Adaptive Automobile Headlight System

Overview:

The project aims to develop an adaptive automobile headlight system that automatically adjusts its brightness based on ambient light conditions. This system utilizes an Arduino microcontroller, a photoresistor, and a TIP122 transistor circuit to control the intensity of the headlight, ensuring optimal visibility for drivers in various lighting environments.

Use Case:

The primary use case of this project is to enhance road safety by improving the visibility of vehicles at night or in low-light conditions. By automatically adjusting the brightness of the headlight according to the surrounding ambient light levels, the system ensures that drivers have adequate illumination without causing discomfort or glare to other road users. This feature is especially beneficial in scenarios such as driving through tunnels, transitioning between daylight and nighttime, or encountering sudden changes in weather conditions.

Advantages:

1. Enhanced Safety :- The adaptive headlight system improves driving safety by providing optimal illumination tailored to ambient light conditions, reducing the risk of accidents caused by poor visibility.

2. Energy Efficiency :- By adjusting the headlight brightness based on ambient light levels, the system minimizes energy consumption compared to traditional fixed-intensity headlights, thereby contributing to environmental sustainability and reducing fuel consumption.

3. Customizable :- The system can be easily customized to accommodate preferences for brightness levels and response thresholds, allowing for personalized driving experiences.

4. Cost-Effective Solution :- Utilizing readily available components and open-source hardware platforms like Arduino makes the project cost-effective and accessible for DIY enthusiasts and automotive hobbyists.

Disadvantages:

1. Dependency on Sensor Accuracy :- The accuracy of the ambient light sensor (photoresistor) may vary depending on factors such as environmental conditions, sensor calibration, and component quality. Inaccurate sensor readings could affect the system's ability to adjust the headlight brightness effectively.

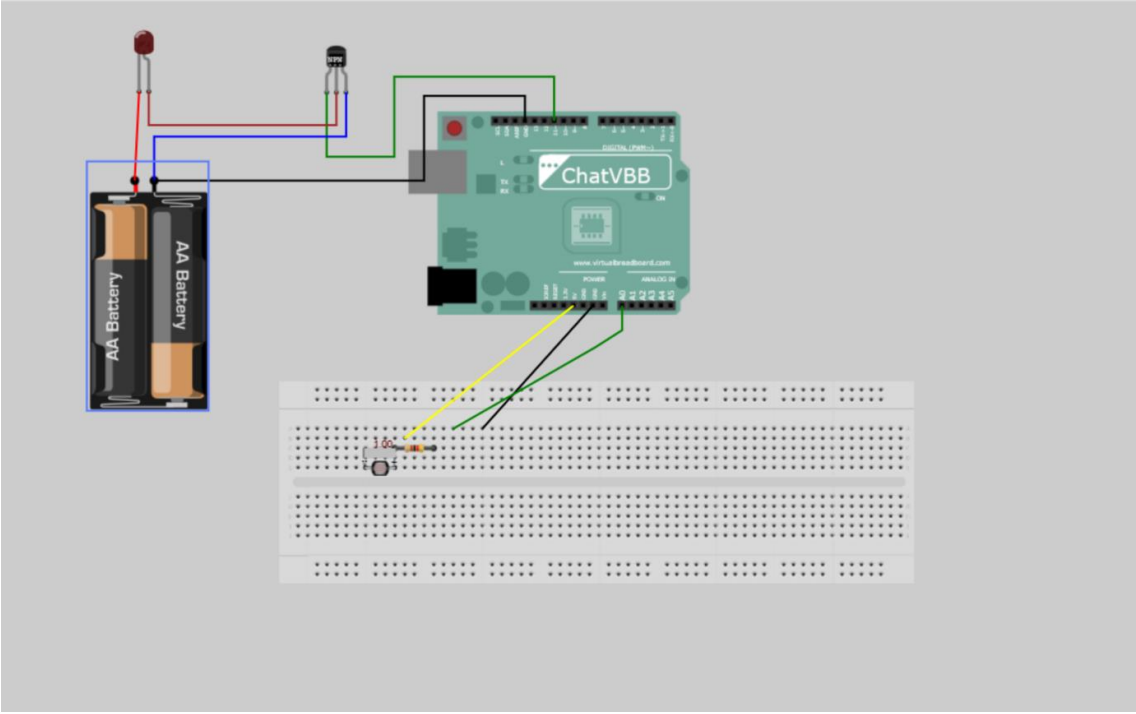
2. Maintenance Requirements :- The system may require periodic calibration and maintenance to ensure the proper functioning of components and the reliability of light intensity adjustments over

time. Regular checks and adjustments may be necessary to address sensor drift or component degradation.

List of Components:

- Arduino Uno x1
- TIP122 NPN Darlington Transistor x1
- Photoresistor x1
- 1k ohm resistor x1
- 12V LED x6
- Breadboard x1
- Jumper wires
- 9V Batteries x2
- USB 2.0 Cable Type A/B

Circuit Diagram:



Code:

```
// Define pin connections
const int lightSensorPin = A0;
const int ledPin = 11;

void setup() {
  // Initialize serial communication
  Serial.begin(9600);
  Serial.println("Setup initialized");

  // Set LED pin as output
  pinMode(ledPin, OUTPUT);
}

void loop() {
  // Read the value from the light sensor
  int lightLevel = analogRead(lightSensorPin);

  // Print the light level to the serial monitor
  Serial.print("Light level: ");
  Serial.println(lightLevel);

  // Check if light level is greater than 500
  if (lightLevel > 500) {
    // Turn off the LED
    digitalWrite(ledPin, LOW);
    Serial.println("LED turned off");
  }
else {
    // Map the light level to the PWM range (0-255)
    int brightness = map(lightLevel, 0, 500, 255, 0);

    // Print the brightness value to the serial monitor
    Serial.print("Brightness: ");
    Serial.println(brightness);

    // Set the LED brightness
    analogWrite(ledPin, brightness);
  }

  // Small delay to stabilize the readings
  delay(100);
}
```

Photoresistor Circuit:

1. Connect one end of the photoresistor to the 5V pin on the Arduino.
2. Connect the other end of the photoresistor to a point on the breadboard.
3. Connect one end of the 1k ohm resistor to the same point on the breadboard where the photoresistor connects.
4. Connect the other end of the 1k ohm resistor to the GND (ground) pin on the Arduino.
5. Connect a jumper wire from the point where the photoresistor and the resistor meet to the A0 (analog pin 0) on the Arduino.

FOR LED Circuit:

1. Connect pin 11 of the arduino to the base of the TIP122.
2. Now we Connect the arduino ground to the emmitor of the transistor, we also Connect the negative side of the battery to the ground of the arduino .
3. We Connect the +ve side of the battery to the one side of the resistive load ,the other side of our load goes to the collector of the transistor.

Conclusion:

In summary, the adaptive automobile headlight project offers a promising solution to improve road safety and driving comfort by intelligently adjusting headlight brightness based on ambient light conditions. While it presents several advantages such as enhanced safety, energy efficiency, and customization options, it also faces challenges related to sensor accuracy and maintenance requirements. Overall, the project demonstrates the potential of integrating technology into automotive systems to address real-world challenges and enhance the driving experience.