**Drizzle-Dome: Project Overview & Features**

**Project Overview**

**What is Drizzle-Dome?**

Drizzle-Dome is an **intelligent automated clothesline system** that autonomously protects laundry from unexpected rainfall. Using Arduino-based control, the system continuously monitors weather conditions and instantly retracts clothes to safety when rain is detected, then automatically extends them back out when conditions clear.

**Core Problem Solved**

**Problem:** People forget to bring clothes inside when it starts raining, resulting in wet laundry, extra washing cycles, and inconvenience.

**Solution:** Fully automated system that eliminates human intervention - your clothes are always protected, whether you're home or away.

**🧠 Smart State Management System**

**Technology:** Finite State Machine (FSM) with 4 operational states

* **EXTENDED:** Normal operation, clothesline ready for use
* **RETRACTING:** Emergency mode, pulling clothes to safety (5 seconds)
* **RETRACTED:** Protected mode, clothes safely stored under shelter
* **EXTENDING:** Recovery mode, deploying clothesline after rain (5 seconds)

**🔋 Hybrid Power Architecture**

**Technology:** Dual power system optimized for different loads

* **Arduino Control:** USB powered (5V, stable, always-on)
* **Motor System:** 4S Li-ion battery (14.8V, 3000mAh, high-current)
* **Runtime:** 30+ hours standby, 600+ motor operation cycles
* **Charging:** Smart 4S balance charger with BMS protection

**🛡️ Emergency Override System**

**Technology:** Priority-based interrupt system

* **Emergency Condition:** Rain detected during clothesline extension
* **Response:** Immediate motor reversal, abort extension sequence
* **Priority:** Highest system priority, overrides all other operations
* **Safety:** Prevents clothes exposure even during system transitions

**⏱️ Intelligent Timing Control**

**Technology:** Non-blocking millisecond precision timing

* **Motor Operations:** 5-second precise timing for complete travel
* **Safety Delays:** 30-second buffer after rain stops (configurable)
* **Response Speed:** <100ms loop time for instant rain response
* **No Blocking:** System remains responsive during all operations

**🌡️ Environmental Resilience**

**Technology:** All-weather operation capability

* **Operating Temperature:** -10°C to +50°C
* **Weather Rating:** IP65 electronics, outdoor-rated components
* **Corrosion Resistance:** Stainless steel cables, aluminum frame
* **UV Protection:** UV-resistant materials and coatings

**🎯 Key Features**

* 🌦️ **Instant Rain Detection** - Advanced sensor triggers immediate clothesline retraction
* ⚙️ **Dual Motor System** - Balanced and smooth operation with two synchronized DC motors
* 🧠 **Smart State Management** - Intelligent logic prevents unnecessary operations
* 🔋 **Hybrid Power System** - USB for Arduino, Li-ion for high-current motors
* 🛡️ **Emergency Override** - Immediate retraction if rain detected during extension
* 💡 **Visual Feedback** - LED status indicators and optional buzzer alerts
* 🔧 **Modular Design** - Easy to customize and expand functionality

**📊 Performance Specifications**

* **Response Time**: < 2 seconds from rain detection to motor start
* **Operation Time**: 5 seconds for complete retraction/extension
* **Power Consumption**: 50mA standby, 3.1A during motor operation
* **Battery Life**: 30+ hours continuous operation, 600+ motor cycles
* **Weather Rating**: IP65 (with proper enclosure)
* **Operating Temperature**: -10°C to +50°C