# Autonomous Irrigation Robot

**Group Project**

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## Introduction

Efficient water management is a critical challenge in agriculture and gardening. Traditional irrigation methods often lead to overwatering, resulting in water wastage and reduced soil health. Automation in irrigation can help address this issue by delivering water only when required.
This project presents an **Autonomous Irrigation Robot** designed to detect plants and measure soil moisture in real time. Based on sensor feedback, the robot decides whether watering is necessary, thereby improving irrigation efficiency and reducing water wastage.

## Objective

The main objectives of this group project are:

- To design an autonomous mobile robot for plant-based irrigation.
- To detect plants using infrared (IR) sensors.
- To measure soil moisture in real time.
- To automate watering using a moisture-based decision system.
- To reduce unnecessary water usage.

## System Overview

The autonomous irrigation robot consists of a mobile platform controlled by an Arduino microcontroller. The robot moves forward continuously while monitoring its surroundings using an IR sensor. When a plant is detected, the robot stops and checks the soil moisture near the plant.
If the soil moisture level is below a predefined threshold, a water pump is activated to irrigate the plant. Once adequate moisture is achieved, the pump is turned off and the robot resumes movement.

## Hardware Components

- Arduino microcontroller
- Infrared (IR) sensor for plant detection
- Soil moisture sensor
- DC motors with wheels
- Dual L293D motor driver ICs
- Servo motor
- DC water pump
- Power supply and connecting wires

## Working Principle

The operation of the robot follows a simple step-by-step logic:

1. The robot moves forward using DC motors.
2. The IR sensor continuously checks for the presence of a plant.
3. When a plant is detected, the robot stops.
4. The soil moisture sensor measures the moisture content of the soil.
5. If the soil is dry, the water pump is switched ON.
6. Watering continues until the moisture level reaches the desired threshold.
7. The pump is switched OFF and the robot resumes movement.

This logic ensures that water is supplied only when necessary.

## Software Logic

The Arduino program controls all system operations, including:

- Reading analog values from IR and soil moisture sensors.
- Comparing sensor values with predefined threshold levels.
- Controlling motor movement using L293D motor drivers.
- Activating and deactivating the water pump.
- Using serial communication for monitoring and debugging.

## Advantages

- Reduces water wastage by avoiding unnecessary irrigation.
- Operates autonomously with minimal human intervention.
- Low-cost and easy to implement.
- Demonstrates practical application of embedded systems and sensors.

## Limitations

- Limited coverage area due to mobile platform constraints.
- Accuracy depends on proper calibration of sensors.
- Not suitable for large-scale agricultural fields in its current form.

## Future Scope

The system can be further enhanced by:

- Adding wireless communication for remote monitoring.
- Integrating multiple sensors for larger coverage.
- Using GPS-based navigation for structured movement.
- Connecting the system to IoT platforms for data logging.

## Conclusion

This group project successfully demonstrates an autonomous irrigation robot capable of detecting plants and watering them based on real-time soil moisture measurements. The system improves irrigation efficiency and reduces water wastage using simple yet effective embedded control techniques. The project provides valuable hands-on experience in robotics, sensor interfacing, and microcontroller-based system design.