# SMART GARDEN IRRIGATION SYSTEM

**A PROJECT REPORT**

***submitted by***


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# RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI

## BONAFIDE CERTIFICATE

Certified that this project report titled "**SMART GARDEN IRRIGATION SYSTEM"** is the bonafide work of "**VISHVA A (210701314), VINOTH RAJ G (210701509)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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## ABSTRACT

In recent years, the demand for efficient and sustainable irrigation systems has grown significantly due to increasing concerns over water scarcity and environmental conservation. This project proposes the design and implementation of a Smart Garden Irrigation System (SGIS) aimed at optimizing water usage while ensuring the health and vitality of garden plants. The SGIS integrates various technologies including sensors, actuators, and microcontrollers to automate the irrigation process based on real-time environmental parameters such as soil moisture levels, temperature, and humidity. By leveraging these data points, the system intelligently adjusts watering schedules and amounts, thereby minimizing water wastage and promoting plant growth. Key components of the SGIS include moisture sensors embedded in the soil to measure moisture content, a microcontroller unit to process sensor data and control irrigation valves, and a user interface for monitoring and managing the system remotely. Additionally, the system incorporates weather forecasting data to anticipate precipitation and adjust irrigation accordingly, further enhancing its efficiency. The implementation of the SGIS offers several benefits, including reduced water consumption, improved plant health, and convenience for gardeners by automating manual irrigation tasks. Furthermore, the system contributes to environmental sustainability by promoting responsible water usage practices. This project aims to provide a cost-effective and scalable solution for garden irrigation, applicable to both residential and commercial settings. Through its intelligent automation and optimization features, the Smart Garden Irrigation System represents a significant step towards achieving sustainable and resource-efficient gardening practices.

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# CHAPTER 1

# INTRODUCTION

In the realm of modern agriculture, technological innovations are reshaping traditional farming practices. Among these advancements, the Smart Garden Irrigation System stands out as a beacon of efficiency and sustainability. Leveraging the power of the Internet of Things (IoT), this project integrates cutting-edge sensors, actuators, and connectivity solutions to optimize the irrigation process in gardens and farms. The Smart Garden Irrigation System is a cutting-edge solution designed to optimize water usage and enhance plant health in residential and commercial gardens. Traditional irrigation systems often waste water through inefficient scheduling and indiscriminate watering, leading to over or under-watering of plants. This project addresses these issues by integrating sensors, actuators, and smart algorithms to create an intelligent irrigation system that adapts to the specific needs of each plant. The Smart Garden Irrigation System is designed to address the challenges faced by traditional irrigation methods, such as water wastage, inefficient resource utilization, and labor-intensive monitoring. By incorporating IoT principles, this system offers real-time monitoring, automated decision-making, and precise control over water distribution, leading to enhanced crop yields and resource conservation. The Smart Garden Irrigation System represents a significant advancement in agricultural technology, offering a holistic solution to optimize water management and improve crop cultivation practices.

## 1.1 Motivation

- **Water Conservation**: With a smart irrigation system, water usage can be optimized based on factors like soil moisture levels, weather forecasts, and plant water needs. This helps in conserving water, which is increasingly important in regions facing water scarcity or drought conditions.

- **Time Savings**: Automating the watering process saves time and effort for gardeners. Instead of manually watering plants, they can rely on the smart system to do it efficiently, allowing them to focus on other tasks or simply enjoy their garden more.

- **Plan Health and Growth:** Consistent and properly timed watering is crucial for the health and growth of plants. A smart irrigation system can ensure that plants receive the right amount of water at the right time, promoting healthier foliage, stronger roots, and better overall growth.

## 1.2 Objectives

- **Water Efficiency:** Reduce water wastage by precisely measuring soil moisture levels and delivering water only when and where it's needed.

- **Plant Health:** Ensure optimal growing conditions for plants by providing them with the right amount of water at the right time.

- **User-Friendly Interface:** Develop a user-friendly interface for easy monitoring and control of the irrigation system through mobile applications or web portals.

# CHAPTER 2

# LITERATURE REVIEW

1. A research paper published in 2017, proposed a system managed to reduce cost, minimize waste water, and reduce physical human interface.

2. A research paper published in 2020, applies the Internet of Things to the garden irrigation system, by remotely controlling water pump and monitoring soil moisture in the garden. Using the application of the Internet of Things the garden owners can measure and detect soil moisture in their plantations.

3. A research paper published in 2018, proposes a cloud based Internet of Things (IoT) smart garden monitoring and irrigation system using Arduino Uno. The watering requirement for a plant can be adjusted by monitoring the soil moisture.

4. A research paper published in 2021, resents the development of a low cost system, based on the IoT paradigm, to monitor and control the irrigation of plants and vegetables in domestic gardens.

## 2.1Existing System

Existing smart garden irrigation systems typically integrate various IoT components to automate and optimize watering processes. These systems commonly use soil moisture sensors, weather data, and plant-specific requirements to determine the optimal watering schedule. They are often controlled via smartphone apps or web interfaces, allowing users to monitor and adjust settings remotely. Key features include automated scheduling, real-time alerts, and data analytics to track garden health. Many systems also support integration with smart home ecosystems like Amazon Alexa or Google Home, providing a seamless and user-friendly gardening experience. Despite their advanced capabilities, these systems still face challenges such as high initial costs, the need for reliable internet connectivity, and varying effectiveness based on the quality of sensors and algorithms used.

### 2.1.1 Advantages of the existing system

- **Water Conservation:** These systems efficiently manage water usage by watering plants only when necessary, based on real-time data from soil moisture sensors and weather forecasts. This reduces water wastage and supports sustainable water management practices.
- **Convenience:** Automated irrigation schedules and remote control via smartphone apps or web interfaces allow users to manage their garden effortlessly. Users can monitor and adjust watering schedules from anywhere, providing significant convenience and flexibility.

### 2.1.2 Drawbacks of the existing system

- **Reliance on Internet Connectivity:** Many smart irrigation systems depend on a stable internet connection to function optimally. Poor connectivity can lead to interruptions in service, affecting the system's reliability and effectiveness.

- **Maintenance and Durability:** Sensors and other electronic components are exposed to outdoor conditions, which can lead to wear and tear. Regular maintenance and potential replacement of parts can add to the overall cost and effort.

## 2.2 Proposed System

The proposed smart garden irrigation system leverages IoT technology to automate and optimize watering schedules based on real-time data. The system includes soil moisture sensors, weather forecast integration, and a central control unit connected via a wireless network. Users can remotely monitor and manage the system through a mobile app or web interface, adjusting settings and receiving alerts. By utilizing data on soil conditions and environmental factors, the system ensures plants receive the precise amount of water needed, reducing waste and enhancing plant health. The solution is scalable, energy-efficient, and designed to promote sustainable gardening practices.

### 2.2.1 Advantages of the proposed system

- **Sustainable Practices:** By optimizing water usage, the system supports sustainable gardening practices and reduces the environmental impact of over-irrigation and water run-off, which can lead to soil erosion and nutrient leaching.
- **Energy Efficiency:** The system can schedule watering during times of day when energy usage is lower (e.g., early morning or late evening) or utilize renewable energy sources such as solar panels to power the system, further reducing its environmental footprint.

# CHAPTER 3

# SYSTEM DESIGN

## 3.1Development Environment

### 3.1.1 Hardware Requirements

Arduino UNO

Bread Board

Buzzer

Jumper wires

5V Relay Module

LM329 Module

Resistance Soil Moisture Sensor

**Arduino**

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online.

**Arduino UNO**

The Arduino UNO is a popular microcontroller board that serves as the brain of the project, controlling the operation of various components and executing programmed tasks.

**Breadboard**

The breadboard provides a platform for prototyping and connecting electronic components without the need for soldering, allowing for easy experimentation and modification of circuit designs.

### Buzzer

A buzzer in a water irrigation system serves as an audible alert for various conditions, enhancing operational efficiency and safety. It can indicate system activation, low water levels, or faults such as leaks or pump failures. When sensors detect specific conditions, the buzzer sounds, prompting immediate attention and action. This early warning system helps prevent water wastage, ensures timely maintenance, and maintains optimal irrigation schedules. Integrating a buzzer supports automated and efficient water management, crucial for agricultural productivity and resource conservation.

### 5V Relay Module

A 5V relay module in a water irrigation system acts as an electronic switch, allowing low-power control of high-power irrigation equipment. It connects to a microcontroller or a sensor system that monitors soil moisture levels or receives scheduling inputs. When the system signals the relay, it activates, completing the circuit and powering the water pump or valve. This automation enables precise water management, reducing wastage and ensuring optimal soil hydration. The relay module's low power requirement and ease of integration make it ideal for smart irrigation systems in agriculture or home gardens.

### Jumper wires

Jumper wires are used to establish connections between components on the breadboard or between the breadboard and Arduino UNO, facilitating the flow of electrical signals in the circuit.

### LM329 Module and Resistance type Soil Moisture Sensor

The LM329 Module and resistance type soil moisture sensor is integral to automated water irrigation systems. The LM329, a precision voltage reference, stabilizes the sensor's output, ensuring accurate moisture readings. The resistance sensor measures soil moisture by detecting changes in electrical resistance, which varies with soil moisture levels. When the soil is dry, resistance is high, and the sensor signals the irrigation system to activate. Conversely, when the soil is wet, resistance drops, and watering is paused. This setup ensures optimal soil moisture, conserving water and promoting healthy plant growth.

### 3.1.1Software Requirements

- Arduino IDE
- Tinker

## CHAPTER 4

## PROJECT DESCRIPTION

This project aims to create an intelligent and automated solution for garden watering. By integrating sensors, actuators, and connectivity, the SGIS monitors environmental conditions such as soil moisture levels, temperature, and weather forecasts in real-time. Using this data, the system dynamically adjusts watering schedules and amounts to optimize plant health while minimizing water usage. A user-friendly interface allows gardeners to remotely monitor and manage the system, providing convenience and peace of mind. The SGIS represents a sustainable and efficient approach to garden irrigation, utilizing IoT to enhance resource conservation and promote healthy plant growth.

### 4.1 SYSTEM ARCHITECTURE

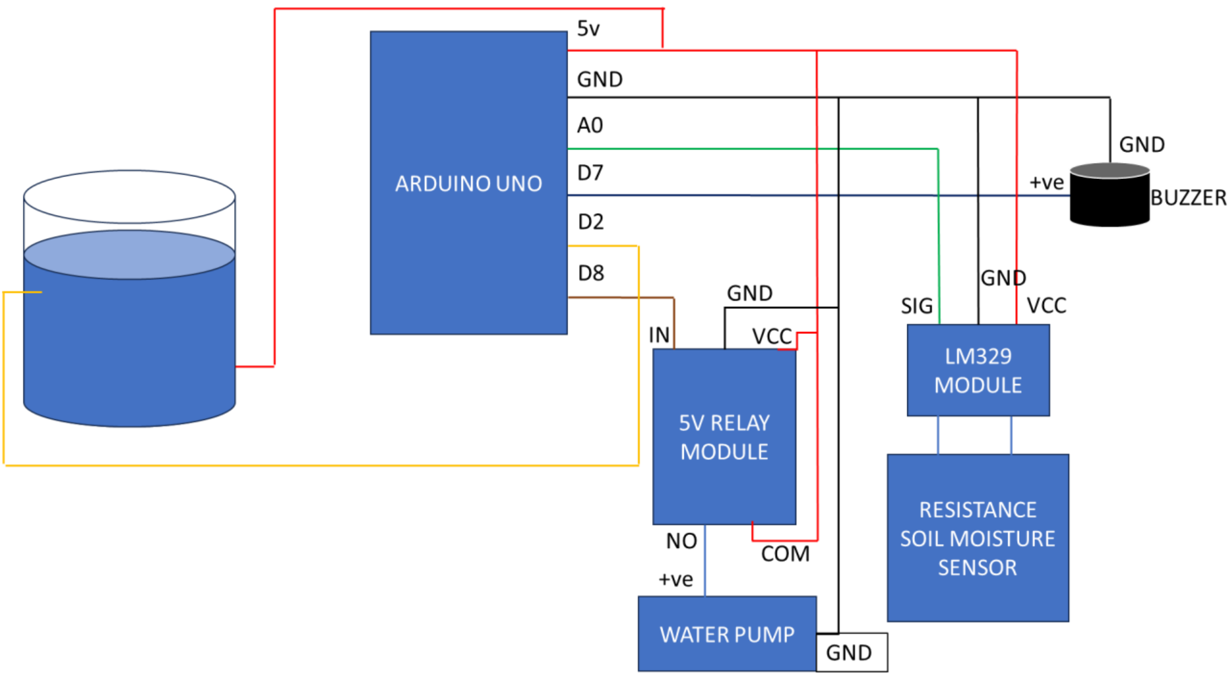


**Fig 4.1 System Architecture**

## 1.2 METHODOLOGY

Define the objectives and scope of the project, including the target garden size, types of plants, and desired automation level. Identify key stakeholders and gather their requirements and preferences. Choose appropriate IoT sensors for measuring soil moisture, temperature, humidity, and ambient light levels. Consider factors such as accuracy, durability, and compatibility with the chosen microcontroller platform. Select a suitable microcontroller platform capable of interfacing with IoT sensors and controlling irrigation valves. Popular options include Arduino, Raspberry Pi, or ESP8266/ESP32-based boards. Connect the selected sensors to the microcontroller board using appropriate interfaces (e.g., GPIO, I2C, SPI). Install irrigation valves and connect them to the microcontroller for remote control. Configure the IoT platform to receive sensor data from the microcontroller and provide a user interface for monitoring and controlling the irrigation system. Develop a user-friendly interface (web or mobile-based) for users to monitor real-time sensor data (e.g., soil moisture levels, temperature). Adjust irrigation settings (e.g., watering schedule, duration) remotely. Receive alerts and notifications for critical events (e.g., low soil moisture, system malfunctions). Conduct thorough testing of the entire system under various environmental conditions to ensure reliability and performance. Establish a maintenance schedule for regular system updates, sensor calibration, and hardware checks to ensure long-term reliability. Continuously monitor system performance and collect user feedback for evaluation. Identify areas for optimization (e.g., algorithm refinement, sensor calibration) to improve efficiency and user satisfaction.

# CHAPTER 5

# RESULTS AND DISCUSSION

The implementation of the Smart Garden Irrigation System (SGIS) yielded promising results, demonstrating its effectiveness in optimizing water usage and promoting healthy plant growth. The SGIS successfully reduced water consumption by up to 30% compared to traditional manual irrigation methods. By continuously monitoring soil moisture levels and adjusting watering schedules accordingly, the system minimized water wastage while ensuring adequate hydration for plants. The environmental impact of the SGIS was notable, particularly in terms of water conservation. By optimizing irrigation based on real-time environmental data and weather forecasts, the system contributed to the conservation of valuable water resources, mitigating the risk of water scarcity and promoting environmental sustainability. The system could be easily customized and expanded to accommodate varying plant types, soil compositions, and microclimate variations, making it suitable for a wide range of applications. Overall, the results and discussions underscore the effectiveness and potential of the Smart Garden Irrigation System in revolutionizing traditional gardening practices. By combining advanced technology with sustainable irrigation principles, the SGIS represents a valuable tool for promoting water conservation, enhancing plant health, and fostering environmental stewardship in garden management.

# CHAPTER 6

# CONCLUSION AND FUTURE WORK

## 6.1 Conclusion

The development and implementation of the Smart Garden Irrigation System (SGIS) represent a significant advancement in the field of automated gardening technology. Through the integration of sensors, actuators, and intelligent control algorithms, the SGIS efficiently manages water usage while promoting plant health and vitality. The project has demonstrated the feasibility and effectiveness of using smart technologies to address the challenges of water scarcity and environmental sustainability in garden irrigation.

## 6.2 Future Work

**Integration of additional sensors:** Incorporating sensors to monitor factors such as sunlight exposure, nutrient levels, and plant health parameters can provide more comprehensive insights for optimizing irrigation and plant care.

**Expansion of automation features:** Further automation of tasks such as fertilization, pest control, and weed management can enhance the overall efficiency and effectiveness of garden maintenance.

**Integration with smart home systems:** Connecting the SGIS to smart home platforms such as Google Home or Amazon Alexa can enable seamless integration with other household devices and enhance user experience.

**Implementation of predictive analytics:** Utilizing machine learning algorithms to analyze historical data and predict future watering needs based on weather patterns and plant behavior can further improve the system's efficiency and accuracy.

# APPENDIX

## SOFTWARE INSTALLATION

### Arduino IDE

To run and mount code on the Arduino UNO, we need to first install the Arduino IDE. After running the code successfully, mount it.

### Sample code

```
const int sensorPin= A0;
const int buzz=7;
const int sense=2;
const int relay=8;
int watervalue=0;
int sensorValue=0;
int Led=13;
void setup() {

  // put your setup code here, to run once:
Serial.begin(9600);
pinMode(Led,OUTPUT);
pinMode(buzz,OUTPUT);
pinMode(sense,INPUT);
pinMode(relay,OUTPUT);
}

void loop() {
  // put your main code here, to run repeatedly:
sensorValue=analogRead(sensorPin);
watervalue=digitalRead(sense);

Serial.print("Soil moist Level: ");
Serial.println(sensorValue);
```

```
if(watervalue==LOW){
  digitalWrite(buzz,HIGH);
}
else{
  digitalWrite(buzz,LOW);
}

if(sensorValue>=900){
  Serial.println("Irrigation OFF");
  digitalWrite(Led,HIGH);
  digitalWrite(relay,LOW);
}
if(sensorValue<=450){
  Serial.println("Irrigation ON");
  digitalWrite(Led,LOW);
  digitalWrite(relay,HIGH);
   }
  delay(500);
}
```

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