Objective:

Design a "Smart Home Lighting System" that adjusts the brightness of an LED and home curtains based on ambient light conditions, displays relevant information on a character LCD, sends data to a PC via USART, and includes a feature to manually override the LED brightness using a potentiometer.

Project Breakdown:

1. LCD Display

- **Interface the 16x2 LCD with the AVR microcontroller.**

- **Display "Light: XXXX" and "Out: XXXX" and "LED: XXX%" and CUR: (close/open) on the LCD.**

2. Analog-to-Digital Converter (ADC)

- **Read the ambient light level from the LDR.**

- **Read the manual brightness level from the potentiometer.**

- **Read outdoor light level from LDR.**

3. USART Communication

- **Send ambient light, outdoor light, Curtain status and LED brightness data to a PC.**

- **Use serial communication to display data on a serial monitor.**

4. Timers and Interrupts

- **Use a timer to periodically read sensor values and update the LCD.**

- **Use an interrupt to switch between automatic and manual LED brightness control modes using a button.**

5. Outputs

- **Use ONE LED to light the room, and control it with PWM.**

- **Use a servo motor to control curtain**

Detailed Implementation:

Circuit Diagram

Create a circuit diagram connecting all components. Here's a brief overview:

- **LCD: Connect RS, E, D4-D7 to appropriate microcontroller pins.**

- **LDR: Connect through a voltage divider to an ADC channel (e.g., ADC0, ADC1) (TWO LDRs).**

- **Potentiometer: Connect to another ADC channel (e.g., ADC2).**

- **LED: Connect one LED to a PWM capable pin to control light.**

- **USART: Connect TX and RX to the PC using a serial-to-USB converter (Or serial monitor in Proteus).**

- **Button: Connect to an interrupt-capable pin with a pull-down resistor.**

- **Servo motor: Connect a servo motor to a PWM capable pin**

Control Process

- **LED: the LED lights the room. if the room ambient light is higher that 800 lux, decrease the LED light by PWM until it reaches 800lux ± 50lux. if the ambient light is lower that 800 lux, increase LED light with PWM to reach 800lux ± 50lux.**

- **Curtain: Check the outdoor light, if the outdoor light is lower than the ambient (indoor) light, the glass may be transparent, so open the curtains. if the ambient light is lower, close the curtain. For changing the curtain status, use a servo motor. the -90 degree is closed curtain and +90 degree is opened curtain.**

Steps for Doing :

1. Set up the hardware on a breadboard or Proteus.

2. Write the code step-by-step, testing each peripheral independently before integrating.

3. Debug and troubleshoot any issues, using serial output for debugging.

4. Document the process and explain each part of the code and its function.

5. Demonstrate the project, showing light level and LED brightness on the LCD and serial monitor, and switching between automatic and manual modes.

Evaluation Criteria:

*   Correct implementation of LCD, ADC, USART, Timer, and Interrupts.

*   Properly functioning lighting system with accurate sensor readings and LED control.

*   Clear and well-documented code.

*   Successful demonstration of the project, including switching between automatic and manual modes.

Good Luck!