IOT_58_3.1

Developing a Smart Irrigation System

Objective

To build a system that automatically waters plants *only* when the soil is dry, preventing water wastage and keeping plants healthy without human intervention.

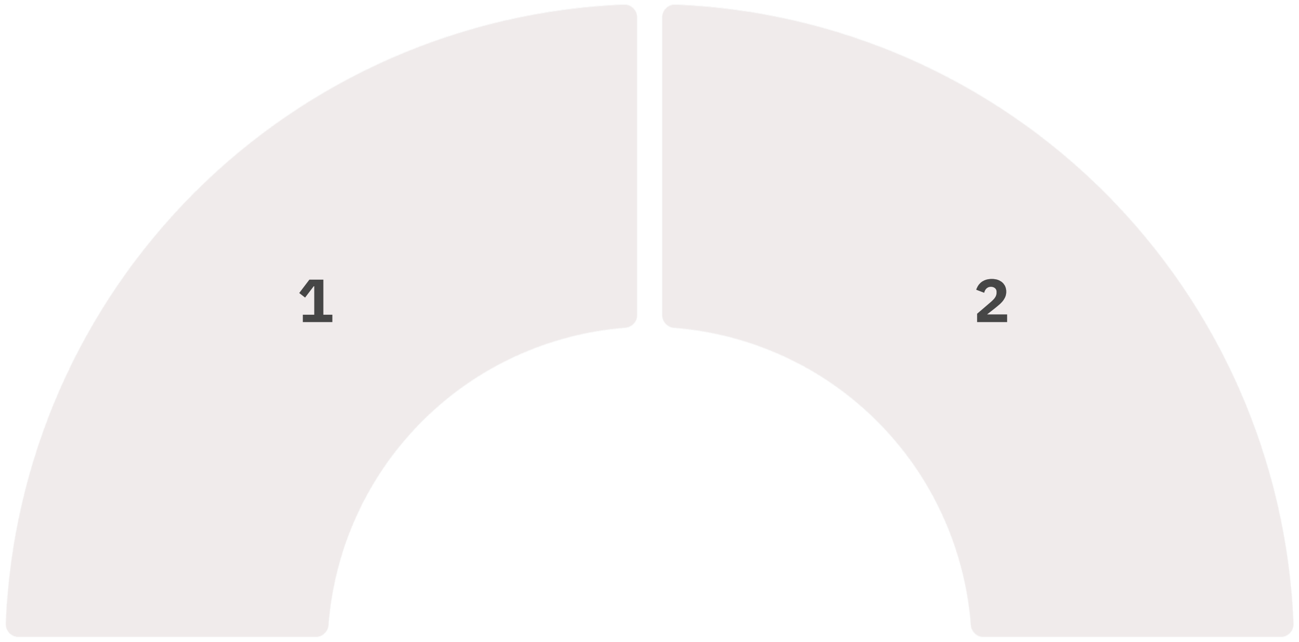
1. What is Smart Irrigation?

Traditional irrigation uses timers (watering every day at 8 AM), regardless of whether it rained or not. Smart irrigation uses **feedback** from the environment.

- **Input:** The system "feels" the soil moisture.
- **Process:** The microcontroller decides if water is needed.
- **Output:** The system turns on a pump if the soil is dry.

2. Why use IoT for this?

- **Efficiency:** Saves water by running only when necessary.
- **Health:** Prevents over-watering (which rots roots) and under-watering.
- **Automation:** Reduces manual labor for farmers or gardeners.



The Hardware Components

To build this system, we need three main categories of hardware:

1. The Senses (Input)

Soil Moisture Sensor: This device has two metal probes that go into the dirt. It measures resistance.

- *Wet Soil:* Conducts electricity well (Low Resistance).
- *Dry Soil:* Does not conduct well (High Resistance).

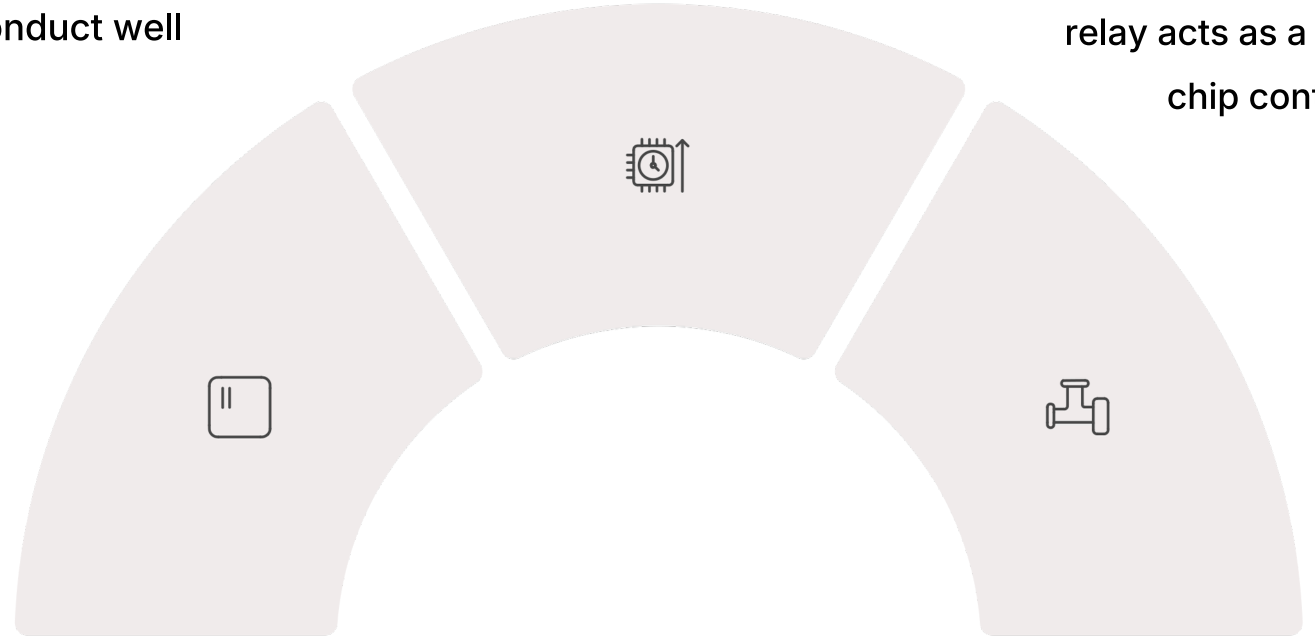
2. The Brain (Processing)

Microcontroller (Arduino/ESP8266): Reads the signal from the sensor and runs the code logic.

3. The Muscle (Output)

Water Pump: A small DC motor that moves water.

Relay Module: Crucial Component. The microcontroller (3.3V/5V) cannot power a pump (12V/220V) directly. The relay acts as a switch that lets the small chip control the big motor.



Understanding the Sensor Data

1. Analog vs. Digital Signals

Most soil moisture sensors have two pins for data: **A0 (Analog)** and **D0 (Digital)**. For this project, we use **Analog**.

Analog Reading (0 - 1023): This gives us a precise number representing moisture level.

Value ~1000: Very Dry (in air).

Value ~300: Very Wet (in water).

(Note: These values vary by sensor, so we must calibrate them first).

2. Setting a Threshold

To make the system "smart," we must define a "Trigger Point" or **Threshold**.

- *Example:* We decide that if the sensor value goes **above 700** (meaning high resistance/dry), the soil is too dry.

Circuit Connection (The Setup)

1. Wiring the Sensor

- **VCC:** Connect to 5V on the Arduino.
- **GND:** Connect to Ground (GND).
- **A0:** Connect to Analog Pin A0.

2. Wiring the Pump via Relay

The pump connects to the relay, not the Arduino directly.

- **Relay IN:** Connect to Digital Pin (e.g., Pin 7).
- **Relay VCC/GND:** Connect to Arduino 5V/GND.
- **Pump Circuit:** The positive wire of the pump is cut and connected to the **COM** (Common) and **NO** (Normally Open) ports of the relay.

The Logic (Programming)

1. The Algorithm

The code runs in a continuous loop (forever):

1.**READ** the moisture value from Pin A0.

2.**COMPARE** the value to our Threshold (e.g., 700).

3. **DECIDE:**

- **IF** (Value > 700): Soil is Dry $\rightarrow$ Turn Relay **ON** (Pump starts).
- **ELSE**: Soil is Wet $\rightarrow$ Turn Relay **OFF** (Pump stops).

4.**WAIT:** Pause for 1 second before checking again.

2. Crucial Logic Tip

Always add a "delay" or "hysteresis" so the pump doesn't rapidly click on and off if the moisture is right at the borderline (e.g., 699... 701... 699).

Conclusion

By combining a **resistive sensor**, a **microcontroller**, and a **relay**, we created a closed-loop control system. The system monitors the environment and reacts to changes physically.

Questions

Q1: Why is a Relay Module necessary in this project?

A microcontroller operates at low voltage/current (5V) and cannot drive a powerful water pump directly. The relay acts as an electrically operated switch to control the high-power circuit.

Q2: What happens to the resistance of the soil sensor when water is added?

The resistance **decreases**. Water conducts electricity better than air, so electricity flows easily between the probes.

Q3: Is this system an "Open Loop" or "Closed Loop" system?

It is a **Closed Loop** system because the output (watering) affects the input (soil moisture), which feeds back into the system to stop the process.