

How the ET-Based IoT Irrigation System Works

Overview:

This system uses Internet of Things (IoT) principles to automate irrigation based on real-time weather data and evapotranspiration (ET) calculations.

Components:

- ESP32 Microcontroller: Acts as the main control unit.
- Relay Module: Controls the water valve (active LOW logic).
- Solenoid Valve: Opens/closes based on the relay.
- Wi-Fi Connectivity: ESP32 connects to the internet to fetch weather data.
- OpenWeatherMap API: Provides current and forecast weather data.
- Web Dashboard: Displays sensor data and system status through a web server on the ESP32.

Workflow:

1. ESP32 connects to Wi-Fi and synchronizes time via NTP (Network Time Protocol).
2. The ESP32 fetches weather data from OpenWeatherMap's One Call API once every 24 hours.
3. It extracts maximum and minimum temperatures and computes the reference ET using the Hargreaves equation.
4. Based on the ET and crop coefficient (K_c), the system calculates how long the valve should be open.
5. The relay module activates the solenoid valve (LOW = ON) for the computed duration.
6. The web dashboard allows users to:
 - View real-time temperature and humidity (from API)
 - Toggle manual override mode
 - Manually open or close the valve
7. The dashboard also shows:

- Last computed ET
- Last irrigation timestamp
- Duration of the last irrigation

8. Every 5 seconds, the dashboard auto-updates temperature and humidity via AJAX.

Advantages:

- Weather-aware and efficient water usage.
- Reduced manual labor and errors.
- Adaptable for different crops by changing K_c .
- Extendable with more valves or sensors.

Notes:

- Relay uses active LOW logic: digital LOW turns the valve ON.
- System operates autonomously when manual override is disabled.