REPORT

Embedded Systems & IoT Automatic

Light Control Using ESP32 & LDR

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ABSTRACT

This project presents an automatic light control system using a Light Dependent Resistor (LDR) and a microcontroller. The LDR continuously senses the surrounding light intensity and converts it into an analog signal. The microcontroller reads this signal and compares it with a predefined threshold value. When the ambient light level falls below the threshold, the system automatically turns the LED ON, and when sufficient light is detected, the LED is turned OFF. This project demonstrates basic concepts of sensor interfacing, analog-to-digital conversion, and conditional control logic. The system is cost-effective, easy to implement, and can be extended for applications such as street lighting, home automation, and energy-saving lighting systems.

WORKING PRINCIPLE

An LDR (Light Dependent Resistor) is a passive sensor whose resistance varies with the intensity of incident light. When light falls on the LDR, its resistance decreases due to increased conductivity of the semiconductor material. In low-light or dark conditions, the resistance increases significantly. The LDR is connected in a voltage divider circuit, which converts this resistance variation into a corresponding analog voltage.

The ESP32 microcontroller reads this analog voltage through its built-in Analog-to-Digital Converter (ADC) using GPIO pin 34. The ADC converts the analog voltage into a digital value that represents the ambient light intensity. This digital value is continuously monitored by the ESP32.

The obtained ADC value is compared with a predefined threshold stored in the program. If the measured light intensity is below the threshold value, it indicates a dark environment, and the ESP32 activates the output pin connected to the LED, turning it ON. Conversely, when the light intensity exceeds the threshold value, indicating sufficient brightness, the ESP32 deactivates the LED, keeping it OFF.

CIRCUIT DIAGRAM

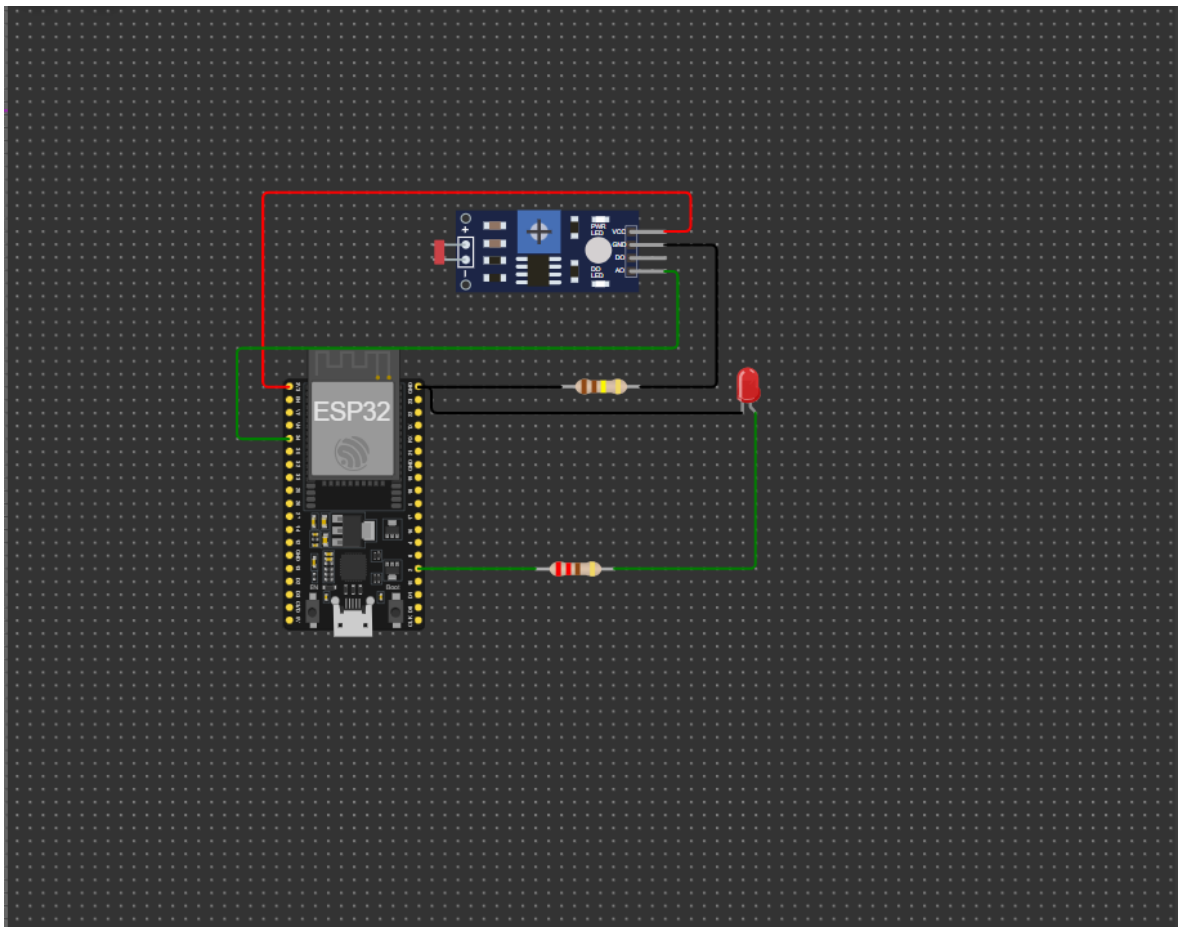

Figure 1 shows the circuit diagram of the Automatic Light Control System using ESP32 and LDR sensor.

SOURCE CODE

```
// Define pin numbers
#define LDR_PIN 34      // ADC pin connected to LDR
#define LED_PIN 2       // GPIO pin connected to LED

// Threshold value for light intensity
int threshold = 2000;

void setup()
{
  Serial.begin(115200);        // Initialize serial communication
  pinMode(LED_PIN, OUTPUT);    // Set LED pin as output
}

void loop()
{
  // Read analog value from LDR
  int ldrValue = analogRead(LDR_PIN);

  // Print LDR value to Serial Monitor
  Serial.println(ldrValue);

  // Check light condition
  if (ldrValue < threshold)   // Dark condition
  {
    digitalWrite(LED_PIN, HIGH);  // Turn LED ON
    delay(200);                   // ON time

    digitalWrite(LED_PIN, LOW);   // Turn LED OFF
    delay(200);                   // OFF time
  }
  else                          // Bright condition
  {
    digitalWrite(LED_PIN, LOW);   // Keep LED OFF
    delay(200);
  }
}
```

CONCLUSION

This internship project provided hands-on experience in embedded systems, sensor interfacing, and automation logic. The use of the Wokwi simulator enabled efficient testing and validation of the project without physical hardware.