Advanced Technological Institute

Colombo 15

Higher National Diploma in Engineering

Department of Electrical and Electronic Engineering

Project Proposal of

SMART SOLAR IRRIGATION SYSTEM

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INTRODUCTION

Agriculture plays a vital role in ensuring food security and economic stability in many developing countries. However, traditional farming methods often rely heavily on manual labor and inefficient resource management. Irrigation systems frequently waste water due to uncontrolled watering, while water tanks used for irrigation require manual monitoring and refilling.

To address these issues, this project proposes the development of a Solar Powered Smart Irrigation Robot with Automatic Water Tank Management System. The system integrates a mobile irrigation robot with an automated solar-powered water management unit. The robot monitors soil moisture levels and irrigates crops automatically, while the water tank system ensures that sufficient water is always available by pumping water from a well when the tank level decreases.

By combining automation, sensors, robotics, and renewable energy, this system provides a sustainable solution for modern agriculture while reducing human labor and water wastage.

PROBLEM STATEMENT

Farmers face several challenges in traditional irrigation and water management systems:

- Manual irrigation requires significant time and labor.
- Excessive irrigation results in water wastage.
- Water tanks used for irrigation must be monitored and filled manually.
- Electricity supply is often unreliable in rural farming areas.
- Lack of automation reduces farming efficiency.

This project addresses these issues by introducing an automated irrigation and water supply system powered by solar energy.

OBJECTIVES

Main Objective

To design and develop a solar-powered automated irrigation robot integrated with an automatic water tank filling system.

Specific Objectives

- To develop a robot capable of monitoring soil moisture levels.
- To implement an automatic irrigation system based on soil moisture conditions.
- To design an automatic water tank filling system using water level sensors.
- To integrate a solar energy system to power the entire setup.
- To reduce water wastage through smart irrigation control.
- To minimize human effort in agricultural water management.

SYSTEM OVERVIEW

The proposed system consists of two main subsystems that work together.

Automatic Irrigation Robot

The irrigation robot moves through the agricultural field and continuously monitors the moisture level of the soil using sensors. When the soil becomes dry, the robot activates a water pump to irrigate the plants.

Key Features

- Soil moisture monitoring
- Automatic irrigation control
- Motor-driven robotic movement
- Sensor-based decision making
- Solar-powered operation

Solar Water Tank Management System

The water tank management system ensures that water is always available for irrigation. A sensor monitors the water level in the tank. When the water level drops below a certain level, the system automatically pumps water from a well into the tank.

Key Features

- Water level detection using sensors
- Automatic pump control
- Water pumping from well to tank
- Solar-powered operation
- Prevents tank overflow

MAIN COMPONENTS

The system consists of the following major components:

Control System

- Arduino Uno
- ESP32

Sensors

- Soil moisture sensors
- HC-SR04
- Float switches (optional)

Actuators

- 12V DC water pump
- DC motors for robot movement
- Servo motors (for planting or mechanism control)

Power System

- Solar panel (10–20W)
- 12V rechargeable battery
- Solar charge controller

Control Devices

- Relay module
- Motor driver
- LCD display (16×2)

SYSTEM BLOCK DIAGRAM

Solar Panel
↓
Charge Controller
↓
Battery

Battery supplies power to:

- Microcontroller (Arduino Uno / ESP32)
- Sensors
- Motor drivers
- Relay modules
- Water pump
- LCD display

Sensors send data to the controller, and the controller makes decisions to operate pumps and motors.

WORKING PRINCIPLE

The complete system operates in the following stages:

1. Solar Energy Generation

A solar panel converts sunlight into electrical energy. The energy is stored in a battery through a charge controller.

2. Soil Moisture Monitoring

Soil moisture sensors detect the moisture level in the soil and send data to the microcontroller.

3. Automatic Irrigation

If the soil moisture level falls below the set threshold, the microcontroller activates a relay that switches on the water pump to irrigate the field.

4. Water Tank Monitoring

An ultrasonic sensor or float sensor continuously monitors the water level in the storage tank.

5. Automatic Tank Refilling

When the tank water level becomes low, the controller activates a pump that transfers water from the well to the tank.

6. Pump Deactivation

Once the tank becomes full or the soil moisture level reaches the desired value, the pumps are automatically turned off.

METHODOLOGY

The project will be implemented using the following steps:

1. Design the system architecture and circuit diagram.
2. Select appropriate sensors and microcontrollers.
3. Develop the robotic movement platform.
4. Install soil moisture sensors and water level sensors.
5. Integrate relay modules and pumps for irrigation and tank filling.
6. Implement solar power supply with battery storage.
7. Program the microcontroller for automatic control.
8. Test the complete system and analyze performance.

EXPECTED RESULTS

After successful implementation, the system will be able to:

- Automatically detect soil moisture conditions
- Irrigate crops only when required
- Maintain water availability by refilling the tank automatically
- Reduce water wastage
- Operate using renewable solar energy
- Reduce labor requirements in farming

ADVANTAGES OF THE SYSTEM

- Saves water through controlled irrigation
- Reduces manual labor in agriculture
- Uses renewable solar energy
- Works even in areas without electricity
- Improves crop productivity
- Provides smart farming automation

FUTURE IMPROVEMENTS

Future developments may include:

- IoT-based remote monitoring through mobile apps
- GPS navigation for robot movement
- AI-based crop monitoring
- Weather-based irrigation prediction
- Higher capacity solar power systems

BUDGET REPORT

Item	Quantity	Unit Price (LKR)	Total (LKR)
Solar Panel	1	3750	3750
12V DC Battery	1	2400	2400
10A Solar Charger Control	1	1720	1720
12V , 5V Power Supply	2	825	1650
Arduino Uno	1	2550	2550
ESP 32 Board	1	1150	1150
ESP32 Camera	1	300	300
PUC Item	1	2650	2650
Water Pump	2	2600	2600
Relay	2	140	280
Solenoid Valve	5	680	3400
Structure			5800
Total Estimated Cost			**28,250/=**

Supervised By,

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Date Signature

CONCLUSION

The proposed Solar Powered Smart Irrigation Robot with Automatic Water Tank Management System provides an efficient and sustainable solution for modern agriculture. By integrating robotics, sensors, and renewable energy, the system can automate irrigation and water supply processes while minimizing water wastage and human effort. This project demonstrates the potential of smart technologies to improve agricultural productivity and sustainability.

CERTIFICATION

This is to certify that the project titled **"**Solar Smart Irrigation System**"** is a record of the work carried out by the following students in partial fulfillment of the requirements for their academic program.

This project has been completed under the guidance and supervision of the instructor. The work presented in this report is the result of the collective effort of the group members under the leadership of the project leader. It is also declared that this project has not been submitted previously to any other institution for any academic qualification.

We hereby certify that the project has been successfully completed and submitted for evaluation.

Project Leader

Name : K.A.A.Eranda

Student Number : COL/EE/2021/F/141

Signature : _____

Date : _____

Group Members

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