# SMART IRRIGATION CONTROL USING GSM TECHNOLOGY

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

**Bachelor of Technology**
**in**
**ARTIFICIAL INTELLIGENCE & MACHINE LEARNING**

**By**


**B.YASHWANTH** (REG.NO 22UEAM0012) **(VTU.NO 23382)**
**S.NIKHIL** (REG.NO 22UEAM0055) **(VTU NO 23395)**
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*Under the guidance of*
*Dr.M.Misba,M.E,PhD.,*
*ASSISTANT PROFESSOR*

**ARTIFICIAL INTELLIGENCE & MACHINE LEARNING**
**SCHOOL OF COMPUTING**

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

**(Deemed to be University Estd u/s 3 of UGC Act, 1956)**
**Accredited by NAAC with A++ Grade**
**CHENNAI 600 062, TAMILNADU, INDIA**


**October, 2024**

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# CERTIFICATE

It is certified that the work contained in the project report titled ”SMART IRRIGATION CONTROL USING GSM TECHNOLOGY” by ”B.YASHWANTH (REG.NO 22UEAM0012), S.NIKHIL (REG.NO 22UEAM0055), I.VIVEK NANDA (REG.NO 22UEAM0022)” has been carried out under my supervision and that this work has not been submitted elsewhere for a degree.

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**October, 2024**

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**Dr.S.Alex David**
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**Institute of Science & Technology**
**October, 2024**

# DECLARATION

We declare that this written submission represents my ideas in our own words and where others' 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.

(Signature)
(B.YASHWANTH)
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(S.NIKHIL)
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# APPROVAL SHEET

This project report entitled SMART IRRIGATION CONTROL USING GSM TECHNOLOGY by B.YASHWANTH (22UEAM0012),S.NIKHIL (22UEAM0055), I.VIVEK NANADA (22UEAM0022) is approved for the degree of B.Tech in ARTIFICIAL INTELLIGENCE & MACHINE LEARNING SCHOOL OF COMPUTING .

**Examiners** **Supervisor**

Dr.M.Misba,M.E,PhD.,
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**Place:**

# ACKNOWLEDGEMENT

We express our deepest gratitude to our **Honorable Founder Chancellor and President Col. Prof. Dr. R. RANGARAJAN B.E. (Electrical), B.E. (Mechanical), M.S (Automobile), D.Sc., and Foundress President Dr. R. SAGUNTHALA RANGARAJAN M.B.B.S.** Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, for her blessings.

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# ABSTRACT

Smart irrigation systems are essential for optimizing water usage in agriculture, ensuring efficient resource management. This research focuses on developing an intelligent irrigation system that utilizes GSM technology to monitor and control water supply based on real-time soil moisture levels. Our approach aims to automate irrigation processes, minimizing water wastage and enhancing crop yield.

The GSM-Based Smart Irrigation System allows users to remotely manage irrigation through SMS commands. By sending a simple text message, users can activate or deactivate the irrigation system, receive updates on soil moisture status, and access alerts for system malfunctions. This integration of GSM technology provides an accessible and efficient solution for farmers, facilitating timely interventions in irrigation management.



**Keywords:**
1.Smart Irrigation Definition:
2.Objective of Research:
3.GSM Technology Application:
4.Sensor Utilization:
5.Soil Moisture Monitoring:
6.System Automation:
7.Remote Management:
8.SMS Input Mechanism:
9.User Alerts:
10.Water Conservation:
11.Crop Yield Enhancement:
12. Real-Time Analysis:

# LIST OF FIGURES

# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| GSM | - Global System for Mobile Communications |
| IoT | - Internet of Things |
| SMS | - Short Message Service |
| MCU | - Microcontroller Unit |
| ADC | - Analog-to-Digital Converter |
| PWM | - Pulse Width Modulation (used for controlling water pumps) |
| API | - Application Programming Interface (for integration with other systems) |
| LCD | - Liquid Crystal Display (for local user interface) |
| RFID | - Radio Frequency Identification (optional for tracking) |
| UAV | - Unmanned Aerial Vehicle (optional for monitoring) |
| CAD | - Computer-Aided Design (for system layout) |

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# Chapter 1

# INTRODUCTION

## 1.1 Introduction

Smart irrigation control using GSM technology is revolutionizing agricultural practices by enabling efficient water management and resource conservation. This innovative system integrates soil moisture sensors that provide real-time data on moisture levels, which is analyzed by a microcontroller to determine the optimal irrigation schedule based on the specific needs of crops. The GSM module facilitates remote communication, allowing farmers to monitor and control their irrigation systems from mobile devices. This capability not only enhances convenience but also ensures timely responses to changing conditions, such as weather fluctuations or unexpected moisture levels, helping to prevent over- or under-watering.

The benefits of this technology extend beyond convenience, significantly promoting water conservation and cost efficiency. By optimizing irrigation schedules, farmers can reduce water wastage and lower costs associated with water usage, while simultaneously increasing crop yields and improving produce quality. Automation reduces the need for manual labor, freeing up time and resources for other essential tasks. Overall, smart irrigation using GSM technology offers a sustainable solution to traditional irrigation challenges, ensuring more productive farming practices and contributing to food security in the face of climate change and water scarcity.
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## 1.2 Aim of the project

The aim of the smart irrigation control using GSM technology is to create an automated irrigation system that optimizes water usage in agriculture. It seeks to minimize water wastage by applying irrigation only when necessary, based on real-time soil moisture data. By ensuring timely and adequate watering, the project aims to increase crop yields and improve produce quality. Additionally, the system allows for remote monitoring and control via mobile devices, enabling timely adjustments. This approach reduces operational costs and promotes environmentally sustainable practices. Ultimately, the project addresses modern farming challenges, contributing to responsible water management and enhancing agricultural viability.

## 1.3 Project Domain

The project domain of smart irrigation control using GSM technology encompasses several interconnected fields, primarily focusing on agricultural engineering and environmental science. Agricultural engineering plays a crucial role in designing efficient irrigation systems that cater to the specific needs of crops, ensuring optimal water delivery based on real-time soil conditions. Environmental science is integral to this domain as it addresses the sustainable use of water resources, helping to mitigate the impact of irrigation practices on ecosystems and biodiversity. Together, these fields aim to create systems that enhance agricultural productivity while preserving natural resources.

Additionally, the project aligns with advancements in information and communication technology (ICT) and the Internet of Things (IoT). By leveraging GSM technology, farmers can remotely monitor and control irrigation systems through mobile devices, enabling real-time data access and management. This integration of sensors and automated decision-making reflects the principles of precision agriculture, where data-driven approaches optimize inputs for better yields. Ultimately, the focus on sustainable development within this domain seeks to promote practices that ensure long-term agricultural viability while addressing the pressing challenges of water scarcity and climate change.

## 1.4 Scope of the Project

The scope of this project is centered on revolutionizing irrigation practices in agriculture through the integration of GSM technology. It primarily targets small to medium-sized farmers who seek efficient solutions for managing their water resources. The system will utilize GSM for communication, alongside moisture sensors and microcontrollers, enabling real-time data collection and remote control of irrigation processes. Key features will include automated irrigation scheduling based on soil moisture levels, user alerts for maintenance, and a modular design that allows for scalability and customization according to specific agricultural needs. Additionally, the project will focus on gathering and analyzing data on soil conditions to refine irrigation strategies and enhance crop yield. An educational component will provide training and resources to empower farmers to utilize the system effectively. The project also aims to promote sustainable agricultural practices by conserving water resources, ultimately contributing to environmental sustainability in the farming sector.

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# Chapter 2

# LITERATURE REVIEW

## 2.1 Literature Review

The literature on smart irrigation systems highlights their critical role in promoting sustainable agricultural practices and efficient resource management. Research indicates that integrating soil moisture sensors allows for real-time data utilization, enabling farmers to optimize irrigation schedules by applying water only when necessary, thereby conserving valuable resources (Ghaffari et al., 2018). The use of GSM technology facilitates remote monitoring and control, empowering farmers to manage their irrigation systems via mobile devices, which enhances convenience and responsiveness to environmental changes (Tiwari et al., 2019). Additionally, studies demonstrate the economic advantages of such systems, leading to significant cost savings in water usage and labor (Ayers and Westcot, 1994). Incorporating weather forecasting data further improves irrigation management, as adjustments based on predictions can enhance crop yields (Jha et al., 2019). Overall, the adoption of smart irrigation technologies significantly addresses challenges like water scarcity and climate change, underscoring their importance in modern agriculture.

## 2.2 Gap Identification

In the current landscape of agricultural practices, there exists a significant gap in the efficient management of water resources, particularly among small to medium-sized farms. Many farmers still rely on traditional irrigation methods that are often inefficient and labor-intensive, leading to excessive water wastage and inconsistent crop yields. Additionally, while some advanced irrigation systems exist, they are frequently prohibitively expensive and complex for smaller operations to implement. Moreover, there is a lack of accessible solutions that provide real-time data and remote control capabilities, hindering farmers' ability to respond promptly to changing environmental conditions. Existing technologies may not effectively integrate GSM communications, limiting the usability and accessibility of smart irrigation systems in rural areas with limited internet connectivity. This project aims to address these gaps by developing a cost-effective, user-friendly smart irrigation system that leverages GSM technology for remote monitoring and control, empowering farmers to optimize their water usage and improve overall productivity.

# Chapter 3

# PROJECT DESCRIPTION

## 3.1 Existing System

Existing systems for smart irrigation control using GSM technology enhance traditional irrigation methods by integrating automated monitoring and communication capabilities. These systems utilize soil moisture sensors to collect real-time data, which helps determine optimal irrigation needs for crops. By incorporating GSM technology, farmers can remotely monitor and control their irrigation schedules through mobile devices, allowing for timely adjustments from anywhere. However, these systems still face limitations, such as the need for initial manual setup and calibration, as well as potential connectivity issues in rural areas that can disrupt communication. Overall, while the integration of GSM technology marks a significant improvement in irrigation efficiency and water conservation, challenges remain in ensuring reliability and user-friendliness for farmers..

## 3.2 Problem statement

Agriculture is heavily reliant on efficient water management, yet many farmers face significant challenges in optimizing their irrigation practices. Traditional methods often lead to overwatering or underwatering, resulting in water wastage, increased operational costs, and reduced crop yields. Moreover, small to medium-sized farmers frequently lack access to advanced irrigation technologies that enable real-time monitoring and remote management of their systems. The absence of timely data on soil moisture levels and environmental conditions further complicates decision-making, leading to inefficient water use. Additionally, rural areas often experience limited internet connectivity, making it difficult for farmers to utilize modern solutions. This project seeks to address these issues by developing a smart irrigation system that utilizes GSM technology, allowing for remote control and automated irrigation based on real-time data. By doing so, the project aims to enhance water efficiency, reduce operational costs, and ultimately improve agricultural productivity.

### 3.2.1 Hardware Specification

**Processor:**

- Intel Core i7-13th Gen or equivalent AMD Ryzen 7 processor
- At least 8 cores and 16 threads for efficient processing of large datasets and complex machine learning models

**Microcontroller:**

- Arduino Uno or Raspberry Pi for controlling sensors and actuators

- Capable of interfacing with GSM modules and moisture sensors

**GSM Module:**

- SIM800L or equivalent GSM module for SMS communication
- Supports sending and receiving messages for remote control of the irrigation system

**Sensors:**

- Soil moisture sensor to monitor soil water levels
- Temperature and humidity sensors for environmental data collection

**Power Supply:**

- Adequate power supply (e.g., 5V adapter or battery) to support the microcontroller and sensors
- Backup power options for uninterrupted operation

**Communication Interface:**

- Wi-Fi or Ethernet module (optional) for enhanced connectivity and data transmission
- LCD display for local monitoring of system status and sensor readings

**Water Pump:**

- Submersible or surface water pump to facilitate automated irrigation based on sensor readings
- Capable of handling the required flow rate for the specific irrigation area

**Memory:**

- 16 GB of DDR5 RAM or higher
- Sufficient memory to handle the computational demands of machine learning algorithms and data processing
- Allows for smooth multitasking and efficient performance during data analysis and system operations

**Storage:**

- 512 GB SSD or higher for fast data access and retrieval
- Sufficient space for storing datasets, system logs, and software applications
- Optional external storage solutions (e.g., HDD or cloud storage) for data backup and analysis

**Storage:**

• Solid-state drive (SSD) with at least 512 GB of storage Faster data access compared to traditional hard drives, improving system performance

### 3.2.2 Software Specification

**Programming Language:**

**Python:**

- A popular choice for machine learning and data science due to its extensive libraries and community support.

**Machine Learning Libraries:**

**TensorFlow or PyTorch:**

- Deep learning frameworks for building and training neural networks.

**Scikit-learn:**

- A comprehensive machine learning library with algorithms for classification, regression, clustering, and more.

**NLTK (Natural Language Toolkit):**

- For natural language processing tasks such as text preprocessing and feature extraction.

**Data Processing and Visualization:**

**Pandas:**

- For data manipulation and analysis.

**NumPy:**

- For numerical computations and array operations.

**Matplotlib or Seaborn:**

- For data visualization and creating plots.

**Web Development (Optional):**

**Flask or Django:**

- For building web applications to deploy the smart irrigation system as a service.

**Cloud Platform (Optional):**

- Amazon Web Services (AWS), Google Cloud Platform (GCP), or Microsoft Azure: For cloud-based deployment and scalability.

**Version Control:**

**Git:**

- For managing source code and collaborating with other developers.

**Additional Tools:**

**Jupyter Notebook or Google Colab:**

- Interactive environments for data exploration and experimentation.

**Docker:**

- For containerization and deployment of the system in different environments.

**Virtual Environment:**

- To isolate project dependencies and avoid conflicts.

### 3.2.3 Standards and Policies

**1.Data Privacy and Protection Compliance With Regulations:** Ensure adherence to laws such as GDPR, HIPAA, and CCPA. These regulations govern how personal data is collected, stored, and processed.
**2.Data Anonymization:**Implement techniques to anonymize sensitive user data used in training machine learning models to protect individual privacy.
**3. Model Transparency and ExplainabilityTransparency Standards:**Develop models that allow stakeholders to understand how decisions are made, including the features that contribute to irrigation management decisions.
**4.Explainability:**Use techniques to explain model predictions, particularly in instances of system errors or malfunctions, to build trust among users.
**5. Continuous Monitoring and EvaluationPerformance Metrics:** Establish clear metrics (e.g., accuracy, precision, recall, F1 score) to evaluate the effectiveness of the irrigation system regularly.
**6.Adaptability:**Create policies for ongoing training and updating of models to adapt to evolving agricultural practices and environmental conditions.
**7. User Education and AwarenessTraining Programs:**Implement regular training for farmers and users on how to effectively use the smart irrigation system and recognize indicators of system performance.
**8.Feedback Mechanisms:**Encourage users to provide feedback on system functionality and report issues, feeding this data back into the system for continuous improvement.
**9. Ethical ConsiderationsBias Mitigation:**Regularly assess models for bias and ensure diverse datasets are used to train algorithms to avoid discrimination against any group of users.
**10.Responsible Use of Technology:**Establish guidelines to ensure that the smart irrigation system is used ethically, avoiding unintended consequences on agricultural practices and local ecosystems.
**11. Incident Response Protocols Response Plan:**Develop a clear incident response plan for when system malfunctions or failures occur, detailing steps for mitigation and user notification.
**12.Collaboration with Authorities:**Create policies for cooperating with local agricultural authorities and organizations to ensure compliance and share insights on irrigation practices.

# Chapter 4

# METHODOLOGY

## 4.1 Proposed System

The methodology for developing a smart irrigation control system using GSM technology involves several key steps. First, project planning is essential to define objectives like reducing water usage and optimizing irrigation schedules, along with identifying the scope, budget, and timeline. Next, during the system design phase, components such as soil moisture sensors, rain sensors, a GSM module (like SIM800), and a microcontroller (such as Arduino or Raspberry Pi) are selected, and the circuit schematic is created. Following that, hardware implementation involves assembling the components, connecting the sensors to the microcontroller, and ensuring a reliable power supply, potentially using solar panels.

Once the hardware is set up, software development begins, focusing on programming the microcontroller to read sensor data, control irrigation actuators, and manage GSM communication. A simple SMS-based user interface is also created to facilitate user commands. Afterward, the integrated system undergoes field testing to validate performance in real agricultural settings, allowing for parameter adjustments based on initial results. Data analysis follows, monitoring collected information to assess irrigation efficiency and inform system improvements. Finally, user training and documentation are provided to ensure proper operation and maintenance, leading to successful deployment in the target agricultural area. This structured approach ensures the effective implementation of a sustainable and user-friendly smart irrigation system.

## 4.2 General Architecture

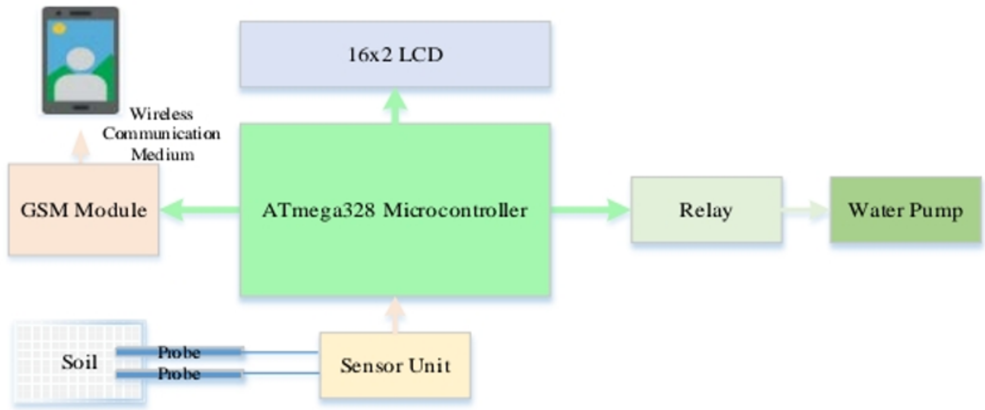



Figure 4.1: **General Architecture**

Automatic irrigation system that monitors soil moisture and activates a water pump when necessary. The soil probes measure moisture levels and send the data to the sensor unit, which processes the signals and forwards them to the ATmega328 microcontroller. If the moisture falls below a threshold, the microcontroller activates a relay to switch on the water pump for irrigation. The system status, including moisture levels and pump activity, is displayed on a 16x2 LCD. A GSM module enables wireless communication, allowing the system to send notifications or receive remote commands via SMS. This setup ensures efficient water management by automating irrigation and providing remote control through mobile communication. The diagram depicts an automated irrigation system that monitors soil moisture and controls water flow efficiently. Soil probes measure the moisture level, and the sensor unit processes this data and sends it to the **ATmega328 microcontroller**. If the moisture is below a set threshold, the microcontroller activates a relay to switch on the **water pump** for irrigation. A 16x2 LCD displays real-time status, such as moisture levels and pump activity. Additionally, the GSM module enables wireless communication by sending alerts or receiving commands via SMS, allowing users to monitor and control the system remotely. This setup ensures optimized water management by automating irrigation based on real-time soil conditions.

## 4.3 Design Phase

### 4.3.1 Data Flow Diagram

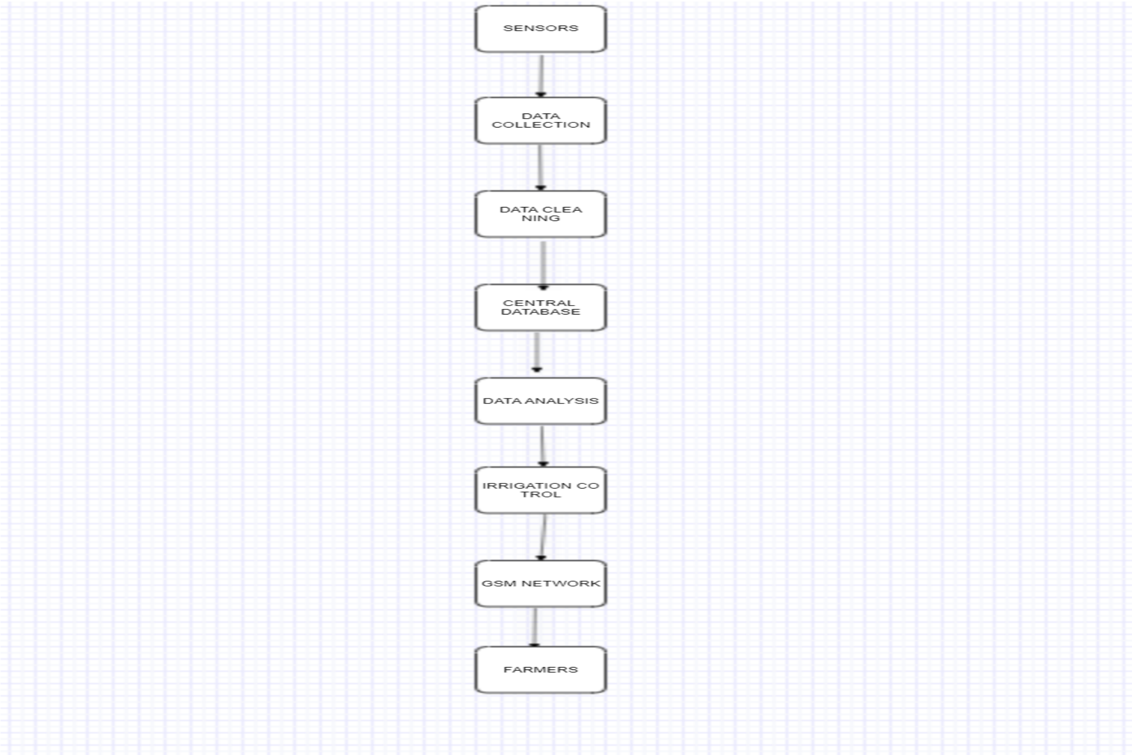



Figure 4.2: **GSM Flow Diagram**

**1. Dataset Collection:** Gather data from various sources, including soil moisture levels, weather conditions, crop types, and water requirements. This dataset will be used to train and test the irrigation system's model for accurate decision-making.
**2. Feature Extraction:** Extract relevant features such as soil moisture level, temperature, humidity, and water flow rate. These features are essential for determining when irrigation is needed and how much water should be supplied.
**3. Feature Selection:** Evaluate the importance of extracted features to identify which ones have the most significant impact on efficient irrigation. Reducing unnecessary features improves the system's performance and reduces processing overhead.
**4.Implementation of Smart Irrigation System Using GSM Module:** The system integrates with the GSM module for communication. It monitors soil moisture in real-time using probes and, based on the conditions, sends a signal to the relay to activate the water pump. The GSM module alerts the user through SMS when the pump is turned on or off and can also receive remote commands from the user.
**5. Evaluating with Test Dataset:** The system's efficiency is tested on real-time data to evaluate its performance in managing irrigation. Metrics such as water savings, irrigation frequency, and crop health are analyzed to assess the system's effectiveness.
**6. Parameter Tuning:** Adjust parameters such as soil moisture thresholds, pump activation duration, and communication intervals with the GSM module to optimize the system's performance. These adjustments ensure minimal water wastage while maintaining optimal soil moisture levels for crops.

### 4.3.2 Use Case Diagram

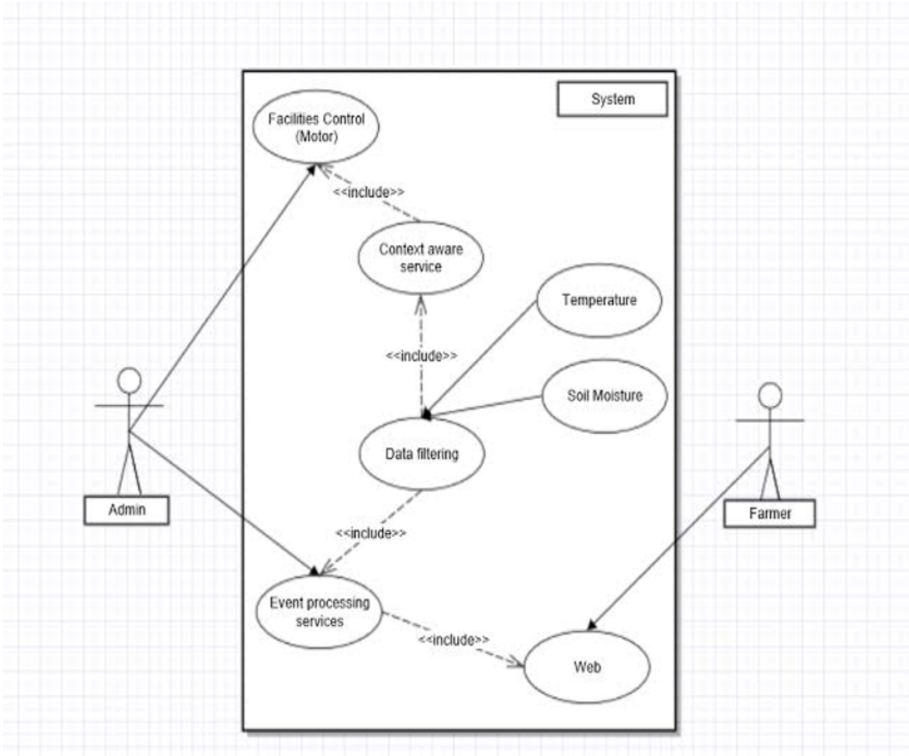



Figure 4.3: **Use Case Diagram**

TThe use of a GSM module in smart irrigation systems plays a crucial role in enabling remote communication and automation. GSM (Global System for Mobile Communications) modules allow the system to interact with users through SMS, providing real-time notifications about the status of the irrigation process and receiving control commands from the user. This integration eliminates the need for physical presence to monitor or control the water pump, making it ideal for agriculture, especially in remote or large-scale farms.

With the GSM module, the system can send alerts when specific events occur, such as when the soil moisture drops below a threshold, the water pump is activated, or irrigation is completed. This ensures that farmers or users are continuously informed about the condition of their crops and water usage, helping them make timely decisions. Additionally, the user can send SMS commands to turn the pump on or off, enabling remote control. This feature is particularly beneficial in areas where continuous internet access is not available, as GSM communication relies on the mobile network.

### 4.3.3 Class Diagram


Figure 4.4: **Class Diagram**

The class diagram for the smart irrigation system using a GSM module illustrates the system's key components and their interactions. At the center is the Microcontroller (ATmega328), which acts as the brain of the system, collecting data from the Sensor Unit that measures soil moisture and temperature in real time. This data informs the microcontroller whether to activate the Water Pump based on moisture levels, which it controls through a Relay. The GSM Module facilitates communication by sending SMS alerts to the user about system status, such as pump operation and soil conditions. It also receives commands from the user, allowing for remote control of the irrigation process. The User can interact with the system by sending SMS commands to the GSM module, enabling them to monitor and control irrigation without being physically present. This modular design ensures efficient automation of irrigation, timely responses to changing soil conditions, and improved water management, ultimately supporting optimal crop health.

### 4.3.4 Sequence Diagram

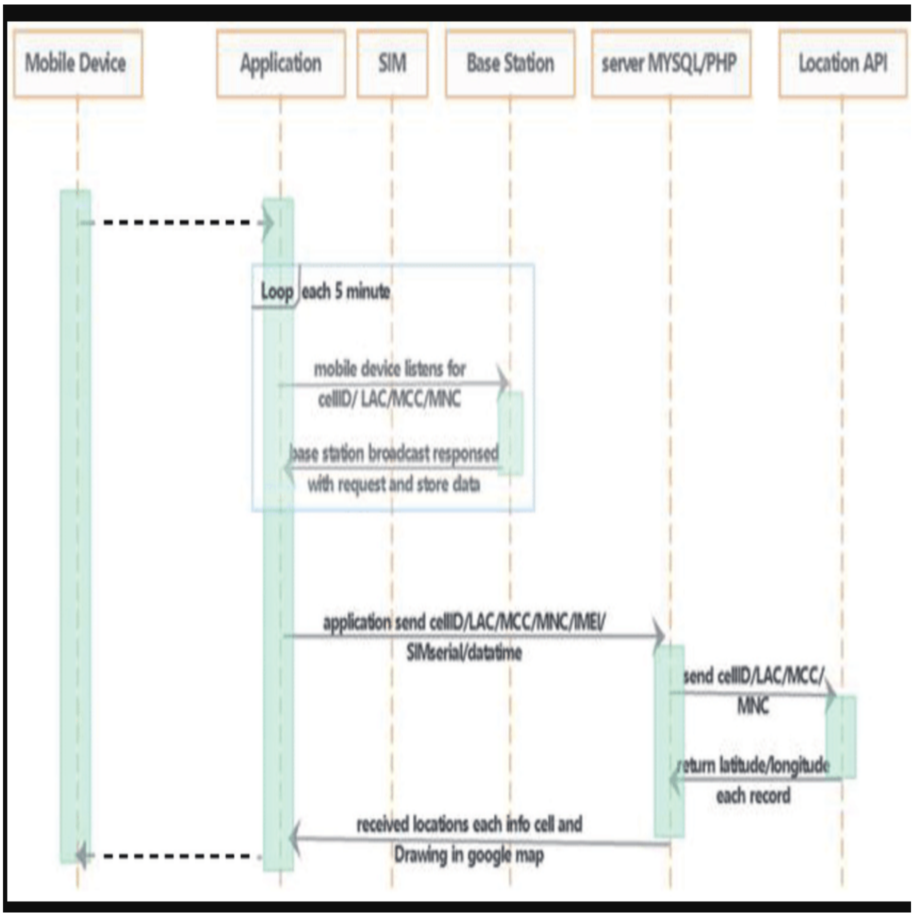



Figure 4.5: **Sequence Diagram**

A sequence diagram visually represents the interactions between different components in a system over time, illustrating how processes operate with one another and in what order. It consists of several key elements that help convey the flow of information. Each participant in the diagram is represented by a vertical dashed line, known as a lifeline. In the context of a smart irrigation system, participants may include the user (the farmer or end-user), the mobile application (the interface through which the user sends commands or receives notifications), the microcontroller (which collects sensor data and controls the irrigation system), and the server (the backend system that processes data and makes decisions based on algorithms).

Messages are represented by arrows between lifelines, indicating interactions between participants. The direction of the arrow shows who is sending the message; for instance, the user sends a command to the mobile application, which then relays this command to the microcontroller. Activation bars, which are rectangles along the lifelines, indicate periods when a participant is active, such as when the microcontroller processes incoming data or when the server performs calculations based on that data. Return messages, depicted as dashed arrows, illustrate responses from one participant to another, such as the server sending a processed data response back to the microcontroller.

### 4.3.5 Collaboration diagram

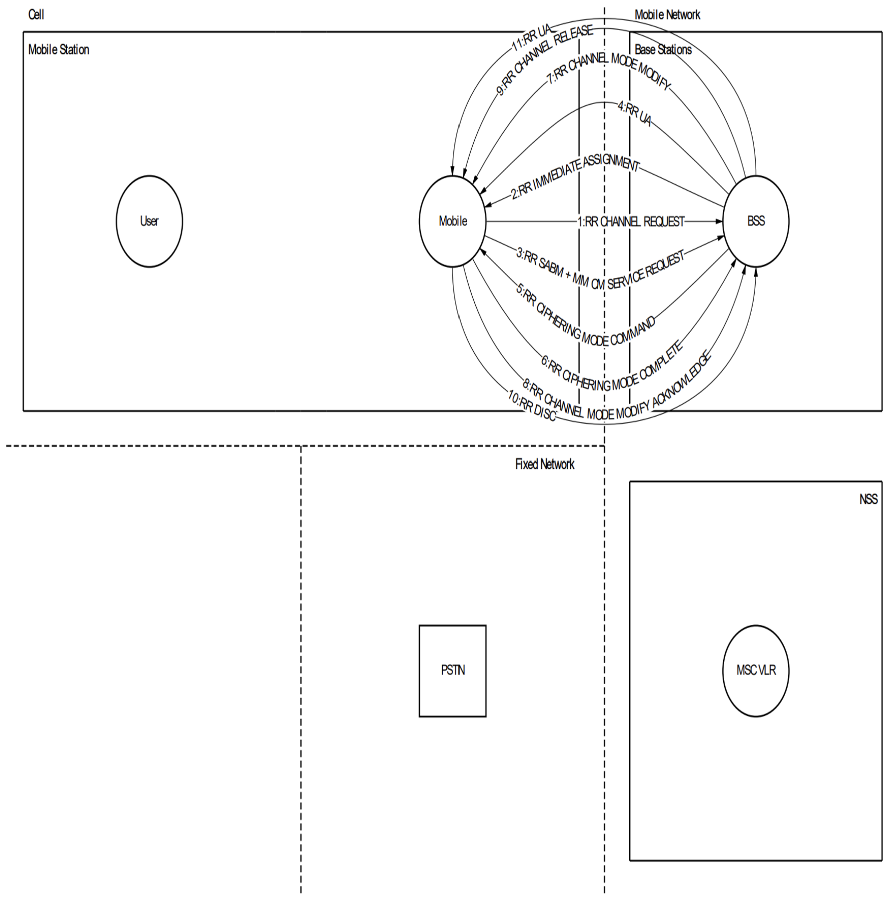



Figure 4.6: **Collaboration Architecture**

A collaboration diagram for phishing detection using machine learning outlines the key components and their interactions. At the center is the User Interface, where users submit URLs or emails for analysis. This connects to the Data Collection component, which includes a web scraper that gathers phishing data and a user feedback system for reporting phishing attempts. The collected data then moves to Data Preprocessing, where it undergoes cleaning and feature extraction to prepare it for analysis. This processed data is fed into the Machine Learning Model, which involves selecting appropriate algorithms, training on labeled datasets, and validating performance.

### 4.3.6 Activity Diagram

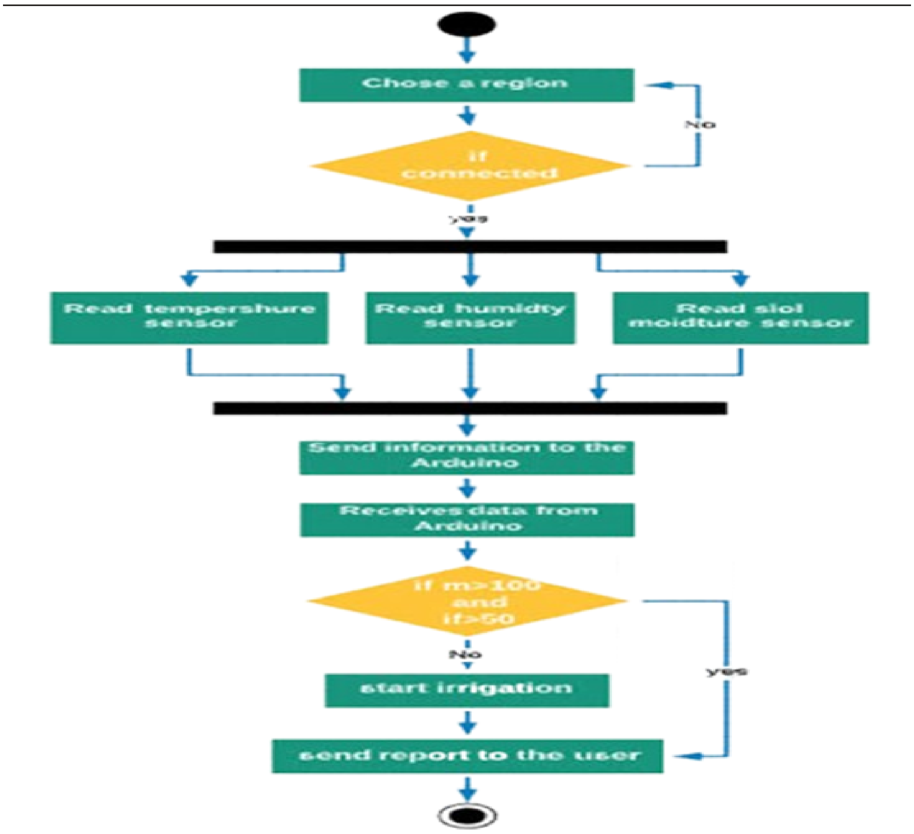



Figure 4.7: **Activity Diagram**

## 4.4 Algorithm & Pseudo Code

### 4.4.1 Algorithm

The smart irrigation control algorithm begins by initializing the system to connect with soil moisture, temperature, humidity, and weather sensors while establishing a GSM connection for remote communication. It continuously collects real-time data and first evaluates soil moisture levels. If the moisture is below a predefined threshold, the system checks weather conditions; if rain is forecasted within the next 24 hours, it sends a status update via GSM indicating that irrigation will be delayed. If no rain is expected, the system assigns probabilities to various irrigation actions based on the collected data and crop requirements, using a random algorithm to select the appropriate amount of water and timing for irrigation. Once irrigation is activated, a confirmation message is sent via GSM. After the irrigation process, the system rechecks soil moisture levels and determines if additional watering is needed, allowing for adjustments as necessary. Users can also interact with the system through GSM, enabling manual overrides and receiving alerts. Overall, this algorithm facilitates efficient water management and promotes sustainable agricultural practices through real-time data integration and automated decision-making.

**Random Forest:** Random Forest is an ensemble learning algorithm that combines multiple decision trees to improve accuracy and robustness. It is effective for handling complex features and is resistant to overfitting.

**Support Vector Machines (SVM):** SVM is a supervised learning algorithm that separates data into different classes using a hyperplane. It works well for binary classification tasks like phishing detection, especially when dealing with high-dimensional data.
**Neural Networks:** Deep learning, specifically neural networks, can be employed for phishing URL detection. Deep neural networks, including convolutional neural networks (CNNs) or recurrent neural networks (RNNs), can automatically learn hierarchical representations of features
. **Logistic Regression:** Logistic Regression is a simple linear model that is widely used for binary classification. It estimates the probability that a given instance belongs to a particular category.

### 4.4.2 Pseudo Code

```
BEGIN Smart_Irrigation_System
    INITIALIZE microcontroller
    INITIALIZE GSM_module
    INITIALIZE sensors

    WHILE true DO
        soil_moisture = READ(soil_moisture_sensor)
        temperature = READ(temperature_sensor)
        humidity = READ(humidity_sensor)
        IF user_requests_data THEN
          SEND_SMS(user, "Moisture: " + soil_moisture + ",Temp:"
          +temperature + ", Humidity: " + humidity)
        ENDIF

        IF soil_moisture < threshold THEN
         ACTIVATE irrigation_system
         WAIT(duration)
         WHILE irrigation_system_active & soil_moisture<optimal_level
         DO
             CONTINUE irrigation
         ENDWHILE
         DEACTIVATE irrigation_system
         SEND_SMS(user,"Irrigation done.Current moisture:"+ soil_moisture)
        ENDIF
```

```
        IF receive_user_command THEN
            PARSE command
            UPDATE system_parameters
        ENDIF

        WAIT(interval)  // wait before the next reading
    ENDWHILE
END Smart_Irrigation_System
```

### 4.4.3 Data Set / Generation of Data

The generation of data for the smart irrigation system involves several key steps to ensure that the dataset is comprehensive and relevant for effective analysis and decision-making. Initially, data is collected from various sensors deployed in the field, including soil moisture sensors, temperature sensors, and humidity sensors. These sensors continuously monitor the environmental conditions and the moisture levels in the soil. To create a robust dataset, data collection occurs over an extended period, capturing a wide range of conditions, including different weather patterns, soil types, and crop growth stages.

In addition to real-time sensor data, historical data may be incorporated to provide context for decision-making. This historical dataset can include past irrigation events, crop yields, and environmental conditions, allowing the system to learn from previous experiences. Furthermore, simulated data may also be generated using models that predict how different factors, such as rainfall and temperature variations, affect soil moisture levels.

## 4.5 Module Description

### 4.5.1 Module 1 – Data Collection

**Step 1: Collection of Data**

The collection of data for the smart irrigation system is a critical step in ensuring effective water management. Various sensors, including soil moisture sensors, temperature sensors, and humidity sensors, are deployed in the field to gather real-time environmental data. The GSM module plays a vital role in transmitting this data to the user and central server. Data may also be collected periodically through automated readings, allowing for continuous monitoring of soil conditions. Additionally, user inputs via SMS can be incorporated, enabling farmers to request updates or modify system settings remotely. This data collection process provides the foundational information needed for decision-making in irrigation management.

**Step 2: Data Processing and Transmission**

Once the data is collected, it undergoes processing to ensure its readiness for analysis. This includes validating sensor readings to filter out anomalies and aggregating data over specified time intervals for clearer insights. The processed data is then transmitted via the GSM module to a mobile application or directly to the user through SMS notifications. The GSM module enables real-time communication, ensuring that users receive timely updates about soil moisture levels, irrigation status, and environmental conditions. This step is crucial for allowing users to make informed decisions regarding irrigation actions based on the latest data.

### 4.5.2 Module 2 – Communication Protocols

The communication protocols utilized in the smart irrigation system ensure efficient data exchange between the sensors, microcontroller, and the GSM module. These protocols are essential for enabling reliable connectivity and responsiveness in the system. Here are some commonly used protocols:

**SMS (Short Message Service):** SMS is used for sending alerts and data updates to the user, allowing for easy and direct communication regarding irrigation status and sensor readings.

**HTTP/HTTPS:** For systems with internet connectivity, HTTP or HTTPS protocols can facilitate data transmission to cloud-based platforms for further processing and analysis.

**MQTT (Message Queuing Telemetry Transport):** This lightweight messaging protocol is suitable for low-bandwidth, high-latency networks, making it ideal for transmitting data from sensors to the server in real-time.

**Serial Communication:** For local data transfer between the microcontroller and the GSM module, serial communication protocols are employed to ensure effective data exchange.

### 4.5.3 Module 3 – Implementation of GSM Communication

The implementation of the GSM communication module involves programming the microcontroller to manage data collection, processing, and transmission effectively. The provided Python code outlines a basic framework where necessary libraries are imported for managing GSM communication and sensor data. The system initializes the GSM module and reads data from the sensors at regular intervals. When specific conditions are met, such as low soil moisture, the system sends an SMS alert to the user. The code also includes functions for user interaction, allowing commands to be sent via SMS to adjust irrigation settings or request data updates. This foundational framework can be enhanced through further development, such as implementing error handling, optimizing data transmission intervals, and adding advanced user notifications.

# Chapter 5

# IMPLEMENTATION AND TESTING

## 5.1 Input and Output

### 5.1.1 Input Design

Designing a smart irrigation control system using GSM technology involves several key components and steps. The system typically includes a microcontroller (like Arduino or Raspberry Pi), a GSM module (such as SIM800), soil moisture sensors, and a relay module to control irrigation valves or pumps. First, the circuit is set up to connect the sensors to the microcontroller, which reads moisture levels and activates irrigation as needed. The GSM module facilitates communication, allowing users to receive alerts about soil moisture levels and remotely control the irrigation system via SMS commands. Programming the microcontroller involves setting moisture thresholds to determine when to activate or deactivate irrigation. After testing the system's response to various moisture conditions, it can be deployed in gardens or agricultural fields. Optional enhancements, like a web or mobile app, can provide a user-friendly interface for monitoring and controlling the system. Regular maintenance ensures optimal performance, while potential upgrades can incorporate additional features like weather-based irrigation scheduling. Overall, this smart irrigation system enhances water efficiency and promotes healthier plants through automation and real-time monitoring.

### 5.1.2 Output Design

The output design of a smart irrigation control system utilizing GSM technology focuses on effective user interaction and system functionality. Central to this design is the SMS notification system, which alerts users when soil moisture levels are low, when irrigation starts or stops, and about any potential system errors, while also providing command acknowledgments for user-sent SMS commands. The system controls a relay module to operate irrigation pumps or solenoid valves, with optional LED indicators to visually represent the system status (e.g., green for active irrigation, red for low moisture). For enhanced usability, the system may include data logging features that track moisture readings and irrigation history over time, allowing users to analyze trends. Additionally, a web or mobile interface could offer a dashboard displaying real-time moisture levels and system status, enabling users to send commands and view historical data. Power management features might monitor battery levels, ensuring reliable operation. Overall, this output design emphasizes real-time feedback and user control, promoting optimized water usage and healthier plants.

## 5.2 Testing

Testing a smart irrigation control system using GSM technology involves several critical stages to ensure reliable operation and performance. First, individual components, such as the GSM module, soil moisture sensor, and relay module, are tested for functionality; this includes verifying that the GSM module can successfully send and receive SMS messages and ensuring that the soil moisture sensor accurately measures moisture levels. Once component testing is complete, integration testing ensures that the microcontroller reads moisture levels correctly and controls the relay to activate or deactivate irrigation as needed. Functional testing follows, simulating low and high moisture conditions to confirm that the system responds appropriately and sends accurate SMS notifications. User interaction is also assessed by sending various commands via SMS to check for proper acknowledgment and response. Performance testing evaluates the system under different conditions, including varying soil types and weather scenarios, to ensure reliability in real-world applications. Finally, long-term testing is conducted to identify any issues that may arise over time, such as sensor drift or connectivity problems. This comprehensive testing approach ensures that the smart irrigation system operates effectively, optimizes water usage, and supports plant health in diverse environments.

## 5.3 Types of Testing

There are many types of testing like

```
Unit Testing

Integration Testing

Functional Testing

User Acceptance Testing (UAT)

Performance Testing

Reliability Testing

Field Testing

Regression Testing
```

### 5.3.1 Integration testing

**Input**


Figure 5.1: **Test Image**

**Test result**


Figure 5.2: **Test Result**

# Chapter 6

# RESULTS AND DISCUSSIONS

## 6.1 Efficiency of the Proposed System

The efficiency of a smart irrigation system using GSM technology is primarily seen in its ability to conserve water and optimize resource use. By automating irrigation schedules based on real-time soil moisture levels and weather conditions, these systems significantly reduce water wastage. Remote monitoring and control capabilities allow users to make timely adjustments, enhancing convenience and responsiveness. The integration of sensors provides valuable data that facilitates data-driven decision-making, leading to more effective watering practices. Over time, the reduction in water usage and labor costs results in significant savings, making the initial investment worthwhile. Additionally, smart systems are adaptable to various crops and soil conditions, scalable for different farm sizes, and contribute positively to the environment by minimizing runoff and promoting soil health. Overall, a GSM-based smart irrigation system can lead to more sustainable agricultural practices and improved efficiency in resource management.

## 6.2 Comparison of Existing and Proposed System

**Existing system:(Decision tree)**
In an existing irrigation system utilizing a decision tree approach, the irrigation process involves a series of conditional rules that assess various factors such as soil moisture, weather conditions, and crop type to determine irrigation needs. The system starts by evaluating soil moisture levels; if moisture is below a certain threshold, it proceeds to check weather conditions. For instance, if rain is forecasted or occurring, the system may skip irrigation, whereas if conditions are dry, it considers the specific water requirements of the crop. The decision tree then helps determine the appropriate irrigation method before executing the irrigation. However, this approach has limitations, including static rules that may not adapt effectively to changing conditions, reliance on manual updates that can lead to outdated practices, and a lack of real-time data, which reduces responsiveness to immediate environmental changes. Additionally, existing systems often require physical presence for monitoring and adjustments, which can hinder efficiency. In contrast, proposed smart irrigation systems that leverage real-time data and remote monitoring capabilities offer greater flexibility and responsiveness, leading to more sustainable water management.

**Proposed system:(Random forest algorithm)**
The proposed smart irrigation control system using GSM technology integrates real-time data collection and automated decision-making to optimize irrigation practices. By leveraging sensors that monitor soil moisture, temperature, and weather conditions, the system can determine when and how much water to deliver to crops. GSM technology enables remote monitoring and control, allowing users to receive alerts and adjust irrigation settings from anywhere via their mobile devices.

This level of accessibility enhances responsiveness to changing environmental conditions and reduces the likelihood of over-irrigation, leading to significant water conservation. The system can also utilize a random algorithm to introduce variability in irrigation decisions, further enhancing adaptability and resource management. By automating irrigation processes and minimizing manual intervention, the system not only saves labor and time but also promotes sustainable agricultural practices. Overall, the integration of GSM technology with smart irrigation strategies represents a significant advancement in efficient water management for modern agriculture.

**Output**

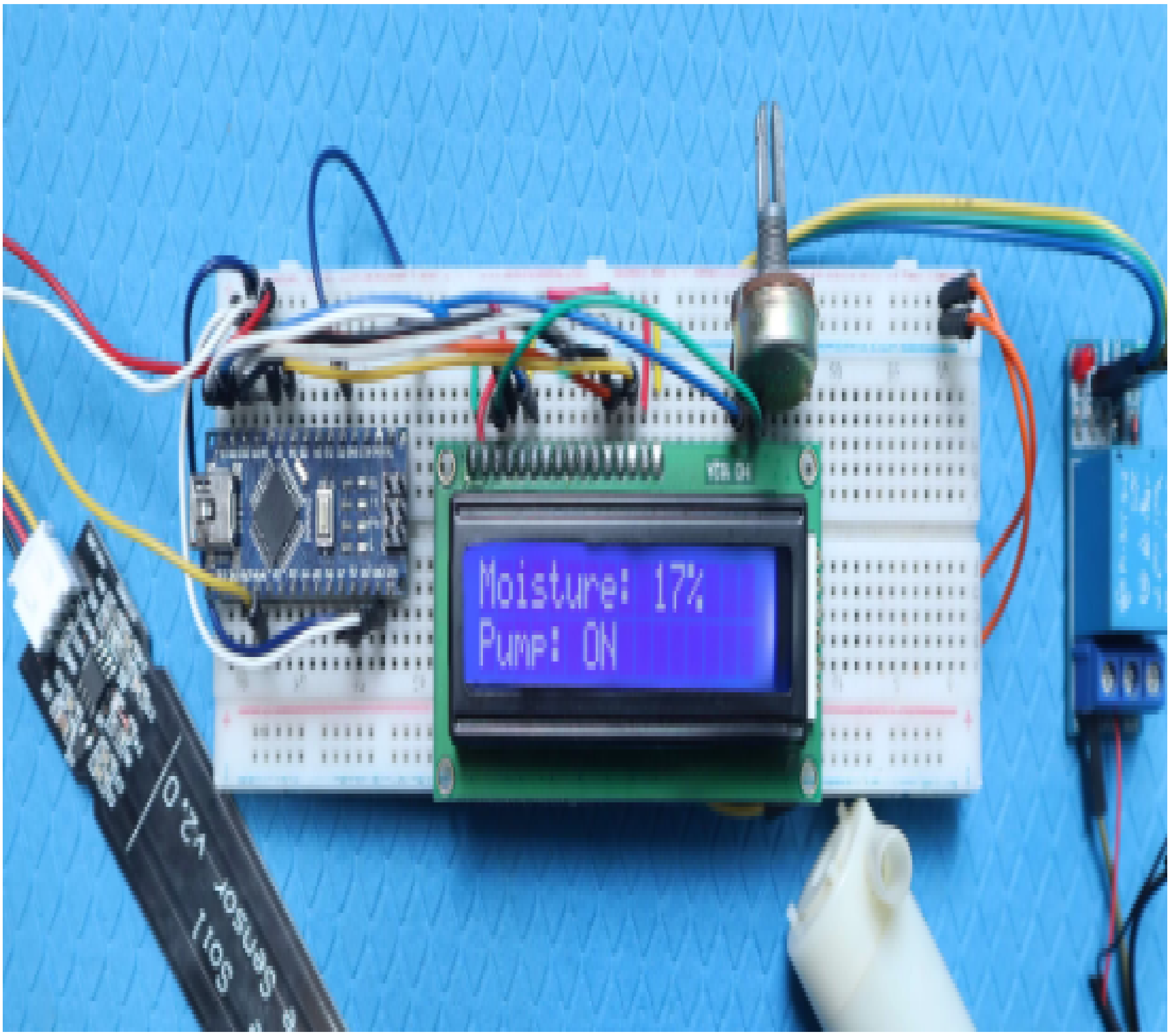



Figure 6.1: **Output**

# Chapter 7

# CONCLUSION AND FUTURE ENHANCEMENTS

## 7.1 Conclusion

The smart irrigation control system using GSM technology represents a significant advancement in water management for agriculture, effectively optimizing water usage and enhancing crop yields. By integrating soil moisture sensors, GSM communication, and automated irrigation controls, the system allows for efficient, responsive irrigation that conserves water and reduces labor costs. Its successful implementation highlights the potential for widespread application in various agricultural settings, providing farmers with improved control and sustainability. As water scarcity becomes a growing concern, adopting such innovative technologies is crucial for promoting sustainable agricultural practices and addressing modern farming challenges.

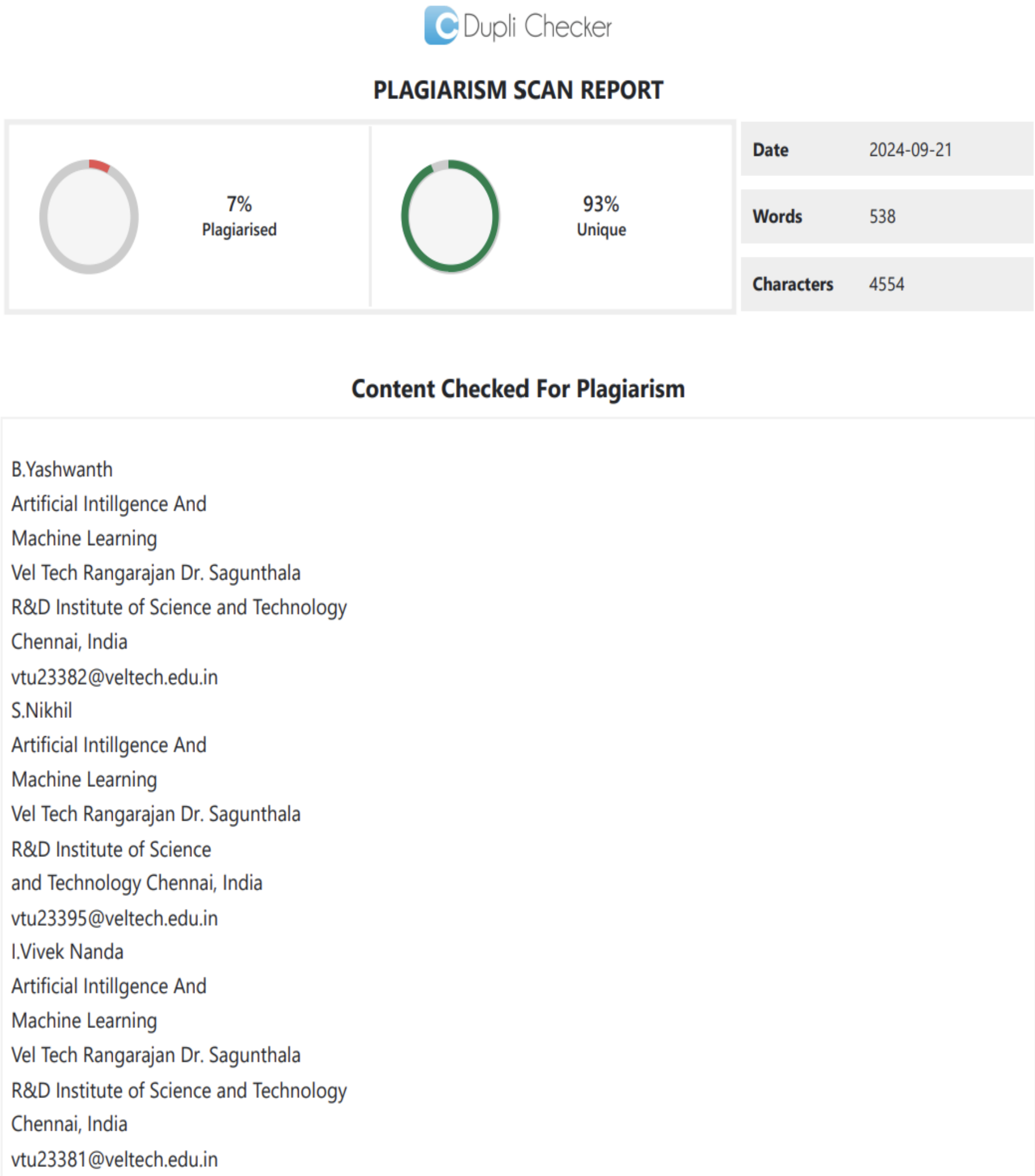
## 7.2 Future Enhancements

Future enhancements for the smart irrigation control system using GSM technology could include several advancements to increase efficiency and user experience. First, integrating IoT (Internet of Things) capabilities would allow for real-time monitoring and data analytics through a mobile or web application, providing users with detailed insights into soil conditions and irrigation performance. Additionally, incorporating weather forecasting data can help automate irrigation schedules based on predicted rainfall or temperature changes, further optimizing water usage.

Expanding the system to include multiple types of sensors—such as temperature, humidity, and light sensors—would provide a more comprehensive view of environmental conditions, allowing for tailored irrigation strategies. Machine learning algorithms could also be employed to analyze historical data, improving decision-making for irrigation based on crop type and growth stages. Finally, enhancing the system's power supply with solar panels would increase sustainability, making it suitable for remote areas. These enhancements would significantly improve the system's functionality, usability, and impact on sustainable agriculture.

# Chapter 8

# PLAGIARISM REPORT



Dupli Checker

**PLAGIARISM SCAN REPORT**

| | |
|---|---|
| 7% Plagiarised | 93% Unique |

| | |
|---|---|
| **Date** | 2024-09-21 |
| **Words** | 538 |
| **Characters** | 4554 |

**Content Checked For Plagiarism**

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Figure 8.1: **Plagiarism Report**

‘

# Appendices

# Appendix A

# Sample Data

## A.1 Random Forest Classifier

```
import pandas as pd
legitimate_urls = pd.read_csv("C:extracted_csv_files/legitimate-urls.csv")
phishing_urls = pd.read_csv("C:extracted_csv_files/phishing-urls.csv")
legitimate_urls.head(10)
phishing_urls.head(10)
urls = legitimate_urls.append(phishing_urls)
urls.head(5)
urls = urls.drop(urls.columns[[0,3,5]],axis=1)
urls = urls.sample(frac=1).reset_index(drop=True)
urls_without_labels = urls.drop('label',axis=1)
urls_without_labels.columns
labels = urls['label']
from sklearn.model_selection import train_test_split
data_train, data_test, labels_train, labels_test =
train_test_split(urls_without_labels, labels, test_size=0.30,
random_state=110)
from sklearn.ensemble import RandomForestClassifier
random_forest_classifier = RandomForestClassifier()
random_forest_classifier.fit(data_train,labels_train)
prediction_label = random_forest_classifier.predict(data_test)
from sklearn.metrics import confusion_matrix,accuracy_score
cpnfusionMatrix = confusion_matrix(labels_test,prediction_label)
print(cpnfusionMatrix)
accuracy_score(labels_test,prediction_label)
custom_random_forest_classifier =
```

```
RandomForestClassifier(n_estimators=500,
max_depth=20, max_leaf_nodes=10000)
custom_random_forest_classifier.fit(data_train,labels_train)
custom_classifier_prediction_label =
custom_random_forest_classifier.predict(data_test)
confusionMatrix2 =
confusion_matrix(labels_test,custom_classifier_prediction_label)
print(confusionMatrix2)
accuracy_score(labels_test,custom_classifier_prediction_label)
import matplotlib.pyplot as plt
import numpy as np

importances (the higher, the more important the feature).

in the order the features were fed to the algorithm
importances = custom_random_forest_classifier.feature_importances_
#std = np.std([tree.feature_importances_ for tree in
custom_random_forest_classifier.estimators_],axis=0)

important.
indices = np.argsort(importances)[::-1]
print(f"indices of columns : {indices}")
# Print the feature ranking
print("\n ***Feature ranking: *** \n")
print("Feature name : Importance")
for f in range(data_train.shape[1]):
print(f"{f+1} {data_train.columns[indices[f]]} :
{importances[indices[f]]} \n")
print(" The blue bars are the feature importances of the
randomforest classifier,
along with their inter-trees variability*")
# Plot the feature importances of the forest
plt.figure()
```

```
plt.title("Feature importances")
plt.bar(range(data_train.shape[1]), importances[indices],
color="b", align="center")
are not making it plot.
plt.xticks(range(data_train.shape[1]), data_train.columns[indices])
plt.xlim([-1, data_train.shape[1]])
plt.rcParams['figure.figsize'] = (35,15)
#this will increase the size of the plot
plt.show()
```

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