# Smart Home & Security System

**A Project has been submitted in partial fulfillment of the requirements for the Degree of**
**Bachelor of Science in Electrical and Electronic Engineering**

**By**


**Subrta Kumer**

ID:163-33-354

**Mehedi Hasan**

ID: 163-33-342


**Supervised by**


**Md. Ashraful Haque**
**Assistant professor**
**Department of EEE**




**DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**

**FACULTY OF ENGINEERING**
**DAFFODIL INTERNATIONAL UNIVERSITY**


**October 2020**

# CERTIFICATION

This is to certify that this thesis entitled "**Smart home & Security system.**" is done by the following students under my direct supervision and this work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering. The presentation of the work was held on October 2020.

**Supervised by**

_____

**Md. Ashraful Haque**
Assistant professor,
Department of EEE
Daffodil International University.

Signature of the candidates

_____

**Name: Subrta Kumer**
ID 163-33-354

_____

**Name: Mehedi Hasan**
ID 163-33-342

# BOARD OF EXAMINERS

_____

Md. Ashraful Haque

Assistant Professor

Department of EEE, DIU

Coordinator

_____

Dr. Alam Hossain Mondal

Associate Professor

Department of EEE, DIU

Internal Member

_____

Dr. M. Abdur Razzak

Professor

Department of EEE

External Member

Dedicated to

# MY PARENTS
# And
# TEACHERS
# With Love & Respect

# DECLARATION

We do hereby declare that this thesis is based on the result found by ourselves. The materials of work found by other researchers are mentioned by reference. This thesis is submitted to Daffodil International University for partial fulfillment of the requirement of the degree of B.Sc. in Electrical and Electronics Engineering. This thesis neither in whole nor in part has been previously submitted for any degree.

**Supervised by**

Md. Ashraful Haque
Assistant professor
Department of EEE
Daffodil International University

**Submitted by**

Subrta Kumer
ID: 163-33-354

Mehedi Hasan
ID: 171-33-398

# ACKNOWLEDGEMENT

I would remain forever obliged to The Department of Electrical and Electronics Engineering, Daffodil International University, Bangladesh for giving me the scope to carry out this thesis. I would like to express my cordial gratitude to my thesis guide, Md. Ashraful Haque Department of Electrical and Electronic Engineering. Daffodil International University for his sincere efforts to make this thesis report a successful one. It was his guidance and incessant motivation during the course of any doubts that has helped me immensely to go ahead with this thesis. I would like to express my heartfelt thankfulness Md. Ashraful Haque Asistant professor of the Department of Electrical and Electronic Engineering for his guidance and support. I am also grateful to the faculties of Electrical Engineering Department for offering their helpful hands during the course of my thesis. Lastly, I want to acknowledge the contribution of my parents, family members and my friends for their constant and never ending motivation.

# TABLE OF CONTENTS

# List of figure:

## List of Table:



## Bar Chart:

# ABSTRACT

**None conservative use is observed among the Bangladesh people in non-conservative utilization of public power supply. This increases power bills and may hinders a nation from diverting power to industrial areas, limiting the process of industrialization and waste of energy. Individuals are often observed power on the lightings, cooling systems when not needed at homes, offices and marketable centers. To head off these, this paper presents development of automatic switch using passive infrared sensor and solid-state relay for day and night detection (LDR). The objective of this project is to cut out the electromagnetic relays which may break down as a result of carbon associating resulting from incurving in alive designs with solid state relay. Also, the system is to conserve energy more by ensuring that light is not powered on during the day time except in cases of darkness. The circuit was designed using components such as; Light Dependent resistor (LDR) sensor, power supply, PIR sensor, Microcontroller and SSR, as showed in the circuit figures 8 and 10. The system SSR for switching, LDR to detect night and day and PIR for human detection. The system was tested and worked perfectly. It helped to economize energy.**

**Keywords**: Automatic, conservation, energy, LDR

# CHAPTER-1

## 1.1 Introduction

All over the globe, it is also seen as a means of development of nations However, in third world countries, the barrier or slow rise in development above all in industrialization may be hinged mainly on the careless attitude of individuals in energy management and consumption at home above all 47-powering cooling and lighting systems in unused places. Electricity has been found to be the most clean and easy way for transportation of source of energy. This is because of its rules in the supplying of energy among other forms of transportation. As a result of this, power can't be displeasing to industrial areas so as to fulfill production. In 2008, Sambo in a study, Equalize Electricity supply with requirement in Nigeria affirmed Oyedepo in 2012, revealed the much energy potential in Nigeria. The study maintained that the use of generator is on the increase as a result of the demand for electric energy which isn't sufficient. This however, hamper the economy of a nation as it mounts pressure on the oil sector and reduces foreign exchange possibilities as a result of increase in the consumption of oil product locally. To avoidance this ill, this paper presents development of automatic switch using PIR and SSR for day and night detection as a means of energy conservation at home. Efforts to increase protection attitude among individuals towards energy has been on the pursuit for a long time. This has spurned technology in the direction of the production of low wattage bulbs. In recent years, LED's are used to produce electric bulbs because of its landmark to give output of an appreciable lumen with less power. All these efforts only reduce power expense and not the wastes. Suman et al, developed a home monitoring system for disable and wise where he used PIR among other sensors to sense intruder and then sends an alert via a GSM module. Ajay et al, worked on Motion Detection using PIR sensor and showed how an alarm blares when an intruder is sensed, also Okokpujie et al developed a model for automatic control of home appliances using DTMF techniques. All these fictional designs did not use the control to aid energy conservation except the design done by Adelekun et al. In this study, automatic control of electrical energy consumption using PIR sensor module power supply was designed to fans and lamps using PIR. He used electromagnetic relays which could develop carbonized contacts as a result of arching which may reduce the efficiency of the system with time. moreover, the design did not pay care on the fact that lightening may not be

necessary at day time. This limitation was skilled in the study done by Adewale et al. To improve energy conservation, present project apart from sensing an individual in an area, it also has a light dependent resistor (LDR) to find both night and day. It ensures that the lights are turned on only at night or when it's getting dark.

## 1.2 Project objectives:

To investigate of this project is to develop an intelligent automatic control system aims to minimize power consumption as well as sustainable development of smart energy saving system for our future generation. Moreover, the usage of installed intelligent light controls that enables users to adjust levels according to their preferences inspired us to work on it. Thus, the integration of PIR motion sensors to the lights in low-trafficked areas and high-trafficked areas of departmental store would serve as a replacement of standard light bulbs with no energy-efficient plans. Hence, all these motion sensors that we have worked in our project aims to add a bit of energy-savings strategy fostering efficient method to curb the energy crisis. In this project, the internal environment of lighting system is controlled in such a way that when a person leaves or enters the working areas, the PIR motion sensor will sense their movement and switch the light on or off accordingly. The technology helps customer to do grocery shopping even at midnight. Furthermore, the energy-saving light controls provide comfort, productive visual environment, enhancing quality of work in the Home and finally the reduction of lighting costs. Security system ensures the security of the departmental store. All these advantages serve to find the best way to do a job in a home and the way is developed and worked critically in this Project.

## 1.3 scope of project

In this paper we explore how the internal environment conditions of a departmental store are controlled via Control Unit. The control unit will solely be responsible for communicating with the external environment with three key sectors which are lamps, Lathing Dependent Resistor (LDR) and Passive infrared Sensor (PIR). This project as it provides open-source physical computing platform and can take inputs from a variety of lights, sensors and other physical outputs. One of the outputs leads to the Lathing Dependent Resistor (LDR) and Passive infrared Sensor

(PIR) on a project board and reads out the external data to the 14 inch display monitor. The other output goes all the way to the BC547 transistor, NS555 IC which also reads out its external data via display monitor. Both these sensors are connected to their respective actuators with the help of 6 V Relay. BC547 Transistor can control the relay connection to the actuators. Among the actuators, a 12 V DC fan is also used in relay connection. For intelligent light controls, the intensity is maintained by the lamps influence on a smaller area of space around it. The motion will be detected by a sensor called PIR (Pyro electric infrared sensor) which will detect the human body in specific area and another is light sensor (LDR) which will detect the light intensity of the specified area. All these sensors will be connected to the microcontroller board with the aid of jumper wires.

# CHAPTER-2
# Conservation, energy, SSR, PIR, LDR

## 2.1 Introduction

All over the globe, it is also seen as a means of development of nations However, in third world countries, the barrier or slow rise in development above all in industrialization may be hinged mainly on the careless attitude of individuals in energy management and consumption at home above all 47-powering cooling and lighting systems in unused places. Electricity has been found to be the most clean and easy way for transportation of source of energy. This is because of its rules in the supplying of energy among other forms of transportation. As a result of this, power can't be displeasing to industrial areas so as to fulfill production. In 2008, Sambo in a study, Equalize Electricity supply with requirement in Nigeria affirmed Oyedepo in 2012, revealed the much energy potential in Nigeria. The study maintained that the use of generator is on the increase as a result of the demand for electric energy which isn't sufficient. This however, hamper the economy of a nation as it mounts pressure on the oil sector and reduces foreign exchange possibilities as a result of increase in the consumption of oil product locally. To avoidance this ill, this paper presents development of automatic switch using PIR and SSR for day and night detection as a means of energy conservation at home. Efforts to increase protection attitude among individuals towards energy has been on the pursuit for a long time. This has spurned technology in the direction of the production of low wattage bulbs. In recent years, LED's are used to produce electric bulbs because of its landmark to give output of an appreciable lumen with less power. All these efforts only reduce power expense and not the wastes. Suman et al, developed a home monitoring system for disable and wise where he used PIR among other sensors to sense intruder and then sends an alert via a GSM module. Ajay et al, worked on Motion Detection using PIR sensor and showed how an alarm blares when an intruder is sensed, also Okokpujie et al developed a model for automatic control of home appliances using DTMF techniques. All these fictional designs did not use the control to aid energy conservation except the design done by Adelekun et al. In this study, automatic control of electrical energy consumption using PIR sensor module power supply was designed to fans and lamps using PIR. He used electromagnetic relays which

could develop carbonized contacts as a result of arching which may reduce the efficiency of the system with time. moreover, the design did not pay care on the fact that lightening may not be necessary at day time. This limitation was skilled in the study done by Adewale et al. To improve energy conservation, present project apart from sensing an individual in an area, it also has a light dependent resistor (LDR) to find both night and day. It ensures that the lights are turned on only at night or when it's getting dark.

## 2.2 Passive infrared Sensor (PIR)

The passive infrared sensor is a module that senses human presence by measuring infrared light reflecting from its own field [5]. The light reflecting from its own field changes with the presence of man. Initially, the module outputs a low logic. However, when human presence is sensed, the module outputs a high logic. Figure 3 shows the pictorial view of the module

**Figure No 2.1**: Pictorial view of PIR module.

**2.3 Light Dependent Resistor (LDR):** This photo resistor as shown in Figure 4 is a device that changes resistance with light. Usually, the resistance reduces with increase in light and vice-versa. In the presence of day light, the value of its resistance is 100k Ohms. However, to convert the resistance into voltage, it was connected in series with a 100k Ohms resistor to enforce potential divider rule as shown in Figure 2.2

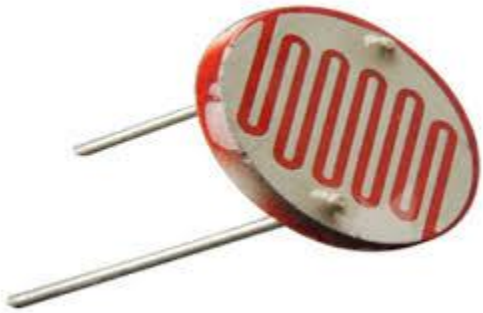


**Figure No 2.2**: Pictorial view of LDR

## 2.4 Solid State Relay

This is a device from LED and an up to switch. A limiting resistor is used in series with the LED point, When the LED in reach lights up, the up to switch is turned on to allow current pass. Just like any other LED. Usually, LED may not be powered with more than 20mA so as to recall damage. Vcc which is the voltage used to power the detect = 5V. Studies from the data sheet of shows that at high logic the controller outputs (Vcc -0.7) Volts. Therefore, output voltage from the controller at high logic = 5- 0.7= 4.3V To calculate the value of the limit resistor, V=IR Resistor value (R)= Since LED may not be powered with more than 20mAlet the current I flowing through the LED be 10mA R = 430Ω ≈ 470Ω The SSR used in this project is Omarion G3MB-202P and is connected as shown in Figure 2.3

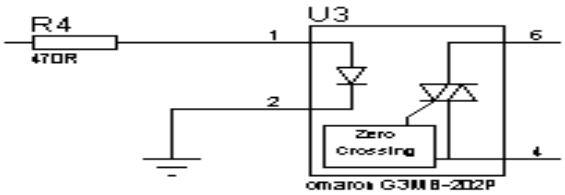



**Figure No 2.3:** Circuit diagram of Solid-State Relay (SSR).

## 2.5 Block diagram for these projects

From Figure 8 above, the PIR sensor is connected to pin 6 of the controller while the output from the LDR is read by the controller too. If human presence is sensed, the controller will first check the status of the environment if it is day or night. If it is day, it will ignore and the lamp will remain OFF. If it senses it ht it will then turn on the lamp.

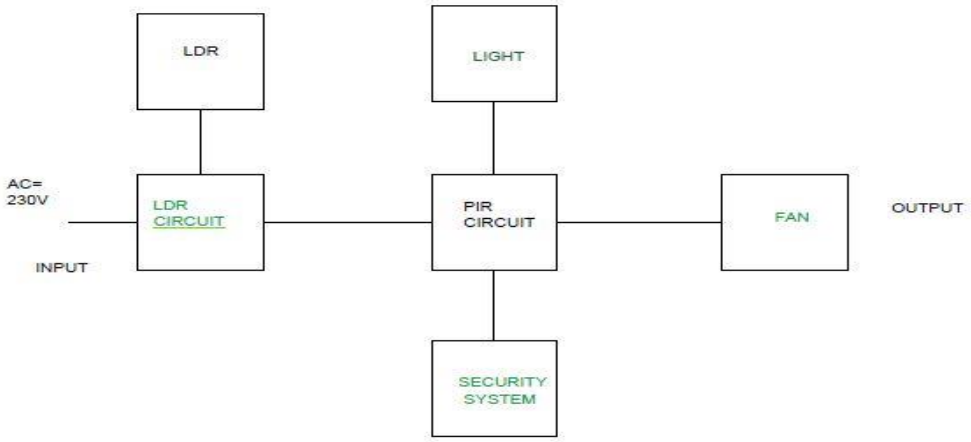



**Fig No 2.4:** Block diagram for these projects

## 2.6 CIRCUIT DIAGRAM FOR THESE PROJECTS

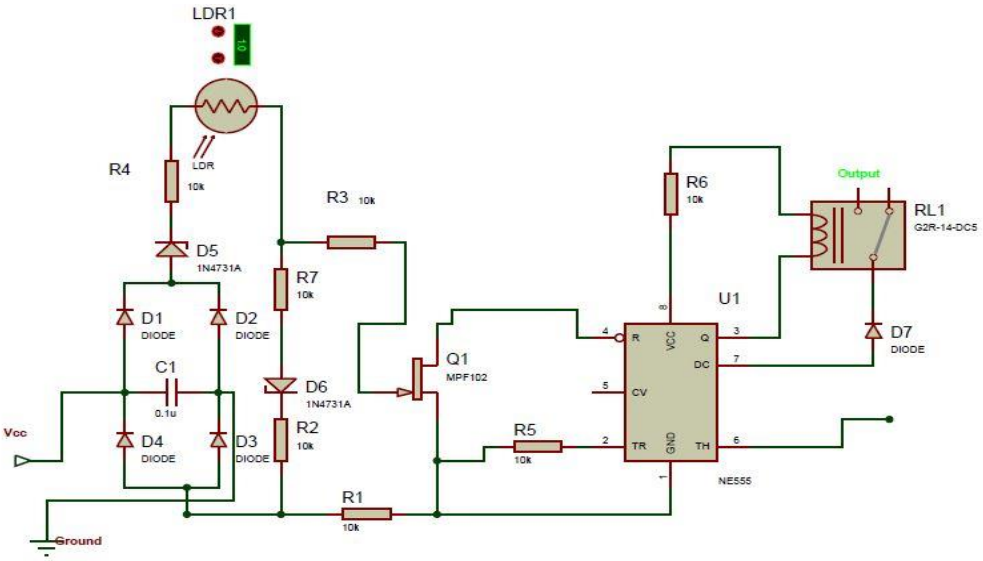



Fig No 2.5: **Circuit diagram for these projects**

## 2.7 Results and Discussions:

The system was built on a Veroboard, it was tested and the results are presented in Table1.

| **S/L No** | **LDR** | **PIR** | **SSR** |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 1 | 0 | 0 |
| 3 | 0 | 1 | 0 |
| 4 | 1 | 1 | 1 |

**Table 1: Result**

**Key:** PIR: 1- Presence of Human Being; 0 – Absence of Human Being LDR: 0- Day Time; 1 – Night Time SSR: 1- On; 0 – Off When PIR senses human presence the logic is 1 and if not, logic is 0. Also, for the LDR if day is sensed, the logic is 0 while at night the logic is 1. Furthermore, SSR is on when it is logic 1 and off when it is logic 0. From Table 1, the SSR is always off except when the human presence is

sensed and when it is night. Furthermore, the risk of carbonized contact in electromagnetic relays is eliminated via the use of SSR. This also makes it noiseless.

## 2.8 List of Component with Price

| SL No | Component Name | UOM | Quantity | Price |
|---|---|---|---|---|
| 1 | LDR (Light Depended Resistor) | Pcs | 1 | 5 |
| 2 | PIF (Passive infrared sensor) | Pcs | 5 | 250 |
| 3 | Partex board | Pcs | | 100 |
| 4 | Some Capacitor | Pcs | | 30 |

| | | | | |
|---|---|---|---|---|
| 5 | Some Diode | Pcs | | 50 |
| 6 | Some Resister | Pcs | | 20 |
| 7 | NS555 IC | Pcs | | 50 |
| 8 | Capacitor 1000MFD/50V | Pcs | | 50 |
| 9 | LED | Pcs | | 40 |
| 10 | 7812 Transistor | Pcs | 2 | 40 |
| 11 | Relay 5v | Pcs | 2 | 30 |
| 12 | BC547 Transistor | Pcs | 2 | 10 |
| 13 | Holder | Pcs | | 20 |
| 16 | Connector | Pcs | 1 | 20 |
| **Total Price (IN TAKA)** | | | | 715tk |

# Chapter-3

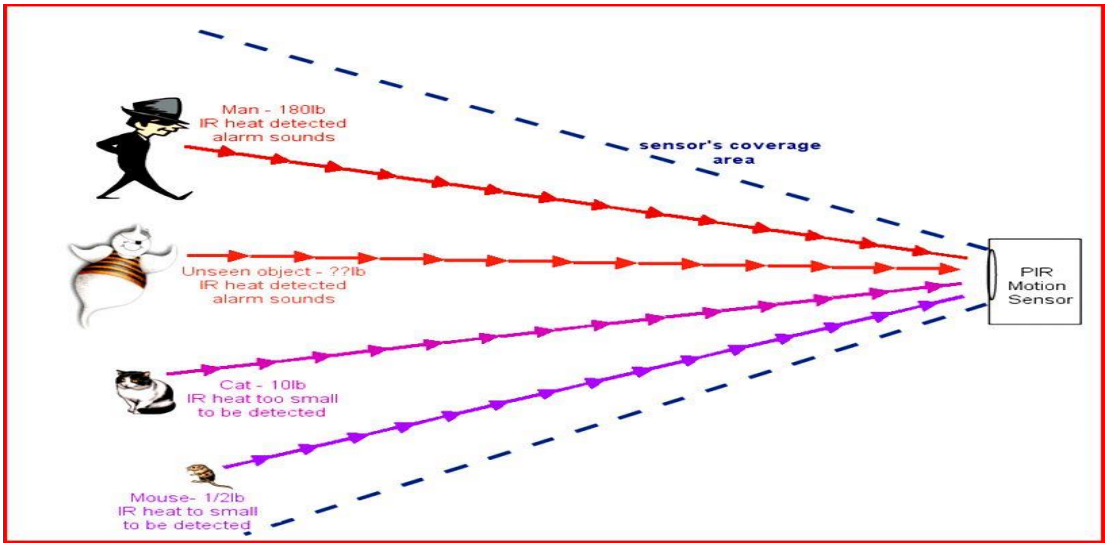
# Passive Infrared Sensor (PIR) & Light Dependent Resistor (LDR)

## 3.1 Introduction

This is a standard value, as the proper detection range is between 5.1m and 12.5m. PIR sensor detects a human being moving around within all most 10m from the sensor. PIR are basically made of a pyro electric sensor, which can detect conditions of infrared radiation. PIR sensors are incredible, they are flat control and small effort, have a wide lens range, and are simple to interface with. Most PIR sensors have a 3-pin connection at the bottom. For uncountable essential projects that need to discover when an individual has left or accessed the area. 1 pin will be ground, another will be signal and the last pin will be power. Power is usually up to 3.7- 5V. Cooperating PIR with LDR base is very easy and simple. Sometimes bigger modules don't have direct output and instead just operate a relay which case there is ground, power and the two switch associations. The PIR acts as a digital output so all you need to do is listening for the pin to flip high or low. The motion can be detected by checking for a high signal on a single I/O pin. Once the sensor warms up the output will remain low until there is motion, at which time the output will swing high for a few of seconds, then return low. If motion continues the output will cycle in this manner until the sensors line of sight of still again. This is because of the settling time included in studying nature's domain.

This could be anyplace from 10-300 seconds. The PIR sensor needs a provide time with a specific end goal to capacity properly.

Throughout this time there ought to be as little movement as could reasonably be expected in the sensors field of perspective.




## 3.2 What is a PIR Sensor?

PIR sensor detects a human being moving find out when an individual has left or accessed the area that's called Passive infrared Sensor.

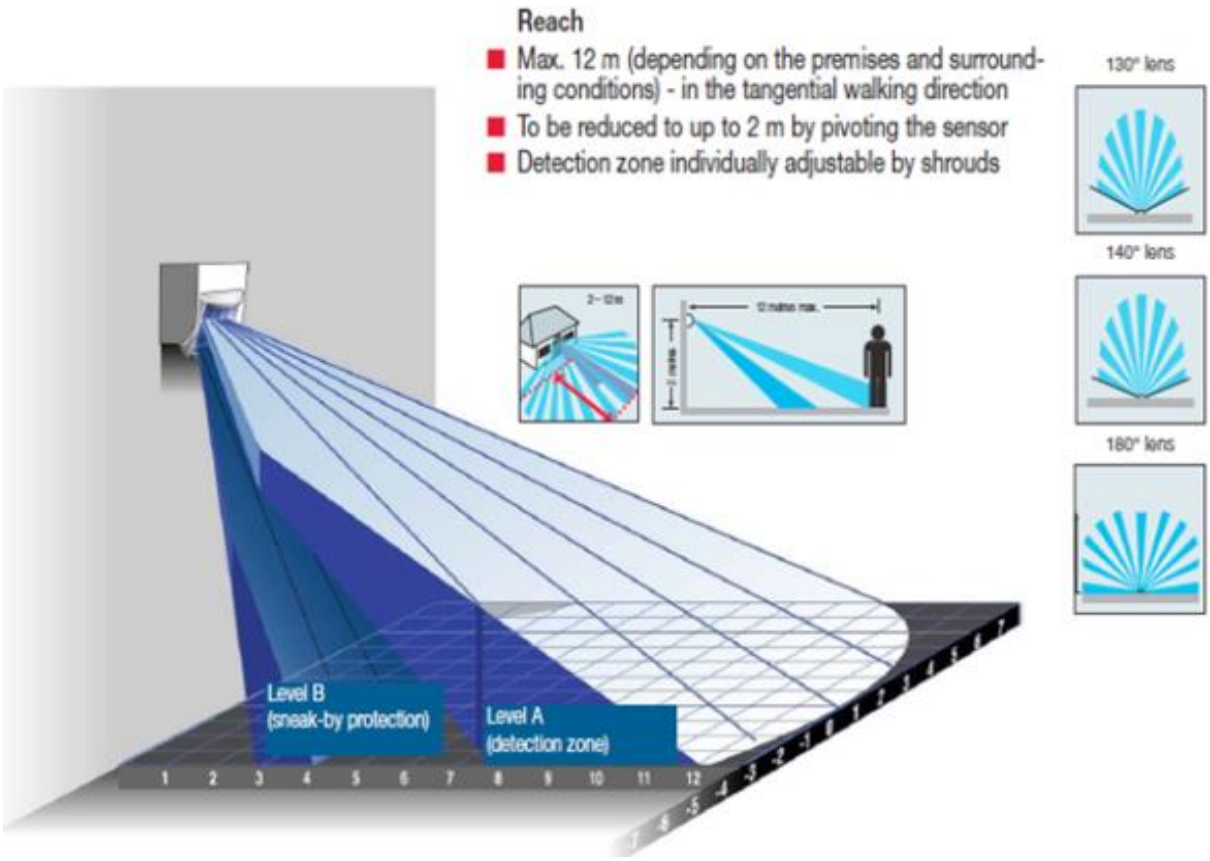



**Figure No 3.2:** Passive infrared Sensor

### 3.2.1 Applications

1.Office

2.Work Place Security

3.Home Security

4.Human Detection

5.Saving Power (Switch ON appliances only when someone is present)

6.Animal Detection

### 3.2.2 PIR Sensors Areas of Applications

1. All outdoor Lights

2. Multi Apartment Complexes

3. Common staircases

4. Lift Lobby

5. Shopping Malls

6. For Basement or Covered Parking Area

7. For garden lights

### 3.2.3 Features

1. Delay Time Adjustable.
2. Supply Voltage – 5V.
3. Complete with PIR, Motion Detection
4. Standard TTL Output.
5. Low Noise and High Sensitivity with Dual Element Sensor.

### 3.2.4 PIR Sensor IC

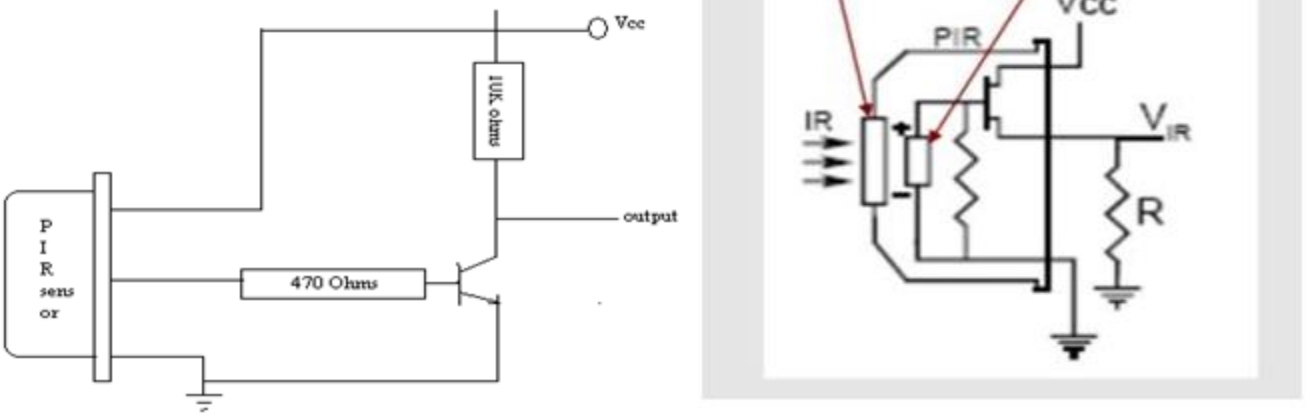



**Fig No 3.3**: The PIR sensor IC consists of Three pins- Vcc, Ground and Output.

In presence of human IR radiations, the sensor detects the radiations and converts it directly to electrical pulses, which is fed to the inverter circuit. The inverter circuit consists of a transistor, which produce into saturation with application of high base current and final develops a low collector voltage. Thus, the transistor output is low based on the input received by the microcontroller, it controls the motor driver, which in turn

controls the motion of the motor. This low inverter output is connected to the microcontroller.

## 3.3 WORKING PRINCIPLE

It can be detected by electronic devices designed for such a purpose. All objects with a temperature above absolute zero emit heat energy in the form of radiation. It radiates at infrared wavelengths because usually this radiation isn't visible to the human eye. PIR Sensor Working

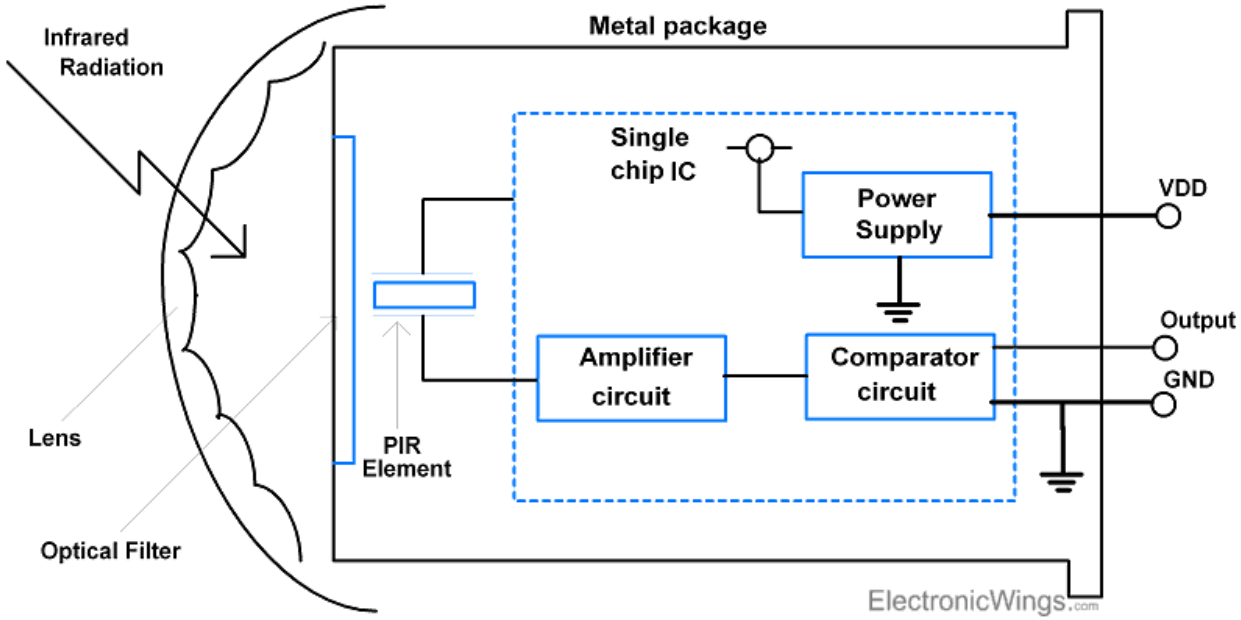



**Figure No 3.4:** PIR Sensor Blocks

- **Human body which radiates heat in form of IR radiation**

1. PIRs are basically made of a pyroelectric sensor, which can detect levels of infrared radiation.
2. Above figure of PIR element shows the round metal can with a rectangular crystal in the centre.

3. Every object emits some low-level radiation, and the hotter objects emits more radiations.
4. The sensor is split in two slots, which are wired up so that they cancel each other out.
5. If one half sees more or less IR radiation than the other, the output will swing high or low.
6. Input signals from both terminals of PIR element are amplified using amplifier circuit and compared using comparator circuit.

**The PIR element is covered by lens to increase range of operation.**

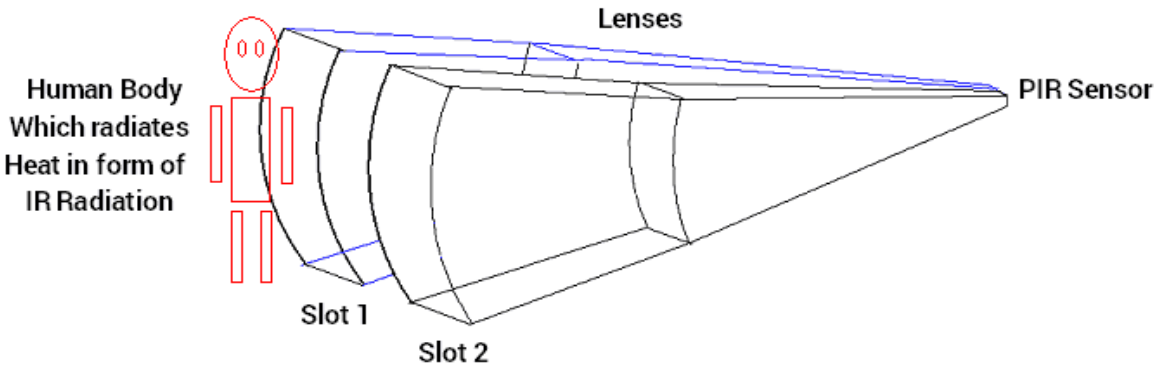



**Figure No 3.5:** IR radiation

### 3.3.1 At Idle Position

1. PIR motion sensor uses element RE200B for infrared detection. Both slots of this sensor are connected to differential amplifier.
2. When the sensor is idle, both slots detect same amount of IR.
3. So, there is no error signal between differential inputs. The output of comparator circuit is zero.

### 3.3.2 Object in Motion

1. When any warm object passes in front of the sensor, it intercepts one slot of the PIR sensor. This causes a positive differential change between the two slots. This change is indicated by Part A in below figure.
2. When the warm body leaves the sensing area, the sensor generates negative differential change. This change is indicated by Part B in below figure.

3. Both these changes in pulse are the detection of warm body which radiate infrared signals.

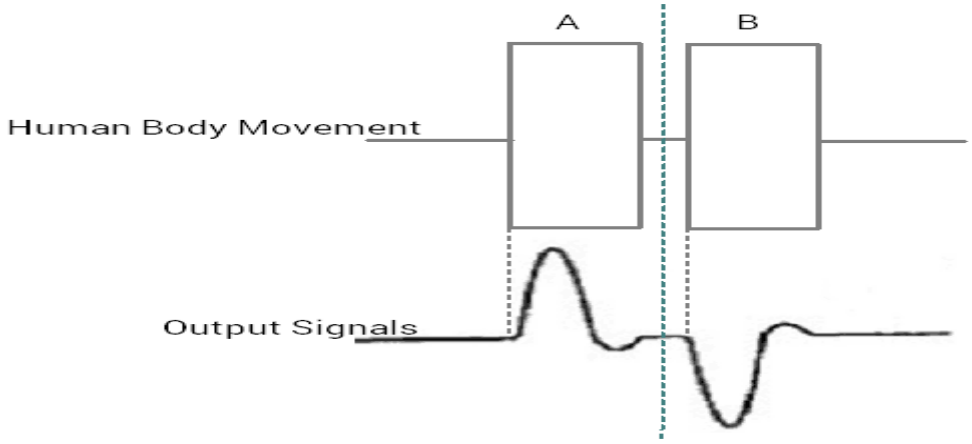



**Figure No 3.6:** Differential changes between two slots

3.3.3Pin Description

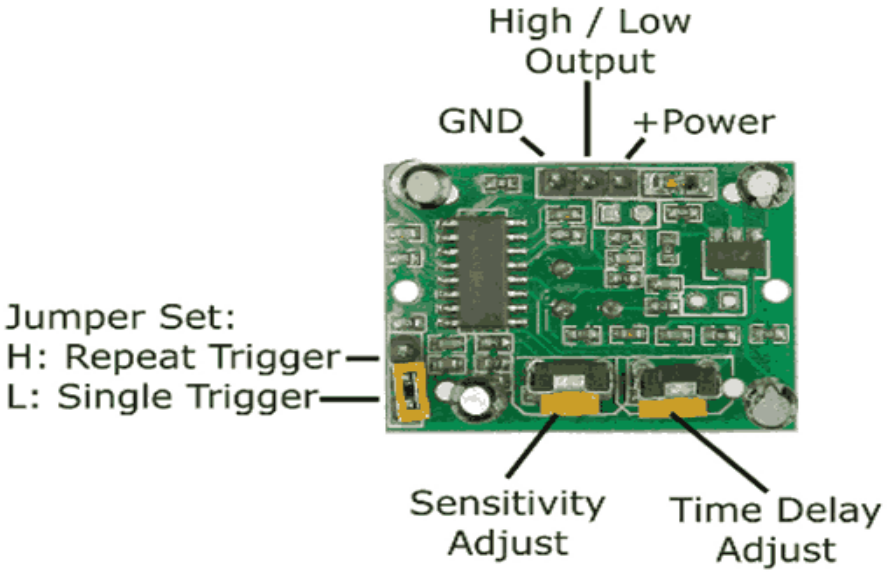



**Figure No 3.7:** Pin Diagram of PIR Sensor

**Pin Diagram of PIR Sensor**

**Pin 1 – GND**

We have to connect this pin to Ground.

**Pin 2 – Output**

This pin gives output (3.5V) when the motion is detected.

**Pin 3 – VCC**

This pin provides supply voltage(+5v) to PIR element and internal circuit.

## 3.4 Modes of Operations

This sensor has two modes of operations:

### 3.4.1 Single Trigger Mode

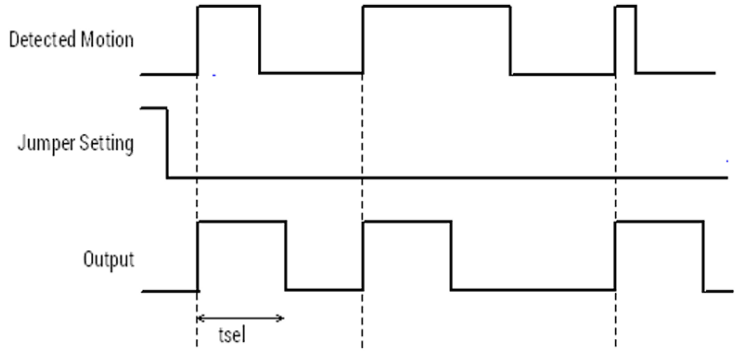



**Figure No 3.8: Single trigger mode timing diagram**

1. To select Single Trigger mode, the jumper setting on PIR sensor must be set on LOW.
2. In case of Single Triggered Mode, Output goes HIGH when motion is detected.
3. After specific delay (tsel) the output goes to LOW even if the object is in motion.
4. The output is LOW for some time and again goes HIGH if object remains in motion.
5. This delay (tsel) is provided by user using the potentiometer. This potentiometer is on board of PIR sensor module.
6. In this way, the PIR sensor gives HIGH/LOW pulses if object is in continuous motion.

### 3.4.2 Repeat Trigger Mode

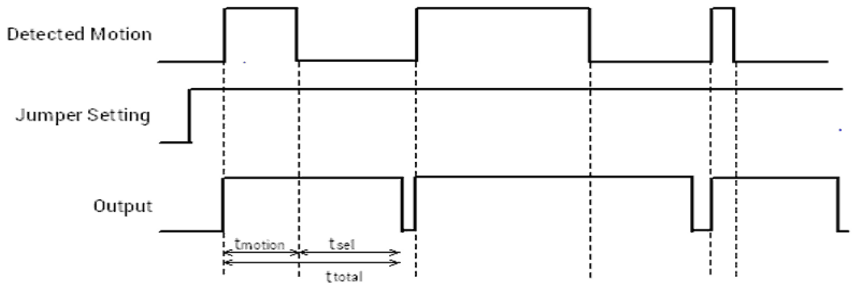



**Figure No 3.9: Repeat trigger mode timing diagram**

1. To select Repeat Trigger mode, the jumper setting on PIR sensor must be set on HIGH.
2. In case of Repeat Triggered Mode, Output goes HIGH when motion is detected.
3. The output of PIR sensor is HIGH until the object is in motion.
4. When object stops motion, or disappears from the sensor area, the PIR continues its HIGH state up to some specified delay (tsel).
5. We can provide this delay (tsel) by adjusting the potentiometer. This potentiometer is on board of PIR sensor module.
6. In this way, the PIR sensor gives HIGH pulse if object is in continuous motion.

### 3.4.3 Changing Sensitivity and Delay time

1. There are two potentiometers on PIR motion sensors board: Sensitivity Adjust and Time delay adjust.
2. It is possible to make PIR more sensitive or Non-Sensitive Enough. The maximum sensitivity can be achieved up to 6 meters.
3. Time Delay Adjust potentiometer is used to adjust the timetsel shown in above timing diagrams.
4. Clockwise Movement makes PIR more Sensitive.

## 3.5 PIR Detector with Fresnel Lenses

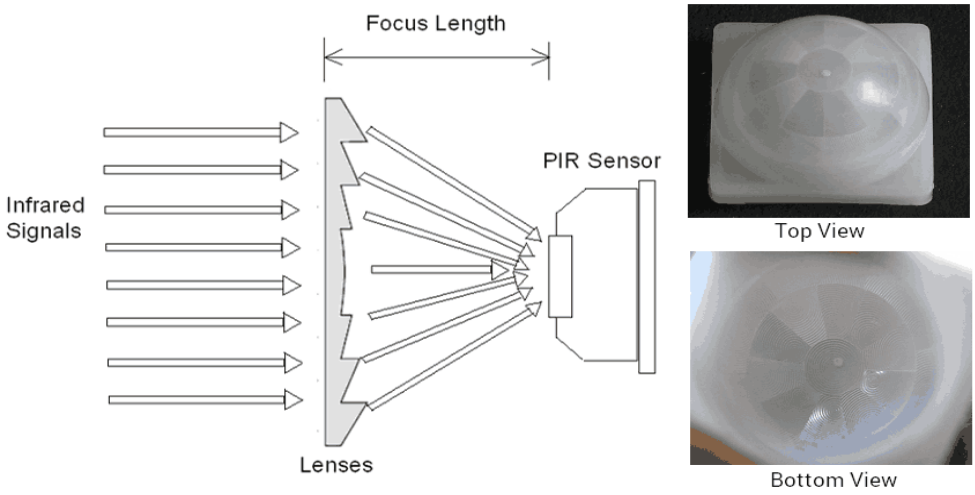


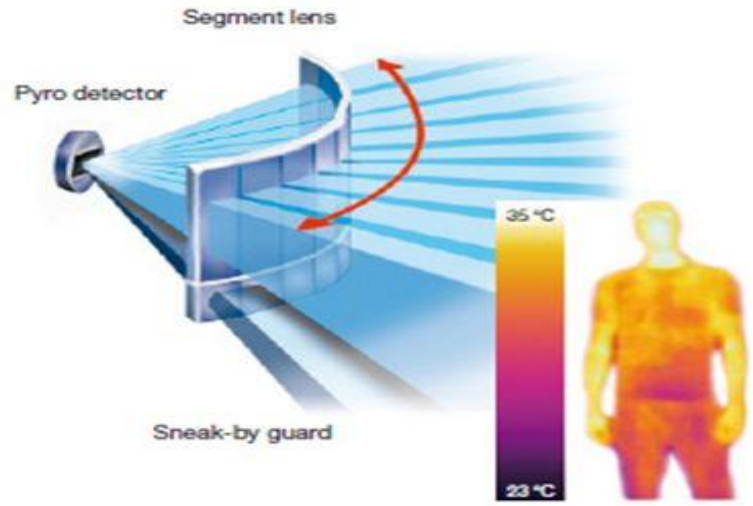

**Figure No 3.10: PIR Detector with Fresnel Lenses**

1. Two things are important while manufacturing PIR sensor: Low cost and High Sensitivity.
2. Both these things can be magically achieved by using Lens cap.
3. The lenses increase range of operation; increases sensitivity and change pattern of Sensing vary easily.

## 3.6 Security applications

This relay completes the circuit across a pair of electrical contacts connected to a detection input circle of the thief alarm control panel. The electronics in the PIR typically control a small relay, when used as part of a security system. the relay contact is closed—a 'normally closed' (NC) relay, the system is usually designed such that if no motion is being detected. If motion is detected, the relay will open the circuit, triggering the alarm; or, if a wire is disconnected, the alarm will also operate.

**The Focus72 allows you to select between two different motion detection methods:**




### 3.6.1 Motion Detection:

When selecting this method motion is triggered based on a certain percentage of pixel change. The percentage varies according to the sensitivity level you set in the app. The lower you set the level, the higher the number of pixels that need to alter before an event is detected and recorded.

### 3.6.2. PIR-based Motion Detection:

In this case motion is detected by means of a PIR sensor, a passive infrared sensor. This sensor detects emitted infrared energy from objects (humans and animals, but also cars) in the form of heat. In general differences of around 5-10º Celsius compared with the ambient temperature in the field of view and within a 10m /30ft range of the camera are detected.

**N.B:**

I am looking for a light sensor that attached to a door, records when the door opens (light activates light sensor) and when it closes (no light deactivates the sensor) and that records the time of opening and closure of the door.

## 3.7 LIGHT DEPENDEND RESISTOR (LDR)

A Light Sensor give up an output signal indicating the intensity of light by measuring the radiant energy that exists in a very small range of frequencies called light, and from Infra-red to Visible up to Ultraviolet light spectrum which ranges in frequency.

Light sensors are more usually known as Photo Sensors because the convert light energy into electricity. That convert this light energy whether visible or in the infra-red parts of the spectrum into an electrical signal output the light sensor is a passive device.

Photoelectric devices can be grouped into two main categories, those which generate electricity when bright, and those which change their electrical properties in some way such as Photo-resistors or Photo-conductors such as Photo-voltaic or Photo-emissive etc. This leads to the following classification of devices.

**Photo-emissive Cells** – These are Photo Sensors which release free electrons from a light sensitive material such as cesium when struck by a photon of sufficient energy. The light and the higher the frequency of the amount of energy the photons have expect on the frequency, the more energy the photons have converting light energy into electrical energy.

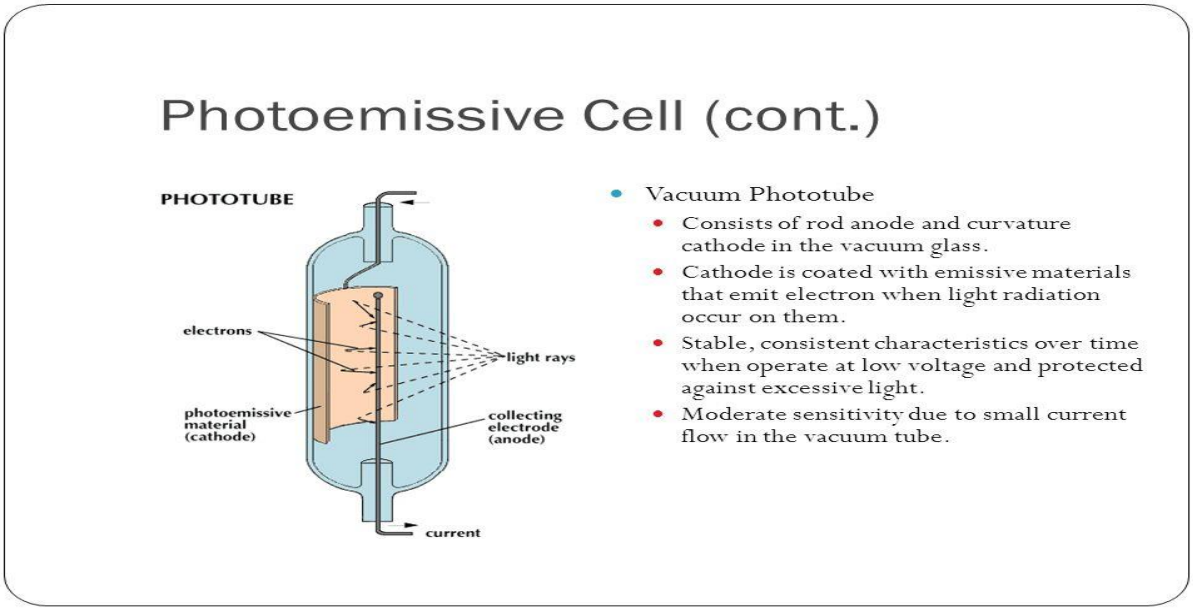



**Fig No 3.11:** Photo-emissive Cells

**Photo-conductive Cells** – These Photo Sensors vary their electrical resistance when subjected to light. Photoconductivity conclusions from light hitting a semiconductor material which controls the current flow through it. Thus, more light increases the current for a given applied voltage. Cadmium Sulphone used in LDR photocells is the most common photoconductive material.

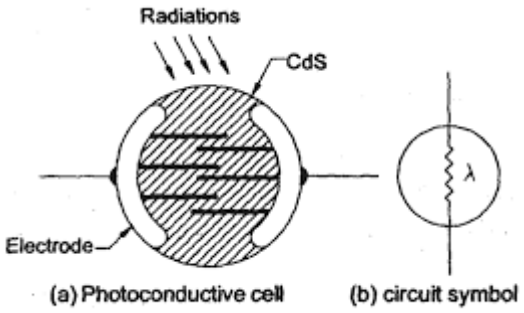



**Fig No 3.12:** Photo-conductive Cells

- **Photo-voltaic Cells –** These Photo Sensors get up an emf in proportion to the radiant light energy received and is related in effect to photoconductivity. Light energy falls on to two semiconductor materials middle together set up a voltage of approximately 0.5.1V. Selenium used in solar cells the most common photovoltaic material.

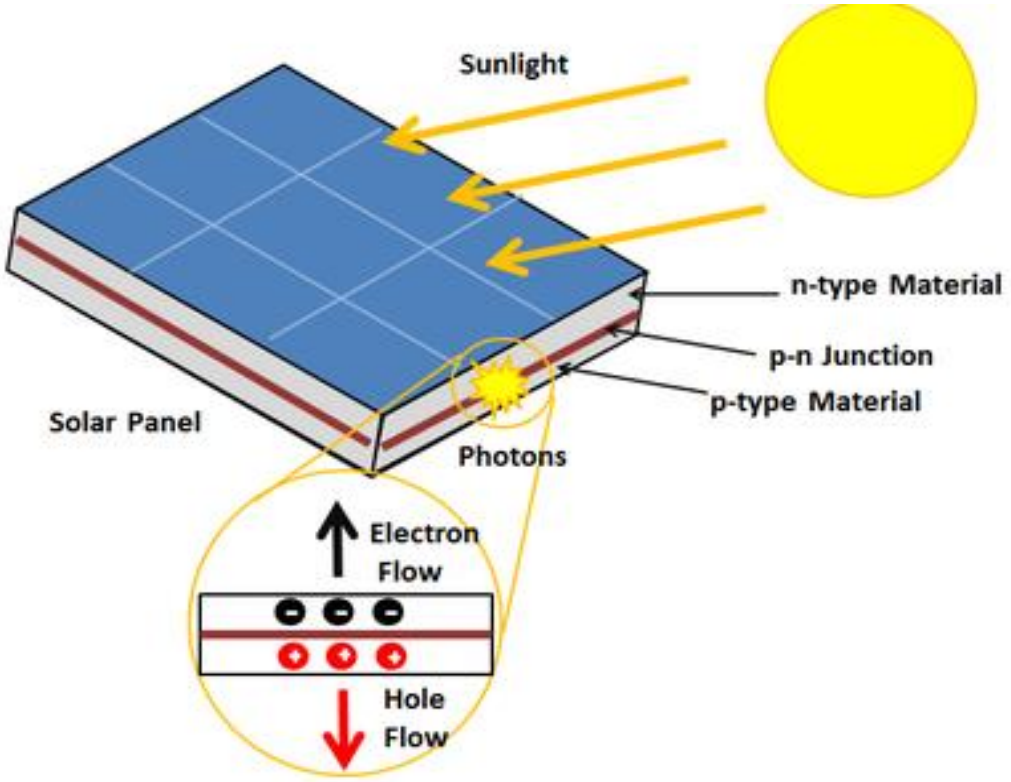



**Fig No 3.13:** Photo-voltaic Cells

- **Photo-junction Devices** – These Photo Sensors are mainly true semiconductor devices such as the photodiode or phototransistor which use light to control the flow of electrons and holes across their PN-junction. Photojunction Photo Sensors devices are specifically designed for detector utilization and light insertion with their spectral response tuned to the wavelength of incident light.

## 3.8 The Light Dependent Resistor

**Fig No 3.14:** Light Dependent Resistor

### 3.8.1 Typical LDR

As its name implies, the Light Dependent Resistor (LDR) is made from a piece of exposed semiconductor material such as cadmium sulphide that changes its electrical resistance from a few thousand Ohms in the dark to only to many hundred Ohms when light falls upon it by creating hole-electron pairs in the material. The net effect is an increase in its conductivity with a decrease in resistance for an increase in illumination. Cadmium sulphide is applied in the execute of photoconductive cells because its spectral feedback curve nearly matches that of the human eye and can even be controlled using a simple torch as a light source. Also, photo resistive cells have a long reply time requiring many seconds to respond to a change in the light intensity. Materials used as the semiconductor substrate include, lead sulphide (PbS), lead selenide (PbSe), indium antimonide (InSb) which detect light in the infra-red area with the most commonly applied of all photo resistive light sensors being Cadmium Sulphide (Cds). Typically, then it has a peak sensitivity wavelength ($\lambda p$) of about 565nm to 605nm in the visible spectral range.

## 3.9 The Light Dependent Resistor Cell

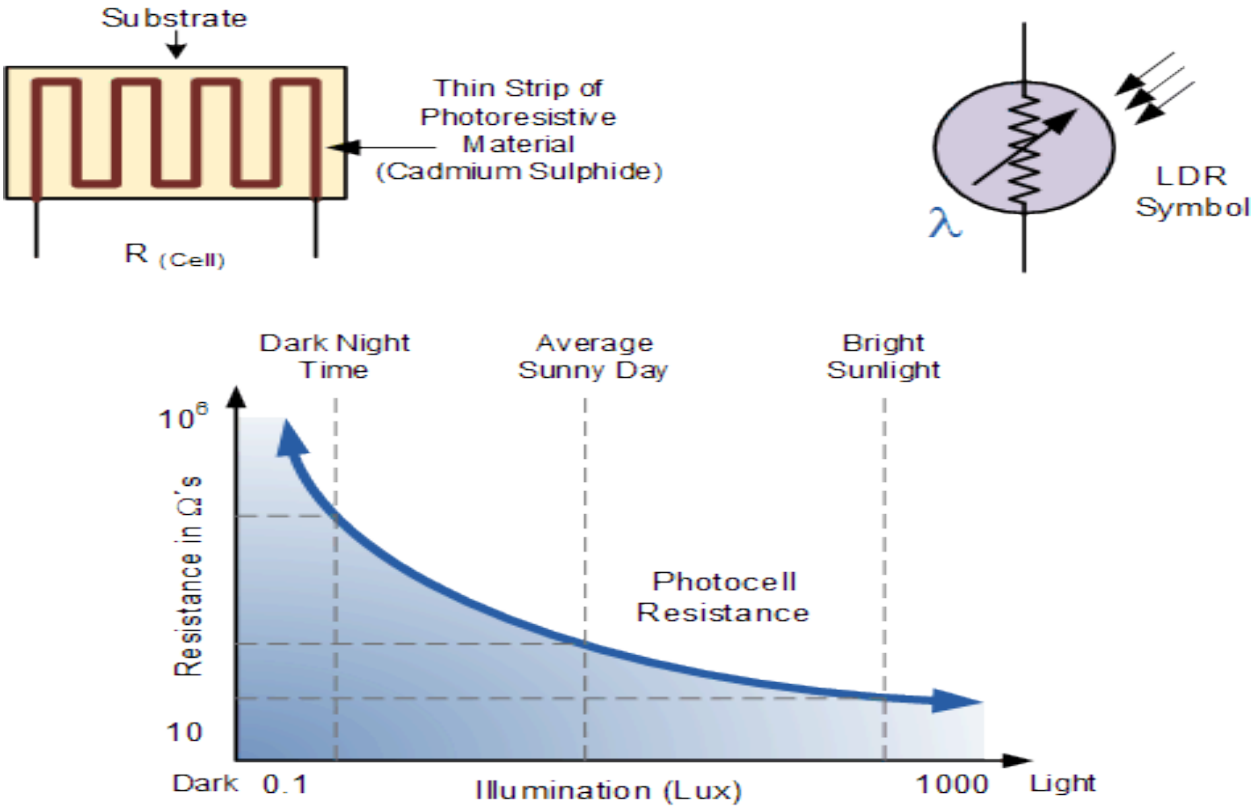


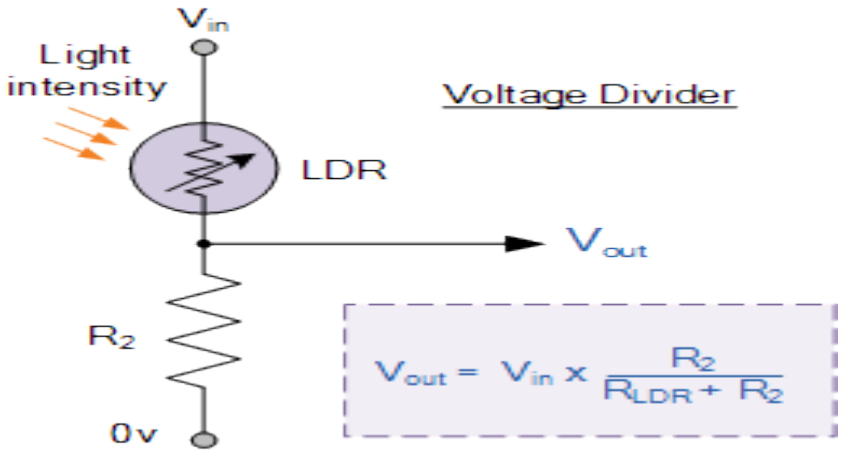

**Fig No 3.15:** The Light Dependent Resistor Cell

The CdS photocell is a very low-cost device often applied in auto dimming, darkness or twilight detection for turning the street lights "ON" and "OFF", and for photographic exposure meter type applications. To increase the dark resistance and therefore reduce the dark current, the resistive path forms a zigzag pattern across the ceramic substrate. The most commonly used photo resistive light sensor is the ORP12 Cadmium Sulphide photoconductive cell. The resistance of the cell when unilluminated (dark resistance) is very high at about 10MΩ's which falls to about 100Ω's when fully illuminated (lit resistance). This light dependent resistor has a spectral feedback of about 610nm in the yellow to orange region of light.

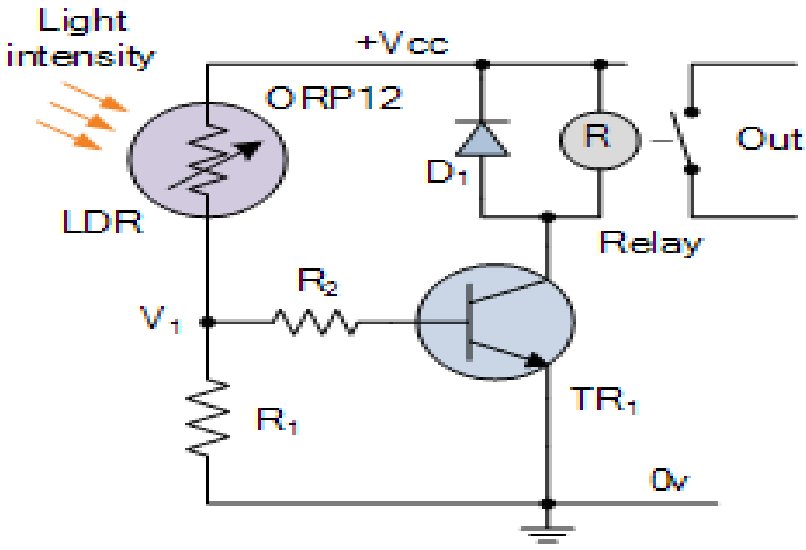
Connecting a light dependent resistor in series with a standard resistor like this across a single DC supply voltage has one better advantage, a different voltage will appear at their junction for different height of light. This ability to generate different voltages produces a very handy circuit called a "Potential Divider" or Voltage Divider Network. The amount of voltage drops across

series resistor, $R_2$ is fixed by the resistive value of the light dependent resistor, the current through a series circuit is common and as the LDR changes its resistive charge due to the light intensity, the voltage present at $V_{OUT}$ will be fixed by the voltage divider equation. An LDR's resistance, $R_{LDR}$ can vary from about 105Ω in the sun light, to over 10MΩ in ab solute darkness with this change of resistance being converted into a voltage changing at $V_{OUT}$ as shown. $R_{LDR}$.

One simple use of a Light Dependent Resistor, is as a light sensitive switch as shown below.




## 3.10 LDR Switch



This basic light sensor circuit is of a relay output light activated switch. A potential divider circuit is formed between the photoresistor, LDR and the resistor R1. When no light is present ie in lightlessness, the resistance of the LDR is genuine high in the MΩ range so zero base bias is utilize to the transistor TR1 and the relay is de-energized or "OFF". As the light level increases the resistance of the LDR starts to decrease causing the base bias voltage at V1 to rise. As the light level falls back to darkness again the resistance of the LDR increases produce the base voltage of the transistor to reduce, turning the transistor and relay "OFF" at a fixed light level determined again by the potential divider network. At some point set by the potential divider network formed with resistor R1, the base bias voltage is high enough to turn the transistor TR1 "ON" and thus activate the relay which in turn is used to control some external circuitry.

By replacing the fixed resistor R1 with a potentiometer VR1, the point at which the relay turns "ON" or "OFF" can be pre-set to a particular light level. This type of simple circuit shown above has a fairly low sensitivity and its switching point may not be consistent due to variations in either temperature or the supply voltage. A more sensitive precision light activated circuit can be easily made by incorporating the LDR into a "Wheatstone Bridge" agreement and replacing the transistor with an Operational Amplifier as shown.

## 3.11 Light Level Sensing Circuit

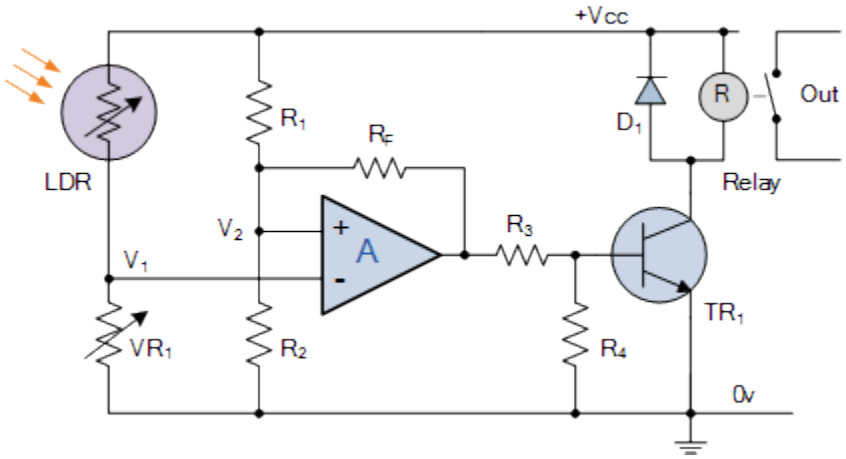



**Fig No 3.17:** Light Level Sensing Circuit

In this basic dark sensing circuit, the light dependent resistor LDR1 and the potentiometer VR1 form one accommodating arm of a simple resistance bridge network, also known commonly as a Wheatstone bridge, while the two set resistors R1 and R2 form the other arm. Both sides of the bridge form potential divider networks across the supply voltage whose outputs V1 and V2 are connected to the non-inverting and inverting voltage inputs cooperatively of the operational amplifier. The operational amplifier is design as a Differential Amplifier also known as a voltage cooperator with assessment whose output voltage order is determined by the difference between the two input signals or voltages, V1 and V2. The resistor connection R1 and R2 form a fixed voltage reference at input V2, set by the ratio of the two resistors. The LDR – VR1 combination provides a variable voltage input V1 proportional to the light level being detected by the photoresistor. As with the previous circuit the output from the operational amplifier is applied to control a relay, which is protected by a free wheel diode, D1. When the light level sensed by the LDR and its output voltage falls below the relating voltage set at V2 the output from the op-amp changes state activating the relay and switching the set load. Likewise, as the light level boost the output will switch back turning "OFF" the relay. The hysteresis of the two switching points is set by the feedback resistor Rf can be selected to give any suitable voltage gain of the amplifier. The operation of this type of light sensor circuit can also be contrariwise to switch the relay "ON" when the light great exceeds the relating voltage great and vice versa by contrariwise the positions of the light sensor LDR and the potentiometer VR1. The potentiometer can be applied to "pre-set" the switching point of the differential amplifier to any particular light great making it ideal as a smooth light sensor project circuit.

## 3.12 Photojunction Devices:

Photojunction Devices are basically PN-Junction light sensors or detectors made from silicon semiconductor PN-junctions which are sensitive to light and which can detect one and the other in view light and infra-red-light levels. Photo-junction devices are specifically made for sensing light and this class of photoelectric light sensors include the Photodiode and the Phototransistor.

### 3.12.1 Photo-diode

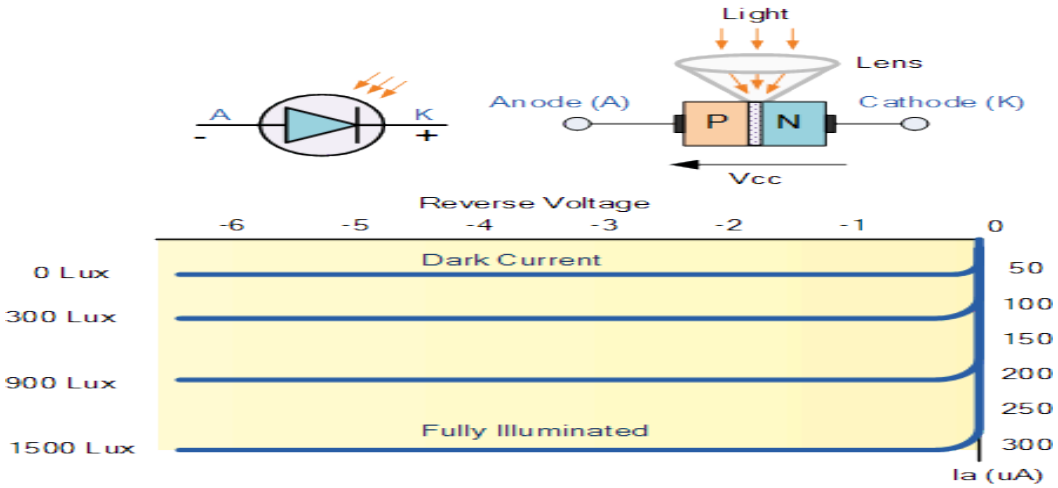



Fig No 3.18: **Photo-diode Construction and Characteristics**

The construction of the Photodiode light sensor is similar to that of a conventional PN-junction diode except that the diodes outer casing is either transparent or has a clear lens to focus the light onto the PN junction for boosted sensitivity. The junction will acknowledge to light specifical higher wavelengths such as red and infra-red rather than apparent light. This nature can be a problem for diodes with transparent or glass bead bodies such as the 1N4148 signal diode. LED's can also be used as photodiodes as they can one and the other emit and detect light from their junction. All PN-junctions are light sensitive and can be applied in a photo-conductive unbiased voltage mode with the PN-junction of the photodiode always "Reverse Biased" so that only the diodes leakage or dark current can flow. The current-voltage characteristic (I/V Curves) of a photodiode with no light on its junction (dark mode) is very like to a natural signal or rectifying diode. When the photodiode is forward biased, there is a mounting increase in the current, the same as for a normal diode. When a reverse bias is applied, a small reverse saturation current appears which causes a boost of the depletion region, which is the sensitive part of the junction. Photodiodes can also be sited in a current mode using a fixed bias voltage across the junction. The current mode is very linear over a wide range. This leakage current boost as the lighting of the junction increases. When used as a light sensor, a photodiode dark current (0 lux) is about 10uA for geranium and 1.1uA for silicon type diodes. When light drop upon the junction more hole/electron pairs are belonging to and the leakage current boost. Thus, the photodiodes current is directly proportional to light might falling onto the PN-junction. one disadvantage of this type of photodevice is the relatively small current flow even when fully lit, but One main advantage of

photodiodes when used as light sensors is their fast feedback to changes in the light grade. The output voltage (Vout) is given as Vout = $I_P$*R$f$ and which is proportional to the light intensity characteristics of the photodiode. The following circuit shows a photo-current-to-voltage converter circuit using an operational amplifier as the amplifying device. This zero-bias op-amp configuration gives a high impedance loading to the photodiode resulting in less influence by dark current and a wider linear range of the photocurrent relative to the radiant light intensity. This type of circuit also utilizes the nature of an operational amplifier with two input terminals at about zero voltage to work the photodiode without bias. Capacitor $C_f$ is applied to prevent oscillation or gain peaking and to set the output bandwidth (1/2πRC.)

## 3.13 Advantages are given below:

A. System is inexpensive

B. -They require a few milliseconds or more to respond fully to the changes in light intensity. They will take few seconds to return to their normal dark resistance once light is removed. The sensitivity and resistance range of the LDRs will vary from one device to another.

C. -In the practical LDR there are different sizes are available and the most popular size is 100mm phase diameter.

D. -In the practical LDR there are different sizes are available and the most popular size is 100mm phase diameter.

E. -They can be used for

1. Relative Fluid Density Measurement.
2. Dark Sensor in street lights.
3. Measurement of Light Intensity.
4. LASER security system (Note: LASER should be used in pulses.

### 3.13.1 The Advantages and Disadvantages of the LDR Sensors

The working principle of LDR sensors is based on domestic photoelectric effect. An LDR photoresistor is formed by build in electrode leads at both ends of a semiconductor photosensitive

material and encapsulating them in a shell with a transparent window. In order to increase the sensitivity, the two electrodes are Generally made into combs. Semiconductors such as metal sulfides. Usually, Selenides and tellurides are the main materials used to manufacture LDR sensors, spraying and sintering methods, thin LDR sensors and comb-shaped ohmic electrodes are fabricated on insulating substrates by coating. Leads are connected and encapsulated in sealed shells with clean mirrors to avoid dampness affecting their sensitivity.

The electron-hole pairs generated by photon excitation will recombine, When the incident light disappears, and the resistance of the LDR sensors will return to its original value. When the metal electrodes at both ends of the LDR sensors are set with voltage, there will be current passing through them. When lighten by a certain wavelength of light, the current will induce with the increase of light intensity, thus actualizing photoelectric conversion.The LDR sensor has no polarity. It is truly a resistor device. It can be used with both AC voltage and DC voltage. The conductivity of a semiconductor bet on the number of carriers in the conduction band.

### 3.13.2 Advantages of LDR Sensor

A. The linearity of photoelectric conversion under strong illumination is poor.
B. Photoelectric relaxation process is long, and the relaxation phenomenon of photoconductivity will happen: that is, after illumination, the photoconductivity of semiconductor increases gradually with illumination time, and reaches the steady state value after a period of time. The photoconductivity decreases gradually after the illumination stops.
C. The frequency response (the ability of the device to detect the fast-changing optical signals) is very low.

The internal photoelectric effect has nothing to do with the electrodes (only photodiodes do), that is, DC power supply can be used.

the wavelength of the incident light & Sensitivity bet on the semiconductor material.

It is coated with epoxy packaging, and has good reliability, small volume, quick response, high sensitivity, and good spectrum characteristic.

### 3.13.3 Defects of LDR Sensors

1. the linearity of photoelectric conversion under strong illumination is poor.
2. Photoelectric relaxation process is long, and the relaxation phenomenon of photoconductivity will happen: that is, after illumination, the photoconductivity of semiconductor increases gradually with illumination time, and reaches the steady state value after a period of time. The photoconductivity decreases gradually after the illumination stops.
3. The frequency response (the ability of the ldr light dependent resistor to detect the fast changing optical signals) is very low.

# Chapter-4

# Hardware and Component

## 4.1 Introduction:

Hardware & Component includes the physical parts of a Diode and symbol, such as the case, SSR, PIR Sensor, LDR, capacitor, compute, NE555 IC, Resistor, breadboard.

## 4.2 POWER SUPPLY

A power supply is an electronic device that arrangements electric imperativeness to an electrical weight. The fundamental limit of a power supply is to change more than one kind of electrical essentialness to another. In this manner, control supplies are now and again insinuated as electric power converters. Some power supplies are discrete, free contraptions; however, others are consolidated with greater devices nearby their stores. Cases of the last fuse control supplies found in PCs and purchaser equipment contraptions. The wellspring of this power can emerge out of various source like the primary AC voltage, a battery or even from a sustainable power source like sun-based board wind turbine or energy unit to give some examples. The most widely recognized wellspring of intensity is generally the principle AC.

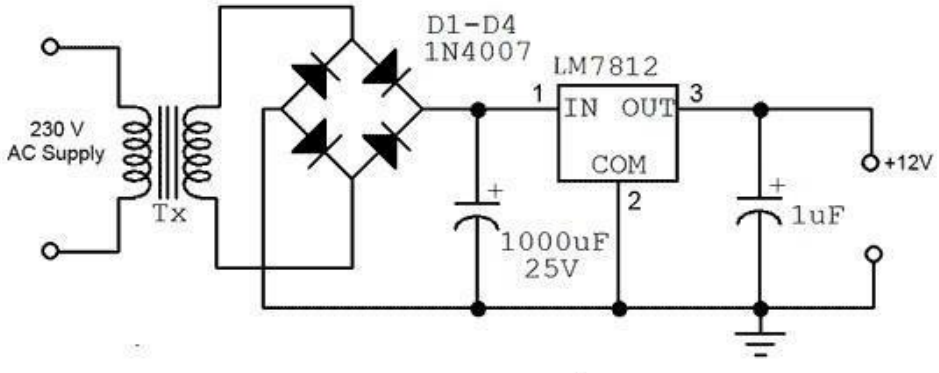



**Fig No 4.1:** AC-DC Power Supply & Circuit Diagram.

## 4.3 TRANSFORMER

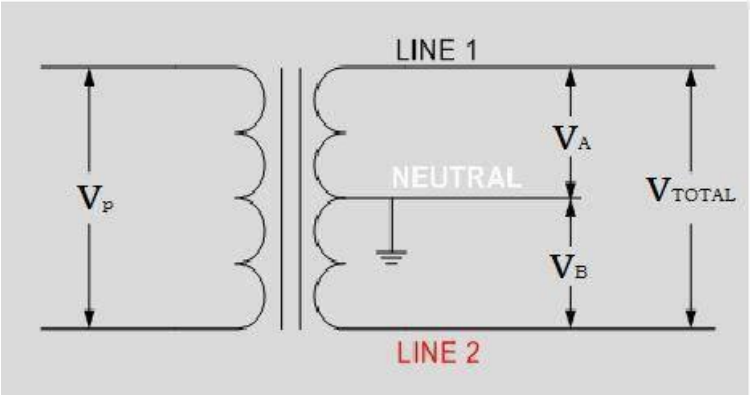



**Fig No 4.2:** Transformer

A transformer is a gadget comprising of two firmly coupled loops called essential and optional curls. An AC voltage applied to the essential shows up over the auxiliary with a voltage increase extent to the turn proportion of the transformer and a present augmentation conversely corresponding to the turn proportion control is saved turn apportion = VP/VS=NP/Ns and power out = control in or Vs

### 4.3.1 WORKING OF THIS TRANSFORMER

The two voltages, between line 1 and unprejudiced and among impartial and line 2 can be named as VA and VB independently. By then the logical association of these two voltages shows that they are dependent upon the basic voltage similarly as the turn distribute of the transformer. One thing that should be noted here is that both the yields VA and VB separately are identical in size yet converse in bearing, which suggests that they are 180 degrees out of stage with each other.

## 4.4 ABOUT DIODE

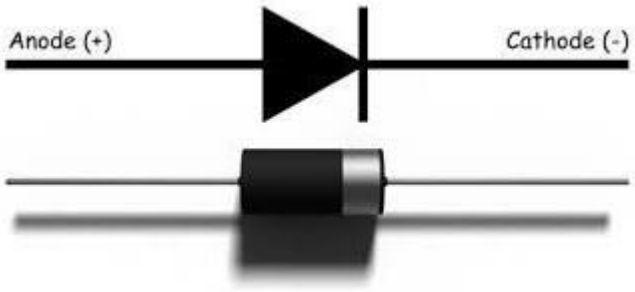



**Fig. No 4.3:** Diode and symbol

The term diode for the most part suggests a little sign gadget with current ordinarily in the milliamp go. A semiconductor diode comprises of a PN unction and has two (2) terminals, an anode (+) and cathode (-) current streams from anode to cathode inside the diode. Diodes are semiconductor gadget that may be portrayed as passing current one way as it were. The last piece of that announcement applies similarly vacuum tube diodes.

### 4.4.1 CHARACTERISTICS:

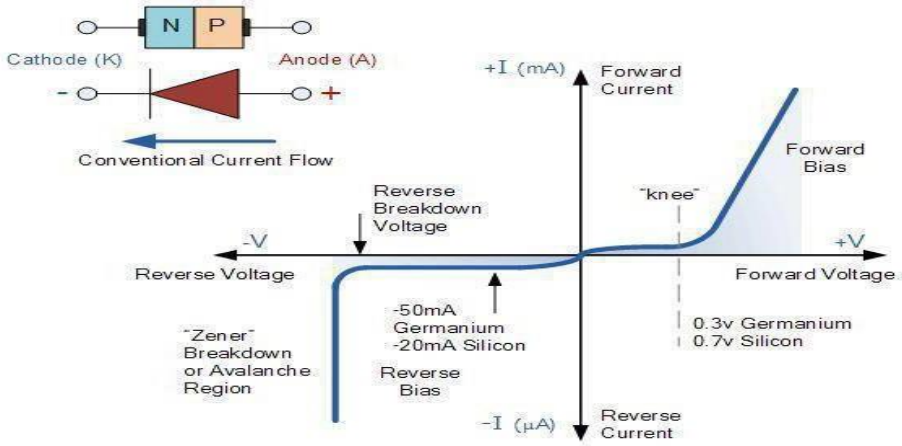



**Fig No 4.4:** Junction diode symbol and static V-I characteristics

There are two working locale and three potential "biasing" conditions for the standard Convergence Diode and these are:

Zero Bias – No outside voltage potential is applied to the PN convergence Diode Switch Bias – The voltage potential is related negative, (- ve) to the P type material and positive,

(+ ve) to the N-type material over the diode which has the effect of Increasing the PN convergence diode's width.

## 4.4.1FULL-WAVE RECTIFIERS

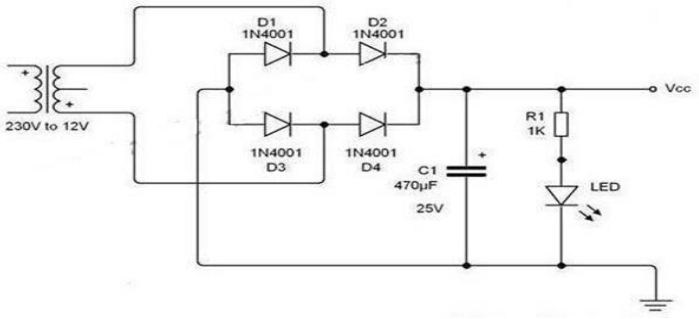



**Fig No 4.5:** Bridge rectifier circuit

A rectifier is an electronic circuit that changes over AC voltage to DC voltage. It very well may be actualized utilizing a capacitor diode blend. The interesting property of diodes, allowing the current to stream a solitary way is used in here.A throbbing dc voltage utilizing both half cycles of the applied air conditioning voltage. Scaffold rectifier is a full wave rectifier circuit utilizing the mix of four diodes to frame an extension.

## 4.4.2 WORKING OF A BRIDGE RECTIFIER

•During the positive half cycle of optional voltage, diodes D2 and D3 are forward one-sided and diodes D1 and D4 are invert one-sided. Presently the present moves through D2–>Load– >D3.

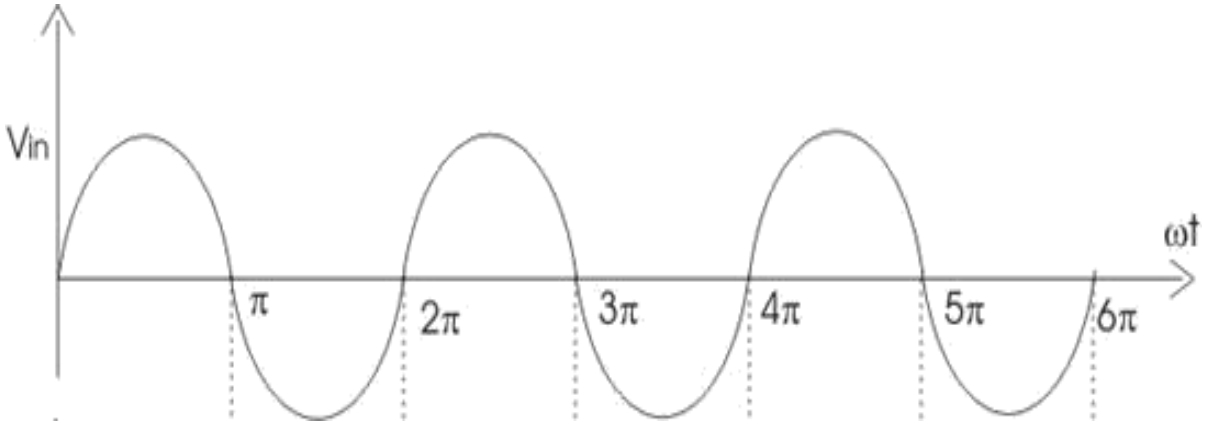



**Fig No 4.6:** Bridge rectifier wave diagram

During the negative half cycle of the auxiliary voltage, diodes D1 and D4 are forward one- sided and rectifier diodes D2 and D3 are invert one-sided. Presently the present moves through D4–>Load>D1.

Addition of a capacitor at the yield changes over the throbbing DC voltage to fixed DC voltage.

•Up to a timespan of t=1s input voltage is expanding, so the capacitor energizes to top estimation of the information. After t=1s input begins to diminish, at that point the voltage over the capacitor switch inclinations the diodes D2 and D4 and along these lines it won't direct. Presently capacitor releases through the heap, at that point voltage over the capacitor diminishes.

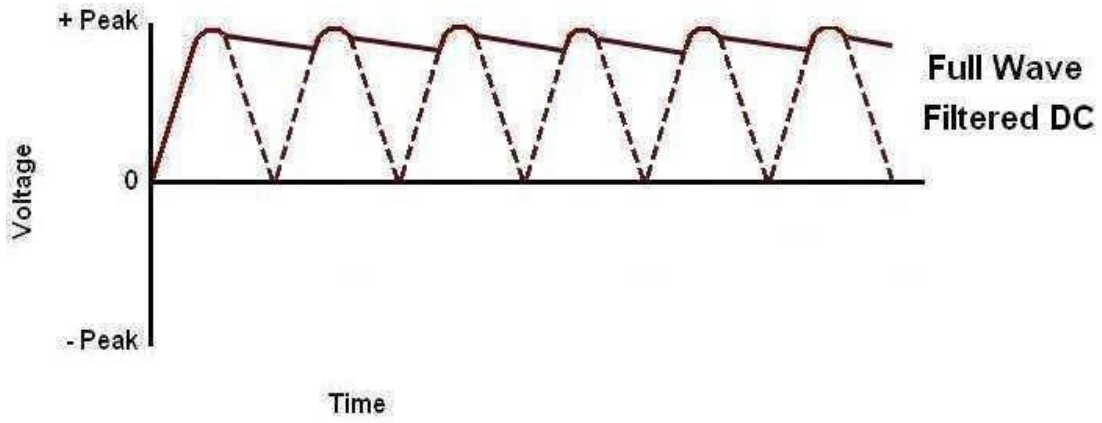



**Fig No 4.7:** Filtered output

## 4.5 CAPACITOR

Capacitor is a detached two-terminal electrical part used to store vitality in an electric field. The types of viable capacitors differ generally, yet all contain in any event two conductors isolated by a non-conductor. Capacitors utilized as parts of electrical frameworks, for instance comprise of metal soils isolated by a layer of protecting film. A capacitor is detached electronic segment comprising of a couple of conveyors isolated by a dielectric (separator) when there is a potential contrast (voltage) over the distinguished on one plate and negative charge on the other plate. Vitality is put away in the electrostatic field and is estimated in farads.


**Fig No 4.8:** Capacitors & Capacitor symbols.

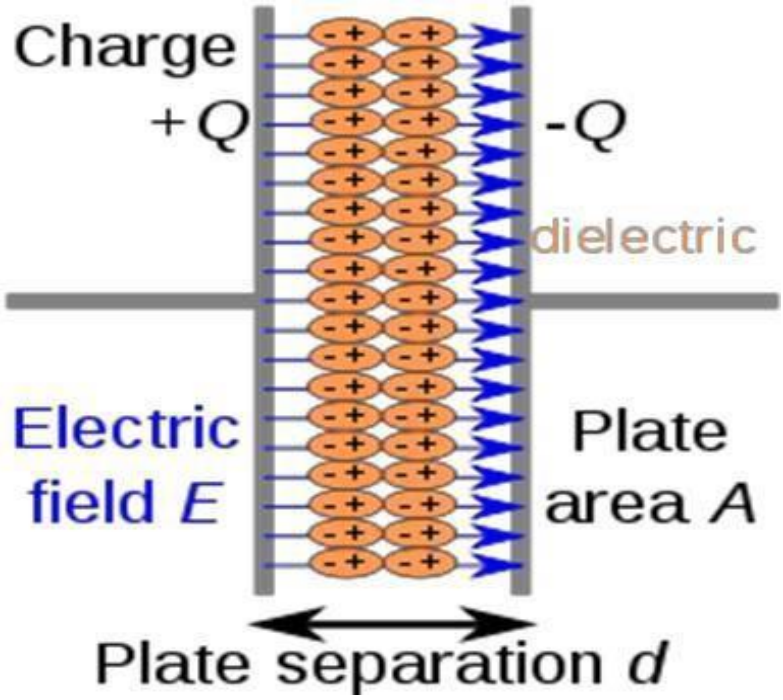



**Fig No4.9:** Internal constriction of capacitors

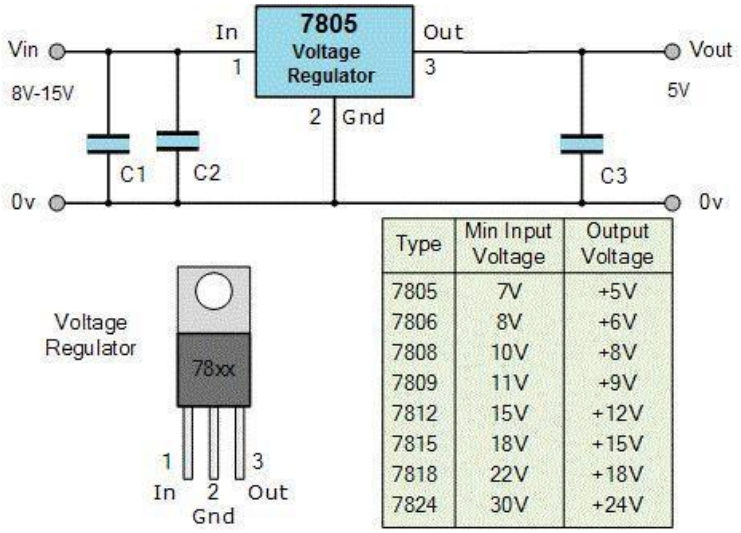
A capacitor comprises of two conductors isolated by a non-conductive district. The non-conductive area is known as the dielectric. In easier terms, the dielectric is only an electrical encasing. Instances of dielectric media are glass, air, paper, vacuum, and even a semiconductor exhaustion area artificially indistinguishable from the conduits. A capacitor is thought to act naturally contained and secluded, with no net electric charge and no impact from any outside electric field. The channels along these lines hold equivalent and inverse charges on their confronting surfaces, and the dielectric builds up an electric field. In SI units, a capacitance of one

farad implies that one coulomb of charge on every conductor causes a voltage of one volt over the gadget.

## 4.6 VOLTAGE REGULATOR

A voltage controller is a framework intended to naturallykeep up a consistent voltage level. A voltage controller may utilize a straightforward feed-forward plan or may incorporate negative criticism. It might utilize an electromechanical system, or electronic segments.

**Voltage Regulators Output Voltages**




| Type | Min Input Voltage | Output Voltage |
|---|---|---|
| 7805 | 7V | +5V |
| 7806 | 8V | +6V |
| 7808 | 10V | +8V |
| 7809 | 11V | +9V |
| 7812 | 15V | +12V |
| 7815 | 18V | +15V |
| 7818 | 22V | +18V |
| 7824 | 30V | +24V |

**Fig No 4.10:** Voltage regulator output voltage

## 4.7: IC 555 Timer Working: Pin Diagram & Specifications

The 555 timer IC is an integral part of electronics projects. Be it a simple project involving a single 8-bit micro-controller and some peripherals or a complex one involving system on chips (SoCs), 555 timer working is involved. These provide time delays, as an oscillator and as a flip-flop element among other applications.Introduced in 1971 by the American company Signetics, the 555 is still in widespread use due to its low price, ease of use and stability. It is made by many companies in the original bipolar and low-power CMOS types. According to an estimate, a billion units were manufactured back in the year 2003 alone.

Depending on the manufacturer, the standard 555 timer package includes 25 transistors, 2 diodes and 15 resistors on a silicon chip installed in an 8-pin mini dual-in-line package (DIP-8). Variants consist of combining multiple chips on one board. However, 555 is still the most popular. Let us look at the pin diagram to have an idea about the timer IC before we talk about 555 timers working

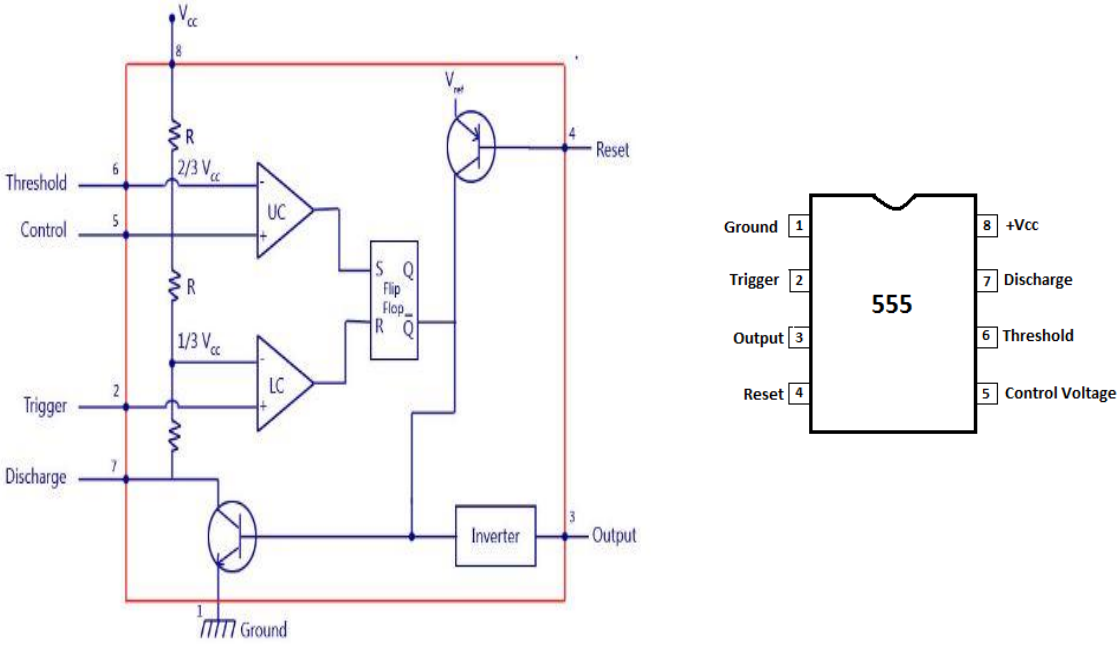



**Fig No 4.11**: Pin diagram and description

| Pin | Name | Purpose |
|---|---|---|
| 1 | GND | Ground reference voltage, low level (0 V) |
| 2 | TRIG | The OUT pin goes high and a timing interval starts when this input falls below 1/2 of CTRL voltage (which is typically 1/3 Vcc, CTRL being 2/3 Vcc by default if CTRL is left open). In other words, OUT is high as long as the trigger low. Output of the timer totally depends upon the amplitude of the external trigger voltage applied to this pin. |
| 3 | OUT | This output is driven to approximately 1.7 V below +Vcc, or to GND. |
| 4 | RESET | A timing interval may be reset by driving this input to GND, but the timing does not begin again until RESET rises above approximately 0.7 volts. Overrides TRIG which overrides threshold. |

| | | |
|---|---|---|
| 5 | CTRL | Provides "control" access to the internal voltage divider (by default, 2/3 Vcc). |
| 6 | THR | The timing (OUT high) interval ends when the voltage at threshold is greater than that at CTRL (2/3 Vcc if CTRL is open). |
| 7 | DIS | Open collector output which may discharge a capacitor between intervals. In phase with output. |
| 8 | Vcc | Positive supply voltage, which is usually between 3 and 15 V depending on the variation. |

## 4.7.1 Some important features of the 555 timers:

555 timers are used in almost every electronic circuit today. For a 555 timer working as a flip flop or as a multi-vibrator, it has a particular set of configurations. Some of the major features of the 555 timers would be,

A. It operates from a wide range of power ranging from +5 Volts to +18 Volts supply voltage.
B. Sinking or sourcing 200 mA of load current.
C. The external components should be selected properly so that the timing intervals can be made into several minutes along with the frequencies exceeding several hundred kilohertz.
D. The output of a 555 timer can drive a transistor-transistor logic (TTL) due to its high current output.
E. It has a temperature stability of 50 parts per million (ppm) per degree Celsius change in temperature which is equivalent to 0.005 %/ °C.
F. The duty cycle of the timer is adjustable.
G. Also, the Hight power dissipation per package is 600 mW and its trigger and reset inputs has logic compatibility.

## 3.7.2: 555 timers working

The 555 generally operates in 3 modes:

A. A-stable
B. Mono-stable
C. Bi-stable modes.

# Chapter 5

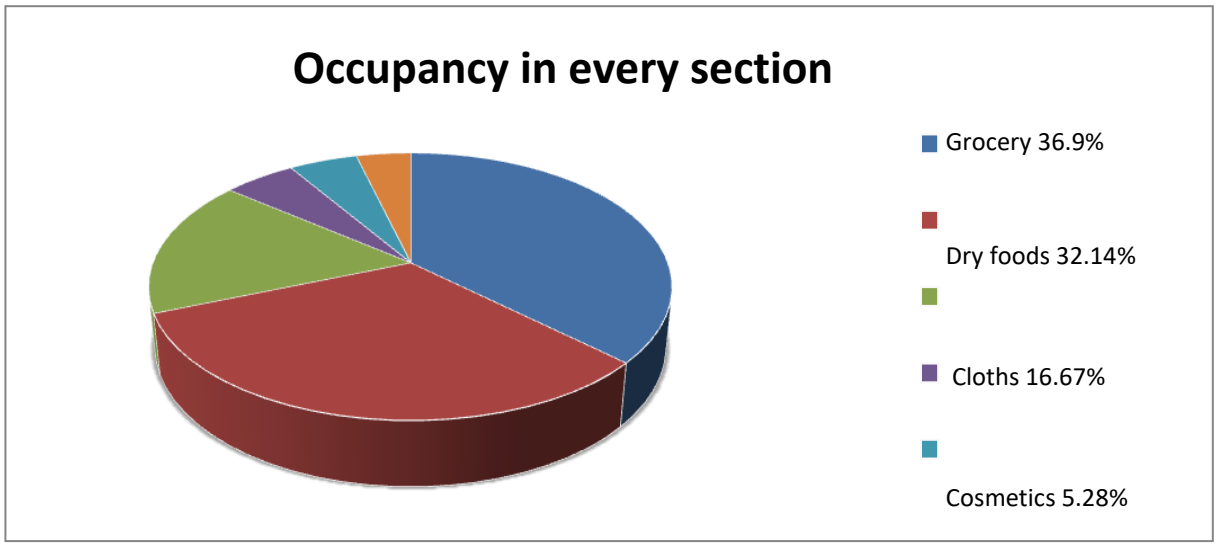
# Calculation for Power Saving

## 5.1 Introduction

The modern era indicates to resolve the energy crisis along with increasing energy consumption day by day which is creating problem in everywhere and energy crisis is any great bottleneck in the supply of energy resources to an economy. There has been an enormous increase in the global demand for energy in recent years as a result of industrial development and population growth. Energy efficiency, means using less energy to provide the same level of energy. In this project the prime objective is to minimize maximum use of electricity by using energy saving lighting system and occupancy sensor. A present departmental store is taken as an example to show the project energy efficiency. Different occupancy density and percentages of occupancy in different sections are shown for power calculation and the yearly saving of energy is also shown in this segment.

## 5.2 Occupancy density

The occupant density refers to the number of persons that can safely fit into the space available and occupancy density of a departmental store is very essential for calculating occupancy in every section which helps further to calculate energy saving. In this project we take an existing departmental store as an example to determine yearly power consumption. The occupancy in different section varies in order to space type. Occupancy is highest in Grocery section which is 36.9 percent, in Dry food section 32.14 percent, in cloths section 16.67 percent, in cosmetic section 5.28 percent, in electronics and crockery's section is 4 percent and in medicine is 4 percent.



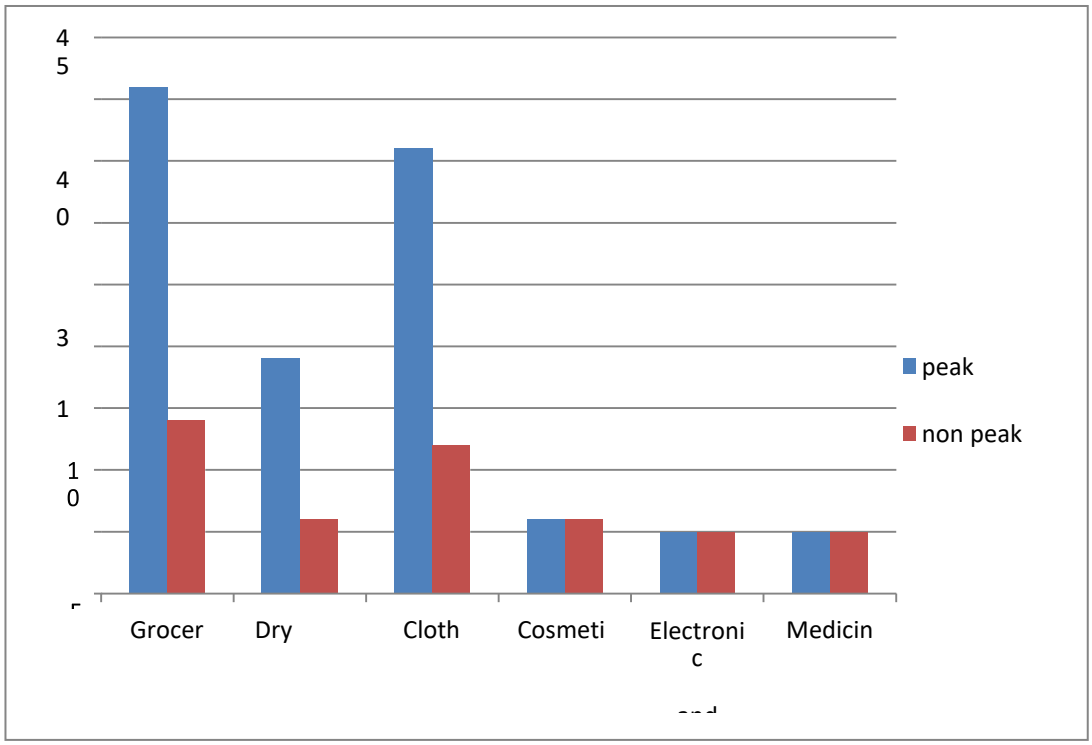

**Pie chart 5.1 Occupancy in every section**

Occupancy in different section also varies in different hours. The operating hour of the store is from 8 am in the morning to 10 pm in the night. According to the store manager occupancy is higher in morning and evening. So, these hours are divided into peak hours and nonpeak hours. Occupancy is higher in peak hours and number of people drops to one third in nonpeak hours.

Operation hour of departmental store = 8 am to 10 pm=14 hours Peak hours =9 am to 12 am and 5 pm to 9 pm= 7 hours

Nonpeak hours = 8 am to 9, 12 pm to 5 pm and 9 pm to 10 pm= 7 hours

It is observed in that departmental store that during peak hours the number of people visit in grocery section is 41, in dry food section 19, in cloths section 36, in cosmetic section 6, in electronics and crockery's section 5 and in medicine section 5. In nonpeak hours the number drops to one third of peak hours. It is also observed that in cosmetic, electronics and crockery's and in medicine section the occupancy remains relatively constant in both peak and nonpeak hours. A bar chart is given below for better interpretation.




**Bar chart 5.2 occupancy in peak and nonpeak hours**

During nonpeak hours the number of people in departmental store drops to one third of the number during peak hours. In peak hours Grocery, Dry foods and Cloths sections are remain 100 percent occupied and in nonpeak hours the percentage of hours remained occupied in these three sections is 75 percent, 68 percent and 60 percent. The number of people in cosmetics Electronics and medicine sections remains relatively constant all day. A table is given below to calculate the operation hours of lights with PIR sensor and without PIR sensor.

**Table 5.2 Operation hours of lights with PIR sensor and without PIR sensor**

| Space type | Number of people per peak hour | Number of people per nonpeak hour | Percentage of hour remain occupied | | Operation hour of lights with PIR sensor | | Operation hour of lights without PIR sensor |
|---|---|---|---|---|---|---|---|
| | | | During Peak hours | During nonpeak hours | During Peak hours | During nonpeak hours | |
| Grocery | 41 | 14 | 100 | 75 | 7 | 5 hrs 15 mins | 14 |
| Dry foods | 19 | 6 | 100 | 68 | 7 | 4 hrs 45 mins | 14 |
| Cloths | 36 | 12 | 100 | 60 | 7 | 4 hrs 12 mins | 14 |
| Cosmetics | 6 | 6 | 50 | 50 | 3 hrs 30 mins | 3 hrs 30 mins | 14 |
| Electronics | 5 | 5 | 50 | 50 | 3 hrs 30 mins | 3 hrs 30 mins | 14 |
| Medicine | 5 | 5 | 50 | 50 | 3 hrs 30 mins | 3 hrs 30 mins | 14 |

## 5.3: Calculation for power saving

In that departmental store fluorescent bulbs of 30W and 1100 lumen were used. One LED bulb creates similar brightness with power capacity from 9 - 13 watt. Most of the LED bulbs of 12 watt which create 1100 lumens are available in different stores in present days. If this bulb replaces fluorescent bulb of power.

| Space type | Operation hour of lights with PIR sensor | | | Operation hour of lights without PIR sensor | Total consumption of energy per day (Wh) | |
|---|---|---|---|---|---|---|
| | During Peak hours | During nonpeak hours | Total | | With PIR sensor and one LED bulb of power capacity 12 watt | Without PIR sensor and with one fluorescent bulb of power capacity 30 watt |
| Grocery | 7 | 5 hrs 15 mins | 12 hrs 15 mins | 14 | 147 | 420 |
| Dry foods | 7 | 4 hrs 45 mins | 11 hrs 45 mins | 14 | 141 | 420 |
| Cloths | 7 | 4 hrs 12 mins | 11 hrs 12 mins | 14 | 134.4 | 420 |
| Cosmetics | 3 hrs 30 mins | 3 hrs 30 mins | 7 | 14 | 84 | 420 |
| Electronics | 3 hrs 30 mins | 3 hrs 30 mins | 7 | 14 | 84 | 420 |
| Medicine | 3 hrs 30 mins | 3 hrs 30 mins | 7 | 14 | 84 | 420 |
| Total | | | | | 674 | 2520 |

capacity 30 watt and similar brightness power consumption drops to a very lower value.

**Table 5.3 power calculation for one LED light**

Here calculations are shown for six bulbs in six sections in that departmental store to find the energy consumption by a single bulb.

Total consumption of energy in watt-hour per day in six sections by six LED bulbs of 12 watt with PIR sensor

Average total consumption of energy in watt-hour per day by one LED bulb of 12 watt with PIR sensor

Total energy consumption by a single LED bulb with PIR sensor per year

Total energy consumption in watt-hour per day by six fluorescent bulbs of 30 watt without PIR sensor= 2520 Wh or 2.52 kWh.

Total energy consumption in watt-hour per day by a single fluorescent bulb of 30 watt without PIR sensor=420 Wh

Total energy consumption by a single fluorescent bulb without PIR sensor per year

So, energy saving per year by a single LED light with PIR sensor

The departmental store was 6000 square feet in area and 2000 fluorescent bulb was used in lighting system. Energy consumption by 2000 bulb per day is

= 840000 Wh or 840 kWh.

In that departmental store 350 KVA or 280 kW of power is being used in every hour that's means in 14 hours, energy consumption is 3920 kWh and energy consumption by lighting system is 840 kWh which is 21.42%.

If 2000 LED bulbs with PIR sensors replace fluorescent bulbs, the total energy consumption of that store drops to 3304.80 kWh and the lighting system consumes 224800 Wh or 224.80 kWh of energy which is 6.80% of the total energy per day.

So, if that department store used LED lighting system with PIR sensors, that would have reduced energy consumption up to 15.69% per day and 224.5 kWh of energy per year.

Now a day's CFLs of 22 watts are available creating similar brightness of 12-watt LED bulbs. In that case lighting system would consume 112.42 kWh per year. So, energy saving per year by a single LED light with PIR sensor is) kWh = 71.42 kWh.

# Chapter-6

# Conclusion

Considering all the above calculations and data from the tables, it can be concluded that using occupancy sensor and LED lighting system reduces amount of energy consumed, and thus being energy- saving and cost effective at the same time. The calculated data confirms that this lighting system will be efficient enough. The system was developed via SSR so as to abstain failure as a result of singe contacts which develop in electromagnetic relays. Furthermore, the system was able to detect day and night effective utilization and energy conservation. Automatic switch is necessary for the purpose of energy salvation mainly at homes.

# REFERENCE

[1] Suman, H., Pradyum J. & TanmayBagla, K. H. “Home Monitoring System for Disabled & Elderly”.International Conference on Recent Issues in Engineering, Science and Technology (ICRIE), (2016).

[2] Adelakun, A., Adewale, A. A. Adulkareem, A., and Olowoleni, J.O., “Automatic Control and Monitoring of Electrical Energy Consumption using PIR sensor Module”. International Journal for Scientific and Engineering Research, 5(5), 493-496, (2014).

[3] Microchip, "PIC16f628A Data Sheet 28/40/44-Pin Enhanced Flash Microcontrollers.,"(2003).

[4] Ajay K. T., Prince R. & Ashish T.Motion Detection using PIR Sensor. International Journal of Scientific Development 53 Michael E., et al CJET Vol.1 No.1, March. 2018 (Special Edition) 47 –54 and Research, 1(5), 103-106, (2016)

[5] Adewale A.A., Samuel I., Awelewa A. A. & Dike U. I.“Design and Development of a Microcontroller based Automatic Switch for Home Appliances”. International Journal of Scientific Development and Research, 2(10), 24-31, (2013).

[6] O. Okokpujie Kennedy, Odusami Modupe, P. Okokpujie Imhade and Olusola Abayomi-Alli, A Model for Automatic Control of Home Appliances using DTMF Technique. Research Journal of Applied Sciencdes, 12 (2) 2017, 266-272

[7] Oyedepo, S. O. “Energy efficiency and conservation measures: tools for sustainable energy development in Nigeria”. International Journal of Energy Engineering, 2(3),86-98, (2012).

[8] Oyedepo S. O. “On energy for sustainable development in Nigeria”. Renewable and Sustainable Energy Reviews, 16(5), 2583-2598, (2012).

[9] Gbadebo, O. O., and Okonkwo, C. “Does energy consumption contribute to economic performance? Empirical evidence from Nigeria”. Journal of Economics and International Finance, 1(2), 44, (2009).

[10] Sambo, A. S.” Matching electricity supply with demand in Nigeria”. International Association of Energy Economics, 4, 32-36, (2008).

[11]. 1Okokpujie, Kennedy, Etinosa Noma-Osaghae, Samuel John, and Prince C. Jumbo. "Automatic home appliance switching using speech recognition software and embedded system." In Computing Networking and Informatics (ICCNI), 2017 International Conference on, pp. 1-4. IEEE, 2017.