



**NEW HORIZON**  
**COLLEGE OF ENGINEERING**

Autonomous College Permanently Affiliated to VTU, Approved by AICTE & UGC  
Accredited by NAAC with 'A' Grade.

**“SMART STREET LIGHT SYSTEM USING  
IR SENSOR”**

**A MINIPROJECT REPORT**

*Submitted by*

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*In partial fulfillment for the award of the degree of*

**BACHELOR OF ENGINEERING**

**IN**

**ELECTRONICS AND COMMUNICATION**

**NEW HORIZON COLLEGE OF ENGINEERING  
DEPARTMENT OF ELECTRONICS AND COMMUNICATION  
ENGINEERING**



**CERTIFICATE**

Certified that the mini project work entitled “**Smart street light system using IR Sensor**” carried out by **Lokesh Y (1NH18EC061)** bonafide student of Electronics and Communication Department , New Horizon College of Engineering, Bangalore.

The mini project report has been approved as it satisfies the academic requirements in respect of mini project work prescribed for the said degree.

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We thank **Dr. Mohan Manghnani**, Chairman of **New Horizon Educational Institution**, for providing necessary infrastructure and creating good environment.

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**Lokesh Y (1NH18EC061)**

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## ABSTRACT

The project on "Automatic Street light System" is being reviewed.

In this project the lights automatically turn ON when necessary and turn OFF themselves when not needed.

Presently, in the entire world, huge amount of energy is being consumed only by the normal street lamps which do not automatically turn OFF when its bright. This is an enormous wastage of energy in the entire world and has to be modified to bring a better change.

Our project "Automatic smart street light system" consists of LED lights, IR sensors, and also a short distance communication network. Before the pedestrians and vehicles come, the lights turn ON and then automatically turn OFF once they cross. By doing this, the power is reduced.

It is basically an intelligent way of controlling the street lights to optimize the power consumption issue late in night.

The dimming of the street lamps on the speed of the motion of the object detected such as the cyclists, cars and pedestrians. The more the speed of the object the more is the level of intensity of the street lights.

Hence, for this sake the innovation in automatic street lighting on comparison with the conventional street lighting has proven to me more effective and reliable as advised by the government of India as well.

## CHAPTER 01

# INTRODUCTION

Presently , according to the survey in our country more than 28 million street lights are lit up during night consisting mainly of metal halide lamps, sodium lamps and compact fluorescent lamps(CFL). Approximately 20% to 40% of the total electricity produced in India is utilised by street lights.To reduce this energy requirement to much lower level the government is trying to consider LED technology . So to overcome this ongoing problem Smart Street Light is the way.

Smart Street light is an automated system. Automation is the use of control system and information technologies to reduce the need of human work in the process of production of services. Presently, Automation plays a very important role in the modern world economy and in daily life. Automatic systems are being preferred over the manual system because of the minimum usage of manpower.

To reduce the power consumption when there is no vehicle movements in the roads is the main aim of the Smart street light.The Street light system can be classified according to the type of lamps used . Such as fluorescent lamp, incandescent lamp, metal halide lamp, high and low pressure sodium lamp and LED lamp. Various types of technologies are used with their luminous efficiency , lamp service life as their considerations.

As far as now , LED is considered a promising solution to modern street lighting system due to its behavior and advantages. like power consumption is less compared to others and life time more compared to others.

## CHAPTER 02

### LITERATURE SURVEY

### SMART STREET LIGHTING SYSTEM

By,

Mohit Kumar Gupta

Rushil Bhatnagar

Department of Electronics and Communication

Jaypee University of Information Technology, Waknaghat, India

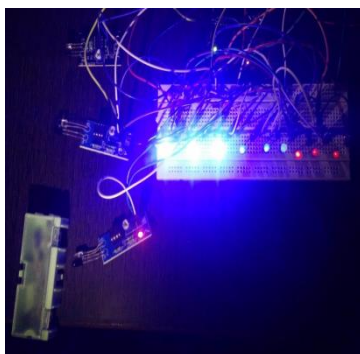
2019

### CONCLUSION

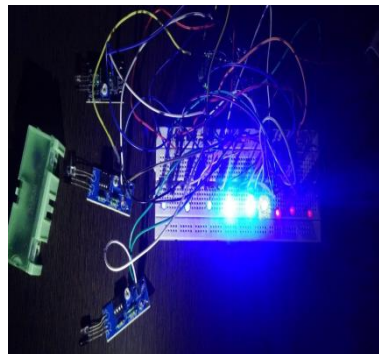
The aim was to control the intensity of the street light framework with regular change in the time intervals , identify the movement of vehicles and switch on the lights when there is car moving and reduce the intensity of the lights when the vehicle movement is past the the sensors.

### OUTPUT

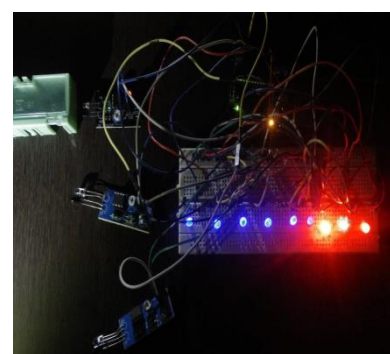
Following shows the outputs through consecutive IR sensors



**FIG 2.1** 1st IR Sensor



**FIG 2.2** 2nd IR sensor



**FIG 2.3** 3rd IR sensor



## VEHICLE MOVEMENT STREET LIGHT WITH AUTOMATIC LIGHT SENSING

By,

Department of Electronics & Communication Engineering  
RCC Institute of Information Technology,  
WestBengal  
May, 2018

By using Smart Street light,

- Surplus amount of energy saved by replacing sodium vapor lamps by LED
- Prevents wastage of electricity which caused due to manual switching.
- Efficient and smart automatic streetlight control system with the help of IR sensors.
- Reduces energy consumption
- Maintains the cost.

### OUTPUT

Following shows the outputs through consecutive IR sensors

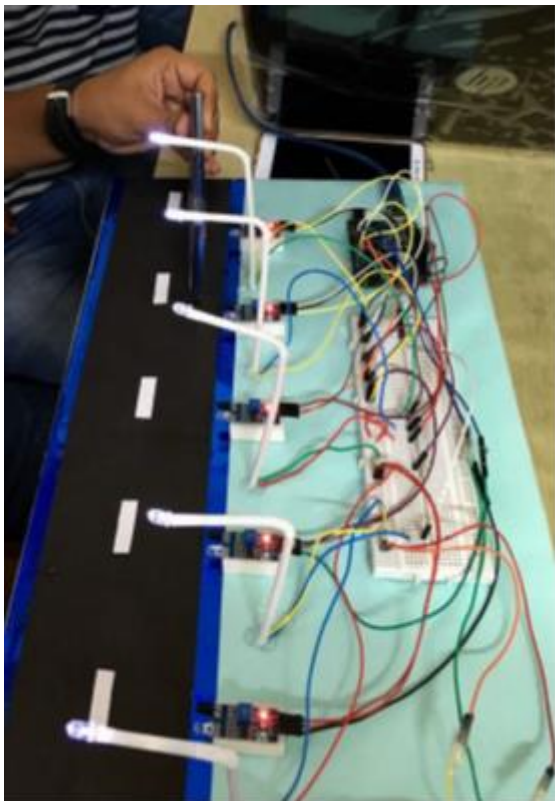


FIG 2.4

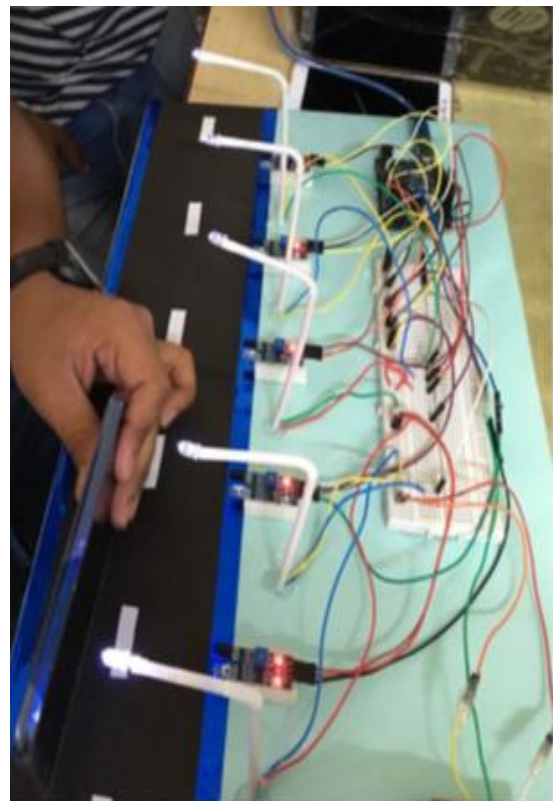


FIG 2.5

## CHAPTER 03

### EXISTING SYSTEM

In accordance to the Automation, Power consumption and Cost Effectiveness are the important considerations in the present field of electronics and electrical related technologies .To control and maintain complex street lighting system more economically; various street light control systems are developed. These systems are developed to control and reduce energy consumption of a town's public lighting system using different technologies.

The existing work is done using HID(High Intensity Discharge) lamps. Now they are upgraded to LED lights because of the following disadvantages of HID lamps

#### **Disadvantages of Existing system.**

1. More Power Consumption by HID lamps
2. Less Life-time of HID lamps.
3. Not applicable to use in all sort of outdoor applications.
4. Causes problem to drivers in the front to see in the vehicles in the behind through rear view mirrors because of the brightness of the lamps since intensity of the lamp cannot be controlled .
5. Not cost effective and not reliable

#### **Advantages of LED lamps**

1. Less Power Consumption compared to other lamps
2. More Life-time with comparison to other lamps.

Jamshedpur Utility Services abbreviated as JUSCO's project in Jamshedpur is the biggest smart city with 300 street lightning deployment in India.They have set up a goal of installing 15000 street lightning by the next 5 years.

## CHAPTER 04

# PROBLEM STATEMENT AND OBJECTIVES

### Problem Statement

The main aim of the project is to build Automatic smart street-light system to detect vehicle, pedestrians etc movement on roads and to switch ON only those block of street lights ahead to them and to switch OFF the trailing lights to save energy.

### Objectives

- To build power saving automatic street light system based on movement of vehicles, pedestrians etc.
- To encourage energy proficiency in the field of transport.
- To promote energy efficiency
- To encourage energy saving methodologies.

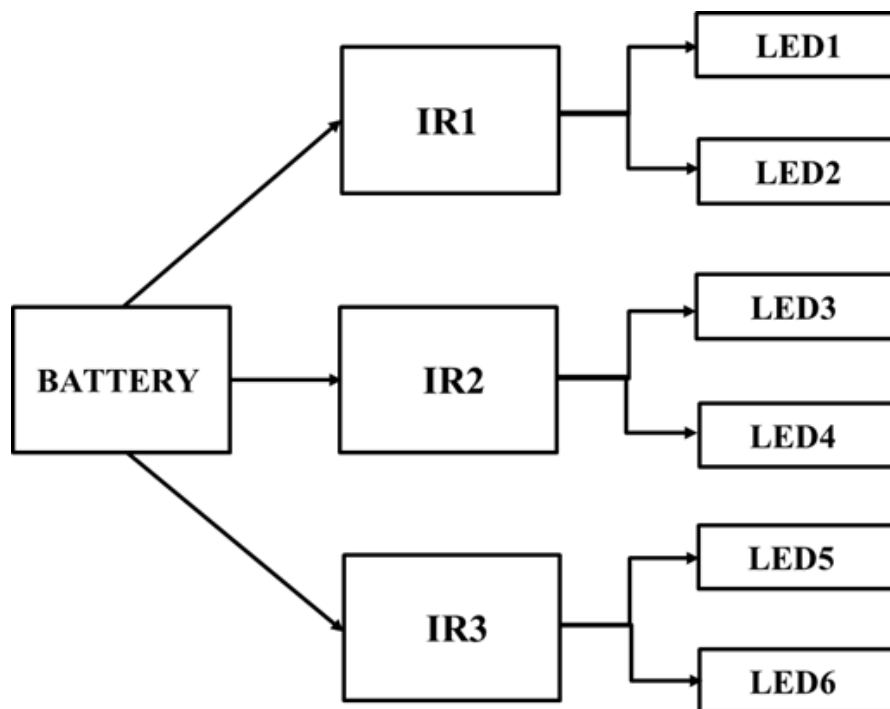
## CHAPTER 05

### PROJECT DESCRIPTION

#### Smart Street Light System Using IR Sensor

The main concept of our project is to create an Automatic smart street light system which helps to turn ON the street light based on movements of vehicles, pedestrians etc else OFF to save energy.

The below given block diagram explains the working of our project in a brief manner.

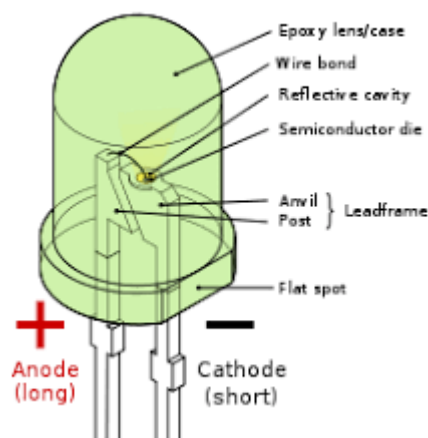


**FIG 5.1 Block Diagram of Smart Street Light System Using IR Sensors**

As seen from the block, we use 1 power supply battery which is connected to 3 IR sensors each connected to 2 LED based street lights respectively.

## COMPONENTS USED IN THE PROJECT

### 1. LEDs



**FIG 5.2 LED: Light Emitting Diode**

It is a semiconductor-light-source which emits light when there's current flow through it. Different light based LEDs can be seen. These different colours of lights are determined by energy required by electrons to cross the band-gap of semiconductor.

There are 2legs in an LED

1. The longer leg is Anode
2. The shorter leg is Cathode

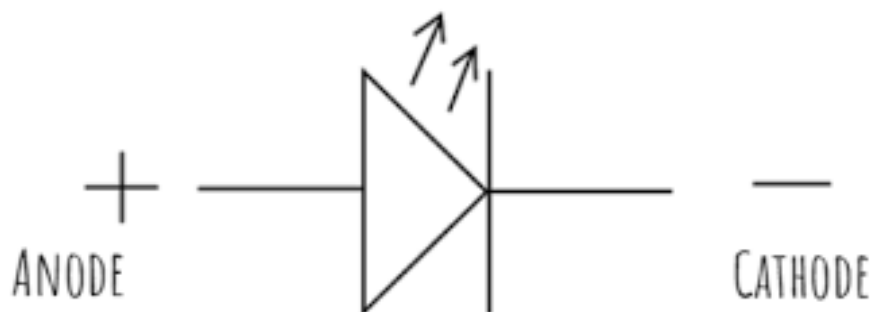
The working principle of LEDs is **Electroluminescence**.

LEDs were invented by:

H J Round(1907), Oleg Losev(1927), Jame R Biard(1961), Nick Holonyak(1962)

The first production was done in October 1962.

### Pin Diagram:



**FIG 5.3 Pin diagram OF Light Emitting Diode**

LEDs are commonly used over other light sources because of their **advantages** which includes

- Low energy consumption

- Improved physical robustness
- Small size
- Long lifetime
- Fast switching etc

### **Applications:**

- Automotive headlights
- Street lights
- Traffic signals
- Lightning Wallpapers
- Medical devices
- Decorative purposes etc

## **2. Nine-volt Battery**



**FIG 5.4 Nine-volt Battery**

Nine Volt Battery was introduced for early transistor based radios which is a common sized battery. It is rectangular shaped with round edges and has a polarized snap connected at the top. Commonly used in clocks, walkie-talkies, experiments involved in small energy consumption.

It is available primarily in Carbon zinc and alkaline chemistry, primary lithium iron disulfide and rechargeable in nickel cadmium, nickel metal hydride, lithium ion.

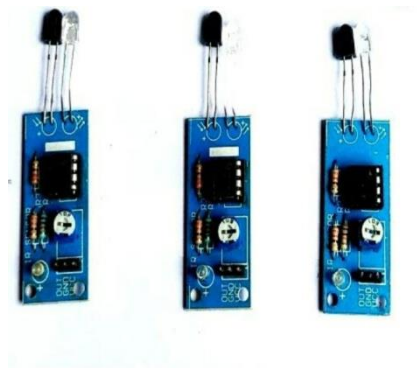
Six individual 1.5V LR61 cells are used in construction of most nine volt alkaline batteries.

There are two terminals at the top of the battery.

- The smaller circular terminal(Male): Positive
- The larger octagonal or hexagonal terminal(Female): Negative

The larger one connects to the smaller one of the connector and vice-versa.

### 3. Infrared Sensor(IR)



**FIG 5.5 IR Sensor**

Infrared sensors are also known as smart sensors which are used for sensing objects.

There are two parts in an IR sensor Light Emitting diode(LED) and a Receiver collectively known as Outo/Photo Coupler.



The emitting circuit is IR LED which emits infrared rays and the detector circuit is IR photodiode which receives the action when infrared rays emitted strikes any object.

IR sensor has 3 pins,

- Output
- Ground
- Vcc

The positive terminal of a battery will be connected to Vcc.

The negative terminal of a battery will be connected to Ground.

The output terminal to the load.

Output becomes 1 when the detector circuit detects any action when infrared rays emitted strikes objects and reflects back or else 0. When output is 1 it drives the load.

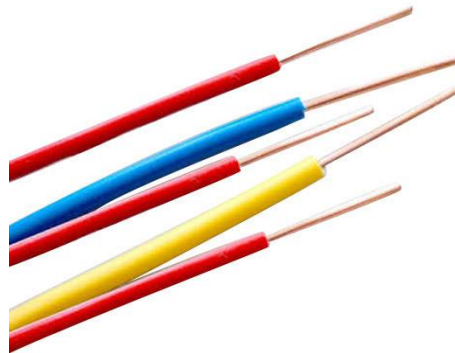
## **4. Connecting Wires**

Wires are commonly used to connect different components to build up a circuit. Mostly wires are of copper as copper is a good conductor of electricity. Based on different applications single, multi-stranded or jumper wires are used.

In case of connecting processors or any pin based components Jumper wires are used which have pins (Male or Female which makes connection easy).

Single strand wires are used when there's not much encounter of movements in circuits.

Multistrand wire consists of a bunch of small wires bunched together to form one thick wire. These are used when there's a need for higher resistance to metal fatigue.



**FIG 5.6 Single strand wire**



**FIG 5.7 Multi strand wire**



**FIG 5.8 Jumper wire**

## CIRCUIT DIAGRAM

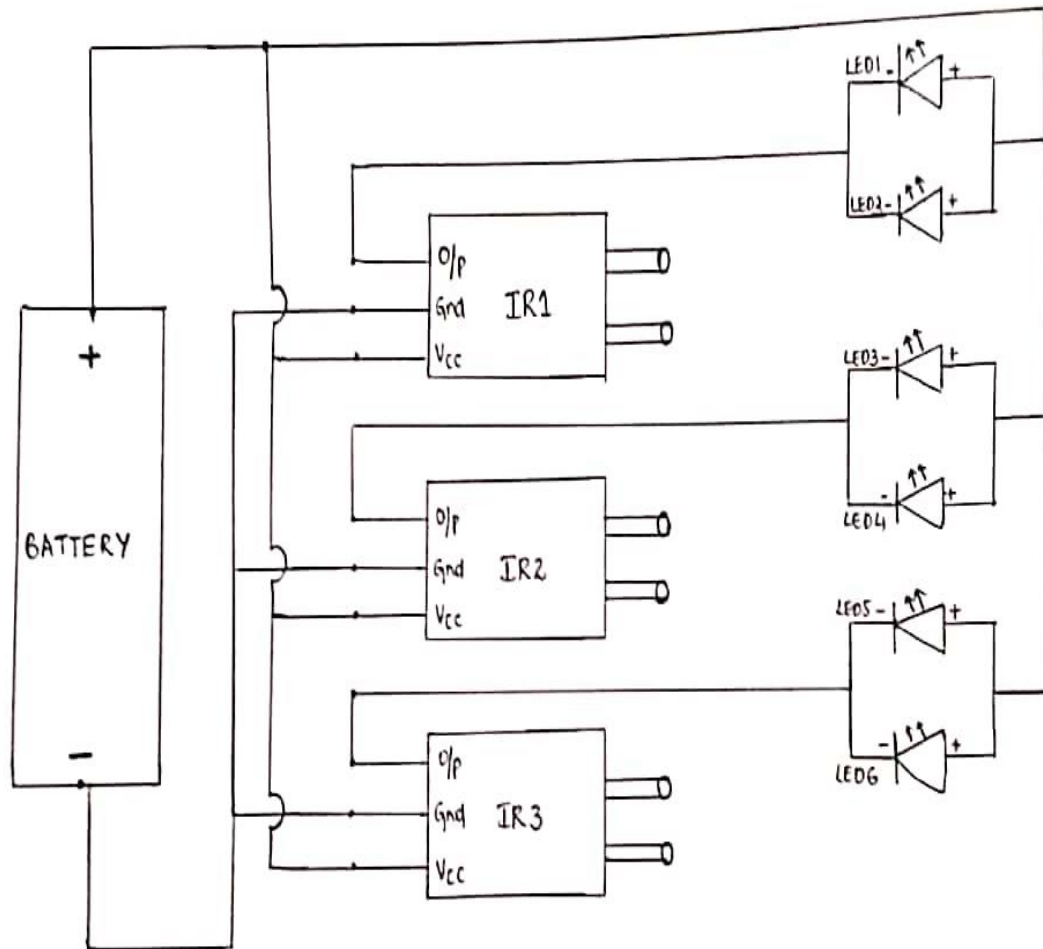


FIG 5.9 Circuit Diagram of Smart Street Light System Using IR Sensors

### Circuit connections:-

- The negative terminal of the battery is connected to "gnds" of all the IR sensors.
- The positive terminal of the battery is connected to the "Vcc" of all the IR sensors.
- And, then the output of the IR sensors is connected to the LED's.

As per the circuit diagram shown above, the main component used in our project is **IR Sensor**.

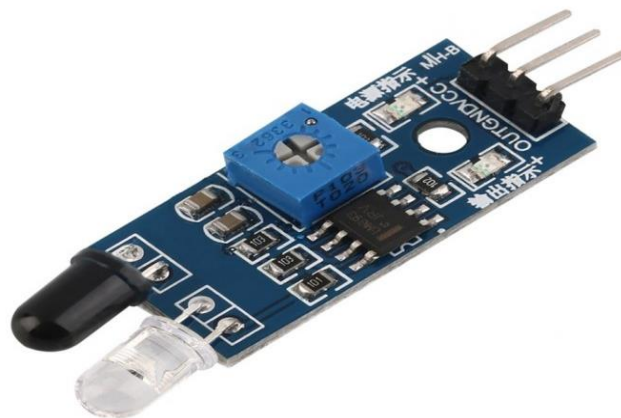
## IR sensor

An infrared sensor is an electronic device, which emits the light in order to sense the objects in the surroundings. An IR sensor can detect the motion of an object and also the heat of an object. Usually in the infrared spectrum, all the objects radiate some form of the radiations called thermal radiations. But this type of radiation is invisible to our eyes, hence this type of radiation can be detected by infrared sensors.

IR's are used for sensing the vehicle.

Infrared sensors basically has two parts:- 1) IR LED(Emitter)

2) IR Photodiode



**FIG 5.10 IR SENSOR**

The emitter is an IR LED(Light Emitting Diode), which is also known as IR Transmitter and the detector is an IR photodiode, which is also known as IR Receiver.

Photodiode is very sensitive to the IR light of the wavelength, which is the same that is emitted by the IR LED. There will be a change in resistances and output voltages seen to the magnitude of IR light received, whenever the IR light falls on.

There are five elements used in typical infrared detection system:-

1. Infrared source
2. Transmission medium
3. Optical component
4. Infrared detectors or receivers
5. Signal processing

Infrared sources include infrared lasers and infrared LED's of specific wavelengths.

We use an **Active type infrared sensor** in our project and its brief description can be seen below.

## Types of IR Sensors:-

There are two types of IR sensors and they are,

- Active Infrared Sensor
- Passive Infrared Sensor

### 1. Active Infrared Sensor

Active infrared sensors consist of two elements namely infrared source and Infrared detector.

Infrared sources includes infrared laser diodes or the LED. Infrared detectors include photodiodes or phototransistors. The energy, which is emitted by an infrared source is reflected by an object and then falls on the infrared detector.

## 2. Passive Infrared Sensor

Passive infrared sensors are basically infrared detectors. These sensors do not use any infrared sources and infrared detectors. Passive infrared sensors are of two types: quantum and thermal.

- Quantum infrared sensors have higher detection performance. Quantum types of infrared sensors are faster than thermal types of infrared detectors. The photosensitivity of quantum infrared sensors is basically a wavelength dependent.
- Thermal infrared sensors use the infrared energy as a source of heat. Bolometers, thermocouples and pyroelectric detectors are the common types of thermal infrared detectors.

## IR Sensor Working Principle

Depending on the wavelengths, output power and response time there are many different types of infrared transmitters. An IR sensor basically consists of two parts: IR LED and IR Photodiode, both together called as PhotoCoupler or OutoCoupler.

### IR Transmitter or IR LED

Infrared Transmitter is a light emitting diode(LED) which emits the infrared radiations called IR LED's. Though IR LED looks like a normal LED, the emitted radiation is invisible to the human eye.

The picture shown below is an Infrared LED.



**FIG 5.11 IR LED or IR Transmitter**

#### **IR Receiver or Photodiode**

Infrared receivers or infrared sensors help to detect the radiation from an IR transmitter. They come in the form of photodiodes and phototransistors. These are different from the normal photodiodes as they detect only the infrared radiations.

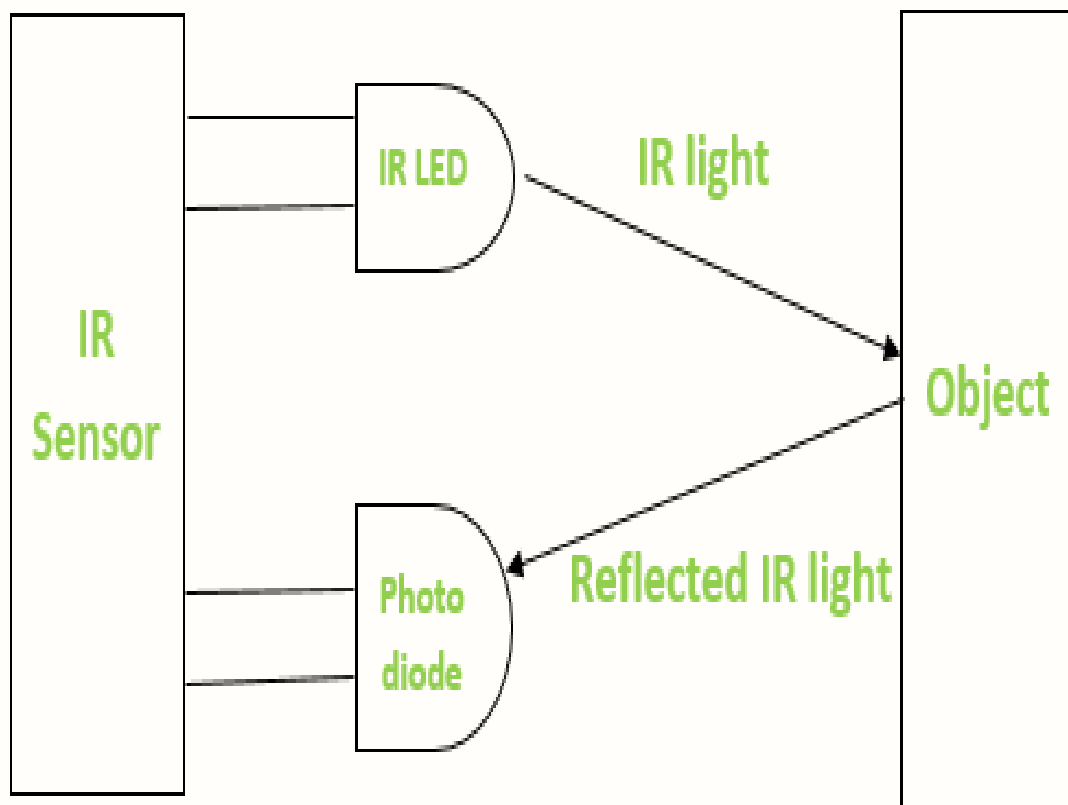
The picture shown below is an IR receiver or a photodiode.



**FIG 5.12 IR Photodiode or IR Receiver**

Based on the wavelength, voltage, package etc, different types of IR receivers exist. The wavelength of the receiver should match with the wavelength of the transmitter, whenever used in transmitter-receiver combination.

The emitter is an IR transmitter and the detector is an IR receiver. The IR photodiode is very sensitive to the IR light emitted by IR LED. The output voltage and photodiode's resistances changes in proportion to the IR light received. The above explanation is the working principle of the IR sensor.





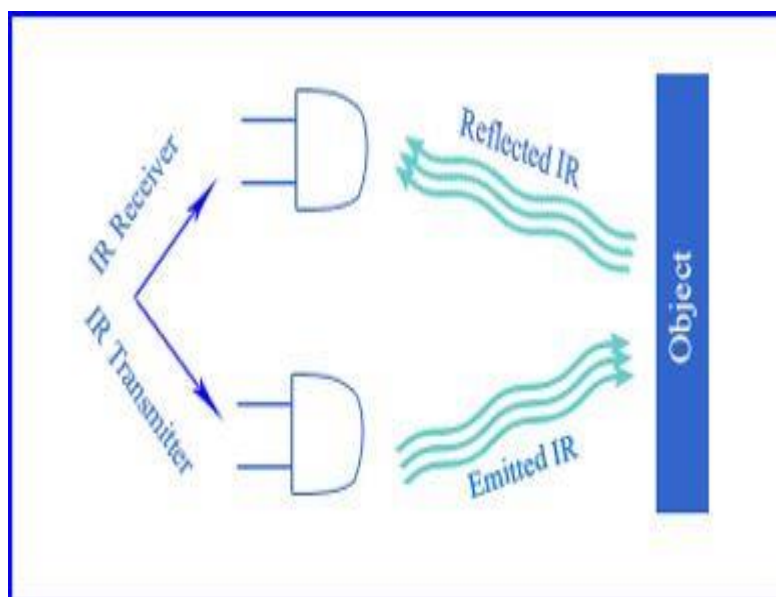
When the IR LED emits radiation, it reaches the object and some of the radiation will be reflected back to the IR receiver. Based on the intensity of reception by the photodiode or IR receiver, the output of the sensor will be defined.

## WORKING OF CIRCUIT

In this project, Infrared sensors are used for sensing the vehicle. As mentioned earlier, IR sensors have 2 parts: IR LED(Emitter) and IR Photodiode(Receiver).The emitter is IR Transmitter and detector is IR Receiver, these both are collectively called as photo-coupler or outo-coupler.

In IR sensor, the white led(IR LED) is emitter, which emits the infrared rays and the black led(IR photodiode) is a receiver, which senses the temperature and movement around.

When an object comes closer to the sensor, the infrared light from IR LED(IR Transmitter) emits radiations and this reaches the object and some of the radiations will be reflected back to the IR photodiode(IR Receiver).



Based on the intensity by IR receiver, the output of the sensor will be defined. Once the IR receiver receives infrared rays, the output of the IR sensor becomes 1. As the output of the IR sensor is connected to LED, so when the output is 1, the street light associated with respect to that sensor will switch ON and OFF.

This will be achieved by sensing an approaching vehicle and then switches "ON" for the block of street lights and switch "OFF" the trailing lights automatically, as the vehicle passes away. Thus we save a lot of energy by this system.

## Applications of IR Sensor

IR sensors are used in various projects and also in various electronic devices.

### Night Vision Devices



**FIG 5.13 Night Vision Devices**

An infrared technology, which is implemented in night vision devices, converts the ambient photons of light into electrons and it also amplifies them using electrical and chemical processes before converting them into visible light.

This technology is implemented in night vision equipment if there is no visible light available to see unaided.

## Radiation Thermometer



**FIG 5.14 Radiation Thermometer**

IR sensors used in the radiation thermometers help to measure the temperature depending on temperature and material of the object. These radiation thermometers have following features:

- Faster response
- Easy pattern measurements
- Measurements without direct contact with the object

### **Other Key Applications Areas:**

- Climatology
- Meteorology
- Flame Monitors
- Gas detectors
- Water analysis and gas analysers
- Petroleum exploration

## Advantages of IR Sensors

- Most of the electronic devices like telephones,laptops,PDA's use the IR sensors because of its low power requirements.
- In the presence or absence of light these IR sensors will be able to detect the motion.
- No contact required with the object for detection.
- Very low power consumption as of which the battery used will last longer.
- Due to point to point mode or line of sight mode of communication the sensors provide secured communication.
- They can measure the distance to the soft objects which cannot be easily detected by ultrasound.
- Very much affordable and also smaller in size.
- They provide good stability over the time.
- Neither oxidation nor corrosion will affect the accuracy of the sensor.
- High repeatability is delivered.
- Faster time response than a thermocouple.

## Disadvantages of IR Sensors

- Hard objects like dust,smoke,fog or sunlight might affect the infrared frequencies.
- It will not work through doors and walls.
- High power delivered by the infrared rays can easily damage the human eye.
- It can only control one device at a time in case of control and monitoring applications.
- It is very difficult to control the things that are not in the Line of Sight.
- Its performance gets degraded with longer distances.
- It only supports shorter range.
- It only supports the lower data transmission on comparison with the wired transmission.

## Advantages of Smart street light system

- Smart street light system contributes more to the livable cities by helping them improve safety and also reduces congestion.
- They very efficiently manage electricity which will lead to cost savings on comparison with the simple LED luminaries.
- There is also an increase in the revenue opportunities.
- Energy is saved without any compromise as per the standards.
- Wireless controlling and monitoring through the most reliable and cheapest GSM Technology.
- It has a Four mode Protection for a better management and also its updation is simple.
- It has a remote equipment test technology.
- Emergency ON and OFF through the control room itself.
- Total darkness can also be complained and will be attended by the control room.
- CMCS(Centralized Computer)can monitor the operating parameters and deal with their updation.

## Disadvantages of smart light system

- It has a very low luminous efficiency.
- Requirement of external power supply.
- Reduction in range of color temperatures.
- Heat emission is high.
- Battery must be replaced.
- Snow,rain,moisture,etc can get accumulated over the PV panels and hinder the energy production.
- Risk of theft.
- Little expensive based on the standard.

## CHAPTER 06

### RESULT AND DISCUSSION

This project for developing a smart street light system using IR sensors is being reviewed. The system is built in such a way that the lights turn ON when necessary and turn OFF when not required. Currently in the entire world, huge amounts of electrical energy is being consumed by the usage of street lights alone. So there is a huge wastage of energy on doing so.

So this system has to be slowly organised and developed in every country for the betterment of the scenario and to see vast change all over the world.

The targets of our development of this projects is as follows:

- Very easy extension and installation: Every single unit can easily be installed one after the other to the network by setting up all the parameters. It is distributed autonomously and host computer is not required.
- Low cost: Usage of only mass production parts.
- Easy Updation: Firmwares of each and every unit can be easily updated. Control algorithms have been developed based on the situations like shopping street, quiet residential areas, mountain roads and main roads.
- Self-diagnosis: These lights do not turn ON while the pedestrians pass by. Failures are being recorded by each unit where the motion is also detected without any advanced notification from the rest of the units.

## CHAPTER 7

# CONCLUSION AND FUTURE SCOPE

### CONCLUSION

The aim of our project was to develop a smart street light system which uses Infrared Sensors, which can be used to avoid manual operations for turning the street lights ON and OFF whenever necessary. In order to conserve the energy in a very efficient manner such system was being designed.

This proposed system is in accordance with the government's policy of conservation of energy by reducing unwanted consumption of power. It can also be termed as A innovative project in the street lights that can be implemented in national and state highways.

### FUTURE SCOPE

It can be further extended to two-way traffic system by using the GSM technology.

This project has a very good scope of improvement. In order to get more reliability many enhancements can also be done to keep it more interesting.

For example, when a person or a vehicle meet with an accident, the street light can be On so that the situation can quickly be communicated to the respective authorities for further actions.

The system can also be used to inform the respective technicians about the default.

All this will be managed and possible only through innovation, modernization, hardwork and last but very important is with advanced use of technology.



## THE GSM TECHNOLOGY IN SMART STREET LIGHTS



**FIG 7.1 GSM TECHNOLOGY**

We can build an intelligent system for controlling and monitoring of street lights using the Global System for Mobile Communication(GSM) technology.

The advancement in this system turns the lights ON and OFF depending on the pedestrian or the vehicle movement.

It makes use of light intensity and a real time clock at the same time.

It is mainly developed for increase in the efficiency and better performance.

One major advantage is that the system uses wireless communication.

This system can be introduced further as an extension to the one way traffic system for power saving and also more reliability.

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