Department of Electronic and Telecommunication Engineering

University of Moratuwa

EN1190 – Engineering Design Project

FINAL PROJECT REPORT

SMART LIGHT CONTROL SYSTEM

Empowering efficiency, lighting automatically

Presented by Team *Ampulse*

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Abstract

Our design is a power-efficient automatic light controller that senses whether people are in a room or other place and automatically turns lights on and off. The controller detects human movement and turns on and off the lights using sensors, including PIR sensors and millimeter wave sensors. Energy usage is decreased while utilizing this kind of controller because lights are only triggered as required. The use of an automatic light controller can help save energy and be more economical. Additionally, regularly turning off lights promotes the conservation of energy resources and helps extend the lifespan of bulbs, contributing to overall energy efficiency and sustainability.

In this report, we have considered what people think about our product through the survey. Furthermore, the technical feasibility and budget of the product are also included in this report.

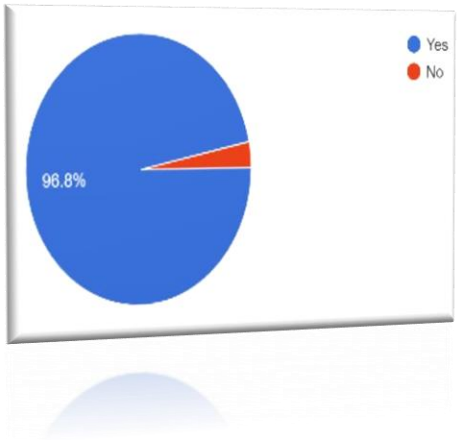
Problem & Solution

Many people often forget to turn off the lights when they leave a room, which leads to wasted energy. When energy consumption goes up, so does the electricity bill, causing us to waste money. To avoid this, we can use an automated lighting system that turns off lights when no one is in the room. This would help save energy and contribute to a more sustainable future. At the very least, we should try to switch off the lights when we leave a room.

Additionally, forgetting to turn off lights can also lead to safety risks, like fire hazards or property damage. In our society, people with disabilities, like those who use wheelchairs, often struggle with tasks like turning on lights without assistance. An automatic lighting system would make it easier for them to operate lights independently, improving their ability to move around without relying on others. This system would help increase their independence and make their daily lives easier.

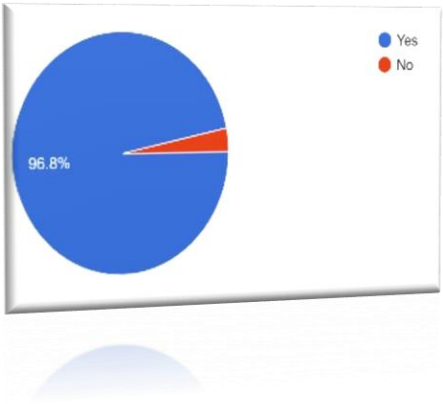
Survey and Summary

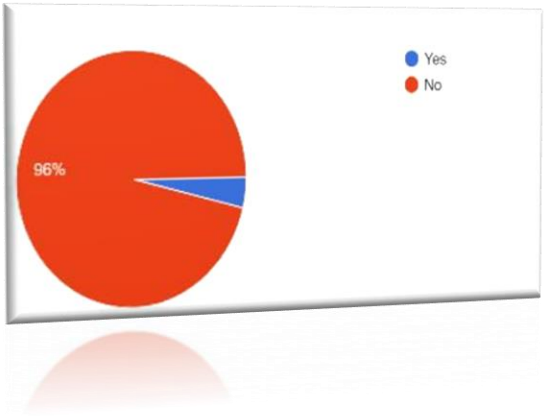
We did a small survey on our project. Some of the responses are shown below.



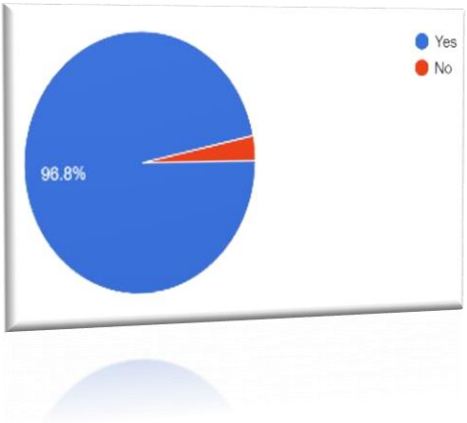
Majority of people agrees that electricity is been wasted in Sri Lanka due to unnecessary operation of light bulbs in houses and other enclosed areas.

They also agree that they have to bear an additional cost for their electricity bill because of this unnecessary operation of bulbs when not needed.





Majority of the people do not have this type of smart light control system at their houses or offices.



Furthermore, most of the people agree that this product will help save unnecessary energy wastage and the additional charges of their electricity bills.

Technical Feasibility

❖ Resource Requirements

The system's hardware needs include PCBs, sensors, lightbulbs, switches and power supplies These parts can be made and designed, and they are easily found in the market. The firmware for the microcontrollers is among the required software. We required the following software: Solid Works, Altium, and Arduino etc.

❖ Performance Targets

The system's performance targets are based on industry standards and there are no mistakes. The system will be designed to turn on the lights automatically when someone enters the room and turn them off when they leave, thereby conserving energy. The system will also have a user-friendly control system because of the manual and automatic systems.

❖ Technical Risks

The main technical risks of the project involve hardware and software compatibility. To address these, we've carefully chosen compatible components and developed software that works seamlessly with them. We've also thoroughly tested the system in a controlled environment, identifying and resolving any issues that came up during testing.

❖ Testing and Evaluation

The system will be tested using both manual checks and automated tools, including simulations and real hardware. Tests will be done in a controlled setting that mimics different situations, like changes in light levels and room occupancy. We'll evaluate the system based on how well it saves energy, how quickly it responds, how reliable it is, and how accurate it performs. The test results will help us improve the system's design and boost its overall performance.

Marketing, Sales, and After-Sale Service Considerations

Marketing:

1) To effectively promote the product, it's crucial to identify the target audience. In this case, the focus should be on middle-aged individuals, as they tend to show a strong interest in technology and convenient solutions.
2) Leveraging social media platforms alongside digital marketing strategies can help reach a broader audience. Additionally, advertising on television is a valuable strategy since it captures the attention of a wide demographic, including those active on social media.
3) Collaborating with companies specializing in home automation and energy-efficient solutions can enhance the product's visibility and attract new customers. Given the ongoing energy crisis, the product's energy-saving features are likely to appeal to a broad audience.
4) Participating in trade shows and exhibitions provides an excellent opportunity to showcase the product and generate interest among potential customers.

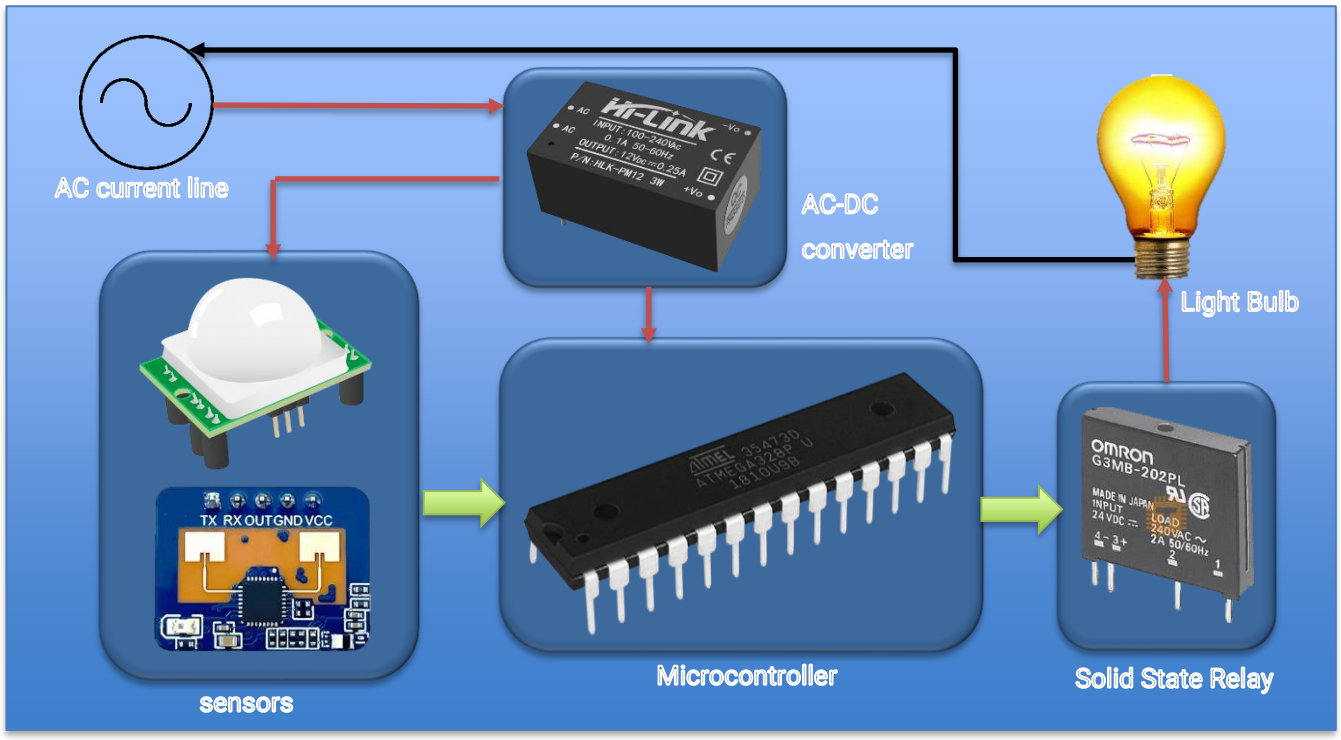
Sales:

1) Establish a sales strategy to ensure that the automatic light bulb system is priced competitively. Based on our survey, a price above Rs.5000.00 is acceptable, as the production cost already exceeds this amount.
2) Assemble a dedicated sales team to actively promote and sell the product to potential customers.
3) Introduce discounts or special pricing offers to enhance the product's appeal and attract more buyers.
4) Provide incentives to retailers and distributors to encourage them to actively promote and sell the product.
5) Develop a sales forecast to estimate revenue and set sales targets. Although this is primarily a back-office task, it is essential for achieving the overall sales goals.

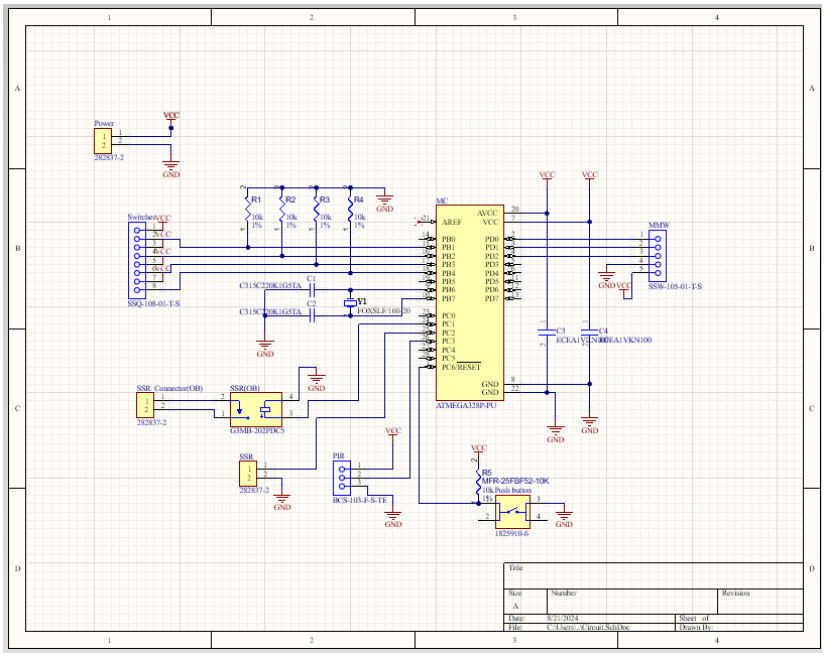
After-Sale Service:

1) Offer a warranty and maintenance plan for the automatic light bulb system, carefully considering the duration and terms.
2) Establish customer support channels via email, phone, or online chat to assist with inquiries and resolve any issues.
3) Create a customer feedback system to track satisfaction levels and gather insights for product improvement, which will also benefit market positioning.
4) Provide training and educational resources to help customers maximize the benefits of the product.
5) Develop a comprehensive repair and replacement plan to address any potential problems that may occur.

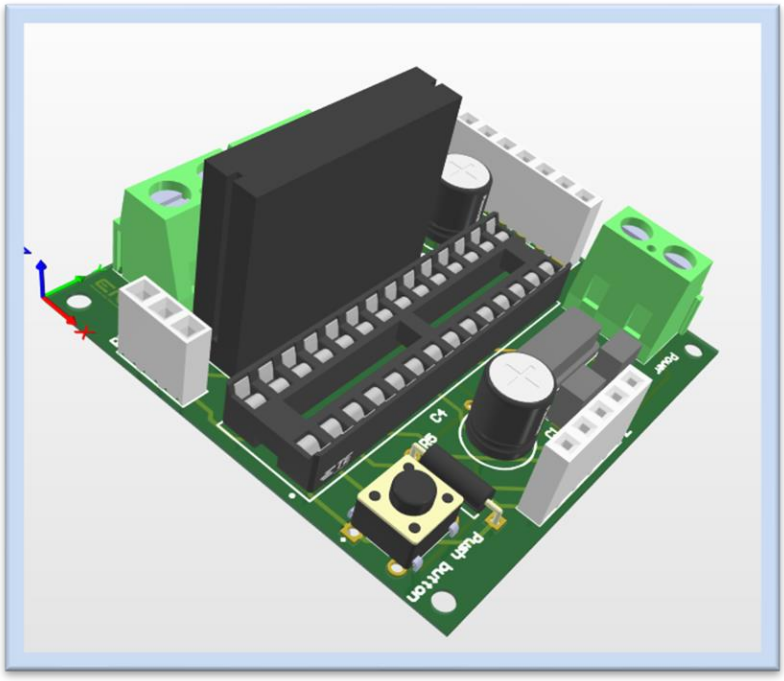
Product architecture

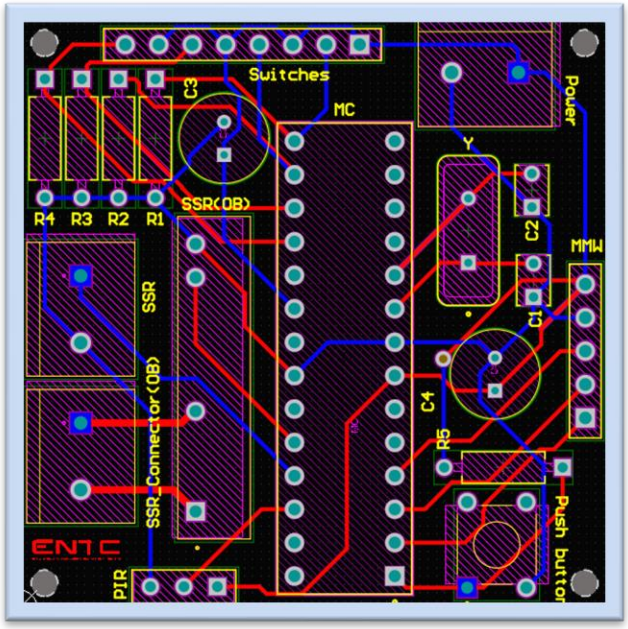


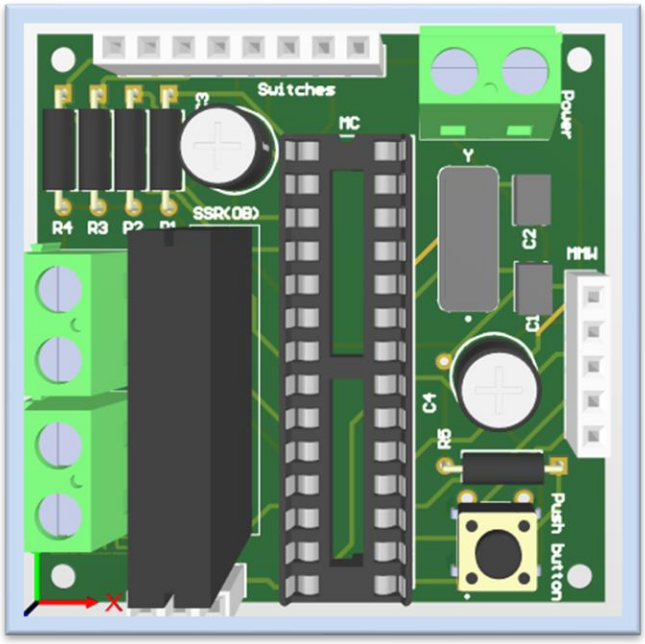
Circuit Diagram



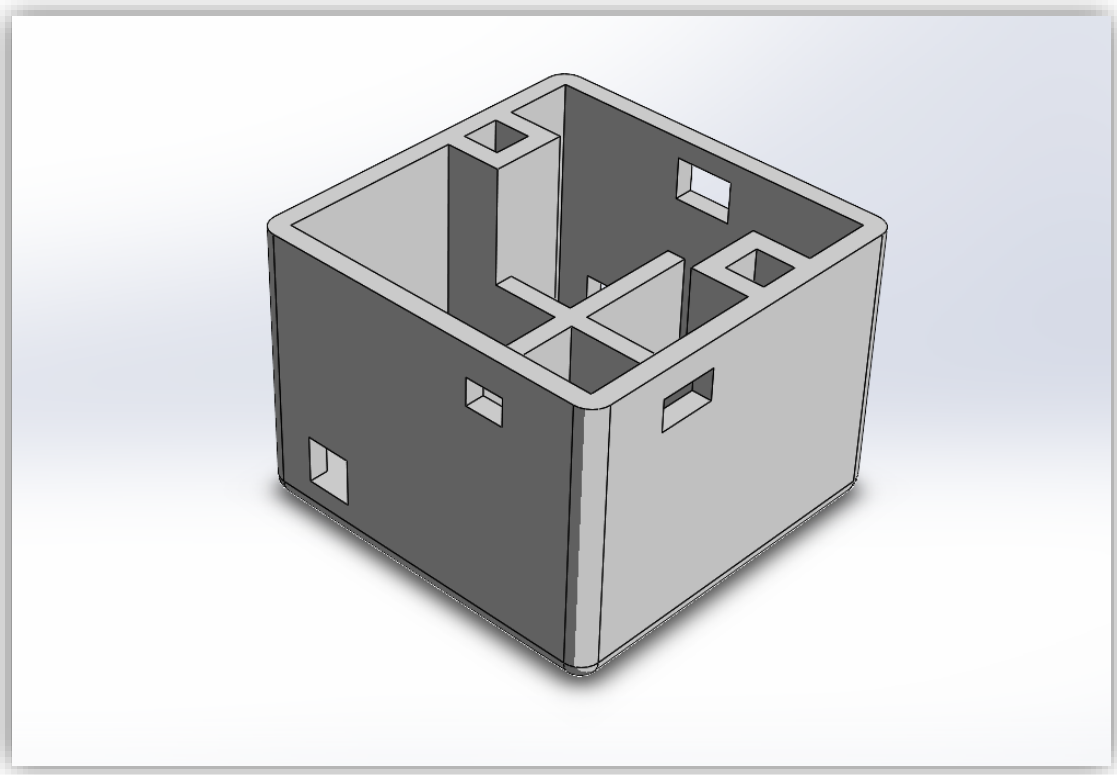
PCB Design

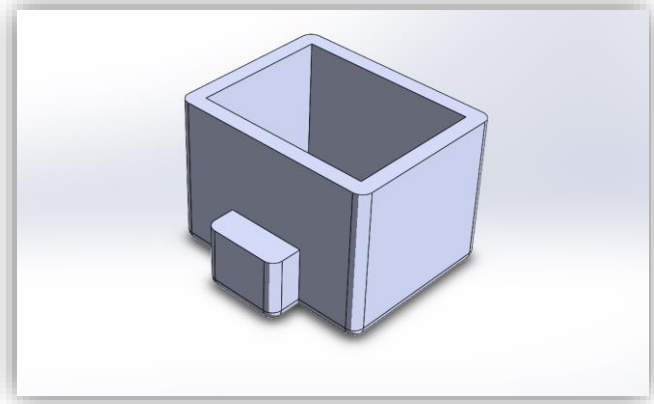

C4
R5
Power
Push button

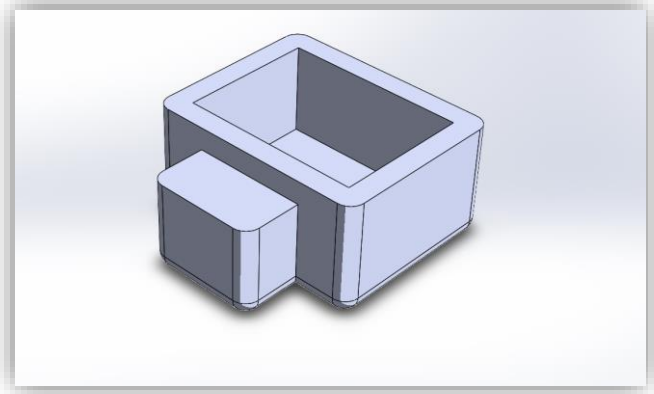

Switches
C3
MC
Power
Y
R4 R3 R2 R1
SSR(OB)
C2
MMW
SSR
C1
C4
R5
SSR_Connector(OB)
Push button
ENTC
PIR

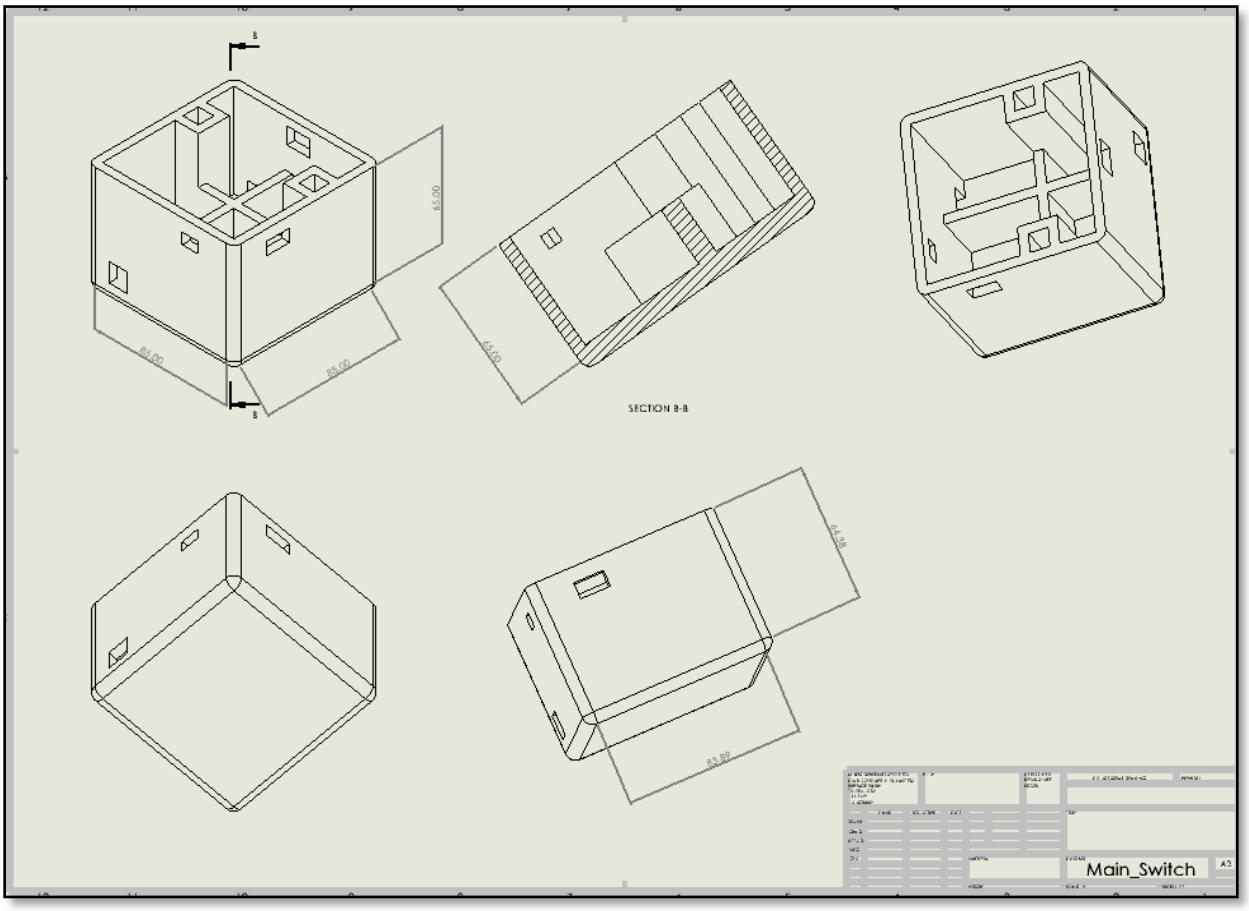

Switches
MC
Power
Y
R4 R3
SSR(OB)
C2
MMW
C1
C4
R5
Push button

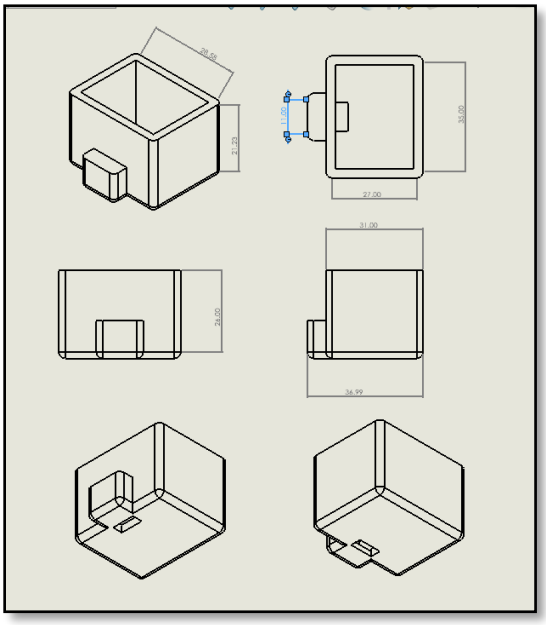
Enclosure Design

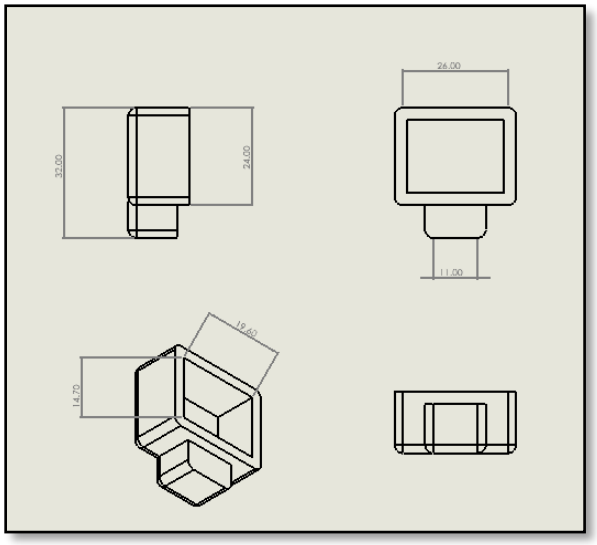






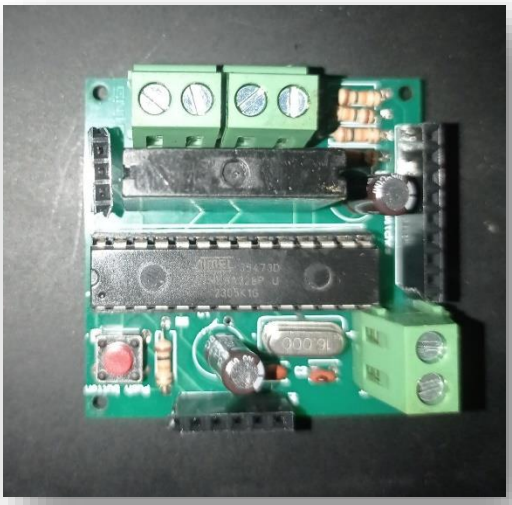

SECTION B-B
Main_Switch



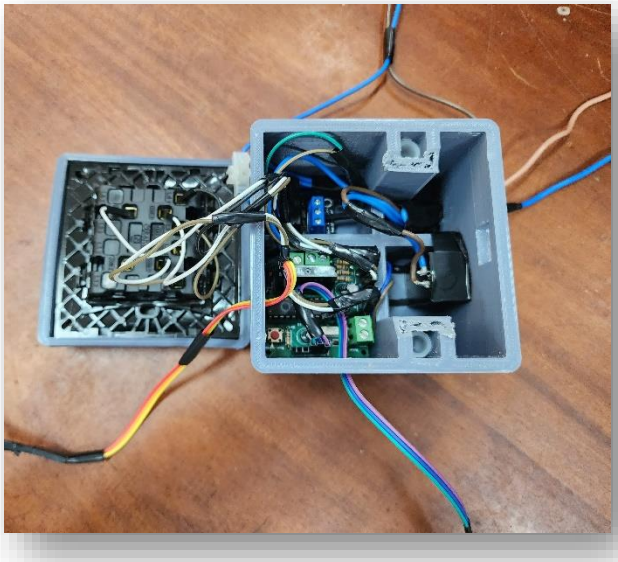


Final Product

- ***PCB:***



- ***Final prototype:***



Bill of quantities

Product	Quantity	Price of one quantity (Rs.)	Price (Rs.)
Enclosure	1	2800	2800
PCB	1	240	240
PIR sensors	1	250	250
Millimeter wave sensor	1	290	290
Hi-Link HLK-5M05 220VAC to 5VDC 5W Step-Down Power Supply Module	1	1050	1050
SSR module	2	330	660
Switch	1	500	500
Microcontroller	1	1350	1350
Other accessories			1500
Total (Rs.)			**8640**

Task Allocation

1. **Rathnayake R M T N B (220528X)**

Gave the contribution to the Circuit algorithm developing part and built up the full circuit diagram into the finalized version and designed the PCB used for the switch control system. Combined the all the algorithm codes into the final coding part in microcontroller.

2. **Fernando A R D (220161N)**

Contributed to build up the circuit algorithm section, in the primary level base. Did the soldering part of main PCB used in the final circuit and some other components needed to the final product. Tested the IR sensor and ultrasonic sensor process with relevant codes.

3. **Kalubowila K A T S (220299T)**

Similarly Did the circuit algorithm finalizing part. Designed the Enclosure for the main switch setting space. And built up the other enclosures which were used for setting the sensors. Tested the ultrasonic sensor used in circuit with its unique code.

4. **Peiris T P N S (220454P)**

Did the circuit algorithm contribute part in circuit logic. Set up all the final dimensions needed for the laser cutter to enclosure design. Finalized some part of code (switch On-off) in the end code.