

**Department of Electronic and Telecommunication Engineering**  
**University of Moratuwa**

EN2160 - Electronic Design Realization



Final Report

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# **Motion and Dark Sensor Light Switch with Remote Control**

Automatic Room Light Control System: An Eco-Friendly Solution for Efficient Energy Consumption

## **Abstract**

The Automatic Room Light Control System is an innovative, eco-friendly solution designed to address the economic and energy crises by optimizing energy consumption. This smart system automatically turns on the lights when a person enters a dark room, ensuring adequate illumination. Conversely, it switches the lights off when the room is unoccupied or sufficiently lit, minimizing unnecessary energy usage. By adopting this technology, individuals and organizations can play a significant role in conserving energy and reducing their carbon footprint. Embracing this cost-effective solution promotes a sustainable approach to living, contributing to a greener future while simultaneously cutting electricity bills and promoting responsible energy management.

## **Table of Contents**

Title	Page No.
1. Product Specifications	– 4
2. Extra Features	– 4
3. Functionality	– 4
3.1 Sensor Input circuit	– 5
3.2 Output Circuit	– 5
3.3 Power Circuit	– 5
4. Production Procedure	– 6
4.1. PCB Manufacturing	– 6
4.1.1.PCB Specifications	– 6
4.1.2.PCB Soldering	– 6
4.2. Enclosure Manufacturing	– 6
5. Testing	– 6
6. Assembly Process	– 6
7. Packaging	– 6
8. Schematics	– 7
9. PCB Layout	– 8
10.Enclosure Design	– 9
11.BOM	– 10

## 1. Product Specifications

- Input Voltage - 230V AC/50Hz
- Operating voltage – 3.3V
- Output Voltage - 230V AC
- Best sensing distance - 3-5 meters
- Induction angle -110degree
- There are 2 connector wires :
  - Brown - Connect to Live wire (L),
  - Blue - Connect to Neutral wire (N).
- PIR motion sensor light has features of small size and lightweight, easy to install and operate in room or anywhere.
- Application lamps - ceiling lamps, panel lights, floodlights ,etc.
- Function :
  - ✓ Auto switches on/off in the dark when someone enters the induction range.
  - ✓ Widely Suitable for auto lighting corridors, stairs , bathrooms, basements, garages, advertisement light and other places.



## 2. Extra Features

This product is normally used in places which we stay for very little time. As examples, corridors, bathrooms, garages, some rooms etc. It operates automatically according to the darkness and motion.

Additionally, the latest update introduces a manual control option through the integration of a remote-control feature, empowering users to operate the device at their convenience.

This enhanced product offers versatile functionality, accommodating two distinct modes of operation: automated motion-based on/off control and the added convenience of remote control, providing users with flexible and seamless lighting management.

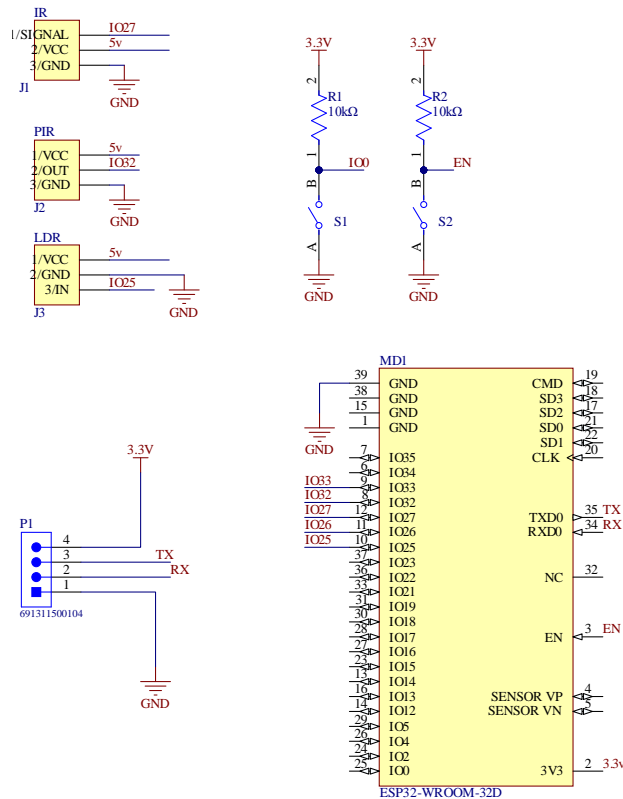
## 3. Functionality

This product consists with two operation modes: automatic mode and manual mode. In automated mode the light will be switch on based on the darkness and the motion detection of the environment. In manual mode user control the light through remote.

The circuit contains three main parts.

- Sensor input circuit
- Power circuit
- Output circuit

### 3.1 Sensor Input circuit

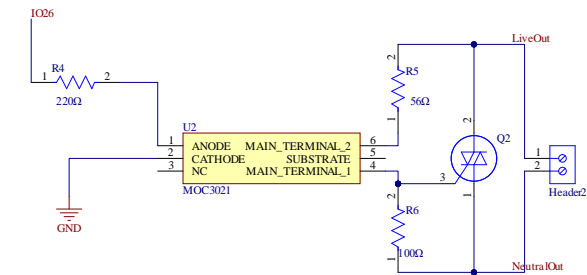


This product uses three main sensors to collect environmental data to the circuit to perform the output.

- PIR sensor – detect the availability of motion.
- LDR sensor – detect light condition in the environment.
- IR receiver – detect remote control signal.

Input these signals to ESP32 microcontroller and it process data and output the resultant command to the output circuit.

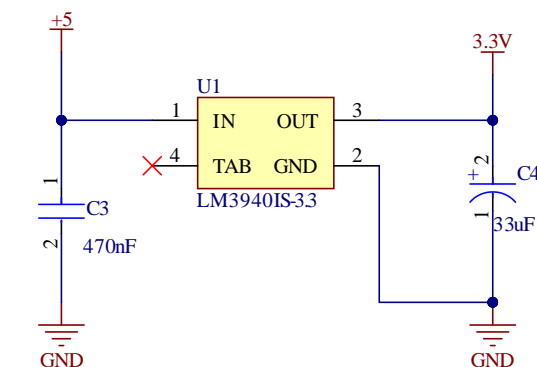
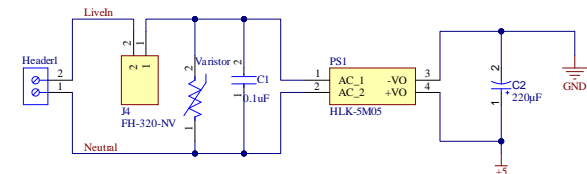
### 3.2 Output Circuit



The output signal which output from the ESP32 microcontroller is giving to a triac through an optocoupler. It works as a switch for alternating current circuit. From that we can control the light bulb.

### 3.3 Power Circuit

For all this functionality, the ESP32 microcontroller wants 3.3V operating voltage. It supplies using following two circuits.



Firstly, 230v converts to 5V using hi-link. Then it converts to 3.3V which requires to operate the microcontroller.

## 4. Production Procedure

PCB fabrication, soldering, testing, and enclosure manufacturing process are discussed in the following sections.

### 4.1 PCB Manufacturing

PCB is designed using Altium 22.7.1. This is two-layer PCB. All components are placed in top layer and soldered in bottom layer. PCB manufacture is outsourced to a Chinese company because there aren't enough facilities in the area to produce PCBs locally.

**PCB Manufacturer:** Jia Li Chuang (Hong Kong) Co., Limited (JLC PCB)

<https://jlcpcb.com/>

#### 4.1.1 PCB Specifications

- Layers : 2
- Thickness : 0.41148mm
- Copper Weight : 1oz
- Material Type : FR4-Standard

#### 4.1.2 PCB Soldering

The PCB design incorporates both through-hole and surface mount (SMD) components, and the preferred assembly method is hand soldering. Hand soldering is recommended due to the relatively small number of components on the board, which helps minimize unnecessary costs. This technique also helps to reduce soldering errors, ensuring a more precise and efficient assembly process.

The sensors should be connected using 3-pin JST connectors. Make sure the ESP32 microcontroller is not subject to high temperature as it can be damaged.

## 4.2 Enclosure Manufacturing

Enclosures are modelled from CAD software Solidworks 2020. The lid and box are the parts in the enclosure.

There are relevant holes to assemble sensors to the enclosure and mounting bosses to mount the PCB.

## 5. Testing

The functionality of the PCB can be tested by uploading a code to the ESP32 microcontroller. It can be written to get PIR sensor, LDR sensor, IR receiver inputs and print it as the serial output.

## 6. Assembly Process

All the sensors are assembled using 2mm diameter screws and PCB is mounted using 3mm diameter screws. The lid is connected to the box using 3mm diameter screws. Both mounting bosses and pertinent holes are present for mounting the PCB and assembling the sensors to the enclosure.

**Step1 :** Fix the PCB to the base using 3 screws. All the connectors should be on the top side and connectors should be placed in the correct location.

**Step2 :** Connect the JST cable of the PIR sensor, LDR sensor and IR sensor in the PCB. Connect the wires coming from bulb holder to the live and neutral terminal blocks in the PCB.

**Step3 :** Fix the cover to the base using 8 screws.

## 7. Packaging

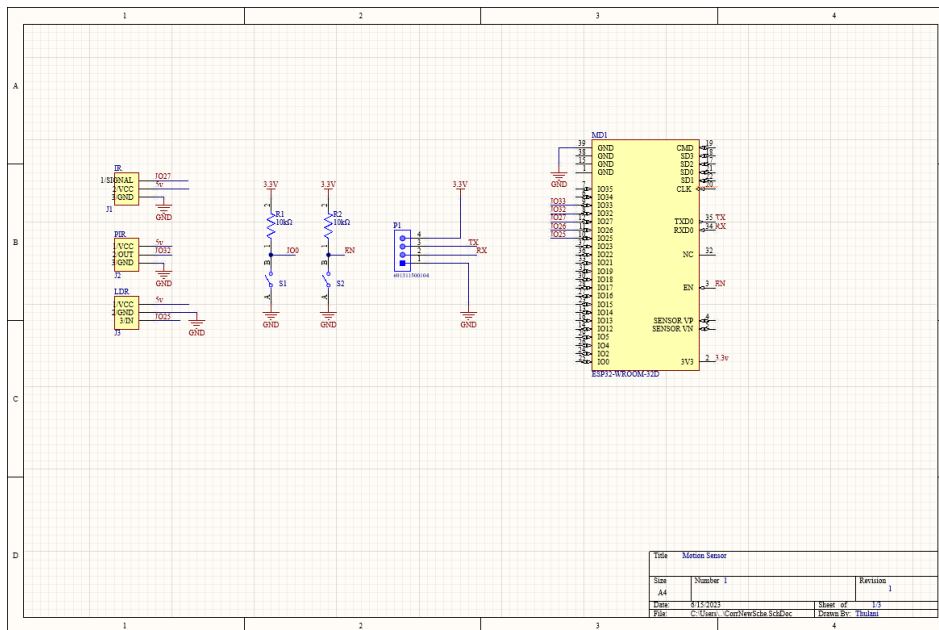
All the components should be fitted inside a rigifoam fitting covered with a cardboard box sealed with gum tape.

Package must include:

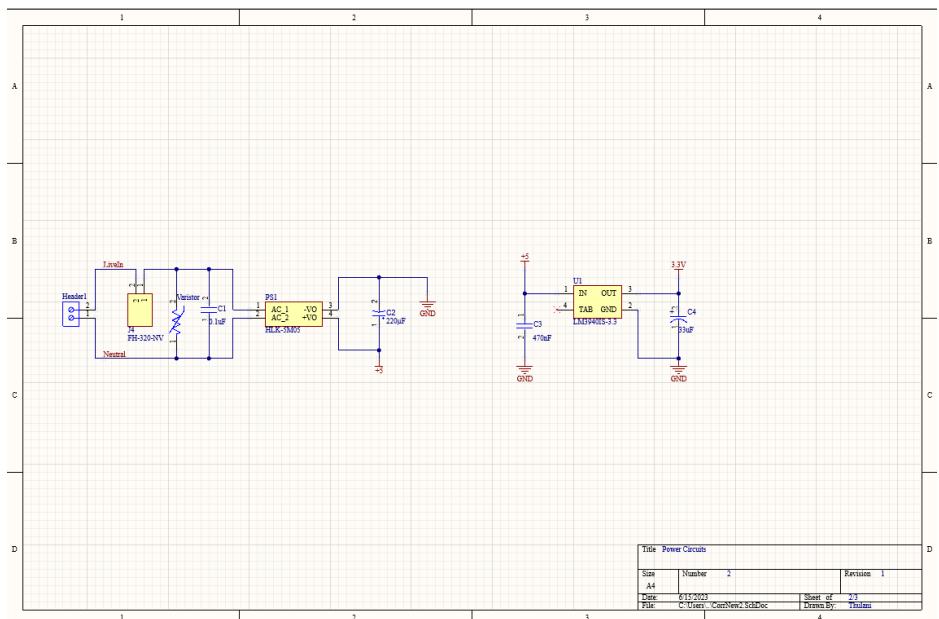
1. Main unit
2. User manual
3. Warranty Certificate

## 8. Schematics

## Main Sensor input circuit



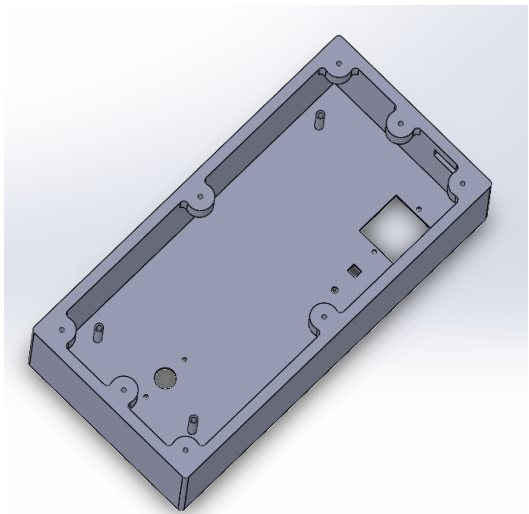
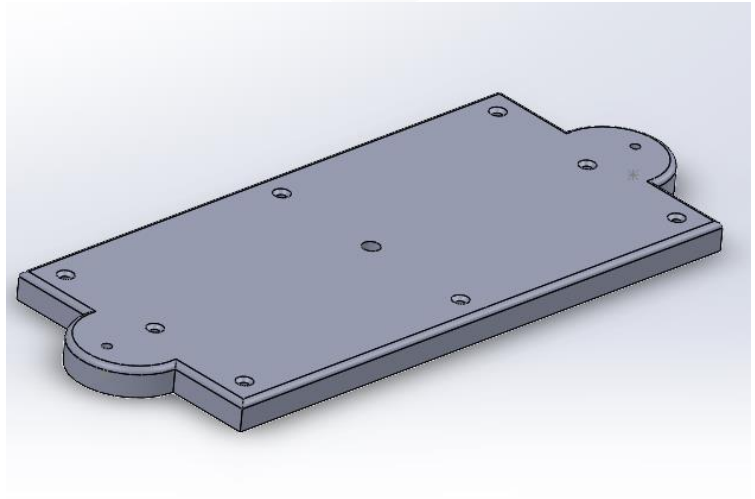
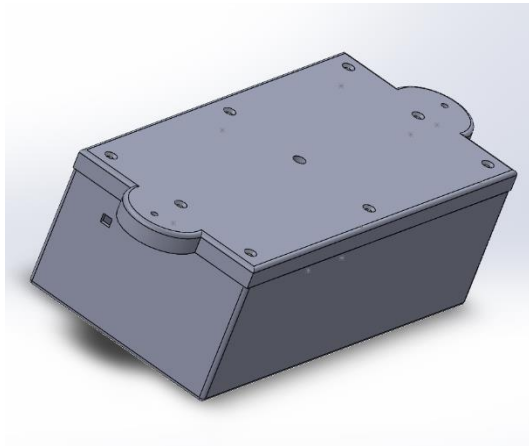
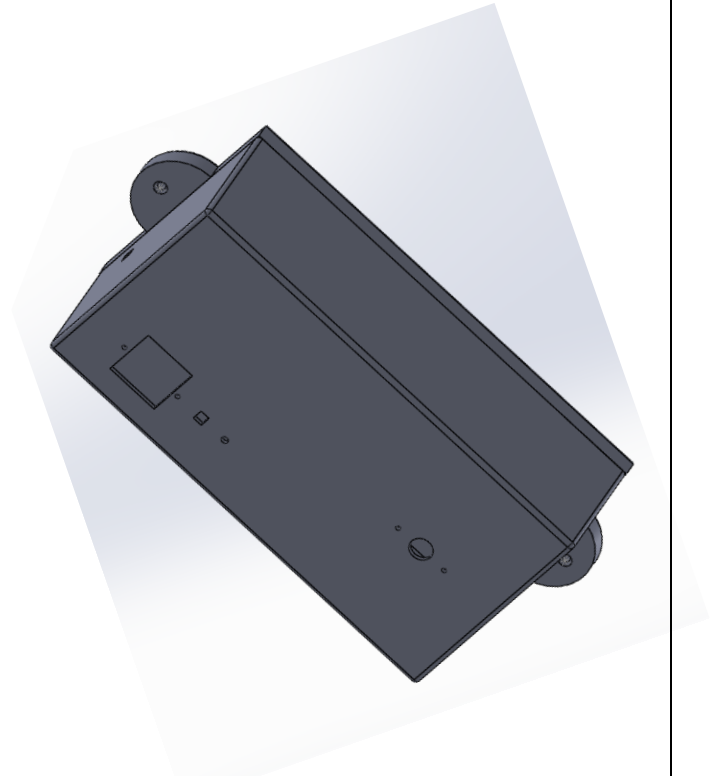
## Power Circuit



[illegible]



## 10.Enclosure Design



## 11. BOM

No.	Comment	Description	Quantity	Unit Price	Supplier
1	RDER72E474K4M1H03A	Ceramic Capacitor 470nF ±10% 250V	1	\$0.16	
2	ECA-2GM330	CAP ALUM 33UF 20% 400V RADIAL	1	\$0.20	
3	R46KF3100CKM1M	CAP FILM 0.1UF 20% 560VDC RADIAL	1	\$0.07	LCSC
4	ECA-1HM221	Aluminum Electrolytic Capacitor, 22	1	\$0.50	
5	MOC3021	Integrated Circuit	1	\$0.15	LCSC
6	ESP32-WROOM-32D	WIFI MODULE 32MBITS SPI FLASH	1	\$4.08	Mouser
7	HLK-5M05	Power Supply	1	\$2.09	LCSC
8	BT136X-600E_DG,127	Triac	1	\$0.46	LCSC
9	MBA02040C2200FC100	RES 220 OHM 0.4W 1% AXIAL	2	\$0.58	
10	56 ohm	RES 56 OHM 0.4W 1% AXIAL	1	\$0.20	
11	100 ohm	RES 100 OHM 0.4W 1% AXIAL	1	\$0.34	
12	10k ohm	RES 10K OHM 0.4W 1% AXIAL, RES 1	2	\$0.69	LCSC
13	ASM1117	1A Low Dropout Regulator for 5V to	1	\$0.73	
14	MOV-14D471K	VARISTOR 470V 4.5KA DISC 14MM	1	\$0.07	LCSC

### List of Suppliers

- Mouser
- LCSC
- Scion Electronics