

Smart Irrigation System with Solar Tracking Project

The **Smart Irrigation System with Solar Tracking** is an innovative **IoT + renewable energy project** designed for **students, farmers, and automation enthusiasts**. It automates water supply using soil moisture sensors and powers itself using a **solar panel with a dual-axis tracking system**. This project helps learners explore **IoT, embedded systems, and green energy solutions**.

“Smart irrigation saves water and ensures efficient farming, while solar tracking maximizes clean energy output.”

Why Build Smart Irrigation with Solar Tracking?

- Saves water by automating irrigation
- Eco-friendly with renewable solar energy
- Dual-axis solar tracking increases energy efficiency
- IoT-enabled (optional) for remote monitoring
- Practical application in agriculture and smart cities

Key Features of the Project

- Microcontroller: ESP32 / Arduino Uno
- Soil Moisture Sensor for irrigation control
- Solar Panel with dual-axis servo motors
- Motor driver to control pump and tracking system
- Optional IoT Dashboard for monitoring data

System Basics

The **Smart Irrigation System** checks soil moisture and automatically waters plants when the soil is dry. The **Solar Tracking System** uses LDR sensors to rotate the solar panel toward the sun, improving energy capture.

Main Components

- Soil Moisture Sensor
- Solar Panel + LDR sensors
- Servo Motors (for tracking)
- Relay Module for water pump
- ESP32/Arduino + Motor Driver

Quick Specs

- Soil Moisture Range: 0–1023 (analog)
- Servo Angle: 0–180°
- Pump Voltage: 5V–12V DC
- Operating Voltage: 3.3V/5V
- Wi-Fi enabled (if using ESP32)

First Project: Smart Irrigation + Solar Tracking

This project waters the plants automatically when the soil is dry and tracks the sun using servo motors.

Connections:

- Soil Sensor → A0 (Analog pin)
- Relay Module → GPIO 5 (Pump control)
- Servo Motors → GPIO 12, 13
- LDR Sensors → A1, A2

Code Example:

```
// Smart Irrigation + Solar Tracking
#include <Servo.h>

int soilPin = A0;
int pumpPin = 5;
Servo servoX, servoY;
int ldr1 = A1, ldr2 = A2;

void setup() {
  pinMode(pumpPin, OUTPUT);
  servoX.attach(12);
  servoY.attach(13);
  Serial.begin(9600);
}

void loop() {
  int soil = analogRead(soilPin);
  int l1 = analogRead(ldr1);
  int l2 = analogRead(ldr2);

  // Irrigation control
  if (soil < 400) { // Dry soil
    digitalWrite(pumpPin, HIGH);
  } else {
    digitalWrite(pumpPin, LOW);
  }

  // Solar tracking
  if (l1 > l2) {
    servoX.write(servoX.read() + 1);
  } else {
    servoX.write(servoX.read() - 1);
  }

  delay(500);
}
```

Learning Outcomes:

- Understand soil moisture sensor interfacing
- Control water pumps using relay modules
- Implement solar tracking with servo motors
- Learn basics of IoT and renewable energy

Next Steps & Applications

After this project, students can expand into **IoT-based remote monitoring**, automated greenhouses, and **AI-based smart farming**. It is a stepping stone to building **sustainable agriculture solutions**.

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