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Abstract

This report illustrates the mid-term of the development of the Agriculture monitoring system with automated irrigation and the Water tank system which is based in Arduino Uno. As many businesses and farmers still rely on traditional agriculture methods and face many problems because of it, this project aims to solve those problems and make the agriculture system even more efficient and productive. After the completion of this project, there would be a system that automates the water tank and irrigation system and monitors the indoor agriculture environment such as Nursery and Greenhouse.

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1. Introduction

1.1. Introduction to the topic

As the technological revolution continues, every aspect is leaning towards the technology to make the maximum use of it. Farmers are also slowly adopting technology in the agriculture field. As the necessary goal to trend up in agriculture continues, the use of an Agriculture Monitoring system with automated Irrigation and water tank system can be a very great option to adapt to. The monitoring and automation system can be implemented in the agriculture sector to gain efficiency and simplicity by reducing the cost and resources and utilizing the technology for the better (Vineela et al., 2018).

1.2. Current Scenario

The use of technology to improve agriculture has always been viewed as having great potential. Due to the efficiency and productivity that technology offers, agriculture around the globe is rapidly leaning towards the use of technology in agriculture. But in the context of Nepal, the population that uses technology in agriculture is very few. About 80% of the total population relies on farming but still, Nepal is totally dependent on India and other markets for agricultural goods. The dependency on rainwater and lack of utilization of water have led to inefficient and less productive agricultural production (Shukla et al., 2014).

Figure 1 Nepal's Agriculture imports 2018 (Prasain, 2018).

The agriculture land is decreasing, and the population is increasing each year which has increased the need to adopt the technology and shift toward the systematic agriculture system. (Trading Economics, 2014)

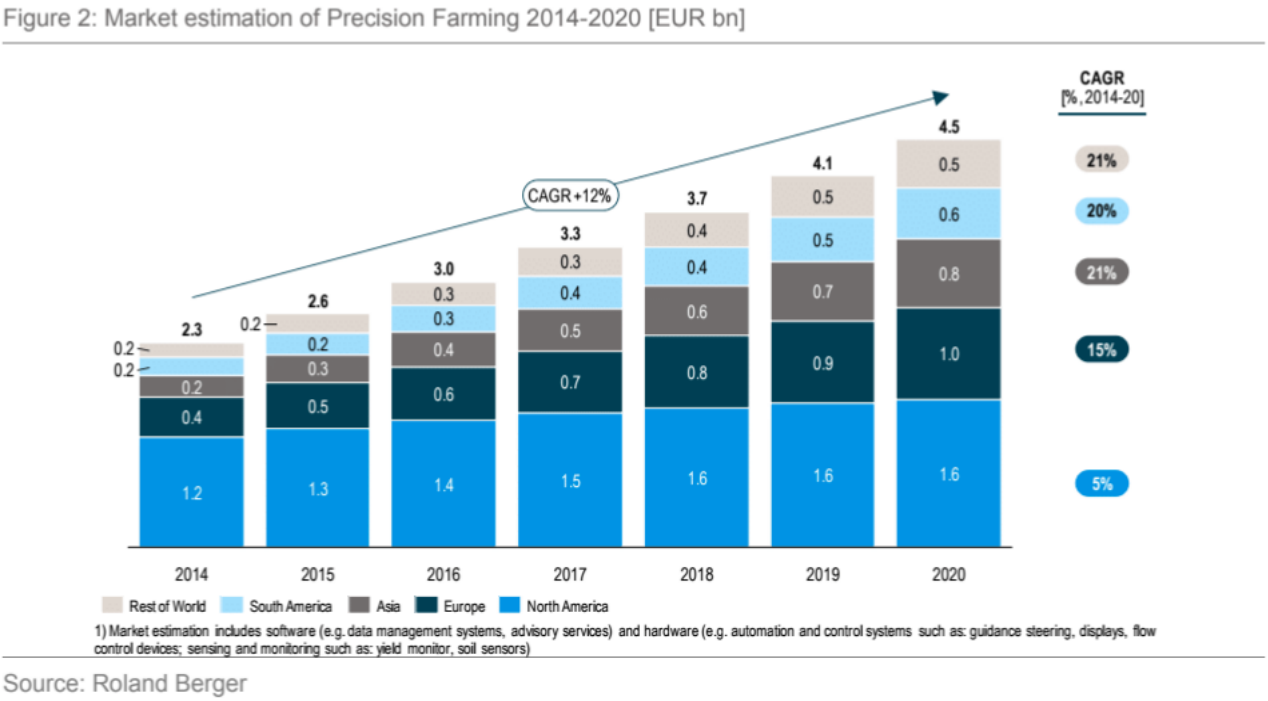

Figure 2 Use of IoT on Agriculture based on the continents. (Igor, 2018)

1.3. Problem Statement

Agriculture is the most important sector of the world. In a country like Nepal, about 80 percent of people are involved in agriculture and the major source of the country's economy comes from it, but still, the agriculture industry is facing many problems as people are unaware of the new technologies that cost them less than the traditional method. Some of the major problems faced by farmers because of the lack of technology use are:

i. Wastage of water.
ii. Unscientific and Ineffective agriculture method resulting in the waste of human resources and money.
iii. Decrease in crop production because of a lack of monitoring system (Sarkar et al., 2018).

1.4. The project as a solution

The use of an Agriculture Monitoring system with an automated Irrigation system provides the user-friendly interface to monitor agriculture and automated irrigation at a lower cost, that makes the field cultivation process much simpler and efficient. The agriculture process can be carried out in a systematic environment with the help of technology which helps to increase productivity and decrease the cost. Some of the major solutions to the problems that the project provides are:

i. Utilizes water, power consumption, and manpower.
ii. Monitors the environment and keeps the record and analyses it.
iii. Monitoring and controlling from a remote distance.
iv. Increases crop production because of applied scientific-technological measures (Sukumar et al., 2018).

1.5. Aim and Objectives

1.5.1. Aim

The main aim of this project is to eradicate the problems of the traditional agriculture methods and introduce a cost and work efficient technology to manage and automate the various aspects of agriculture in a productive, efficient and scientific manner.

1.5.2. Objectives

The Objectives of the project are:

- To use the IoT devices to develop a prototype project of Agriculture monitoring and automated irrigation and water tank system.
- To have extensive knowledge of programming concepts.
- To determine the application areas of the project.
- To collect and analyze the requirements from the client.
- To automate the irrigation and water tank system.
- To analyze the data to generate simple and meaningful information.
- To research the domain IoT and its use on agriculture.

1.6. Report Structure

1.6.1. Background

The background provides a better understanding of the project by clarifying the requirements and description of the project and its targeted customers. It also helps to learn about similar projects and compare this project with similar projects to provide a better understanding of the features and components.

1.6.2. Development

Development explains how the project is going to be developed. It explains about considered and selected the methodologies and analyses different phases of the selected methodologies. It also shows the different task breakdowns (WBS) that are carried out and that are to be carried out in a timeline format (Gantt chart).

1.6.3. Analysis of progress

This section explains and analyzes the progress to date. It provides the current scenario of the progress, reviews it and shows the development progress. It shows the hardware and software development progress with the circuit diagram. It also explains why the project was lacking behind according to the Gantt chart of the proposal and provides the action plan to cover the lost time and complete the project.

1.6.4. Future Work

Future work is the last section that explains the phases (development and documentation) that are yet to complete and plans for carrying out and completing the project.

2. Background

2.1. Client's Description and Requirements

2.1.1. Client's Name

Gautam Nursery

2.1.2. Description

The client for the project is Gautam Nursery which is in the Kausaltar, Bhaktapur. It is an agriculture-related organization that grows plants and protects it in a systematic environment. It provides the landscape and gardening solution for its customers. It has worked in the agriculture sector for 6+ years.

Gautam Nursery has agreed to by the client for this project as they found this project feasible and useful. They are willing to cooperate with the suggestions and by providing the necessary requirements.

2.1.3. Requirements

1. The system should be able to automate the water tank:

The system should turn off the water supply when the water level is full and provide an alert when the water level is too low. The system should keep track of the water level and display it.

2. The System should be able to automate the Irrigation system:

The plants are categorized according to the amount of water they need to grow, so the irrigation must be customizable to adjust the water level that is required by the

plant. After the irrigation process is customized according to the requirement of the plant, the moister sensor should sense the moister level and automate the irrigation if the water requirement level falls below the threshold level. The moister level should be displayed to the user and an alert message should be sent at the starting and completion of the irrigation process.

3. The agriculture Monitoring System:

The system should be able to monitor the plant and provide various information such as temperature, humidity, and time. The data collected from the monitoring system should be displayed on the web-page in a simple manner.

4. Storing:

All the data should be stored so that it can be accessed in the future. The stored data helps to reflect the growth and requirement of the plant. It can be helpful to understand the changes and water requirements in various seasons.

5. Display:

The above-mentioned information should be displayed on a web-page so that it can be accessed easily from anywhere. The interface should be clean and simple for the ease of understanding the given information. The user should also be able to access the data.

6. Cost-effective:

The system should be cost-efficient as the cost is the most important factor that business management would consider.

7. Accessibility:

The monitoring system should be accessible from a remote place through the internet. The alert message should also be forwarded to the webpage.

2.2. Understanding the Project

2.2.1. IoT as a platform

IoT (Internet of Things) means the network of devices that are connected to the internet, collecting and sharing data. IoT consists of a main device such as Raspberry Pi and Arduino which can be programmed to perform certain tasks. It might consist of one or many sensors to interact with the environment and generate the data (Hassan, 2018). The IoT devices can perform basic to advance tasks and can be very useful to run various operations because of its properties of connectivity and the ability to share data (Pal & Purushothaman, 2017).

2.2.2. Project Elaboration

The project uses two Arduino Uno for controlling the multiple aspects of the agricultural system. One Arduino automates the Water tank system, and another automates the irrigation and monitoring system. The first component measures and regulates the water level in the tank. The system alerts the user if the water level is low and turns the motor off if the water level reaches too high. It also displays the level of water present in the tank. The second component performs the irrigation as per the data sent by the moisture sensor. If the moisture level is too low the systems irrigate the plant and stops irrigation when the threshold level of moisture is met. The threshold level can be set by the user as per the type and growth of the plant. The user must categorize the plant for irrigation to work effectively. It utilizes water from the water tank. The second component also monitors and displays the temperature, moisture, humidity and time from the agriculture land to the user. The data generated by the sensors are forwarded to the web-page remotely using third-party API. The user can

monitor and control the system using the webpage. The user must be connected to a network to receive and send the information.

The expected outcome of the project would be a prototype IoT device which is made up of motors, sensor and other various electronic components which is connected to the Arduino that acts as the brain of all the hardware used.

2.2.3. Project Deliveries

The project is targeted to the farmers and business sectors who are willing to do agriculture in a scientific way using technology. The project is mainly aimed at the indoor and systematic agriculture environment. The project can also be useful to the agriculture researchers as the displayed information helps to provide information based on various categories.

2.3. Similar projects

2.3.1. Project 1: IoT Based Smart Agriculture Monitoring and Irrigation System Using Raspberry Pi Kit

Author: P. Nandhini, V. Kalpana, J. Sikkandhar Batcha

The project aims to reduce the wastage of water, and fertilizers and increase crop production using IoT technology. The project uses four major components Raspberry Pi, DHT11Sensor, Soil moisture sensor, and Relay. This project uses the wireless sensor network that collects data from the various sensors which are distributed and functional at various points and forward it through the wireless protocol. The author believes that traditional agriculture system is not as effective as the automated system, so the given system helps to increase the productivity at every stage of the production. The software used in the projects is Python programming and ThingSpeak (an opensource IOT application and API). The project helps to provide the solution for the irrigation problems and lack of utilization of the water (Nandhini et al., 2018).

2.3.2. Project 2: Intelligent Irrigation system based on Arduino

Authors: C. Gilarranz, S. Altares, M. Loizu

The project uses the Arduino as the main component along with humidity, temperature, pressure, and water flow sensors. The project aims to automate the irrigation system to increase the accuracy and efficiency in terms of water application allowing a user to manage the system more comfortably. The project uses four Arduino devices and sensors that would communicate through the Bluetooth module HC-05. All the Arduinos collects the data from its sensors and sends it to the central Arduino which is responsible for analyzing and forwarding all the data. The author thinks that the use of traditional methods slows the entire agriculture industry down because of

which sooner or later agriculture companies should start applying the technology in agriculture (Gilarranz et al., 2013).

2.3.3. Project 3: Automatic Water Tank Filling System Controlled using Arduino based Sensor for Home Application.

Authors: Eka Cahya Prima, Siti Sarah Munifaha, Robby Salam, Muhamad Haidzar Aziz, Agustin Tia Suryani

The project uses an ultrasonic sensor and Arduino to automate the water tank system. The system alerts the user if the water level is too low or too high. The project targets to eliminate the wastage of water and energy consumption and make the user aware of their water consumption. The project also saves the time of the user as the user does not need to worry about the water tank anymore (Prima et al., 2017).

2.4. Comparison of Table

Table 1 Project comparison table.

S. N	Features	Project 1	Project 2	Project 3	This project
1.	Medium for communication.	Wi-Fi	Bluetooth	Pin	Wi-Fi
2.	Microcontroller used.	Raspberry Pi	Arduino Uno	Arduino Uno	Arduino Uno
3.	Automated Irrigation.	✓	✓	✗	✓
4.	Automated Water-tank.	✗	✗	✓	✓
5.	Agriculture Monitoring system.	✓	✓	✗	✓
6.	Web-app to display output.	✗	✓	✗	✓
7.	Remote data accessibility.	✓	✓	✗	✓
8.	Easy to use.	✓	✗	✓	✓
9.	Provides alert.	✓	✓	✓	✓

2.5. The conclusion from similar projects

Taking all the features provided by similar projects into consideration, we can clearly see that the purposed system provides all the basic features at a very minimal cost. It does decent work with less complexity. None of the projects had both automated water-tank and irrigation systems along with a monitoring system like this project. The composition of all these features aims to satisfy the requirement and expectations of the client.

(**Resource Requirements**: Appendix 1)

3. Development

3.1. Considered methodologies

3.1.1. Waterfall methodology

It is a type of methodology where all the phrases of a development process are divided into separate and the result of a phrase acts as the start point for the next phase sequentially. In this methodology all the requirements are gathered at first then the tasks are divided into different sequential phrases (Charvat, 2003). This methodology was considered as all the requirements were collected from the client but since there could be changes in the requirements of the client it is not feasible for the project.

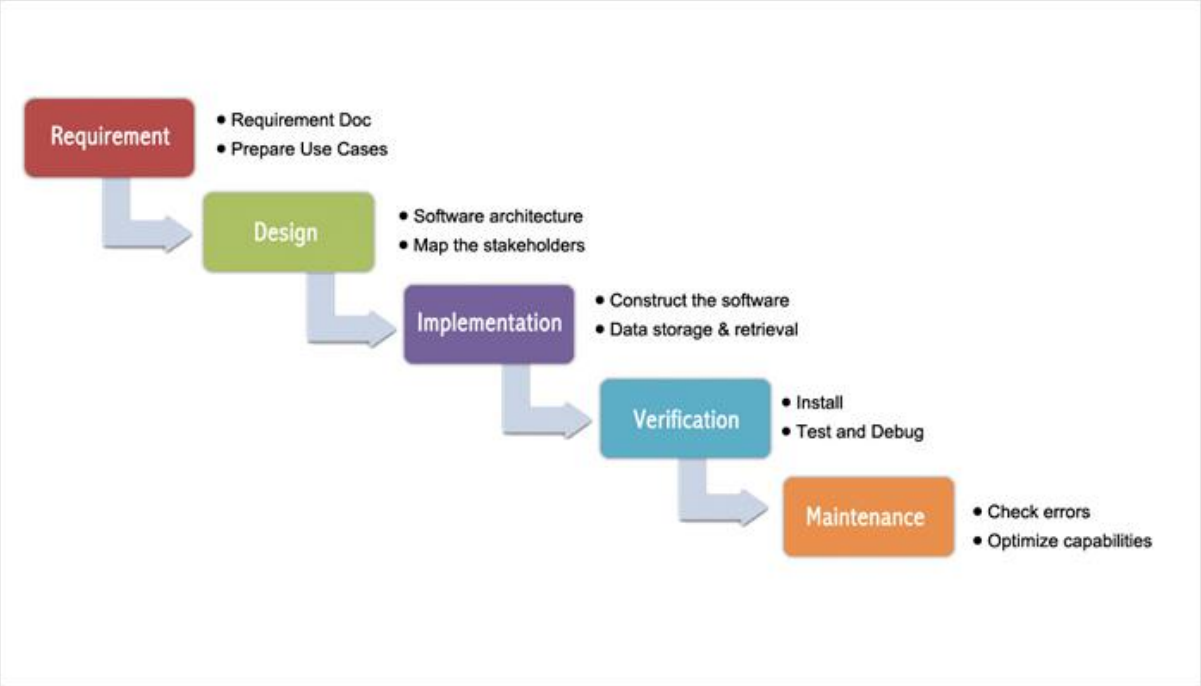

Figure 3 Waterfall Methodology (Mobile App Daily, 2019).

3.1.2. Agile methodology

It is a type of methodology where the requirement and the solution of it evolve through the collective action of teams and the client. The task is broken down into several phrases and continuous improvement and iteration are done by interacting with the stakeholders. The divided portions are called sprints (Charvat, 2003). This methodology was considered as various tasks that could be carried out dividing them into portions but client interaction and involvement in every sprint are not possible because of which it was not selected.

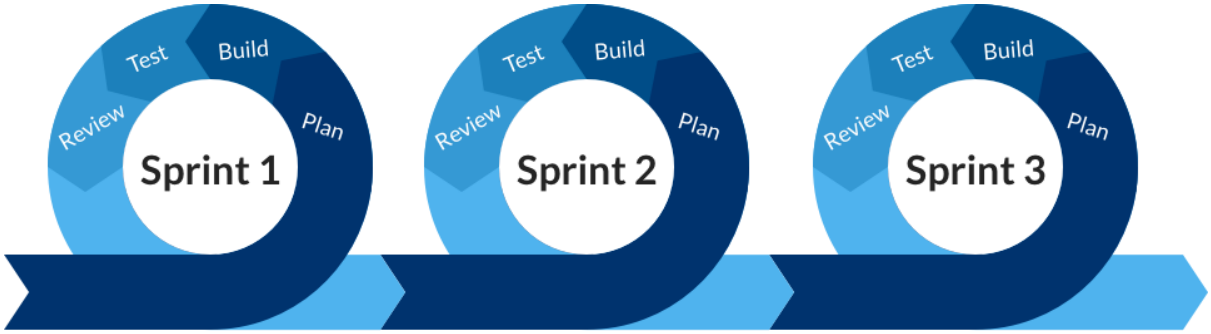

Figure 4 Agile Methodology (Littlefield, 2019).

3.1.3. Prototype methodology

It is the type of methodology in which the initial requirement is collected, successive prototypes are produced with added features and improvements and the process is repeated until the product that satisfies the client is produced. Prototype methodology is the most feasible methodology in the context of this project. (Charvat, 2003)

The four types of prototype methodologies are:

- Rapid throwaway prototype.
- Evolutionary prototype.
- Incremental prototype.
- Extreme prototype.

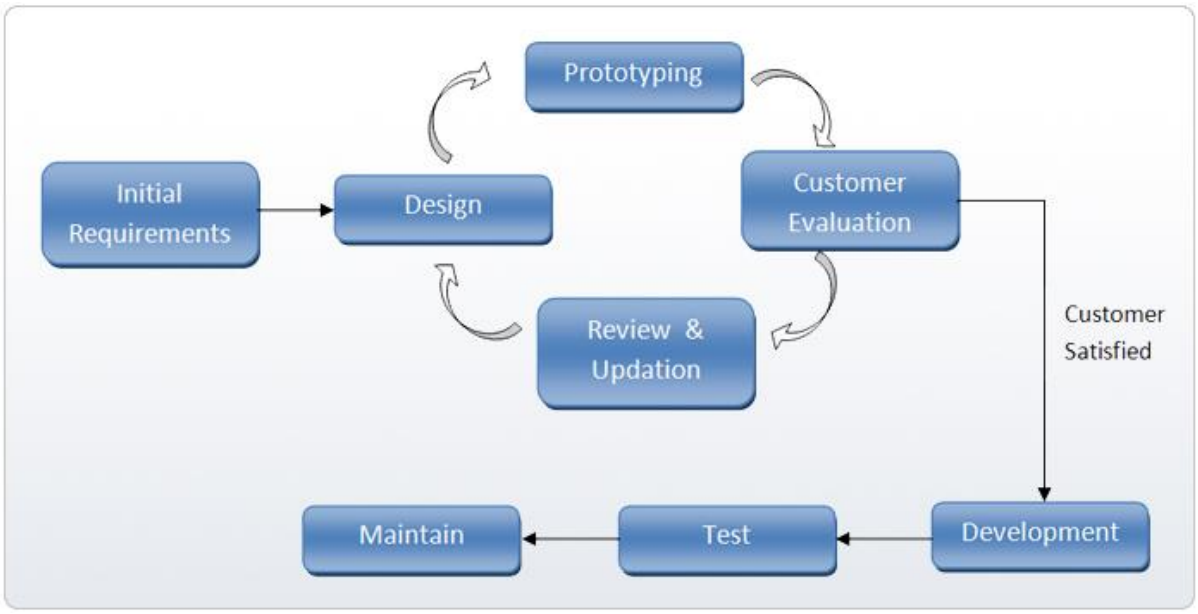

Figure 5 Prototype Methodology (Littlefield, 2019).

3.2. Selected methodology

3.2.1. Evolutionary Prototyping

Evolutionary prototyping (Breadboard prototyping) aims to build a robust system by constantly refining it until the exception of the client is met. It allows to add or remove the feature according to the change in the requirement (Charvat, 2003).

The methodology followed for the system is Evolutionary Prototype methodology as changes are a common and necessary part of the system. The new features could be added, or an old feature could be removed to make the project more practical, efficient, and market-ready. Innovations are common in the IoT system and with new ideas come new changes, this provides the system to be flexible. Design, testing, and improvement is what makes the innovation and changes possible which will eventually be able to satisfy the customer. The prototype can be changed multiple times as the requirement of the client is not very clear from the project perspective and it might change over time. The evolutionary prototype methodology also welcomes criticism from the internal and external supervision in the context of this system.

The advantages and disadvantages of evolutionary prototyping are:

Table 2 Advantage and Dis-advantage of the evolutionary prototype.

Advantages	Disadvantage
Ensures client's satisfaction and comfort.	Costly and time-consuming.
New requirements are welcomed.	Documentation with the development can be frustrating as the product is continuously changing.
Flexibility in terms of design.	Frequent changes and high maintenance cost.
Most needed functionalities are integrated first.	The customer might lose interest if the first prototype does not satisfy their expectations.

The four phases of the Evolutionary Prototyping methodology are:

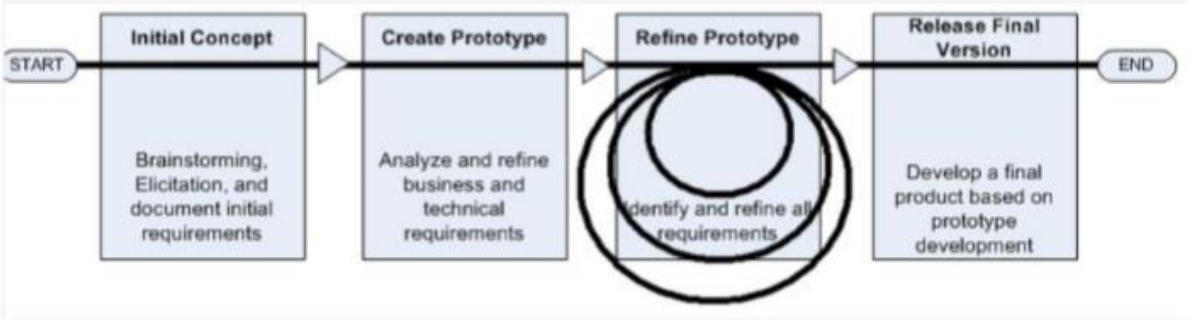

Figure 6 Phases of Evolutionary prototyping model.

3.2.1.1. Initial Concept

It is the first phase in which initial requirements are collected and analyzed from the client. The client might not have a clear vision of the requirements, but it provides the basic idea of how the system should be made. The basic requirements include expected outputs, must-have features, most important components and so on (Budde et al., 1992).

3.2.1.2. Create a Prototype

In this phase, a prototype is created by analyzing and refining the basic requirements collected from the client. A prototype based on a basic requirement is made and presented to the client.

3.2.1.3. Refine Prototyping

The third phase helps in project modification, refinement, and optimization as per the requirement of the client. The original prototype is rebuilt continuously with the help of requirements that the client provides, and it is done until the final output that satisfies the client is produced (Budde et al., 1992).

3.2.1.4. Release final Version

The final phase aims to produce the finalized prototype. The scope of the project is altered, and enhancement is done as per the feedback of the client. Upon completion, the product will be provided to the client (Budde et al., 1992).

(**Survey Findings**: Appendix 2)

3.3. Work breakdown structure

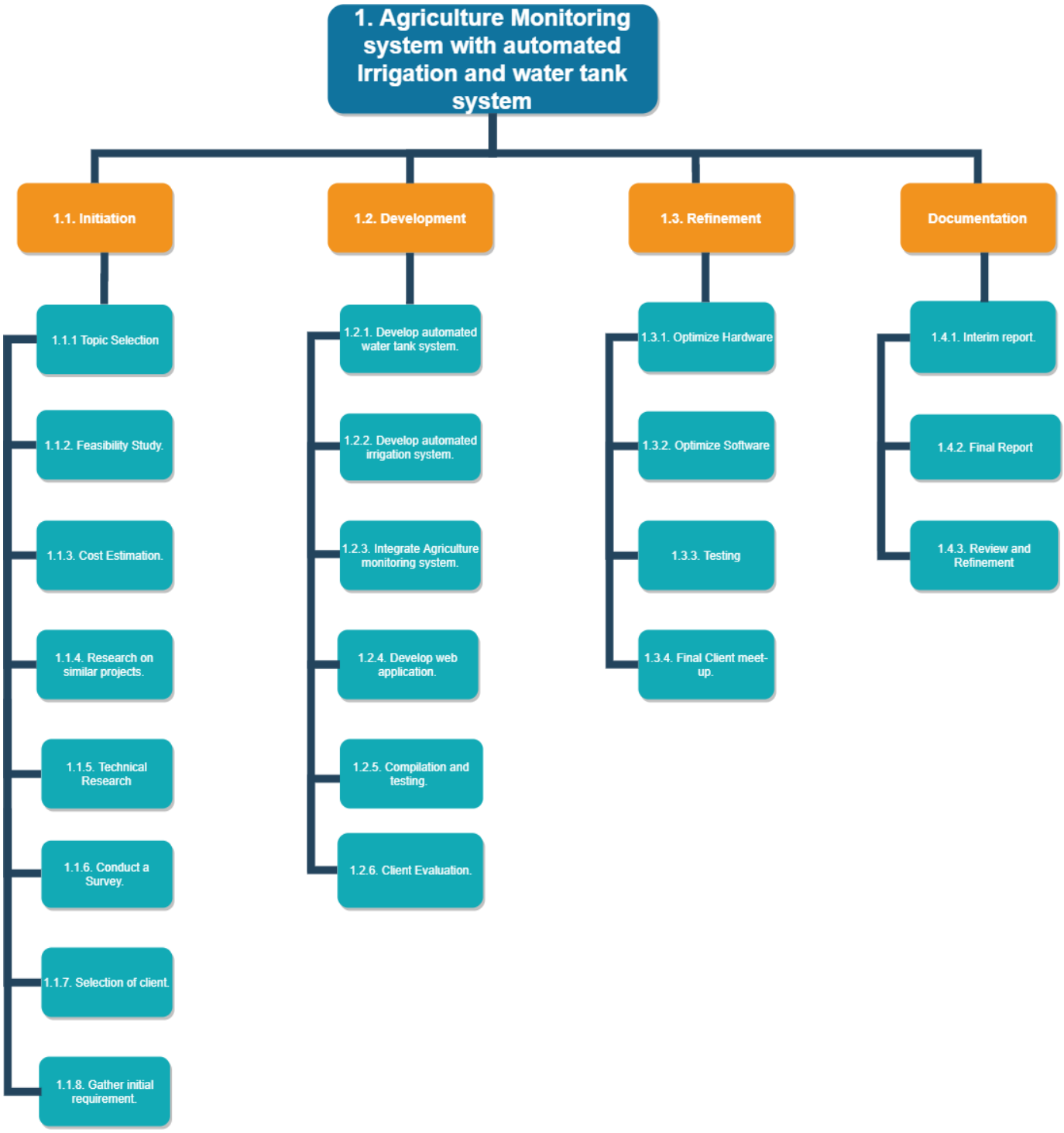

Figure 7 Updated Work Breakdown Structure.

(**Milestones Review**: Appendix 3)

3.4. Gantt chart

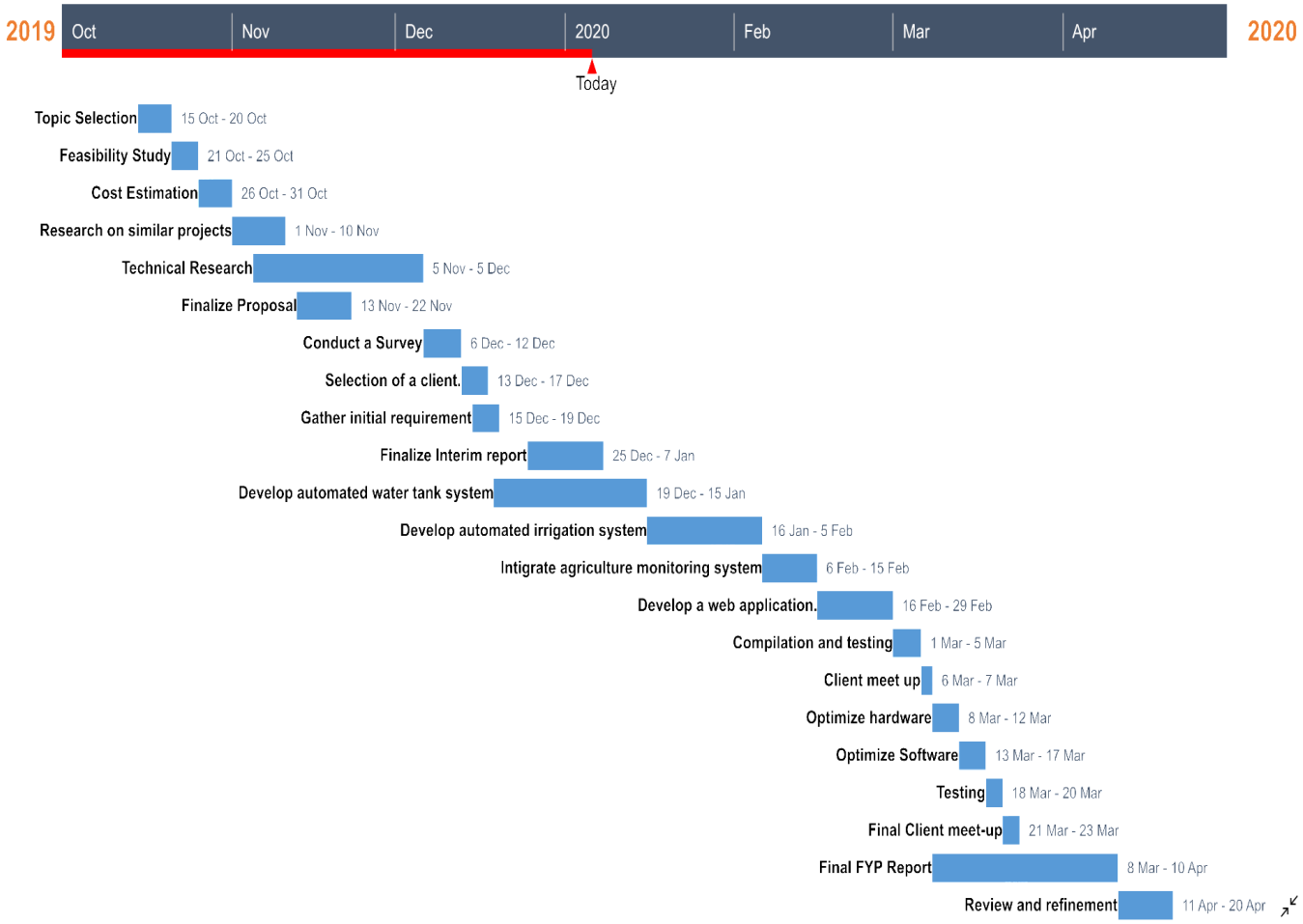

Figure 8 Updated Gantt Chart.

The Gantt chart's date, duration, and percentage of completion is shown in the tabular format below:

Table 3 Gantt chart's date and durations.

SN	Tasks	Start Date	End Date	Duration (Days)
1	Topic Selection	15/10/2019	20/10/2019	6
2	Feasibility Study	21/10/2019	25/10/2019	5
3	Cost Estimation	26/10/2019	31/10/2019	6
4	Research on similar projects	01/11/2019	10/11/2019	10
5	Technical Research	05/11/2019	05/12/2019	31
6	Finalize Proposal	13/11/2019	22/11/2019	10
6	Conduct a Survey	06/12/2019	12/12/2019	7

7	Selection of a client.	13/12/2019	17/12/2019	5
8	Gather initial requirement	15/12/2019	19/12/2019	5
9	Finalize Interim report	25/12/2019	07/01/2020	14
10	Develop an automated water tank system	19/12/2019	15/01/2020	28
11	Develop an automated irrigation system	16/01/2020	05/02/2020	20
12	Integrate agriculture monitoring system	06/02/2020	15/02/2020	10
13	Develop a web application.	16/02/2020	29/02/2020	14
14	Compilation and testing	01/03/2020	05/03/2020	5
15	Client meet up	06/03/2020	07/03/2020	2
16	Optimize hardware	08/03/2020	12/03/2020	5
17	Optimize Software	13/03/2020	17/03/2020	5
18	Testing	18/03/2020	20/03/2020	3
19	Final Client meet-up	21/03/2020	23/03/2020	3
20	Final FYP Report	08/03/2020	10/04/2020	29
21	Review and refinement	11/04/2020	20/04/2020	10

4. Analysis of progress

4.1. Progress Table

Table 4 Progress Table.

SN	Tasks	Status	Progress (%)
1	Topic Selection	Completed	100%
2	Feasibility Study	Completed	100%
3	Cost Estimation	Completed	100%
4	Research on similar projects	Completed	100%
5	Technical Research	Partially Completed	60%
6	Finalize Proposal	Completed	100%
6	Conduct a Survey	Completed	100%
7	Selection of a client.	Completed	100%
8	Gather initial requirement	Completed	100%
9	Finalize Interim report	Completed	100%
10	Develop an automated water tank system	Partially Completed	40%
11	Develop an automated irrigation system	Incomplete	0%
12	Integrate agriculture monitoring system	Incomplete	0%
13	Develop a web application.	Incomplete	0%
14	Compilation and testing	Incomplete	0%
15	Client meet up	Incomplete	0%
16	Optimize hardware	Incomplete	0%
17	Optimize Software	Incomplete	0%
18	Testing	Incomplete	0%
19	Final Client meet-up	Incomplete	0%
20	Final FYP Report	Incomplete	0%
21	Review and refinement	Incomplete	0%

4.2. Progress Review

4.2.1. Current scenario of progress

In the initial phase, the process of topic selection and feasibility study was carried out for making sure if the topic is viable or not. The survey was conducted to collect the data then a client was selected. To gather the initial requirement an interview with the client was conducted. Based on the requirements the cost estimation was done and most of the hardware component was purchased to start with the development work. In addition to that, research on similar projects and tools and technique was done to have an in-depth idea to start with the project work.

The Survey was conducted among 25 people to have an idea of what do people expect from a project like this. Survey also helped to have an idea about the important features and its usability. It also helped the project target mainly indoor environments like greenhouse and Nursery. After doing the detailed analysis, the evolutionary prototype methodology was chosen for the development of the system. Work break down structure and Gantt charts were made for the ease of carrying out the development work.

The development of the first component i.e. Automated Water-tank system was started. 40% development of the first component is completed to date.

(**Screenshots of development work**: Appendix 4)

4.2.2. Progress Timeline

The works of the project could not be carried out on time according to the Gantt chart submitted in the proposal because the research process took longer than it was initially thought and there was some addition in tasks such as conducting the survey, interview with the client which caused the planned timeline to be out of track.

4.2.3. Action plan

The tasks of the project will be carried out according to the new Gantt chart made for the interim report. Multiple tasks such as reporting, development, testing, and project refinement will be carried out simultaneously to bring back the project back in track.

4.2.4. Circuit diagram

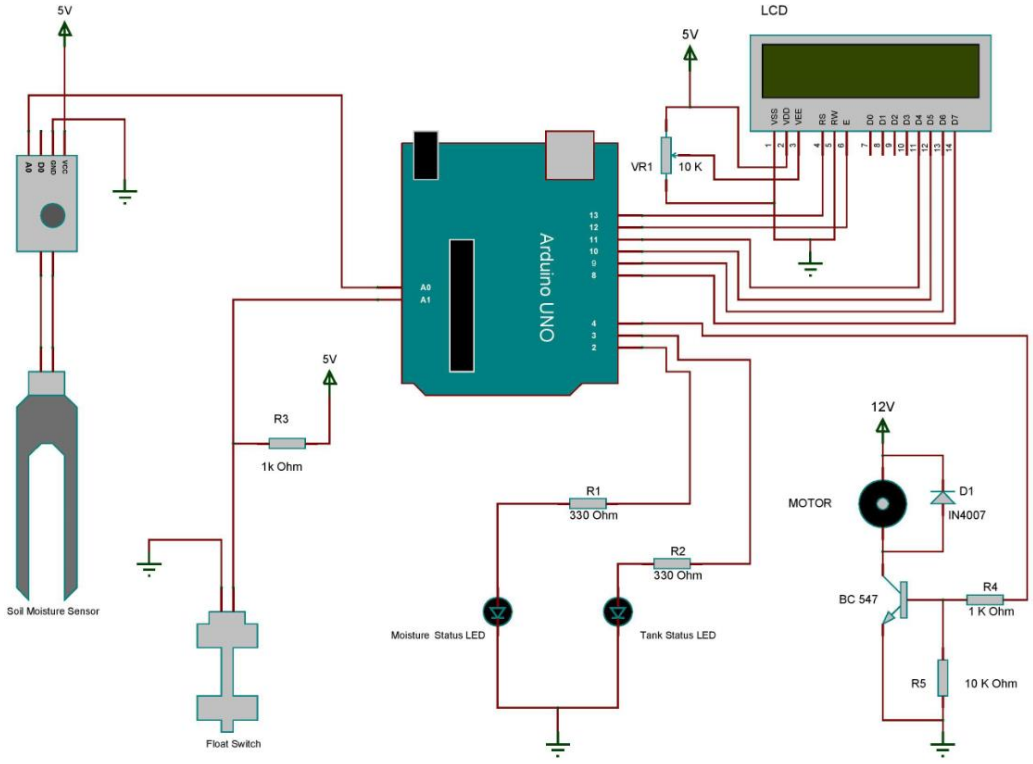

Figure 9 Circuit diagram of an automated irrigation system.

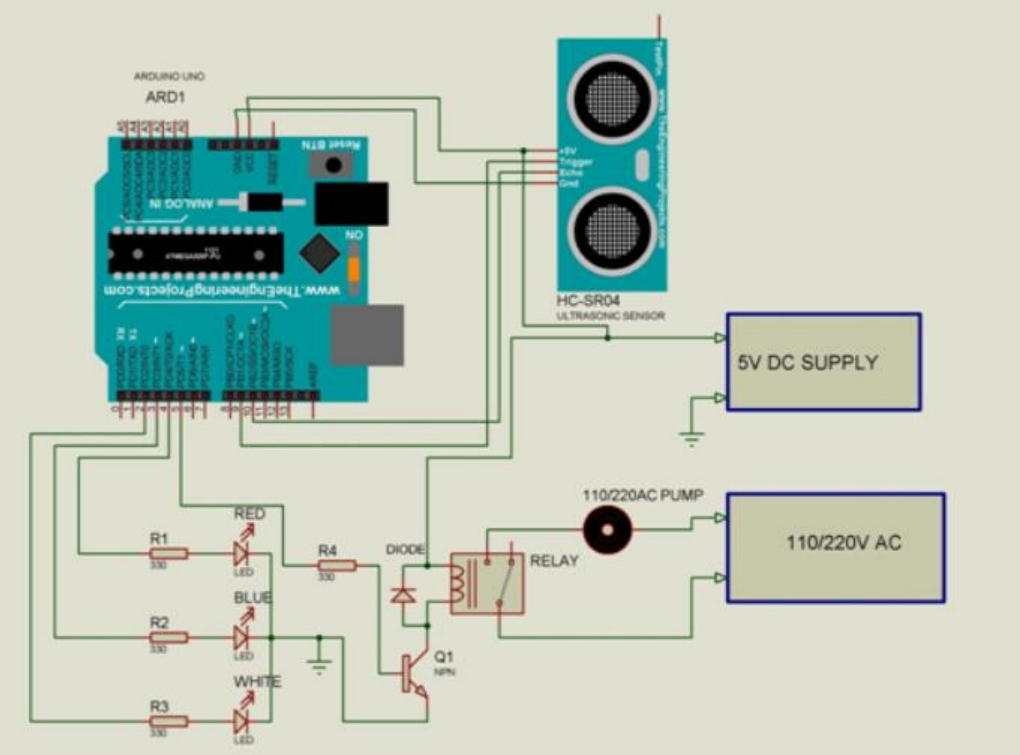

Figure 10 Circuit diagram of an Automated water-tank system.

5. Future work

5.1. Phases to complete

5.1.1. Prototype development

I would carry out the development work to develop the prototype system. I would work on the second phase of the evolutionary prototype methodology as the initial requirement gathering is already completed in the first phase i.e. initial concept. The prototype will be based on the basic requirements of the client. The prototype will be divided into two portions. The first one is an automated water-tank system, the system will automate the water-tank with the help of Arduino Uno, ultrasonic sensor and relay. The second portion is automated irrigation and monitoring system, the system will automate the irrigation process by using water Arduino Uno water motor, soil moisture sensor, and relay, the monitoring system will also be based on same Arduino and it will be used to monitor temperature, humidity and moisture by using the sensor. Along with that, wee-app will be created to carry out the monitoring process and to get the alerts.

5.1.2. Prototype refinement

In this stage, feedback from the client is taken and changes are made according to their interest. The product from the prototype development phase is modified according to the requirement from the client. Requirement gathering, refinement and client evaluation is repeated until the product that satisfies the client is produced.

5.1.3. Testing, implementation, and documentation

The final product is tested and implemented in the client's environment. Along with the completion of the development, the final documentation portion is also carried out.

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8. Appendix

8.1. Appendix 1: Resource requirements

There are various hardware and software tools needed for the completion of the project.

The hardware requirements are:

Table 5 Hardware requirements.

Computer	A laptop or a desktop computer is required to program the Arduino and document the necessary information about the project. It is also required to build the database and carry out the research work. A computer with a proper internet connection is mandatory.
Arduino Uno	It is the small-sized, single-board computer that provides various functionalities such as browsing the internet, performing computational tasks and so on. It can be programmed using the Arduino programming language and Arduino Software (IDE) (Blum, 2013). In the project, Arduino acts as the brain as it will be programmed to control and instruct all the sensors and analyze the data. Multiple Arduino will be used in the project (Halfacree, 2018).
Sensors	It helps to generate the data based on the environment it is exposed to. As this is an IOT project there are various sensors that will be used in the project. The sensors that will be used in the project are the Temperature sensor, Humidity sensor, Soil Moisture

	Sensor, Ultrasonic Sensor, and Temperature sensor (Yuvaraju & Priyanga, 2018).
Other hardware required	Other hardware requirements are: A/D converter, led lights, jumper wires, Wi-Fi module, relay, a proper Internet connection, and a good environment to make and run the system.

The software requirements are:

Table 6 Software requirements.

C++	C++ is the programming language that will be used for programming the Arduino Uno for the project.
HTML	HTML will be used to develop the webpage that displays all the necessary information that is sent by the sensors through the API or Server.
Documentation Software	Various software is required for the process of documentation. Some of them are Microsoft word, snipping tool, designing tools (Visio, draw.io), simulation software and so on.

8.2. Appendix 2: Survey Findings

The survey was conducted among 25 people with different age groups, occupations, and gender (72% male and 28% female). 15 of them were a student and 6 of them were related to agriculture.

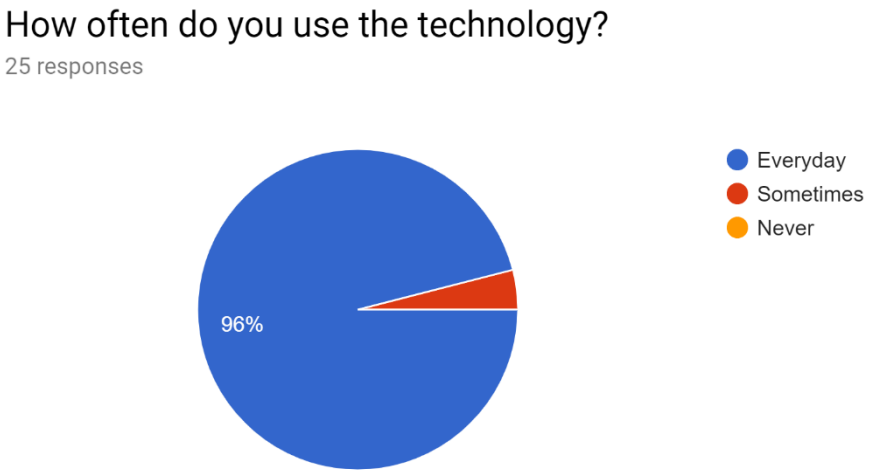

Figure 11 Survey question 1.

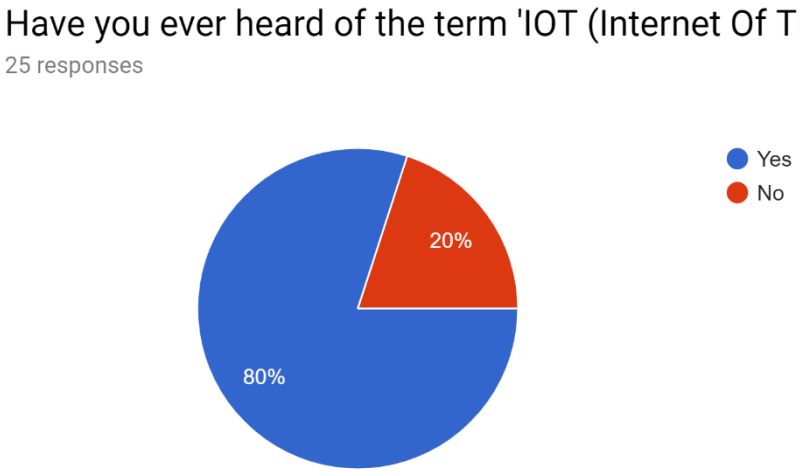

Figure 12 Survey question 2.

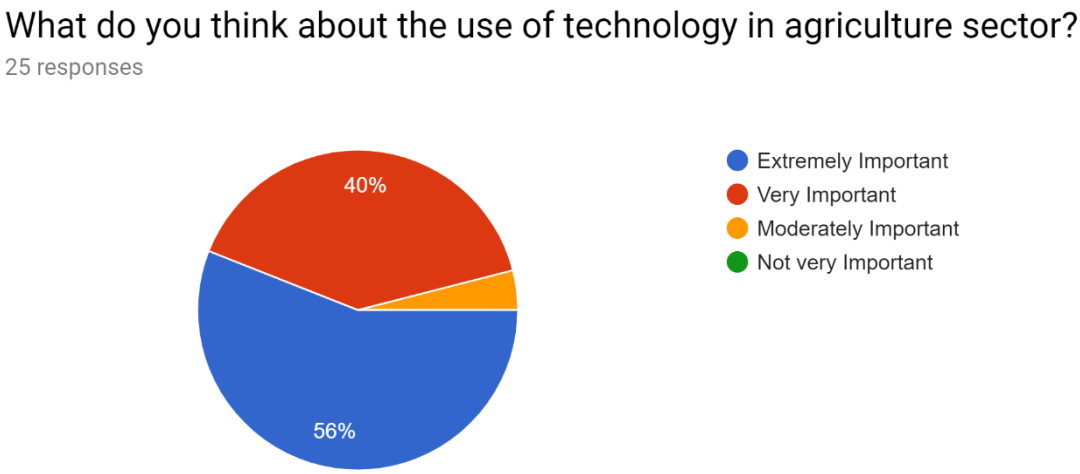

Figure 13 Survey question 3.

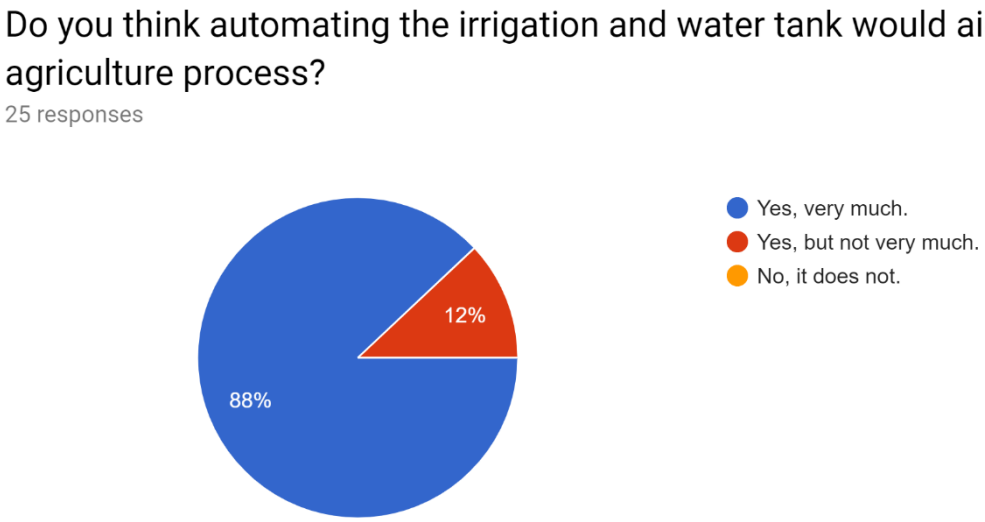

Figure 14 Survey question 4.

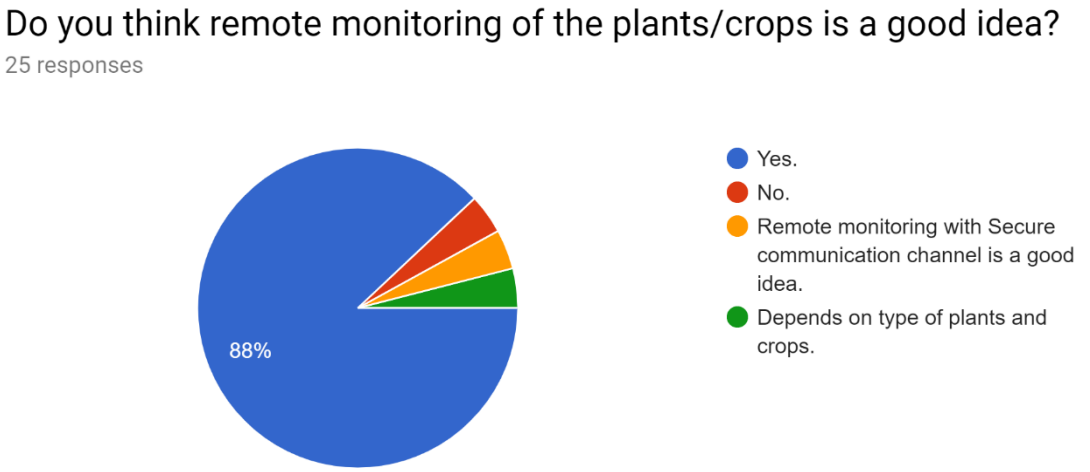

Figure 15 Survey question 5.

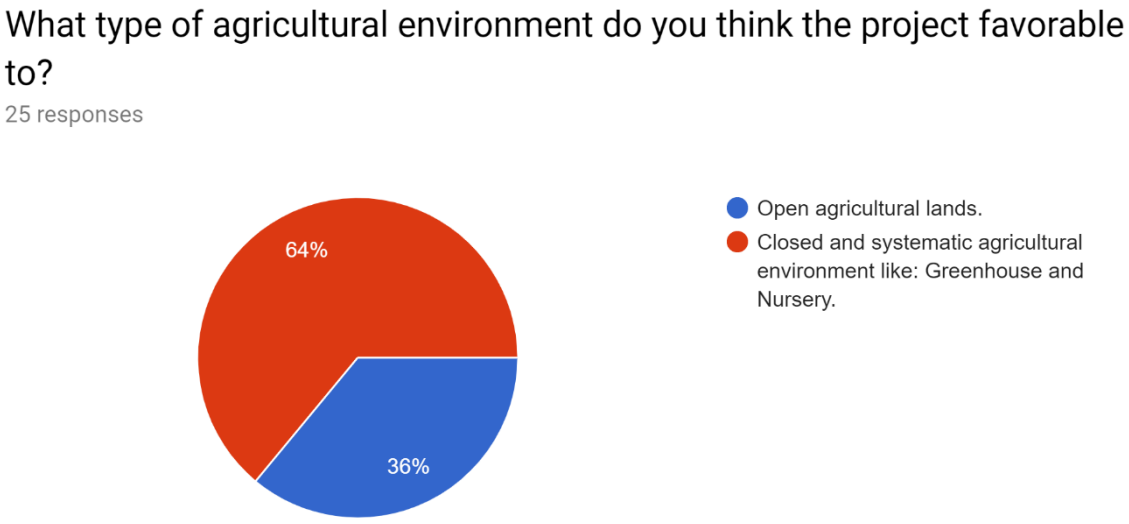

Figure 16 Survey question 6.

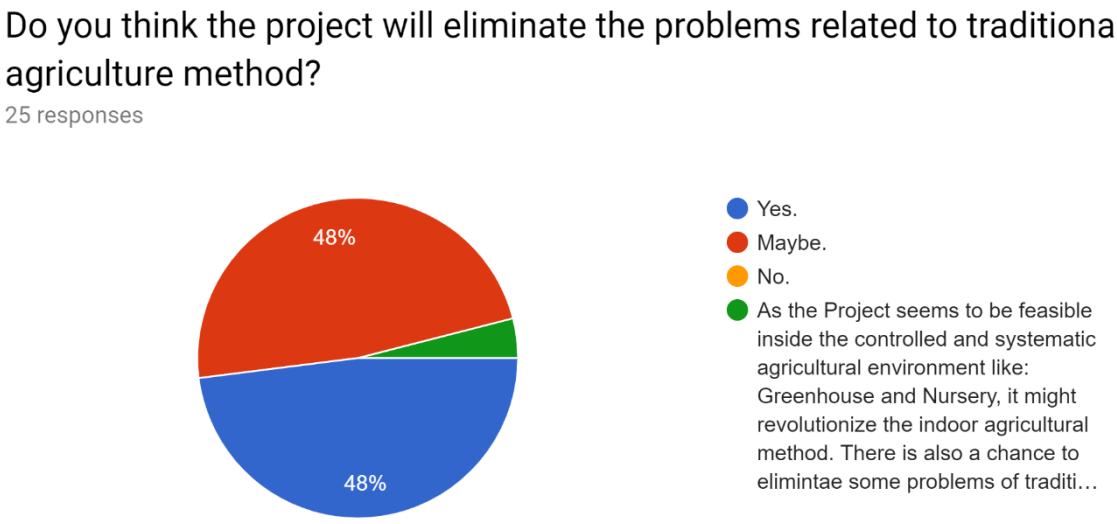

Figure 17 Survey question 7.

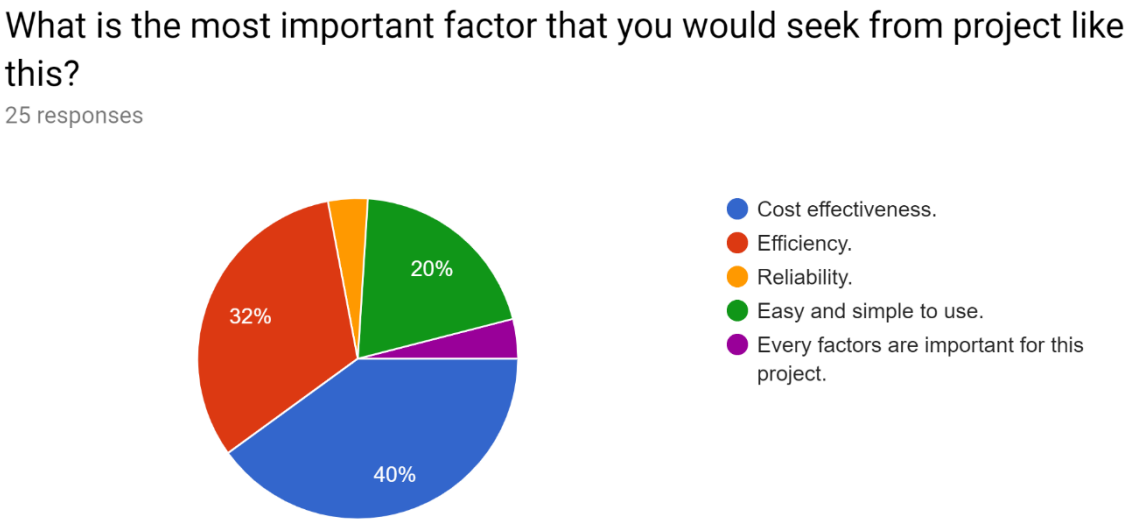

Figure 18 Survey question 8.

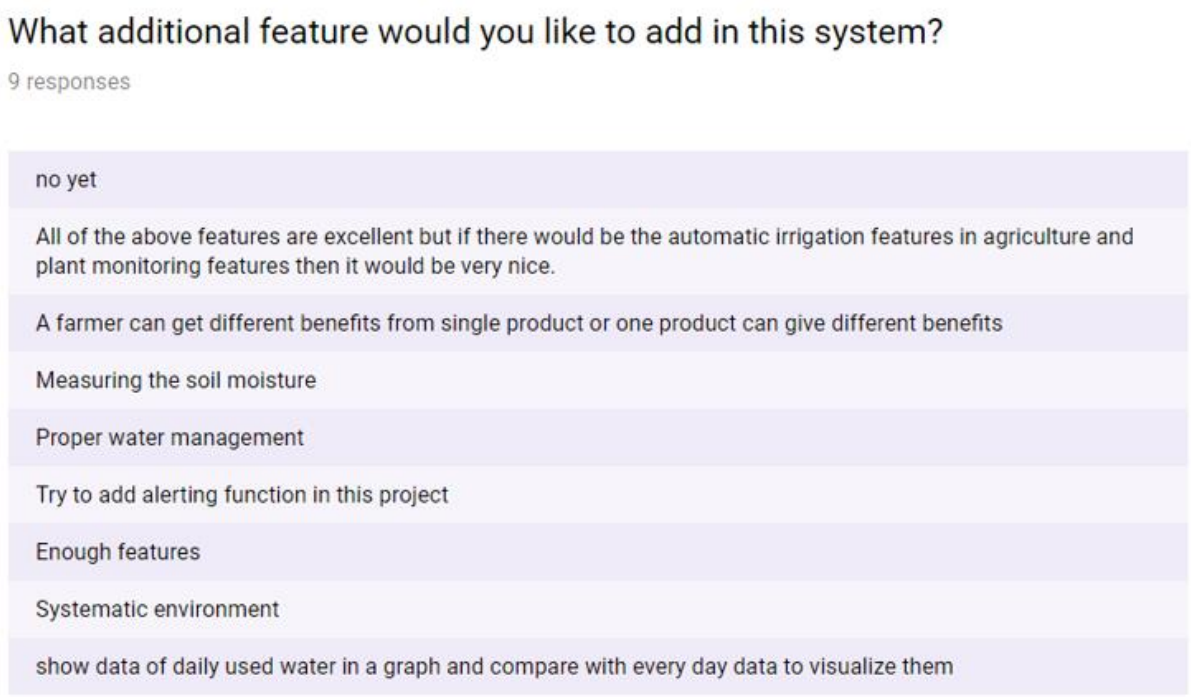

Figure 19 Survey question 9.

8.3. Appendix 3: Milestones review

- ✓ **Milestone 1:** Topic selection.
  - **Status:** Completed.
- ✓ **Milestone 2:** Proposal Submission.
  - **Status:** Completed.
- ✓ **Milestone 3:** Client selection.
  - **Status:** Completed.
- ✓ **Milestone 4:** Interim report Submission.
  - **Status:** Completed.
- ✓ **Milestone 5:** Complete development related to the Water-tank system.
  - **Status:** Ongoing.
- ✓ **Milestone 6:** Complete development related to Irrigation System.
  - **Status:** Not completed.
- ✓ **Milestone 7:** Complete development related to Agriculture monitoring system.
  - **Status:** Not completed.
- ✓ **Milestone 8:** Complete development related to the website.
  - **Status:** Not completed.
- ✓ **Milestone 9:** Completion of Testing.
  - **Status:** Not completed.
- ✓ **Milestone 10:** Complete the final documentation.
  - **Status:** Not completed.
- ✓ **Milestone 11:** Project submission.
  - **Status:** Not completed.

8.4. Appendix 4: Development Work

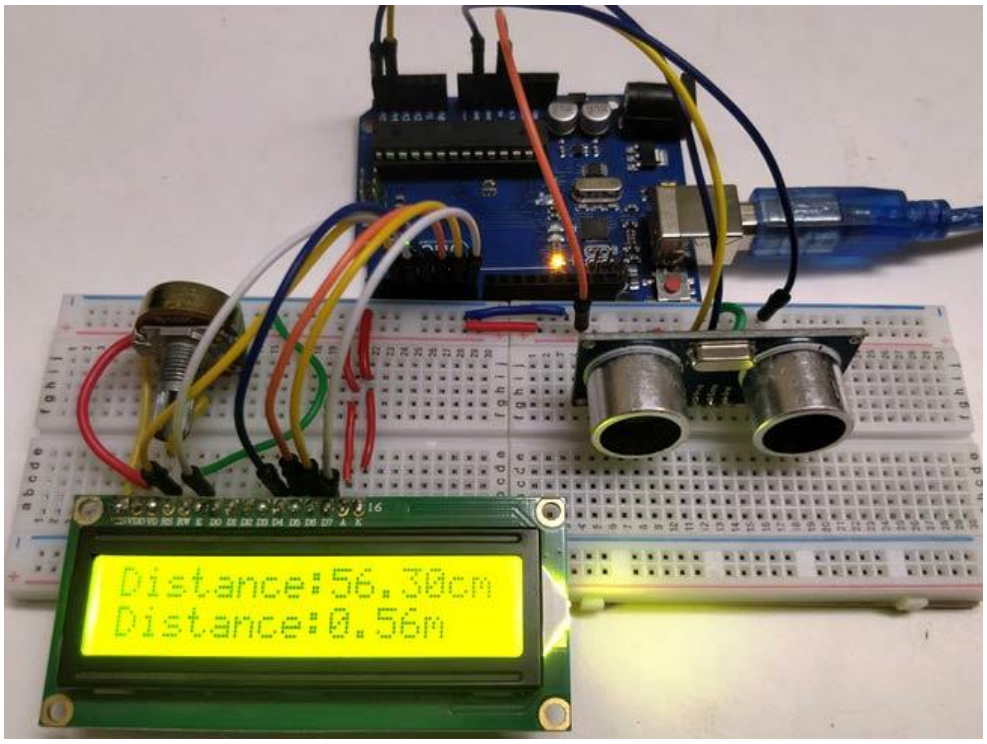

Figure 20 Hardware of Automated Water-tank System.

arduinoTest

```
#include <LiquidCrystal.h>

#define trigger 10
#define echo 11
#define motor 8
#define buzzer 12

LiquidCrystal lcd(7,6,5,4,3,2);

float time=0,distance=0;
int temp=0;
void setup()
{
 lcd.begin(16,2);
 pinMode(trigger,OUTPUT);
 pinMode(echo,INPUT);
 pinMode(motor, OUTPUT);
 pinMode(buzzer, OUTPUT);
 lcd.print("  Water Level ");
 lcd.setCursor(0,1);
 lcd.print("   Indicator  ");
 delay(2000);
}

void loop()
{
 lcd.clear();
 digitalWrite(trigger,LOW);
 delayMicroseconds(2);
 digitalWrite(trigger,HIGH);
 delayMicroseconds(10);
 digitalWrite(trigger,LOW);
 delayMicroseconds(2);
 time=pulseIn(echo,HIGH);
 distance=time*340/20000;
```

Done compiling.

Figure 21 Development related to Automated water-tank system 1.

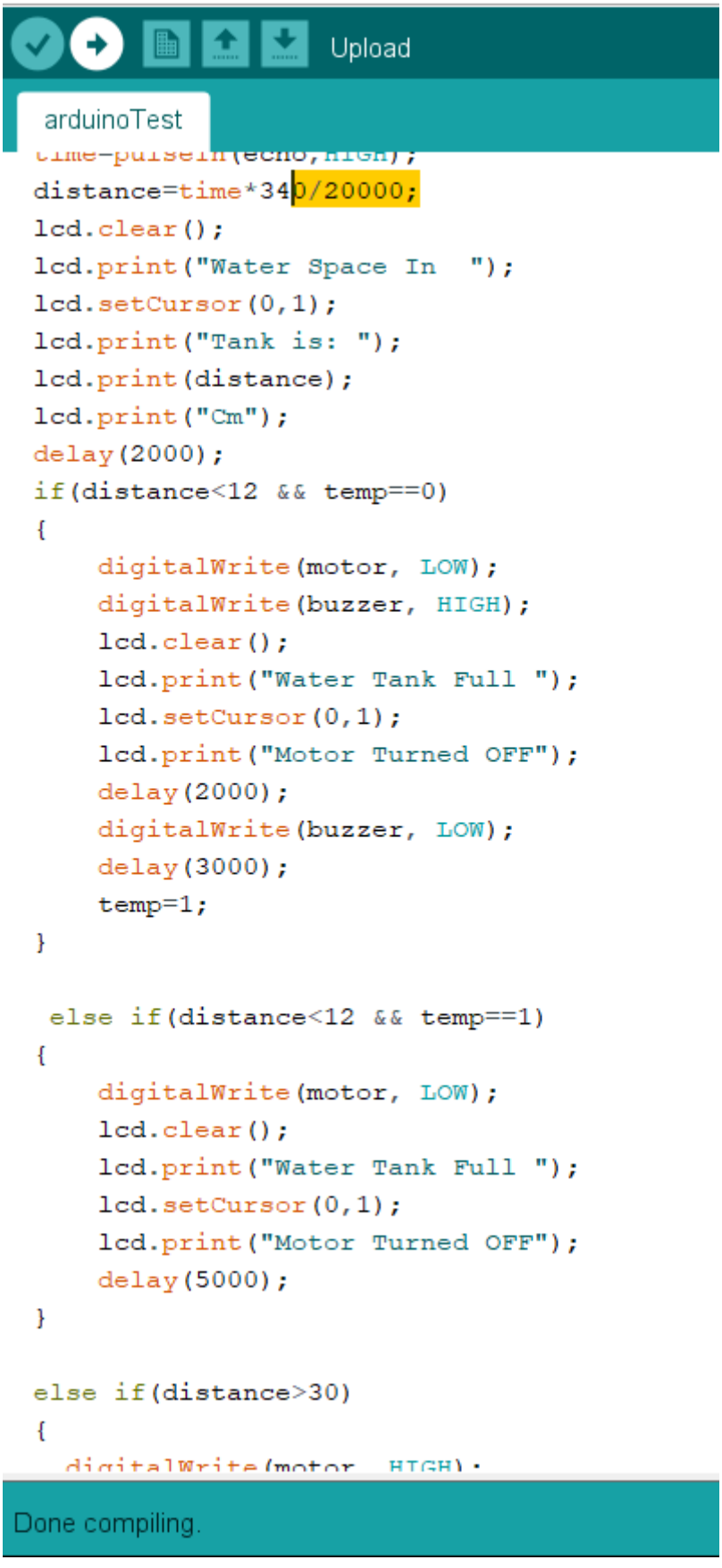

Figure 22 Development related to Automated water-tank system 2.

arduinoTest

```
if(distance<12 && temp==0)
{
    digitalWrite(motor, LOW);
    digitalWrite(buzzer, HIGH);
    lcd.clear();
    lcd.print("Water Tank Full ");
    lcd.setCursor(0,1);
    lcd.print("Motor Turned OFF");
    delay(2000);
    digitalWrite(buzzer, LOW);
    delay(3000);
    temp=1;
}

 else if(distance<12 && temp==1)
{
    digitalWrite(motor, LOW);
    lcd.clear();
    lcd.print("Water Tank Full ");
    lcd.setCursor(0,1);
    lcd.print("Motor Turned OFF");
    delay(5000);
}

else if(distance>30)
{
  digitalWrite(motor, HIGH);
  lcd.clear();
  lcd.print("LOW Water Level");
  lcd.setCursor(0,1);
  lcd.print("Motor Turned ON");
  delay(5000);
  temp=0;
}
}
```

Done compiling.

Figure 23 Development related to Automated water-tank system 3.