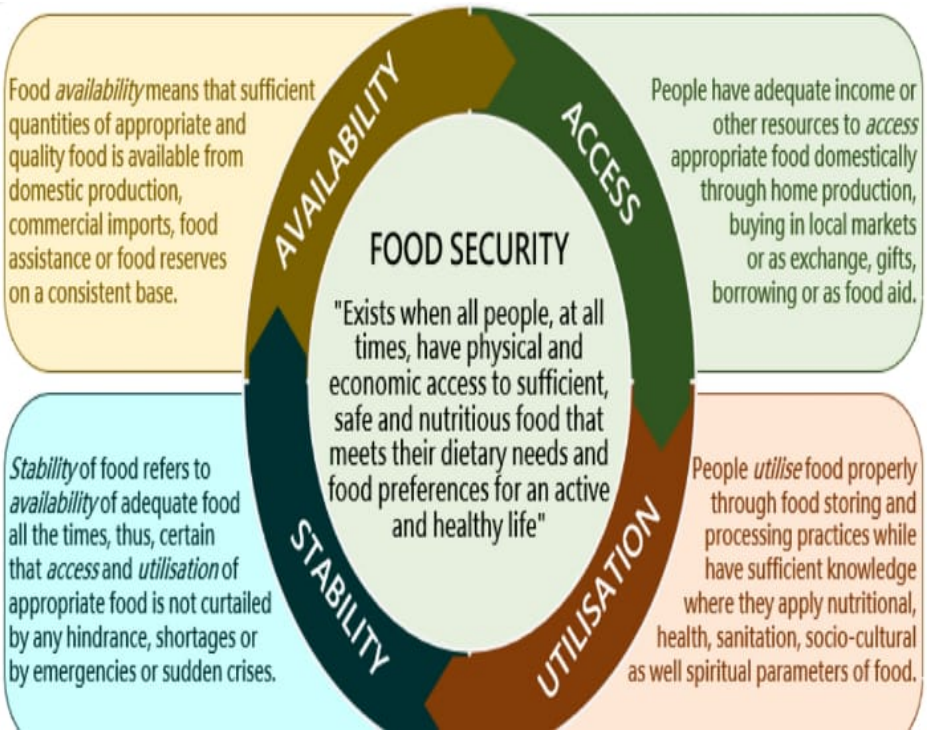
3.1.EMPATHY & MAP CANVAS

An empathy map is a simple, easy-to-digest visual that captures knowledge about a user's behaviours and attitudes.

It is a useful tool to helps teams better understand their users.Creating an effective solution requires understanding the true problem and the person who is experiencing it. The exercise of creating the map helps participants consider things from the user's perspective along with his or her goals and challenges.

Example:



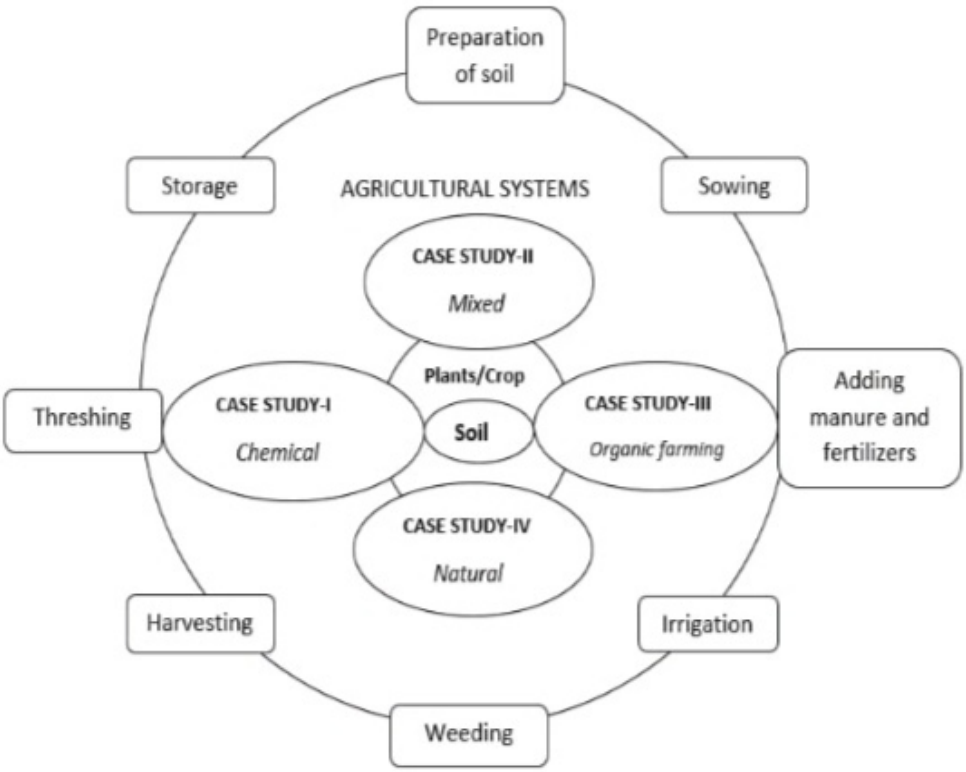


3.2.IDEATION & BRAINSTORMING

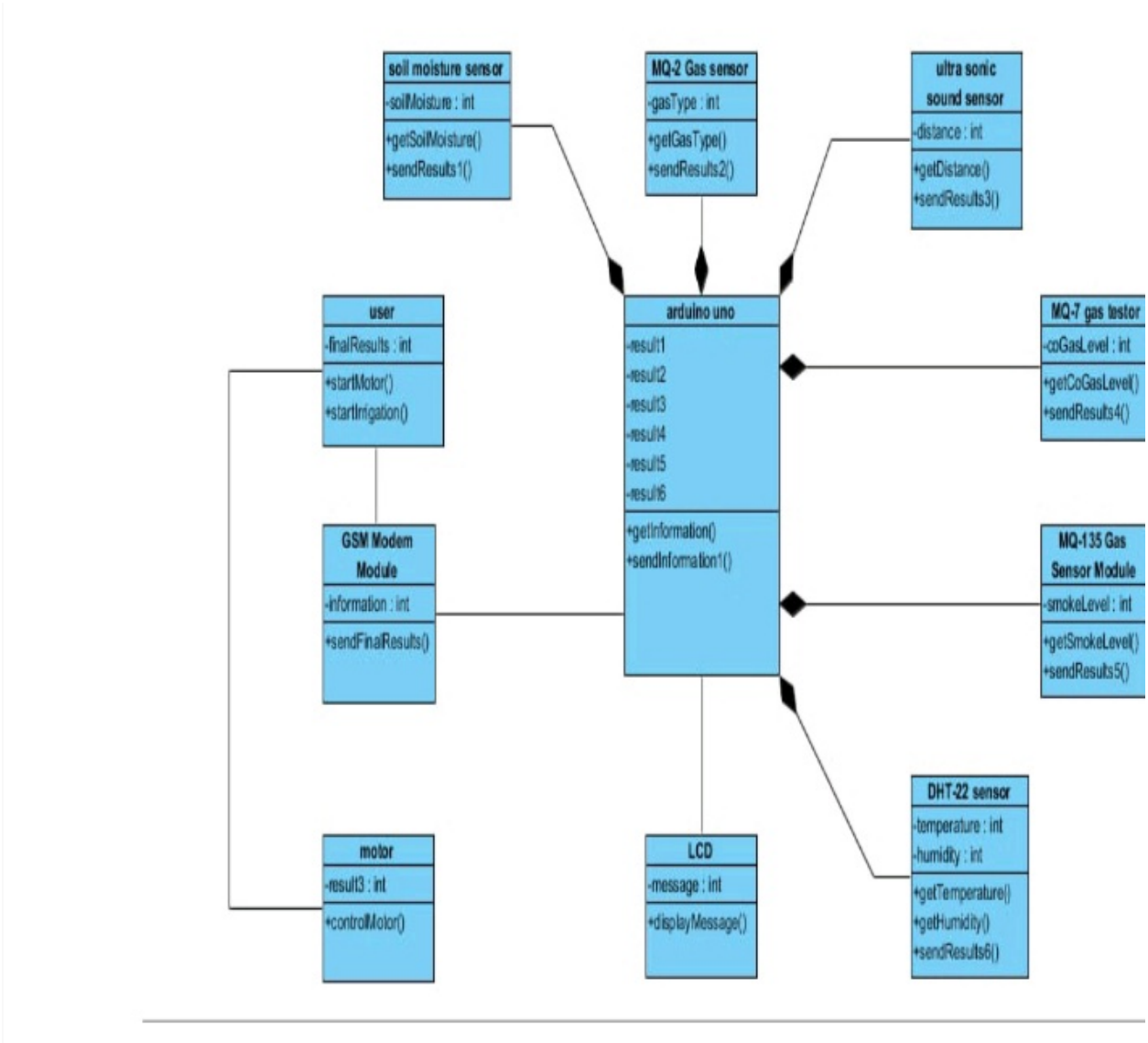
Smart crop protection system :

Agriculture meets food requirements of the people and produces several raw materials for industries. But because of animal interference and fire in agricultural lands,there will be huge loss of crops. Crop will be totally getting destroyed.

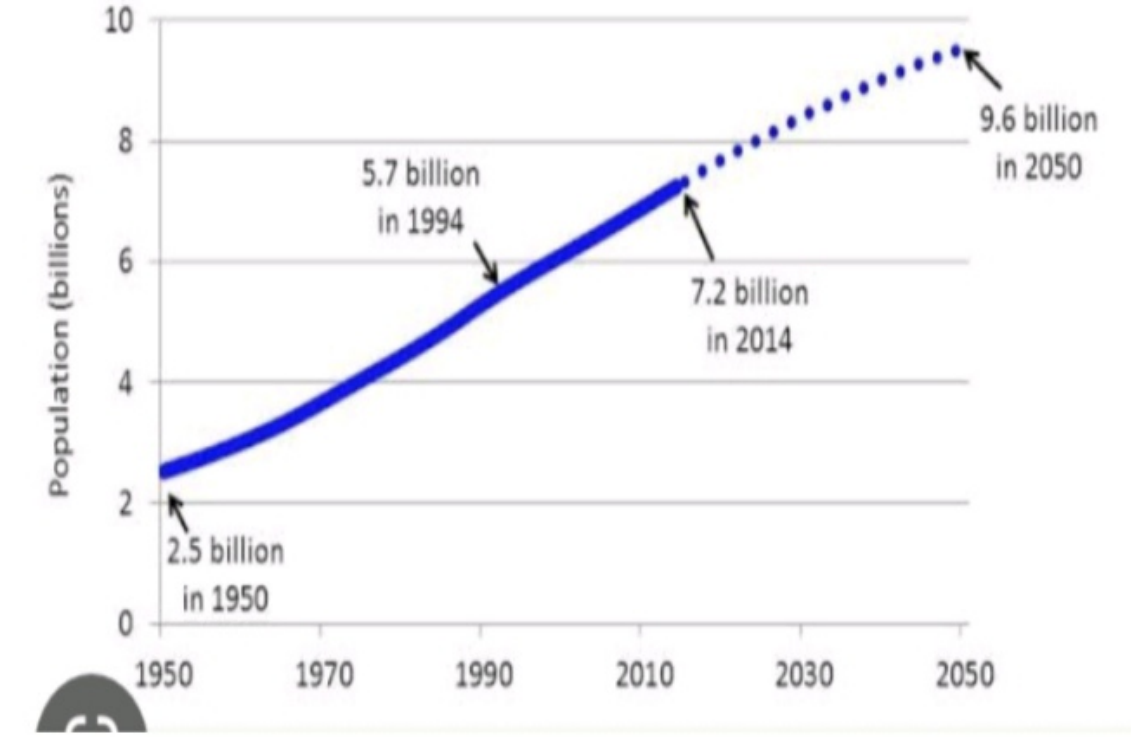
Step-1: Team Gathering, Collaboration and Select the Problem Statement



Step - 2 : Brainstorm , idea Listing and grouping



Step - 3 : Idea Prioritization



3.3 Proposed solution

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

s.no	parameter	Description
1.	problem Statement (problem to be solved)	Overuse of pesticides and fertilizer in agricultural fields leads to destruction of the crop as well as reduces the efficiency of the field increasing the soil vulnerability toward pest.
2.	Idea/solution description	Safety of people@animal Low cost solutions,lower dependency on power Simple solution to suite the farmer
3.	Novelty/Uniquness	destruction of crop residues, deep plowing, crop rotation, use of fertilizers, strip-cropping, irrigation, and scheduled planting operations
4.	Social impact/Customer Satisfaction	Improve the productivity save lives of farmers.
5.	scalability of the solution	As the advance of information and digital technology, the cost of developing and

		implementation of smart farming technologies become more affordable. In addition, smart farming technologies are extended to small-scale farming

3.4. Problem solution fit

- Crop protection helps to keep plants healthy and maintain sustainable yields. The choice of plant protection strategy depends on the type of cultures grown and the threat. It can be diseases, insects, or weeds. At the same time, measures must be timely and, wherever possible, preventive.

- Modern crop protection compounds make extensive use of digital solutions. They enable the precise analysis of soil and plant conditions and provide accurate information about external factors such as weather conditions. At the same time, they allow optimizing the use of resources.

As a result, farmers can protect crops, increase profits, and minimize environmental damage.

Purpose :

Crops in farms are many times ravaged by local animals like buffaloes, cows, goats, birds etc. This leads to huge losses for the farmers.

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signals the microcontroller to take action.

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Template:

1.Customers segment people: The user can access anywhere at any time

2.Jobs to be done\ problem: Lack of information,high adoption costs,and security concerns.

3.Triggers: monitor crop conditions remotely,and better manage natural resources.

Emotions before\After: Together with the development of lightweight snapshot cameras that can be used to calculate biomass development.

5.Available solutions: Sowing in the right time and getting right seeds.

6.customer contrains: User access the data base only under certain terms and conditions.

7.Behavior: Framing is a behavior in which an organism promotes of others organism in or on a substrate as a food source.

8.channels of behavior online: Online platform has been made for way of operate the system.

9.Problem root cause: It requires active sensors connection.

4.REQUIREMENT ANALYSIS

4.1.Functional Requirements

Following are the functional requirements of the proposed solution

FR NO.	Functional requirements(Epic)	Sub requirements(story/Sub-Task)
FR-1	User Registration	Registration through Form Registration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	Log in to system	Check Credential Check Roles of Acess
FR-4	Manage Modules	Manage System Admins Manage Roles of User Manage User permission
FR-5	Check whether details	Temperature details Humidity details
FR-6	Log out	Exit

4.2.Non Functional Requirements(NFRS)

Following are the non-functional requirements of the proposed solution

FR NO.	Non-Functional Requirement	Description
FR-1	Usability	The smart crop protection system senses animals nearing the crop field and sounds alarm to woo them away as well as sends SMS to farmer using PIC .
FR-2	Security	This system uses a motion sensor to detect wild animals approaching near the field.
FR-3	Reliability	The IOT device is used to indicate the farmer by a message while someone enter into the farm and we are used SD card module that helps to store a specified sound to fear the animals.
FR-4	Performance	The agricultural sector plays an important role in contributing to the economics of a country. The IoT-based agriculture leads to lucrative yields and there are several types of platforms used by farmers in increasing agricultural yields
FR-5	Availability	Remote Management. With farms being located in far-off areas and distant lands, farmers are seeking a better solution to their management issues. ...
FR-6	Scalability	Smart farming can make agriculture more profitable for the farmer. Decreasing resource inputs will save the farmer

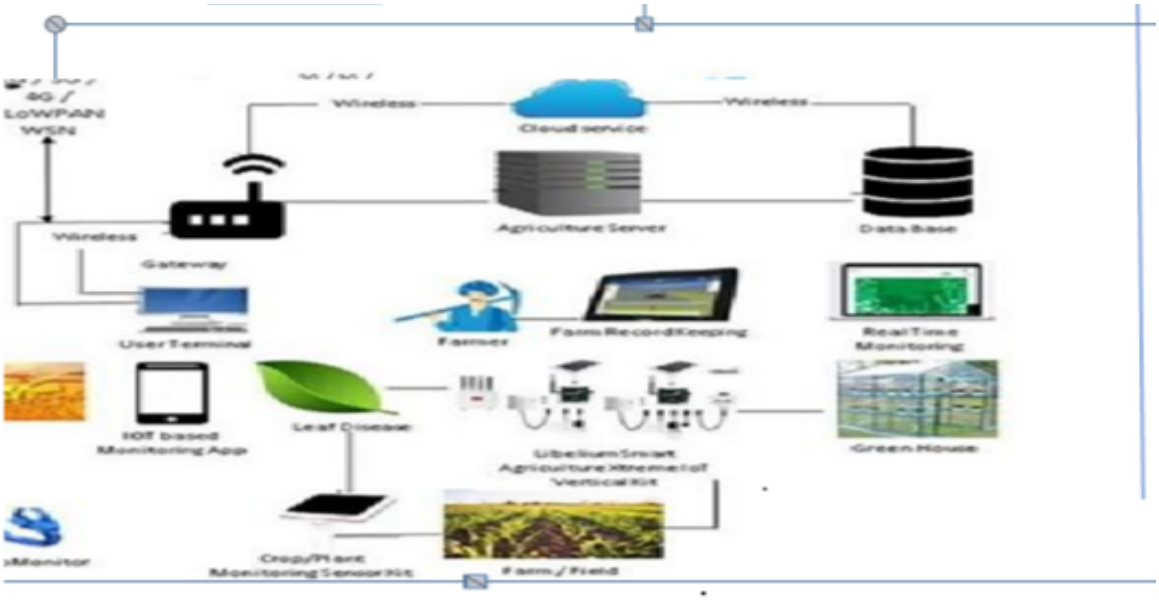
		money and labor, and increased reliability of spatially explicit data will reduce risks.

5. PROJECT DESIGN

5.1. Dataflow Diagram

A Data Flow Diagram (DFD) the farmer by a message while someone enter into the farm and we are used SD card module that helps to store a specified sound to fear the animalsThis project is smart crop protection system for protect the farm from animals as well as unknown person

Example:(simplifed)



5.2 Solution &Technical Architecture

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

• Find the best tech solution to solve existing business problems.

• Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.

• Define features, development phases, and solution requirements.

• Provide specifications according to which the solution is defined, managed, and delivered.

Example - Solution Architecture Diagram:

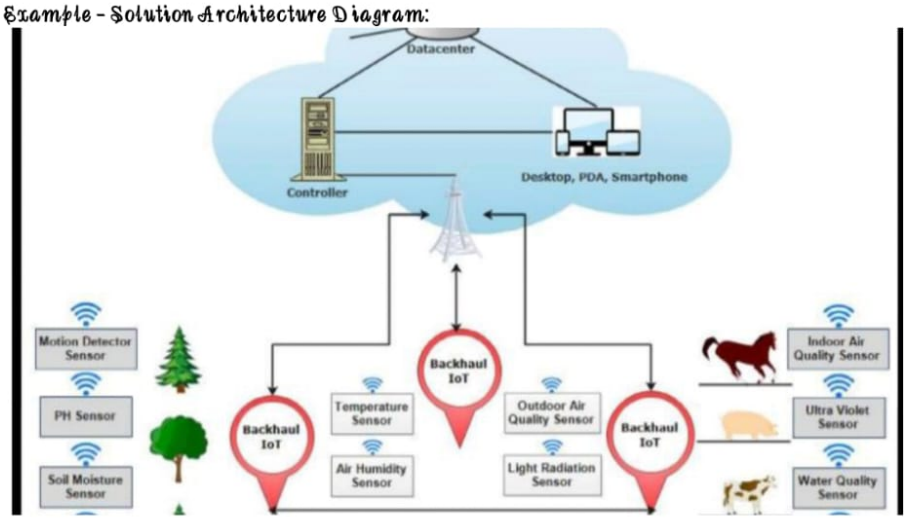


Figure 1: Architecture and data flow of the voice patient diary sample application

5.3 User Stories

	monitoring system	LPBluetooth, RS485 communication to the server through MQ telemetry transport	data analytics	irrigation using sensor values	irrigation using sensor values
Objectives	Collect real time data from sensors	Minimum Loss by sending 10 identical data in wireless transmission	Increase crop production and control agricultural cost using analyzed data	Control the water supply and monitor the plants through a smartphone	Prevention of crops from spoilage during rains and recycling rainwater
Advantages	Decision support, alerts solar power	Wired and wireless transmissions, any number of devices can be added easily	Temperature and rainfall factors are predicted, Crop patterns	Water management	PIR sensor is used to detect motions, rainwater is recycled
Protocol	Zigbee	LPWAN, LPBluetooth, RS485	Zigbee, prediction using Naïve Bayesian classifica-tion, map reduce	Raspberry Pi	Arduino, GSM
Future	Pest detection	Wireless transmission in kms	Interfacing different soil nutrient	Outdoor utilization system	Detect plant disease, crop theft

Use the below temp
list all the user stories for the product.

6.Project Planning & Scheduling

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	Mahapreethi(Team leader)
sprint - 1	Login	USN - 2	As a user, I will receive confirmation email once I have registered for the application	1	High	Ushalakshmi(team memeber 1)
sprint - 2	user interface	USN - 3	As a user, I can register for the application through Facebook	2	Low	Ragavi(team member 2)
sprint - 1	data visulization	USN - 4	As a user, I can register for the application	2	Medium	Maheshwari(team member 3)

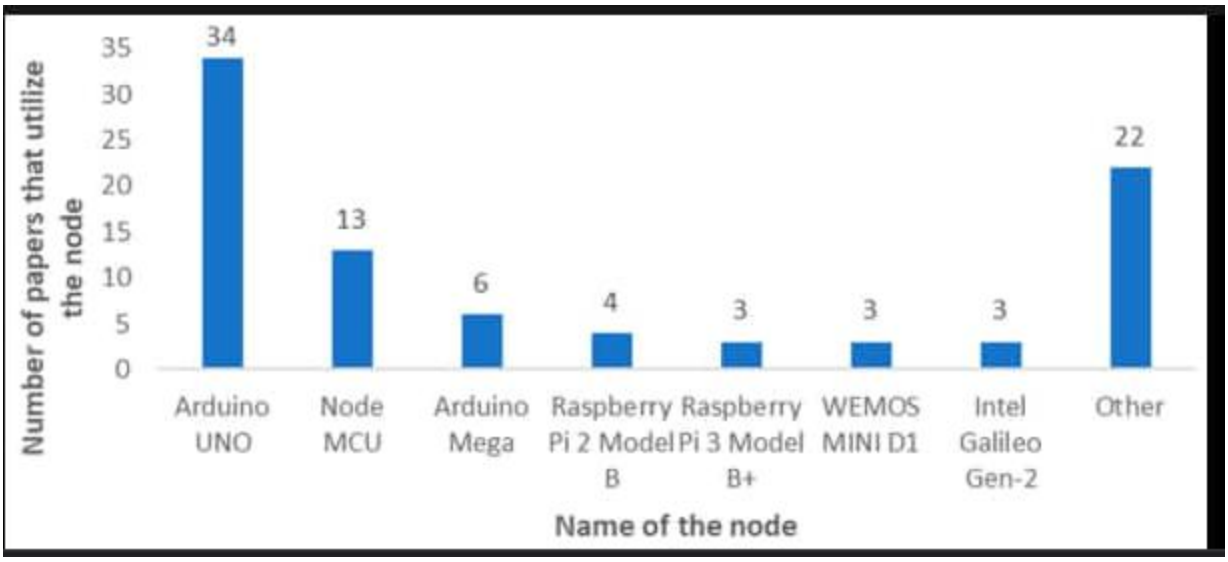
			through Gmail			
sprint - 1	login	USN - 5	As a user, I can log into the application by entering email & password	1	High	

6.2. Sprint Delivery Schedule

Project Tracker, Velocity & Burndown Chart:

sprint	**Total Story Points**	**Duration**	**Sprint Start Date**	**Sprint End Date (Planned)**	**Story Points Completed (as on Planned End Date)**	**Sprint Release Date (Actual)**
Sprint-1	20	6 days	24 Oct 22	29 Oct 22	20	29 Oct 22
Sprint-2	20	6 days	31 Oct 22	05 nov 22	20	05 nov 22
Sprint-3	20	6 days	07 Oct 22	12 Nov 22	20	12 Nov 22
Sprint-4	20	6 days	14 Oct 22	19 Nov 22	20	19 Nov 22

6.3. Reports from JIRA

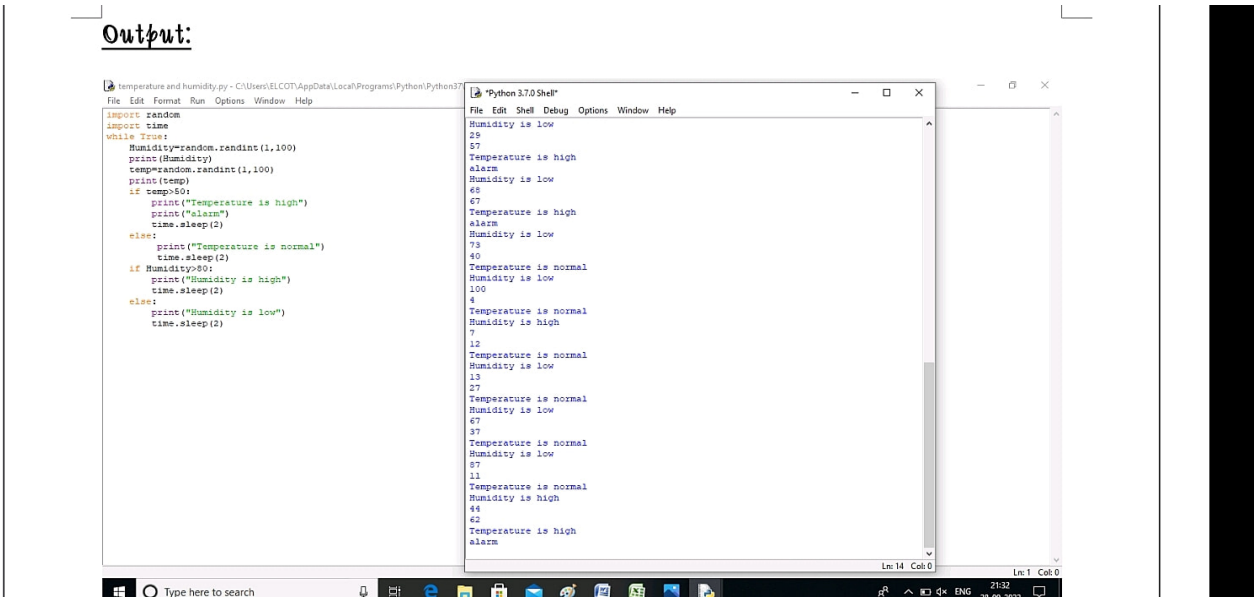


7.CODING & SOLUTIONING

7.1.Feature 1

```
import random
import time
while True:
    Humidity=random.randint(1,100)
    print(Humidity)
     temp=random.randint(1,100)
    print(temp)
if temp>50:
    print("Temperature is high")
    print("alarm")
    time.sleep(2)
else:
     print("Temperature is normal")
    time.sleep(2)
     if Humidity>80:
print("Humidity is high")
 time.sleep(2)
else:
    print("Humidity is low")
     time.sleep(2)
```

7.2. Feature

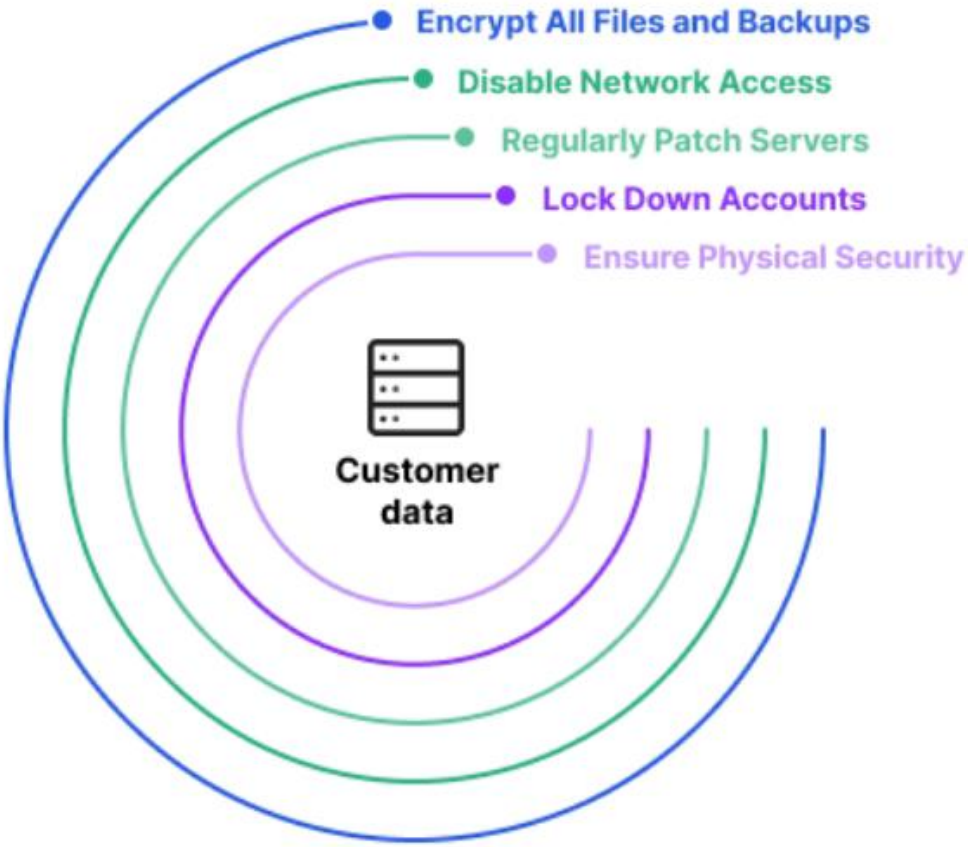


7.3.Database Schema (if Application)

A database server is a physical or virtual machine running the database. Securing a database server, also known as “hardening”, is a process that includes physical security, network Ensure Physical Database Security

Refrain from sharing a server for web applications and database applications, if your database contains sensitive data. Although it could be cheaper, and easier, to host your site and database together on a hosting provider, you are placing the security of your data in someone else’s hands.

If you manage your database in an on-premise data center, keep in mind that your data center is also prone to attacks from outsiders or insider threats. Ensure you have physical security measures, including locks, cameras, and security personnel in your physical facility. Any access to physical servers must be logged and only granted to authorized individuals.curity, and secure operating system configuration.


Encrypt All Files and Backups
Disable Network Access
Regularly Patch Servers
Lock Down Accounts
Ensure Physical Security
Customer data

8.TESTING

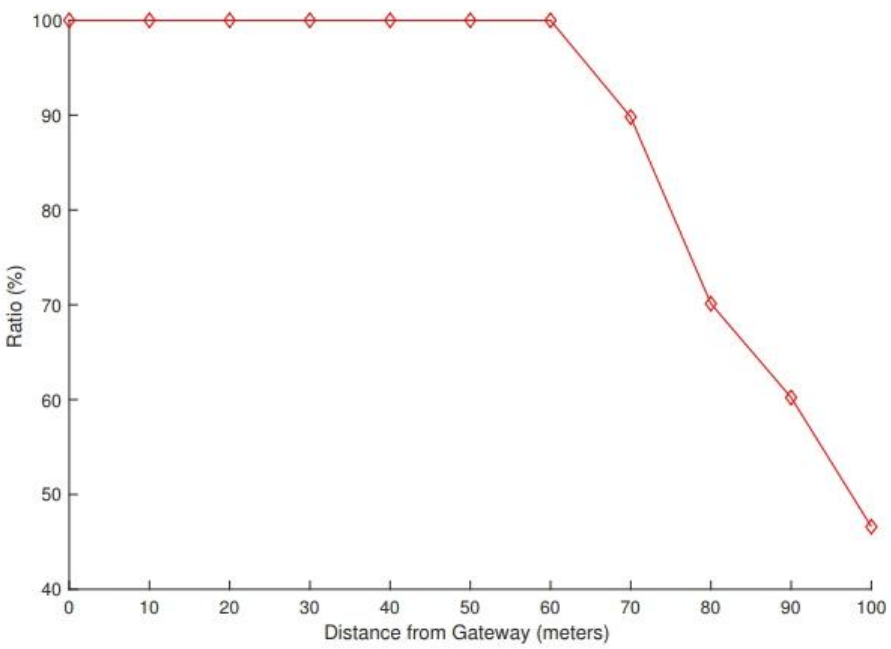
8.1 Test Case

As depicted in figure 6, the devices in this use case are located close to a building and the activity is transmitted over a leased HDSL line to the cloud. The sensors are uniformly randomly distributed in a distance of at least 50 meters away from the gateway device. This is important to have an understanding about the communication range of our deployed board. The gateway device is located at the exterior of the building at a height of 4 meters for maximum performance and it is connected over WiFi to the gateway HDSL capable router that is located inside the building.

During our testing period, we carried out some NETWORK performance tests. We deployed 7 repeller devices running the RIOT Operating System. Table I shows the IP addressesof the Repeller Devices and the gateway. During this test we wanted to test and analyze the maximum distance that a IEEE 802.15.4 can operate and the packet loss at several distances.

As shown in figure 7, at a distance of up to 60 meters from the gateway, we have 100% packet delivery. At ≥ 60meters, the packet delivery ratio decreases. The maximum distance reached before the connection was lost is 104.58 meters at Line-of-Sight (LOS).

From figure 7, the yellow links from the gateway to the repeller devices indicate a very good packed delivery ratio compare to the red links. Furthermore, we wereable to estimate the maximum number of devices that the6LoWPAN network could host per gateway in order to havethe maximum effectiveness.



8.2. User Acceptance Testing

User Acceptance Testing (UAT) is a process to check whether the system accepts a user's requirements. It's performed at a time when actual users use the system. This testing comes after - Unit Test--->Integration Test, --->System Test, --->Acceptance Test in the process. Its testing process related to another analogy, such as manufacturing pens. While production of a ballpoint pen, the cap, the body, the tail, the clip, the ink cartridge, with the help of things mentioned above, a full ballpoint pen manufactured after that single pen was produced with a combination of every single item.

Each component specified above was tested to ensure that each component will make the pen in a working condition. When a complete pen is integrated, System Test is performed. Once it is over, perform the Acceptance test to confirm that each ball pen is in working condition and ready for customers. You can also explore more about Integration Test in this insight.

9. RESULTS

9.1. Performance Metrics

We conducted experimentation by varying training datasets for the detection of animals and classification purposes. the testing model for the proposed algorithm. R-CNN algorithm generates regions using selective search and extracts around 2000 regions in each image. Computation time will be much higher because of its process in making a prediction, which is around 40-50 seconds. SSD algorithm works on backbone model and SSD head contains pre-trained image classification network as a featured network. Here we have used 4 × 4 grids for detecting the objects in the region of the image. The prediction for the algorithm, SSD outstands in predicting and classifying the animals compared to R-CNN, and also computation time will be very less. The Twilio API interface decimates the information to the farmers to take necessary action in their farm field .

10. ADVANTAGES AND DISADVANTAGES

Advantages :

Highly-flexible

 Fit & Forget System

No need of human effort

. High security is provided

• Farms can be monitored and controlled remotely.

• Increase in convenience to farmers.

• Less labour cost.

• Better standards of living

Disadvantages :

On the other hand, the disadvantages to widespread pesticide use are significant. They include domestic animal contaminations and deaths, loss of natural antagonists to pests, pesticide resistance, Honeybee and pollination decline, losses to adjacent crops, fishery and bird losses, and contamination of groundwater

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11. CONCLUSION

The problem of crop vandalization by wild animals has become a major social problem in current time. It requires urgent attention as no effective solution exists till date for this problem. Thus this project carries a great social relevance as it aims to address this problem.

This project will help farmers in protecting their orchards and fields and save them from significant financial losses and will save them from the unproductive efforts that they endure for the protection their fields. This will also help them in achieving better crop yields thus leading to their economic wellbeing.

Superiority of citizenry of India rely on agriculture. Our farmers are cladding lots of injuries like intruders or animals destroying in agricultural place which eventually lead to economicaffair,starvation,orpoverty.Uptillnowthesekind of conflicts have been stored in National Bulletin.

So in this project, the main goal of this device is to virtualized or vigilant agricultural place by installing sensing element whichismergedalongwithbuzzerthatwilldriveoutanimals and prevent them to get in agricultural place, by creating ultrasonicsound frequency. It is the futuristic provision in the device according to the request.

Farmers can benefit greatly from an IoT-based smart agriculture system. As a result of the lack of irrigation, agriculture suffers. Climate factors such as humidity, temperature, and moisture can be adjusteddependent on the local environmental variables. This technology also detects animal invasions, which are a major cause of crop loss.

12. FUTURE SCOPE

In the future, there will be a large scope for this system. The IR sensors and Ultrasonic sensors are used to collect the information and transmitted ithrough GSM. This project is further enhanced by wireless sensor network.The type of sensors like finding the moisture content of the soil, growth of the crop and nutrition content in the soil. These sensors gather informations which is useful to the farmers and able to conscious of the farm land from anyplace in the world.

Farmers can benefit greatly from an IoT-based smart agriculture system. As a result of the lack of irrigation, agriculture suffers. Climate factors such as humidity, temperature, and moisture can be adjusteddependent on the local environmental variables. This technology also detects animal invasions, which are a major cause of crop loss. This technology aids in the scheduling of irrigation based on present data from the field and records from a climate source. It helps in deciding the farmer to whether to do irrigation or not to do.

13. APPENDIX

Source code

```
#include<WiFi.h>//library for wifi
#include<PubSubClient.h>//library for MQTT
void callback(char* subscribetopic, byte* payload,unsigned int payloadlength);
//----------------credentials of IBM Account------
#define ORG "izyy6o"// IBM ORGANIZATION ID
#define DEVICE_TYPE "iotdeviceproject"//DEVICE TYPE MENTIONED IN IOT WATSON PLATFORM
#define DEVICE_ID "229714"//DEVICE ID MENTIONED IN IOT WATSON PLATEFORM
#define TOKEN "24681012"//Token
String data3;
float dist;
//------------customize the above value-------
char server[]=ORG ".messaging.internetofthings.ibmcloud.com";//server name
char publishtopic[]="ultrasonic/evt/Data/fmt/json";/*topic name and type of event perform
 and format in which data to be send*/
char subscribetopic[]="ultrasonic/cmd/test/fmt/String";/*cmd REPRESENT Command tupe and
COMMAND IS TEST OF FORMAT STRING*/
char authMethod[]="use-token-auth";//authentication method
char token[]=TOKEN;
char clientid[]="d:" ORG ":" DEVICE_TYPE":" DEVICE_ID;//CLIENT ID
//-------------------------------------
WiFiClient wifiClient;// creating an instance for wificlient
PubSubClient client(server, 1883 , callback , wifiClient);/*calling the predefined client id
by passing parameter like server id,portand wificredential*/
int LED =4;
int trig =5;
int echo=18;
void setup()
{
  Serial.begin(115200);
  pinMode(trig,OUTPUT);
```

```
  pinMode(echo,INPUT);
  pinMode(LED,OUTPUT);
  delay(10);
  wificonnect();
  mqttconnect();
}
void loop()//recursive function
{
  digitalWrite(trig,LOW);
  digitalWrite(trig,HIGH);
  delayMicroseconds(10);
  digitalWrite(trig,LOW);
  float dur=pulseIn(echo,HIGH);
  float dist=(dur * 0.0343)/2;
  Serial.print("distance in cm");
  Serial.println(dist);
  PublishData(dist);
  delay(1000);
  if (!client.loop()){
    mqttconnect();
  }
}
/*.....retriving to cloud.....*/
void PublishData(float dist){
  mqttconnect();//function call for connecting to ibm
  /*creating the string in form of JSON to update the data to ibm cloud*/
  String object;
  if(dist<100)
  {
    digitalWrite(LED,HIGH);
```

```
    Serial.println("no object is near");
    object="Near";
  }
  else
  {
    digitalWrite(LED,LOW);
    Serial.println("no object found");
    object="No";
  }
  String payload="{\"distance\":";
  payload +=dist;
  payload +="," "\"object\":\"";
  payload += object;
  payload += "\"}";

  Serial.print("Sending payload: ");
  Serial.println(payload);
  if(client.publish(publishtopic, (char*) payload.c_str())){
    Serial.println("Publish ok");/* if its sucessfully upload data on the cloud then it will print
    publish ok in serial monitor or else it will print publish failed*/
  } else{
    Serial.println("Publish failed");
  }
}
void mqttconnect(){
  if(!client.connected()){
    Serial.print("Reconnecting client to ");
    Serial.println(server);
    while(!!!client.connect(clientid,authMethod, token)){
      Serial.print(".");
      delay(500);
```

```
    Serial.println("no object is near");
    object="Near";
  }
  else
  {
    digitalWrite(LED,LOW);
    Serial.println("no object found");
    object="No";
  }
  String payload="{\"distance\":";
  payload +=dist;
  payload +="," "\"object\":\"";
  payload += object;
  payload += "\"}";

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void mqttconnect(){
  if(!client.connected()){
    Serial.print("Reconnecting client to ");
    Serial.println(server);
    while(!!!client.connect(clientid,authMethod, token)){
      Serial.print(".");
      delay(500);
```
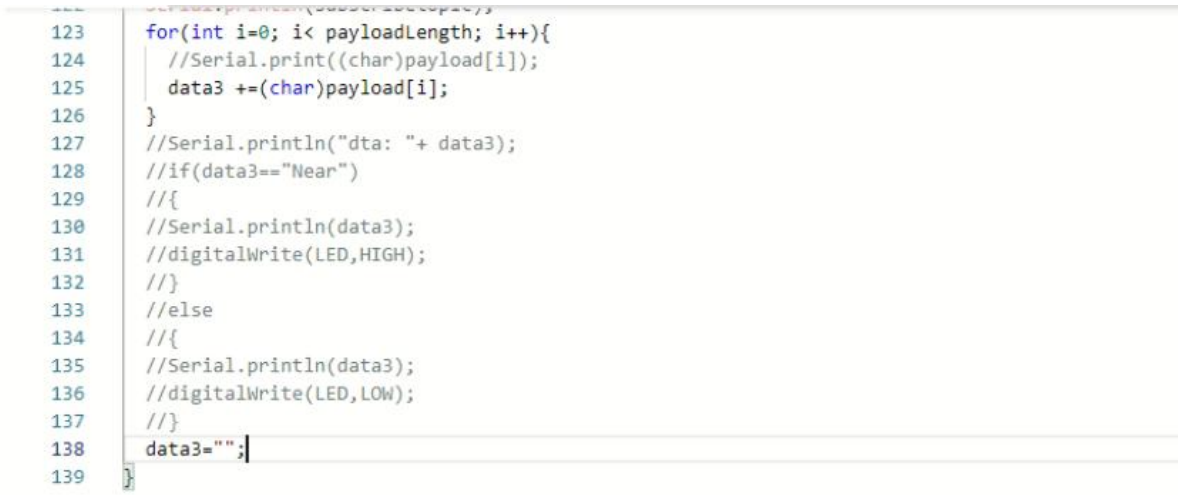

```
    }
    initManagedDevice();
    Serial.println();
  }
}
void wificonnect()//function defenition for wificonnect
{
  Serial.println();
  Serial.print("Connecting to ");
  WiFi.begin("Wokwi.GUEST", "",6);//PASSING THE WIFI CREDIDENTIALS TO ESTABLISH CONNECTION
  while (WiFi.status() !=WL_CONNECTED){
    delay(500);
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");
  Serial.println("IP address");
  Serial.println(WiFi.localIP());
}
void initManagedDevice(){
  if(client.subscribe(subscribetopic)){
    Serial.println((subscribetopic));
    Serial.println("subscribe to cmd OK");
  }else{
    Serial.println("subscribe to cmd failed");
  }
}
void callback(char* subscribetopic,byte*payload,unsigned int payloadLength)
{
  Serial.print("callback invoked for topic: ");
  Serial.println(subscribetopic);
```



```
123   for(int i=0; i< payloadLength; i++){
124     //Serial.print((char)payload[i]);
125     data3 +=(char)payload[i];
126   }
127   //Serial.println("dta: "+ data3);
128   //if(data3=="Near")
129   //{
130   //Serial.println(data3);
131   //digitalWrite(LED,HIGH);
132   //}
133   //else
134   //{
135   //Serial.println(data3);
136   //digitalWrite(LED,LOW);
137   //}
138   data3="";
139 }
```

Github Final Deliverables Link: https://github.com/IBM-EPBL/IBM-Project-32169-1660208491

Demo Video Link: https://youtu.be/lixo6awX_0U