PROJECT ABSTRACT

Automatic Curtain Opener with Light Sensor

An ESP32 curtain opener that reads ambient light with an LDR, drives curtains on a rail with a stepper motor, applies hysteresis to avoid flicker, and offers manual override. Delivered built-to-order with working prototype, firmware, calibration procedure, report, PPT and viva kit.

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01. Title

Automatic Curtain Opener with Light Sensor

02. Introduction / Background

Curtains regulate light, heat and privacy, but their position is wrong most of the day: closed on a bright morning, open at noon when the room overheats. Motorized curtains exist but are costly and their light automation is primitive. The student-scale version is a clean control problem: measure ambient light with an LDR, decide open or closed with hysteresis so passing clouds do not cause endless motion, and drive a stepper motor with enough precision to stop exactly at the end of the rail. This project builds that on an ESP32.

03. Problem Statement

Light-driven automation that reacts to every flicker is worse than no automation: the core engineering problem is a stable decision — open vs closed — from a noisy light signal, plus precise rail positioning without mechanical limit switches. The project addresses this with hysteresis-based thresholds, step-counted positioning, and a manual override for user control.

04. Objectives

- Measure ambient light with an LDR sensor module and calibrate open/close thresholds.
- Drive curtains along a rail with a stepper motor and belt/pulley transmission.
- Apply hysteresis bands so the curtains do not oscillate under flickering light.
- Track curtain position by step counting with end-of-travel protection.
- Show light level and curtain state on an LCD with a manual override button.
- Deliver the complete student kit: prototype, firmware, calibration procedure, report, PPT and viva Q&A.;

05. Proposed Methodology

The system works in three stages. (1) Sensing: the LDR module output is sampled and smoothed; the firmware compares it against two thresholds (bright-open, dark-close) with hysteresis between them. (2) Motion: a stepper driver moves the carriage a calibrated step count; software end-stops bound travel so no limit switches are needed. (3) Interface: the LCD shows light level and OPEN / CLOSED / MOVING, and the override button toggles the curtains regardless of light.

06. System Architecture / Working

The LDR watches room light; its smoothed reading is compared to the open threshold (bright enough to welcome daylight) and the close threshold (dark enough to need privacy). Crossing a threshold starts the stepper, which drives the carriage the calibrated step count while the LCD shows MOVING. Between the thresholds nothing changes — the hysteresis band that prevents oscillation. The override button flips the state manually at any time.

07. Hardware / Software Requirements

- ESP32 development board
- LDR light sensor module
- Stepper motor with belt/pulley rail
- Stepper driver (A4988 / ULN2003 class)
- 16x2 character LCD
- Push button
- 12 V motor supply + 5 V logic
- Arduino IDE (C/C++ firmware)

08. Expected Outcomes

- A working demo where bright light opens and darkness closes the model curtains.
- A documented threshold-calibration procedure with the hysteresis band explained.
- Live light-level and curtain-state readout on the LCD.
- A complete report, PPT and viva Q&A; covering LDR interfacing, stepper control and hysteresis design.

09. Applications

- Home-automation demos for daylight control.
- Teaching hysteresis and threshold design in control loops.
- Demonstrating stepper positioning without limit switches.

10. Future Scope

- Time-of-day scheduling layered over light control.
- Multi-room curtain sequencing from one controller.
- Wi-Fi control and scheduling from a phone.
- Solar-powered outdoor awning variant.