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# Embedded systems

## FINAL PROJECT
## Car Flash Light detector

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***Abstract***

*This project report details the design, implementation, and performance of a flash light detector system. The system utilizes three Light Dependent Resistor (LDR) sensors to detect the direction of incoming light and accordingly maneuver a vehicle. Key components include LDR sensors, a dual H-bridge motor driver, a rechargeable battery, DC motors, a crystal oscillator, a PIC16F877A microcontroller, and LEDs. The vehicle responds to light stimuli by moving towards the light source and modulating LED brightness based on the proximity of the light.*

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# 1. INTRODUCTION

In the field of embedded systems, light detection and responsive motion control are fundamental functionalities with diverse applications, ranging from robotics to security systems. This project explores the development of a flash light detector vehicle that navigates towards a light source and adjusts its behavior based on light intensity. The primary objective is to create an efficient and responsive system that can accurately detect light direction and modulate movement and LED brightness accordingly.

## 2.1 Light Dependent Resistors (LDRs)

Function and Operation
LDRs, also known as photo resistors, are light-sensitive devices whose resistance decreases as the light intensity increases. In this project, three LDR modules are strategically placed to detect the presence and direction of the light source. The LDRs are connected to the analog inputs of the microcontroller, which continuously monitors the voltage changes corresponding to the light intensity.

Application in the Project
The LDRs play a crucial role in determining the direction towards which the vehicle should move. When one of the LDRs detects higher light intensity compared to the others, the microcontroller processes this information to adjust the vehicle's direction, ensuring it moves towards the light source.

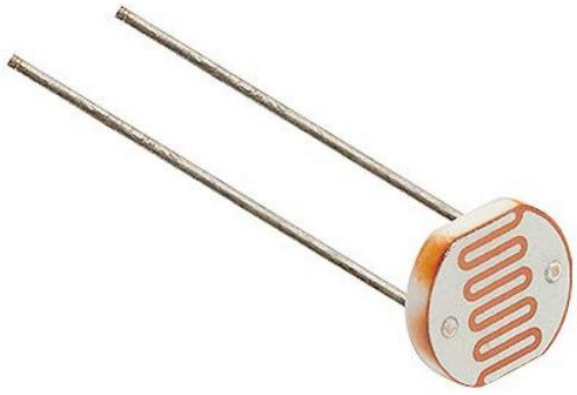

**Figure 1: Light Dependent Resistors (LDRs)**

## 2.2 Dual H-Bridge DC & Stepper Motor Driver (L298N)

### Function and Operation

The L298N motor driver is designed to control two DC motors or a stepper motor, allowing for bidirectional movement. It operates using an H-bridge circuit configuration, which enables the motors to run forward or backward. The driver can handle high current and voltage, making it suitable for driving the motors in this project.

### Application in the Project

In this project, the L298N driver is used to control the four DC motors attached to the vehicle's wheels. The microcontroller sends control signals to the driver, which then adjusts the speed and direction of the motors based on the inputs from the LDRs. This ensures precise and coordinated movement of the vehicle towards the light source.


**Figure 2: Dual H-Bridge DC & Stepper Motor Driver (L298N)**

## 2.3 18650 3.7V Li-ion Rechargeable Battery (2200mAh)

**Function and Operation**
The 18650 Li-ion battery is a popular choice for portable electronics due to its high energy density, long cycle life, and ability to provide stable voltage. It has a nominal voltage of 3.7V and a capacity of 2200mAh, which can be charged up to 4.2V.

**Application in the Project**
The battery provides the necessary power for the entire system, including the microcontroller, sensors, and motors. Its rechargeable nature ensures that the project can be powered for extended periods without frequent battery replacements, making it a reliable power source for the vehicle.

**Figure 3: 18650 3.7V Li-ion Rechargeable Battery (2200mAh)**

## 2.4 WD Robot Smart Car 6V DC Motors

**Function and Operation**

The WD Robot Smart Car 6V DC motors are compact and efficient motors commonly used in robotic applications. They provide adequate torque and speed, making them suitable for driving the wheels of the vehicle. Each motor operates at 6V and is capable of rotating in both directions.

**Application in the Project**

These motors are connected to the L298N motor driver, which controls their operation. The motors are responsible for moving the vehicle towards the light source detected by the LDRs. Their compact size and efficient performance make them ideal for this application.

**Figure 4: WD Robot Smart Car 6V DC Motors**

## 2.5 Crystal Oscillator (8MHz)

### Function and Operation

A crystal oscillator provides a precise clock signal to the microcontroller, ensuring accurate timing and synchronization of its operations. The 8MHz frequency is suitable for the PIC16F877A microcontroller, providing a stable and reliable clock source.

### Application in the Project

The crystal oscillator ensures that the microcontroller operates at the correct frequency, enabling it to process inputs from the LDRs and control signals to the motor driver accurately. This is essential for the real-time operation of the system.


**Figure 5: Crystal Oscillator (8MHz)**

## 2.6 LEDs

### Function and Operation

LEDs (Light Emitting Diodes) are semiconductor devices that emit light when an electric current passes through them. They are used for indication and signaling purposes due to their low power consumption and high brightness.

**Figure 6: LED**

**Application in the Project**

Four LEDs are used to provide visual feedback about the vehicle's proximity to the light source. When the light source is too close or too far from the LDRs, the LEDs light up gradually. The intensity of the LEDs increases from low to very bright, providing a clear indication of the light source's distance. This feature enhances the user interface and allows for easy monitoring of the vehicle's operation.

## 3.1 Circuit design

Circuit for our Flash light detector that contains all sensors and actuators.

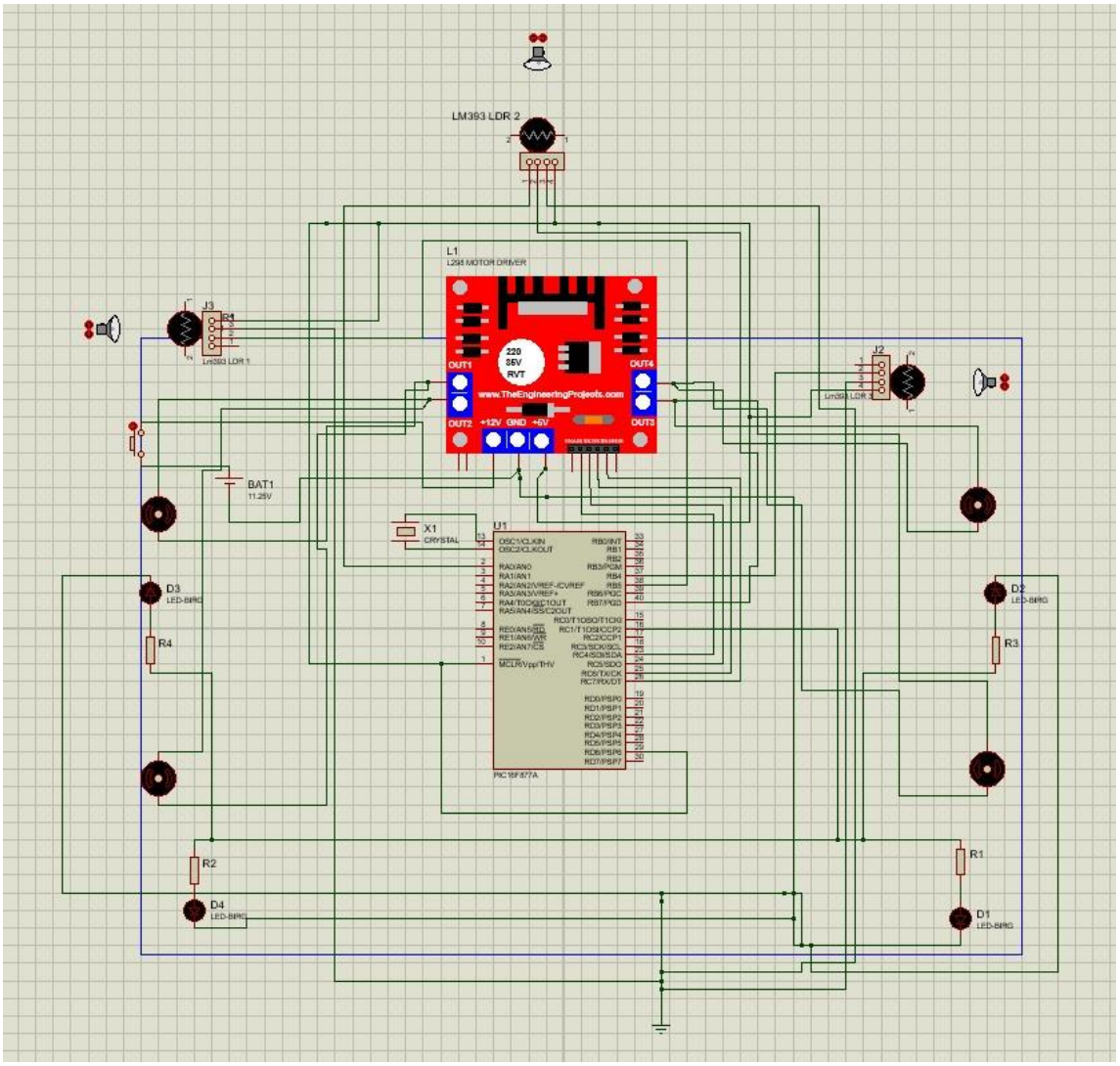


**Figure 7: circuit design**

## 3.2 Software design

A software design for our Flash light detector that contains all sensors and actuators.

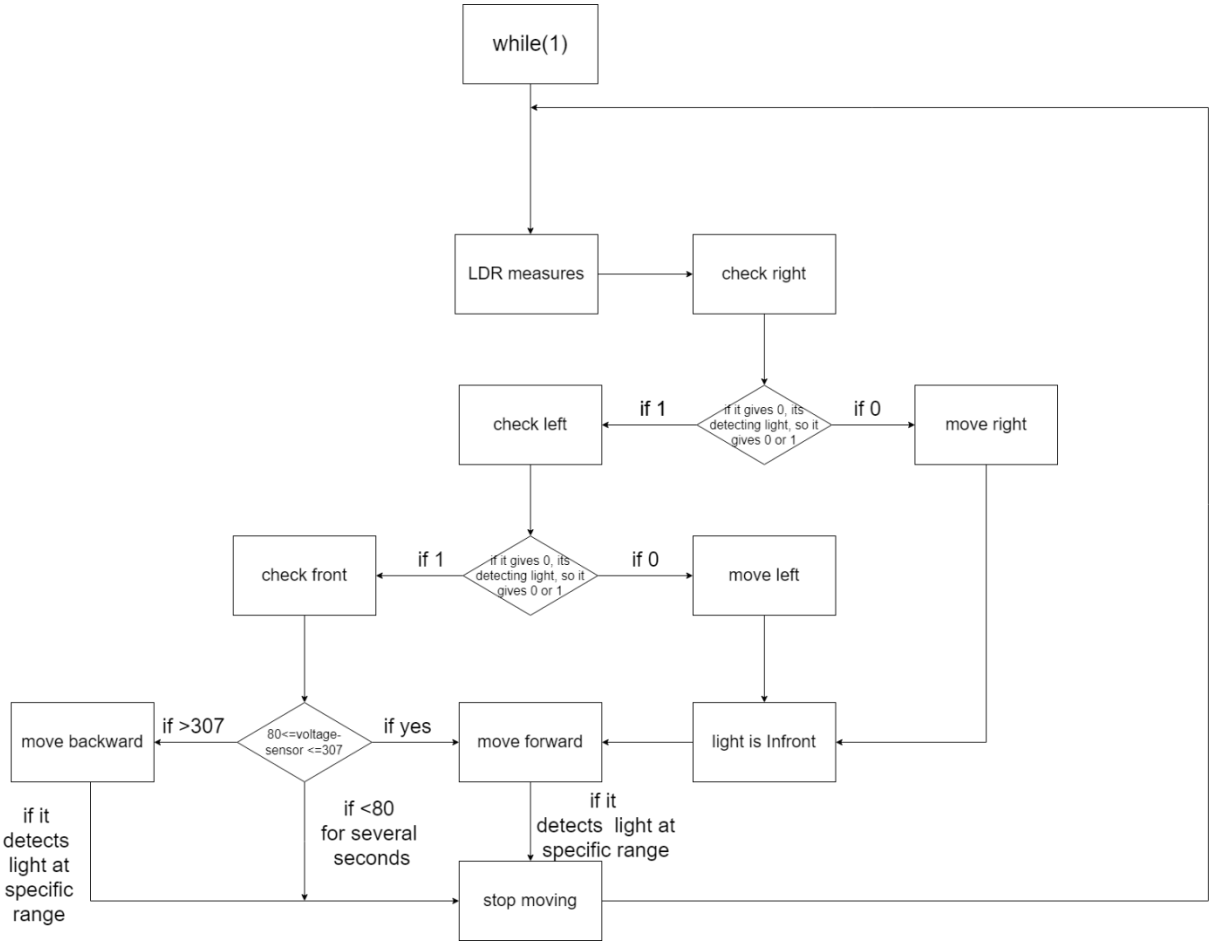


**Figure 8: block diagram**

## 3.3 Conclusion

The flash light detector project successfully demonstrates the integration of various electronic components to achieve responsive motion control based on light detection. The system effectively navigates towards light sources and provides visual feedback through LEDs, showcasing the potential applications of such a system in robotics and automated systems.