**Mini Project Report**

on

# “IoT-based Automated Light System”

Submitted in partial fulfillment for the award of the degree of

## BACHELOR OF TECHNOLOGY

in

## INFORMATION TECHNOLOGY

Submitted by


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Under the Guidance of

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**Government College of Engineering, Karad**

**(An Autonomous Institute of Government of Maharashtra)**


**Academic Year 2022-2023**

# Government College of Engineering, Karad

**(An Autonomous Institute of Government of Maharashtra)**

## Department of Information Technology

# *CERTIFICATE*

**This is to certify that the project entitled " IoT based Automated Light System" has been carried out by team:**

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Apart from individual efforts, the success of any project depends largely on the encouragement and guidelines of many others. We take this opportunity to express our gratitude to the people who have been instrumental throughout the project work.

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We deeply express our sincere thanks to our Head of Department Dr. S. J. Wagh for encouraging and allowing us to present the project on the topic “IoT-based Automated Light System” and providing us with the necessary facilities to enable us to fulfill our project requirements as best as possible. We take this opportunity to thank all faculty members and staff of the Department of Information Technology, who have directly or indirectly helped our project.

We pay our respects to honorable Principal Dr. A. T. Pise for their encouragement. Our thanks and appreciations also go to our family and friends, who have been a source of motivation and inspiration throughout the duration of the project.

# ABSTRACT

This project is all about motion detection using a Passive Infra-Red (PIR) sensor and light detection using a Light Dependent Resistor (LDR) sensor with Arduino, wirelessly. Besides that, it also acted as an auto power-switching system. When the sensor is triggered, the signal will transmit wirelessly to take action. Relays manage small currents that can control much larger currents. When a small current flows through the first circuit, it activates the electromagnet, which generates a magnetic field all around it. The PIR sensors detect changes in the amount of infrared radiation incident on it and then the LDR sensor checks for the light present. Whenever any object like a human being passes in front of the PIR sensor, the temperature of the area will change from room temperature to body temperature. The temperature will be back again when the object has moved ahead. Arduino is coded to take the input from PIR and LDR, if it receives a high input then it activates the relay and the light is switched On. Before switching on it checks for both the conditions one of PIR and one of LDR. The Relay Module is a device that switches power to auxiliary devices.

# LIST OF FIGURES

# ABBREVIATIONS

| Acronym | Definition |
|---|---|
| PIR | Passive Infrared Sensor |
| LDR | Light Detecting Resistor |
| IoT | Internet of things |
| IR | Infrared radiations |
| IDE | Integrated development environment |

# TABLE OF CONTENTS

# Chapter 1
# INTRODUCTION

## 1.1 Background:

Nowadays as all are using traditional bulbs that cause a large amount of wastage of electricity and know that electricity is a non-renewable resource so in order to save electricity on a day-to-day basis, our small contribution can reflect a large change.

So, this project aimed to develop a lightning system that will work only when its necessary conditions are satisfied and remain off when not. But it should be done automatically without any human interference. In the market, there are some options for this but they provide only half the facility that we wanted. Some products are just based on the intensity of light [1], and some only track the motion [2] but for better efficiency the both conditions need to be integrated so is this project.

## 1.2 Motivation:

Automation in various daily used devices is becoming more and more popular and crucial these days. Automated lightning is a crucial part as it makes human life easy along with saving the waste of electricity. Most lightning systems available are expensive and complex and also hard to install [3]. Here is an automated light system prototype developed to replace ordinary light switches. An easy-to-install, and automated system for saving electricity was the ultimate goal of this project.

## 1.3 Scope:

The Automated Light system is a boon for both rural areas and even metropolitan cities for conserving power. Here the proposed method uses an Automatically controlled system based on IoT [4]. In this method, lights are automatically controlled which increases the energy efficiency and cost saving of things.

This system can be implemented in both public places as well as in private places as it uses sensors instead of a camera to sense movement. It can be used in households as well.

## 1.4 Expected Outcome:

- When a human interference occurs in front of a light bulb and does not have the required intensity then light should glow.
- To reduce the use of light bulbs and save electricity for future generations and minimize pollution by using this system.
- By using a small sensor, we can reduce the use of electricity and hence minimize the waste of electricity.

# Chapter 2
# LITERATURE SURVEY

| Paper Title | Advantages | Disadvantages | Technologies used |
|---|---|---|---|
| Motion Detection Using Arduino[1] Prof.Akshay Agrawal, Mr.Mahesh Kshirsagar, Mr.Vivek Yadav, Miss.Rupali Ghodvinde | - Messaging System<br>-Frame Detection Through Camera | -Complicated System Architecture.<br>-Accessible through Any Random<br>-Android Device within the Bluetooth Range.<br>-Camera makes Circuit Costly. | - Camera<br>- Bluetooth<br>- Android device |
| Motion Detection Using PIR Sensor[2] Yogesh Pawar, Abhay Chopde, Mandar Nandre | -PIR used Makes Circuit Cheap and Affordable. | -Covers Small Installed Region. | - PIR sensor |
| Motion Detection Using PIR Sensor [3] Ajay Kumar Tiwari, Prince Raj | -Less Energy Consumption<br>-Small Circuit. | -Circuit Output is Of Small Volts (5-12 volts).<br>-Devices requiring large voltage cannot be used here. | - PIR sensor with 5-volt LED |

| | | | |
|---|---|---|---|
| Real-Time Lighting Control System for Smart Home Applications [4] Siti Nurmani Bambang Tukuto SarifaPutri Raflesia | -Notification System and real-time control.<br>-It has 4 different modes for each bulb connected. Has a feature of manual on/off and timer on/off | -Response server was used which requires a strong network connection.<br>-Accessible through Any Random Android Device located anywhere with an internet connection.<br>-System was costly due to the peripherals used. | -Notification system<br>-Android device |
| Automated Smart Utilization of Background Lights and Daylight for Green Building Efficient and Economic Indoor Lighting Intensity Control [5] Muhammad M. A. S. Mahmoud | -The issue of a lot of energy being consumed<br>- Unnecessarily during the daytime indoors was solved. | -Continuous changing in the intensity of the bulb for any reason may result in Photophobia.<br>-LCD was used to monitor the intensity of light.<br>-Digital Light sensor BH1750 and Arduino mega used makes the system much more Costly. | -LDR sensor<br>-Arduino mega<br>- LCD display |
| PIR and IR Sensor Based Smart Home Automation System Using IoT for Energy Saving Application [10] P,Eben Sophia, Prithvirajan.R , Thirunavukarasu.S, Muntharaj.K, S. Sarmila | - Uses PIR and IR sensor for motion detection<br>- Works on large 220-volt supply | - No any option to detect current light intensity.<br>- Light will also be on in day time although it has a required amount of light | - Arduino UNO<br>- PIR sensor<br>- IR sensor |

# Chapter 3

## RELATED THEORY AND PROBLEM DEFINITION

### 3.1 Problem Statement:

IoT Based Automated Light System for detection of Human interference using PIR sensor and environmental light by using LDR sensor and switching the light bulb on and off.

### 3.2 Related Theory

- What is IoT?

The Internet of Things (IoT) describes the network of physical objects— "things"—that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. These devices range from ordinary household objects to sophisticated industrial tools. With more than 7 billion connected IoT devices today, experts are expecting this number to grow to 10 billion by 2020 and 22 billion by 2025. Oracle has a network of device partners.

- Why is Internet of Things (IoT) so important?

Over the past few years, IoT has become one of the most important technologies of the 21st century. Now that we can connect everyday objects—kitchen appliances, cars, thermostats, baby monitors—to the internet via embedded devices, seamless communication is possible between people, processes, and things.

By means of low-cost computing, the cloud, big data, analytics, and mobile technologies, physical things can share and collect data with minimal human intervention. In this hyperconnected world, digital systems can record, monitor, and adjust each interaction between connected things. The physical world meets the digital world—and they cooperate.

- What technologies have made IoT possible?

While the idea of IoT has been in existence for a long time, a collection of recent advances in a number of different technologies has made it practical.

- Access to low-cost, low-power sensor technology. Affordable and reliable sensors are making IoT technology possible for more manufacturers.
- Machine learning and analytics. With advances in machine learning and analytics, along with access to varied and vast amounts of data stored in the cloud, businesses can gather insights faster and more easily. The emergence of these allied technologies continues to push the boundaries of IoT and the data produced by IoT also feeds these technologies.
- Conversational artificial intelligence (AI). Advances in neural networks have brought natural-language processing (NLP) to IoT devices (such as digital personal assistants Alexa, Cortana, and Siri) and made them appealing, affordable, and viable for home use.

# Chapter 4
# DESIGN METHODOLOGY

## 4.1 Proposed system Architecture:

- Flow Chart

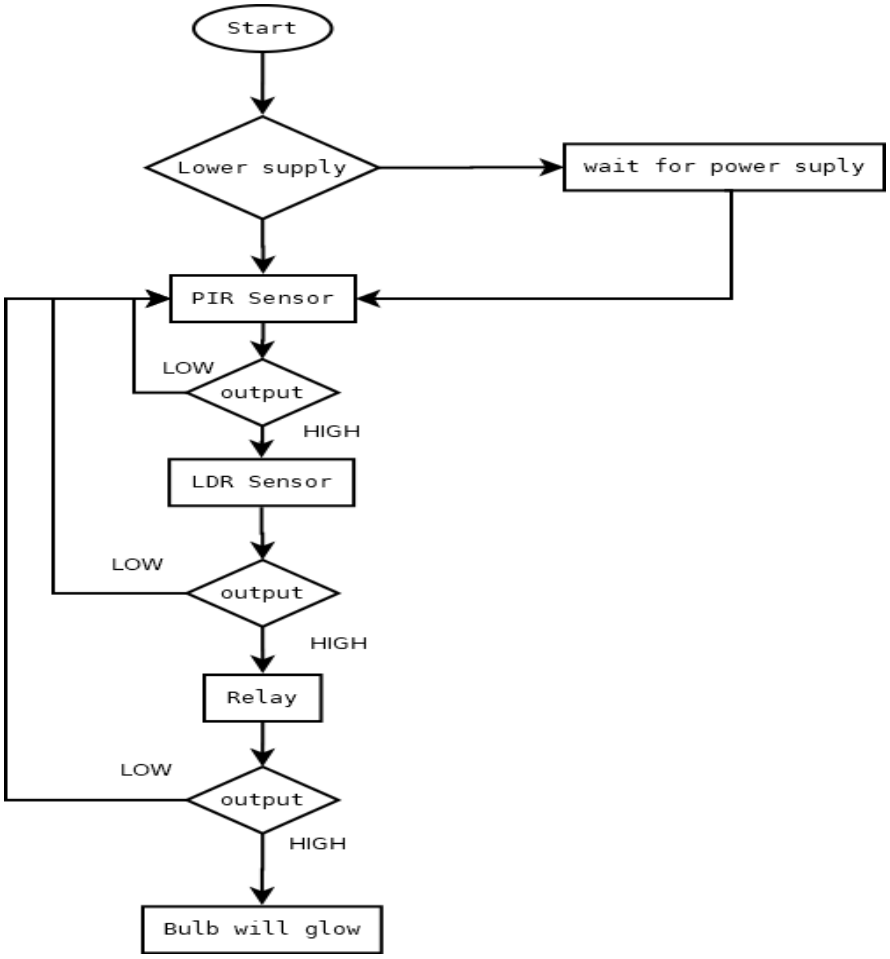


Fig. 1 Flow Chart

Firstly, the Arduino and the bulb are provided an external power supply from our domestic Electricity boards. As the circuit starts the PIR Sensor comes into action very first. As the PIR detects human and animal motion. Humans emit Infrared radiations. When a human comes into the sensing range of the PIR sensor, these changes in radiation are detected by the PIR sensor which causes the output of the sensor to go high. If PIR remains low it keeps on checking again and again till it gets high.

As shown in the fig. 1 if the PIR sensors go to high it goes next to the LDR sensor. In the presence of light, the LDR sensor tends to be low and in the absence of the light it goes to high. If the LDR gives the low then it goes back to the PIR and keeps checking continuously and when the LDR gives high the with firstly the PIR being high it the relay modules gets activated and this results the bulb to glow.

## 4.2 Internal Logic of the system:

There are some cases where light is only required such as if the room has enough light intensity, then there is no need for light, and if there is darkness in the room but no one is in the room then also glowing light is a waste of electricity. But when there's a dark room and human interference, then only the bulb should glow.

On the basis of these cases, we have developed a logic where the system first checks for motion using a PIR sensor if PIR gives high output, then and then only it checks for light intensity and light will glow only if both conditions have been satisfied.

## 4.3 Technical Specifications

Software Requirements:

- Arduino Software (IDE)

Languages used for Front-end:

- C
- C++

Hardware:

- PIR
- LDR
- Arduino UNO
- Relay module
- Bulb

# Chapter 5

# IMPLEMENTATION

## 5.1 Arduino UNO:

The Arduino UNO is a standard board of Arduino. Here UNO means 'one' in Italian. It was named UNO to label the first release of Arduino Software. It was also the first USB board released by Arduino. It is considered a powerful board used in various projects. Arduino.cc developed the Arduino UNO board.

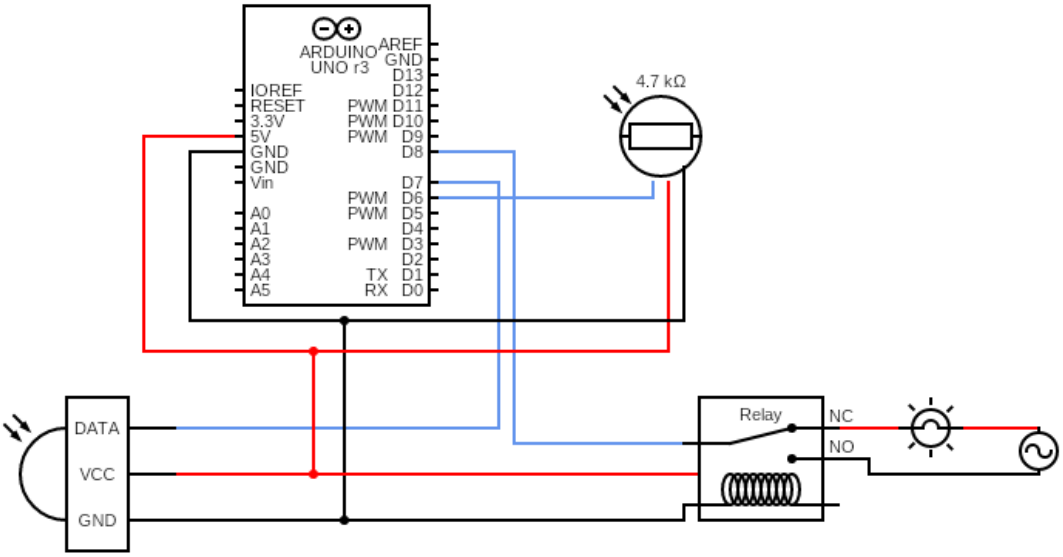


Fig 3. Circuit diagram

The Arduino UNO includes 6 analog pin inputs, 14 digital pins [1] , a USB connector, a power jack, and an ICSP (In-Circuit Serial Programming) header. It is programmed based on IDE, which stands for Integrated Development Environment. It can run on both online and offline platforms.

- ATmega328 Microcontroller- It is a single-chip Microcontroller of the ATmel family. The processor code inside it is 8-bit. It combines Memory (SRAM, EEPROM, and Flash), Analog to Digital Converter, SPI serial ports, I/O lines, registers, timers, external and internal interrupts, and an oscillator.

ICSP pin - The In-Circuit Serial Programming pin allows the user to program using the firmware of the Arduino board[1] . Power LED Indicator- The ON status of LED shows the power is activated. When the power is OFF, the LED will not light up.

- Digital I/O pins- The digital pins have the value HIGH or LOW. The pins numbered from D0 to D13 are digital pins.
- TX and RX LEDs- The successful flow of data is represented by the lighting of these LEDs
- AREF- The Analog Reference (AREF) pin is used to feed a reference voltage to the Arduino UNO board from the external power supply.
- Reset button- It is used to add a Reset button to the connection.
- USB- It allows the board to connect to the computer. It is essential for the programming of the Arduino UNO board
- Crystal Oscillator- The Crystal oscillator has a frequency of 16MHz, which makes the Arduino UNO a powerful board.
- Voltage Regulator- The voltage regulator converts the input voltage to 5V.
- GND- Ground pins. The ground pin acts as a pin with zero voltage.
- Vin- It is the input voltage.
- Analog Pins- The pins numbered from A0 to A5 are analog pins[1] . The function of Analog pins is to read the analog sensor used in the connection. It can also act as GPIO (General Purpose Input Output) pins.

## 5.2 PIR sensor:

The most common motion sensor for residential properties, PIRs detect body heat [2], which alters infrared energy. When a sensor detects the slightest change in temperature within its protective grid, it signals an alarm. In the past, PIRs could be tripped by incoming sunbeams, but this issue has been rectified in newer infrared sensors. (The word “passive” in the term “passive infrared” refers to the principal nature of the sensor. Proximity sensors must generate their own infrared radiation actively, which is interrupted or reflected by nearby objects whereas PIR doesn’t need to generate or emit any type of radiation).

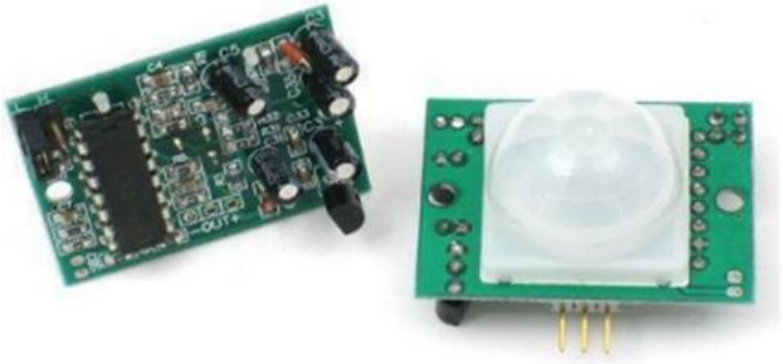

Fig. 4 PIR sensor image

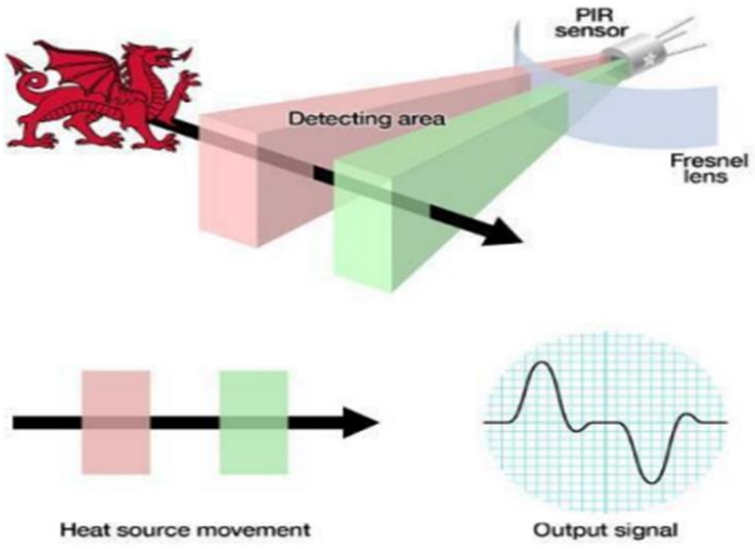


Fig. 5. PIR sensor working

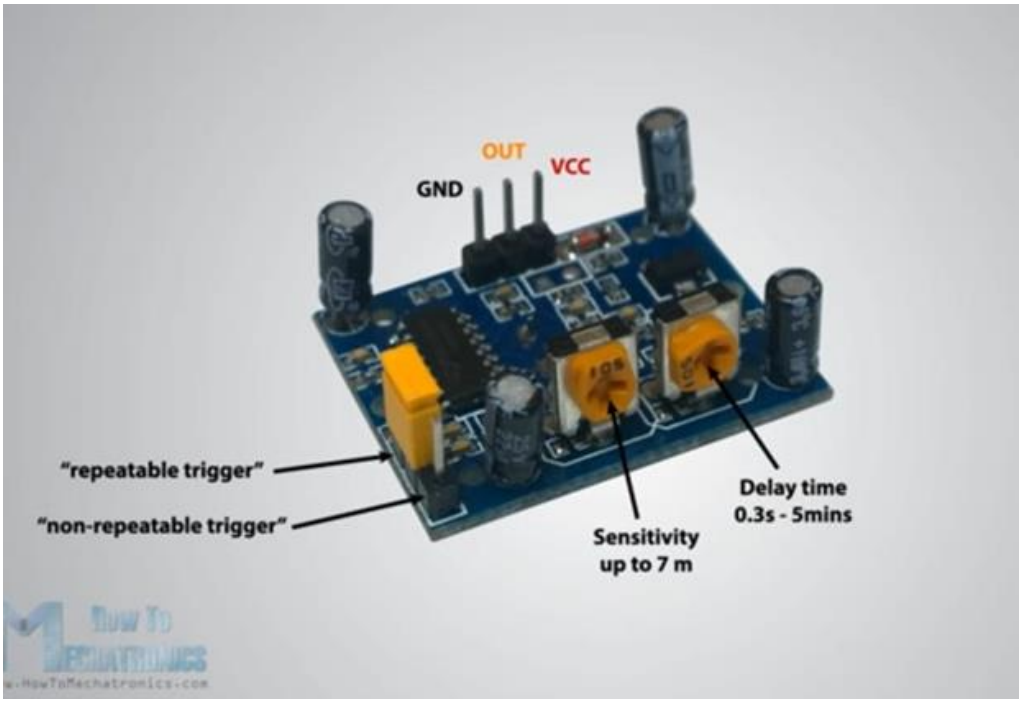


Fig 6. pins of PIR

PIRs are basically made of a pyroelectric sensor [2] (which you can see below as the round metal can with a rectangular crystal in the center), which can detect levels of infrared radiation. Everything emits some low-level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is actually split into two halves. The reason for that is that we are looking to detect motion (change), not average IR levels. The two halves are wired up so that they cancel each other out. If one half sees more or less IR radiation than the other, the output will swing high or low.

## 5.3 LDR:

Photoresistors, also known as light-dependent resistors (LDR), are light-sensitive devices most often used to indicate the presence or absence of light, or to measure the light intensity. In the dark, their resistance is very high, sometimes up to 1 MΩ[6], but when the LDR sensor is exposed to light, the resistance drops dramatically, even down to a few ohms, depending on the light intensity. LDRs have a sensitivity that varies with the wavelength of the light applied and are nonlinear devices. They are used in many applications, but this light-sensing function is often performed by other devices such as photodiodes and phototransistors. Some countries have banned LDRs made of lead or cadmium over environmental safety concerns.

Fig 7. LDR

### 5.3.1 Types of photoresistors and working mechanisms

Based on the materials used, photo resistors can be divided into two types: intrinsic and extrinsic. Intrinsic photoresistors use undoped materials such as silicon or germanium. Photons that fall on the device excite electrons from the valence band to the conduction band. This creates more free electrons in the material that is available to carry current, and therefore less resistance. Extrinsic photoresistors are made of materials doped with impurities, also called dopants. The dopants create a new energy band above the existing valence band, populated by electrons. These electrons need less energy to make the transition to the conduction band thanks to the smaller energy gap. The result is a device sensitive to different wavelengths of light. Regardless, both types will exhibit a decrease in resistance when illuminated. The higher the light intensity, the larger the resistance drop is. Therefore, the resistance of LDRs is an inverse, nonlinear function of light intensity.

### 5.3.2 Wavelength dependency

The sensitivity of a photoresistor varies with the light wavelength. If the wavelength is outside a certain range, it will not affect the resistance of the device at all. It can be said that the LDR is not sensitive in that range of light wavelengths. Different materials have different unique spectral response curves of wavelength versus sensitivity. Extrinsic light-dependent resistors are generally

designed for longer wavelengths of light, with a tendency towards infrared (IR). When working in the IR range, care must be taken to avoid heat buildup, which could affect measurements by changing the resistance of the device due to thermal effects. The Figure shown here represents the spectral response of photoconductive detectors made of different materials, with the operating temperature expressed in K and written in parentheses.

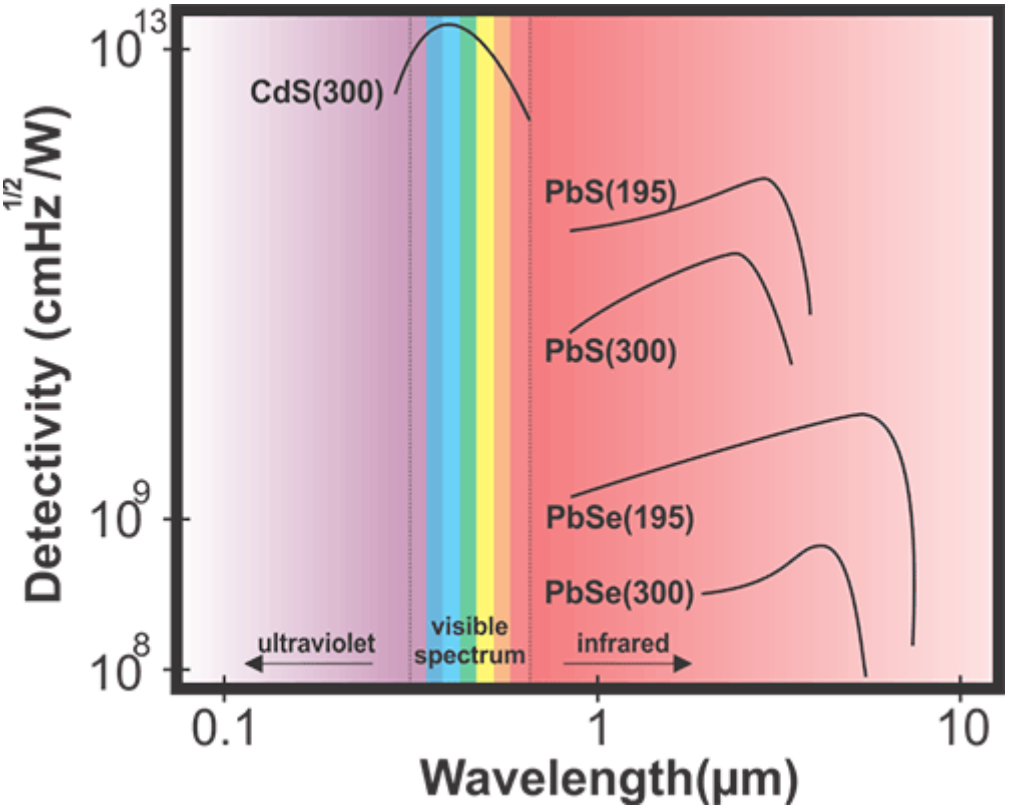


Fig 8. Wavelength detection

### 5.3.3 Sensitivity

Light-dependent resistors have lower sensitivity than photo diodes and phototransistors. Photodiodes and phototransistors are true semiconductor devices that use light to control the flow of electrons and holes across P-N junctions, while light-dependent resistors are passive components, lacking a P-N junction. If the light intensity is kept constant, the resistance may still vary significantly due to temperature changes, so they are sensitive to temperature changes as well. This property makes LDRs unsuitable for precise light intensity measurements.

### 5.3.4 Latency

Another interesting property of photoresistors is that there is time latency between changes in illumination and changes in resistance. This phenomenon is called the resistance recovery rate. It takes usually about 10 ms for the resistance to drop completely when light is applied after total darkness, while it can take up to 1 second for the resistance to rise back to the starting value after the complete removal of light. For this reason, the LDR cannot be used where rapid fluctuations of light

are to be recorded or used to actuate control equipment. But at this same time latency property is exploited in some other devices, such as audio compressors, where the function of the light-dependent resistor is to smooth the response.

## 5.4 Relay:

A relay is an electromechanical device that uses an electric current to open or close the contacts of a switch. The single-channel relay module is much more than just a plain relay, it comprises components that make switching and connection easier and act as indicators to show if the module is powered and if the relay is active or not.

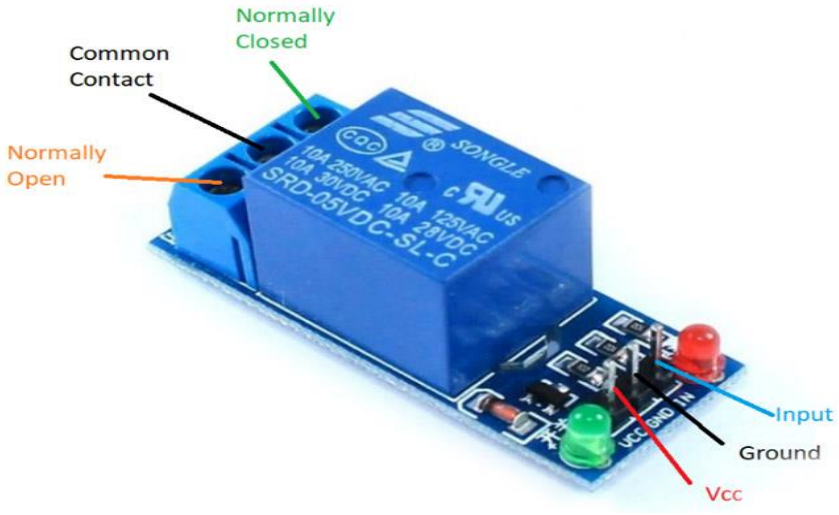


Fig 9 Single channel Relay module

Table. 1 pin of single channel relay

| **Pin number** | **Pin name** | **Description** |
|---|---|---|
| 1 | Relay Trigger | Input to activate the relay |
| 2 | Ground | 0V reference |
| 3 | VCC | Supply input for powering the relay coil |
| 4 | Normally Open | Normally open terminal of the relay |
| 5 | Common | Common terminal of the relay |
| 6 | Normally Closed | Normally closed contact of the relay |

**Single-Channel Relay Module Specifications**

- Supply voltage – 3.75V to 6V
- Quiescent current: 2mA
- Current when the relay is active: ~70mA
- Relay maximum contact voltage – 250VAC or 30VDC
- Relay maximum current – 10A

## 5.5 Implementation of Project:

1. Firstly, give power supply to Arduino with laptop.
2. Connect Ground and VCC to PIR, LDR, and Relay.
3. Connect the output pin of PIR and LDR to Arduino digital pin.
4. Connect the digital pin of Arduino to Relay for output.
5. Give AC supply to LED Bulb and Relay.
6. open Arduino IDE and read input and output pins.
7. In our case pins used are:
    - PIR input pin: D7
    - LDR input pin: D6
    - Relay output pin: D8
8. then first check for PIR output if it is LOW then do nothing and the bulb remains off.
9. PIR output in HIGH then we check for LDR output if LDR output in low then again do nothing.

# Chapter 6
# RESULT

## 6.1 Light and no human interference

Here the whole circuit is in its rest state in the light. The bulb here won't glow as there is the presence of light in the environment and no human interference occurs. Firstly, it checks PIR which gives a low signal as there is no human interference and then, LDR remains low which means there is a presence of light.

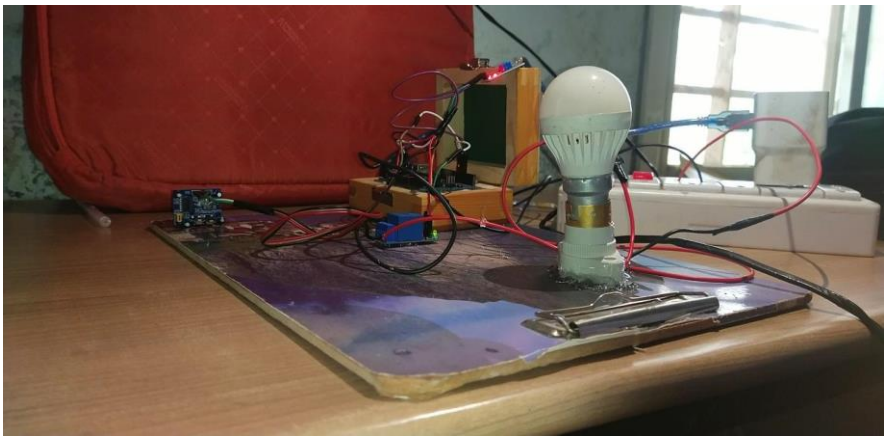

Fig 10. Result of light and no human interaction

## 6.2 Light and human interference

Here as the human interference occurs the PIR sensor gives a high signal which fulfills the condition of the PIR sensor, and then it checks for the LDR. Here due to the presence of the light, the LDR gives a low signal and here the condition for LDR fails. The bulb will glow only when both conditions are satisfied and here one of them fails so it won't glow.

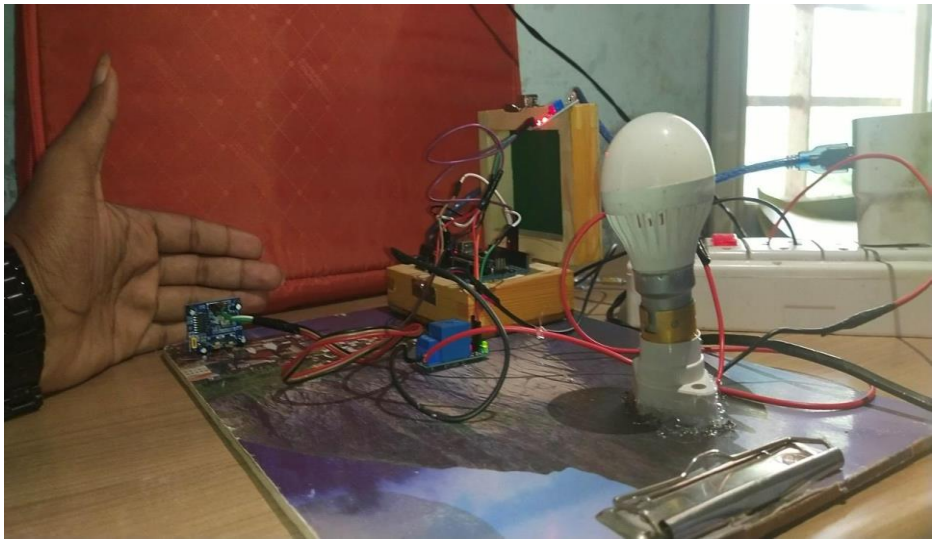

Fig 11. Result of light and human interaction

## 6.3 Light and object (non-living) interference

As the PIR sensor is an infrared sensor and senses the change in the heat in the environment it senses the body heat of the living beings if it occurs then the change is detected in the infrared radiations. Here due to the non-living interference there is no change in the infrared radiations. So here the very first condition of the PIR fails, due to the failure of very first condition it won't check second and so here the bulb won't glow.

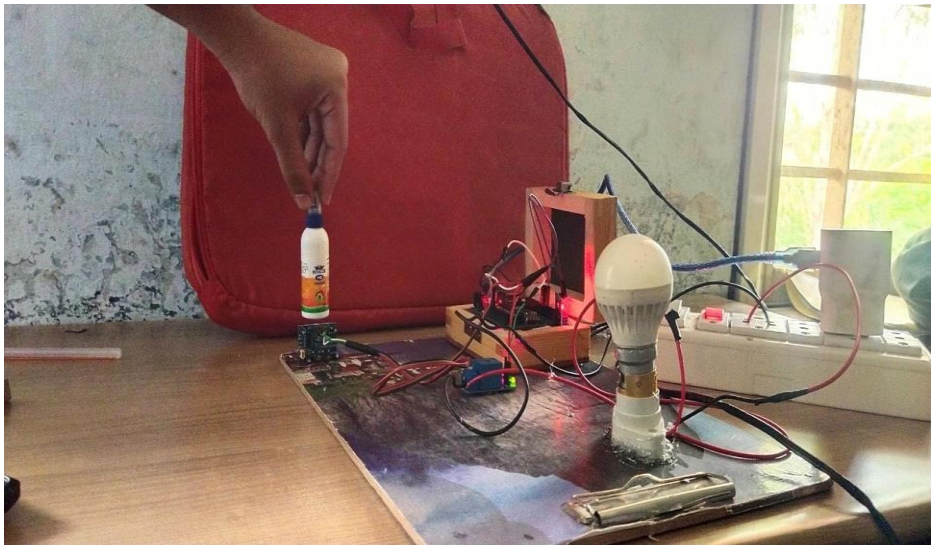

Fig 12. Result of light and Non-living interaction

## 6.4 Dark and no human interference

Here the whole circuit is in its rest state as due to absence of the human interference very first condition fails. It won't check for the LDR's condition because for the failure of the first condition itself.

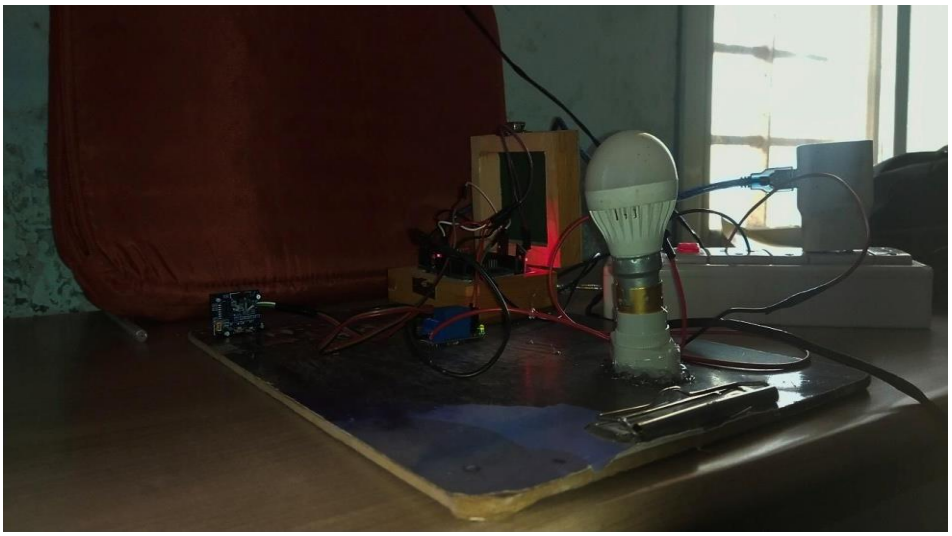

Fig 13. Result of dark and no human interaction

## 6.5 Dark and object (non-living) interference

As here there occurs the non-living interference the PIR doesn’t detect any change in its emitted IR radiations and then due to the failure of the first condition itself it doesn’t check for the second. Henceforth here the bulb won't glow.

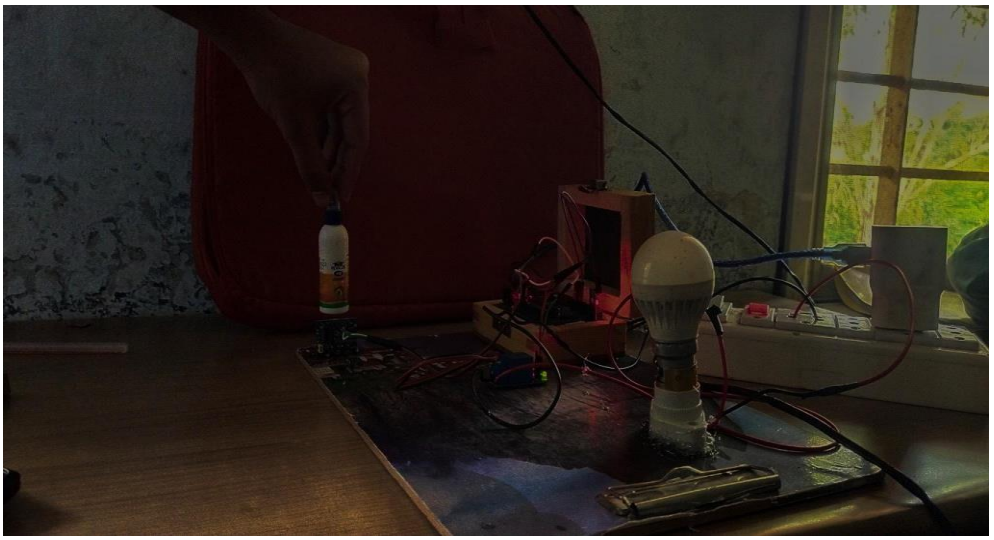

Fig 14. Result of dark and non-living interaction

## 6.6 Dark and human interference

Here the PIR firstly detects the change in its emitted IR radiations and then it goes towards LDR. Here due to the dark environment the LDR gives the high signal and hence here both the conditions necessary for the bulb to glow are satisfied. Thus due to satisfaction of both the conditions relay gets activated and the bulb glows.

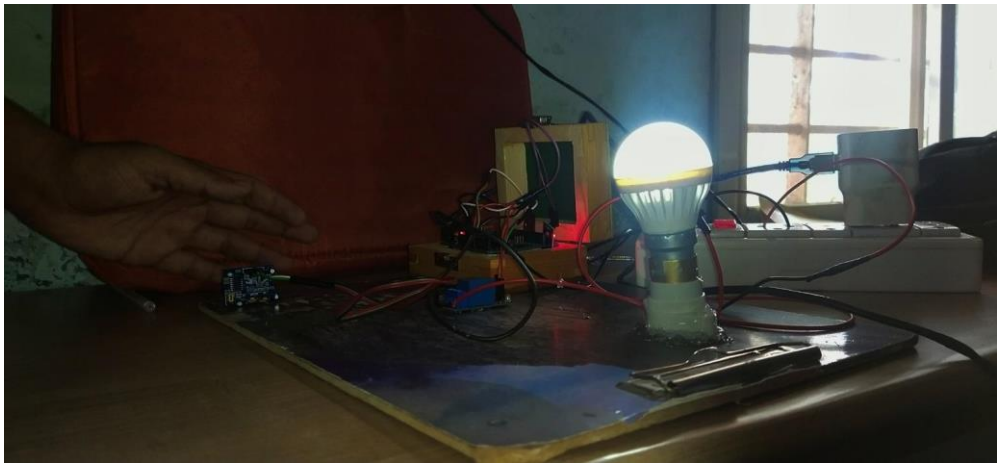

Fig 15. Result of dark and human interaction

# Conclusion

Here as proposed in the “Automated Light System” bulb is supposed to glow only when the sensor senses living interference in dark, and in any of the other conditions the bulb should remain off. This can be used for automation in lights and also saving electricity in public places or places where the bulbs need to be switched on and off frequently. The PIR sensor is used for detecting human or animal interference and the LDR sensor is used for detecting the presence of light. Here we are saving a lot of power without any wastage. Relay module was used to switch the bulb on and off, which resulted in the illumination of the manually switching switches. Here a fully Automated System with no man power required system is built. Also, the goal of saving wastage of electricity has been achieved. The target of making the circuit cost cheaper is also achieved. The proposed system is easy to install and has minimum installation cost. When we use a bulb consuming a lot of power and needs to be switched on when in use only then there to save wastage of power this system can be used.

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