🌧️ Irrigation Control System 1.0 (BETA): Features & Applications

This web-based platform is designed to manage and monitor an irrigation system in **Los Ebanos, Texas**, prioritizing **water conservation** and cost-efficiency through automated, data-driven control.

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1. Core System Features and Functions

The platform primarily resides on the sprinklers.html page, focusing on the **Sprinkler Override & Status** panel and its associated logic.

Feature Category	Component / Function	Details & Purpose
Control Logic	**Rainfall Threshold** (threshold input)	User-set **rain gauge value (in.)** that acts as the primary shut-off/activation condition. If **Current Rainfall** is **below** this threshold, the system **ACTIVATES**.
Data Input	**Current Rainfall** (rainfall input)	Represents the local rainfall amount (in.). It attempts to **auto-load** from localStorage (dashboardTotalRainfall) but falls back to the manual input value if the data is unavailable or invalid.

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Override	**Day of Week Scheduling**	Allows the user to enable/disable irrigation for any day of the week via checkboxes. If the current day is **disabled**, the system is immediately **OFFLINE (Scheduled)**, overriding the rainfall check.
Cost Simulation	**Cost per Gallon ($)** (costPerGallon)	Defines the water cost for calculating the **Running Cost Simulator** (default: $0.005).
Cost Simulation	**Flow Rate (GPM)** (flowRate)	Defines the water flow rate of the sprinklers (default: 10 GPM) for calculating usage and cost.
Status & Output	**System Status** (statusMessage, sprinklerLed)	Provides real-time feedback: **ACTIVATED** (Green LED), **OFFLINE (Saturated)**, **OFFLINE (Scheduled)**, or **Awaiting Check...**
Status & Output	**System Output** (systemOutput)	Logs important events, including activation/deactivation reasons, email notification status, and error messages.
Logging	**Data Logging** (logSprinklerActivation)	**Logs incremental gallons used and cost every second** to a server-side endpoint (log_sprinkler_data.php) to build historical data.
Communication	**Email Notification** (sendSprinklerActivationEmail)	Triggers a **server-side email** (send_sprinkler_email.php) upon system **ACTIVATION** to a configured recipient (uclabs.llc@gmail.com), including rainfall, threshold, and external weather metrics.

2. Monitoring and Reporting Features

These features provide visual and quantitative data on system usage and external conditions.

A. Real-time Cost Simulator

- **Total Gallons Used**: Tracks the cumulative gallons used since the current run started.
- **Total Running Cost**: Displays the total monetary cost of the current run, calculated from gallons and Cost per Gallon.
- **calculateCost() function**: This runs every second when the system is **ACTIVATED**, incrementing usage and cost based on the configured Flow Rate (GPM).

B. Data Visualization (Charts)

- **Gallons Chart**: A real-time line graph showing the accumulation of **Total Gallons Used** over the last 30 seconds/points.
- **Running Cost Chart**: A real-time line graph showing the accumulation of the **Total Running Cost** over the last 30 seconds/points.
- **Total Daily Cost History Chart**: A historical bar chart that is populated by fetching aggregated daily cost data from the server's log endpoint.

C. External Weather Data

The **Weather Info Panel** displays **forecasted soil conditions** for Los Ebanos, TX, sourced from the **ECMWF IFS Model**.

- **Soil Temperature**: Shows Max, Min, and Daily Range.
- **Soil Moisture (Volumetric)**: Shows Max and Min values in m^3/m^3 units.

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3. Real-World Uses and Examples

This system provides significant benefits for property owners, farmers, and irrigation managers focused on sustainability and cost control.

Use Case	Example	Benefit
Water Conservation	A user sets the **Threshold** to **0.5 inches**. If the local weather station reports **0.6**	Prevents overwatering, conserving precious resources and avoiding fines

Use Case	Example	Benefit
	inches of rain, the system remains **OFFLINE (Saturated)**.	during droughts.
Cost Management	By inputting the utility's $ Cost per Gallon $, the system provides immediate, real-time cost tracking and historical data in the charts.	Allows for accurate budgeting and helps identify zones with high flow rates or leaks based on cost spikes in the logs.
Scheduled Maintenance	The user disables irrigation on weekends via the **Day of Week Scheduling**.	Ensures the system remains off during critical times like planned lawn treatment or scheduled maintenance periods.
Remote Monitoring	The **Email Notification** is triggered upon unexpected activation.	The manager is notified immediately if the sprinklers turn on, allowing them to verify the necessity (e.g., check for sensor errors or unusual dry spells).
Data-Driven Optimization	A user reviews the **Total Daily Cost History Chart** and sees a consistently high cost every Tuesday.	This visual data prompts them to reduce the run time or review the flow rate for the zones scheduled for Tuesday, leading to long-term cost savings.
Agricultural Context	Combining the **Rainfall Threshold** with the displayed **Soil Moisture** data.	An operator can adjust the threshold dynamically. If soil moisture is already high despite low rainfall, the threshold can be slightly lowered to delay activation, ensuring optimal soil conditions.