SMART AGRICULTURE SYSTEM

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SMART AGRICULTURE SYSTEM

DIARY DANA RAFIQ

A report submitted in partial fulfilment of the
requirements for the award of the degree of Bachelor of Computer Science
(Computer Networks & Security)

Faculty of Computing
Faculty of Engineering and Science
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DEDICATION

I would want to express my gratitude to everyone who participated in this endeavor. In this endeavor, I'd want to express my gratitude to my supervisor. I would want to express my gratitude to my supervisor, Dr.Diyari A. Hassan, who was very helpful in guiding my education on this project. The successful execution of this project was supported by his suggestions and criticisms. I would want to express my appreciation to the management of the institution for giving me such an important opportunity. It is likely that in the years to come, I will take part in further activities of this kind. I promise that I was the only one involved in the creation of this project and that it is not a fake. In conclusion, I would want to convey my appreciation to both my parents and my friends for the valuable feedback and direction they provided during the process of completing this project.

ACKNOWLEDGEMENT

In the course of working on my thesis, I had conversations with a wide variety of individuals, including academics, researchers, and industry professionals. They have helped me comprehend and think more clearly thanks to their contributions. In particular, I would like to offer my heartfelt gratitude to the primary thesis supervisor for my dissertation, Dr.Diyari A Hassan, for his support, direction, friendship, criticism, and advices, as well as his ability to motivate me. This thesis would not have been delivered in the same form if he had not consistently shown his attention and support throughout the process.

My fellow student should also be recognised for their support. My sincere appreciation also extends to all my colleagues and others who have provided assistance at various occasions. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space. I am grateful to all my family member.

ABSTRACT

Water plays a crucial role in food production, and manual operation of water pumps by farmers can be time-consuming and inefficient. To address this issue, researchers propose an alternative approach using technology. The Auto Farming project is a self-iterating Internet of Things (IoT) solution designed to assist farmers in irrigating their crops. By harnessing modern computing power and IoT technology, farming processes can be digitized, leading to more efficient plant growth while conserving water and fertilizer usage. The project utilizes sensors to monitor soil temperature, humidity, and moisture levels, enabling autonomous irrigation without human intervention. This intelligent approach to agriculture aims to improve crop yields and farm management while contributing to the growth of the industry. By integrating sensors and Wi-Fi, the system can be remotely controlled via smart devices or computers with internet connectivity. With increasing pressure on farmers to enhance food production while reducing resource consumption, the remote monitoring and control system will empower them to meet these demands effectively. The ultimate goal is to create a smart farming system capable of irrigating crops with minimal water and energy usage, optimizing food production and sustainability in agriculture.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

CSS	-	Cascading Style Sheets
DHT22		Temperature and Humidity Sensor
ET	-	Eastern Time
ESP32	-	Espressif 32
HTML	-	Hyper Text Markup Language
IoT	-	Internet of Things
SDLC	-	Software Development Life Cycle

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Introduction

Water has a significant influence on how food is produced. Farmers need to physically operate the water pump regularly. They might have to drive a considerable distance only to turn on the pump and wait until it has to be turned off, which leads to time consumption. For this reason, researchers interested in an alternative approach could solve this issue using technology. Based on the state-of-the-art approaches we have proposed the Auto Farming project, a self-iterating Internet of Things project that helps farmers irrigate their crops. Getting Things Online With the use of modern computing power, farming may be done digitally. Several industries are now automating their processes with the help of cutting-edge technology since it is essential in today's world. Internet of Things (IoT)-enabled agricultural innovation is expected to help farmers and manufacturers maximize plant growth while minimizing water and fertilizer use. For farmers, this means more efficient management of their herds, fields, budgets, and resources (IoT in Smart Agriculture Solutions and Applications, 2023). The project starts with hardware connected to sense and get information about the plant's soil. The project will run without human intervention by obtaining the temperature and humidity status of the sensor. It will help farmers efficiently harvest more plants and monitor the farm's quality. Our effort to make agriculture more intelligent will undoubtedly contribute to the growth of this industry. Due to a number of problems, agriculture has not been fully automated. It has intelligent irrigation and intelligent control that take into account the most recent field data. smart warehouse management, which includes preserving temperatures, humidity, and soil moisture levels. These actions will all be carried out by combining sensors and Wi-Fi, and they can all be managed by any distant smart device or computer with an internet connection.

1.2 Problem Background

Our way of life necessitates that everything be controlled remotely. Humans have mostly automated their lives, with the exception of a few niche tasks. Farmers are under growing pressure to increase food production while decreasing water and energy use as a result of climate change, soil erosion, biodiversity loss, changing consumer food preferences, and concerns about the safety of food production (Anon, n.d.). With irrigation, water is applied to the land via various means, most often sprinklers and drip systems. Erosion happens as water moves over soil.

Good irrigation management may lessen the severity of erosion and its consequences. It impedes the flow of water, pollutes bodies of water utilized for pleasure, and affects aquatic ecosystems (Forage Information System, 2009). Farmers will be better able to handle these demands with the aid of a remote monitoring and control system. As a result, the goal of my project is to create a smart farming system (IoT) capable of irrigating crops while using less water and energy. Farmers and gardeners will have reliable information on the soil's state, including temperature, pH, moisture content, and surrounding humidity, which can also provide more food and fruit. Less human labor is needed, and more green spaces can be harvested using this technology, which will help farmers efficiently harvest more plants and monitor the farm's quality.

1.3 Project Aim

An autonomous and efficient irrigation system that conserves water and promotes crop growth is the end aim of the smart agricultural system. The system's purpose is to monitor variables such as soil moisture, temperature, and plant water requirements in real time. The system will automatically take care of the watering process based on this data, ensuring that the crops get the ideal quantity of water at the ideal moment. The system's goal is to improve crop yields, reduce water use, promote sustainable and accurate agricultural methods, and reduce the amount of manual labor required.

1.4 Project Objectives

The objectives of the project are:

(a) To study the requirement of the system.

(b) To design the smart agriculture system.

(c) To test the smart agriculture system.

1.5 Project Scope

The scopes of the project are:

(d) Web-base

(e) Can read done from sensor

(f) Can stop/start water pump

1.6 Project Importance

Farmers and factories depend on irrigation a lot to give crops the water they need to grow. (World Bank, 2017) The irrigation of crops is made easier by this project. Irrigation systems are specifically made to hydrate plants in lesser amounts over longer periods of time, which will cause plants to develop quicker and greener. Installing an irrigation system will considerably accelerate the growth of your plant.

1.7 Report Organization

At the end of this project consists of six chapters:

First chapter discussed an introduction to the problem and solution, then the problem was discussed in detail, then the aim of this project, then the objective of this project that it is trying to achieve, after that the scope of the project was discussed, and finally the importance of the project was discussed. Second chapter will discuss the literature review, in which the previous works and system will be discussed and taken as references. Third chapter discussing methodology. Choosing a methodology, as well as the hardware and software to be used for this project. Forth chapter creating sequence, use case, and activity diagrams based on this project. Fifth chapter is about testing and implementation. Sixth chapter is the conclusion, accomplishment, and recommendation for future improvements.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter, the literature review for the-stat-of-art approaches in the circa of the smart agriculture system has been discussed. This project is involve developing smart agriculture system for irrigate the farms (corps, fruits). This study conducts smart agriculture system that exists and make comparison between them what are the positive and negative side about them and which criteria is different with this project. In this project review those technologies that will be used in the system and the existing prototypes available.

2.2 Case Study (If any)

According to the results of a survey that was administered to people who utilize conventional agriculture and modern smart agriculture, responses to an excessive number of questions that were not intended to be asked were obtained via them.

According to the results of the poll, the vast majority of people feel uncomfortable with conventional farming methods and find it challenging to live in such a way. After we gave them some hints about it, they really loved the idea, and they were asking more about it. Prior to that, some of them were completely unaware that there was something like in Kurdistan. According to the results of the poll that we made public, the issue that they faced was as follows:

When they departed their farms, one of the challenges they encountered was that they often neglected to turn off the water pump before leaving.

2.2.1 Manual Operation

In manual irrigation, water is physically transferred from one plant to another. This method is quite time-consuming and labor-intensive, since it requires the use of a hose or a bucket. Also, you don't have as much control over the water's quality or quantity, and you can end up with more runoff from your farm if you use these techniques (Futurepump, 2019). In addition, you may have to invest a lot of time and effort into the process, what with the necessary physical work of lifting water from your water source, delivering the water to your crops, and ensuring that everything gets the regular water it requires.

2.3 Current System Analysis

In this session, we will analyze and briefly review various systems, beginning with an analysis of the current system in Iraq and then moving on to an analysis of current systems in general.

2.3.1 Current System Analysis in Iraq

The Iraqi Ministry of Agriculture launched a program for employing contemporary irrigation techniques in 1991. The initiative was really put into action in 2000, directly under Iraqi government control. The main justification for implementing this initiative was to address a lack of food supply. Iraq needs to produce more grain and wheat, especially through expanding planted acreage and improving land productivity. Due to the restricted water resources accessible for agriculture, it has become vital to consider employing contemporary technology. The objective is to enhance crop area and yield while using the same quantity of water as conventional irrigation techniques. It had been given serious thought after the oil-for-food arrangement. This is because the pact allowed for the first time the introduction of sprinkler and drip irrigation systems (www.elsevier.com, n.d.). The amount of moisture present in the soil is critical to the growth and continued existence of a plant, and this is especially true in a country like Iraq, where the climate may quickly change from arid desert to verdant river valleys. In order to survive in the arid regions of Iraq, several plant species, such as the date palm and the tamarisk, have evolved extensive root systems that may reach groundwater. On the other hand, the fertile land in the region surrounding the rivers Tigris and Euphrates is perfect for cultivating cereal grains and other crops that need a lot of water, such as rice, wheat, and barley. These plants thrive in the winter since this is the period of year when we have more rainfall and the soil has the opportunity to naturally replenish itself. Plants such as reeds and papyrus are able to thrive in the marshlands of southern Iraq due to the high levels of soil moisture present there. These plants may sometimes even be observed growing straight in water that is not moving. As a result, the requirements for soil moisture that plants have in Iraq are mostly determined by the plant type and the geographic location of the plant.

2.3.2 Current System Analysis in general

The most common modern irrigation techniques are sprinklers, drip irrigation, timed sprinklers, and subterranean water pipelines. Smart irrigation controllers may use accurate, high-resolution weather data from ET "ET controllers are devices used for the scheduling of irrigation that are based on the principles of soil water balance. These principles are used to determine when and how much water should be irrigated". Everywhere to tailor watering schedules for each area. useable in both sandy soil and rocky areas. protects plants from frost by keeping out the cold. The sprinkler system may be used to spread fertilizer and pesticide. Soil conservation is aided by this (HydroPoint, 2020).

2.4 Comparison between existing systems

As with other kinds of smart controllers, such as soil moisture sensor controllers, a weather-based irrigation controller is sometimes referred to as an ET or evapotranspiration controller. Plant water requirements are calculated using ET-based controllers using meteorological factors. Therefore, a variety of models or computer computations may determine ET using meteorological factors like temperature, relative humidity, and wind speed. Different kinds of ET controllers exist. The ET data is sent wirelessly to a signal-based controller. The historical ET controllers use a water consumption curve that is programmed using data collected on water use patterns at particular locations. Temperature and solar radiation might be accounted for by modifying the curve. On-site weather data is used by controllers to determine the required level of ongoing water and ET monitoring (windmill, 2017).

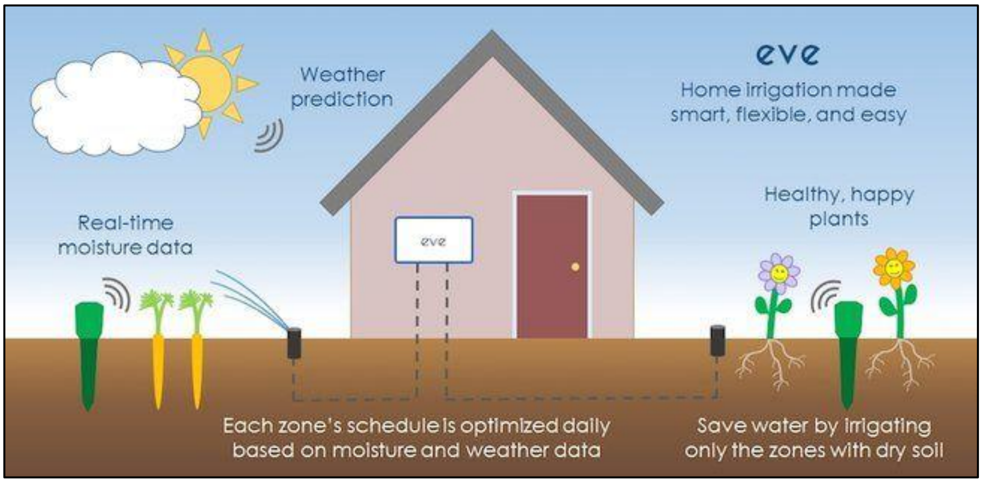

Figure 2.1 Weather-based irrigation controller (indiamart.com. (n.d.)).

The soil moisture sensor is a one-of-a-kind device that measures the soil's moisture and, with the aid of the right mechanism, allows for precise control over the quantity of water used in the irrigation of various soil types. In order to prevent wasteful watering, a controller may be set up to cut off the irrigation system after the soil has reached a certain moisture level. The controller will restart the system after the earth has dried out. An automated irrigation system allows water to be delivered to plants as needed or turned off entirely to save water. Traditional timed controllers and automated watering schedules with start and end times are employed in suspended cycle irrigation systems. The gadget will not irrigate again until the soil has absorbed all the water it needs (Millán et al., 2019).

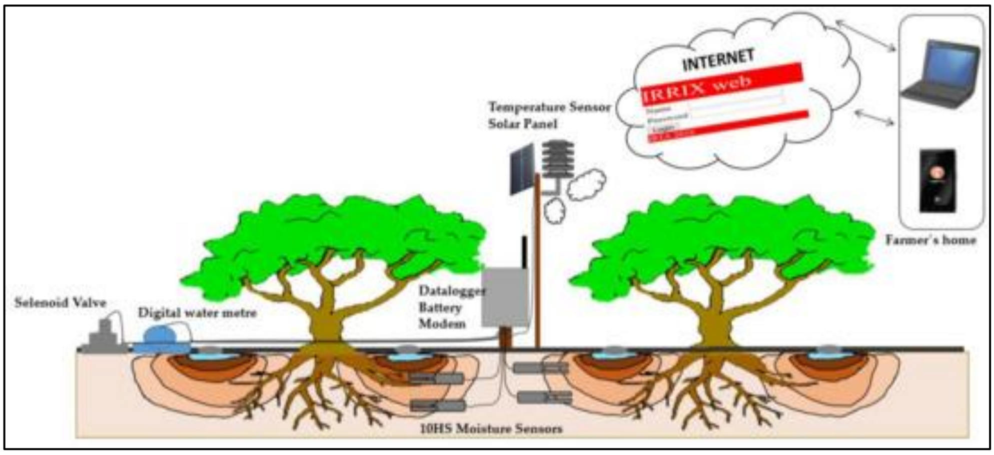

Figure 2.2: Soil moisture sensor controllers (Millán et al., 2019)

2.5 Literature Review of Technology Used

The "internet of things," a term used to describe the proliferation of internet connectivity among the world's countless smart devices, is improving productivity in the workplace. Data gathered by these internet-connected sensors may be used to develop innovative approaches to issues like parking, waste management, and communication. Therefore, the use of the IoT in farming is essential. (IJRASET, n.d.) The objective of the project is to create an Internet of Things-integrated smart farm network. An Arduino serves as the system microcontroller. The temperature, humidity, and soil moisture in the nearby area are monitored using the DHT22 the DHT22 is a fundamental digital temperature and humidity sensor that is available at a very low cost and a soil moisture sensor.

2.6 Chapter Summary

This chapter covered the literature review, the present system, as well as its advantages and disadvantages, in this chapter. It also discussed other works and systems that were comparable to this project. This chapter is about the technology that would be employed in both our system and those of other systems.

CHAPTER 3

SYSTEM DEVELOPMENT METHODOLOGY

3.1 Introduction

By outlining the activities to be taken and the methods to be used, it is possible to standardize the development process and product while also improving control and management of the system development process. It may quickly increase the system's quality, structure, and usefulness with the aid of a methodology. This chapter will cover the methods utilized to create a smart agricultural system as well as the rationale behind their selection. This chapter is also spoke about and will assess the system's tools and technology.

3.2 Methodology Choice and Justification

Software development is done using a cycle called the Software Development Life Cycle, or (SDLC). There are six phases: planning, requirements, design, development, testing, and deployment. The software development life cycle has several facets and paradigms (waterfall, iterative, agile, etc.) (SmartSheet, 2018).

Waterfall methodology is sequential development process that starts with requirement, design, implementation, testing and ends with deployment. In this model each phase must completed before moving on another phases. For example, to design and then have to implement the requirements and you cannot return to the design while in implementation phase. (Jevtic, 2019).

Agile methodology is an iterative and incremental approach to software development, with the necessity of being able to modify based on the needs of the client. It assisted with adaptive planning, iterative development, and time management. It’s a theoretical framework that encourages and predicts interactions at all stages of the developmental life cycle. Regular testing is made possible by agile, and users, stakeholders, and the company all have the ability to offer feedback on the project as it progresses. When business needs and user actually want fluctuate often during development, agile helps remain flexible and make changes rapidly.

Figure 3.1: Water fall VS Agile (Blog, 2021)

Agile methodology over other methodologies because it requires more dependability; you can change your system based on the requirements and comments that you receive, whereas in waterfall methodology, you cannot make any changes until all phases are completed. In agile, we have sprints, and within these sprints, you will create your project. For example, if there are six phases in the agile life cycle, you will create sprints for each of them. Each sprint has a time limit, and you must complete that task within that time limit in order to complete your project on time. For each sprint, you will get your feedback, and based on the feedback, you can easily make changes to your project.

You must divide your tasks into sprints when using agile methodology. Sprints are the period of time that you have to complete your tasks in that period, so each chapter of the project has been divided into sprints based on the chapters in the Gantt chart below, which has shown the date of the sprints and the duration of the sprints.

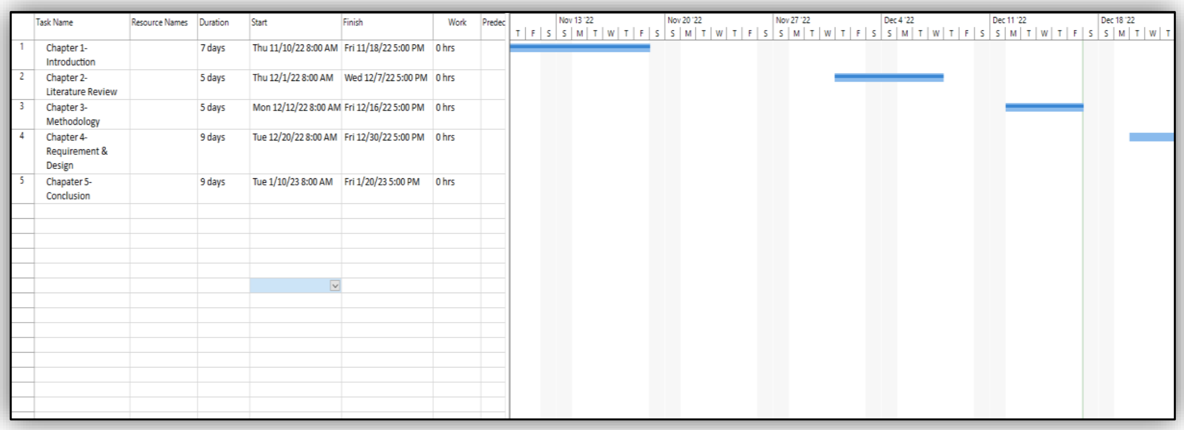

Figure 3.2: Gantt Chart

3.3 Phases of the Chosen Methodology

The agile methodology has six phases as shown in Figure 3.3, the phases are requirement (plan), design, develop, test (Tyagi, n.d.).

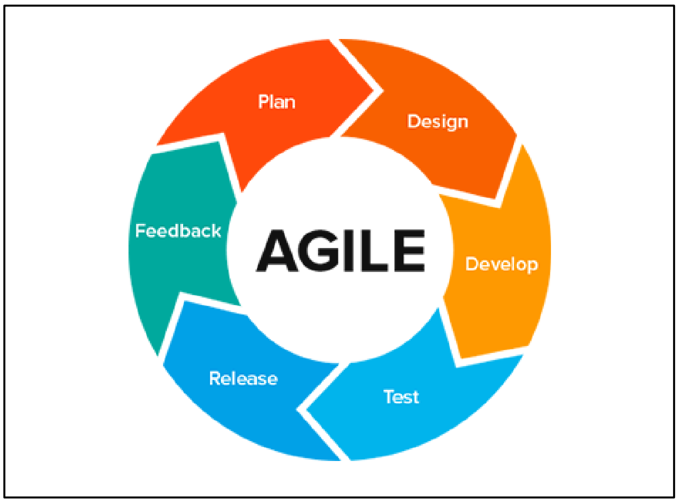

Figure 3.3: Agile methodology (Texas Software, 2020)

A smart agricultural system might be developed utilizing Agile's iterative and incremental procedures, with an emphasis on providing small, functional increments at frequent intervals. Agile development often splits the creation of a product into numerous stages: requirements analysis, design, coding, and testing. The steps that may be taken to implement a smart agricultural system are outlined below.

3.3.1 Requirement

Farmers, agricultural specialists, end-users, and other stakeholders help the project team determine which system needs are most important. The characteristics and capabilities of the smart agricultural system should be specified in these specifications. Sensor data gathering, automated irrigation, crop health monitoring, integrated weather forecasting, insect detection, etc. are all examples.

3.3.2 Design

During this stage, the team comes up with the overarching framework for the intelligent farming system. They achieve this by dividing the requirements into user stories, which are like mini-tasks. Scalability, modularity, and component integration should all be thought through throughout the design process. Sensor networks, data processing modules, decision making algorithms, user interfaces, and communication infrastructure are all possible components of the design.

3.3.3 Development

The development team will begin the process of building the intelligent agriculture system in phases depending on the user stories that have been prioritized. In Agile, work is broken down into parts called sprints or iterations, and each sprint may last anywhere from one to four weeks. Each iteration of the sprint results in the delivery of a newly developed and fully operational component of the system. For instance, the team may place a higher priority on the installation of the sensor network during the first sprint, whereas during the second sprint, they may place a higher priority on the integration of data processing and storage.

3.3.4 Testing

The Agile development approach wouldn't be complete without testing. The quality and functioning of a system depend on a variety of tests conducted at various points in the development cycle.

3.4 Technology Used Description

The technologies that were employed in the creation of a smart agricultural system in this part, along with the advantages that these technologies provide for this system.

3.4.1 Arduino IDE

The offline IDE makes it easy to write code and upload it to the board without an Internet connection. The Arduino Software (IDE) makes it easy to write code and upload it to the board offline. It recommends it for users with poor or no internet connection. This software can be used with any Arduino board (docs.arduino.cc, n.d.). connects to the Arduino boards to upload programs and communicate with them.

3.4.2 HTML

The most essential component of a webpage is HTML (Hyper Text Markup Language). a simple-to-use interface and added functions for the website (“HTML: HyperText Markup Language”).

3.4.3 CSS

CSS, or “Cascading Style Sheets,” is used for styling and laying out webpages. It can be used to adjust content size, spacing, color and font or add decorative features, such as animations or split content into columns. (“HTML: HyperText Markup Language”).

3.5 Hardware and Software Requirement Analysis

The hardware items that were used to create this project are:

Table 3.1 Hardware requirements

Item Used	Specification
ESp32	Processors: Central Processing Unit: Xtensa LX6 32-bit dual-core (or single-core) microprocessor, 160/240 MHz, 600/9200 DMIPS. Both random access memory (RAM) and read-only memory (ROM) are capped at 320 KB. Connectivity without wires: Internet Protocol Versions: 802.11 b/g/n
DHT22	The operating voltage ranges from 3.50V to 5.50V. Current consumption when operating: 0.3mA (measured) / 60uA (standby) There will be serial data released. The temperature may be anything from freezing to warm. Prevailing Humidity: 20% to 90% Temperature and humidity readings have a 16-bit resolution. Precision: 1 degree Celsius/1%
Soil Sensor	Volumetric soil water content (VWC) between 0 and 45% (from 0 to 100% with re-calibration). Current consumption: 3 mA at 5VDC Temperature range of -40 to +60 degrees Celsius Dimensions 8.9 x 1.7 x 0.6 inches (22 x 7 x 0.2 cm) (active sensor length 5 cm) Known-good calibration values saved the slope is 108% per volt Average: -42%
Water Pump 12V	DC 3V-5V is the input voltage range. The average flow rate is between 1.2 and 1.6 liters per minute. 80 degrees Celsius is the optimal working temperature. Input current is between 0.1 and 0.2A. The 0.8-meter suction distance (Max) The water exit has an outside diameter of 7.5mm.

	Water outlet measures 5.0 mm in diameter inside. The water intake is 5.0 mm in diameter.
Relay 2 channel	Supply voltage – 3.75V to 6V Trigger current – 5mA Current when relay is active - ~70mA (single), ~140mA (both) Relay maximum contact voltage – 250VAC, 30VDC Relay maximum current – 10A
Breadboard	Distribution There are two strips. The gauge of the wire ranges from 21 to 26. There are two hundred ties. The maximum AC voltage it can withstand is 1,000V. We use a 630-point grid for ties within IC. DC 500V, or 500M, is the insulation resistance. It measures 6.5 x 4.4 x 0.3 inches (inches). The maximum amps are 5A.
Jumper Wire	tin-plated copper wire P3
USB Cable	Cable connected to get power

The software used to create this project are:

Table 3.2 Software requirements

Software	Minimum Specification
Operating System	GMS System
Integrated Development Environment	Arduino IDE
Web Browser	Google Chrome, Brave

The system requirements for every system are hardware and software. Hardware devices are those physically attached devices that give you input and output based on the memory and processor devices in them. Software is a set of instructions for a computer to do specific tasks, such as coding and building a system.

3.6 Chapter Summary

In conclusion, this chapter explained the methodology used in developing smart agriculture systems. Justification was made clearly and explained the methodology for the system, and each phase of the methodology was explained and well understood. For example, what is the relationship between the requirement and design phases, and how does the design phase work for other faces. The technologies that are used in the system are clearly explained, along with the hardware and software requirements and perspectives.

CHAPTER 4

REQUIREMENT ANALYSIS AND DESIGN

4.1 Introduction

This chapter will go into the design and analysis of the smart agricultural system. Through the use of sequence diagrams, case diagrams, and activity diagrams and explain how the user function works inside the system.

4.2 Requirement Analysis

A product's requirements are established via a procedure called a requirements analysis. An actor, representing the smart agricultural system controller, is crucial to meeting user expectations in this architecture. System controller: it's up to the user of the system to control the system and make sure it works properly. The System Controller can manage the device list's details. The System Controller has the ability to perform system maintenance.

4.2.1 Use Case Diagram

Use case diagram depicts the interaction that takes place between the various actors, the users, and the system. a diagram showing a use case as well as the requirements the interaction between users and the software is shown in this use-case diagram for a smart agricultural system.

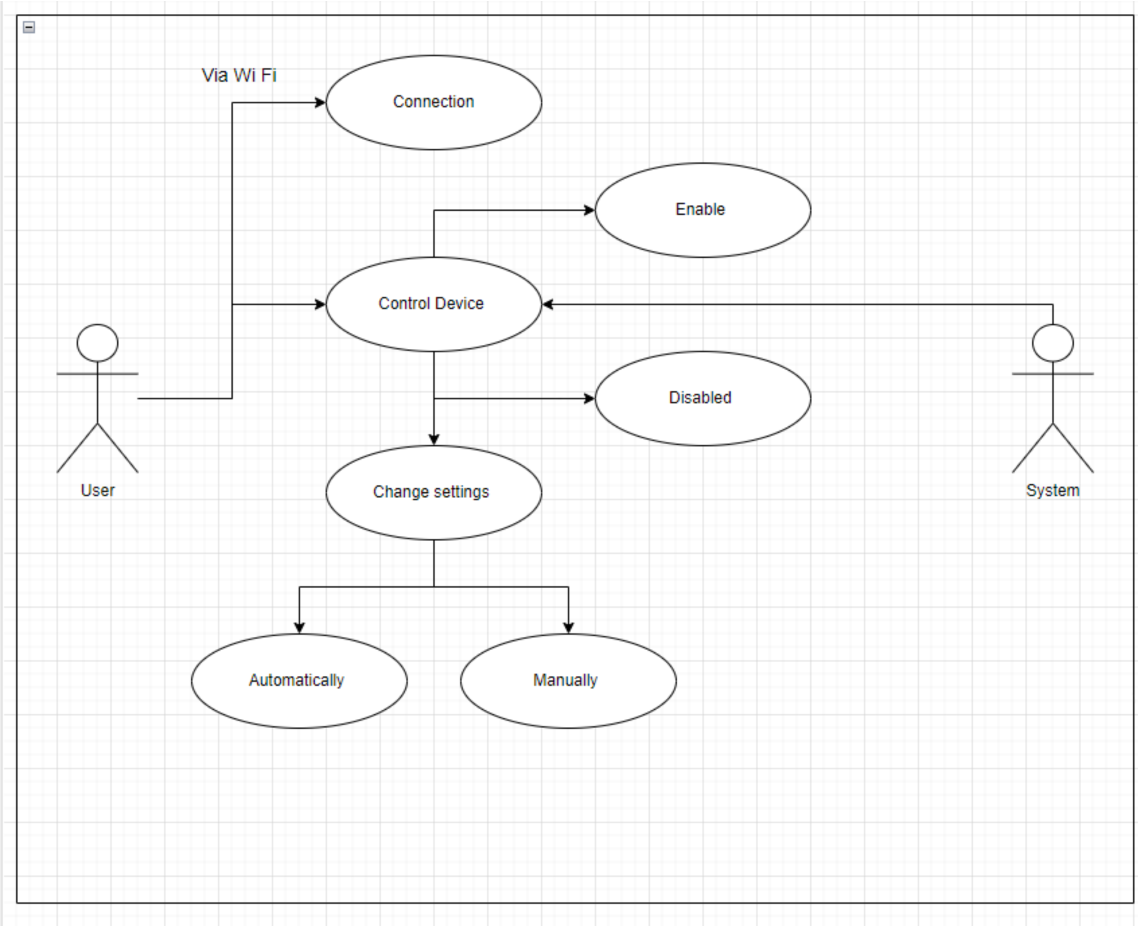

Figure 4.1: use case diagram

According to this use case diagram, which is shown in the above Figure 4.1, when a user connects to the system via Wi-Fi, he or she can control the device by enabling or disabling it, and the system can change the settings (mode) via a website.

4.2.2 Sequence Diagram

Sequence diagram represents the work flow of the use cases and describes their functions.

4.2.2.1 Connection Sequence Diagram

This diagram is shown in Figure 4.2 is the connection sequence diagram how that use case is working with the system for user.

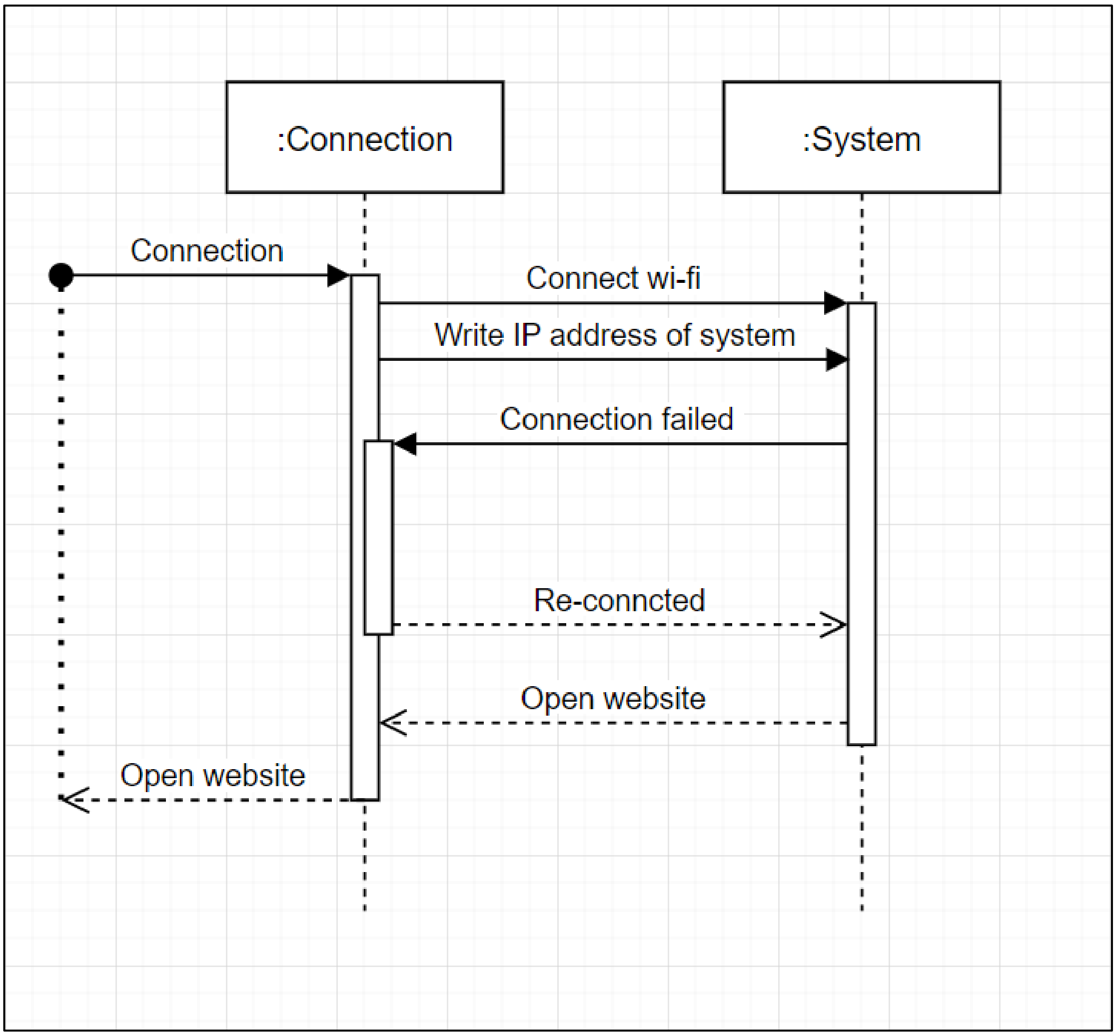

Figure 4.2: Connection sequence diagram

From this sequence diagram, the user must connect to a Wi-Fi, write the website IP address, and the website will open. If the user loses connection, he or she has to reconnect, and the website will open.

4.2.2.2 Enable Sequence Diagram

Based on Figure 4.3, it describes to the user how to enable the system.

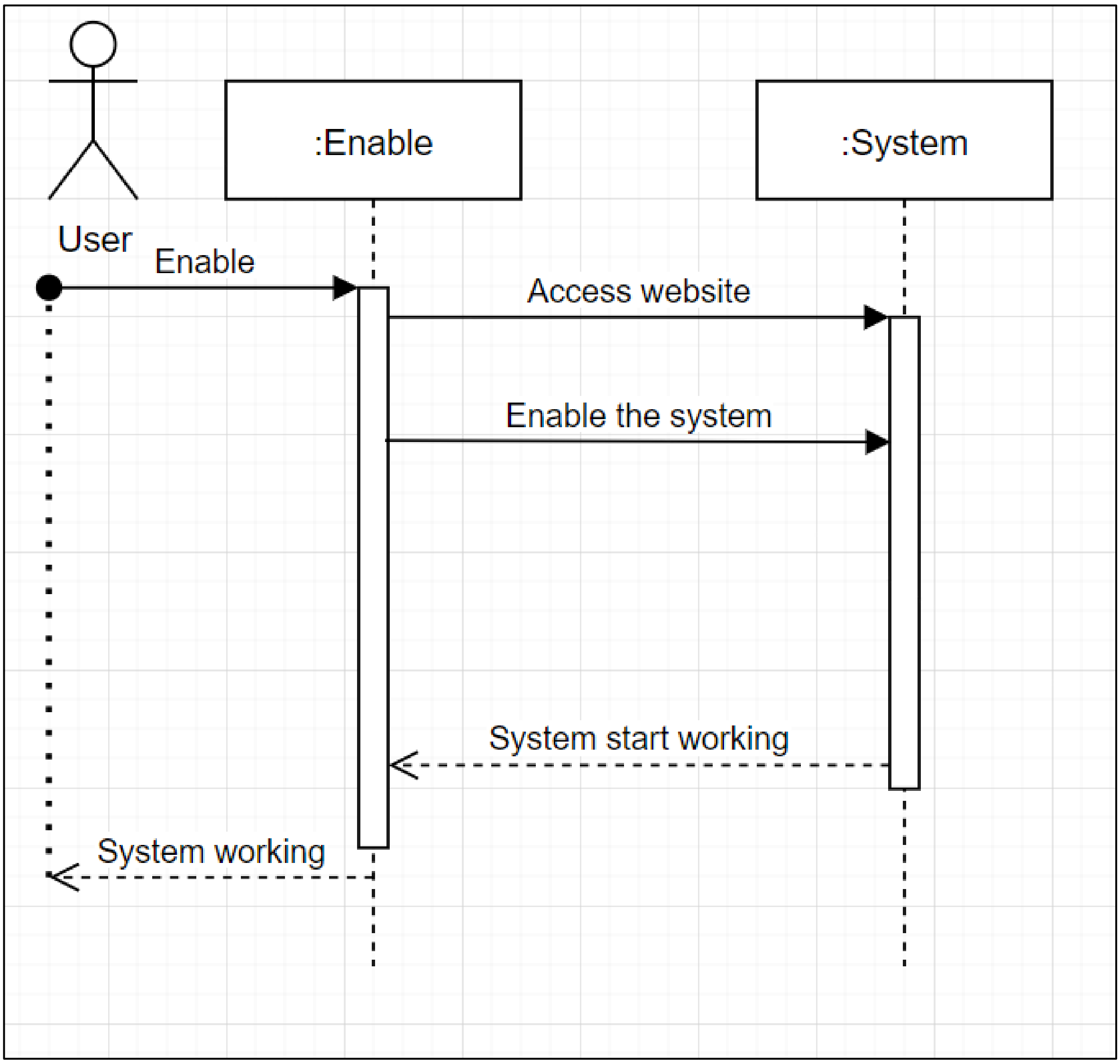

Figure 4.3: Enable Sequence diagram

From this diagram, the user has to access the website to enable the system to start working.

4.2.2.3 Disable Sequence Diagram

Based on Figure 4.3, it describes to the user how to disable the system.

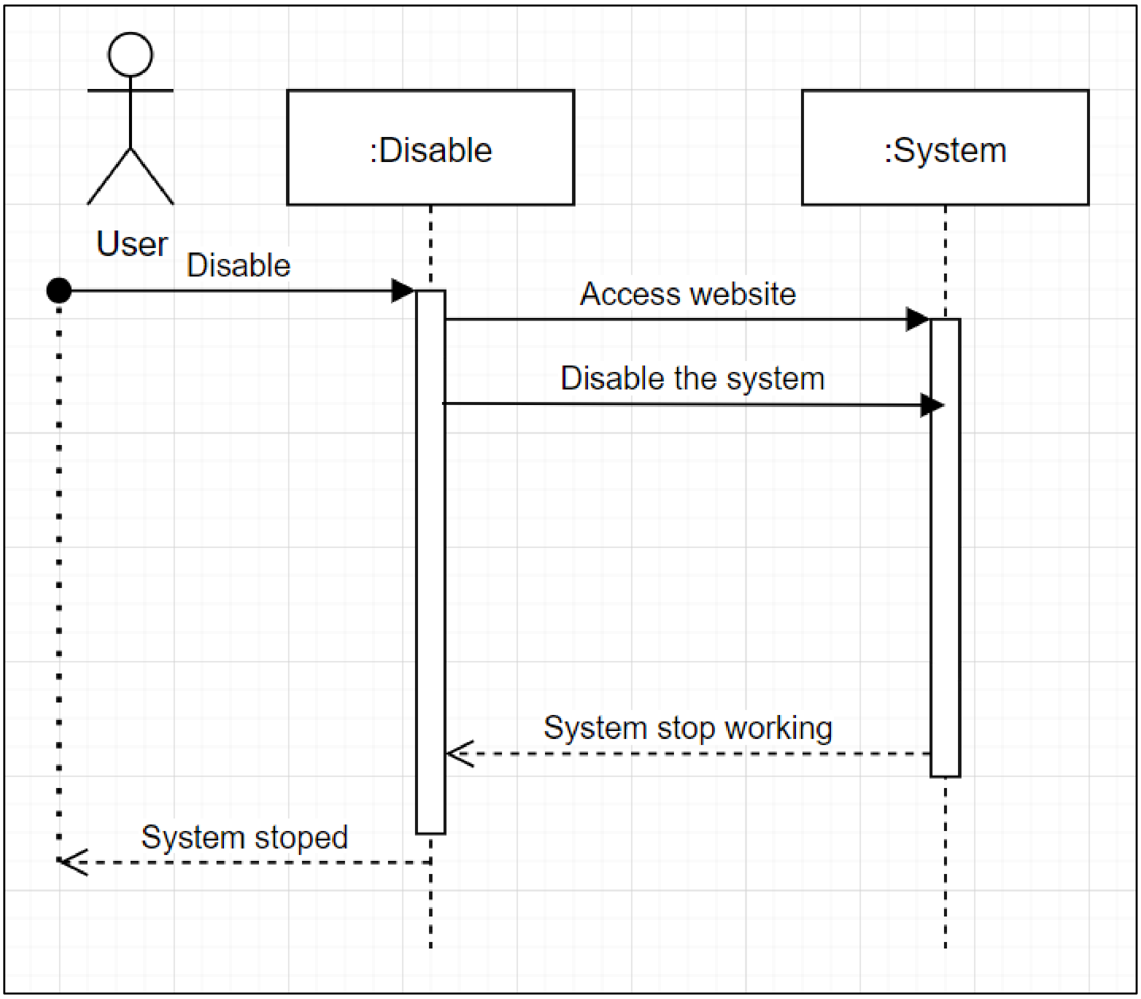

Figure 4.4: Disable sequence diagram

From this diagram, the user must access the website to disable the system in order to stop or shut it down.

4.2.2.4 Change setting Sequence Diagram

This sequence diagram depicts the two types of changes that a user can make to the system settings on the website: automatically and manually. This is shown in Figure 4.5.

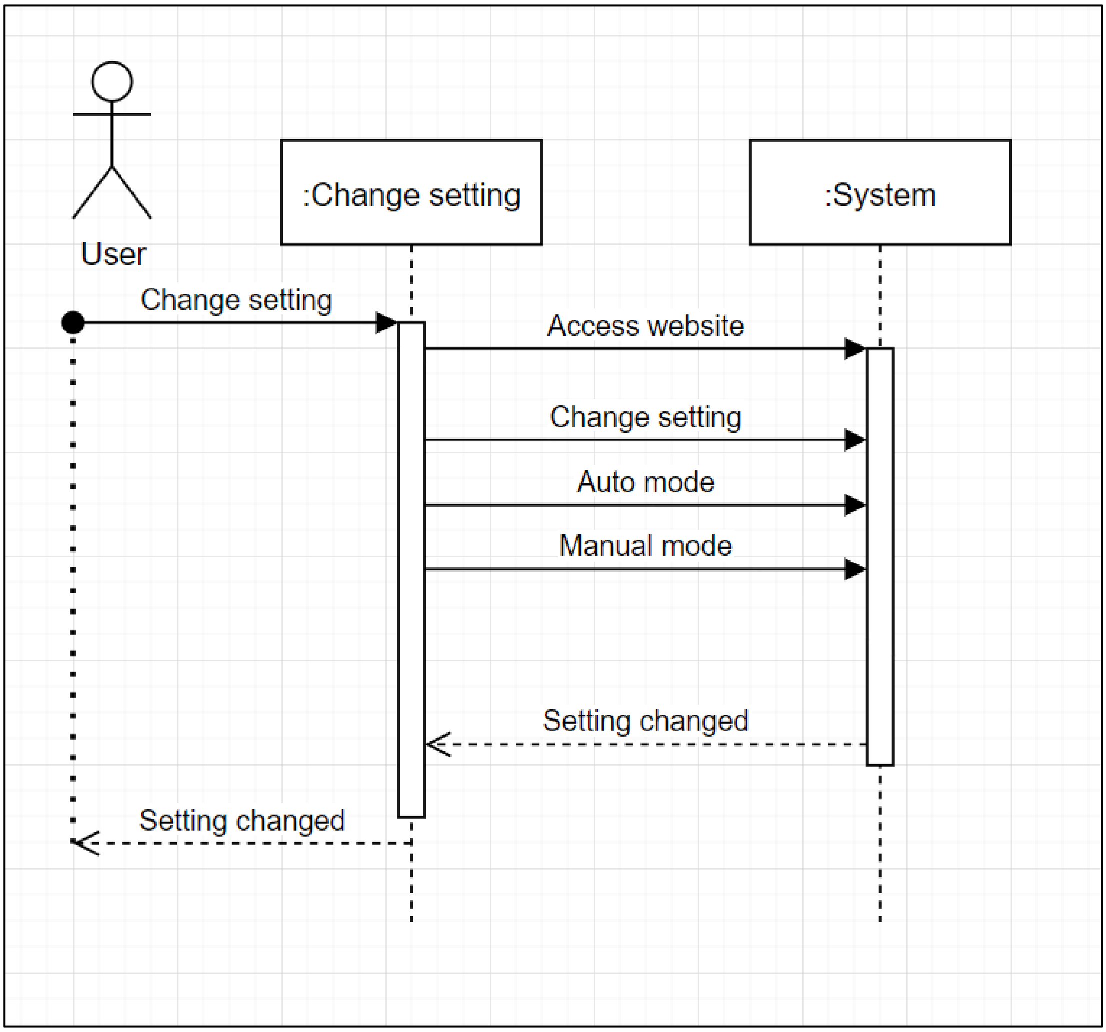

Figure 4.1 Change setting sequence diagram

4.2.3 Activity Diagram

For this project smart agricultural system, there is one activity diagram to understand how the system works. Activity diagrams are graphical representations of system operations and use cases.

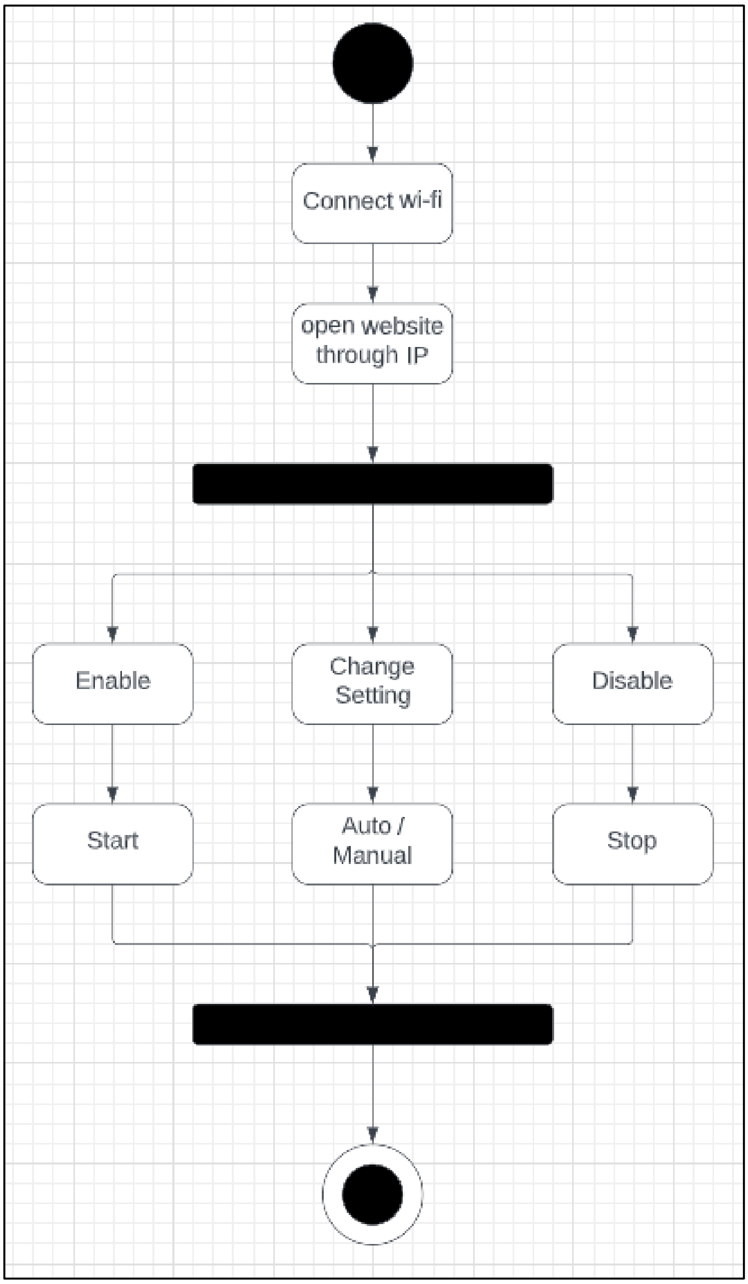

Figure 4.6: Activity diagram

4.3 Project Design

Figure 4.7 shows the design of smart agriculture system.

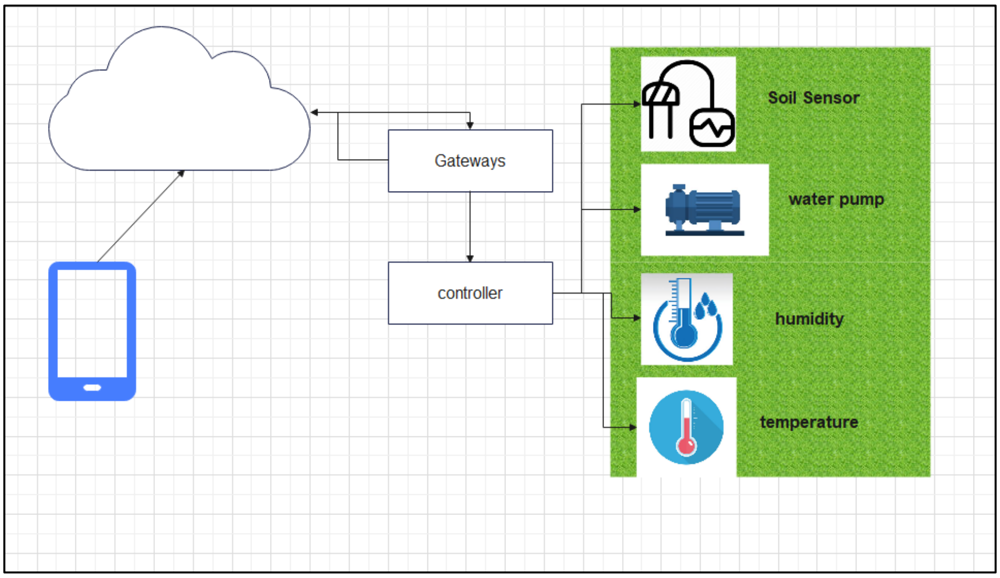

Figure 4.7 project design

4.4 Interface Design

These images depict the design interface for the smart agriculture system.

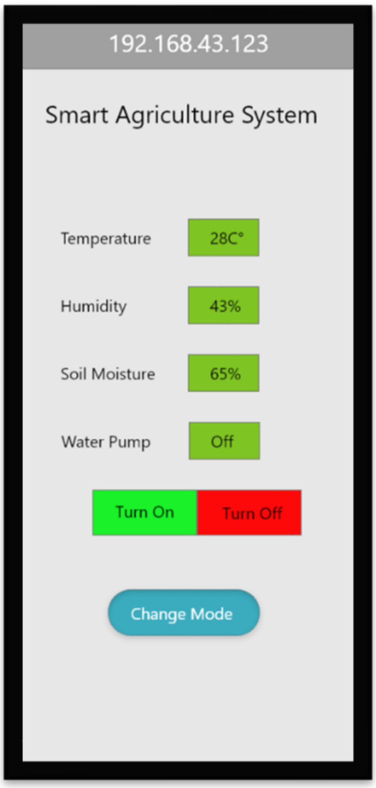

Figure 4.8: Main page

The above figure is the main page of the website for this project. From the sensors, it shows the temperature, humidity, and soil moisture of the plant.

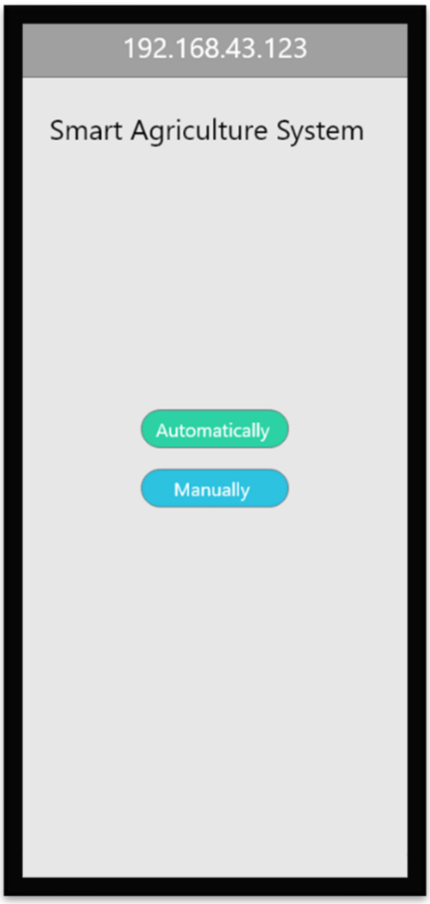

Figure 4.9: Changing mode page

This figure describes changing the mode either automatically or manually. In the automatic mode, the system automatically watering the plant depends on the level of soil moisture, but in the manual mode, the user can manually water the plant by turning on or off the water pump.

4.5 Chapter Summary

In the chapter, it describes the system analysis and design for the smart agriculture system. Many diagrams were created to explain the analysis and design in many ways. a sequence diagram, an activity diagram and use case diagram.

CHAPTER 5

SYSTEM IMPLEMENTATION AND TESTING

5.1 Introduction

The testing and execution of the project will be the primary focuses of this chapter. There will be descriptions and examples of each system code so long as the project maintains its primary functions and features. Coding and testing are both aspects of the process that are covered at this level.

5.2 Coding of System Main Functions

The primary goal of this code is to facilitate the development of an intelligent agricultural irrigation system. The gadget uses a dirt sensor, a water pump, and a DHT22 sensor to keep track of and adjust the watering schedule. The programmed activates the Wi-Fi connection, starts the sensors, and launches a web server so that the gadget may be monitored and controlled remotely. Constantly monitoring soil moisture, this system adjusts the water pump's operation accordingly. The water pump may be operated manually, or an automated mode can be used that activates and deactivates the pump dependent on the moisture level of the soil. This code generates an HTML website that displays sensor data and provides a web interface for manually and automatically turning on and off the water pump.

```
#include <WiFi.h>
#include <WebServer.h>

const char* ssid = "Diary";
const char* password = "12341234";
WebServer server(80);

#include <DHT.h>
uint8_t DHTPIN = 22;
#define DHTTYPE DHT22
DHT dht(DHTPIN, DHTTYPE);
int Temprature = 0;
int Humidity = 0;

const byte WaterPump_PIN = 23;
bool WaterPump_STATUS = false;
bool webBTN_STATE = false;
const int SoilMoistureSensor_PIN = 36;
int SoilMoisture_STATE = 0;
bool isAuto = true;

void setup() {
  Serial.begin(115200);
  Serial.println("Connecting To WiFi");
  WiFi.begin(ssid, password);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.print(".");
  }
  Serial.println("\nWiFi connected..!");
  Serial.print("Got IP: ");
  Serial.println(WiFi.localIP());

  pinMode(WaterPump_PIN, OUTPUT);
  digitalWrite(WaterPump_PIN, HIGH);

  dht.begin();

  server.on("/", handle_OnConnect);
  server.on("/waterPumpOn", handle_waterPump_On);
  server.on("/waterPumpOff", handle_waterPump_Off);
  server.on("/autoOn", handle_auto_On);
  server.on("/autoOff", handle_auto_Off);
  server.onNotFound(handle_NotFound);

```

Figure 5.1: main function

```
  server.begin();
  Serial.println("HTTP server started");
}

void loop() {
  CheckSensors();
  server.handleClient();
}

void CheckSensors(){
  SoilMoisture_STATE = analogRead(SoilMoistureSensor_PIN);
  SoilMoisture_STATE = map(SoilMoisture_STATE, 4096, 0, 0, 100);
  Serial.print("Soil Sensor: ");
  Serial.print(SoilMoisture_STATE);
  Serial.println("%");

  if(isAuto){
    if(SoilMoisture_STATE < 30){
      digitalWrite(WaterPump_PIN, LOW);
      WaterPump_STATUS = true;
      Serial.println("Water Pump: On");
    }
    else{
      digitalWrite(WaterPump_PIN, HIGH);
      WaterPump_STATUS = false;
      Serial.println("Water Pump: Off");
    }
  }
  else{
    if(webBTN_STATE){
      digitalWrite(WaterPump_PIN, LOW);
      WaterPump_STATUS = true;
      Serial.println("Water Pump: On");
    }
    else{
      digitalWrite(WaterPump_PIN, HIGH);
      WaterPump_STATUS = false;
      Serial.println("Water Pump: Off");
    }
  }

  Humidity = dht.readHumidity();
  Temprature = dht.readTemperature();
```

Figure 5.1: main function

```
  if (isnan(Humidity) || isnan(Temprature) || Humidity > 100 || Temprature > 100){
    Serial.println("Failed to read from DHT sensor!");
    return;
  }
  else{
    Serial.print("Temperature: ");
    Serial.println(Temprature);
    Serial.print("Humidity: ");
    Serial.println(Humidity);
  }
  Serial.println("==========");
  //delay(1000);
}

void handle_OnConnect() {
  server.send(200, "text/html", SendHTML());
}

void handle_auto_On() {
  isAuto = true;
  Serial.println("Auto: ON");
  server.send(200, "text/html", SendHTML());
}
void handle_auto_Off() {
  isAuto = false;
  Serial.println("Auto: OFF");
  server.send(200, "text/html", SendHTML());
}

void handle_waterPump_On() {
  webBTN_STATE = true;
  Serial.println("Water Pump: ON");
  server.send(200, "text/html", SendHTML());
}
void handle_waterPump_Off() {
  webBTN_STATE = false;
  Serial.println("Water Pump: OFF");
  server.send(200, "text/html", SendHTML());
}

void handle_NotFound(){
```

Figure 5.1: Main function

Those figures above are the main functions of this project, which contain a soil sensor, a water pump, and a DHT22 sensor to monitor and control the irrigation process. The code establishes a Wi-Fi connection and the soil moisture level.

5.3 Interfaces of System Main Functions

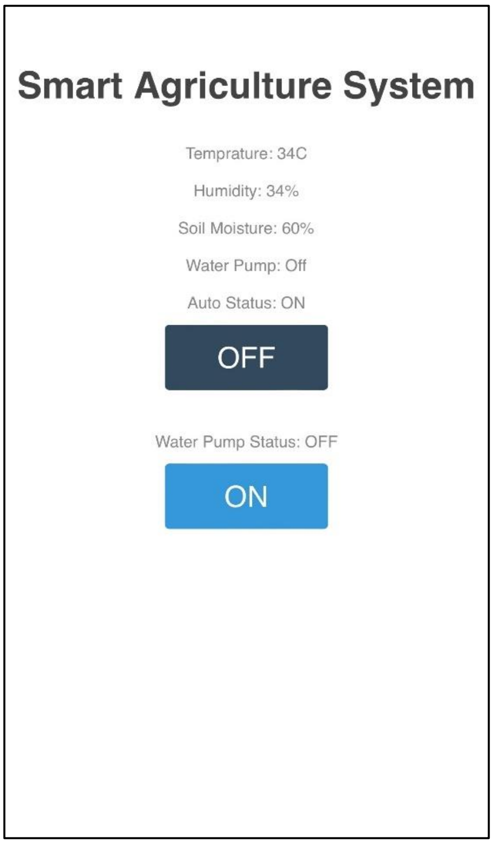

Figure 5.2: Interfaces of the system

Through these interfaces, the system's central components may communicate with one another, ultimately producing a comprehensive smart agricultural irrigation system. Sensor interfaces gather data for monitoring, while the Wi-Fi interface enables remote access. The web server interface talks to users using the hypertext markup language (HTML) web interface. The irrigation process can't be managed effectively without both the water pump interface and the auto mode interface. Automatic irrigation is carried out in response to soil moisture levels. Together, these many user interfaces provide for a smart agricultural system that is easy to implement and maintain.

5.4 Project IoT Design

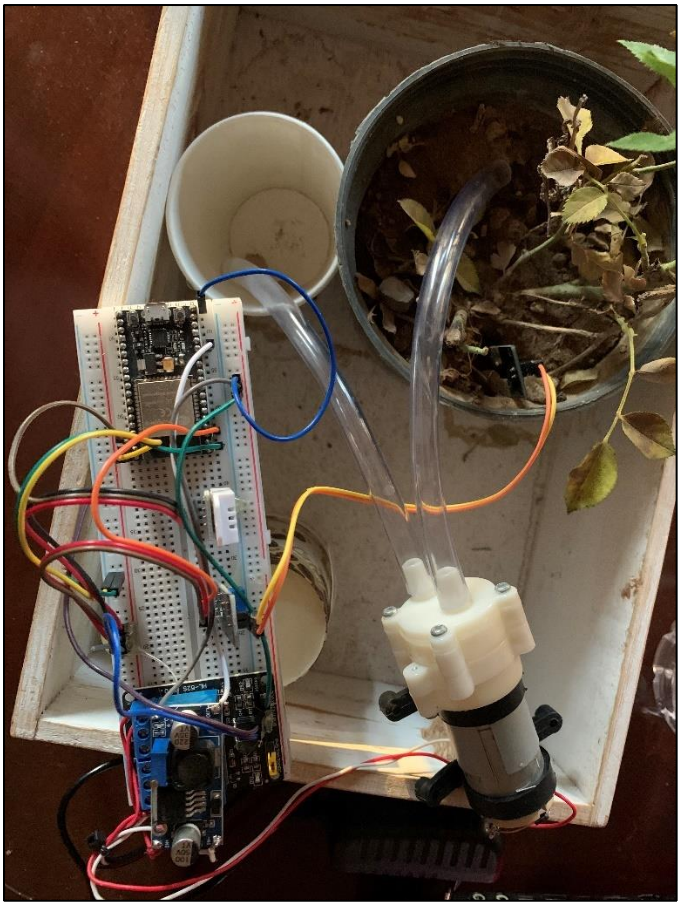

Figure 5.3: IoT design

A soil sensor, DHT22 sensor, water pump, and ESP32 microcontroller make up this smart agriculture system. A breadboard connects these components to build a system. The ESP32 processes sensor data and controls the water pump depending on ambient conditions as the central processing unit.

The soil sensor measures soil moisture and provides valuable information about the soil's hydration state. The DHT22 sensor, on the other hand, can measure both the air temperature and humidity. Both sensors are crucial for keeping an eye on the factors that have a direct bearing on crop development and watering requirements.

The irrigation process is controlled by the water pump, another crucial component. The ESP32 determines when and how much water plants need based on readings from the soil sensor and the DHT22 sensor. The system will automatically turn on the water pump to irrigate the plants if the soil moisture level is low and the temperature is high. The plants will flourish to their full potential with the help of this automated system, which will also significantly cut down on water waste.

This smart agriculture system provides an easy and effective method of automatic watering by assembling these parts on a breadboard and using the ESP32 microcontroller for data processing and control. To maximize agricultural output and efficiency, the system includes a web server that allows farmers and producers to remotely monitor and control the irrigation operation.

5.5 Chapter Summary

This chapter discusses the implementation of the system as well as its enhancement, including an illustration of the project's primary function codes, the interface for the project, and the IoT design for the project.

CHAPTER 6

CONCLUSION

6.1 Introduction

This chapter will discuss the result and achievement of the smart agriculture system and the future improvement of the system.

6.2 Achievement of Project Objectives

The smart agriculture system has made a lot of progress because it has kept going after its goals. At first, the group found out about the situation by talking to farmers and other potential clients. Because of this, must-have features were picked out and moved up in the development schedule. The system's goals were very clear because there was a lot of written information about both functional and non-functional factors. During the planning stage, a flexible and modular structure was made so that it would be easy to add more sensors and other parts. Thanks to a great data management strategy and an easy-to-use interface, farmers can now access and understand data much more easily. Also, strong contact networks made sure that information kept flowing. The last round of testing was thorough and looked at how the system worked and how well it worked in different scenarios. During user approval testing, users gave feedback to make sure the product met their needs. A careful look at the system's safety and dependability led to a design that is strong and reliable. So, the smart agriculture system has become a powerful tool that gives farmers data-driven ideas that help them grow more crops, use their resources more efficiently, and farm in a way that is better for the environment.

6.3 Suggestions for Future Improvement

Future iterations of the smart agriculture system will likely include cutting-edge hardware and AI to enhance data collection and analysis. Farmers will be able to manage the system from anywhere thanks to enhanced online monitoring and management tools. Reduce your environmental impact and lower your utility bills by prioritizing energy efficiency and sustainable practices. Systems will be able to exchange data more efficiently and reliably with the help of interoperability and standards. Adoption fails without thorough user training and support. As long as the technique has room to develop and adapt, it will remain relevant and applicable. By prioritizing data security and privacy, sensitive information may be protected. Motivating individuals to collaborate and exchange knowledge may spark innovation. If the strategy is low-cost and simple to use, more small farmers will adopt it and spread the word about it.

6.4 Chapter Summary

This chapter is about the achievements of this project and the suggestions for future improvement.

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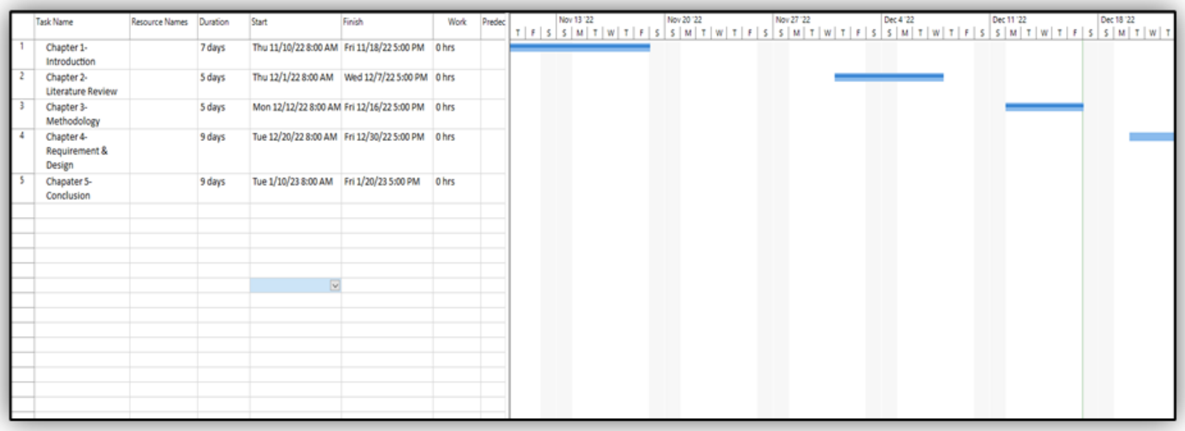
Appendix 1

Gantt Chart



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2	Chapter 2- Literature Review		5 days	Thu 12/1/22 8:00 AM	Wed 12/7/22 5:00 PM	0 hrs	
3	Chapter 3- Methodology		5 days	Mon 12/12/22 8:00 AM	Fri 12/16/22 5:00 PM	0 hrs	
4	Chapter 4- Requirement & Design		9 days	Tue 12/20/22 8:00 AM	Fri 12/30/22 5:00 PM	0 hrs	
5	Chapater 5- Conclusion		9 days	Tue 1/10/23 8:00 AM	Fri 1/20/23 5:00 PM	0 hrs	

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3