

PROJECT REPORT

IOT BASED SMART CROP PROTECTION SYSTEM FOR AGRICULTURE

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ABSTRACT

IOT Based Smart Crop-Protection for Agriculture monitoring is a system describes how to monitor crop field. It is developed by using sensors and according to the decision from a server based on sensed data, the irrigation and monitoring system is enhanced. Through wireless transmission the sensed data is forwarded to web server database. If the irrigation is automated, then the moisture and temperature fields are decreased below the potential range. The user can monitor and control the system remotely with the help of application which provides a web interface to user. By smart Agriculture monitoring system and one of the oldest ways in agriculture is the manual method of checking the parameters. In this method farmers by themselves verify all the parameter and calculate the reading. It aims at making agriculture smart using automation and IoT. The cloud computing devices are used at the end of the system that can create a whole computing system from sensors to tools that observe data from agriculture field. It proposes a novel methodology for smart farming by including a smart sensing system and smart irrigator system through wireless communication technology. This system is cheap at cost for installation. Here one can access and control the agriculture system in laptop, cell phone or a computer.

Chapter – 1

INTRODUCTION

1.1 PROJECT OVERVIEW

As we know that Indian economy is one of the largest developing economies of the world. The agricultural sector has its largest contribution in the Indian economy. To achieve maximum utilisation of man power and to obtain maximum profit in a given stipulated there is a need in the upgradation of various engineering techniques that are being used today. Thus maintaining proper amount of water level in the soil is one of the necessary requirements to harvest a good crop that can be a source of various types of nutrients whether micro or macro for their proper growth. If we talk about Indian farmers they are worst hit by the famines that occurs due to failure of crops depending upon various drought factors. Rain plays the key role in deciding the future of these crops as well as the farmers every year. The over utilisation of ground water has drastically reduced the ground water level in the last 15 years. So it is the need of hour to utilise each and every drop of water wisely so that it can also be used by our coming generations also. Also we should develop some new methods that use the renewable sources of energy. The development of these new techniques are going to reach our goal of sustainable development as well as to cut off the emission of greenhouse gases to a minimum level. As the name of our project that is **AUTOMATIC IRRIGATION SYSTEM** with the help of the Solar power is a step to utilise some new engineering techniques. This technique will be a very good option for the small and medium farmers who suffer every year just because of failure of crops that took place every year. The implementation of this technology has a wide scope in the nearby future.

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1.2 PURPOSE

The main objective of this project was to design a small-scale irrigated system that would use water in the more well-organized way in order to prevent excess water loss and minimize the cost of labor. The following aspects were considered in the choice of design solution

- Installation cost
- Water saving
- Human intervention
- Reliability
- Power consumption
- Maintenance
- Expandability

A critical Consideration in the segment costs, since cost defines the viability and feasibility of a project. Water saving was also an important feature, since there is demand to decrease.

Chapter-2

LITERATURE SURVEY

S.No	Author and journal		Name of the topic	Features
	P. Rekha IEEE		Preventing agricultural land from animal and automated irrigation system.	<ul style="list-style-type: none">❖ This system makes use of IR sensor for the detection of animals and a soil moisture sensors or to find the moisture of soil and automatically control the waterpump an for auto irrigation system..❖ A system by using wireless sensor networks to detect the intrusion of birds and animals in agricultural lands is discussed
2	Tejas Kharee IEEE	2019	automated crop field surveillance using computer vision	<ul style="list-style-type: none">❖ In this system the long range camera are placed at the corner of field or land withconsidering maximum field of view of camera.❖ When animal is detected by the camera the distance between camera and speaker is calculated.❖ The speaker nearest to the animal is identified.

3	Damini kalra IEEE	2020	proposed a system for crop protection	<ul style="list-style-type: none"> ❖ automatic irrigation system by sensing moisture, humidity and temperature of soil. ❖ The main advantage of this system is this system works in different circumstances like in night and dark (shadow).
4	M Jaya Prabha	2019	a smart crop protection system from animals using Arduino UNO.	<ul style="list-style-type: none"> ❖ The system is consisting of IR sensor for animal detection, ultrasonic sensor which rotates 360 degrees for detection of birds and a GSM module to send alert message to the farmer. ❖ It is a very simple system and cannot differentiate between human and animals. Stefano Giordano et al, [5] this paper's motive is to design IOT based system to prevent animal intrusion in the crop field and providing weather conditions

5	Alaa Adel Araby, Mai Mohamed Abd Elhameed, Hassan Mostafa	2020	Smart IoT Monitoring System for Agriculture with Predictive Analysis	❖ Precision agriculture is a new concept in agriculture, it is defined as the farm management system using information technology to identify, analyze and manage the variability of fields to ensure profitability, sustainability, and protection of the environment. ❖ It is obvious that precision agriculture increases the efficiency that can be realized by understanding and dealing
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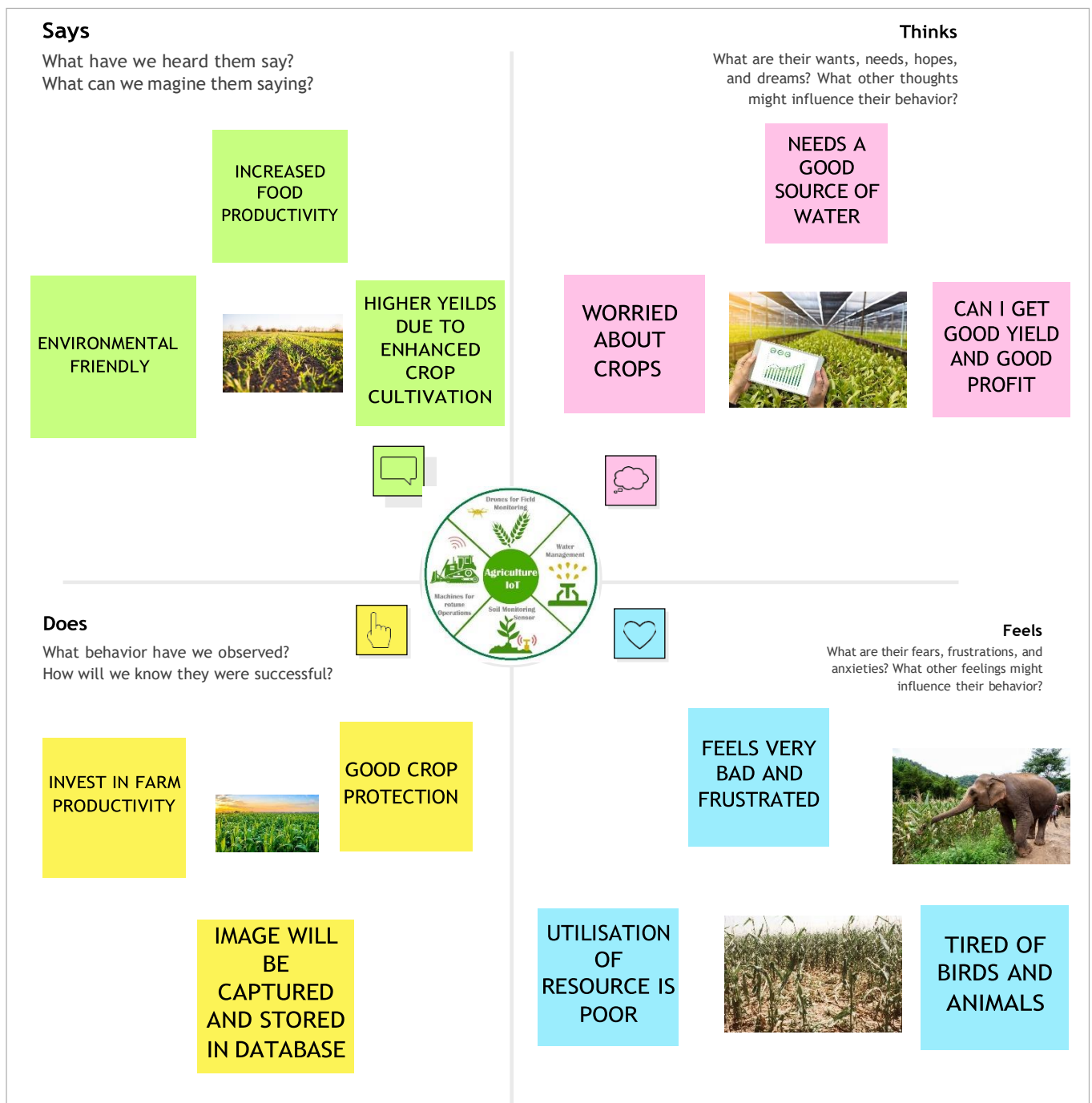
- Farmers are to be present at farm for maintenance irrespective of the weather conditions.
- They must ensure that the crops are well irrigated, and the routine activities of the field must be monitored by them physically.
- To get good, cultivate or yield farmers need to stay in the field for longer time for good yield
- Demand and supply are more if the field is to be monitored monotonously if it covers vast area
- Anytime crops may be prone to various calamities which leads to poor yield of the crops

And these are some cons that is been faced by the farmers and which leads them to cultivate crops for less yield despite heavy work

Chapter-3

IDEATION & PROPOSED SOLUTION


3.1 Empathy Map Canvas:



3.2 Ideation & Brainstorming:




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


Template



Brainstorm & idea prioritization


Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.


 10 minutes to prepare
 1 hour to collaborate
 2-8 people recommended



Before you collaborate


A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

 10 minutes




Team gathering

Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.



Set the goal

Think about the problem you'll be focusing on solving in the brainstorming session.



Learn how to use the facilitation tools


Use the Facilitation Superpowers to run a happy and productive session.

[Open article](#) →


1

Define your problem statement

What problem are you trying to solve? Frame your problem as a How Might We statement. This will be the focus of your brainstorm.


 5 minutes


The problem of crop vocalization is a major threat to agriculture as well as for humans. This leads to poor yield of crops and if you focus on vocal loss to the owners of the land. The problem is so pronounced that sometimes the farmers decide to leave the areas barren due to such "losses" or the attacks.





Key rules of brainstorming


To run a smooth and productive session


 Stay in topic.


 Encourage wild ideas.

 Defer judgment.

 Listen to others.

 Go for volume.

 If possible, be visual.



[Share template feedback](#)

Step-2: Brainstorm, Idea Listing and Grouping

2

Brainstorm

Write down any ideas that come to mind that address your problem statement.

🕒 10 minutes

KARPAGAM K

If birds entry detected, sound system is turn on.

Pepper flakes are used for avoiding rats in field

Soil conditions are checked before planting

Corntoy is used to protect crops from birds

DIVYA J

Temperature can be detected by mobile apps

Using low cost software can increase productivity

using the mobile notificatin to control

improves productivity and enables greater numbers of resources

ANJALI B

Automatic irrigation for growth to be implemnted

Unwanted water stagnation avoided by water pumps and motors

pH sensors is used for monitoring plant growth

Proper field sanitation

KAVINA G

Prefering plants which are mutated to resist against insects

Planting insect resistant plants

Prefering proper insecticides

Acoustic sensors to detect insect sounds.

3

Group ideas

Take turns sharing your ideas while clustering similar or related notes as you go. Once all sticky notes have been grouped, give each cluster a sentence-like label. If a cluster is bigger than six sticky notes, try and see if you and break it up into smaller sub-groups.

🕒 20 minutes

If birds entry detected sound system is turn on

Acoustic sensors to detect insect sounds



Unwanted water stagnation avoided by water pumps and motors

Temperature can be detected by mobile apps



imoroves productivity and enables greater number of resources

Automatic irrigation for growth to be implemented

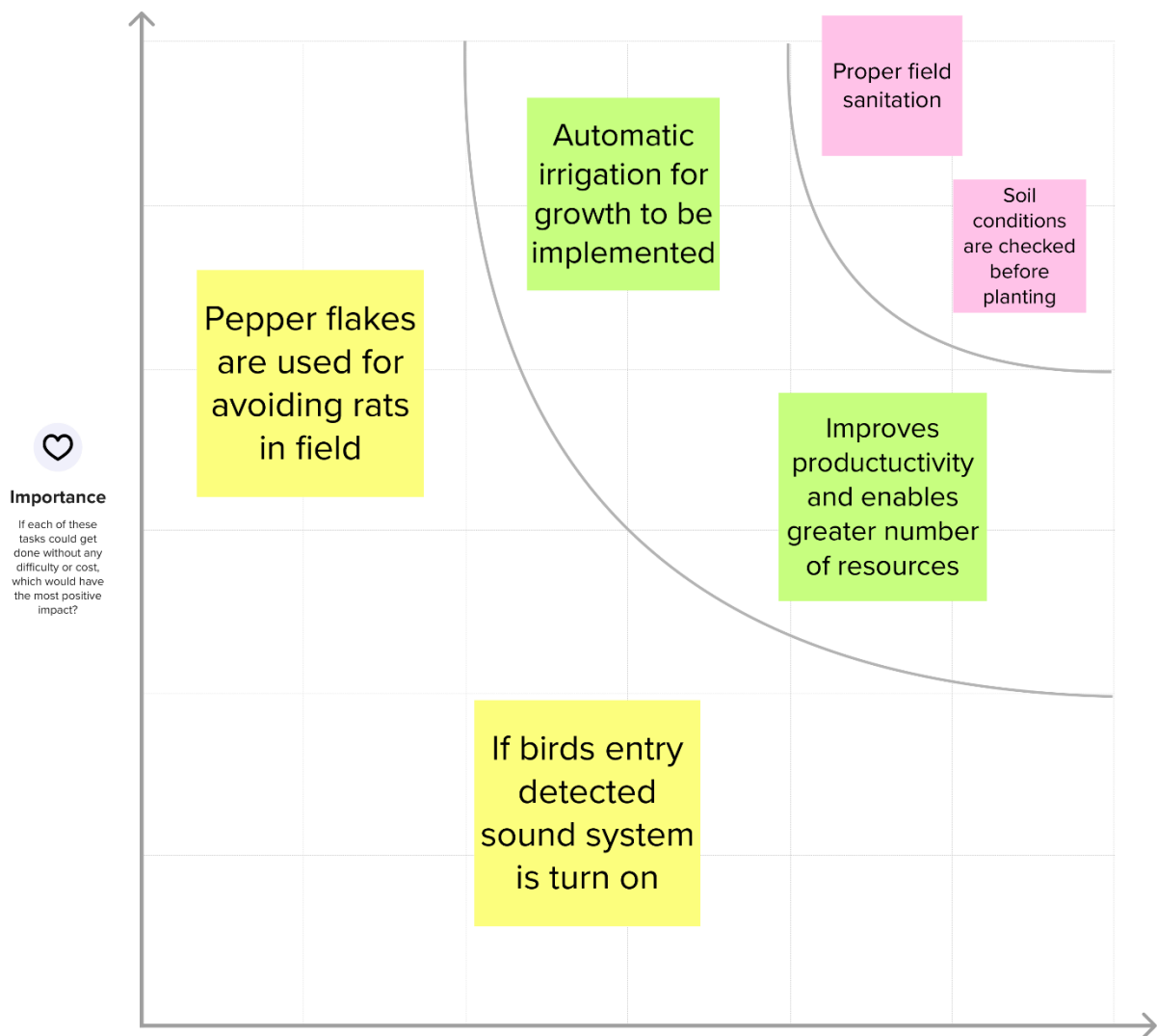
Step-3: Idea Prioritization

4

Prioritize

Your team should all be on the same page about what's important moving forward. Place your ideas on this grid to determine which ideas are important and which are feasible.

🕒 20 minutes



3.3 Proposed Solution:

S.No	Parameter	Description
1.	Problem Statement (Problem to be solved)	Wild animal attacks are a special challenge for farmers throughout the world. Animals cause serious damage to crops. They can damage the plants by feeding on plant parts or simply by running over the field and trampling over the crop fields. Therefore, wild animals may easily cause significant yield losses and provoke additional financial problems. Another aspect to consider is that wild animal crop protection requires a particularly cautious approach.
2.	Idea / Solution description	We are developing a drone, which monitors the entry of wild animals inside the field in the absence of farmers. In addition, it sprays fertilizers periodically and senses the presence of weeds growing along the crops.
3.	Novelty / Uniqueness	In the existing solutions, they have developed drones only for monitoring purposes. But we have proposed additional solutions for sensing weeds alongside crops and doing add-on work like spraying fertilizers and detecting crop growth.
4.	Social Impact / Customer Satisfaction	This technology will protect the crops from damage and hence farmers will not suffer from crop losses and it will result in an increase in crop yield.
5.	Business Model (Revenue Model)	Deploying drones for crop protection purposes with understandable technology and multi-purpose tasking will enhance the protection of crops. The investment in drone technology for crop protection is higher than in the conventional types of equipment as

		well as functionalities.
6.	Scalability of the Solution	Crop protection using drones in case of a wild animal breach, weed formation, and climatic hazards gives the farmers great relief from this and can fully concentrate on crop production.

3.4 Problem Solution fit:

Project Title: IoT-based smart crop protection system for agriculture

Project Design Phase-I – Solution Fit Template

Team ID: PNT2022TMID30551

Define CS, fit into	<p>1. CUSTOMER SEGMENT(S) CS</p> <p>Who is your customer? I.e. working parents of 0-5 y.o. kids</p> <div data-bbox="284 593 561 712"> <p>Farmers who face problems in protecting their crops.</p> </div>	<p>6. CUSTOMER CONSTRAINTS CC</p> <p>What constraints prevent your customers from taking action or limit their choices of solutions? I.e. spending power, budget, no cash, network connection, available devices.</p> <div data-bbox="667 533 1005 801"> <p>Most of the target customers are farmers and people working in agricultural fields. They find difficulty in spending lot of fertilizers, pesticides which costs them high amount and high risk of spoiling the crops due to chemical infusion.</p> </div>	<p>5. AVAILABLE SOLUTIONS AS</p> <p>Which solutions are available to the customers when they face the problem</p> <p>or need to get the job done? What have they tried in the past? What pros & cons do these solutions have? I.e. pen and paper is an alternative to digital notetaking</p> <div data-bbox="1109 533 1417 712"> <p>Already existing solution have cctv camera fixed around the agri land but will let us know only after the impact.</p> </div>	Explore AS, Focus on J&P, tap into BE, understand
	Focus on J&P, tap into BE, understand	<p>2. JOBS-TO-BE-DONE / PROBLEMS J&P</p> <p>Which jobs-to-be-done (or problems) do you address for your customers? There could be more than one; explore different sides.</p> <div data-bbox="258 981 566 1281"> <p>Choosing the position of placing the smart sign board. Customers are assigned with monitoring the feed through the screen given to them and can access the database of the parameters measured via drones and ground.</p> </div>	<p>9. PROBLEM ROOT CAUSE RC</p> <p>What is the real reason that this problem exists? What is the back story behind the need to do this job? I.e. customers have to do it because of the change in regulations.</p> <div data-bbox="670 1034 1034 1272"> <p>There are many causes like unexpected climatic condition, unexpected intrusion of wild animals due to deforestation and poaching of forest dumps, ill effects of fertilizers and pesticides.</p> </div>	

3. TRIGGERS**TR**

What triggers customers to act? I.e. seeing their neighbour install solar panels, reading about a more efficient solution in the news.

Farmers are deeply affected by the attack caused in their Agri lands due to wild animals, small insects like bugs, and locusts thereby affecting production and creating a mass-level failure in the profit making.

4. EMOTIONS: BEFORE / AFTER**EM**

How do customers feel when they face a problem or a job and afterwards?
I.e. lost, insecure > confident, in control - use it in your communication strategy & design.

Farmers would feel very difficult to curb the intrusion of wild animals in their agri lands and would suffer massive loss due to it.

10. YOUR SOLUTION

If you are working on an existing business, write down your current solution first, fill in the canvas, and check how much it fits reality.
If you are working on a new business proposition, then keep it blank until you fill in the canvas and come up with a solution that fits within customer limitations, solves a problem and matches customer behaviour.

We are working on drone which will be used to monitor the whole agri-land 24*7 and detects any intrusion of wild animals using image processing and thermal imaging, detecting using vibration sensor in the ground and also detecting climate conditions so that the farmers can decide whether to sow or to cultivate.

SL**8. CHANNELS of BEHAVIOUR****CH****8.1 ONLINE**

What kind of actions do customers take online? Extract online channels from #7

Here farmers are the customers. They can make use of tablets which is specially made for the farmers. Through tablet, farmers can access the database collected from the drone, and can even monitor through it.

8.2 OFFLINE

What kind of actions do customers take offline? Extract offline channels from #7 and use them for customer development.

Farmers can easily operate the drones because printed catalogues are issued to them in their regional language so that they can learn to operate with the basic mechanisms.

Chapter - 4

REQUIREMENT ANALYSIS

4.1 Functional Requirement:

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	Farm monitoring (drone)	<ul style="list-style-type: none">➤ Sensors (data transfer)➤ Monitoring intrusion of wild animals, rodents, macro insects➤ Releasing RF waves to destroy them
FR-2	Weather forecast (drone)	<ul style="list-style-type: none">➤ Current weather in the field as well as in the region➤ Temperature and humidity➤ Wind speed and direction to detect storm➤ Rainfall detection before impact
FR-3	Field Livestream to tablets	<ul style="list-style-type: none">➤ All images and live casts from the field➤ Live Weather forecast readings updated➤ Live forecast from sensors in the land portion➤ Customized tablets for easy operation, and multilingual facilities.➤ Generates alarm messages when any of the parameters goes abnormal
FR-4	Farm monitoring (land part)	<ul style="list-style-type: none">➤ Sensors (data transfer)➤ Footprints of the animals detected➤ The sounds of the animals detected
FR-5	Power consumption (drone & tablet)	<ul style="list-style-type: none">➤ Solar panels used for conventional supply

4.2 Non-Functional Requirement:

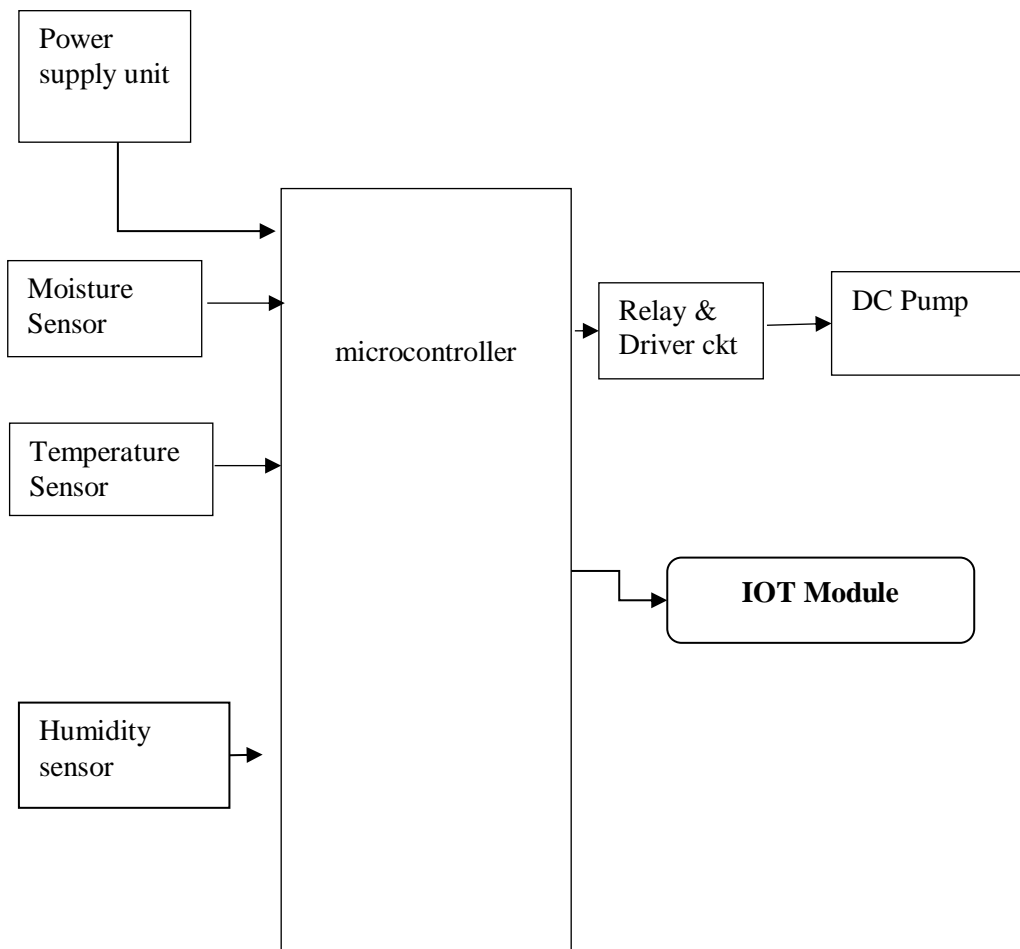
FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Understandable, multilingual, user-friendly applications in the tablet
NFR-2	Security	<ul style="list-style-type: none">➤ Database collected are accessed using TCP-IP protocol system (esp. UDP), stored in the cloud.➤ The communication interface is done using SP-D2GCS protocol➤ Security was established using Transport layer security protocol and IoT Security.

NFR-3	Reliability	Consistency in tolerance, accuracy maintained, application uptime enhanced
NFR-4	Performance	Provides accurate data, efficient functioning despite unexpected variations in climatic conditions and geographical terrains
NFR-5	Availability	Drone's downtime: available 90% of the time in every month Tablet's downtime: available 99% of the time

Chapter-5

PROJECT DESIGN

5.1 Data Flow Diagrams:

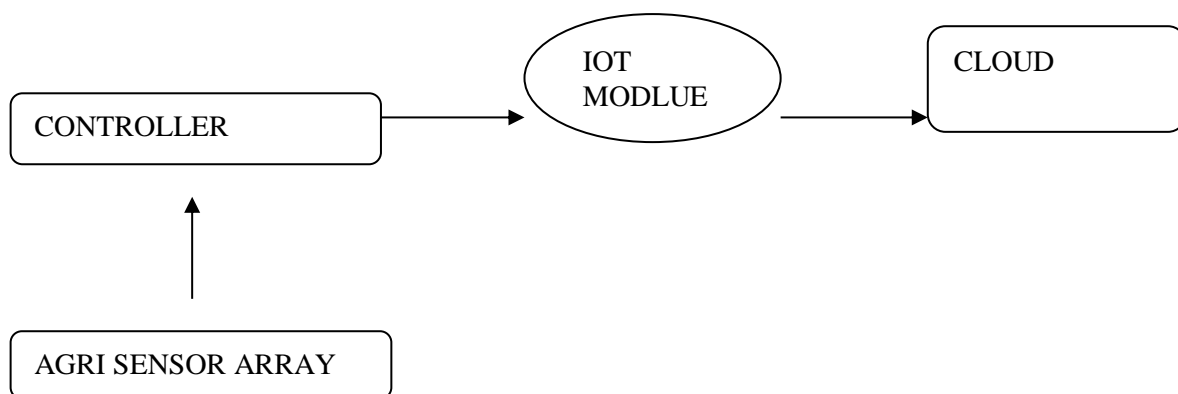


5.2 Solution & Technical Architecture:

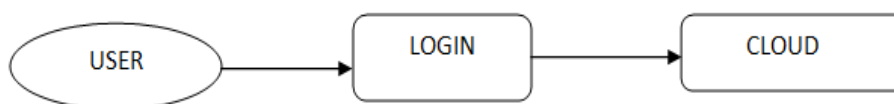
Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

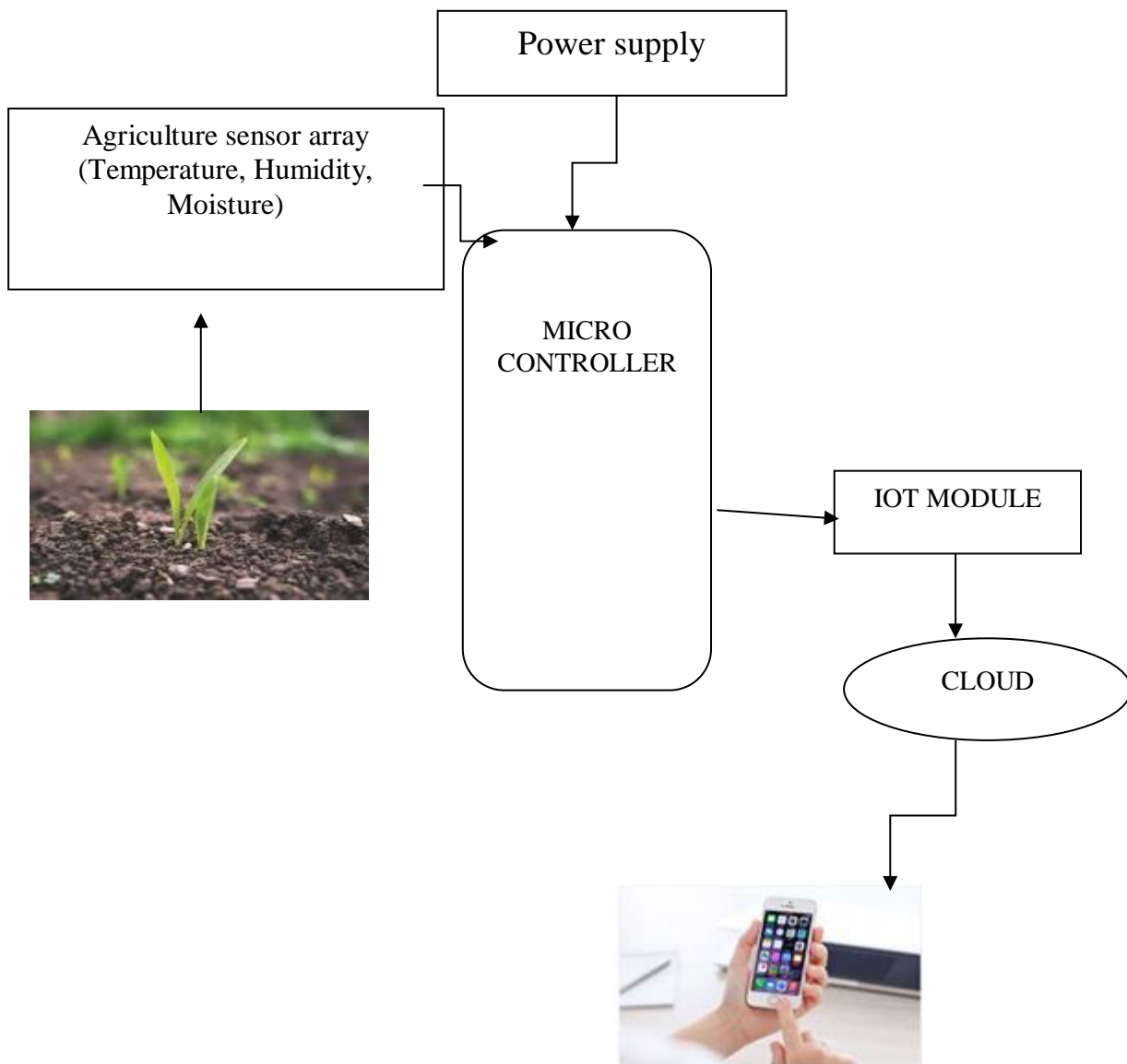
- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.

MODULE 1



MODULE 2





Explanation for the Architecture Diagram:

- ❖ 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.
- ❖ 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

5.3 User Stories:

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, and password, and confirming my password.	I can access my account/dashboard	High	Sprint-1
	Mail Confirmation	USN-2	As a user, I will receive a confirmation email once I have registered for the application	I can receive a confirmation email & click confirm	High	Sprint-1
	Facebook Access	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
	Register	USN-4	As a user, I can register for the application through Gmail	I can register for the application	Medium	Sprint-1
	Login	USN-5	As a user, I can log into the application by entering my email & password	I can log into the required application	High	Sprint-1
Customer (Webuser)	Same as Mobile user	Same as Mobile user	Same as Mobile user	Same as Mobile user	High	Sprint-1
Customer Care Executive	Farmer Welfare Department	USN-1	As a user, I manage a team of representatives offering customer support	I can communicate with them in a proper manner	High	Sprint-1
	Agriculture Extension Department	USN-2	As a user, I provide technical aid to farmers on any agriculture issues	I can implement activities of agriculture extension	High	Sprint-1
Administrator	Farm Administrator	USN-1	As a user, I provide administrative support for farmers	I informed them about the financial and physical performance	High	Sprint-1
		USN-2	As a user, I live and work on a farm or an estate	I take responsibility	Medium	Sprint-1

Chapter – 6

PROJECT PLANNING & SCHEDULING

6.1 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.	3	High	K.Karpagam
Sprint-1		USN-2	As a user, I will receive confirmation email once I have registered for the application	2	High	J.Divya
Sprint-2	Cloud Service	USN-3	As a user, I can register for the application through Facebook or any social media	1	Low	B.Anjali
Sprint-4		USN-4	As a user, I can register for the application through Gmail / web service	2	Medium	G.kavina
Sprint-3	Login	USN-5	As a user, I can log into the application by entering email & password	4	High	J.Divya
Sprint-2	Pre processing	USN-6	As a farmer, the user must be able to find the system easy to access so the Pre-processes and other task must be perfect	3	High	K.Karpagam
Sprint-1	Collecting Dataset	USN-7	To collect various sources of animal threats and keep developing a dataset using Clarifai.	3	Medium	B.Anjali
Sprint-4	Integrating	USN-8	To integrate the available dataset and keep improving the accuracy of finding animals	2	Medium	G.kavina
Sprint-3		USN-9	To find and use appropriate compiler to run and test the data so that we can implement our program	1	Low	B.Anjali
Sprint-2		USN-10	Request AVS Engineering College to deploy the project in our	1	Low	J.Divya

			campus and test			
Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Training	USN-11	As programmer, we need to train our data perfectly so that the program runs smoothly	3	High	G.kavina
Sprint-3		USN-12	Train the data using out available service and IBM dataset from server and improve that	2	Medium	K.Karpagam
Sprint-4	Coding	USN-13	To modify the code according to our program and improve the efficiency of that code	4	High	B.Anjali
Sprint-2		USN-13	To improve performance	1	Low	J.Divya
Sprint-2	Record	USN-5	To record the data and plot the graph to show the characteristics officially	4	Medium	G.Kavina
Sprint-1	Planning	USN-4	Plan the programming language and feasibility	3	High	K.Karpagam
Sprint-4		USN-14	Demonstrate the working and improve accuracy overall	2	Low	B.Anjali

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	6 Days	20Oct 2022	24 Oct 2022	20	31 Oct 2022
Sprint-2	20	6 Days	25 Oct 2022	29 Oct 2022	20	7 Oct 2022
Sprint-3	20	6 Days	31 Oct 2022	4 Nov 2022	20	12 Nov 2022
Sprint-4	20	6 Days	5 Nov 2022	11 Nov 2022	20	19 Nov 2022

6.2 Sprint Delivery Schedule:

TITLE	DESCRIPTION	DATE
Literature Survey on The Selected Project and Information Gathering	A Literature Survey is a compilation summary of research done previously in the given topic. Literature survey can be taken from books, research paper online or from any source.	19 September 2022
Prepare Empathy Map	Empathy Map is a visualization tool which can be used to get a better insight of the customer	19 September 2022
Ideation-Brainstorming	Brainstorming is a group problem solving session where ideas are shared, discussed and organized among the team members.	19 September 2022
Define Problem Statement	A Problem Statement is a concise description of the problem or issues a project seeks to address. The problem statement identifies the current state, the desired future state and any gaps between the two.	19 September 2022
Problem Solution Fit	This helps us to understand the thoughts of the customer their likes, behaviour, emotions etc.	12 October 2022
Proposed Solution	Proposed solution shows the current solution and it helps is going towards the desired result until it is achieved.	12 October 2022
Solution Architecture	Solution Architecture is a very complex process I.e it has a lot of sub-processes and branches. It helps in understanding the components and features to complete our project.	12 October 2022
Customer Journey	It helps us to analyse from the perspective of a customer, who uses our project.	15 October 2022
Functional Requirement	Here functional and nonfunctional requirements are briefed. It has specific features like usability, security, reliability, performance, availability and scalability.	15 October 2022
Data Flow Diagrams	Data Flow Diagram is a graphical or visual representation using a standardized set of symbols and notations to describe a business's operations through data movement.	15 October 2022
Technology Architecture	Technology Architecture is a more well defined version of solution architecture. It helps us analyze and understand various technologies that needs to be implemented in the project.	15 October 2022
Prepare Milestone & Activity List	It helps us to understand and evaluate our own progress and accuracy so far.	29 October 2022

Spring Delivery Plan	Sprint planning is an event in scrum that kicks off the sprint. The purpose of sprint planning is to define what can be delivered in the sprint and how that work will be achieved.	In Progress
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Chapter-7

CODING & SOLUTIONING

7.1 Feature 1: Coding for Animals or pests enter into the field

```
8  #include <ESP8266WiFi.h>
9  #include <WiFiClient.h>
10 #include <PubSubClient.h>
11 #include "DHT.h"
12
13 const char* ssid = "SMART-G";
14 const char* password = "10112019";
15
16 #define DHTPIN D6
17 #define G D0
18 #define DHTTYPE DHT11
19 DHT dht(DHTPIN, DHTTYPE);
20
21 #define ID "ryup3j"
22 #define DEVICE_TYPE "ESP8266"
23 #define DEVICE_ID "TEST"
24 #define TOKEN "TEST-12345"
25
26 char server[] = ID ".messaging.internetofthings.ibmcloud.com";
27 char publish_Topic1[] = "iot-2/evt/Data1/fmt/json";
28 char publish_Topic2[] = "iot-2/evt/Data2/fmt/json";
29 char publish_Topic3[] = "iot-2/evt/Data2/fmt/json";
30 char publish_Topic4[] = "iot-2/evt/Data2/fmt/json";
31 char authMethod[] = "use-token-auth";
32 char token[] = TOKEN;
33 char clientId[] = "d:" ID ":" DEVICE_TYPE ":" DEVICE_ID;
34
35 WiFiClient wifiClient;
36 PubSubClient client(server, 1883, NULL, wifiClient);
37
38 void setup() {
39   pinMode(D0,OUTPUT);
40   digitalWrite(D0,HIGH);
41   Serial.begin(115200);
42   dht.begin();
43   Serial.println();
44   WiFi.begin(ssid, password);
```

```
45 while (WiFi.status() != WL_CONNECTED) {
46     delay(500);
47     Serial.print(".");
48 }
49 Serial.println("");
50 Serial.println(WiFi.localIP());
51
52 if (!client.connected()) {
53     Serial.print("Reconnecting client to ");
54     Serial.println(server);
55     while (!client.connect(clientId, authMethod, token)) {
56         Serial.print(".");
57
58         delay(500);
59     }
60     Serial.println("Connected TO IBM IoT cloud!");
61 }
62
63 long previous_message = 0;
64 void loop() {
65     client.loop();
66     long current = millis();
67     if (current - previous_message > 3000) {
68         previous_message = current;
69         float hum = dht.readHumidity();
70         float temp = dht.readTemperature();
71         float MOI = map(analogRead(A0), 0, 1023, 100, 0);
72         float bi = map(digitalRead(D1), 0, 1, 100, 0 );
73         if (isnan(hum) || isnan(temp) ){
74             Serial.println(F("Failed to read from DHT sensor!"));
75             return;
76         }
77
78         Serial.print("Temperature: ");
79         Serial.print(temp);
80         Serial.print("°C");
81         Serial.print(" Humidity: ");
82         Serial.print(hum);
83         Serial.print("%");
84         Serial.print("SOIL MOITURE: ");
85         Serial.print(MOI);
86         Serial.print(" ANIMAL AND BIRD: ");
87         Serial.print(bi);
88         if(MOI<=10)
```

```

89  {
90    digitalWrite(D0,LOW);
91    delay(100);
92    digitalWrite(D0,HIGH);
93  }
94  else
95  {
96    digitalWrite(D0,HIGH);
97  }
98
99
100  String payload = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
101    payload += "\",\"Temperature\":";
102    payload += temp;
103    payload += "}}";
104
105  Serial.print("Sending payload: ");
106  Serial.println(payload);
107
108  if (client.publish(publish_Topic1, (char*) payload.c_str())) {
109    Serial.println("Published successfully");
110  } else {
111    Serial.println("Failed");
112  }
113  String payload1 = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
114    payload1 += "\",\"Humidity\":";
115    payload1 += hum;
116    payload1 += "}}";

117    Serial.print("Sending payload: ");

118    Serial.println(payload1);
119    Serial.println("\n");
120
121    if (client.publish(publish_Topic2, (char*) payload1.c_str())) {
122      Serial.println("Published successfully");
123    } else {
124      Serial.println("Failed");
125    }
126
127
128  String payload3 = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
129    payload3 += "\",\"Moiture\":";
130    payload3 += MOI;

```

```
131     payload3 += "}}";
132
133     Serial.print("Sending payload: ");
134     Serial.println(payload3);
135
136     if (client.publish(publish_Topic3, (char*) payload3.c_str())) {
137         Serial.println("Published successfully");
138     } else {
139         Serial.println("Failed");
140     }
141
142
143
144 String payload4 = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
145     payload4 += "\",\"Animal&Bird\":\"";
146     payload4 += bi;
147     payload4 += "}}";
148
149     Serial.print("Sending payload: ");
150     Serial.println(payload4);
151
152     if (client.publish(publish_Topic4, (char*) payload4.c_str())) {
153         Serial.println("Published successfully");
154     } else {
155         Serial.println("Failed");
156     }
157 }
158 }
```


158.1 **Feature 2:** coding for moisture level checking

```
7  #include <ESP8266WiFi.h>
8  #include <WiFiClient.h>
9  #include <PubSubClient.h>
10 #include "DHT.h"
11
12 const char* ssid = "SMART-G";
13 const char* password = "10112019";
14
15 #define DHTPIN D6
16 #define G D0
17 #define DHTTYPE DHT11
18 DHT dht(DHTPIN, DHTTYPE);
19
20 #define ID "ryup3j"
21 #define DEVICE_TYPE "ESP8266"
22 #define DEVICE_ID "TEST"
23 #define TOKEN "TEST-12345"
24
25 char server[] = ID ".messaging.internetofthings.ibmcloud.com";
26 char publish_Topic1[] = "iot-2/evt/Data1/fmt/json";
27 char publish_Topic2[] = "iot-2/evt/Data2/fmt/json";
28 char publish_Topic3[] = "iot-2/evt/Data2/fmt/json";
29 char publish_Topic4[] = "iot-2/evt/Data2/fmt/json";
30 char authMethod[] = "use-token-auth";
31 char token[] = TOKEN;
32 char clientId[] = "d:" ID ":" DEVICE_TYPE ":" DEVICE_ID;
33
34 WiFiClient wifiClient;
35 PubSubClient client(server, 1883, NULL, wifiClient);
36
37 void setup() {
38   pinMode(D0,OUTPUT);
39   digitalWrite(D0,HIGH);
40   Serial.begin(115200);
41   dht.begin();
42   Serial.println();
43   WiFi.begin(ssid, password);
44   while (WiFi.status() != WL_CONNECTED) {
45     delay(500);
```

```
46     Serial.print(".");
47   }
48   Serial.println("");
49   Serial.println(WiFi.localIP());
50
51   if (!client.connected()) {
52     Serial.print("Reconnecting client to ");
53     Serial.println(server);
54     while (!client.connect(clientId, authMethod, token)) {
55       Serial.print(".");
56       delay(500);
57     }
58
59     Serial.println("Connected TO IBM IoT cloud!");
60   }
61 }
62 long previous_message = 0;
63 void loop() {
64   client.loop();
65   long current = millis();
66   if (current - previous_message > 3000) {
67     previous_message = current;
68     float hum = dht.readHumidity();
69     float temp = dht.readTemperature();
70     float MOI = map(analogRead(A0), 0, 1023, 100, 0);
71     float bi = map(digitalRead(D1), 0, 1, 100, 0 );
72     if (isnan(hum) || isnan(temp) ){
73       Serial.println(F("Failed to read from DHT sensor!"));
74       return;
75     }
76
77     Serial.print("Temperature: ");
78     Serial.print(temp);
79     Serial.print("°C");
80     Serial.print(" Humidity: ");
81     Serial.print(hum);
82     Serial.print("% ");
83     Serial.print("SOIL MOITURE: ");
84     Serial.print(MOI);
85     Serial.print("ANIMAL AND BIRD: ");
86     Serial.print(bi);
```

```

87  if(MOI<=10)
88  {
89      digitalWrite(D0,LOW);
90      delay(100);
91      digitalWrite(D0,HIGH);
92  }
93  else
94  {
95      digitalWrite(D0,HIGH);
96  }
97
98
99      String payload = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
100          payload += "\",\"Temperature\":";
101          payload += temp;
102          payload += "}}";
103
104      Serial.print("Sending payload: ");
105      Serial.println(payload);
106
107      if (client.publish(publish_Topic1, (char*) payload.c_str())) {
108          Serial.println("Published successfully");
109      } else {
110          Serial.println("Failed");
111      }
112      String payload1 = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
113
114          payload1 += "\",\"Humidity\":";
115          payload1 += hum;
116          payload1 += "}}";
117          Serial.print("Sending payload: ");
118
119          Serial.println(payload1);
120          Serial.println("\n");
121
122          if (client.publish(publish_Topic2, (char*) payload1.c_str())) {
123              Serial.println("Published successfully");
124          } else {
125              Serial.println("Failed");
126          }

```

```
127 String payload3 = "{\"d\":{\"Name\":\"\" DEVICE_ID \"\"\"";
128     payload3 += "\",\"Moiture\":\"";
129     payload3 += MOI;
130     payload3 += "}}";
131
132 Serial.print("Sending payload: ");
133 Serial.println(payload3);
134
135 if (client.publish(publish_Topic3, (char*) payload3.c_str())) {
136     Serial.println("Published successfully");
137 } else {
138     Serial.println("Failed");
139 }
140
141
142
143String payload4 = "{\"d\":{\"Name\":\"\" DEVICE_ID \"\"\"";
144     payload4 += "\",\"Animal&Bird\":\"";
145     payload4 += bi;
146     payload4 += "}}";
147
148 Serial.print("Sending payload: ");
149 Serial.println(payload4);
150
151 if (client.publish(publish_Topic4, (char*) payload4.c_str())) {
152     Serial.println("Published successfully");
153 } else {
154     Serial.println("Failed");
155 }
156 }
157 }
```

157.1 Feature 3:

```
7  #include <ESP8266WiFi.h>
8  #include <WiFiClient.h>
9  #include <PubSubClient.h>
10 #include "DHT.h"
11
12 const char* ssid = "SMART-G";
13 const char* password = "10112019";
14
15 #define DHTPIN D6
16 #define G D0
17 #define DHTTYPE DHT11
18 DHT dht(DHTPIN, DHTTYPE);
19
20 #define ID "ryup3j"
21 #define DEVICE_TYPE "ESP8266"
22 #define DEVICE_ID "TEST"
23 #define TOKEN "TEST-12345"
24
25 char server[] = ID ".messaging.internetofthings.ibmcloud.com";
26 char publish_Topic1[] = "iot-2/evt/Data1/fmt/json";
27 char publish_Topic2[] = "iot-2/evt/Data2/fmt/json";
28 char publish_Topic3[] = "iot-2/evt/Data2/fmt/json";
29 char publish_Topic4[] = "iot-2/evt/Data2/fmt/json";
30 char authMethod[] = "use-token-auth";
31 char token[] = TOKEN;
32 char clientId[] = "d:" ID ":" DEVICE_TYPE ":" DEVICE_ID;
33
34 WiFiClient wifiClient;
35 PubSubClient client(server, 1883, NULL, wifiClient);
36
37 void setup() {
38   pinMode(D0,OUTPUT);
39   digitalWrite(D0,HIGH);
40   Serial.begin(115200);
41   dht.begin();
42   Serial.println();
43   WiFi.begin(ssid, password);
```

```
44 while (WiFi.status() != WL_CONNECTED) {
45     delay(500);

46     Serial.print(".");
47 }
48 Serial.println("");
49 Serial.println(WiFi.localIP());
50
51 if (!client.connected()) {
52     Serial.print("Reconnecting client to ");
53     Serial.println(server);
54     while (!client.connect(clientId, authMethod, token)) {
55         Serial.print(".");
56         delay(500);
57     }

58     Serial.println("Connected TO IBM IoT cloud!");
59 }
60 }
61
62 long previous_message = 0;
63 void loop() {
64     client.loop();
65     long current = millis();
66     if (current - previous_message > 3000) {
67         previous_message = current;
68         float hum = dht.readHumidity();
69         float temp = dht.readTemperature();
70         float MOI = map(analogRead(A0), 0, 1023, 100, 0);
71         float bi = map(digitalRead(D1), 0, 1, 100, 0 );
72         if (isnan(hum) || isnan(temp) ){
73             Serial.println(F("Failed to read from DHT sensor!"));
74             return;
75         }
76
77         Serial.print("Temperature: ");
78         Serial.print(temp);
79         Serial.print("°C");
80         Serial.print(" Humidity: ");
81         Serial.print(hum);
82         Serial.print("%");
83         Serial.print("SOIL MOITURE: ");
84         Serial.print(MOI);
```

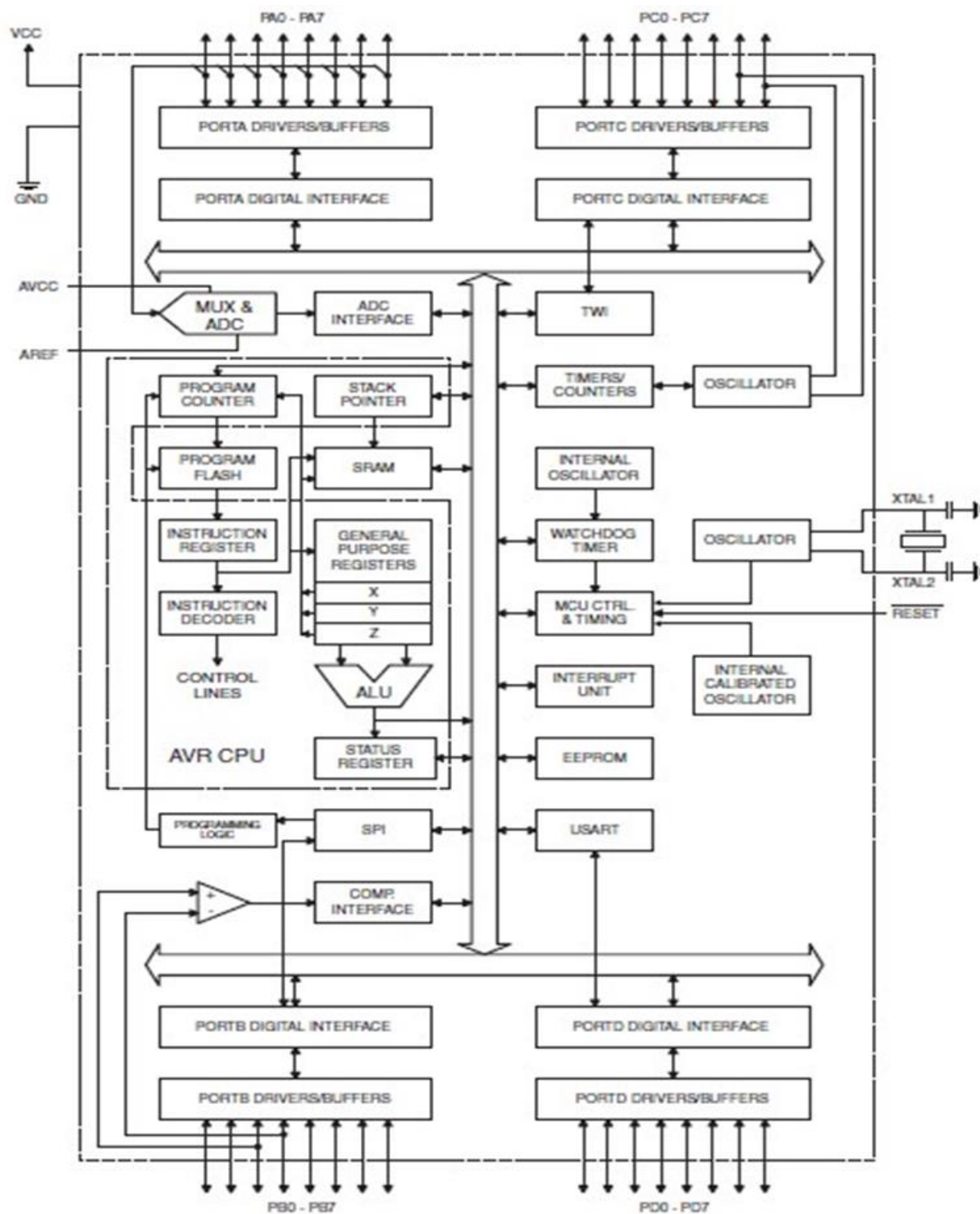
```
85  Serial.print("ANIMAL AND BIRD: ");
86  Serial.print(bi);
87  if(MOI<=10)
88  {

89      digitalWrite(D0,LOW);
90      delay(100);
91      digitalWrite(D0,HIGH);
92  }
93  else
94  {
95      digitalWrite(D0,HIGH);
96  }
97
98
99      String payload = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
100          payload += "\",\"Temperature\":";
101          payload += temp;
102          payload += "\"}"}";
103
104      Serial.print("Sending payload: ");
105      Serial.println(payload);
106
107      if (client.publish(publish_Topic1, (char*) payload.c_str())) {
108          Serial.println("Published successfully");
109      } else {
110          Serial.println("Failed");
111      }
112      String payload1 = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";

113          payload1 += "\",\"Humidity\":";
114          payload1 += hum;
115          payload1 += "\"}"}";
116          Serial.print("Sending payload: ");

117          Serial.println(payload1);
118          Serial.println("\n");
119
120          if (client.publish(publish_Topic2, (char*) payload1.c_str())) {
121              Serial.println("Published successfully");
122          } else {
123              Serial.println("Failed");
```

```
124     }
125
126
127     String payload3 = "{\"d\":{\"Name\":\"\" DEVICE_ID \"\"";
128         payload3 += "\",\"Moiture\":\"";
129         payload3 += MOI;
130
131         payload3 += "}}";
132
133     Serial.print("Sending payload: ");
134     Serial.println(payload3);
135
136     if (client.publish(publish_Topic3, (char*) payload3.c_str())) {
137         Serial.println("Published successfully");
138     } else {
139         Serial.println("Failed");
140     }
141
142
143 String payload4 = "{\"d\":{\"Name\":\"\" DEVICE_ID \"\"";
144     payload4 += "\",\"Animal&Bird\":\"";
145     payload4 += bi;
146     payload4 += "}}";
147
148     Serial.print("Sending payload: ");
149     Serial.println(payload4);
150
151     if (client.publish(publish_Topic4, (char*) payload4.c_str())) {
152         Serial.println("Published successfully");
153     } else {
154         Serial.println("Failed");
155     }
156 }
157 }
```

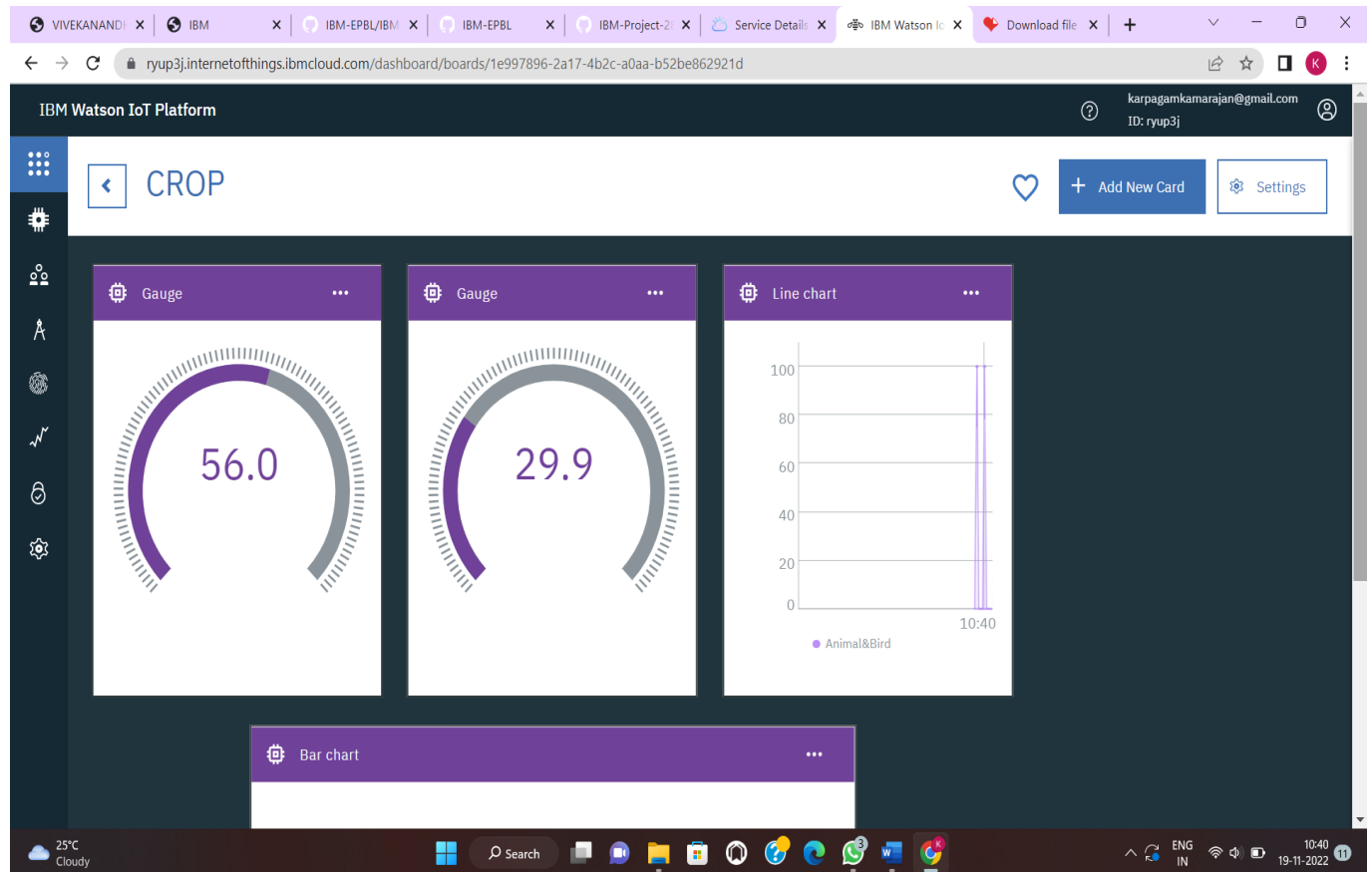



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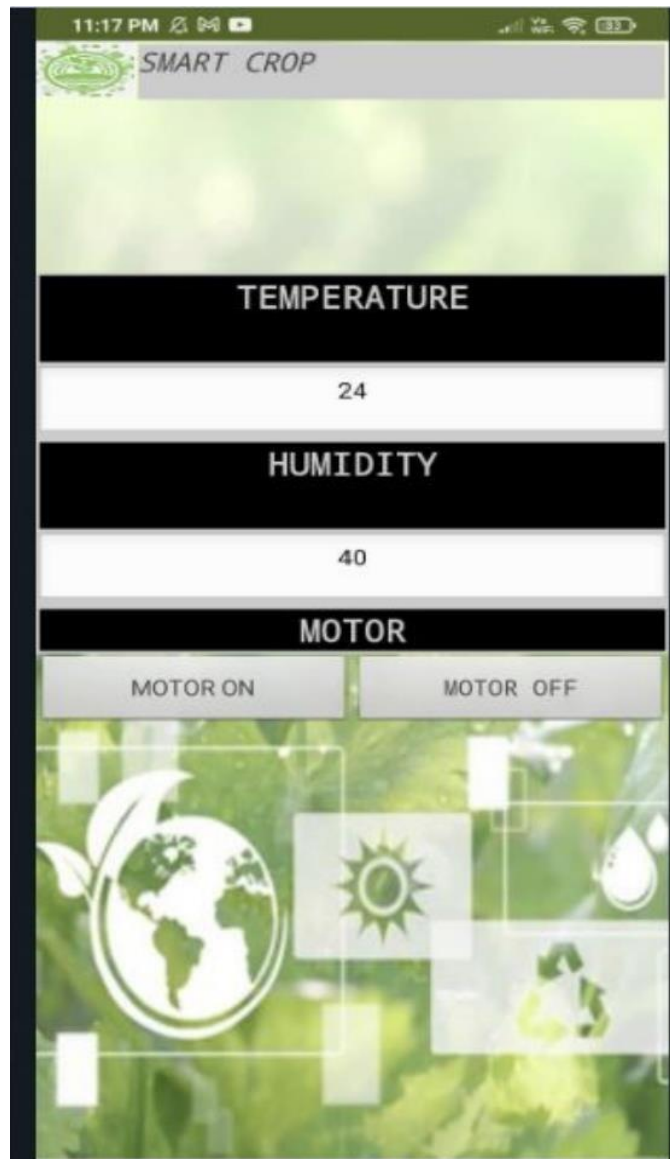
RESULTS

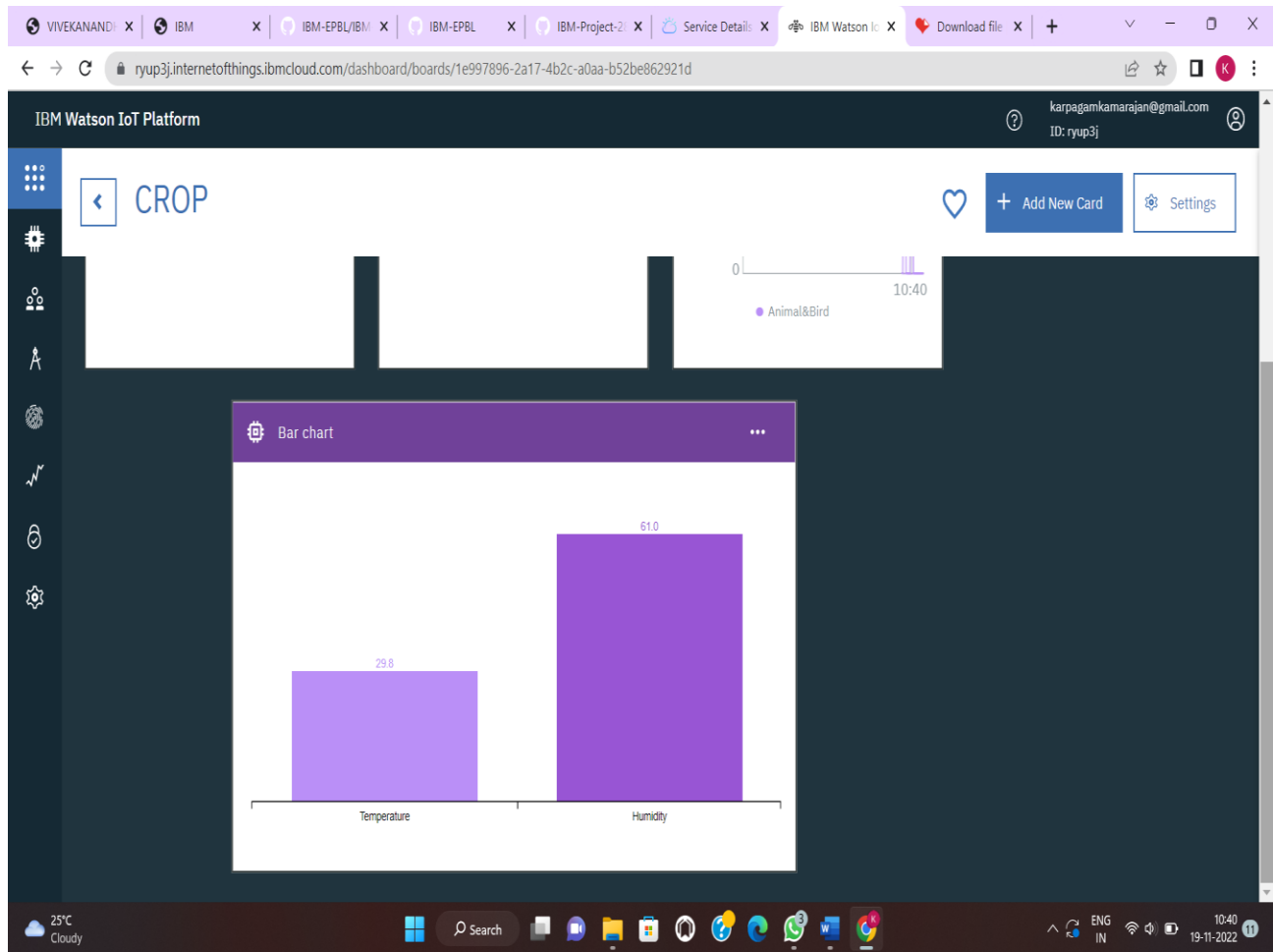
SOIL MOISTURE

ANIMAL AND BIRD DETECT



MOBILE APP





TEMPERATURE AND HUMIDITY

25°C
Cloudy

Chapter – 9

ADVANTAGES AND DISADVANTAGES

Advantages:

- ☐ Farms can be monitored and controlled remotely.
- ☐ Increase in convenience to farmers.
- ☐ Less Manpower.
- ☐ Better standards of living.

Disadvantages:

- ☐ Lack of internet/connectivity issues.
- ☐ Added cost of internet and internet gateway infrastructure.
- ☐ Farmers wanted to adapt the use of WebApp.

Chapter – 10

CONCLUSION

This system focuses on developing devices and tool to manage, display and alert the users using the advantages of a wireless sensor network system. It aims at making agriculture smart using automation and IoT. The cloud computing devices are used at the end of the system that can create a whole computing system from sensors to tools that observe data from agriculture field. It proposes a novel methodology for smart farming by including a smart sensing system and smart irrigator system through wireless communication technology. Thus, the objective of the project to implement an IoT system in order to help farmers to control and monitor their farms has been implemented successfully.

Chapter – 11

FUTURE SCOPE

Agriculture domains encounters with many challenges starting from soil parameters, seed sowing, crop growth and its quality, weed handling, disease management till harvesting and storing crop. Artificial intelligence driven techniques along with other available tools and automation can address these challenges and proven the revolution in agriculture. Most popular AI application in agriculture is use of Robot and Drones, they perform almost all task like humans even at a faster rate with accuracy. From literature review it is clear that precision farming is probable by integrating sensors, cameras, data analytics, GPS and remote sensing. Image recognitions software's, IoT sensors can be used for disease recognition at primary stages and hence crop health can be supervised which increases superior quality production with minimum loss. Table 1 demonstrate the various applications in view of Smart Agriculture for improved evolution as well as superiority. Still there are several challenges associated with AI and IoT application in smart agriculture which is the promising future to be explored area for researchers. Some of major challenges are: • Awareness issues • Hardware implementation challenges • Cost of software and hardware • Network management • Energy management • Privacy issues • Security challenges • Interoperability of systems with the induction of Computer vision, Deep learning, Big data also agriculture sector has influenced a lot. Researchers can integrate IoT sensors along with smart systems and computational optimization algorithms to overcome the limitations/shortcomings. Smart Agriculture has a budding potential towards productivity, precision, optimization, adaptive resource management and intelligent food traceability. It will contribute to environment also in terms of efficient use of water, prevent disease contamination and precise use of pesticides.

Chapter – 12

APPENDIX

SOURCE CODE

```
#include <ESP8266WiFi.h>
#include <WiFiClient.h>
#include <PubSubClient.h>
#include "DHT.h"

const char* ssid = "SMART-G";
const char* password = "10112019";

#define DHTPIN D6
#define G D0
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);

#define ID "ryup3j"
#define DEVICE_TYPE "ESP8266"
#define DEVICE_ID "TEST"
#define TOKEN "TEST-12345"

char server[] = ID ".messaging.internetofthings.ibmcloud.com";
char publish_Topic1[] = "iot-2/evt/Data1/fmt/json";
char publish_Topic2[] = "iot-2/evt/Data2/fmt/json";
char publish_Topic3[] = "iot-2/evt/Data2/fmt/json";
char publish_Topic4[] = "iot-2/evt/Data2/fmt/json";
char authMethod[] = "use-token-auth";
char token[] = TOKEN;
char clientId[] = "d:" ID ":" DEVICE_TYPE ":" DEVICE_ID;

WiFiClient wifiClient;
PubSubClient client(server, 1883, NULL, wifiClient);

void setup() {
    pinMode(D0,OUTPUT);
    digitalWrite(D0,HIGH);
```

```

Serial.begin(115200);
dht.begin();
Serial.println();
WiFi.begin(ssid, password);

while (WiFi.status() != WL_CONNECTED) {
    delay(500);
    Serial.print(".");
}
Serial.println("");
Serial.println(WiFi.localIP());

if (!client.connected()) {
    Serial.print("Reconnecting client to ");
    Serial.println(server);
    while (!client.connect(clientId, authMethod, token)) {
        Serial.print(".");
        delay(500);
    }
    Serial.println("Connected TO IBM IoT cloud!");
}
}

long previous_message = 0;
void loop() {
    client.loop();
    long current = millis();
    if (current - previous_message > 3000) {
        previous_message = current;
        float hum = dht.readHumidity();
        float temp = dht.readTemperature();
        float MOI = map(analogRead(A0), 0, 1023, 100, 0);
        float bi = map(digitalRead(D1), 0, 1, 100, 0 );
        if (isnan(hum) || isnan(temp) ){
            Serial.println(F("Failed to read from DHT sensor!"));
            return;
        }

        Serial.print("Temperature: ");
        Serial.print(temp);
        Serial.print("°C");
        Serial.print(" Humidity: ");
        Serial.print(hum);

```

```
Serial.print("% ");
Serial.print("SOIL MOITURE: ");
Serial.print(MOI);
Serial.print("ANIMAL AND BIRD: ");
Serial.print(bi);
if(MOI<=10)
```

```
{
    digitalWrite(D0,LOW);
    delay(100);
    digitalWrite(D0,HIGH);
}
else
{
    digitalWrite(D0,HIGH);
}
```

```
String payload = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
    payload += "\",\"Temperature\":";
    payload += temp;
    payload += "\"}\"";
```

```
Serial.print("Sending payload: ");
Serial.println(payload);
```

```
if (client.publish(publish_Topic1, (char*) payload.c_str())) {
    Serial.println("Published successfully");
} else {
    Serial.println("Failed");
}
```

```
String payload1 = "{\"d\":{\"Name\":\"" DEVICE_ID "\"";
    payload1 += "\",\"Humidity\":";
    payload1 += hum;
    payload1 += "\"}\"";
    Serial.print("Sending payload: ");
    Serial.println(payload1);
    Serial.println("\n");
```

```
if (client.publish(publish_Topic2, (char*) payload1.c_str())) {
    Serial.println("Published successfully");
} else {
    Serial.println("Failed");
```

```
}
```

```
String payload3 = "{\"d\":{\"Name\":\"\" DEVICE_ID \"\"";  
    payload3 += "\",\"Moiture\":\"";  
    payload3 += MOI;  
    payload3 += "}\"}";
```

```
Serial.print("Sending payload: ");  
Serial.println(payload3);
```

```
if (client.publish(publish_Topic3, (char*) payload3.c_str())) {  
    Serial.println("Published successfully");  
} else {  
    Serial.println("Failed");  
}
```

```
String payload4 = "{\"d\":{\"Name\":\"\" DEVICE_ID \"\"";  
    payload4 += "\",\"Animal&Bird\":\"";  
    payload4 += bi;  
    payload4 += "}\"}";
```

```
Serial.print("Sending payload: ");  
Serial.println(payload4);
```

```
if (client.publish(publish_Topic4, (char*) payload4.c_str())) {  
    Serial.println("Published successfully");  
} else {  
    Serial.println("Failed");  
}  
}  
}
```

GitHub & Project Demo Link

<https://github.com/IBM-EPBL/IBM->

[Project-15201-1659594906](#)

DEMO VEDIO LINK

<https://youtu.be/R02l0eYRGmY>