

Smart Clothes Drying System

Introduction

This project is based on the **ATmega328P Xplained Mini** microcontroller and transforms a conventional clothes drying stand into a smart system, capable of responding automatically to outdoor weather changes.

The idea originated from smart home awnings and automated pergola covers, adapting their weather-responsive behavior to a clothes drying stand.

The main goal of the project is to automate the clothes drying process, save time and make it more efficient and reliable, while still giving the user full control when needed.

This system is useful for anyone who dries clothes outdoors, especially people who are away from home during the day and cannot monitor weather changes.

General Description

The system is fully standalone and operates independently, requiring only a 5V power supply via a MicroUSB adapter.

The system starts in **Automatic Mode** by default. Once powered, it begins continuously reading data from the rain sensor and the LDR. The behavior of the system adapts based on the following scenarios:

- **Optimal Conditions (Sunny and Dry):** if there is enough light and no rain is detected, the microcontroller commands the servomotor to keep the drying stand in the extended position. The green LED turns on to signal normal operation. At the same time, the I2C LCD shows a message indicating the current favorable weather and the extended position of the rack.
- **Unfavorable Conditions (Rain or Night):** if the rain sensor detects precipitation, or if the LDR registers a drop in light levels below a specific threshold (indicating nighttime), the system reacts immediately. The servomotor automatically retracts the drying stand to protect the clothes. The red LED turns on to signal bad weather, and the LCD screen updates to reflect the status and the retracted position.
- **Manual mode:** at any point, the user can briefly press the push-button to switch the system into Manual Mode. In this mode, the yellow LED turns on to indicate manual control, and the user can long press the button to toggle the extension or retraction of the stand. Pressing the button again returns the system to the standard Automatic Mode.



The system logic is built around a state machine with two main states: **Automatic Mode** and

Manual Mode. These are the main modules:

- ATmega328P Xplained Mini - main controller, reads sensor data and controls all outputs
- Rain sensor — detects precipitation and provides analog readings via ADC
- LDR Light sensor — measures ambient light level and transmits analog data via ADC
- Push button — triggers mode switching or stand toggling via external interrupt
- Servomotor — controls the physical position of the drying stand via PWM signal
- LCD 16×2 Display — shows system status and weather conditions via I2C communication
- Status LEDs — provide visual feedback: green (normal), red (bad weather), yellow (manual mode)
- State machine — core software logic that processes sensor input and decides system behavior

Hardware Design

Component	Quantity	Role
ATmega328P XMini	1	Main controller
Rain sensor module	1	Detects precipitation
LDR Light sensor	1	Measures ambient light level
LCD 1602 16×2 with I2C	1	Displays system status
Servomotor SG90 180°	1	Controls drying stand position
LED 5mm Green	1	Signals normal conditions
LED 5mm Red	1	Signals bad weather
LED 5mm Yellow	1	Signals manual mode
Resistor 220Ω 0.25W	3	Current limiting for LEDs
Push button 6x6x5	1	Mode switching and stand toggling
Breadboard 830 points	1	Circuit prototyping
Jumper wires	as needed	Electrical connections
5V 2A MicroUSB Power Supply	1	Powers the system
MicroUSB breakout board	1	MicroUSB power input connector
Capacitor 1000uF 50V	1	Power supply filtering for servomotor

Electric Diagram



The ATmega328P Xplained Mini board was not available in the EasyEDA library, so an Arduino Nano symbol was used as a pin-compatible schematic representation. The following pin mapping was applied:

- D3 = PD3 → Push Button
- D4 = PD4 → Green LED
- D5 = PD5 → Red LED
- D6 = PD6 → Yellow LED
- D9 = PB1 → Servomotor PWM
- A0 = PC0 → Rain Sensor AO
- A1 = PC1 → LDR Light Sensor AO

- A4 = PC4 → LCD SDA
- A5 = PC5 → LCD SCL

Software Design

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