

# **Automatic Light Controller Design using esim**

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## **Abstract:**

The automatic light control systems also reduce the power consumption by switching the lights ON/OFF as needed. This project will cover the design and simulation of the Automatic Room Light Controller using the eSim tool. The circuit is designed such that the lights will switch ON automatically when motion is detected, and it will switch OFF automatically in the absence of motion. Here, the PIR sensors and relay modules are not available in the eSim, so we will use the equivalent ones to perform the automatic switching action of the circuit.

## **Introduction:**

Energy conservation is one of the critical factors in modern electric and electronic devices. A considerable amount of electrical energy is wasted in homes, offices, educational institutions, and other public places due to switches being ON even when they are not in use. This unnecessary consumption of energy increases electricity bills and puts an extra burden on the overall energy generation facilities.

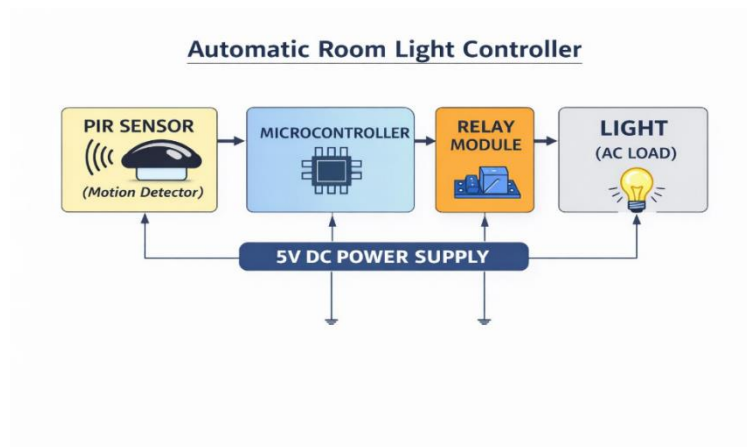
Automatic room light controllers are effective solutions to this issue in that they control lights using the presence of individuals. In this regard, room lights are automatically switched ON in the presence of individuals or automatically switched OFF in the absence of individuals. In the implementation scenario, the necessary devices in this regard include the PIR sensor, the microcontroller, and the relay. In this project, an automatic room light controller is proposed using equivalent devices in that scenario with the help of eSim.

## Objective:

The objectives of this project are:

- To design an automatic room light controller circuit using eSim
- To simulate motion detection using an equivalent signal source
- To control a light using transistor switching
- To analyse the output behaviour of the circuit
- To understand the working of automatic lighting systems

## Block Diagram:



## Block Diagram Description:

The block diagram of an automatic room light controller consists of the following blocks:

- Motion Sensor (PIR Sensor)
- Controller Unit
- Switching Device (Relay)
- Light Load
- Power Supply

The motion sensor detects the presence of a person in the room and sends a signal to the controller. The controller processes this signal and activates the switching device, which turns the light ON or OFF. In this project, these blocks are functionally simulated using equivalent components available in eSim.

## **Proposed Solution:**

The proposed solution implements an automatic room light controller that operates based on motion detection to reduce unnecessary power consumption. The system is designed to automatically switch the light ON when motion is detected and turn it OFF when no motion is present. In eSim, a pulse voltage source is used to simulate the motion sensor output, and a BC547 transistor is used as a switching device to control the light represented by an LED. This approach provides a simple and effective method to demonstrate automatic lighting control using equivalent components.

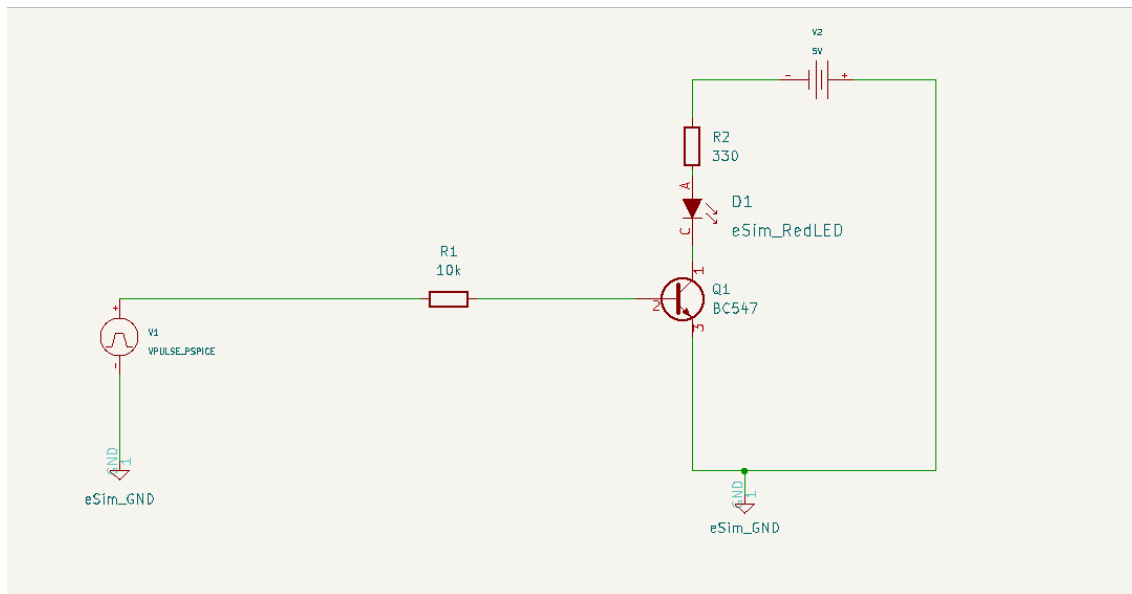
## **Working Principle:**

The automatic room light controller operates based on the detection of motion.

- When motion is detected, the sensor output becomes HIGH.
- This signal is used to drive a switching device.
- The switching device turns ON the light.
- When no motion is detected, the light is automatically turned OFF.

In eSim, this behaviour is simulated using a pulse voltage source to represent motion detection. The pulse drives the base of an NPN transistor through a resistor. When the base voltage is high, the transistor turns ON and allows current to flow through the LED, turning it ON. When the pulse goes low, the transistor turns OFF and the LED also turns OFF.

## eSim Circuit:



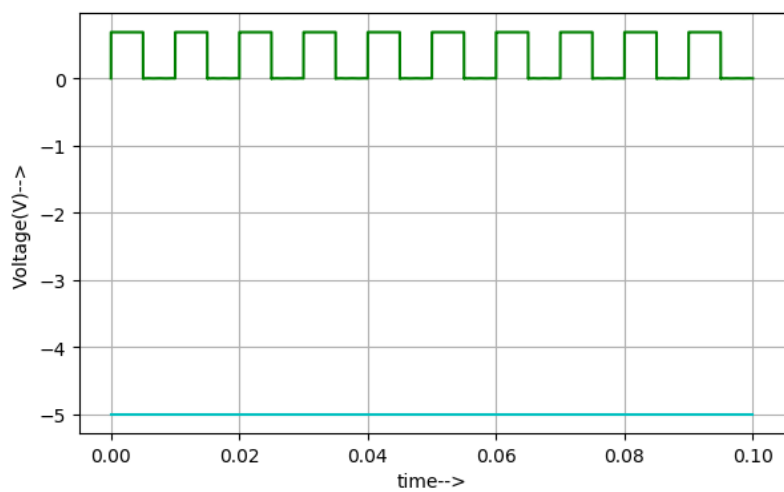
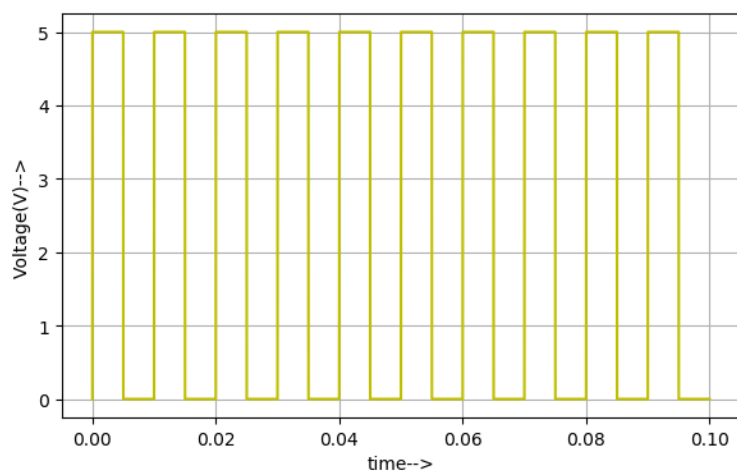
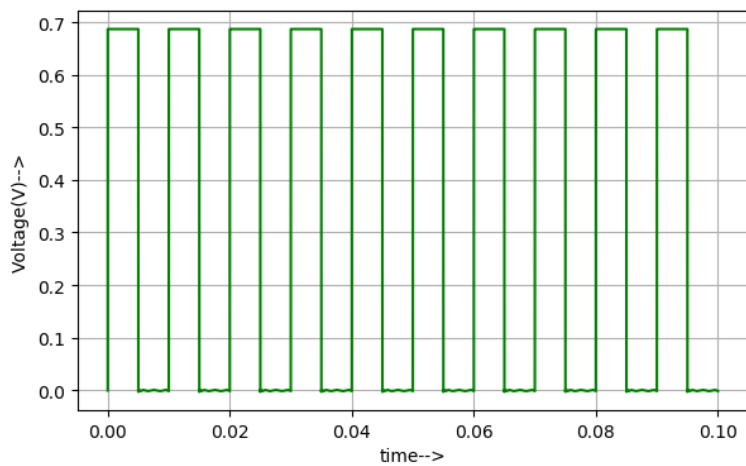
## Circuit Description:

The circuit consists of the following components:

- VPULSE source to simulate motion detection
- BC547 NPN transistor used as a switching element
- Base resistor (10 k $\Omega$ ) to limit base current
- Current limiting resistor (330  $\Omega$ ) for the LED
- Red LED representing the room light
- 5 V DC power supply
- Common ground connection

The base of the transistor is driven by the pulse source through a resistor. The emitter is connected to ground, and the collector is connected to the LED and resistor combination. This configuration allows the transistor to act as a switch.

## Output Waveforms:



## Applications:

Automatic room light controllers are widely used in various environments to improve energy efficiency and convenience. Some important applications of the proposed system are listed below:

- Residential buildings for automatic control of room lighting
- Offices and educational institutions to reduce unnecessary power usage
- Corridors, staircases, and hallways for safety and energy saving
- Smart home and building automation systems
- Public places such as parking areas, libraries, and auditoriums
- Security lighting systems for automatic illumination

## Conclusion:

The automatic room light controller was successfully designed and simulated using eSim. The correctness of the system is verified through the three observed output waveforms, which demonstrate proper switching behaviour of the circuit. The collector voltage waveform confirms correct transistor operation in saturation and cutoff regions, while the voltage across the LED clearly indicates its ON and OFF states corresponding to motion detection.

The observed waveforms validate that the circuit responds accurately to the control signal and performs automatic light switching as intended. Minor voltage variations are due to normal transistor saturation and do not affect system performance. Overall, the simulation confirms that the proposed automatic room light controller provides a simple, reliable, and energy-efficient solution for motion-based lighting control.

## Reference:

A. Jogdand, B. Thakur, and R. Pame, "Automatic room lights controller using Arduino and PIR sensor," *Int. J. Res. Appl. Sci. Eng. Technol.*, vol. 9, no. 8, 2021. <https://www.ijraset.com>