AUTOMATIC IRRIGATION WITH IoT MONITORIZING SOIL MOISTURE

Minor project-1 report submitted
in partial fulfillment of the requirement for award of the degree of

Bachelor of Technology
in
Computer Science & Engineering

By

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VEL TECH RANGARAJAN DR. SAGUNTHALA R&D INSTITUTE OF SCIENCE & TECHNOLOGY

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Accredited by NAAC with A++ Grade
CHENNAI 600 062, TAMILNADU, INDIA

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CERTIFICATE

It is certified that the work contained in the project report titled “AUTOMATIC IRRIGATION WITH IOT MONITORIZING SOIL MOISTURE” by BHUVANESWARI S (21UECS0090), G RUPESH (21UECB0007), YAZHINI G (21UECM0265) has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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DECLARATION

We declare that this written submission represents our ideas in own words and where other's ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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APPROVAL SHEET

This project report entitled "AUTOMATIC IRRIGATION WITH IOT MONITORIZING SOIL MOISTURE" by BHUVANESWARI S (21UECS0090), G RUPESH (21UECB0007), YAZHINI G (21UECM0265) is approved for the degree of B.Tech in Computer Science & Engineering.

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ACKNOWLEDGEMENT

We express our deepest gratitude to our respected **Founder Chancellor and President Col. Prof. Dr. R. RANGARAJAN B.E. (EEE), B.E. (MECH), M.S (AUTO),D.Sc., Foundress President Dr. R. SAGUNTHALA RANGARAJAN M.B.B.S.** Chairperson Managing Trustee and Vice President.

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ABSTRACT

The growing demand for efficient and sustainable agricultural practices has led to the integration of Internet of Things (IoT) technologies in agriculture. This study focuses on the development and implementation of an automatic irrigation system empowered by IoT for real-time soil moisture monitoring. The aim is to enhance water resource management in agriculture, optimize irrigation processes, and ultimately improve crop yield. The proposed system consists of wireless soil moisture sensors deployed across the agricultural field, continuously measuring the moisture content of the soil. These sensors communicate with a central IoT gateway, which processes the data and sends it to a cloud-based platform for storage and analysis. Farmers can access this platform through a user-friendly interface, allowing them to monitor soil moisture levels remotely. This Project is about Cultivation, water consumption-vacation, automated irrigation, remote monitoring, and control by incorporating IoT technology. The existing system, where has some drawbacks like inefficient water storage, labor intensive, reduced crop yielding, and lack of automation in the system. So, by introducing a new method of smart irrigation system that addresses the limitations of existing systems by utilizing IoT technology and soil moisture sensors to optimize irrigation practices. To monitor and control moisture content of soil the materials used are soil moisture sensors, data transmission, decision-making algorithms, automated actuation, and remote access to control the irrigation process. By using these technologies, efficiently store water, increase crop yield, reduce cost, environmental sustainability and data-driven insights. The existing system, which has some drawbacks like inefficient water storage, labor intensive, reduced crop yielding, and lack of automation in the system. So, by introducing a new method of smart irrigation system that addresses the limitations of existing systems by utilizing IoT technology and soil moisture sensors to optimize irrigation practices.

Keywords:

Remote monitoring, Soil moisturing sensing, Smart irrigation, IoT technology, Environmental sustainability .

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LIST OF ACRONYMS AND ABBREVIATIONS

API	Application Program Interface
CSS	Cascading Style Sheets
DHT	DiHydroTestosterone
GSM	Global System for Mobile Communications
HTML	Hyper Text Markup Language
HTTP	Hypertext Transfer Protocol
IDE	Integrated Development Environment
IoT	Internet of Things
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MQTT	Message Queing Telemetry Transport
ROI	Return On Investment
SSS	Soil Science Society
TDR	Time-Domain Reflectometry
WSN	Wireless Sensor Network

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Chapter 1

INTRODUCTION

1.1 Introduction

Agriculture is the strength of Indian Economy. However, for agriculture water consumption is more than rainfall every year. Improving farm yield is essential to meet the rapidly growing demand of food for population growth across the world. By considering and predicting environmental circumstances, farm yield can be increased. Crop quality is based on data collected from field such as soil moisture, ambient temperature and humidity etc. Advanced tools and technology can be used to increase farm production. Developing IoT technologies can help to collect large amount of environmental and crop recital data. IoT encompasses many new intelligent concepts for using in the near future such as smart home, smart city, smart transportation, and smart farming. The technique can be used for application of accurate amount of fertilizer, water, pesticide etc. to enhance productivity and excellence. Sensors are hopeful device for smart agriculture. The real time environmental parameters like soil moisture level, temperature and tank water level have continuous influence on the crop lifecycle. By forming sensor network, good monitoring of water regulation in the agriculture field can be achieved.

This presents irrigation monitoring and controlling system. The system was developed to monitor the environmental conditions such as temperature, soil moisture content, humidity of the air and water level of agriculture land for controlling the irrigation. Agriculture also has a major impact on economy of their selves. The consumption of water increases day by day that may leads to the problem of water scarcity. The soil health was damaged by using chemical pesticides and also they want more money to buy the pesticides. Farmers need the more human power to remove the unnecessary plants was surviving between cultivated plants. They have lack of technology using instead of human power. The real time conditions sensed data is send to the cloud server for storing and decision making and controlling actions for future. Based on the real-time data, the system employs intelligent algorithms to determine the optimal irrigation schedule for each specific crop and soil condition.

By automating the irrigation process, water usage is optimized, preventing over-irrigation and minimizing water wastage. This not only conserves water resources but also reduces operational costs for farmers.Additionally, the system incorporates weather data and forecasts, enabling it to adapt irrigation schedules based on upcoming weather conditions. This dynamic adjustment ensures that crops receive the appropriate amount of water, taking into account natural precipitation and avoiding unnecessary irrigation during periods of rainfall.

The implementation of this IoT-based automatic irrigation system offers several benefits, including increased water efficiency, reduced manual labor, and improved crop productivity. The system provides valuable insights into soil health, allowing farmers to make informed decisions about their irrigation practices. Furthermore, the remote monitoring capabilities contribute to resource conservation and sustainable agriculture, aligning with the broader goals of precision farming and environmental stewardship. The integration of IoT technologies into agriculture, particularly in the domain of automatic irrigation with soil moisture monitoring, represents a significant step towards achieving sustainable and efficient farming practices. This research contributes to the ongoing efforts to address the challenges of water scarcity and optimize resource utilization in modern agriculture.

The benefits of this Automatic Irrigation System extend beyond water conservation. The integration of IoT enables the system to provide early warnings for potential issues such as waterlogging or drought conditions, allowing farmers to proactively address challenges and mitigate crop damage. Additionally, the system promotes sustainability by minimizing environmental impact through precise water management. The implementation of an Automatic Irrigation System with IoT-based soil moisture monitoring represents a significant advancement in modern agriculture. By harnessing the power of real-time data and intelligent algorithms, this system empowers farmers to make informed decisions, improve resource efficiency, and contribute to sustainable farming practices.

1.2 Aim of the Project

The Automatic Irrigation With IoT Monitorizing Soil Moisture project is to develop an innovative and efficient irrigation system that utilizes IoT technology and soil moisture sensors to optimize the irrigation process.

1.3 Project Domain

The project on “Automatic Irrigation with IoT Monitoring Soil Moisture” primarily falls within the domain of Precision Agriculture, a field that leverages advanced technologies to optimize various aspects of farming practices. Within Precision Agriculture, the project specifically focuses on the integration of Internet of Things (IoT) technology for real-time monitoring of soil moisture levels and the automatic control of irrigation systems.Precision Agriculture involves the use of technology to enhance the efficiency and effectiveness of agricultural practices. The project contributes to precision agriculture by providing a data-driven approach to irrigation, ensuring that water resources are used optimally based on real-time soil moisture data.

1.4 Scope of the Project

The project’s scope involves the development of a comprehensive and scalable smart irrigation solution that addresses the challenges of conventional irrigation systems. By focusing on water conservation, improved crop yield, and ease of use, the project aims to contribute to sustainable agriculture and environmental preservation. Develop the architecture of the automatic irrigation system, outlining the components, their interconnections, and the flow of data. Specify the types of soil moisture sensors to be used and their optimal placement in the agricultural field

Chapter 2

LITERATURE REVIEW

Nazma Tara ,etal.,(2014),"A Systematic Literature Review on IoT-based Irrigation",In this paper the objective is to abstract and accumulate the works regarding IoT-based irrigation. Based on the work, the issues regarding IoT-basedirrigation, sensors, related technologies, wireless communicationprotocols, IoT platforms, and cloud computing will be analyzed toget a clear view and understand its future scope.[1]

B.V.Ashwini,(2016),"A Study on Smart Irrigation System Using IoT for Surveillance of Crop-Field", This paper is aiming to overcome this challenge, the whole system is micro control based and can be operated from remote location through wireless transmission so there is no need to concern about irrigation timing as per crop or soil condition.We know agriculture is the crucial occupation for the rural people and about 70depends upon agriculture sector for their livelihood. The major challenge faced due to urbanization in agriculture sector are rise in environmental pollution, climate change, degradation of soil and water quality.[2]

M.Priyanka ,etal.,(2018),"IOT Based Smart Irrigation System",This paper is IoT-based smart irrigation system is a significant improvement over traditional irrigation systems, providing a sustainable and efficient solution for agriculture. the system's scalability, energy-efficiency, and customizability make it a viable option for farmers looking to adopt new technology to improve their irrigation systems. first, it reduces water wastage and conserves water resources by only irrigating when needed[3]

Sameer Saurav ,etal.,(2018),"A review on Internet of Things (IOT) based Smart Irrigation System" This project is on crop production at low water usage, in order to concentrate on the water available to plants at the appropriate time, farmers have to spend time in the field to check appropriate time for irrigation. Effective water control should be established and the size of the device circuits minimized.[4]

Ms.S.Shobana ,etal.,(2019),“Smart Irrigation System”, This paper is to monitor the soil moisture content during its dry and wet conditions with the aid of a moisture sensor ,an automated water inlet setup which can also monitor and record temperature, humidity etc. It controls the irrigation of Plants automatically where the need for human intervention can be reduced.As water supply is becoming scarce in today’s world there is an urgency of adopting smart ways of irrigation The project describes how irrigation can be handled smartly using IOT.[5]

Abhilash Lad ,etal.,(2020),“A Literature Survey on Smart Agriculture Monitoring and Control System Using IOT”, This paper is to restore vitality and put agriculture back on a path of higher growth, there is a growing need to resolve the issue. A large-scale agricultural system necessitates a great deal of upkeep, knowledge, and oversight. The IoT is a network of interconnected devices that can transmit and receive data over the internet and carry out tasks without human involvement. Agriculture provides a wealth of data analysis parameters, resulting in increased crop yields. The use of IoT devices in smart farming aids in the modernization of information and communication.[6]

Hadhi Jabar ,etal.,(2020),“An overview of smart irrigation systems using IoT”,This paper is based on qualitative design along with focusing on secondary data collection method. Automated irrigation systems are essential for conservation of water, this improvement could have a vital role in minimizing water usage. Agriculture and farming techniques is also linked with IoT and automation, to make the whole processes much more effective and efficient. Sensory systems helped farmers better understand their crops and reduced the environmental impacts and conserve resources.[7]

Sudhir Yadav ,etal.,(2022),“Smart Agriculture System using IoT”,This paper is e IOT based sensor technology we can monitor the soil efficiency, humidity monitoring, fertilizer effectiveness, storehouse monitoring remotely, and so on. The combination of internet of things (IOT) and wireless sensor networks (WSN) will help in advancement in agriculture at a lesser cost. The IOT based sensors are based on Humidity sensorsMoisture sensors will lead to smart agriculture applications.[8]

Chapter 3

PROJECT DESCRIPTION

3.1 Existing System

The existing systems for automatic irrigation with IoT monitoring of soil moisture have made significant advancements, but there are still some challenges and disadvantages. Keep in mind that technology evolves rapidly, so there might be additional developments since then. Here are some common aspects of the existing systems and their associated disadvantages Traditional irrigation methods often lack precision, leading to over-irrigation or under-irrigation. Many conventional systems rely on manual intervention, making them less efficient and responsive to changing soil moisture conditions.

3.2 Proposed System

A proposed system for automatic irrigation with IoT monitoring of soil moisture aims to address the limitations of existing systems and introduce innovative features to enhance efficiency, accuracy, and user-friendliness. Implement high-precision and reliable soil moisture sensors, possibly combining multiple sensor types (capacitance-based, resistive, TDR) for improved accuracy. Design a robust and energy-efficient wireless sensor network for seamless communication between sensors and the central control system. Employ secure and scalable IoT protocols for data transmission between sensors and cloud-based platforms.

3.3 Feasibility Study

3.3.1 Economic Feasibility

Conduct a comprehensive cost-benefit analysis to determine the financial feasibility of the project. Consider initial setup costs, ongoing maintenance expenses, and potential savings in water usage and increased crop yield.Calculate the expected ROI over time to assess whether the benefits outweigh the initial and ongoing costs

3.3.2 Technical Feasibility

The availability and reliability of advanced soil moisture sensors. Ensure that the chosen sensor technology is suitable for the specific agricultural environment and provides accurate readings. Assess the technical feasibility of establishing a robust and secure IoT infrastructure for real-time communication between sensors and the central control system.

3.3.3 Social Feasibility

Evaluate the potential for water conservation and the environmental impact of implementing automatic irrigation.One of the most important factors for plant growth is soil moisture. In order to ensure optimum irrigation scheduling, high spatiotemporal monitoring of soil moisture content is needed. Using a Arduino prototyping board, several IoT-based soil moisture monitoring systems for irrigation management have been created. This is linked to numerous sensors to track real-time soil moisture fluxes for irrigation decision-making and scheduling. Consider the sustainability of the proposed system in terms of energy consumption and its overall contribution to eco-friendly farming practices.

3.4 System Specification

3.4.1 Hardware Specification

- **Arduino UNO**
  The Arduino Uno can play a central role as the microcontroller responsible for gathering data from soil moisture sensors, making decisions based on that data, and controlling the irrigation system.
- **Soil Moisture Sensor**
  A soil moisture sensor is a device designed to measure the water content in the soil. It provides valuable information for various applications, including agriculture, horticulture, environmental monitoring, and smart irrigation systems.
- **Relay module**
  A relay module plays a crucial role in Automatic Irrigation with IoT Monitoring of Soil Moisture by facilitating the control of high-power devices, such as water pumps or solenoid valves, based on the soil moisture data and decisions made by the microcontroller.
- **Mini submersible pump and Water Tank**
  In an Automatic Irrigation System with IoT Monitoring of Soil Moisture, the integration of a mini submersible pump and a water tank is a common configuration.

3.4.2 Software Specification

- **Microcontroller Programming:**
  The microcontroller (e.g., Arduino Uno) is typically programmed using C or C++. The Arduino IDE (Integrated Development Environment) is commonly used for writing, compiling, and uploading code to the microcontroller.

- **IoT Platform Integration:**

  Communication Protocols:

  The system needs to communicate with an IoT platform or cloud service. MQTT (Message Queuing Telemetry Transport) or HTTP (Hypertext Transfer Protocol) are common protocols for IoT communication.

  APIs:

  Integration with APIs (Application Programming Interfaces) of IoT platforms for data transmission and retrieval.

- **Cloud-Based Data Storage and Processing:**

  Database:

  Use a database for storing historical data related to soil moisture, irrigation events, and system status. Common databases include MySQL, MongoDB, or cloud-based solutions like AWS DynamoDB or Firebase Realtime Database.

  Server-Side Scripting:

  Server-side scripting (e.g., Node.js, Python, PHP) for processing and managing data on the cloud server.

- **Web or Mobile Application:**

  Frontend Development:

  Web or mobile applications for user interface design and interaction. HTML, CSS, and JavaScript are common for web development, while languages like Swift (iOS) or Kotlin/Java (Android) are used for mobile app development.

  Real-Time Updates:

  Implement real-time updates to display current soil moisture levels, irrigation events, and system status.

  User Authentication:

  Secure user authentication mechanisms to control access to the application.

Chapter 4

METHODOLOGY

4.1 General Architecture

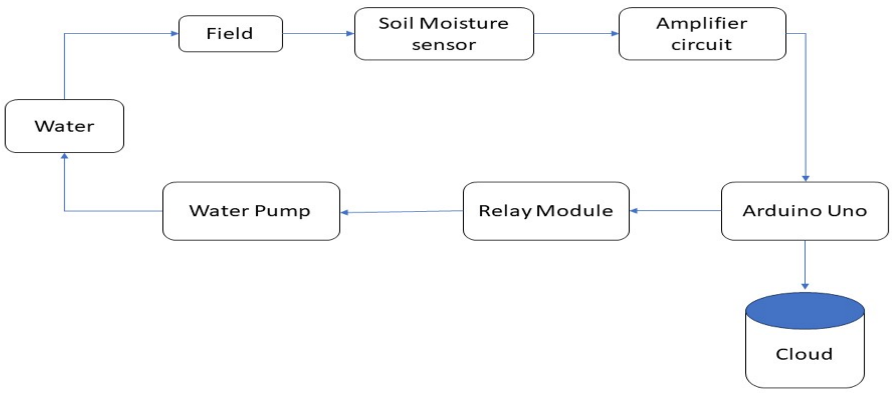

Figure 4.1: **Architecture of Smart Irrigation using IoT**

Design of above IoT technology explains temperature, humidity and soil moisture values using flow chart.With the help of the sensors information the system came to know values of soil moisture, temperature and humidity. In these smart irrigation system low cost soil moisture sensors, temperature sensors, Wi-Fi module is used.The sensor data are stored in database. The web application is meant in such hoe to research the info received and to see with the edge values of moisture and temperature.The decision making is completed at server to automate irrigation.If soil moisture is a smaller amount than the edge value the motor is switched ON and if the soil moisture exceeds the edge value the motor gets turned ON.It proposes low cost and wireless sensors to accumulate the soil moisture and temperature from farm locations. Information's the water level is monitored and notified when there is a fall in water level of the water source.

4.2 Design Phase

4.2.1 Data Flow Diagram

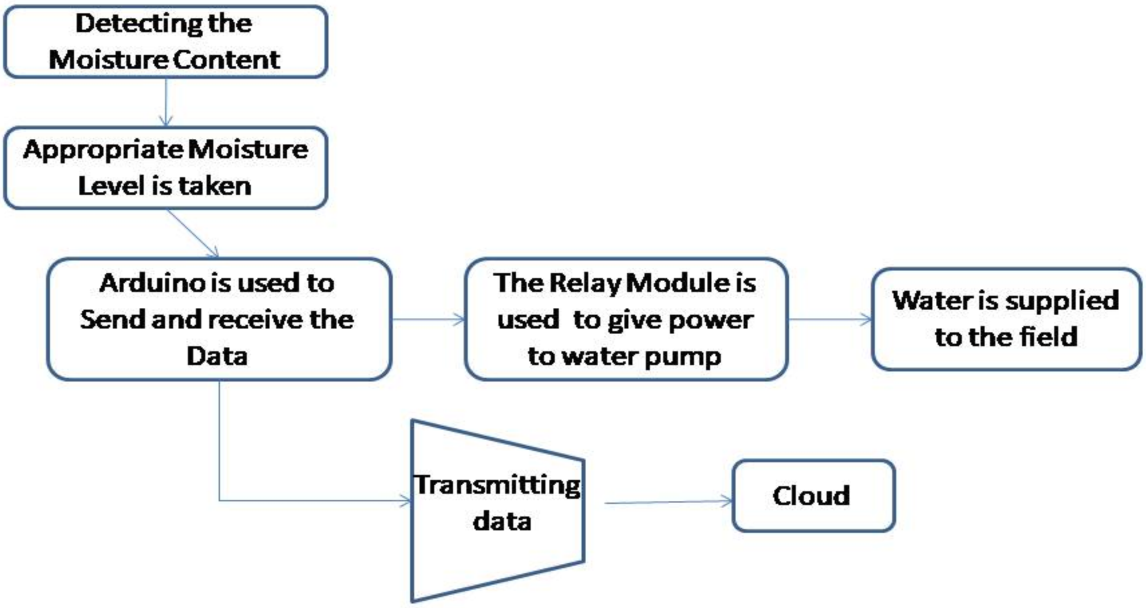

Figure 4.2: **Data Flow Diagram of Smart Irrigation System using IoT**

The data flow diagram, sensors (soil moisture, humidity, temperature) initiate the process by detecting environmental conditions. The sensed data flows to a control unit, where decisions are made based on predefined thresholds.Simultaneously, relevant data is transmitted to the user device, providing real-time updates on soil moisture, humidity, and temperature. The user device serves as an interface, displaying these values to the user and enabling manual intervention if needed. Additionally, feedback from the user device can influence the system, allowing users to remotely control and monitor the irrigation process. This holistic flow ensures efficient, automated irrigation while keeping users informed and engaged.

4.2.2 Use Case Diagram

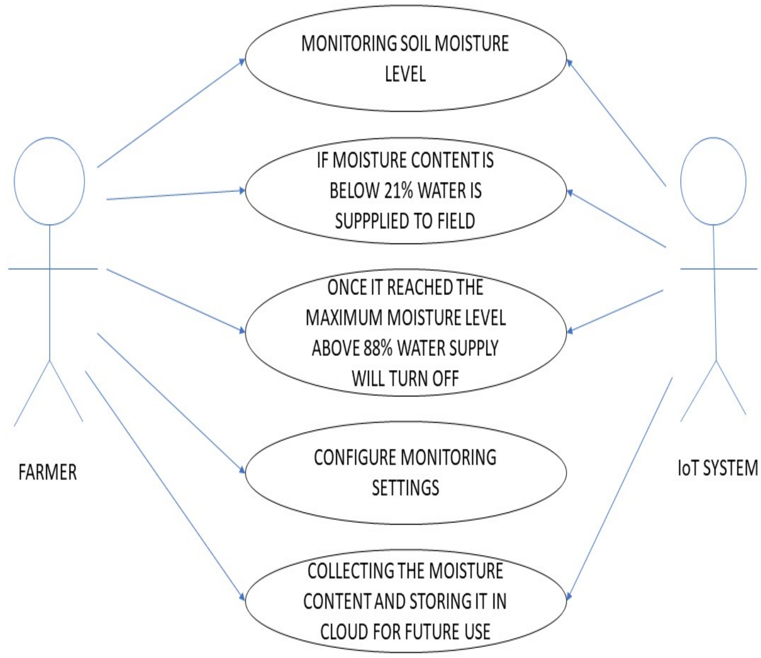

Figure 4.3: **Use Case Diagram of Smart Irrigation System using IoT**

The User interacts with the ”User Device” for monitoring and control. Sensors collect soil moisture, humidity, and temperature data, influencing irrigation decisions.The soil moisture levels in their fields or gardens through sensors connected to the smart irrigation system. Cloud is used to store and manage data, including user profiles, irrigation schedules, sensor readings, and historical information. This diagram succinctly portrays the system’s core functionalities, ensuring efficient irrigation management through real-time data monitoring and user interface feedback.The system provides the output as a binary classification result that indicates the level of danger in each area of the target region. The user can then use the output to make informed decisions about the safety of the target region. The use case diagram highlights the interaction between the user and the system and the system’s ability to provide valuable information to the user.

4.2.3 Class Diagram

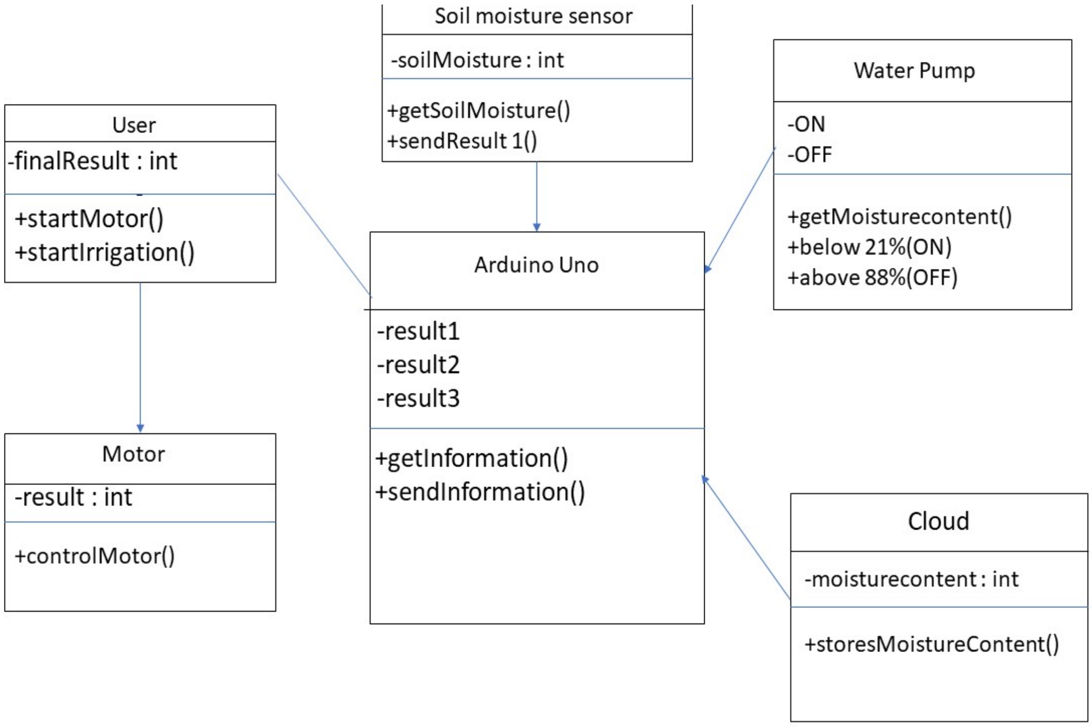

Figure 4.4: **Class Diagram of Smart Irrigation System using IoT**

The above Class Diagram is on automatic smart irrifgation using Iot . Arduino Droid software to develop the code for Arduino UNO which takes the information from the moisture sensor and transmit to the pump to Relay module. Arduino take the moisture content from soil through soil moisture sensor and send the data to Arduino UNO. Installed a software Arduino Droid ,to write and execute the code written . Through that code Arduino UNO takes decision and pass information information to Relay module (to switch ON or OFF the pump). If moisture content is low , switch ON the waterpump which serve the water to crops. If moisture content is high , switch OFF the waterpump. To make decision codes are used in software and runs automatically. The datas are stored in cloud for future use and datas contain moisture content of soil which is detected from soil moisture sensor and sent through arduino.

4.2.4 Sequence Diagram

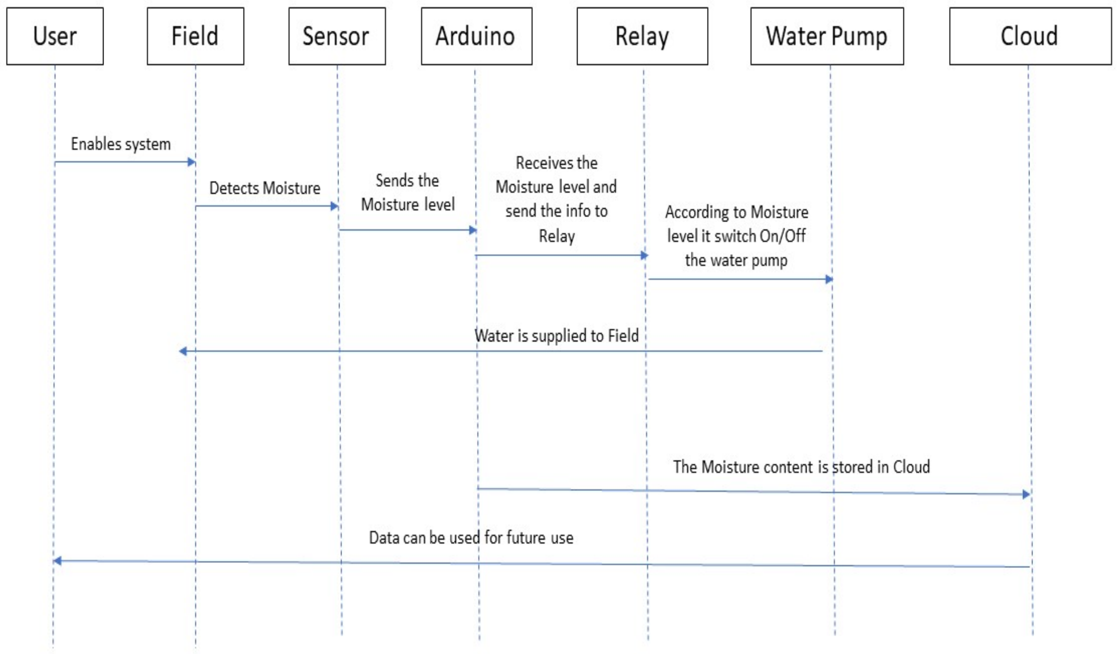

Figure 4.5: **Sequence Diagram of Smart Irrigation System using IoT**

Select soil moisture, humidity, and temperature sensors. Connect them to a microcontroller like Arduino. Write code to read sensor data and program automatic control logic based on thresholds. Integrate actuators to control devices (e.g., irrigation) accordingly. Establish communication (Bluetooth or Wi-Fi) between the microcontroller and a user device. Develop a simple user interface to display real-time values. Test the system in various conditions, calibrate sensors if needed, and optimize power consumption. Document the system design and code for future reference. This concise sequence enables efficient soil monitoring, automated control, and user-friendly data display on a connected device.The proposed work employs the drip irrigation method, which is thought to be more beneficial and is more often used for plant cultivation.

4.2.5 Activity Diagram

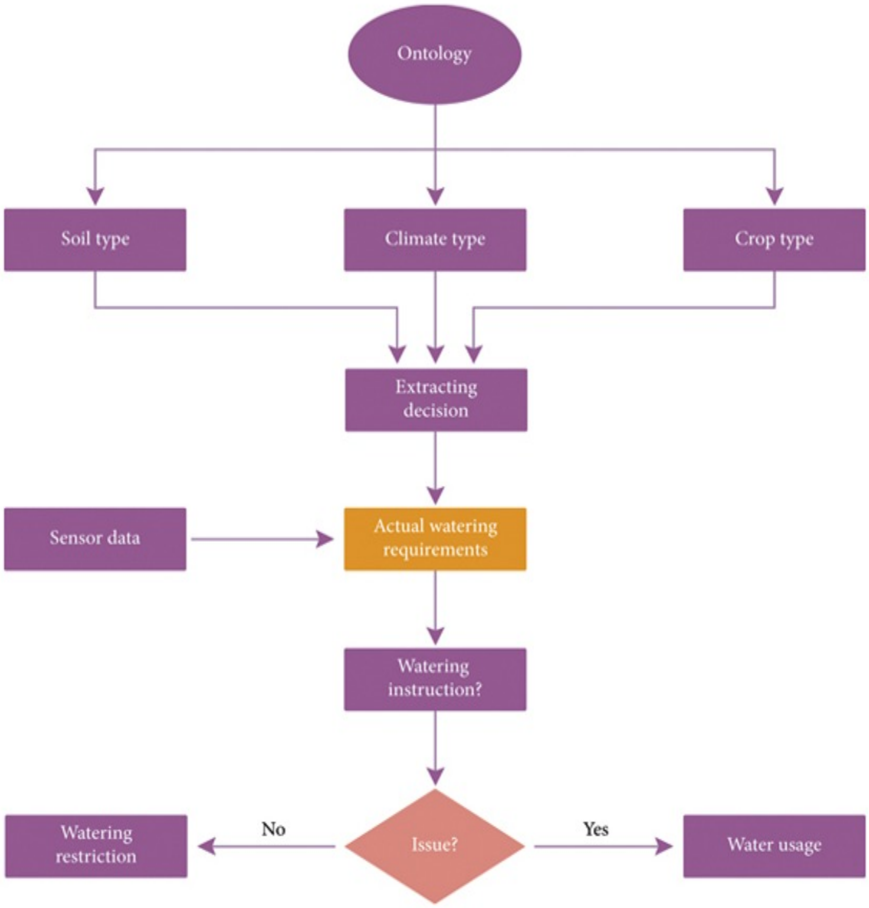

Figure 4.6: **Activity Diagram of Smart Irrigation System using IoT**

Smart irrigation System Architecture presents the overall system architecture of our proposed work, as shown in above figure the sensors such as soil moisture sensors, temperature sensors, leaf wetness sensors deployed in agriculture field, the sensed data from sensors will be compared with pre-determined threshold values of various soil and specific crops. The deployed sensors data are fed to the Arduino Uno processor which is linked to the data centre wirelessly via GSM module.The user interface in smart phone allows remote user to control irrigation system by switching, on and off, the motor pump by the Arduino based on the commands from the Android smart phone.

4.3 Algorithm & Pseudo Code

4.3.1 Algorithm

Step 1: Initialize Parameters: Set the threshold value for soil moisture, above which irrigation is not needed. Set the irrigation duration for how long the system should water the plants. Set the interval for checking soil moisture and weather forecast.

Step 2: Main Loop: Enter an infinite loop to continuously monitor and control the irrigation system.

Step 3: Read Sensors: Read the soil moisture sensor to get the current soil moisture level.Fetch the weather forecast for the day.

Step 4: Check Soil Moisture: If the current soil moisture level is below the threshold, proceed to the next step. Otherwise, skip irrigation.

Step 5: Check Weather Forecast: If the weather forecast indicates dry conditions (e.g., no rain expected), proceed to the next step. Otherwise, skip irrigation.

Step 6: Initiate Irrigation: Open the irrigation valve to start watering the plants. Set a timer for the irrigation duration.

Step 7: Wait for Irrigation to Finish: Wait for the specified irrigation duration.

Step 8: Stop Irrigation: Close the irrigation valve to stop watering.

Step 9: Repeat: Wait for the specified interval before starting the next cycle of sensor reading and decision-making.

Step 10: End of Loop: The loop continues indefinitely, ensuring continuous monitoring and efficient irrigation.

4.3.2 Pseudo Code

```
#include <DHT.h>

#include <ESP8266WiFi.h>

String apiKey = "X5AQ3EGIKMBYW31H";

const char* server = "api.thingspeak.com";

const char *ssid = "CircuitLoop";

const char *pass = "circuitdigest101";

#define DHTPIN D3

DHT dht(DHTPIN, DHT11);

WiFiClient client;


const int moisturePin = A0;
const int motorPin = D0;

unsigned long interval = 10000;

unsigned long previousMillis = 0;

unsigned long interval1 = 1000;

unsigned long previousMillis1 = 0;

float moisturePercentage;

float h;
float t;

void setup()

{

  Serial.begin(115200);

  delay(10);

  pinMode(motorPin, OUTPUT);

  digitalWrite(motorPin, LOW);

  dht.begin();
```

```
  Serial.println("Connecting to ");

  Serial.println(ssid);

  WiFi.begin(ssid, pass);

  while (WiFi.status() != WL_CONNECTED)

  {

    delay(500);

    Serial.print(".");

  }

  Serial.println("");

  Serial.println("WiFi connected");

}


void loop()

{

  unsigned long currentMillis = millis();


  h = dht.readHumidity();

  t = dht.readTemperature();


  if (isnan(h) || isnan(t))

  {

    Serial.println("Failed to read from DHT sensor!");

    return;

  }


  moisturePercentage = ( 100.00 - ( (analogRead(moisturePin) / 1023.00) * 100.00 ) );
```

```
  if ((unsigned long)(currentMillis - previousMillis1) >= interval1) {

    Serial.print("Soil Moisture is  = ");

    Serial.print(moisturePercentage);

    Serial.println("");

    previousMillis1 = millis();

  }


if (moisturePercentage < 50) {

  digitalWrite(motorPin, HIGH);

}

if (moisturePercentage > 50 && moisturePercentage < 55) {

  digitalWrite(motorPin, HIGH);
}

if (moisturePercentage > 56) {

  digitalWrite(motorPin, LOW);

}



if ((unsigned long)(currentMillis - previousMillis) >= interval) {

  sendThingspeak();

  previousMillis = millis();

  client.stop();

}

}

void sendThingspeak() {

  if (client.connect(server, 80))

  {

```

```
    String postStr = apiKey;
    postStr += "&field1=";

    postStr += String(moisturePercentage);
    postStr += "&field2=";

    postStr += String(t);
    postStr += "&field3=";

    postStr += String(h);

    postStr += "\r\n\r\n";

    client.print("POST /update HTTP/1.1\n");

    client.print("Host: api.thingspeak.com\n");

    client.print("Connection: close\n");

    client.print("X-THINGSPEAKAPIKEY: " + apiKey + "\n");

    client.print("Content-Type: application/x-www-form-urlencoded\n");

    client.print("Content-Length: ");

    client.print(postStr.length());

    client.print("\n\n");

    client.print(postStr);

    Serial.print("Moisture Percentage: ");

    Serial.print(moisturePercentage);

    Serial.print(". Temperature: ";

    Serial.print(t);

    Serial.print(" C, Humidity: ");

    Serial.print(h);

    Serial.println(" Sent to Thingspeak";
}
}
```

4.4 Module Description

4.4.1 Soil Moisture Sensor

The Soil Moisture Sensor utilizes capacitive or resistive technology to measure the volumetric content of water in the soil. Provides accurate data on soil moisture levels, enabling the irrigation system to determine when irrigation is needed.

4.4.2 Temperature and Humidity Sensor

The Temperature and Humidity Sensor, such as the DHT series (e.g., DHT11, DHT22), measures the ambient temperature and humidity in the environment. Supplies information on environmental conditions, allowing the irrigation system to consider temperature and humidity in irrigation decisions.

4.4.3 Control and Display Module

The Microcontroller acts as the central processing unit, while the Relay Module serves as an electromechanical switch for controlling the irrigation system. The User Interface Module may include an LCD display, LED indicators, or communication modules (Bluetooth, Wi-Fi). Microcontroller: Processes sensor data and implements irrigation logic.Controls the irrigation system by turning the relay on or off based on the microcontroller's instructions.Displays real-time sensor values, system status, and alerts; facilitates user interaction and remote monitoring/control.

4.5 Steps to execute/run/implement the project

Step 1: Clearly define the project goals, including desired features, sensor thresholds, and user interface requirements for the mobile device.
Step 2: Assemble Hardware Components, Soil moisture sensor Temperature and humidity sensor (e.g., DHT series)Microcontroller (Arduino, Raspberry Pi, etc.)

Relay module Communication module (Bluetooth, Wi-Fi) Power supply

Step 3: Connect Hardware Components,Wire the components based on sensor specifications, microcontroller, relay module, and communication module.Ensure proper power supply connections.

Step 4: Write and Upload Firmware (Code) to Microcontroller,

- Develop firmware to read sensor data, implement control logic, and send data to the mobile device.
- Use the appropriate programming environment for your microcontroller (Arduino IDE for Arduino, Python for Raspberry Pi, etc.).
- Implement communication protocols (Bluetooth, Wi-Fi) for mobile device interaction.Upload the firmware to the microcontroller.

Step 5: Develop Mobile Application,

- Create a mobile application compatible with the chosen communication protocol (Bluetooth, Wi-Fi).
- Implement features for receiving sensor data, displaying real-time values, and providing user control options.Use a mobile app development platform or programming language

Step 6: Pair Mobile Device and Microcontroller,

- Set up the communication link between the mobile device and the microcontroller.Implement pairing procedures for Bluetooth or Wi-Fi connections.

Step 8: Test Sensor Readings, Control Logic, and Mobile App,

- Verify that soil moisture, temperature, and humidity sensors provide accurate readings.
- Test the control logic for automatic irrigation based on sensor thresholds.Ensure the mobile app displays real-time values and allows user control.

Chapter 5

IMPLEMENTATION AND TESTING

5.1 Input and Output

5.1.1 Input Design

Tests	Moisture content of soil	Levels of Moisture content in soil
1	51%	Average
2	31%	Low
3	21%	Low
4	79%	High
5	81%	High
6	45%	Average
7	11%	Low
8	34%	Low
9	0%	Low
10	78%	High
11	90%	High
12	23%	Low
13	34%	Low
14	76%	High
15	38%	Low
16	48%	Average
17	89%	High
18	92%	High
19	65%	Average
20	72%	High
21	68%	Average
22	98%	High
23	42%	Average
24	57%	Average
25	87%	Average

Figure 5.1: **Moisture Content Level Of Soil**

5.1.2 Output Design

Tests	Moisture content of soil	Levels of Moisture content in soil	Motor Pump Status
1	51%	Average	OFF
2	31%	Low	ON
3	21%	Low	ON
4	79%	High	OFF
5	81%	High	OFF
6	45%	Average	OFF
7	11%	Low	ON
8	34%	Low	ON
9	0%	Low	ON
10	78%	High	OFF
11	90%	High	OFF
12	23%	Low	ON
13	34%	Low	ON
14	76%	High	OFF
15	38%	Low	ON
16	48%	Average	OFF
17	89%	High	OFF
18	92%	High	OFF
19	65%	Average	OFF
20	72%	High	OFF
21	68%	Average	OFF
22	98%	High	OFF
23	42%	Average	OFF
24	57%	Average	OFF
25	87%	Average	OFF
26			

Figure 5.2: **Motor Status With Respect to Moisture Content**

5.2 Types of Testing

5.2.1 Unit testing

Input

Soil Moisture Sensor	Depth, z (cm)	Distance, x (m)
SMS 1	37.5	15 (25%L)
SMS 2	15.0	30 (50%L)
SMS 3	7.5	45 (75%L)

Figure 5.3: **Unit Test Image of Depth and Distance**

Test result

Sensor Unit Tests, Ensure that each soil moisture sensor provides accurate readings. Mock or simulate sensor data to test how the system responds to different moisture levels. Microcontroller Unit Tests, Test the individual functions of the microcontroller responsible for collecting and processing sensor data. Mock inputs and outputs to simulate different scenarios.

5.2.2 Integration testing

Input

Operational schedule (OS)	Date of irrigation (dd-mm-yy)	Soil moisture Depletion (%)	Volumetric moisture content (%)		Irrigation application efficiency (%)	Distribution uniformity (DUlq)	Water requirement efficiency (%)
			Gate Open	Gate Close			
OS 1	04.09.20	≥40	27.6	34.1	93.0	0.96	100
	20.09.20	≥30	29.6	33.4	92.8	0.92	100
	10.09.20	≥20	31.6	33.2	83.3	0.82	100
OS 2	05.10.20	≥40	27.6	35.0	89.8	0.87	94.1
	22.10.20	≥30	29.6	35.3	84.7	0.84	91.2
	27.10.20	≥20	31.6	34.9	83.3	0.82	89.5
OS 3	20.11.20	≥40	27.6	34.3	81.6	0.78	86.4
	04.11.20	≥30	29.6	35.5	82.3	0.84	89.2
	11.11.20	≥20	31.6	34.3	88.6	0.91	97.1

Figure 5.4: **Integration Test Image on Communication Between Sensor and Microcontroller**

Test result

Sensor Integration Tests, Verify that the communication between sensors and microcontrollers is reliable. Check how the system handles multiple sensors providing data simultaneously. Microcontroller-Communication Module Integration Tests, Ensure that the communication module (e.g., Wi-Fi, Bluetooth) effectively transmits data from the microcontroller to the central monitoring system

5.2.3 System testing

Input

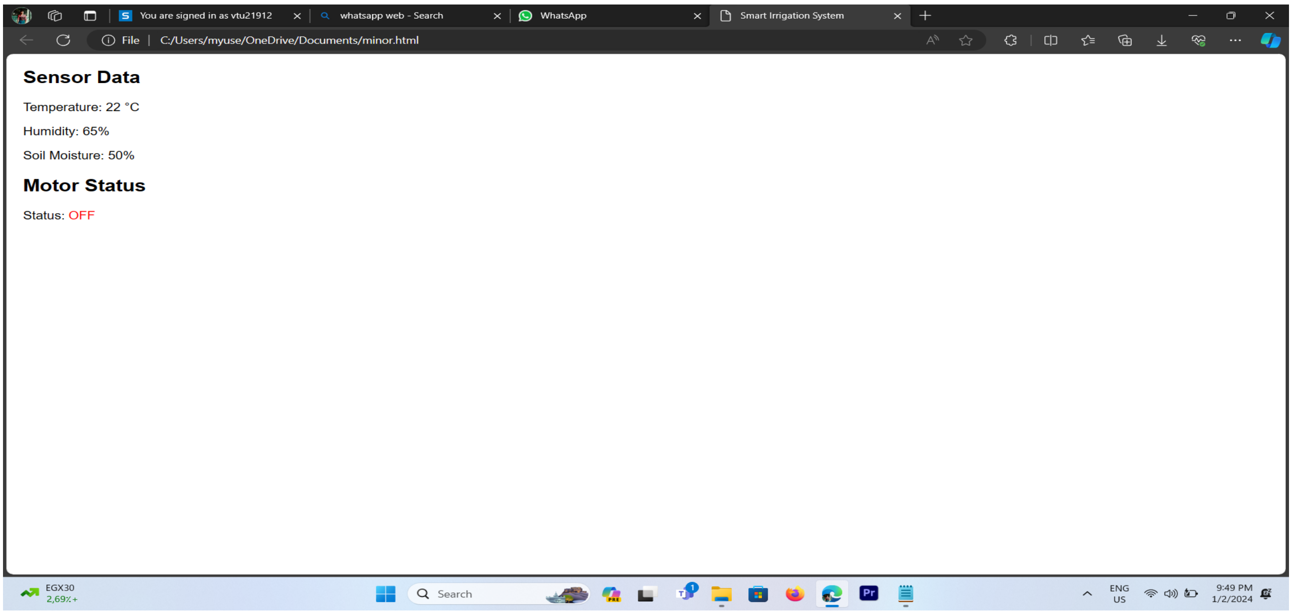

Figure 5.5: **System Test on Moisture Content of Soil**

Test Result

End-to-End Tests, Test the entire system, including multiple sensors, microcontrollers, and communication modules. Validate that the data reaches the central monitoring system accurately. Communication Reliability Tests, Simulate scenarios where network connectivity is poor or temporarily lost. Ensure the system can recover and synchronize data when the connection is restored.

5.2.4 Test Result

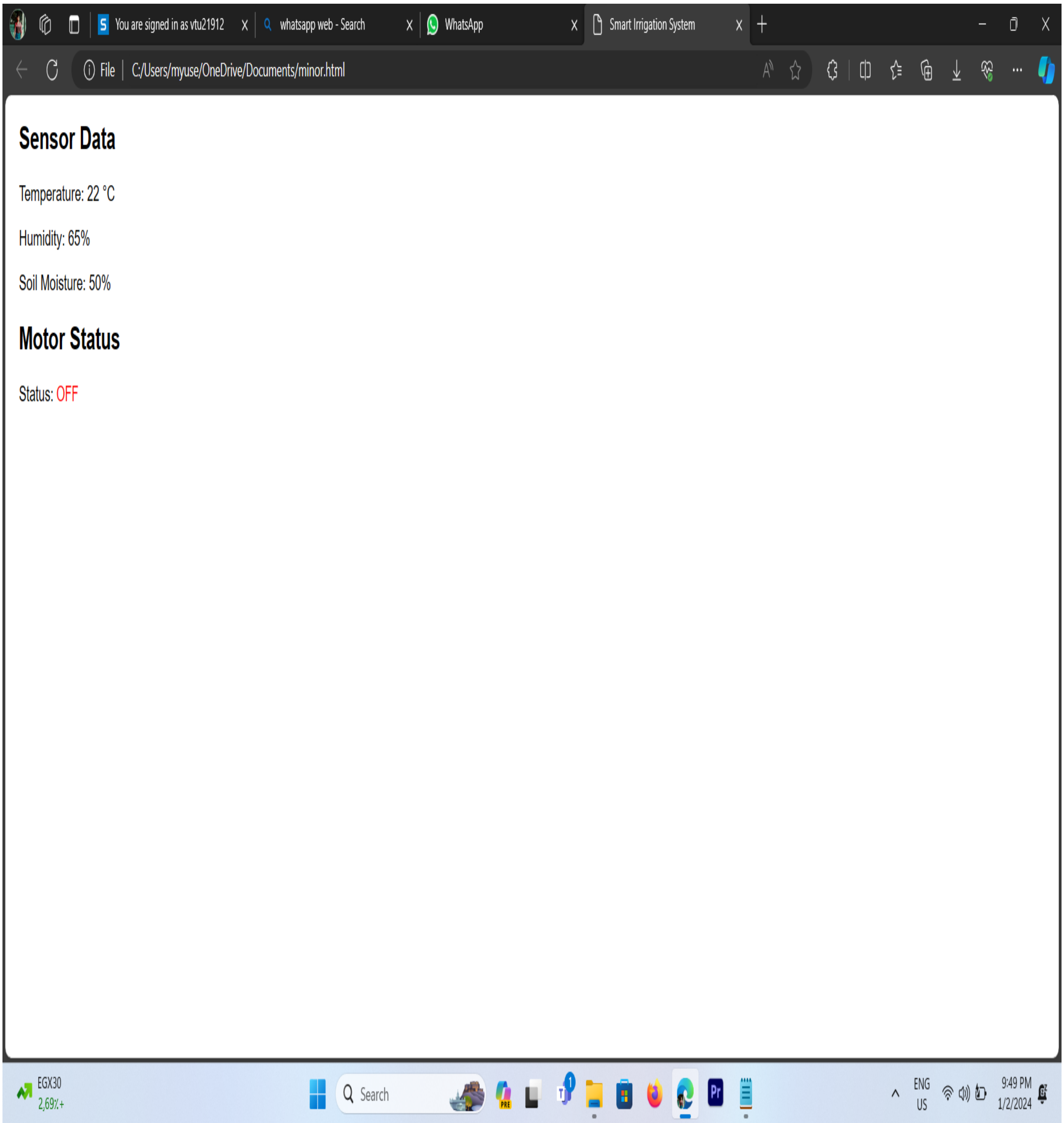

Figure 5.6: **Test Image On Motor Status**

Chapter 6

RESULTS AND DISCUSSIONS

6.1 Efficiency of the Proposed System

It depends on various factors, including accuracy, reliability, scalability, and user-friendliness. Here are key aspects to consider when evaluating the efficiency of the system. The precision of soil moisture sensors is crucial for the system's effectiveness. Ensuring that the sensors provide accurate readings helps in making informed irrigation decisions.The system's ability to provide real-time monitoring and control is vital for responding promptly to changes in soil moisture levels. This feature ensures that irrigation is triggered or adjusted as soon as necessary.Implement drip irrigation or precision irrigation methods to minimize water wastage.Collect and analyze data on soil moisture, weather conditions, and crop requirements. Efficient integration of weather data and the analysis of historical soil moisture data contribute to better decision-making. Advanced algorithms that consider multiple factors, including weather forecasts, enhance the system's overall efficiency.Transmit data from the microcontroller/IoT device to the cloud for further analysis. Utilize a cloud platform for data storage, processing, and hosting the irrigation system's decision-making algorithms.A well-designed power management system, including low-power modes and, if applicable, renewable energy sources, contributes to the system's efficiency and sustainability.

6.2 Comparison of Existing and Proposed System

To compare the existing system with the proposed system for automatic irrigation with IoT monitoring of soil moisture Specify the technology stack used in the current system.Highlight any advancements or changes in the technology stack, such as the use of newer sensors, communication modules, or cloud platforms.

Evaluate the accuracy and precision of soil moisture measurements in the current system.Highlight improvements in sensor technology or algorithms that enhance the accuracy of soil moisture readings.Assess the capabilities of the current system for real-time monitoring of soil moisture. Emphasize any enhancements or additional features that provide more timely and responsive monitoring.Describe how irrigation is controlled based on soil moisture levels in the existing system.Highlight any new control mechanisms or algorithmic improvements for more efficient irrigation management.Evaluate the scalability of the current system, considering the ability to expand sensor networks or add new features. Emphasize design considerations that enhance scalability, allowing for easy integration of additional sensors or devices.

6.3 Sample Code

```
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Smart Irrigation System</title>
    <style>
        body {
            font-family: Arial, sans-serif;
            margin: 20px;
        }

        #sensorData, #motorStatus {
            margin-bottom: 20px;
        }

        #motorStatusText {
            color: green;
        }
    </style>
</head>
<body>
    <div id="sensorData">
        <h2>Sensor Data</h2>
        <p>Temperature: <span id="temperature"></span> C </p>
        <p>Humidity: <span id="humidity"></span>¡/p¿¡p¿Soil Moisture: ¡span id="soilMoisture"¿¡/span¿¡/div¿¡div
            id="motorStatus"¿¡h2¿Motor Status¡/h2¿¡p¿Status: ¡span id="motorStatusText"¿¡/span¿¡/p¿¡/div¿¡script¿let temperatureValue =
            25;let humidityValue = 60;let soilMoistureValue = 40;let motorStatus = "OFF";function updateSensorData( {
            document.getElementById("temperature").innerText = temperatureValue;
            document.getElementById("humidity").innerText = humidityValue;
            document.getElementById("soilMoisture").innerText = soilMoistureValue;
        }

        function updateMotorStatus() {
            document.getElementById("motorStatusText").innerText = motorStatus;
            document.getElementById("motorStatusText").style.color = (motorStatus === "ON") ? "green
                " : "red";
        }

        function simulateDataUpdates() {
            temperatureValue = Math.floor(Math.random() * (30 - 20 + 1)) + 20;
            humidityValue = Math.floor(Math.random() * (70 - 50 + 1)) + 50;
            soilMoistureValue = Math.floor(Math.random() * (60 - 30 + 1)) + 30;
            motorStatus = (soilMoistureValue < 50) ? "ON" : "OFF";

            updateSensorData();
            updateMotorStatus();
        }
```

```

        setInterval(simulateDataUpdates, 5000);
        simulateDataUpdates();
    </script>
</body>
</html>
```

Output

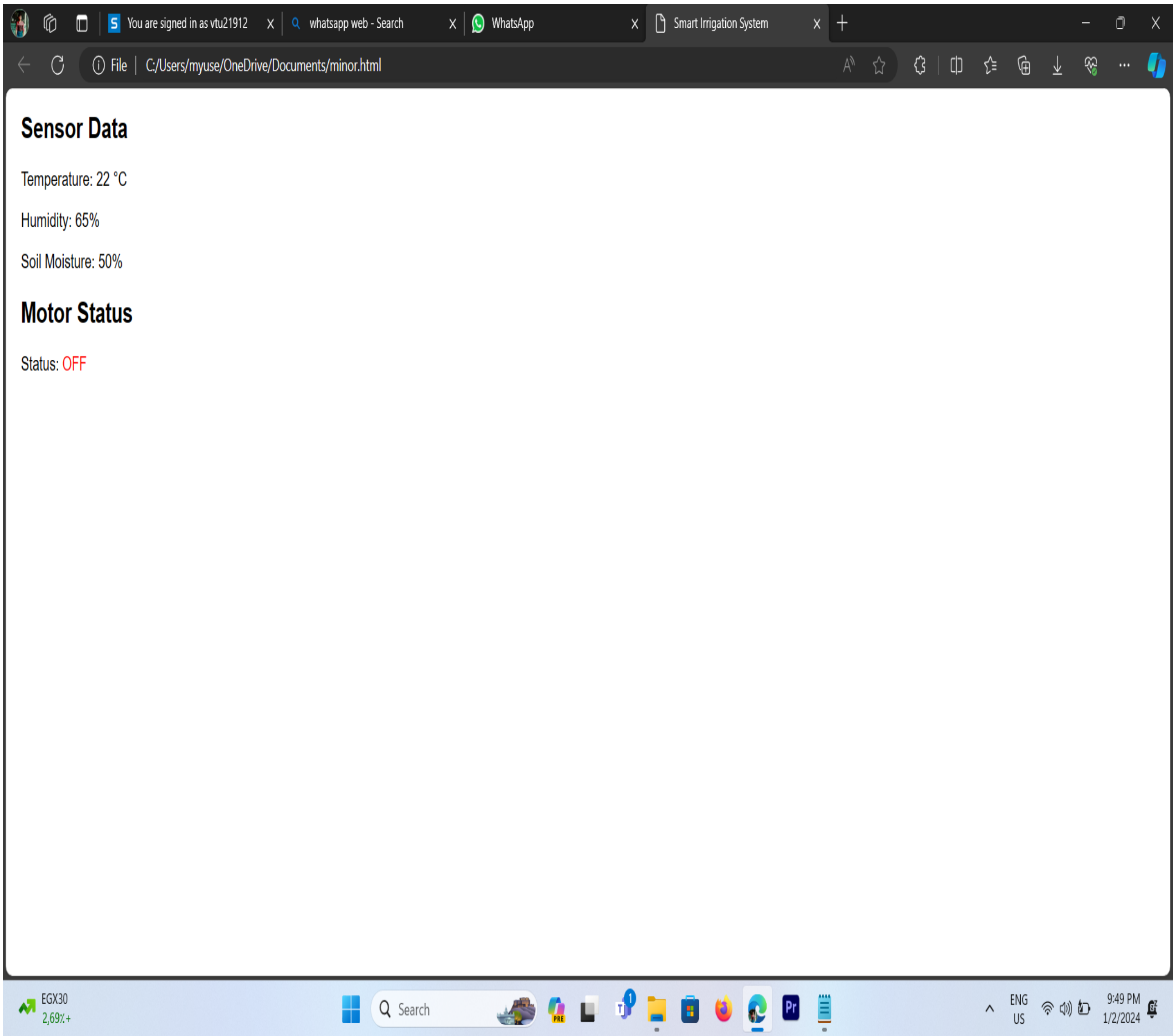

Figure 6.1: **Motor Status With Respect to Moisture Content**

6.4 Conclusion

An automatic check gate has been developed for the basin and connected to IoT through the wireless soil moisture sensor network using GSM with the aim that farmers/users can operate the gate opening and closing remotely with minimum manual interventions.Farmer can get the real-time moisture status of the field remotely and can make a decision of irrigation start and end on the basic real-time moisture status. The system was successfully tested in bare loamy soil. The study attempted to identify the suitable location and number of sensors in the field to increase irrigation application efficiency. Three operational schedules based on a different combination of depth and length along the flow had been evaluated, which indicated that at least two soil moisture sensors are required for the efficient operation of the system.

6.5 Future Enhancements

Smart irrigation is an irrigation system that uses sensors, weather data, and other technologies to optimize water usage. These systems can be programmed to turn on and off at specific times or based on certain conditions, such as soil moisture levels or weather patterns.In the present era, the farmers use irrigation technique through the manual control, in which the farmers irrigate the land at regular intervals. This process seems to consume more water and results in water wastage. Moreover, in dry areas where there is inadequate rainfall, irrigation becomes difficult. Hence, we require an automatic system that will precisely monitor and control the water requirements in the field. Installing Smart irrigation system saves time and ensures judicious usage of water. They can also be controlled remotely through a smartphone or other mobile device, making it easy for farmers and homeowners to monitor and adjust their irrigation systems from anywhere.The data are stored in Cloud for future use and easy to Retrieve the moisture to enhance the prototype with new features.

Chapter 7

PLAGIARISM REPORT

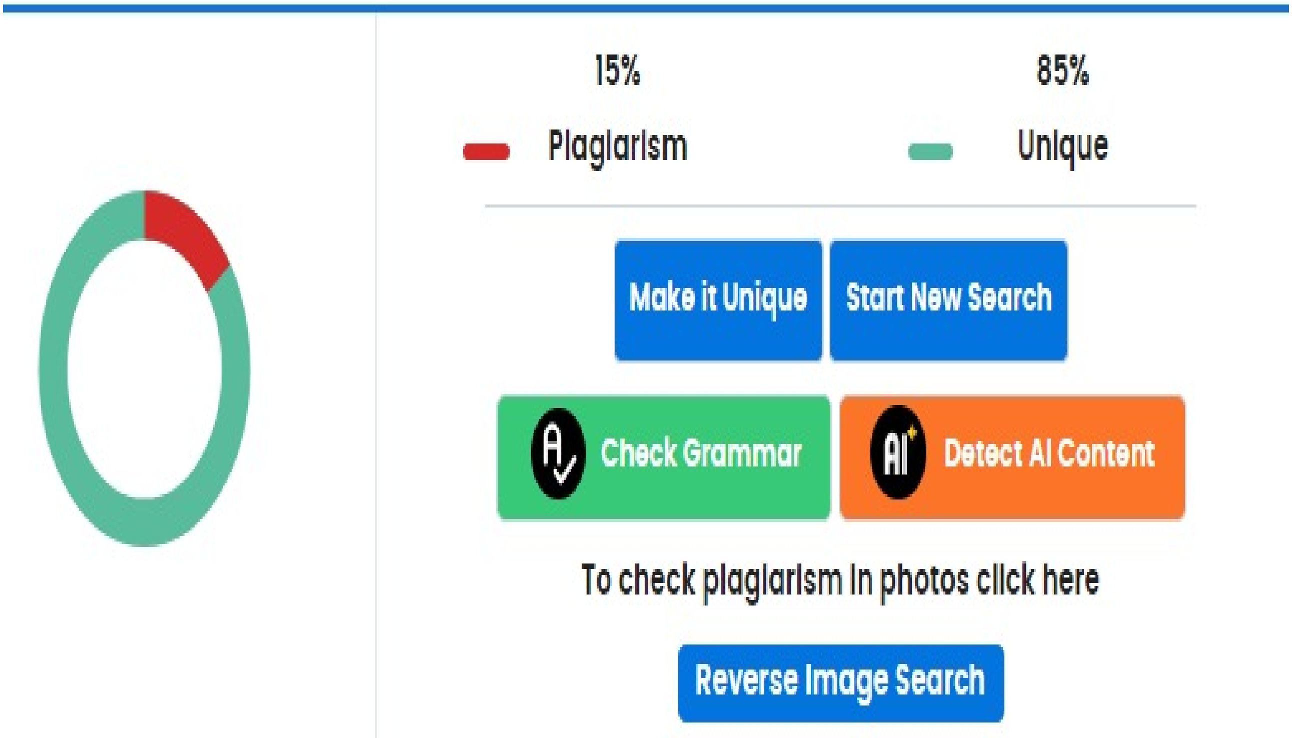

Figure 7.1: **Plagiarism Report**

Chapter 8

SOURCE CODE & POSTER PRESENTATION

8.1 Source Code

```
#include <DHT.h>
#include <ESP8266WiFi.h>

#define MOISTURE_SENSOR_PIN A0
#define WATER_PUMP_PIN 2
#define DHT_PIN 5 // Replace with the appropriate pin connected to the DHT sensor
#define DHT_TYPE DHT22 // Change to DHT11 if you're using that sensor
#define WIFI_SSID "YourWiFiSSID"
#define WIFI_PASSWORD "YourWiFiPassword"

DHT dht(DHT_PIN, DHT_TYPE);

void setup() {
  Serial.begin(115200);
  pinMode(MOISTURE_SENSOR_PIN, INPUT);
  pinMode(WATER_PUMP_PIN, OUTPUT);

  // Connect to WiFi
  WiFi.begin(WIFI_SSID, WIFI_PASSWORD);
  while (WiFi.status() != WL_CONNECTED) {
    delay(1000);
    Serial.println("Connecting to WiFi...");
  }
  Serial.println("Connected to WiFi");
}

void loop() {
  int moistureLevel = analogRead(MOISTURE_SENSOR_PIN);
  float temperature = dht.readTemperature();
  float humidity = dht.readHumidity();

  Serial.print("Moisture: ");
  Serial.println(moistureLevel);
  Serial.print("Temperature: ");
  Serial.println(temperature);
```

```
  Serial.print("Humidity: ");
  Serial.println(humidity);

  // Adjust moisture and temperature thresholds based on your requirements
  if (moistureLevel < 500 || temperature > 30.0 || humidity < 40.0) {
    turnOnWaterPump();
    delay(5000); // Run the pump for 5 seconds, adjust as needed
    turnOffWaterPump();
  }

  delay(600000); // Wait for 10 minutes before checking again, adjust as needed
}

void turnOnWaterPump() {
  digitalWrite(WATER_PUMP_PIN, HIGH);
  Serial.println("Water pump turned ON");
}

void turnOffWaterPump() {
  digitalWrite(WATER_PUMP_PIN, LOW);
  Serial.println("Water pump turned OFF");
}
```

8.2 Poster Presentation

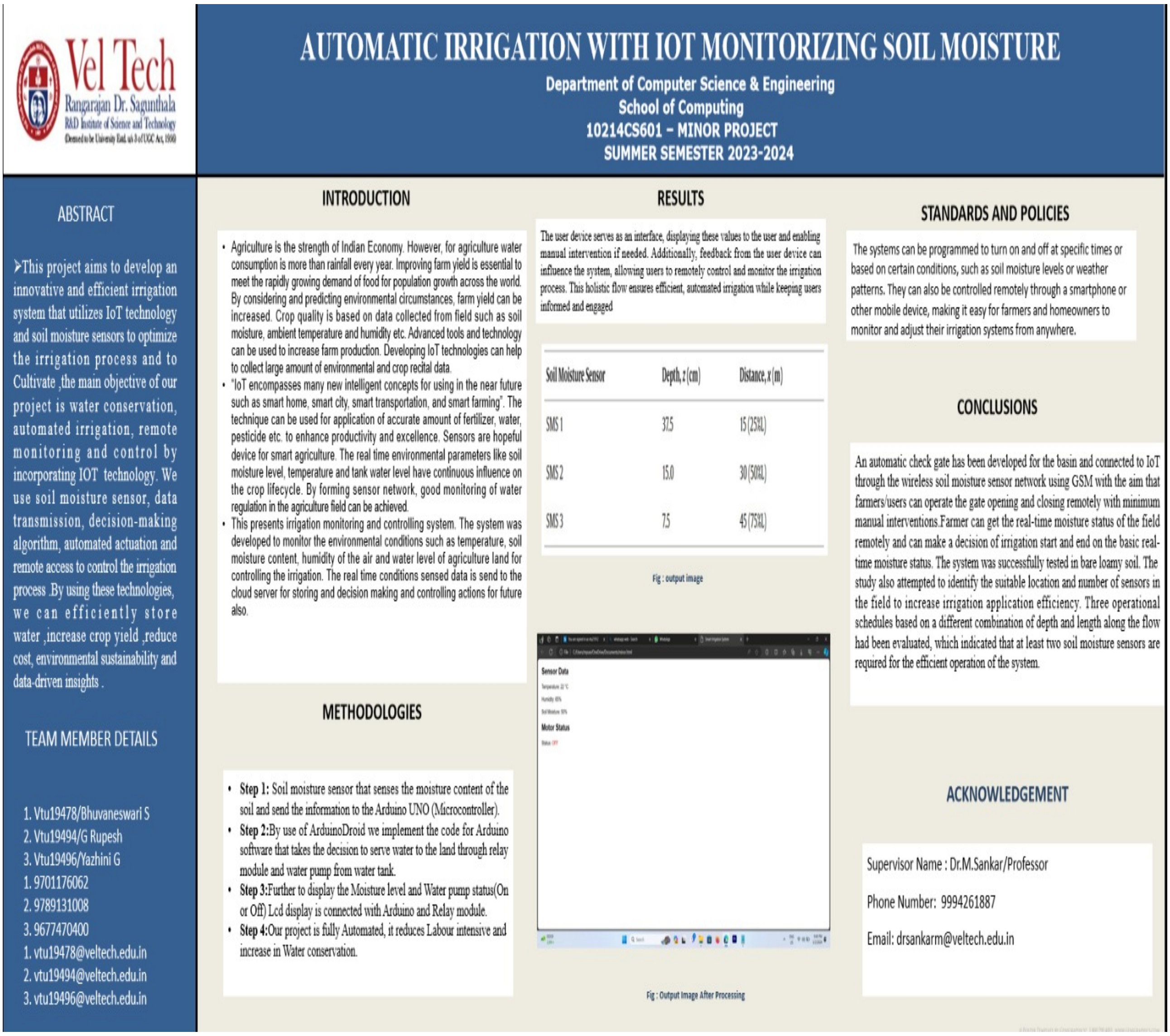

Figure 8.1: **Poster Presentation**

References

[1] M. Ji, J. Yoon et al.,(2019) “LoRa-based Visual Monitoring Scheme for Agriculture IoT,” 2019 IEEE Sensors Applications Symposium (SAS), Sophia Antipolis, France, pp. 1-6, doi: 10.1109/SAS.2019.8706100.

[2] Ayaz,et al., (2019)“Internet-of-Things (IoT)-Based Smart Agriculture: Toward Making the Fields Talk,” in IEEE Access, vol. 7, pp. 129551-129583, doi: 10.1109/ACCESS.2019.2932609.

[3] V. Puranik,etal.,(2019)Automation in Agriculture and IoT, 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU), Ghaziabad,India, 2019, pp. 1-6, doi: 10.1109/IoT SIU.2019.8777619.

[4] O. K. Ogidan and K. R. Afia,(2019) ”Smart irrigation system with an Android-based remote logging and control,” IEEE AFRICON, Accra, Ghana, pp. 1-4, doi: 10.1109/AFRICON46755.2019.9133953.

[5] S. Peraka, R. Sudheer, B. N. Rao, A. R. Teja and E. N. Kumar,(2020) ”Smart Irrigation based on Crops using IoT,” 2020 IEEE 15th International Conference on Industrial and Information Systems (ICIIS), RUPNAGAR, India, pp. 611-616, doi: 10.1109/ICIIS51140.2020.9342736.

[6] H. -B. Zhang, J. -M. Li, R. Huang, P. Pang and Y. Zheng, (2021)”Research on open channel irrigation decision system under the background of smart agriculture,” 2021 International Conference on Intelligent Transportation, Big Data Smart City (ICITBS), Xi’an, China,pp. 594-597, doi: 10.1109/ICITBS53129.2021.00151.

[7] B. Kashyap et al.,(2021) “Sensing Methodologies in Agriculture for Soil Moisture and Nutrient Monitoring,” in IEEE Access, vol. 9, pp. 14095-14121, doi: 10.1109/ACCESS.2021.3052478.

[8] Bhuwan Kashyap etal.,(2021) “Sensing Methodologies in Agriculture for Soil Moisture and Nutrient Monitoring”, IEEE Access, vol. 9, pp. 14095-14121.

[9] K. K. U and V. Janamala,(2022) ”Solar PV Tree Designed Smart Irrigation to Survive the Agriculture in Effective Methodology,” 2022 International Conference on Smart and Sustainable Technologies in Energy and Power Sectors (SSTEPS), Mahendragarh, India, pp. 1-6, doi: 10.1109/SSTEPS57475.2022.00016.

[10] R. Vijay, Y. V. Priya, P. C. Reddy, S. Monisha and V. Ramasamy,(2023) ”A IoT based Smart Auto Irrigation system,” 2023 International Conference on Computer Communication and Informatics (ICCCI), Coimbatore, India, pp. 1-4, doi: 10.1109/ICCCI56745.2023.10128325.

[11] M. Pillewan,et al., (2023)“Review on Design of Smart Domestic Farming based On Internet of Things (IOT),” 2023 Third International Conference on Artificial Intelligence and Smart Energy (ICAIS), Coimbatore, India, pp. 36-40, doi: 10.1109/ICAIS56108.2023.10073779.

[12] A. Raj,et al.,(2023) “Modern Farming Using IoT-Enabled Sensors For The Improvement Of Crop Selection,” 2023 4th International Conference on Intelligent Engineering and Management (ICIEM), London, United Kingdom.

[13] M. R. Barusu,et al.,(2023) Optimal Utilization of Water for Smart Farming Using Internet of Things (IoT),quot; 2023 2nd International Conference for Innovation in Technology(INOCON), Bangalore, India.