



## ECO-SPRAY (WATER SPRINKLER ROBOT)

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**Abstract** – The Plant Irrigation Water Sprinkler Robot System utilizes a mobile robotic platform equipped with a single sprinkler and an integrated water tank. As the robot moves across the field, it continuously sprays water, functioning like a moving irrigation unit that can cover large areas without the need for manual supervision. With the addition of geo-fencing sensors, the robot can navigate within predefined boundaries, ensuring that the entire field is efficiently irrigated without human intervention.

This project is mainly designed for agricultural use, allowing water to be sprayed using a remote- controlled robotic platform. It reduces manual effort, improves work efficiency, and can also be adapted for household gardening or lawn maintenance. The Eco-Sprinkler represents an innovative irrigation approach that supports water conservation and promotes environmentally sustainable watering practices.

**KEYWORDS:** Sprinkler, Battery, Arduino, ultrasonic sensor, Rain sensor, Color Sensor, Arduino software

### I. INTRODUCTION

Sprinklers are often overlooked or underestimated. Some people recognize their value and the advantages they offer, while others dismiss them as an unnecessary expense without truly considering the benefits and possibilities they provide. From improving life safety to business protection, continuity and sustainability, the introduction of automatic sprinklers offers many positive benefits, and they have a long and successful history.

The limitations of water resources combined with increasing global population, make it crucial for agriculture to adopt more efficient irrigation systems. Automation and smart irrigation technologies are transforming the role of the farmer, allowing them to manage water usage more efficiently and reduce labor costs. As technology continues to advance, the ability to improve water productivity and maintain sustainable farming practices is becoming more achievable than ever. Generally, irrigation systems are grouped into two main types: pressure-based and gravitational. Pressure systems include methods like sprinkler and drip irrigation, while gravitational systems typically involve furrow irrigation. Selecting the appropriate

system helps improve water productivity and reduce overall farming costs. Although sprinkler-based irrigation can meet crop needs throughout the growing season, it often requires constant supervision, and relying on a worker to manually monitor and control the system is not practical or economical.

With advancements in technology, as well as the development of modern processors and controllers, farmers can now take on a more supervisory role from a distance. These innovations make off field monitoring easier and more effective, especially with the introduction of newer automated irrigation systems.

#### I. Description of Components and Their Functional Roles

##### Keyboard

The remote contains four keys—forward, reverse, left, and right—allowing simple manual control of the irrigation robot through the microcontroller.

##### Mild steel

Mild steel is used for the robot's frame. Its low carbon content makes it strong, durable, and suitable for agricultural environments.

##### Sprinkler

The sprinkler is the main irrigation component of the system. It distributes water over crops in a controlled manner, like natural rainfall. In this robot, the sprinkler is connected to a water tank and pump, allowing it to spray water evenly as the robot moves across the field. Sprinkler systems are widely used in farms, gardens, and lawns due to their efficiency and uniform water coverage.

##### Micro Controller

When a key is pressed, the controller sends the corresponding command to the robot. This project uses an Arduino Uno microcontroller, which serves as the central unit of the system. It handles all sensor inputs, controls the motors, and manages the robot's overall operation, making it the core component of the project.

### Battery

This block is essential because all components need proper power to operate. The microcontroller runs on +5V, while the relay and DC motors require +12V. The transmitter uses a 9V battery along with a voltage regulator to supply the necessary 5V to the microcontroller.

### RF Transmitter

This project is divided into two main modules: the transmitter and the receiver (Agrobot). The transmitter, which acts as the remote, contains a keyboard and an RF transmitter. The receiver side uses a 12V battery to power the relay and DC motors. A voltage regulator is included to convert the supply down to 5V DC for components like the microcontroller that require lower voltage.

### RF Receiver

The RF receiver, as shown in the block diagram, demodulates the incoming signal. This process extracts the original data sent by the transmitter, allowing the robot to respond to the correct commands.

### Ultrasonic sensor

Ultrasonic sensors enable the robot to detect obstacles, measure distance, and avoid collisions, facilitating autonomous navigation across the field.

### Rain sensor

Rain sensors detect precipitation and signal the irrigation system to halt watering during or after rainfall, preventing unnecessary water usage and plant overwatering.

### Color sensor

The color sensor detects leaf or soil color to identify plant health or dryness. If the soil appears light or leaves look pale, the sprinkler activates automatically. It ensures precise watering only when and where needed.

## III. WORKING

The water sprinkler robot works by automatically detecting plant and soil conditions to control watering efficiently. It moves around the garden or field using wheels controlled by a microcontroller (like Arduino). A **color sensor** checks the leaf and soil color to assess plant health and dryness. A **soil moisture sensor** measures how much water is present in the soil. When the soil is dry or the leaves look pale or yellow, the microcontroller activates the **water pump**. The **pump and sprinkler system** then spray water onto the plants. Once the sensors detect enough moisture or healthy

color, the system automatically stops watering. The robot can navigate to different areas using **ultrasonic sensors** to avoid obstacles. It operates on **battery or solar power**, making it energy efficient. Overall, the robot ensures smart, automatic, and water-saving irrigation for plants. The system primarily consists of a microcontroller, soil moisture sensor, motor driver module, DC motors, and a water pump integrated on a mobile robotic platform. The soil moisture sensor continuously monitors the moisture level of the soil and transmits the corresponding analog signal to the microcontroller. Based on the sensor input, the microcontroller decides whether irrigation is required. When the soil moisture level falls below a predefined threshold, the controller activates the water pump through a relay module to sprinkle water onto the soil. Once the desired moisture level is reached, the pump is automatically turned off.

The robot is capable of navigating across the field using DC motors controlled by the microcontroller and a motor driver circuit. Obstacle detection sensors may also be employed to ensure smooth movement and avoid collisions. This automation ensures efficient water distribution, minimizes wastage, and enhances crop health by maintaining an optimal soil moisture balance. The proposed system represents an intelligent, cost-effective, and energy-efficient approach toward smart irrigation and sustainable agriculture.

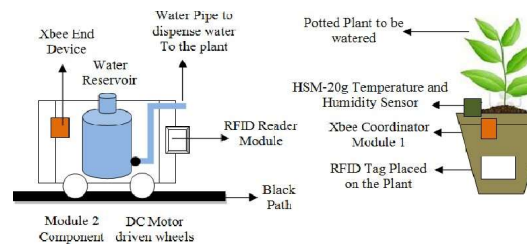


Figure 1 overview of the model

The developed Water Sprinkler Robot was successfully designed, implemented, and tested under various soil conditions to evaluate its performance and reliability. The system effectively detected the soil moisture level and initiated the irrigation process automatically when the moisture content dropped below the preset threshold. During testing, the robot demonstrated accurate sensing and timely actuation of the water pump, ensuring uniform water distribution across the field area. The automated control significantly reduced water wastage compared to manual watering methods.



Figure 2 Final Model

#### IV. RESULTS

The EcoSprinkler/ Eco-spray is an innovative irrigation system designed to promote water conservation and enhance environmental sustainability. By incorporating smart technology, the Eco Sprinkler optimizes water usage based on real-time environmental data, such as weather forecasts, soil moisture levels, and plant needs. This system minimizes water wastage and reduces energy consumption by ensuring that water is delivered efficiently to where it is needed most.

A proper algorithmic proposal in designing a sensor-based controller system for measuring several critical parameters for a plant culture such as moisture of the soil, humidity, intensity of the light, and temperature are under consideration. The automated control significantly reduced water wastage compared to manual watering methods. The robot's mobility and obstacle avoidance features enabled smooth navigation over uneven terrain. Experimental results indicated that the system maintained an optimal soil moisture range of 45– 60%, which is suitable for most crop types.

#### V. CONCLUSION

Eco-Spray represents a transformational advancement in modern agriculture, offering a highly efficient, smart, and sustainable solution for irrigation needs. These robots utilize advanced technologies such as sensors, automation, and artificial intelligence to accurately monitor soil moisture and environmental conditions, delivering the precise amount of water needed by crops at the right time.

Eco-Spray mark a significant leap forward in precision agriculture by enabling targeted water delivery, conserving resources, and fostering sustainable farming practices. While there are some practical and financial challenges to widespread

adoption, the advantages in water conservation, labor reduction, and crop yield make them a valuable investment for the future of agriculture.

#### VI. ACKNOWLEDGMENT

We would like to thank EPCET Bengaluru for providing lab facilities to conduct the research, We are grateful to Principal Dr. Pradip kumar Dixit, Vice Principal and HOD Dr. Yogesh G.S Department of Electronics and Communication .We would to thank our guide Dr. Navya V for the support and guidance while doing the research paper.

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