DEPARTMENT OF ELECTRONIC AND TELECOMMUNICATION ENGINEERING

UNIVERSITY OF MORATUWA

EN2160: ELECTRONIC DESIGN REALIZATION

FINAL PRODUCT REPORT

Light Sensitive Door Closer

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Abstract

Introducing the Light Sensitive Door Closer (LSDC), an innovative device designed to streamline door access with seamless automation. By harnessing the power of Light Dependent Resistors (LDR) sensors, this cutting-edge solution accurately detects ambient light levels in real-time. Once the light intensity falls below a predetermined threshold, the LSDC initiates the door closure process, ensuring privacy and security for users. Powered by a rechargeable lithium-ion battery, this product combines efficiency and sustainability for optimal performance. With its user-friendly design and advanced technology, the LSDC represents a significant advancement in smart home automation, providing unparalleled convenience and adaptability to diverse environments. Step into a future of effortless door management with the Light Sensitive Door Closer.

1. Introduction

1.1. Overview

The Light Sensitive Door Closer (LSDC) is an innovative device equipped with LDR sensors to detect ambient light intensity. It automatically closes connected doors when the light level falls below a set threshold. With a rechargeable lithium-ion battery, the LSDC offers seamless automation, enhancing security and convenience in smart home environments.

1.2. Problem Identification

Traditional door closing systems lack automation and energy efficiency, requiring manual operation. Users often forget to close doors, leading to privacy and security concerns. Moreover, energy wastage occurs when doors remain open in well-lit areas. To address these issues, the Light Sensitive Door Closer (LSDC) utilizes LDR sensors to detect light intensity, enabling automatic door closure when light levels dip below a specified limit, mitigating security risks and optimizing energy consumption.

1.3. Solution

The Light Sensitive Door Closer (LSDC) offers an intelligent solution to automate door closure. Equipped with LDR sensors, it detects ambient light intensity. When the light level falls below the predetermined threshold, the LSDC activates a motor to close the connected door. With this seamless automation, users can ensure privacy, security, and energy conservation without the need for manual intervention. The device's rechargeable lithium-ion battery serves as a sustainable power supply for uninterrupted operation.

1.4. Justification

The Light Sensitive Door Closer (LSDC) provides a justified solution by automating door closure based on ambient light intensity. This ensures privacy, security, and energy efficiency without manual intervention, enhancing user convenience and promoting sustainable living.

2. Product Goals

2.1. Functionality

The Light Sensitive Door Closer (LSDC) functions by utilizing LDR sensors strategically placed in the enclosure to accurately measure ambient light intensity. A user-adjustable variable resistor sets the desired light threshold. When the light level falls below the preset value, the LSDC triggers a 6V Metal Gearmotor to pull the connected cable, effectively closing the door or any other light-weight object. The circuit is equipped with a control system that detects the cable's initial position, enabling the motor to stop once the door is closed. Additionally, a current control mechanism manages the gear motor's stall current, ensuring safe and efficient operation. The LSDC offers an automated, user-friendly solution, providing enhanced security, energy conservation, and seamless door management in various environments.

2.2. Market Goals

- Penetration into Smart Home Automation Market: Capture tech-savvy homeowners with an innovative and convenient door closure solution.
- Commercial and Office Spaces Integration: Target businesses seeking reliable and efficient door closure systems to enhance security and energy conservation.
- Eco-Conscious and Sustainable Living Segment: Attract environmentally conscious consumers with an energy-efficient and eco-friendly product choice.

2.3. Price

Approximate Cost per Unit – Rs. 5,000.00

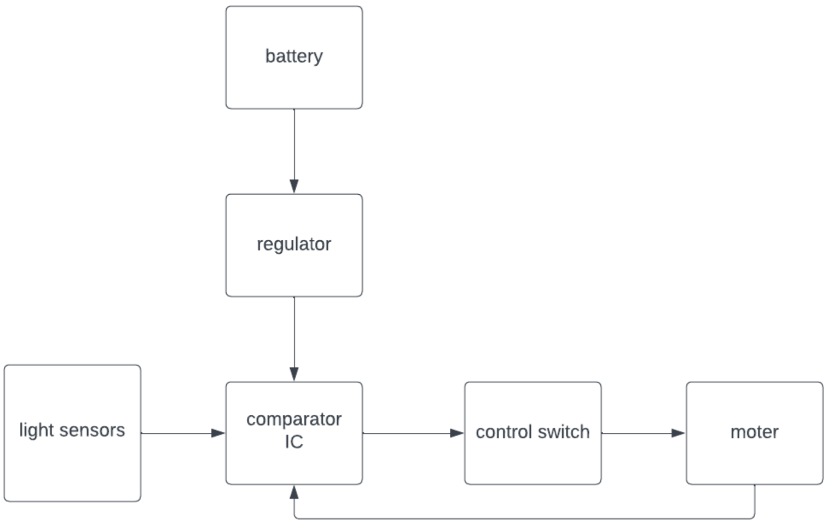
Market Price – Rs. 6,000.00

3. Conceptual Design

In the conceptual design stage of this project, the focus lies on amalgamating several key factors to create a novel, functional, and marketable product. Diverse circuits are explored to achieve the primary goal, while varied enclosure designs are considered to ensure a perfect, attractive, and durable end product. Each functional part is carefully selected for its ability to perform specialized tasks, optimizing the design's overall functionality. The process involves grouping related underlying ideas to streamline the development of the design. Throughout this stage, free-hand sketches are utilized to visualize and refine the concepts, allowing for creative exploration and innovative solutions. By synergizing these elements, the conceptual design aims to bring forth a unique and practical product that caters to user needs, aligns with market demands, and showcases the ingenuity of the design cycle

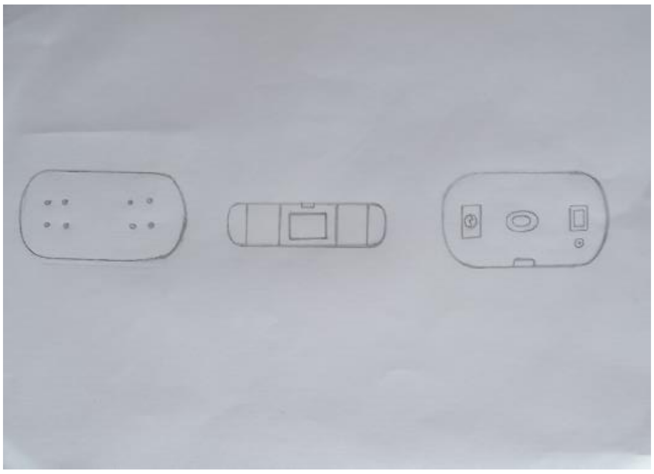
3.1.Circuit Block Diagrams

3.1.1. Block Diagram

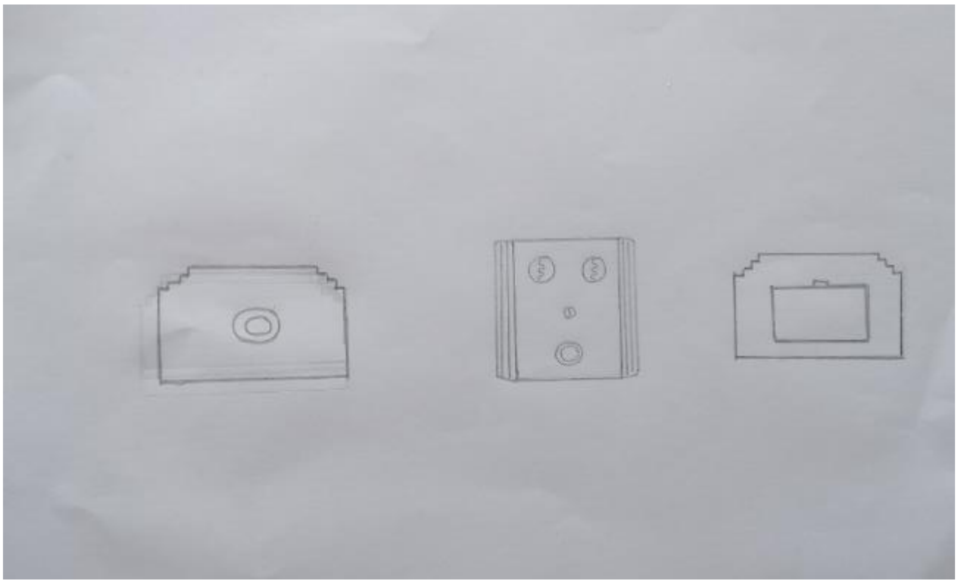


3.2.Enclosure Designs

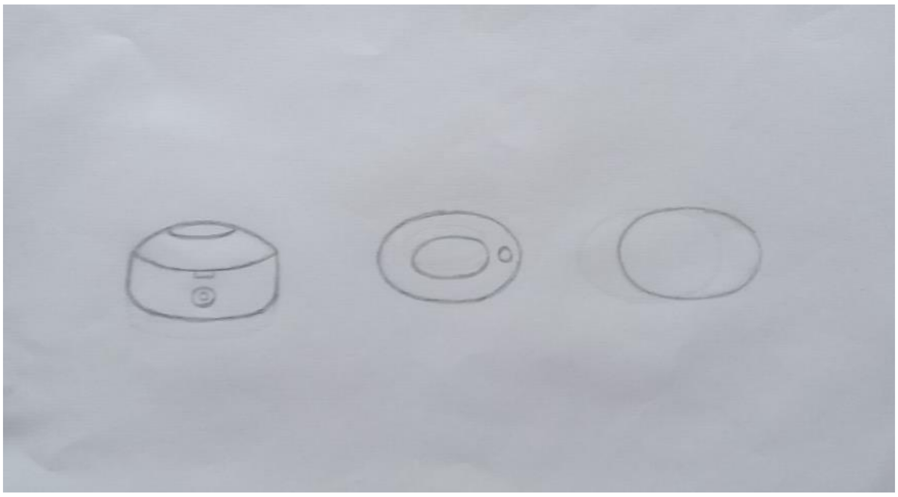
3.2.1. Design 1



3.2.2. Design 2



3.2.3. Design 3



3.3.Selection Matrices

3.3.1. Selection matrix: for sketches

Here, we have considered the following criteria in order to select the best enclosure design for my product.

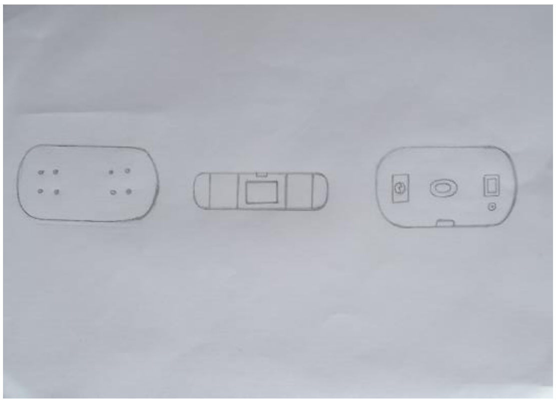
1. Compatibility in manufacturing
2. Safety
3. Easy Assembly
4. Maintenance
5. Complexity

Evaluating each sketch (driven by enclosure design), we came up with the following table with marks for each sketches given according to above mentioned criteria.

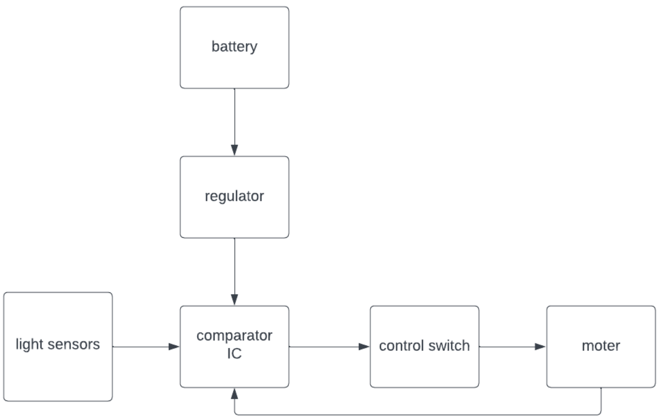
Criteria	Design 1	Design 2	Design 3
Compatibility in manufacturing	**5**	**5**	**5**
Safety	**7**	**7**	**7**
Easy Assembly	**8**	**5**	**8**
Maintenance	**8**	**7**	**6**
Complexity	**7**	**5**	**6**
Total Marks	**60**	**59**	**55**

3.4.Conclusion from the Conceptual Design Cycle

3.4.1. Selected Enclosure Design



3.4.2. Circuit Block Diagram



4. Preliminary Design

4.1.Product Specifications

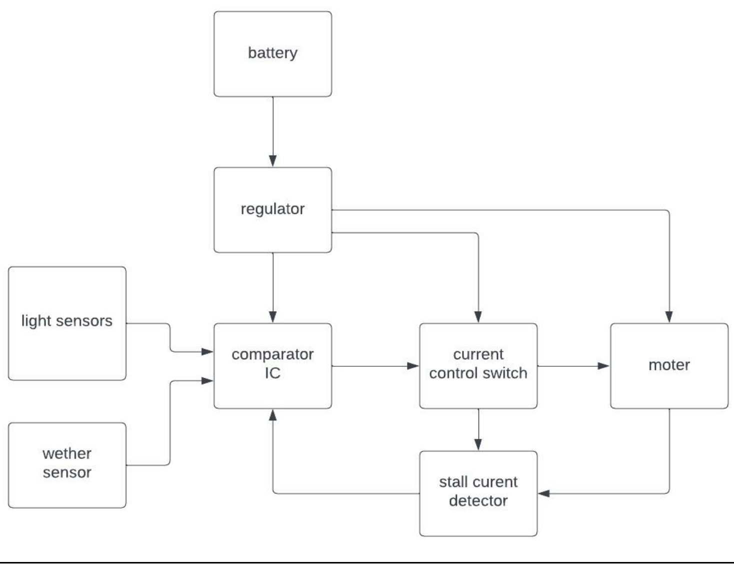
- Power source – 7.4V Lithium Ion Battery (rechargeable)
- Operating voltage – 5V
- Operating temperature – (20 to 60) °C
- Operating light intensity (threshold value) – (20 to 50) lux (this may change in the application)
- Door pulling force – 10 N (average)
- Cable length – 90 cm
- Cable diameter – 0.9 mm
- Product dimensions – 12 × 10 × 3 cm (may change depending on the requirements)

4.2.Extra features which would be implemented in this product.

- Use a display to give feedback to the user.
- Reduce the power consumption.
- Give method to charge the batteries without replacing them.
- Increase the pulling force.

4.3.Improvements/Proposals from the Preliminary Design Cycles

In this design stage the following improved circuit block diagram developed with the improvements proposed above.



4.3.1. Problems Identified by User Feedbacks

- Lack of User Feedback: The initial design lacked a display to provide feedback to users, making it challenging for them to understand the device's status and operation.
- High Power Consumption: The initial design exhibited high power consumption, leading to decreased battery life and reduced overall efficiency.
- Limited Battery Rechargeability: The initial design required battery replacements, which posed inconvenience and added to the product's operational costs.
- Insufficient Pulling Force: The initial design had a limited pulling force, potentially causing issues when closing heavier doors or objects, compromising the device's effectiveness and versatility.

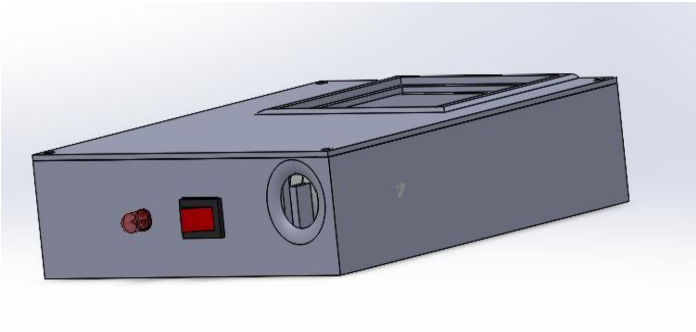
4.3.2. Improvements Proposed by the User Feedbacks

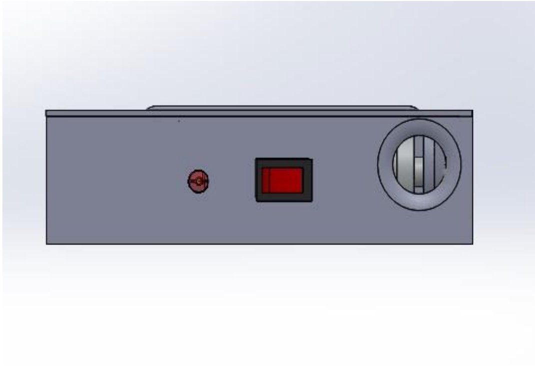
To address the identified problems in the initial design, the following improvements are needed.

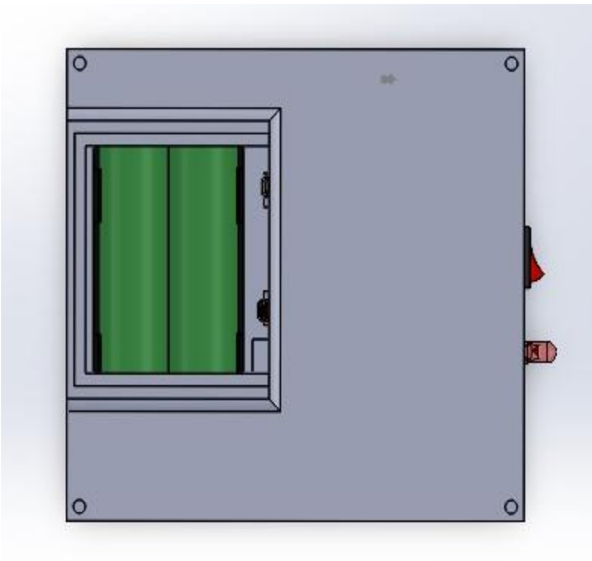
- Display Integration: Incorporate a user-friendly display to provide real-time feedback on the device's status, light intensity readings, and door closure activity, enhancing user understanding and interaction.
- Power Optimization: Implement power-saving measures such as energy-efficient components, sleep modes, and intelligent power management algorithms to reduce power consumption, extend battery life and promote eco-friendly usage.
- Battery Charging Solution: Introduce a rechargeable battery system with a built-in charging port or wireless charging capability, eliminating the need for frequent battery replacements and offering a more convenient and sustainable power solution.
- Enhanced Pulling Force: Upgrade the gear motor or explore alternative motor options to increase the pulling force, ensuring the device's capability to close a wider range of door types and objects with varying weights, improving overall functionality and versatility.

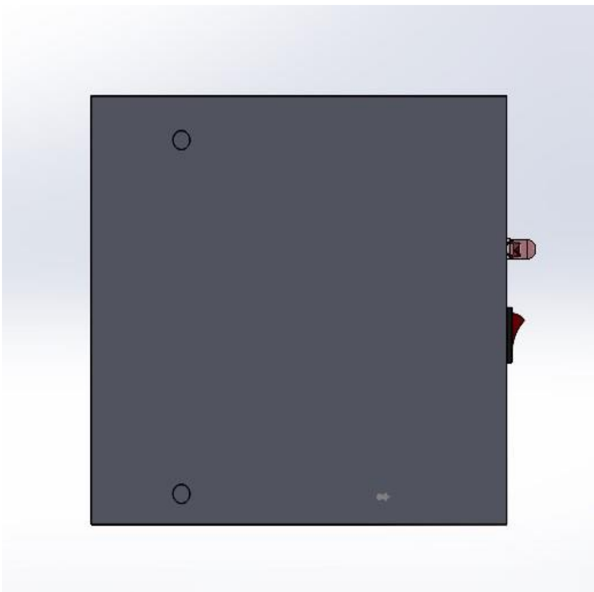
5. Implemented Design

5.1.Implemented Enclosure Design

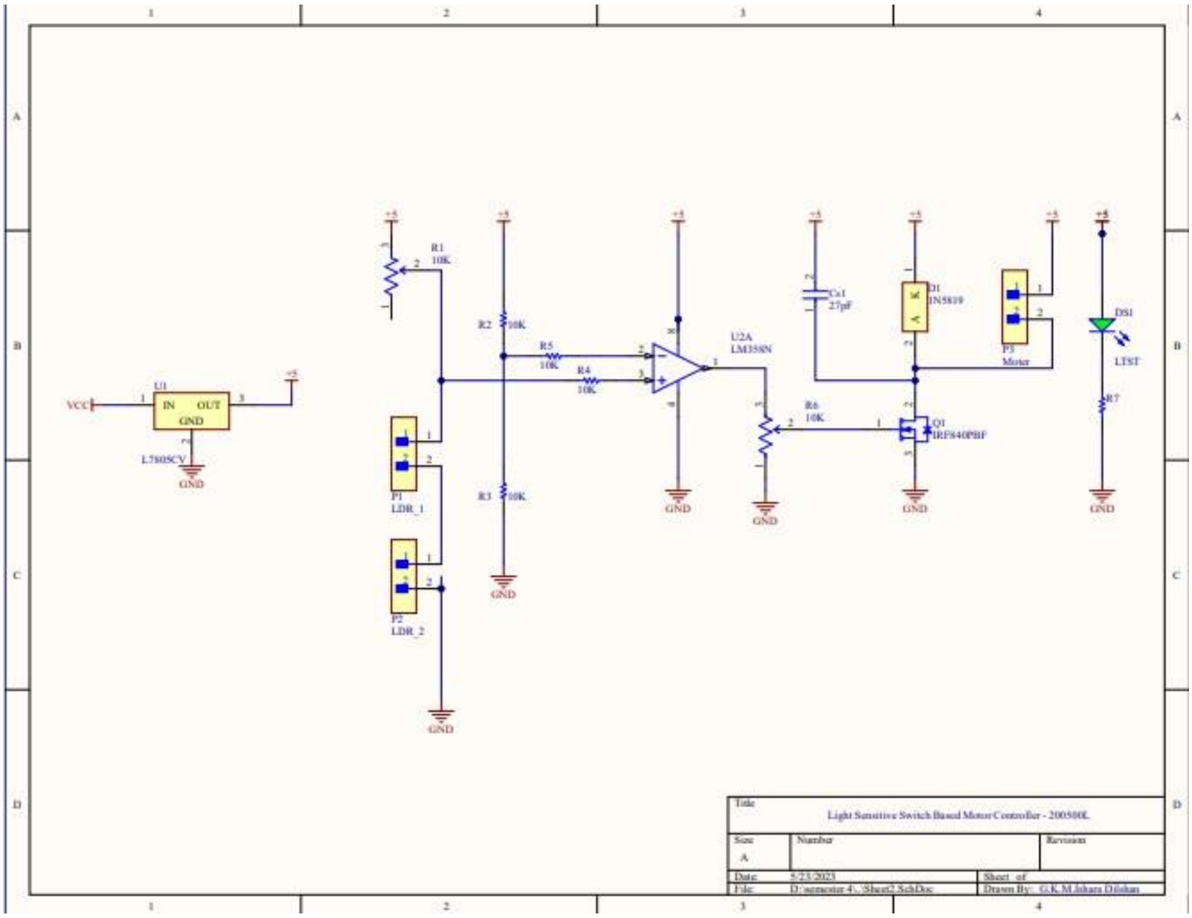






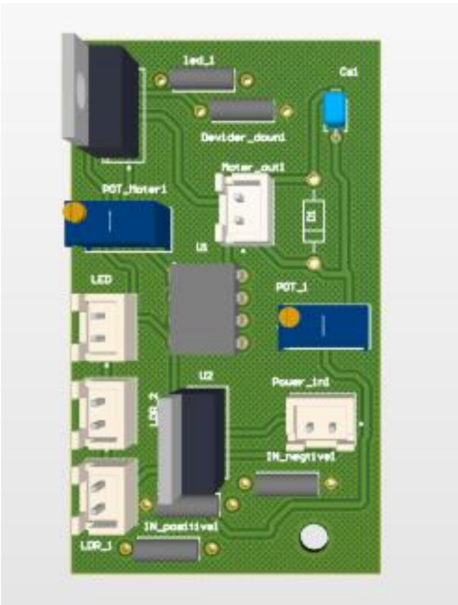


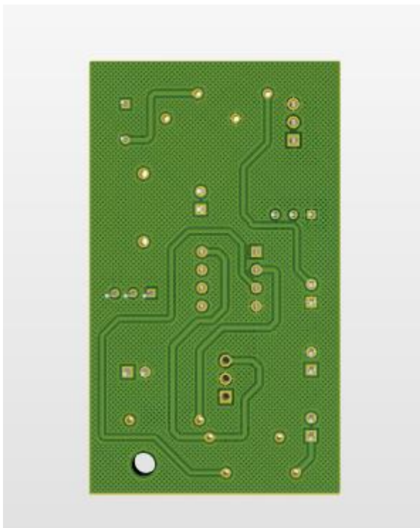
5.2. Implemented Schematic Design



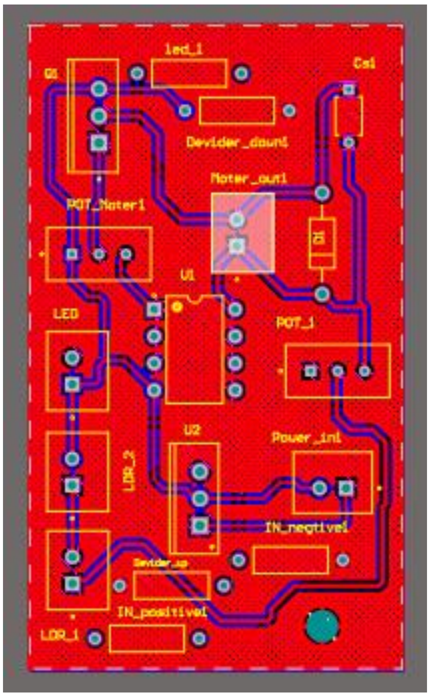
5.3. PCB Design

5.3.1. 3D View

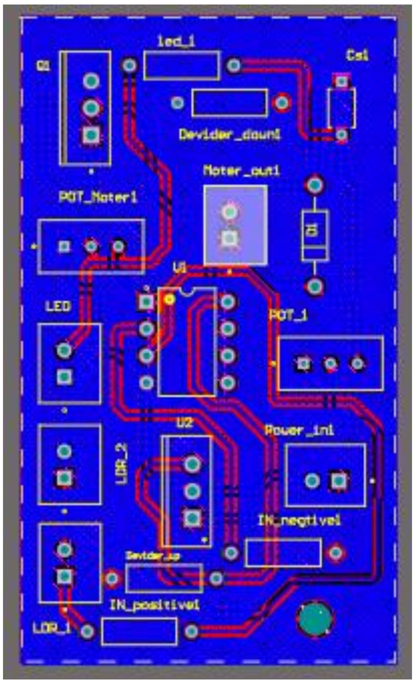




5.3.2. PCB Top Layer



5.3.3. PCB Bottom Layer



6. Bill of Materials

component	description	quntity	price
1N5819	shotky diode	1	20
10K	resistors (0.5W)	5	50
10K	resistors (1W)	2	20
27pF	capacitor	1	10
IRF740PBF	power transistor (N-MOFSET)	1	200
L7805CV	viltage regulator	1	150
LDR	light dependant resistor	2	50
LED	diode	1	5
LM358N	opamp	1	50
moter	6V, DC, gear moter	1	2500
other	elcusure	1	1000
	pcb manufacturing	1	500
	Total (lkr)		4555

7. References

- https://www.arrow.com/en/products/mg16b-120-aa-00/nidec-copal-electronics?q=MG16B-120-AA-00
- https://www.mouser.com/ProjectManager/ProjectDetail.aspx?AccessID=a212f38f83