Automated Light Control louver

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Team: group 17

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1. Summary

The Automated Light Control louver uses a photosensitive module consisting of a photoresistor and an amplification circuit to measure light intensity. A processor compares the light data to a set value and adjusts the position of a motor-driven shutter via a reducer for fine-tuning. Users can adjust the light threshold using physical buttons. Powered by USB, with battery compatibility, the system ensures precise and automated light control in environments such as photography studios, smart homes, or greenhouses.

- User population

  Ideal for photographers, smart home users, and greenhouse operators who need controlled lighting.

- How it Works

  A photoresistor detects light intensity, and the corresponding signal is either directly compared with a pre-set threshold or converted to a digital signal using an ADC for comparison in the processor (we haven't decided to choose which way). If the light level deviates from the setpoint, the processor activates the motor, which adjusts the shutter via a reducer for precise control.

2. Brief "Market" Analysis

- Target Customers

Individuals or businesses needing precise, automated light control in their environments (photography, smart homes, greenhouses).

- Competition:

Competing products include smart blinds or motorized light control systems, but these generally lack the fine-tuning mechanism provided by your product's motor-reducer system.

- Differentiation

our product offers better fine control via the reducer mechanism and real-time response, making it more suited for applications requiring accuracy and responsiveness.

- Price Point

Based on component costs (photoresistor, motor, processor, etc.), an estimated price point could be between $75–$200. Adjustments can be made as production costs become clearer.

3. Requirements

- Functional Requirements
  a) detect light intensity using a photoresistor and amplification circuit.
  b) compare the detected light signal to the setpoint using one of two methods: (1) directly comparing voltages or (2) converting the signal to digital via ADC.
  c) drive the motor to adjust the shutter using a reducer for fine-tuning.
  d) the response time of the shutter after the change of light should be 3 seconds (if it is too short, there are items blocking the sensitive device is easy to cause wrong judgment)
  e) allow users to adjust the setpoint using physical buttons.

- Non-functional Requirements:
  a) be powered by USB, with optional battery backup.
  b) not overheat during prolonged operation.
  c) Should work in various indoor/outdoor lighting conditions.
  d) Should be easy to set up and operate with simple button controls.

4. System Architecture

- Level 0 Block Diagram:

Main Components:

Photosensitive Module (photoresistor with amplification circuit)

Processor (chip)

Motor (with reducer)

Shutter (mechanical component)

Power Supply (USB and optional battery)

- Level 1 Block Diagram:

Connections:

Sensor to Processor: Analog connection (light data transmission)

Processor to Motor: PWM or digital signal (motor control)

Processor to Buttons: Digital inputs (user interface for setpoint adjustments)

Power Supply: USB and battery connections for processor and motor

5. Design Specification

- Sensor: Photoresistor with an amplification circuit to measure light intensity, producing a voltage signal (u1).

- Processor: Use ESP32 for light intensity data processing and motor control.

- Motor and Shutter: Stepper motor is used to ensure the accuracy of shutter adjustment. Motor connected to a reducer for precise shutter control, ensuring fine adjustments to light exposure.

- Power Supply: 5V USB-powered, with optional battery compatibility for portable or backup power.

- User Interface: Two buttons for increasing or decreasing the setpoint, connected to the processor.

- Firmware/Software:

Processor programmed to compare the sensor signal with the threshold and control motor movement accordingly.

Software allows for user adjustment of the set light threshold via button presses.

Development environment: Arduino IDE or a similar platform.