
**NMJ32404 Embedded System Design**

**MINI PROJECT REPORT**

# Automatic Street Light Controller


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# INTRODUCTION

An automatic street lighting system using 8051 microcontroller is a system that automatically controls the streetlights based on the presence of vehicles and pedestrians. Based on the information received from the sensors, the microcontroller determines whether to turn on or off the streetlights. For example, if there are no vehicles or pedestrians in the vicinity of the sensors, the microcontroller will reduce the light to 25 % of the streetlights to conserve energy. Conversely, if the sensors detect the presence of vehicles or pedestrians, the microcontroller will increase to 75 % to make it 100 % of the streetlights to ensure their safety. Overall, this system can be very useful in reducing energy consumption and improving the safety of pedestrians and drivers on the road.

# SCOPE

**Focus of the Project:**

- **Energy Conservation:** Using 8051 microcontrollers is to improve the functionality and efficiency of a conventional street lighting system. By adding additional sensors, such as the PIR motion detection sensor, the system can detect and respond to changes in the environmental conditions more intelligently. This allows the system to adjust the brightness of the streetlights based on the ambient light level and the motion of approaching objects, resulting in energy savings and increased safety for pedestrians and drivers.

- **Cost Reduction:** An Automatic Street Light Controller helps in reducing the cost of electricity bills by automatically controlling the streetlights, which reduces the unnecessary use of electricity during the daytime and nighttime.

- **Safety Enhancement**: The system aims to enhance safety by incorporating a PIR sensor to detect motion. When motion is detected, the system increases the intensity of the streetlights, providing brighter illumination in areas with activity.

**Limitations of the Project:**

- Environmental Factors: External factors such as extreme weather conditions, obstruction of sensors, or changes in the environment (e.g., construction activities) may impact the system's performance and reliability.

- Accuracy of Sensors: The accuracy of the LDR sensor and PIR sensor may be limited by factors such as sensitivity, calibration, and environmental conditions. Variations in sensor readings or false triggers could affect the system's performance.

- Scalability: The project's implementation may be limited in terms of scalability. While it can be applied to a single streetlight or a small area, expanding it to cover an entire street or larger area may require additional considerations such as communication protocols, network infrastructure, and synchronization between multiple units.

## Objective

- **Energy efficiency:**

  The system can detect ambient light levels by incorporating an LDR sensor. During daylight or when sufficient natural light is available, the system can keep the streetlights off, conserving energy and reducing unnecessary power consumption.

- **Cost-effectiveness:**

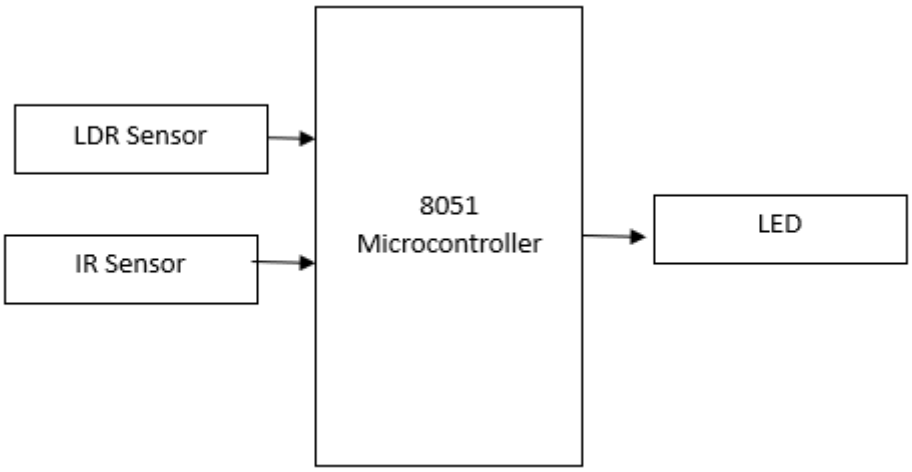
  By incorporating automated features, the system can help reduce energy consumption and optimize the usage of streetlights. This can lead to cost savings in electricity bills and maintenance expenses for the street lighting infrastructure.

- **Environmental impact:**

  Besides energy efficiency, the project can aim to reduce light pollution and minimize the negative environmental impact. By incorporating the LDR sensor, the system can ensure that the streetlights are only activated when the natural light levels drop below a certain threshold, preventing unnecessary light emission during brighter times. This helps preserve the natural nighttime environment and reduces the disturbance to nocturnal animals and ecosystems.

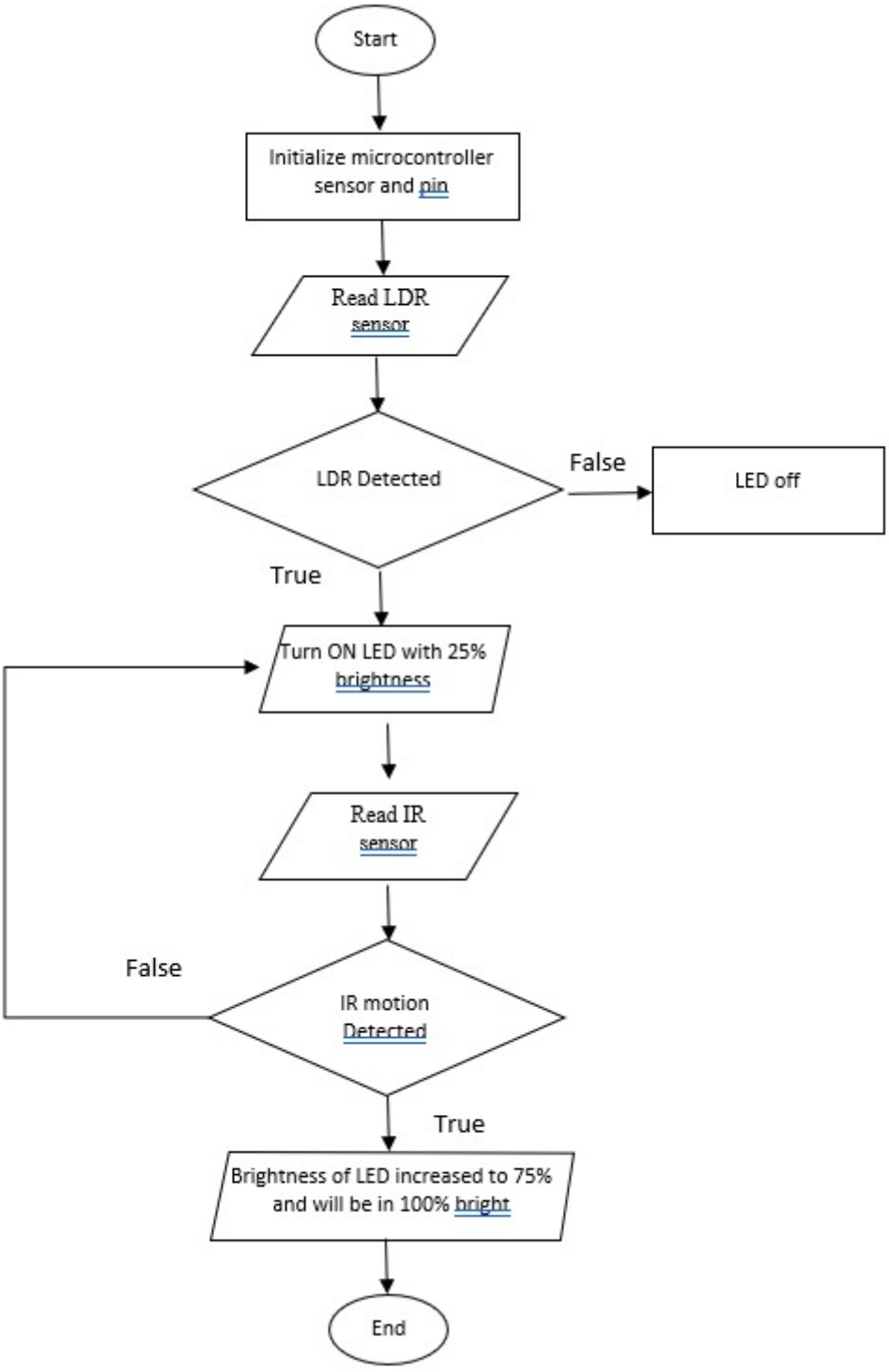
# METHODOLOGY

## BLOCK DIAGRAM




The automatic streetlight controller system uses an 8051 microcontroller, LED, LDR sensor, and PIR sensor. The LDR sensor detects the ambient light level, and when it gets dark, the microcontroller activates the streetlight. The PIR sensor detects motion, and when motion is detected, the system increases the intensity of the streetlights by supplying additional brightness to LED. This system ensures energy efficiency by automatically adjusting the lighting based on the surroundings, while also enhancing safety by providing brighter illumination in the presence of motion.

**FLOWCHART**


Start
Initialize microcontroller sensor and pin
Read LDR sensor
LDR Detected
False
LED off
True
Turn ON LED with 25% brightness
Read IR sensor
False
IR motion Detected
True
Brightness of LED increased to 75% and will be in 100% bright
End

**SPECIFICATIONS OF THE PROJECT BASED ON TITLE**

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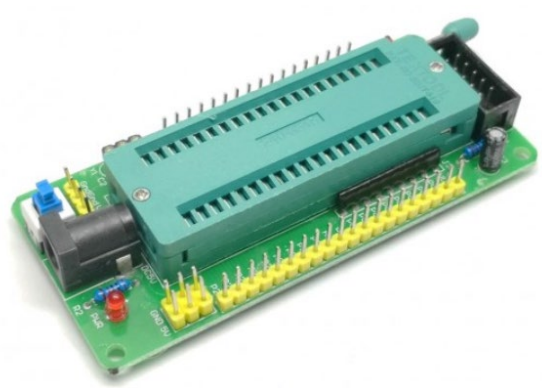
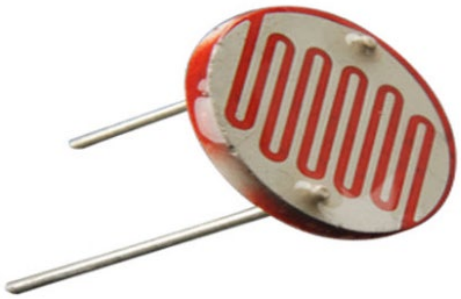
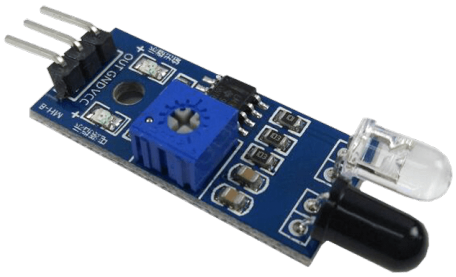
|  | **8051 Microcontroller** |
|  | **Light-Dependent Resistors (LDRs)** |
|  | **Resistors** |
|  | **Breadboard** |

| | |
|---|---|
|  | **IR detection sensor** |

**Details of the design**

For this project we have used duty cycle of 179 when LDR is ON & IR is OFF. So to find the percentage of the Duty cycle percentage we need to implement this formula:

Duty cycle percentage = (duty_cycle / 255) * 100

= (179/255) * 100

= 70.20%

When IR is ON the duty cycle is 64. Soe when we calculate:

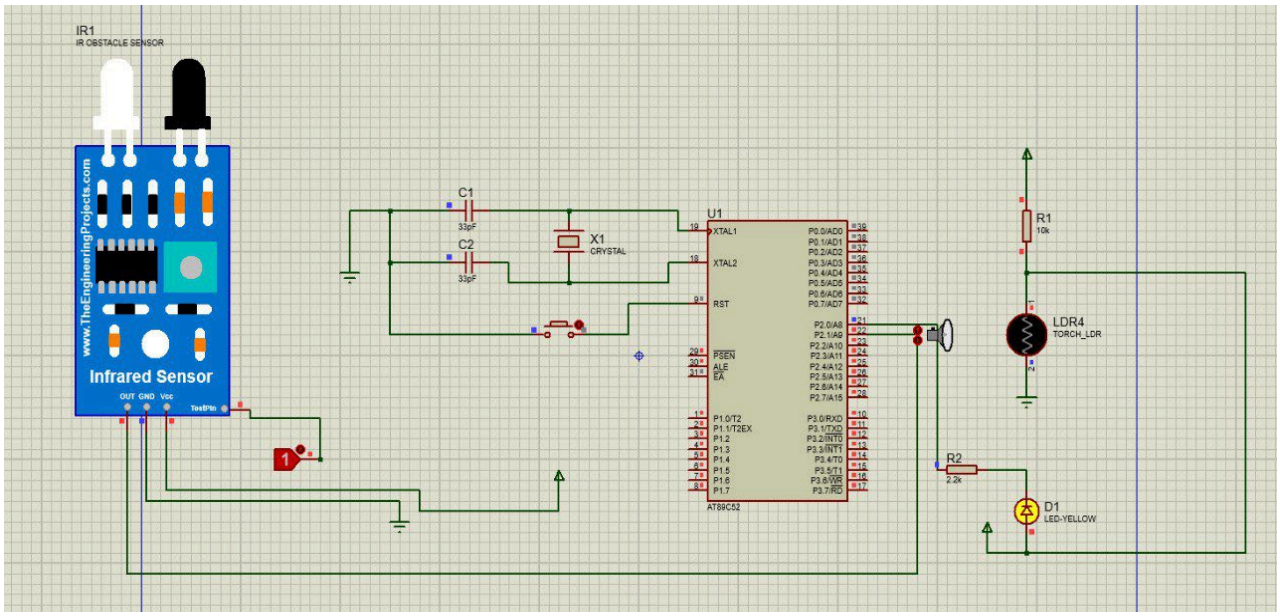
Duty cycle percentage = (duty_cycle / 255) * 100

= (64/255) * 100

= 25%

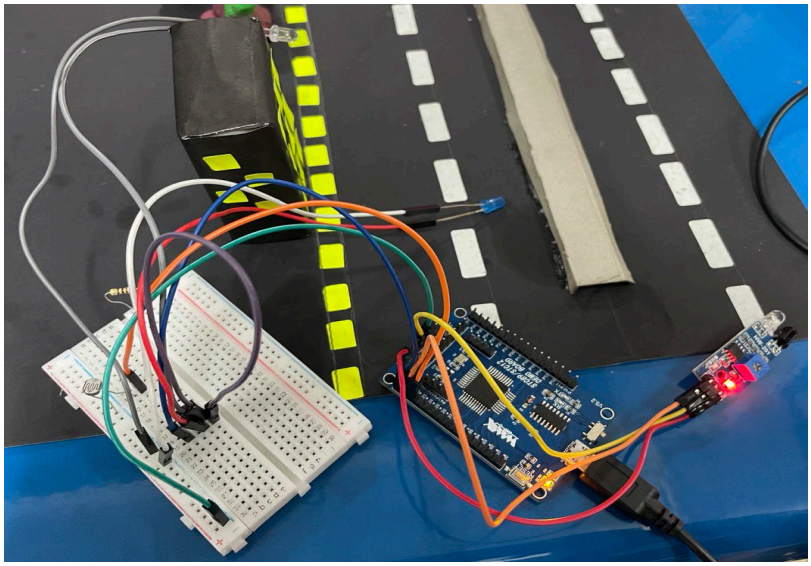
We have also used delay (10000), which is 10 sec when the LDR is ON and IR has just detected the motion; the LED will be ON for 10 sec, and delay (50), which is 0.05 sec when the LDR is ON, the LED will blink within 0.05 sec.

## SCHEMATIC DIAGRAM



## RESULTS AND DISCUSSION

### Screenshots Of Interface



- Circuit of Automatic Streetlight Controller System

```
#include <reg51.h>

sbit LDR_PIN = P2^2;    // LDR pin connected to P2.2
sbit IR_PIN = P2^1;     // IR pin connected to P2.1
sbit LED = P2^0;        // LED pin connected to P2.0

void delay(unsigned int time) {
    unsigned int i, j;
    for(i = 0; i < time; i++) {
        for(j = 0; j < 1275; j++);  // Delay loop
    }
}

void pwmControl(unsigned char duty_cycle) {
    unsigned char i;

    // Turn on the LED for the specified duty cycle
    for (i = 0; i < duty_cycle; ++i) {
        LED = 1;
        delay(1);
    }

    // Turn off the LED for the remaining time
    for (i = duty_cycle; i < 179; ++i) {
        LED = 0;
        delay(1);
    }
}

void main() {
    LDR_PIN = 1;     // Set LDR pin as input
    IR_PIN = 1;      // Set IR pin as input
    LED = 0;         // Set LED pin as output
```

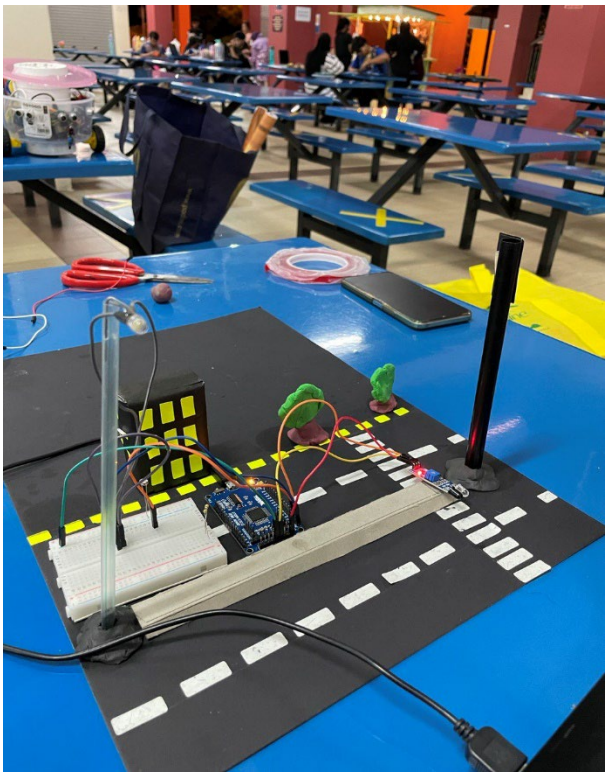
```
    while(1) {

      unsigned char ldr_value = LDR_PIN;

        if (LDR_PIN == 1) {          // If darkness is detected by the LDR
            if (IR_PIN == 0) {      // If darkness is also detected by the IR sensor
                LED = 1;            // Turn on the LED continuously
           pwmControl(179);
              delay(1000);
            } else {
                LED = ~LED;         // Blink the LED
             pwmControl(64);
               delay(50);
            }
        } else {
            LED = 0;                // Turn off the LED
        }
    }
}
```

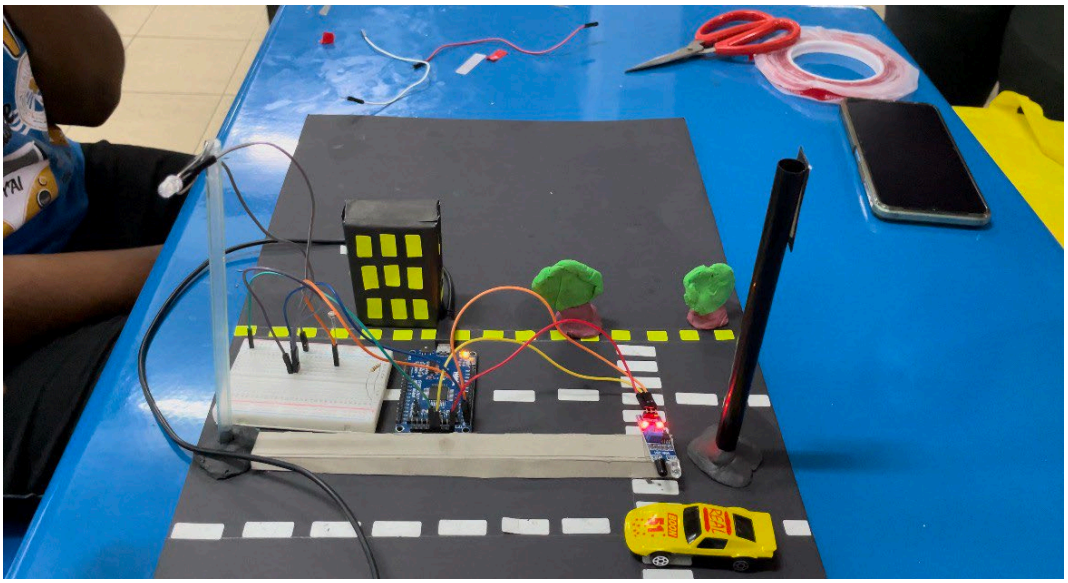
- Interface of Automatic Streetlight Controller System

**Provide Discussion On The System Operation**

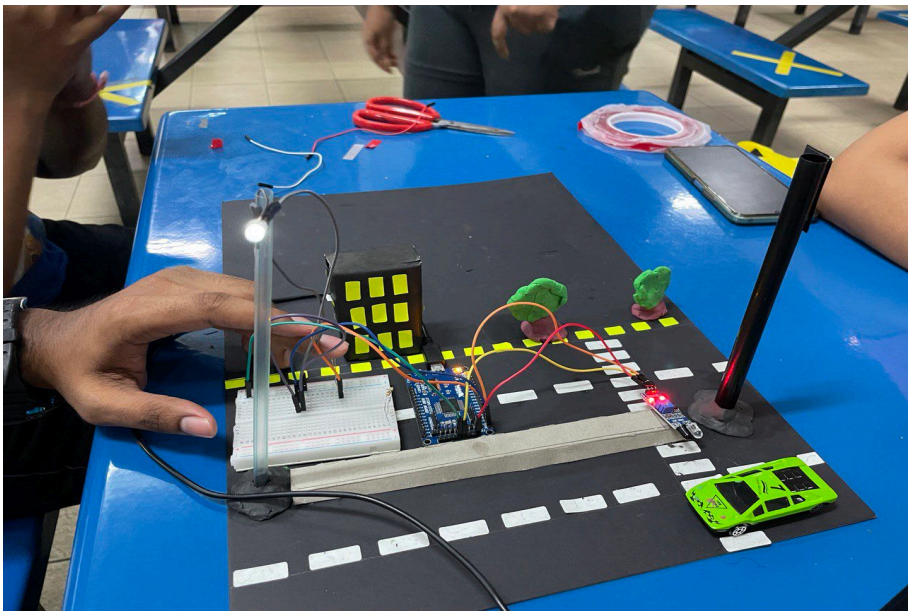


- This is a completed prototype of Automatic Streetlight Controller System as we demonstrated how the system works on pedestrian walkways and on roads where initially the streetlight works when there is a motion.

- The Automatic Street Light Controller System successfully incorporated several components, including STC89 microcontroller, Infrared Sensor (IR), Light Dependent Resistor (LDR) and LED.



- During daytime, the LDR sensor is off, so there is no any motion detected, therefore LEDs remain off and there are no any lights.



- During nighttime, the LDR sensor is on, the LEDs will blink and if there is any motion detected at IR sensor, the LEDs will turn on for 10 seconds and it will blink again until the next motion is detected.

## Supportive Arguments

1. **Reduced Light Pollution**

   Excessive and unnecessary lighting can contribute to light pollution, which has adverse effects on the environment and human health. An automatic streetlight controller can mitigate light pollution by regulating the intensity and duration of street lighting. By dimming or turning off streetlights during low-traffic hours, the system reduces light spillage and glare, preserving the natural darkness of the night sky and minimizing disruption to nocturnal ecosystems.

2. **Scalability and Flexibility**

   The 8051 microcontroller is widely used and offers scalability and flexibility in system design. It can handle a variety of sensors, timers, and communication interfaces required for an automatic streetlight controller. The microcontroller's robustness and availability of development tools make it suitable for both small-scale installations and large-scale deployments, providing a versatile solution for different urban environments.

3. **Environmental Sustainability**

   By optimizing energy usage and reducing light pollution, an automatic streetlight controller contributes to environmental sustainability. The reduced energy consumption lowers carbon emissions, helping to combat climate change. Additionally, by preserving natural darkness, the system supports biodiversity and ecological balance, benefiting local flora and fauna.

# CONCLUSION

In conclusion, the auto streetlight system project offers an excellent opportunity to explore microcontroller programming and sensor interfacing. By implementing different brightness levels based on sensor inputs, you can achieve efficient lighting control. Future work could involve enhancing the system with additional features such as time-based scheduling, remote monitoring, or wireless connectivity for more advanced functionality. This project serves as a solid foundation for further exploration and expansion in the field of smart lighting systems.

# References


- OpenAI. (2023). *ChatGPT* (Feb 13 version) [Large language model]. https://chat.openai.com

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