Water Intake / Water Use Analysis

Documentation & Technical Methodology

1. Concept

This module focuses on understanding the **plant–soil water dynamics**. It operates on the principle that soil moisture levels decrease over time due to:

- **Transpiration**: Plants absorbing water through roots and releasing it via leaves.
- **Evaporation**: Water loss directly from the soil surface.

By monitoring the **rate of decline** in soil moisture between irrigation cycles and correlating it with the **volume of water added** (via pump runtime), the system estimates the plant's water consumption and the efficiency of the irrigation strategy.

2. Method

The analysis relies on two key calculations:

A. Water Delivered (Irrigation Event)

We calculate the total volume of water supplied during an active irrigation cycle.

```
Volume (L) = Pump Runtime (min) × Flow Rate (L/min)
```

- **Input**:
    - `Pump Status`: ON/OFF logs.
    - `Flow Rate`: Constant (e.g., 1.0 L/min).

B. Water Consumption (Depletion Rate)

We estimate how fast the soil dries out, which serves as a proxy for plant water use.

```
Depletion Rate (%/hr) = (Moisture_t1 - Moisture_t2) / (Time_t2 - Time_t1)
```

(Where t1 is just after watering and t2 is just before the next watering)

- **Input**:
    - `Soil Moisture`: Continuous sensor readings (%).

3. Insights

The system derives the following insights from the data:

- **Daily Water Use Trend**: Identifies if water consumption is increasing (plant growth/hotter weather) or decreasing (dormancy/cooler weather).
- **High Demand Days**: Correlates steep moisture drops with environmental data (high temp, low humidity) to flag "thirsty" days.
- **Drought Stress Avoidance**: Verifies if the irrigation logic triggers *before* moisture falls below the critical wilting point (e.g., < 30%).

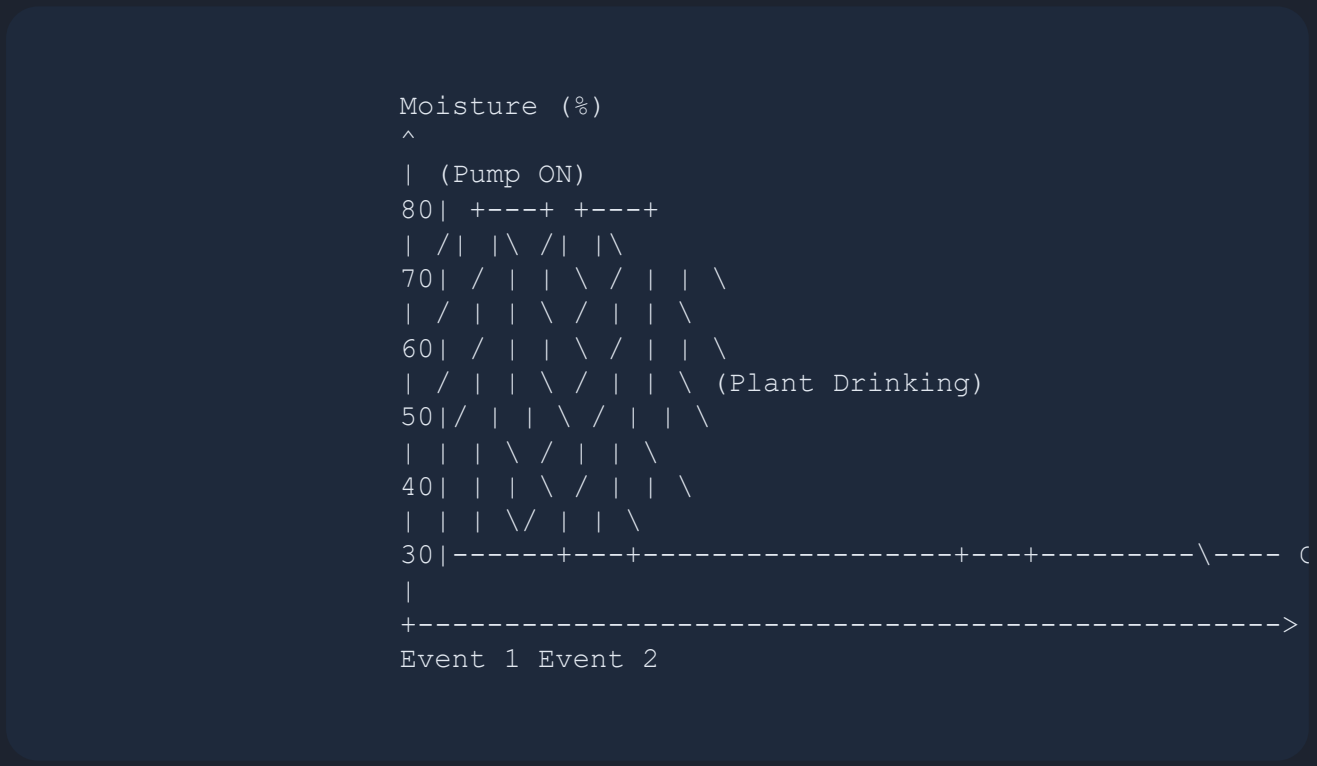
4. Analysis Outputs

A. Water Use Summary Table

Date	Pump Runtime (min)	Water Added (L)	Moisture Drop (%)	Avg. Depletion Rate	Status
2024-05-01	15	15.0	45% → 30%	1.2% / hr	Normal
2024-05-02	20	20.0	40% → 25%	1.8% / hr	**High Demand**
2024-05-03	12	12.0	50% → 35%	1.0% / hr	Normal

B. Soil Moisture & Irrigation Cycle (Diagram)

This ASCII diagram illustrates the "Sawtooth" pattern of soil moisture: rising rapidly during irrigation and declining gradually due to plant use.



C. Interpretation Notes

- **Steep Slope**: Indicates high transpiration (hot/sunny day) or fast drainage (sandy soil).
- **Shallow Slope**: Indicates low water use (cloudy/cool day) or high retention (clay soil).

- **Peak Height**: Confirms if the pump ran long enough to reach field capacity (saturation).
- **Trough Depth**: Shows how close the plant came to water stress before the next cycle.