CHAPTER 1

INTRODUCTION

1.1 Introduction

Street lighting is an essential public service that provides a safer environment at nighttime to commuters including pedestrians. Proper use of street lighting can be considered as a protective method which provides economic and social benefits to the people. There is a shortage of proper street lighting facilities in many areas in developing countries due to lack of financial resources. The lack of adequate light at night has given rise to poor living conditions and as such, street crimes, and other mishaps are commonplace.

The electrical energy consumption of street lighting constitutes an important part of total energy Consumption. Saving energy in street lamps is therefore important for total energy savings. It is known that street lighting levels are excessive in many cases. For instance, in the case of low traffic volumes, the lighting levels are excessive and could be reduced so that energy savings can be achieved. On the other hand, in specific situations and for traffic safety reasons, light levels should be increased even in the case of low traffic volume.

Undoubtedly, excellent street lighting would not only reduce the number of accidents on the roads, but they would also help the people with weak eyesight. These are the people who find it difficult to go outside their houses at nights. Solar urban LED street lighting is one such solution. Solar LED lights come with rechargeable batteries and are powered by the photovoltaic panels. These photovoltaic panels help in charging the batteries in the day time, and then they power the LED lamps to provide optimum light in the nights. Too much lighting can also cause problems. The lights can be customized to decrease the risk of accidents. But before doing that, it is always important to analyze the location and regular traffic.

Different type of light technology used in lighting design with their luminous efficiency, LED is consider a promising solution to modern street lighting system due to it is behavior and advantages

As emphasized in A part from that, the advantages of LED are likely to replace the traditional street lamps such as the incandescent lamp, fluorescent lamp and High pressure Sodium lamp.

The solar LEDs are cost effective, and they are designed to turn on and off automatically according to the lighting conditions. The lights are easy to maintain and very effective. Street lighting must not be ignored because it can lead to fatalities and loss of property as well. Having quality street lights does not only serve the purpose of safety in the urban areas, but they also have a huge impact on our standard of living. By auto intensity control of street lights we can save a lots of energy.

LED lights are the future of lighting, because of their low energy consumption and long life they Are fast replacing conventional lights world over Hence we used LEDs to control the intensity of light. The solar energy is mainly useful in solar street lights, auto solar irrigation system, traffic junction signal lighting etc.

1.2 Objectives:

1. To reduce the energy as our country faces energy crisis.

2. To compensate the growing energy demand by using renewable energy source as solar.

3. To reduce the energy cost.

4. To light the streets of rural areas where there is so many power cuts occurs.

5. To implement low power consumption, longevity, reliability our product.

1.3 Methodology:

1. Study about the solar.

2. Study about the theory of auto Intensity control of LED Street light.

3. Construction and performance of circuit.

1.4 Outline of this Report:

This report consists of five chapter. In first chapter, we discussed introduction and importance of solar and auto intensity control of LED street light. Whereas in chapter 2, we discussed more on Design and Construction that have been done. In chapter 3, the discussion will be on functional details of each equipment which used in our project. Cost analysis and cost comparison of my Well Equipped project are discussed in chapter 4. In chapter 5, we discussed advantage, disadvantage and application of this project. Chapter 6, the discussion will be on the project results and conclusions.

CHAPTER 2

EQUIPMENT'S

2.1 IR LED (Infrared Light Emitting Diode)

2.1.1 Introduction

An Infrared light emitting diode (IR LED) is a special purpose LED emitting infrared rays Ranging 700 nm to 1 mm wavelength. Different IR LEDs may produce infrared light of differing wavelengths, just like different LEDs produce light of different colors. IR LEDs are usually made of gallium arsenide or aluminum gallium arsenide. In complement with IR receivers, these are commonly used as sensors.

The appearance of IR LED is same as a common LED. Since the human eye cannot see the infrared radiations, it is not possible for a person to identify if an IR LED is working. A camera on a cell phone camera solves this problem. The IR rays from the IR LED in the circuit are shown in the camera.

2.1.2 Pin Diagram of IR LED

An IR LED is a type of diode or simple semiconductor. Electric current is allowed to flow in only one direction in diodes. As the current flows, electrons fall from one part of the diode into holes on another part. In order to fall into these holes, the electrons must shed energy in the form of photons, which produce light.

It is necessary to modulate the emission from IR diode to use it in electronic application to prevent spurious triggering. Modulation makes the signal from IR LED stand out above the noise. Infrared diodes have a package that is opaque to visible light but transparent to infrared. The massive use of IR LEDs in remote controls and safety alarm systems has drastically reduced the pricing of IR diodes in the market.

Figure: 2.1.1 IR LED (Infrared Light Emitting Diode)

2.1.3 IR sensor

An IR sensor is a device that detects IR radiation falling on it. Proximity sensors (used in touchscreen phones and edge avoiding robots), contrast sensors (used in line following robots) and obstruction counters/sensors (used for counting goods and in burglar alarms) are some applications involving IR sensors.

2.1.4 Principle of Working

An IR sensor consists of two parts, the emitter circuit and the receiver circuit. This is collectively known as a photo-coupler or an optocoupler. The emitter is an IR LED and the detector is an IR photodiode. The IR photodiode is sensitive to the IR light emitted by an IR LED. The photo-diode's resistance and output voltage change in proportion to the IR light received. This is the underlying working principle of the IR sensor. The type of incidence can be direct incidence or indirect incidence. In direct incidence, the IR LED is placed in front of a photodiode with no obstacle in between. In indirect incidence, both the diodes are placed side by side with an opaque object in front of the sensor. The light from the IR LED hits the opaque surface and reflects back to the photodiode.

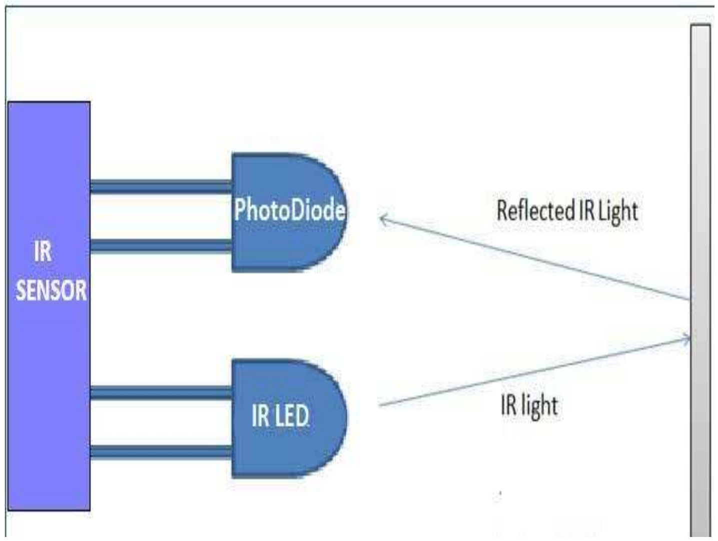


Figure: 2.1.4 working principle of IR LED

2.2 Photodiode:

2.2.1 Introduction

A photodiode is one type of light detector, used to convert the light into current or voltage based on the mode of operation of the device. It comprises of optical filters, built-in lenses and also surface areas. These diodes have a slow response time when the surface area of the photodiode increases. Photodiodes are alike to regular semiconductor diodes, but that they may be either visible to let light reach the delicate part of the device. Several diodes intended for use exactly as a photodiode will also use a PIN junction somewhat than the usual PN junction.

Figure: 2.2.1 Photodiode

2.2.2 Types of Photodiode

Although there are numerous types of photodiode available in the market and They All works on the same basic principles, though some are improved by other effects. The working of different types of photodiodes work in a slightly different way, but the basic operation of these diodes remains the same. The types of the photodiodes can be classified based on its construction and functions as follows.

- PN Photodiode
- Schottky Photo Diode
- PIN Photodiode
- Avalanche Photodiode

2.2.3 Working of Photodiode

The working principle of a photodiode is, when a photon of ample energy strikes the diode, it makes a couple of an electron-hole. This mechanism is also called as the inner photoelectric effect. If the absorption arises in the depletion region junction, then the carriers are removed from the junction by the inbuilt electric field of the depletion region. Therefore, holes in the region move toward the anode, and electrons move toward the cathode, and a photocurrent will be generated. The entire current through the diode is the sum of the absence of light and the photocurrent. So the absent current must be reduced to maximize the sensitivity of the device.

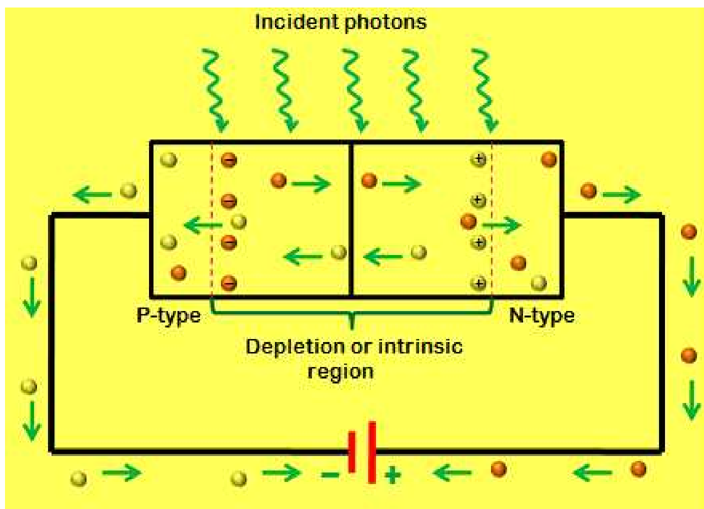


Figure: 2.2.3 PN junction diode

2.2.4 Modes of Operation

The operating modes of the photodiode include three modes, namely Photovoltaic mode, Photoconductive mode and avalanche diode mode.

Photovoltaic Mode: This mode is also known as zero bias mode, in which a voltage is produced by the lightened photodiode. It gives a very small dynamic range & non-linear necessity of the voltage formed.

Photoconductive Mode: The photodiode used in this photoconductive mode is more usually reverse biased. The reverse voltage application will increase the depletion layer's width, which in turn decreases the response time & the junction capacitance. This mode is too fast and displays electronic noise.

Avalanche Diode Mode: Avalanche diodes operate in a high reverse bias condition, which permits multiplication of an avalanche breakdown to each photo-produced electron-hole pair. This outcome in an internal gain in the photodiode, which slowly increases the device response.

2.2.5 Applications of Photodiode

The applications of photodiodes involve in similar applications of photo detectors like charge-coupled devices, photoconductors, and photomultiplier tubes.

These diodes are used in consumer electronics devices like smoke detectors, compact disc players, and televisions and remote controls in VCRs.

In other consumer devices like clock radios, camera light meters, and street lights, photoconductors are more frequently used rather than photodiodes.

Photodiodes are frequently used for exact measurement of the intensity of light in science & industry. Generally, they have an enhanced, more linear response than photoconductors.

Photodiodes are also widely used in numerous medical applications like instruments to analyze samples, detectors for computed tomography and also used in blood gas monitors.

These diodes are much faster & more complex than normal PN junction diodes and hence are frequently used for lighting regulation and in optical communications.

2.3 Resistor

2.3.1 Introduction

Resistor is electrical or electronic components which resist the flow of current across the resistor device. The resistance to current flow results in a voltage drop across the resistor device. Resistors are used extensively throughout electrical and electronic circuits.

Resistor devices may provide a fixed, variable, or adjustable value of resistance. Adjustable resistors are refers to as rheostats, or potentiometers. Resistor values are expressed in Ohms, the electric resistance unit. Resistors are incorporated within an electrical or electronic circuits create a known voltage drop or current to voltage relationship.

2.3.2 Symbol of Resistor

Resistor is a 2 terminal passive device. The symbol is given below.

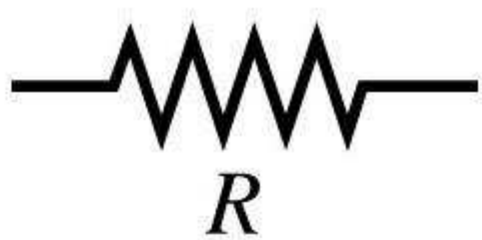


Fig 2.3.2: Symbol of resistor

2.3.3 Working of Resistor

The working of a resistor can be explained with the similarity of water flowing through a pipe. Consider a pipe through which water is allowed to flow. If the diameter of the pipe is reduced, the water flow will be reduced.

If the force of the water is increased by increasing the pressure, then the energy will be dissipated as heat. There will also be an enormous difference in pressure in the head and tail ends of the pipe. In this example, the force applied to the water is similar to the current flowing through the resistance. The pressure applied can be resembled to the voltage.

2.3.4 Color Code of Resistor

Black	0	0	0	1	-
Brown	1	1	1	10	±1%
Red	2	2	2	100	±2%
Orange	3	3	3	1000	-
Yellow	4	4	4	10 000	-
Green	5	5	5	100 000	±0.5%
Blue	6	6	6	1 000 000	±0.25%
Violet	7	7	7	10 000 000	±0.1%
Gray	8	8	8	100 000 000	±0.05%
White	9	9	9	1000 000 000	-
Gold				0.1	±5%
Silver				0.01	±10%
None					±20%

2.3.5 Types of resistors

The most commonly used resistors all look the same. They look like a small worm with colored stripes on the side. There are many types of resistors available.

1. Wire-wound Resistors

Consist of a cylindrical core which is wrapped or wound with wire. The cylindrical core is typically made from a ceramic, plastic, or fiberglass core material. The wire is a type of resistance wire, such as nickel chromium. Wire wound resistors are a type of power resistor and are accurate. Wire wound resistors are available as fixed, or adjustable to be used as a rheostat or potentiometer.

Typical applications for wire wound resistors include device requiring high current handling capability, heat dissipation and resistance stability and accuracy.

2. Carbon Film Resistors

A general class description for cylindrical resistors made by depositing a carbon film on the surface of a center core insulator.

3. Thin Film Resistors

A type of surface-mount film resistor with a relatively thin resistive element, measured in angstroms (millionths of an inch). Thin film resistors are made by sputtering (also known as vacuum deposition) a resistive material, such as nickel chromium or tantalum nitride, onto the surface of a substrate.

4. Thick Film Resistor

Specially built surface-mount film resistor that carries high power for the part size. For thick film resistors, a ruthenium oxide film or metal glaze film is applied using traditional screen-printing technology. These resistor film can be excellent high-voltage or high-power devices.

5. Carbon Composition Resistors

A type of resistor that consists of a clay, alumina, and carbon mixture that has been blended and pressurized into a resistive core and then covered with a molded outer insulating core.

6. Metal Film Resistors

This type of resistor is made by coating with nickel chromium [NiCr]. The process of making this resistor is similar to that of thin film resistors. The difference will be in the compounds used.

7. Fixed Resistors

A fixed resistor is one in which the value of its resistance cannot change.

8. Non-Linear Resistors

A non-linear resistor is a resistor that has resistances that vary significantly with applied voltage, Temperature or light. Types of non-linear resistors are varistors, thermistors and photo resistors.

2.3.6 Uses of Resistors

Though resistors can cause wastage of electricity, it has a lot of advantages and applications in our daily life.

- Resistance is one of the main ingredient in the working of a light bulb. When electricity passes through the filament of the bulb, it burns bright as it turns extremely hot due to its smaller size. Though this mechanism wastes a lot of electricity, we are forced to use it to obtain light. The light used nowadays are highly efficient than the older incandescent lamps.

- The similar filament working is the main ingredient in the working of some of our usual household stuffs like electric kettles, electric radiators, electric showers, coffee makers, toasters, and so on.

- The application of variable resistance is also helpful to us. Our TV's, radios, loud speakers and so on work on this principle.

2.4 Capacitor

2.4.1 Introduction

The capacitor is a passive component and it stores the electrical energy into an electrical field. The effect of the capacitor is known as a capacitance. It is made up of two close conductors and separated by the dielectric material. If the plates are connected to the power, then the plates accumulate the electric charge. One plate accumulates the positive charge and another plate accumulates the negative charge. The electric symbol of the capacitor is shown below.

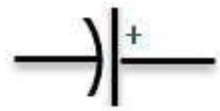


Fig 2.4.1: Capacitor Symbol

2.4.2 Different Types of Capacitors

1. Electrolytic Capacitor:

Generally, the electrolyte capacitors are used when the large capacitor values are required. The thin metal film layer is used for one electrode and for the second electrode (cathode) a semi-liquid electrolyte solution which is in jelly or paste is used. The dielectric plate is a thin layer of oxide, it is developed electrochemically in production with the thickness of the film and it is less than the ten microns.

Fig 2.4.2: Electrolytic Capacitor

This insulating layer is very thin, it is possible to make capacitors with a large value of capacitance for a physical size, which is in small and the distance between the two plates is very small. The types of capacitors in the majority of electrolytic are polarized, which is DC voltage is applied to the capacitor terminal and they must be correct polarity. If the positive to the positive terminal and the negative to the negative terminal as an incorrect polarization will break the insulating oxide layer and there will be permanent damage.

2. Mica Capacitor:

This capacitor is a group of natural minerals and the silver mica capacitors use the dielectric. There are two types of mica capacitors which are clamped capacitors & silver mica capacitor. Clamped mica capacitors are considered as an obsolete because of their inferior characteristic. The silver mica capacitors are prepared by sandwiching mica sheet coated with metal on both sides and this assembly is then encased in epoxy to protect the environment. The mica capacitors are used in the design calls for stable, reliable capacitor of relatively small.

Fig 2.4.3: Mica Capacitor

The mica capacitors are the low loss capacitors, used at high frequencies and this capacitor is very stable chemically, electrically, and mechanically, because of its specific crystalline structure binding & it is a typically layered structure. The most common used are Muscovite and phlogopite mica. The Muscovite mica is better in the electrical properties and the other Mica has a high-temperature resistance.

3. Paper Capacitor:

The construction of paper capacitor is between the two tin foil sheet and they are separated from the paper, or, oiled paper & thin waxed. The sandwich of the thin foils and papers then rolled into the cylindrical shape and then it is enclosed into the plastic capsule. The two thin foils of the paper capacitors attach to the external load.

Fig 2.4.4: Paper Capacitor

In the initial stage if the capacitors the paper was used in between the two foils of the capacitor, but these days the other materials like plastics are used, therefore it is called as a paper capacitor. The capacitance range of the paper capacitor is from 0.001 to 2.000micro farad and the voltage is very high which is up to 2000V.

4. Film Capacitor:

The film capacitors are also capacitors and they use a thin plastic as the dielectric. The film capacitor is prepared extremely thin using the sophisticated film drawing process. If the film is manufactured, it may be metalized depend on the properties of a capacitor. To protect from the environmental factor, the electrodes are added and they are assembled.

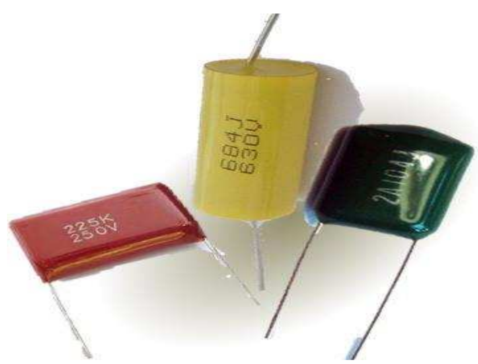


Fig2.4.5: Film Capacitor

There are different types of film capacitors are available like polyester film, metallized film, polypropylene film, PTE film and polystyrene film.

5. Non-Polarized Capacitors:

The non-polarized capacitors are classified into two types plastic foil capacitor and the other one is the electrolytic non-polarized capacitor.

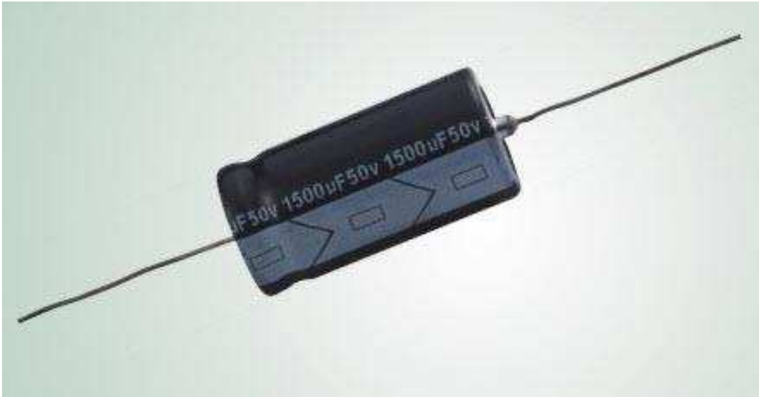


Fig2.4.6: Non-Polarized Capacitors

The examples are the speaker crossover filters and power factor correction network. In these two applications, a large AC voltage signal is applied across the capacitor.

6. Ceramic Capacitor:

The ceramic capacitors are the capacitors and use the ceramic material as a dielectric. The ceramics are one of the first materials to use in the production of capacitors as an insulator.

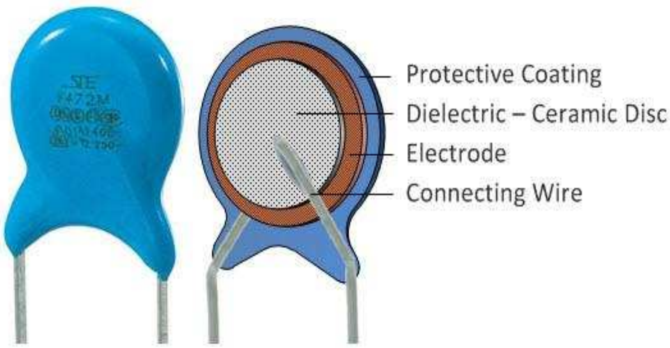


Fig2.4.7: Ceramic Capacitor

There are many geometries are used in the ceramic capacitors and some of them are the ceramic tubular capacitor, barrier layer capacitors are obsolete because of their size, parasitic effects or electrical characteristics. The two common types of ceramic capacitors are multilayer ceramic capacitor (MLCC) and ceramic disc capacitor.

2.4.3 Uses of Capacitors

Capacitors are used commonly and useful as an electronic component in the modern circuits and devices. The capacitor has a long history and usage with more than 250 years ago the capacitors are the oldest electronic component being studied, designed, developed and used. With further technology, the capacitors are come up with different types based on their factors.

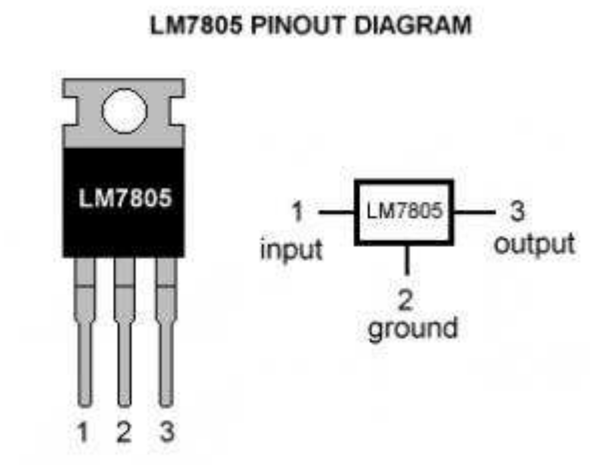
In this article, we are discussing the most popular and most useful types of capacitors. The capacitor is a component and it has the ability to store energy in the form of electrical charge produces the electrical difference across its plates and it is like a small rechargeable battery.

2.5 IC 7805

Voltage sources in a circuit may have fluctuations resulting in not giving fixed voltage outputs. Voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a voltage regulator integrated circuit (IC) is a member of 78xx series of fixed linear voltage regulator ICs used to maintain such fluctuations.

The xx in 78xx indicates the fixed output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add heat sink as well. Let’s look into some of the basic ratings to get an overview.

2.5.1 7805 IC Rating



- Input voltage range 7V- 35V
- Current rating Ic = 1A
- Output voltage range   VMax=5.2V, VMin=4.8V

2.5.2 Pin Details of 7805 IC

PIN 1-INPUT

The function of this pin is to give the input voltage. It should be in the range of 7V to 35V. The unregulated voltage is given to this pin for regulation. For 7.2V input, maximum efficiency can be achieved.

PIN 2-GROUND

The ground is given to this pin. For output and input, this pin is equally neutral (0V).

PIN 3-OUTPUT

This pin is used to take the regulated output. It will be 5V (4.8V-5.2V) the difference between the input and output voltage appears as heat. The greater the difference between the input and output voltage, the more heat is generated. If too much heat is generated, through high input voltage, the regulator can overheat.

If the regulator does not have a heat sink to dissipate this heat, it can be destroyed and malfunction. Hence, it is advisable to limit the voltage to a maximum of 2-3 volts higher than the output voltage. So the two options are, design your circuit so that the input voltage going into the regulator is limited to 2-3 volts above the output regulated voltage or place an appropriate heat sink,that can efficiently dissipate heat.

2.6 Light Emitting Diode (LED)

2.6.1 Introduction

The lighting emitting diode is a p-n junction diode. It is a specially doped diode and made up of a special type of semiconductors. When the light emits in the forward biased, then it is called as a light emitting diode.

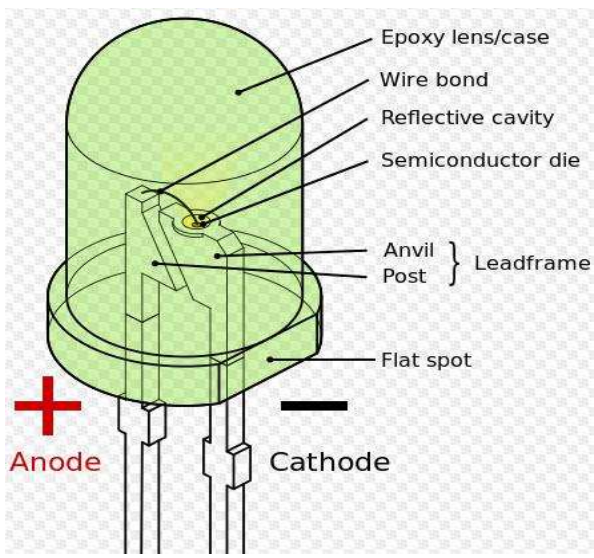


Fig 2.6.1: Light Emitting Diode

2.6.2 Working Principle of LED

The light emitting diode simply, we know as a diode. When the diode is forward biased, then the electrons & holes are moving fast across the junction and they are combining constantly, removing one another out.

Soon after the electrons are moving from the n-type to the p-type silicon, it combines with the holes, then it disappears. Hence it makes the complete atom & more stable and it gives the little burst of energy in the form of a tiny packet or photon of light.

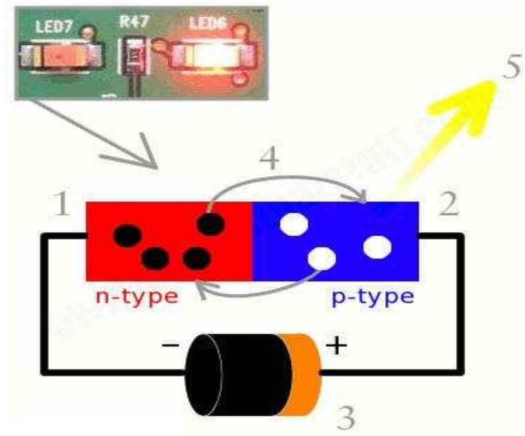


Fig 2.6.2: Working of Light Emitting Diode

The above diagram shows how the light emitting diode works and the step by step process of the diagram.

- From the diagram, we can observe that the N-type silicon is in red color and it contains the electrons, they are indicated by the black circles.
- The P- type silicon is in the blue color and it contains holes, they are indicated by the white circles.
- The power supply across the p-n junction makes the diode forward biased and pushing the electrons from n-type to p-type. Pushing the holes in the opposite direction.
- Electron and holes at the junction are combined.
- The photons are given off as the electrons and holes are recombined.

2.6.3 Types of Light Emitting Diodes

There are different types of light emitting diodes present and some of them are mentioned below.

- Gallium Arsenide (GaAs) – infra-red

- Gallium Arsenide Phosphide (GaAsP) – red to infra-red, orange
- Aluminium Gallium Arsenide Phosphide (AlGaAsP) – high-brightness red, orange-red, orange, and yellow
- Gallium Phosphide (GaP) – red, yellow and green
- Aluminium Gallium Phosphide (AlGaP) – green
- Gallium Nitride (GaN) – green, emerald green
- Gallium Indium Nitride (GaInN) – near ultraviolet, bluish-green and blue
- Silicon Carbide (SiC) – blue as a substrate
- Zinc Selenide (ZnSe) – blue
- Aluminium Gallium Nitride (AlGaN) – ultraviolet

2.6.4 LED Working Principle

A Led consists of two semiconducting materials p-type material and n-type material. By connecting these two types of materials, a p-n junction forms. When p-n junction is forward biased, the majority carriers either electrons or holes start moving across the junction. As shown in the figure above, the electrons start moving from the n region and the holes start moving from the p region.

When they moved from their regions they start to recombine across the depletion region. Free electrons will remain in the conduction band of energy level while holes remain in the valence band of energy level. The Energy level of the electrons is high than holes because electrons are more mobile than holes i.e. current conduction due to electrons are more. During the recombination of electrons and holes, some portion of energy must be dissipated or emitted in the form of heat and light.

The phenomenon into which light emitted from the semiconductor under the influence of electric field is known as electroluminescence. Always remember that the majority of light is produced from the junction nearer to the p-type region. So diode designing is done in such a way that this area is kept as close to the surface of the device to ensure that the minimum amount of light is absorbed.

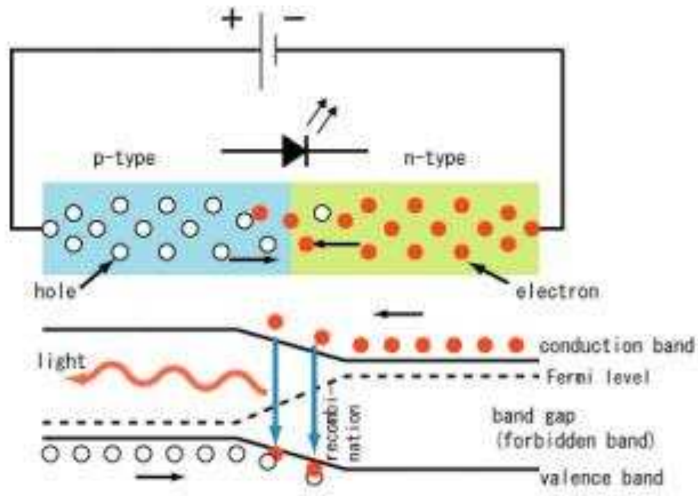


Fig 2.6.4: Working Principle of LED

The electrons dissipate energy in different forms depends on the nature of the diode used. Like for silicon and germanium diodes it dissipates energy in the form of heat and for gallium phosphide (GaP) and gallium arsenide phosphide (GaAsP) semiconductors, it dissipates energy by emitting photons. For the emission of different colors different semiconductors are used like phosphorus for a red light, gallium phosphide for green light and aluminum indium gallium phosphide for yellow and orange light.

2.6.5 I-V Characteristics of LED

There are different types of light emitting diodes are available in the market and there are different LED characteristics which include the color light, or wavelength radiation, light intensity. The important characteristic of the LED is color.

In the starting use of LED, there is the only red color. As the use of LED is increased with the help of the semiconductor process and doing the research on the new metals for LED, the different colors were formed.

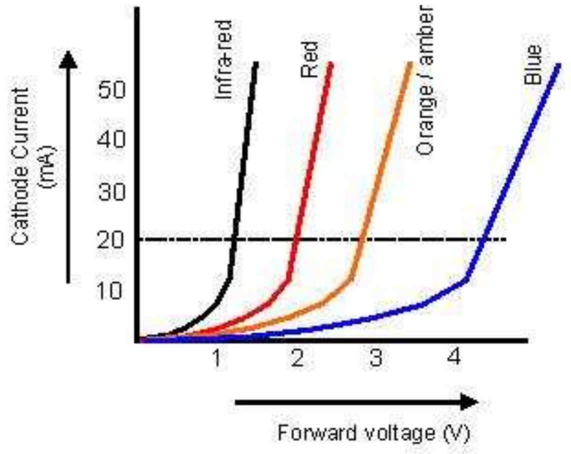


Fig 2.6.5: I-V Characteristics of LED

The following graph shows the approximate curves between the forward voltage and the current. Each curve in the graph indicates the different color.

2.6.6 Advantages of LED lights

Easily controlled and programmed.

Large Life span.

High efficiency.

Low radiated heat.

High levels of brightness and intensity.

High reliability.

Low voltage and current requirements.

Less wiring required.

Low maintenance cost.

Instant lightning.

The intensity of the LED differs with the help of the microcontroller.

2.7 Relay

2.7.1 Introduction

A relay is an electrically operated switch**.** Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have double throw (changeover) switch contacts as shown in the diagram.

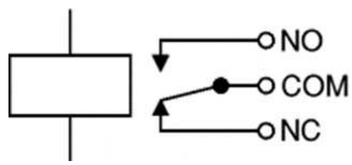


Figure 2.7.1 Circuit symbol of Relays

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical.

2.7.2 How Relays Work

Relays are switches that open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit. As relay diagrams show, when a relay contact is normally open (NO), there is an open contact when the relay is not energized. When a relay contact is Normally Closed (NC), there is a closed contact when the relay is not energized. In either case, applying electrical current to the contacts will change their state. Relays are generally used to switch smaller currents in a control circuit and do not usually control power consuming devices except for small motors and Solenoids that draw low amps. Nonetheless, relays can "control" larger voltages and amperes by having an amplifying effect because a small voltage applied to a relays coil can result in a large voltage being switched by the contacts.

Protective relays can prevent equipment damage by detecting electrical abnormalities, including overcurrent, undercurrent, overloads and reverse currents. In addition, relays are also widely used to switch starting coils, heating elements, pilot lights and audible alarms.

2.7.3 Advantages of relays:

1. Relays can switch AC and DC, transistors can only switch DC.

2. Relays can switch higher voltages than standard transistors.

3. Relays are often a better choice for switching large currents (> 5A).

4. Relays can switch many contacts at once.

Disadvantages of relays:

1. Relays are bulkier than transistors for switching small currents.

2. Relays cannot switch rapidly, transistors can switch many times per second.

3. Relays use more power due to the current flowing through their coil.

4. Relays require more current than many ICs can provide, so a low power transistor may be needed to switch the current for the relay's coil.

2.8 Battery

2.8.1 Introduction

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved additionally to include devices composed of a single cell.

2.8.2 Working principle of battery

Electricity, as you probably already know, is the flow of electrons through a conductive path like a wire. This path is called a circuit.

Batteries have three parts, an anode (-), a cathode (+), and the electrolyte. The cathode and anode (the positive and negative sides at either end of a traditional battery) are hooked up to an electrical circuit.

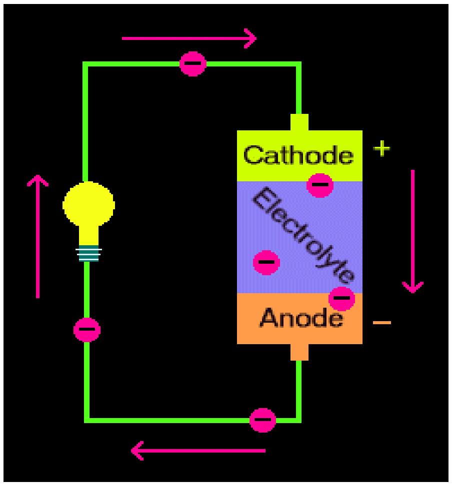


Figure 2.8.2 working principle of battery

The chemical reactions in the battery causes a buildup of electrons at the anode. This results in an electrical difference between the anode and the cathode. You can think of this difference as an unstable build-up of the electrons. The electrons wants to rearrange themselves to get rid of this difference. But they do this in a certain way. Electrons repel each other and try to go to a place with fewer electrons.

In a battery, the only place to go is to the cathode. But, the electrolyte keeps the electrons from going straight from the anode to the cathode within the battery. When the circuit is closed (a wire connects the cathode and the anode) the electrons will be able to get to the cathode. In the picture above, the electrons go through the wire, lighting the light bulb along the way. This is one way of describing how electrical potential causes electrons to flow through the circuit.

However, these electrochemical processes change the chemicals in anode and cathode to make them stop supplying electrons. So there is a limited amount of power available in a battery.

When someone recharge battery, then change the direction of the flow of electrons using another power source, such as solar panels. The electrochemical processes happen in reverse, and the anode and cathode are restored to their original state and can again provide full power.

2.8.3 Store energy in a battery

A battery for the purposes of this explanation will be a device that can store energy in a chemical form and convert that stored chemical energy into electrical energy when needed.

Energy cannot be created or destroyed, but it can be saved in various forms. One way to store it is in the form of chemical energy in a battery. When connected in a circuit, energy stored in the battery is released to produce electricity.

In a solar panel, Solar panels cannot produce energy at night or during cloudy periods. But rechargeable batteries can store electricity: the photovoltaic panels charge the battery during the day, and this power can be drawn upon in the evening.

2.9 Solar panel

2.9.1 Introduction

Solar panels are devices that convert light into electricity. They are called "solar" panels because most of the time, the most powerful source of light available is the Sun, called Sol by astronomers. Some scientists call them photovoltaics which means, basically, "light-electricity."

Figure 2.9.1 Solar panel

A solar panel is a collection of solar cells. Lots of small solar cells spread over a large area can work together to provide enough power to be useful. The more light that hits a cell, the more electricity it produces, so spacecraft are usually designed with solar panels that can always be pointed at the Sun even as the rest of the body of the spacecraft moves around, much as a tank turret can be aimed independently of where the tank is going. DS1's solar cells are even more efficient than regular solar panels made for satellites because they use solar concentrators.

The solar panels are made of solar cells. A cell is a small disk of a semiconductor like silicon. They are attached by wire to a circuit. As light strikes the semiconductor, light is converted into electricity that flows through the circuit. As soon as the light is removed, the solar cell stops producing.

2.9.2 Theory and Construction

Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. The majority of modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can either be the top layer or the back layer. Cells must also be protected from mechanical damage and moisture. Most modules are rigid, but semi-flexible ones are available, based on thin-film cells. The cells must be connected electrically in series, one to another. Externally, most of photovoltaic modules use MC4connectors type to facilitate easy weatherproof connections to the rest of the system.

Modules electrical connections are made in series to achieve a desired output voltage and/or in parallel to provide a desired current capability. The conducting wires that take the current off the modules may contain silver, copper or other non-magnetic conductive transition metals. Bypass diodes may be incorporated or used externally, in case of partial module shading, to maximize the output of module sections still illuminated.

Some special solar PV modules include concentrators in which light is focused by lenses or mirrors onto smaller cells. This enables the use of cells with a high cost per unit area (such as gallium arsenide) in a cost-effective way.

2.9.3 Working principle of solar panel

A solar concentrator uses lenses, called Fresnel lenses, which take a large area of sunlight and direct it towards a specific spot by bending the rays of light and focusing them. Some people the same principle when they use a magnifying lens to focus the Sun's rays on a pile of kindling or paper to start fires.

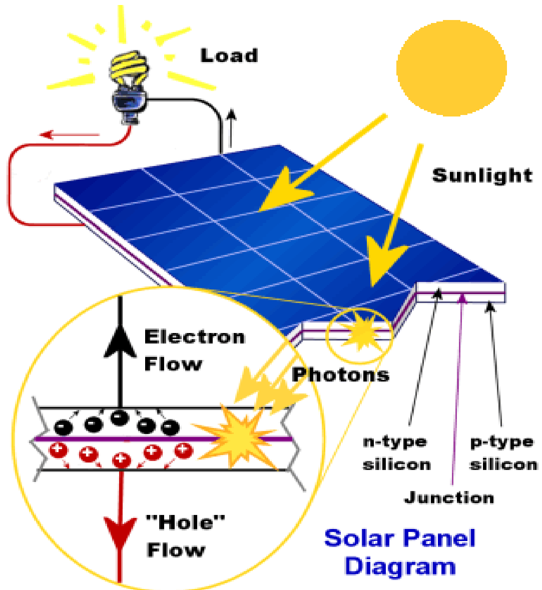


Figure: 2.9.3 working principle of Fresnel lenses

Fresnel lenses are shaped like a dart board, with concentric rings of prisms around a lens that's a magnifying glass. All of these features let them focus scattered light from the Sun into a tight beam.

Solar concentrators put one of these lenses on top of every solar cell. This makes much more focused light come to each solar cell, making the cells vastly more efficient. Concentrators work best when there is a single source of light and the concentrator can be pointed right at it. This is ideal in space, where the Sun is a single light source.

The solar concentrators also have the advantage that the solar cells can be spaced farther apart since light can be focused on each cell. This means fewer solar cells need to be made and the panels cost less to construct. In addition, engineers can now put thick glass or plastic over the solar panel to protect it from micrometorites, something they would have a hard time doing if they had to worry about allowing enough light to reach the solar cells. Fresnel lenses have been around since Augustin Jean Fresnel invented them in 1822. Theaters use them for spotlights and lighthouses use them to make their lights visible at greater distances.

2.9.4 Efficiency

Depending on construction, photovoltaic modules can produce electricity from a range of frequencies of light, but usually cannot cover the entire solar range. Hence, much of the incident sunlight energy is wasted by solar modules, and they can give far higher efficiencies if illuminated with monochromatic light. Therefore, another design concept is to split the light into different wavelength ranges and direct the beams onto different cells tuned to those ranges. This has been projected to be capable of raising efficiency by 50%. Scientists from Spectrolab, a subsidiary of Boeing, have reported development of multi-junction solar cells with an efficiency of more than 40%, a new world record for solar photovoltaic cells. The Spectrolab scientists also predict that concentrator solar cells could achieve efficiencies of more than 45% or even 50% in the future, with theoretical efficiencies being about 58% in cells with more than three junctions.

Efficiencies of solar panel can be calculated by MPP (maximum power point) value of solar panels. Solar inverters convert the DC power to AC power by performing MPPT process: solar inverter samples the output Power (I-V curve) from the solar cell and applies the proper resistance (load) to solar cells to obtain maximum power. MPP of the solar panel consists of MPP voltage and MPP current.it is a capacity of the solar panel and the higher value can make higher MPP.

Table 2: Daily Average of Bright Sunshine Hours at Dhaka City

Month	Daily Mean	Maximum	Minimum
January	8.7	9.9	7.5
February	9.1	10.7	7.7
March	8.8	10.1	7.5
April	8.9	10.2	7.8
May	8.2	9.7	5.7
June	4.9	7.3	3.8
July	5.1	6.7	2.6
August	5.8	7.1	4.1
September	6.0	8.5	4.8
October	7.6	9.2	6.5
November	8.6	9.9	7.0
December	8.9	10.2	7.4
Average	7.55	9.13	6.03

2.9.5 Performance & Degradation

Module performance is generally rated under standard test conditions (STC): irradiance of 1,000 W/m^2, solar spectrum of AM 1.5 and module temperature at 25°C.

Electrical characteristics include nominal power (P_{MAX}, measured in W), open circuit voltage (V_{OC}), short circuit current (I_{SC}, measured in amperes), maximum power voltage (V_{MPP}), maximum power current (I_{MPP}), peak power, (watt-peak, W_p), and module efficiency (%).

Nominal voltage refers to the voltage of the battery that the module is best suited to charge; this is a leftover term from the days when solar modules were only used to charge batteries. The actual voltage output of the module changes as lighting, temperature and load conditions change, so there is never one specific voltage at which the module operates. Nominal voltage allows users, at a glance, to make sure the module is compatible with a given system.

Open circuit voltage or V_{OC} is the maximum voltage that the module can produce when not connected to an electrical circuit or system. V_{OC} can be measured with a voltmeter directly on an illuminated module's terminals or on its disconnected cable.

2.9.6 Maintenance

Solar panel conversion efficiency, typically in the 20% range, is reduced by dust, grime, pollen, and other particulates that accumulate on the solar panel. "A dirty solar panel can reduce its power capabilities by up to 30% in high dust/pollen or desert areas", says Seamus Curran, associate professor of physics at the University of Houston and director of the Institute for Nano Energy, which specializes in the design, engineering, and assembly of nanostructures.

Paying to have solar panels cleaned is often not a good investment; researchers found panels that hadn't been cleaned, or rained on, for 145 days during a summer drought in California, lost only 7.4% of their efficiency. Overall, for a typical residential solar system of 5 kW, washing panels halfway through the summer would translate into a mere $20 gain in electricity production until the summer drought ends—in about 2 ½ months. For larger commercial rooftop systems, the financial losses are bigger but still rarely enough to warrant the cost of washing the panels. On average, panels lost a little less than 0.05% of their overall efficiency per day.

2.9.7 Electricity Crisis in Bangladesh

In Bangladesh, the serious demand-supply gap of electricity is one of the largest bottlenecks for economic growth. As the capacity of power supply facilities is only around 4,000 MW compared to the peak electricity demand of 6,100 MW, they have no choice but to have scheduled load-shedding of electricity supply during the peak time (JICA, 2010). Bangladesh is losing at least 3.5% of Gross Domestic product (GDP) due to the shortage of Power supply according to a research report of Centre for Policy Dialogue (CPD) (Ahmed, R., 2010)

In summary the present power scenario of Bangladesh is (Source: Rahman, M. M., 2009):

Key Facts:

80 Million People do not have access to electricity

Rest 60 Million are getting unreliable power

Load shed up to 1500 MW during hot summer days

Installed Capacity:

5450 MW (Jan 01, 2009)

BPDB: 3809 MW

IPP: 1641 MW

Demand and Supply:

Peak Demand: 6000 MW (Summer 2009) Generation Capacity: 4500 MW (Summer 2009) Load Shedding: 1000-1500 MW (Summer 2009) Per Capita Consumption of Electricity: 149 kWh / annum (FY 2008) Access to Electricity: 45% (FY 2008).

2.9.8 Applications

There are many practical applications for the use of solar panels or photovoltaics. It can first be used in agriculture as a power source for irrigation. In health care solar panels can be used to refrigerate medical supplies. It can also be used for infrastructure. PV modules are used in photovoltaic systems and include a large variety of electric devices:

Photovoltaic power stations

Rooftop solar PV systems

Standalone PV systems

Solar hybrid power systems

Concentrated photovoltaic

Solar planes

Solar-pumped lasers

Solar vehicles

Solar panels on space crafts and space stations.

2.10 Diode 1n4007

2.10.1 Introduction

A rectifier diode is used as a one-way check valve. Since these diodes only allow electrical current to flow in one direction, they are used to convert AC power into DC power. When constructing a rectifier, it is important to choose the correct diode for the job; otherwise, the circuit may become damaged. Luckily, a 1N4007 diode is electrically compatible with other rectifier diodes, and can be used as a replacement for any diode in the 1N400x family.

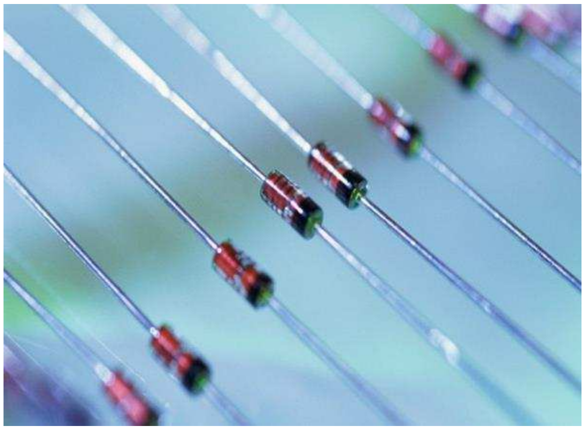


Figure 2.10.1 Diode 1n4007

2.10.2 Features

Case: Epoxy, Molded

Weight: 0.4 gram (approximately)

Finish: All External Surfaces Corrosion Resistant and Terminal Leads are Readily Solderable

Lead and Mounting Surface Temperature for Soldering Purposes: 260 C Max. For 10 Seconds, 1/16 from case

Shipped in plastic bags, 1000 per bag.

Available Tape and Reeled, 5000 per reel, by adding a "RL" suffix to the part number

Available in Fan-Fold Packaging, 3000 per box, by adding a "FF" suffix to the part number

Polarity: Cathode Indicated by Polarity Band

Marking: 1N4001, 1N4002, 1N4003, 1N4004, 1N4005, 1N4006, 1N4007

Pb-Free Packages are Available

2.10.3 Characteristics of 1N4007 diode

- Maximum Recurrent Peak Reverse Voltage - 1000 V
- Maximum Average Forward Output Current - 1 A
- Maximum Forward Voltage Drop per element at 1.0A DC - 1.1 V
- Typical Junction Capacitance 15 pF
- Package - DO-41
- Weight 0.33 grams
- Operating and Storage Temperature Range -65...+175 °C

2.10.4 Polarity & Pin out

1N4007 diode has a cathode (-) and anode (+). In the schematic symbol, the tip of the triangle with the line on top of it is the cathode. The cathode is marked on the body of a diode by a band as shown below.

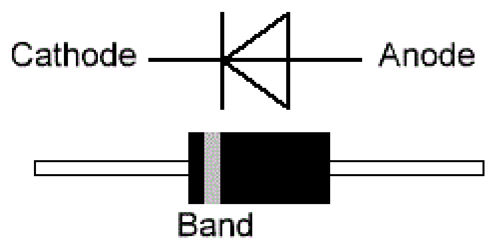


Figure: 2.10.3 Circuit symbol of diode 1N4007

Diode polarity Current can flow from the anode to the cathode only and never from the cathode to the anode - 1N4007 diode is like a one way valve.

2.11 Arduino Pro min:

2.11.1 Introduction

The Arduino Mini Pro 05 is a small microcontroller board originally based on the ATmega168, but now supplied with the 328.Intended for use on breadboards and when space is at a premium. It has 14 digital inputs/output pins (of which 6 can be used as PWM outputs), 8 analog inputs, and a 16 MHZ crystal oscillator. It can be programmed with the USB serial adapter or other USB or RS232 to TTL serial adapter.

The new Mini (revision 05) has a new package for the ATmega328, which enables all components to be on the top of the board. It also has an on board reset button. The new version has the same pin configuration as revision 04.

Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control the physical world.

The first Arduino was introduced in 2005, aiming to provide an inexpensive and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

Arduino boards are available commercially in preassembled form, or as do it yourself kits. The hardware design specifications are openly available, allowing the Arduino boards to be manufactured by anyone. Ad fruit Industries estimated in mid-2011 that over 300,000 official Arduinos has been commercially produced, and in 2013 that 700,000 official boards were in user's hands. The Arduino Mini is a very compact version of the Arduino Nano without an on board USB to serial connection.

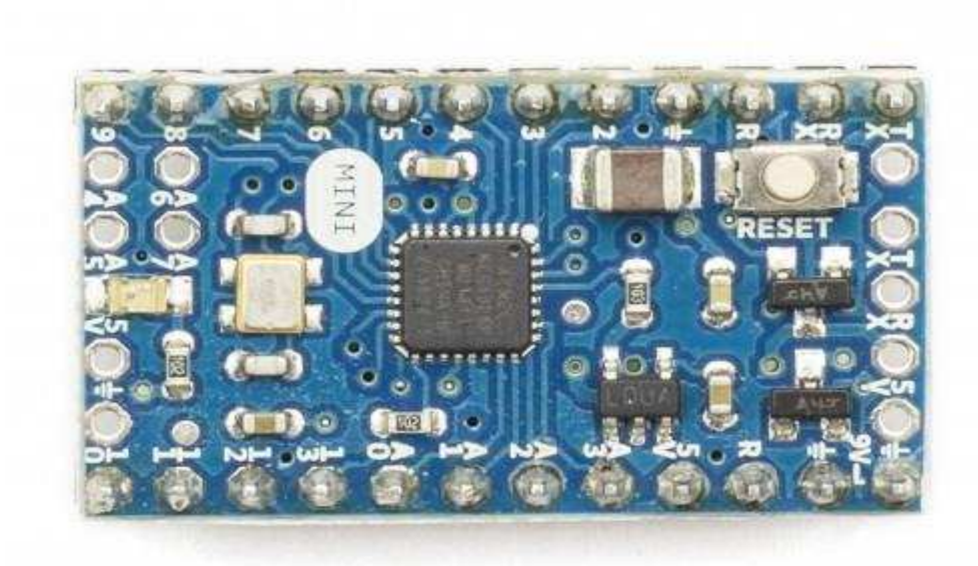


Figure: 2.11.1 Arduino pro min 05

2.11.2 Configuration

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage	7-9 V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	8 (of which 4 are broken out onto pins)
DC Current per I/O Pin	40 mA
Flash Memory	32 KB (of which 2 KB used by boot loader)
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz
Length	30 mm
Width	18 mm

2.11.3 Programming

The Arduino Mini can be programmed with the Arduino software. To program the Arduino Mini, it will be need a USB Serial adapter or other USB or RS232 to TTL serial adapter. The ATmega328 on the Arduino Mini comes pre burned with a boot loader that allows to upload new code to it without the use of an in-system-programmer. The boot loader communicates using the original STK500 protocol (reference, C header files). It can also bypass the boot loader and program the ATmega328 with ICSP (In-Circuit Serial Programming). Boot loading the Mini for information on wiring up an ICSP header to the Mini and the programmer for instructions on using a programmer to upload a sketch.

2.11.4 Input and Output

Each of the 14 digital pins on the Mini can be used as an input or output. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 k Ohms. Pins 3, 5, 6, 9, 10, and 11 can provide PWM output. If anything besides the Mini USB (or other) adapter is connected to pins 0 and 1, it will interfere with the USB communication, preventing new code from being uploaded or other communication with the computer. The Mini has 8 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). Inputs 0 to 3 are broken out onto pins; input 4 to 7 require soldering into the provided holes. By default the analog inputs measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and some low-level code.

2.11.5 Pin Configurations

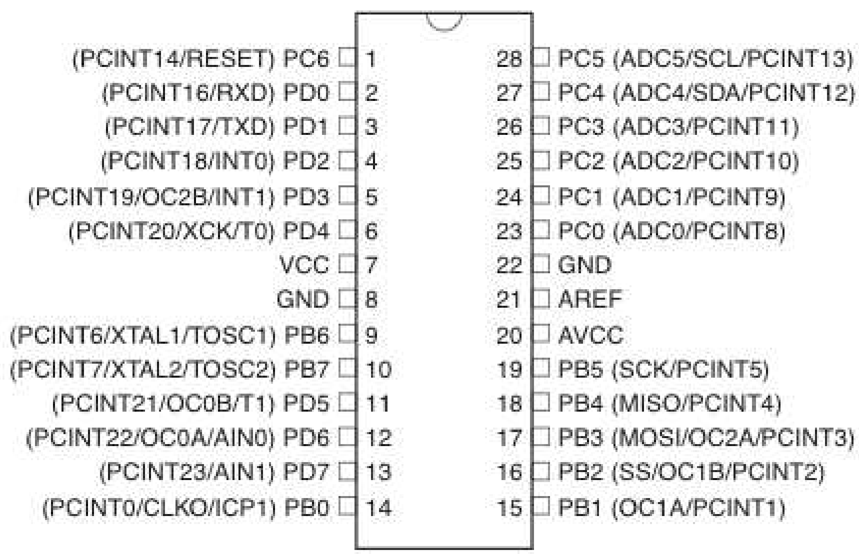


Figure 2.11.5 Pinout ATmega48A/PA/88A/PA/168A/PA/328/P

Table 2.1. 32UFBGA – Pin out ATmega48A/48PA/88A/88PA/168A/168PA

	1	2	3	4	5	6
A	PD2	PD1	PC6	PC4	PC2	PC1
B	PD3	PD4	PD0	PC5	PC3	PC0
C	GND	GND			ADC7	GND
D	VDD	VDD			AREF	ADC6
E	PB6	PD6	PB0	PB2	AVDD	PB5
F	PB7	PD5	PD7	PB1	PB3	PB4

2.11.6 Overview

The ATmega48A/PA/88A/PA/168A/PA/328/P is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega48A/PA/88A/PA/168A/PA/328/P achieves throughputs approaching 1 MIPS per MHz allowing the system Designer to optimize power consumption versus processing speed.

2.11.7 Block Diagram

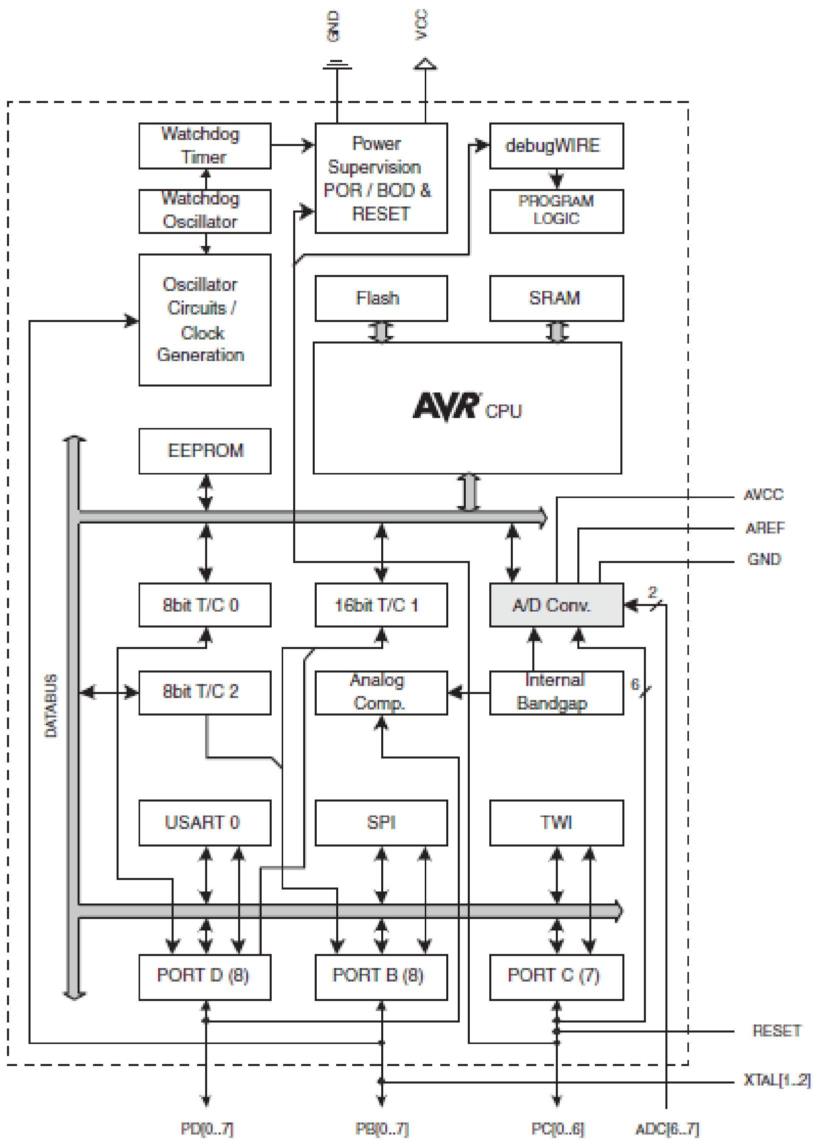


Figure no 2.11.7

The AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in one single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten times faster than conventional CISC microcontrollers.

The ATmega48A/PA/88A/PA/168A/PA/328/P provides the following features: 4K/8Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 256/512/512/1Kbytes EEPROM, 512/1K/1K/2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible Timer/Counters with compare modes, internal and external interrupts, a serial programmable USART, a byte-oriented 2-wire Serial Interface, an SPI serial port, a 6-channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages), a programmable Watchdog Timer with internal Oscillator, and five software selectable power saving modes. The Idle mode stops the CPU while allowing the SRAM, Timer/Counters, USART, 2-wire Serial Interface, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping. The ADC Noise Reduction mode stops the CPU and all I/O modules except asynchronous timer and

ADC, to minimize switching noise during ADC conversions. In Standby mode, the crystal/resonator Oscillator is running while the rest of the device is sleeping. This allows very fast start-up combined with low power consumption. Atmel offers the Q Touch library for embedding capacitive touch buttons, sliders and wheels functionality into AVR microcontrollers. The patented charge-transfer signal acquisition offers robust sensing and includes fully de bounced reporting of touch keys and includes Adjacent Key Suppression technology for unambiguous detection of key events. The easy-to-use Q Touch Suite tool chain allows you to explore, develop and debug your own touch applications.

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip Boot program running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation. By

combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega48A/PA/88A/PA/168A/PA/328/P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications.
The ATmega48A/PA/88A/PA/168A/PA/328/P AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, program Debugger/Simulators, In-Circuit Emulators, and Evaluation kits.

2.12 Transistor 2n2222A

2.12.1 Introduction

The 2N2222 is a common NPN bipolar junction transistor (BJT) used for general purpose low-power amplifying or switching applications. It is designed for low to medium current, low power, medium voltage, and can operate at moderately high speeds. It was originally made in the TO-18 metal can as shown in the picture.

The 2N2222 is considered a very common transistor, and is used as an exemplar of an NPN transistor. It is frequently used as a small-signal transistor, and it remains a small general purpose transistor of enduring popularity.

The 2N2222 was part of a family of devices described by Motorola at a 1962 IRE convention. Since then it has been made by many semiconductor companies, for example, Texas Instruments.

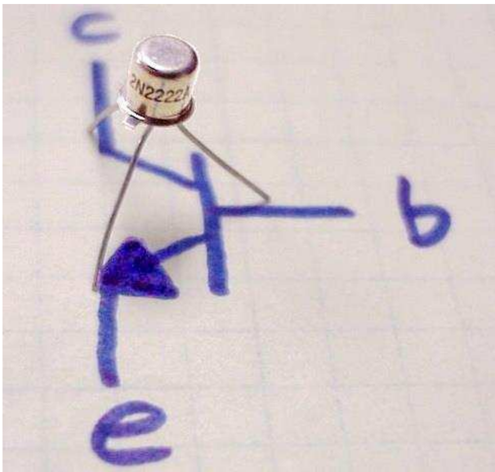


Fig 2.12.1 Transistor 2n2222A

2.12.2 Specification

The JEDEC registration of a device number ensures particular rated values will be met by all parts offered under that number. JEDEC registered parameters include outline dimensions, small-signal current gain, transition frequency, maximum values for voltage withstand, current rating, power dissipation and temperature rating, and others, measured under standard test conditions.

Other part numbers will have different parameters. The exact specifications depend on the manufacturer, case type, and variation. Therefore, it is important to refer to the datasheet for the exact part number and manufacturer.

Manufacturer	V_{ce}	I_c	P_D	f_T
ST Microelectronics 2N2222A	40 V	800 mA	500 mW/1.8 W	300 MHz

2.12.3 Features

Type Designator: 2N2222

Material of Transistor: Si

Polarity: NPN

Maximum Collector Power Dissipation (Pc): 0.5 W

Maximum Collector-Base Voltage |Vcb|: 60 V

Maximum Collector-Emitter Voltage |Vce|: 30 V

Maximum Emitter-Base Voltage |Veb|: 5 V

Maximum Collector Current |Ic max|: 0.8 A

Max. Operating Junction Temperature (Tj): 175 °C

Transition Frequency (ft): 250 MHz

Collector Capacitance (Cc): 8 pF

Forward Current Transfer Ratio (hFE), MIN: 100

Noise Figure, dB: -

Package: TO18

2.13 Summary

In this project we use some major equipment’s and some miscellaneous components. Some components are ignored like wire. Those are not essentially to describe. We describe all the components briefly in this chapter. Every equipment’s features, types and working principle are describe in previous. That’s why we can also learn about all the components that we used in our project.

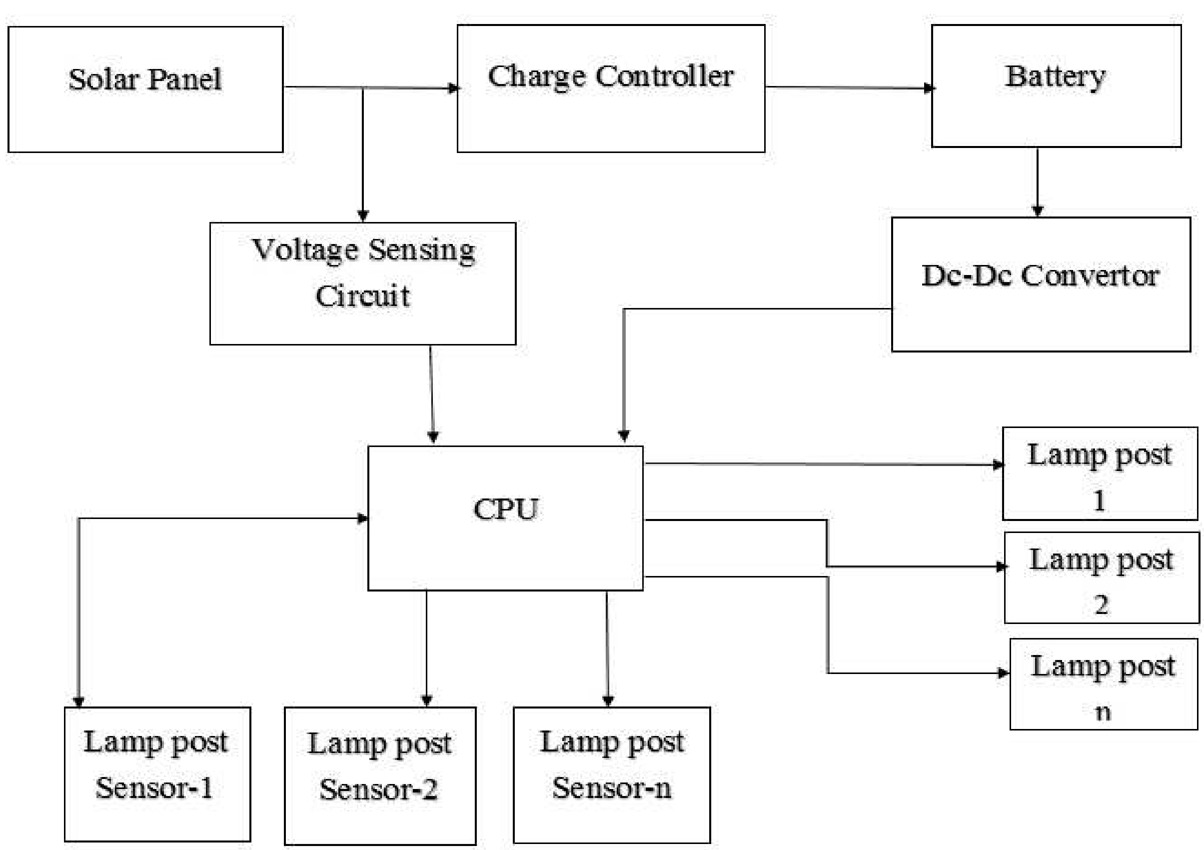
CHAPTER 3

Design and Construction

3.1 Introduction

In this chapter introduce block diagram and circuit diagram of solar LED Street light with auto intensity control. Then we discuss briefly about working principle of this project. Battery were charged from solar in day time and its discharge in nighttime. This process is very smooth and cost effective. This process described briefly in below.

3.2 Block Diagram:



3.3 Circuit Diagram:

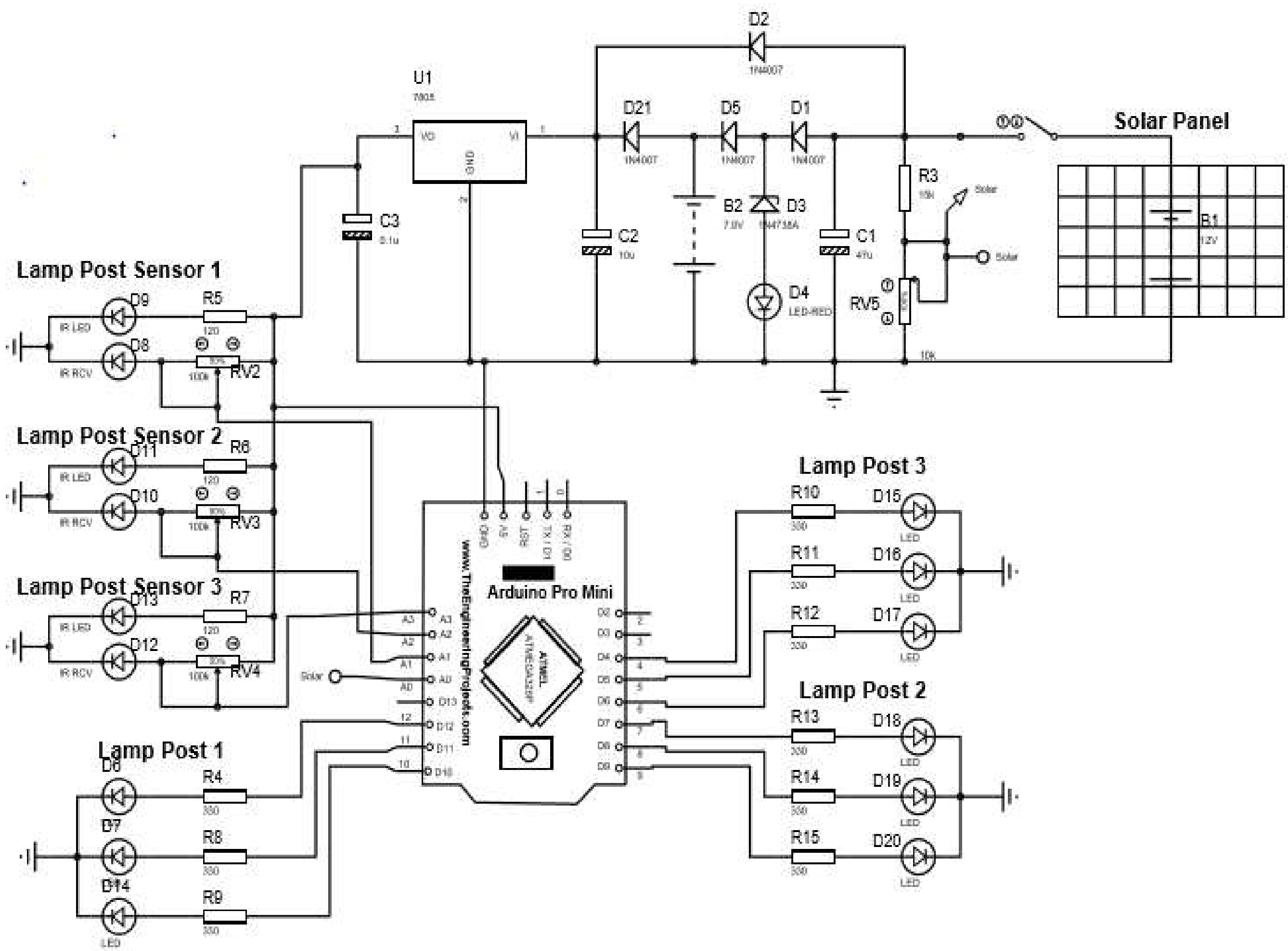


Figure no 3.2

3.4 Working principle:

When switch ON condition, in full sunlight we will get maximum 12v in solar panel. And when OFF condition (No sunlight) we will get 0v in solar panel. It will depends in sunlight that what voltages we will get. Firstly, we consider that we get 12v output from solar. From circuit diagram, this 12v will flow in the first path. There is a diode D3 in this path. From diode characteristics, we know that each diode will drops 0.7v. So now we got 11.3v in this path and it will be 11.3v in everywhere of this wire. Now we see what will happen in second path, this 12v will flow and 0.7v drop in diode D1. Then 0.7v drop in diode D5 and .07 drops in D2. So we get 9.9v from this branch but this is low voltage compare to the first branch voltage.

Now according to diode characteristics, we know that if low voltage flow in anode side and high voltages flow in cathode side, then it will be revers bias and diode will be open. So there will be no current flows from second branch and all the currents will flow in first path. Then current passes through the regulator and running the system. Beside this the 8v battery will be charging easily because we get 10.6v across the battery. We need more than 9.4v to charge the battery because it passes from the solar through two diodes and each diode will drops 0.7v across it.

Now when OFF or night condition, 0v will flows across the diode D1 and D5 and it will be automatic open and no voltage will flows. Then 8v flow from the battery and when it passes the diode D2 it will drops 0.7 volt, so we get 7.3v in this path. And the first path will reverse biased so no voltage flow towards the path. This 7.3v passes through the voltage regulator and its convert 5v. Then it running the microcontroller. Across the battery there is a zener diode R1 parallel and there is a LED-RED connected. The zener diode shine in 7v and the LED shine in approximate 2v. So it need to approximate 9v to shine. In close circuit, we measure 10.5v from the solar. Though it will drop 0.7v in D1, it get 9.8v across this wire and it easily shine the LED light.

The voltage regulator 7805 only can sense voltage up to 7-24v, and it converts to 5v to run the controller. The capacitor are connects to remove the voltage ripple. The R2 and R3 are two resistance that sense day or night time. Below the 5v it sense that it will be night and over the 5v it sense day. It set up from the microcontroller.

Now from lamp post sensor 1, the R5 resistance has one side connected with 5v output from regulator and another side is connected to the anode side of IR LED. Its cathode is connected to the ground. In below there is a variable resistance RV2 of 100k whose one side is connected to the Vcc and other side is connected to the anode side of photo diode D8. The cathode of photodiode is connected to the ground. A wire is connected between resistor and photo diode, It go to the microcontroller's A3 pin. The lamp post sensor 2 and lamp post sensor 3 has same connection as lamp post 1.

When objects like car, people etc. is passing through the IR LED it has reflect an inferred light to the sensor. The voltage of lights are depends upon the reflected light. When object passes through it, the lights are shining and when the object are passed, the lights would be off one-by-one.

We divided 30 sec in three schedule of night time each of 10 sec. Now in lamp post, there will be 5v supply in first 10 sec. then all lights are shinning. It would be only 0v and 5v. In normal condition, one light was given 5v supply and 0v for the other two lights of each lamp post. When there is object the others two lights get 5v supply and those are shining. Similarly when objects are crossed these two lights get 0v supplies and it becomes off.

3.5 summary

Since our country has electricity shortage, if we use this concept then it will eliminate the energy crisis to a larger extent. In monsoon season solar light is more difficult so that we use extra batteries in series to save more power. To improve lighting we use LED panel. The change control is necessary in order to achieve safety and increase the capacity of the battery. In cities currently thousands of street lights are operated and the yearly electricity maintenance cost is very high.

CHAPTER 4

Advantage, disadvantage and Application

4.1 Advantages:

1. Solar Street light are independent of the unity grid. Hence, the operation costs is minimized.

2. Solar Street lights are Require much less maintenance compare to conventional street lights.

3. Since external wire are eliminated, risk of accident is minimized.

4. This is a non-polluting source of electricity.

5. Separate parts of solar can be easily carried to the remote area.

6. To light the street of rural areas with transmission lines as well as solar power where there is so many power cuts occurs.

7. Complete elimination of manpower.

8. Reduce Greenhouse gas emission.

9. Reduce a lots of energy.

4.2 Disadvantages:

1. Initial investment is higher compared to conventional street light.

2. Its take long time for charging the battery.

3. Snow or dust combine with moisture can reduce or even stop energy production.

4.3 Application:

The System is design for outdoor application in un-electrified rural areas. This system is an ideal application for campus and village street lighting.

1. Street lighting.

2. Pathway lighting.

3. Perimeter security lighting.

4. Campus lighting.

5. Park lighting.

6. Gate lighting.

7. Wildlife life.

8. Remote area lighting.

9. LED lighting offers high efficiency, long operating life and low voltage operation which ideal for solar.

CHAPTER 5

RESULTS AND COST ANALYSIS

5.1 Introduction

In this chapter we calculate the charging and discharging value of our battery. Then calculate the cost comparison between tradition system and our system. We show that this process can save energy as well as lots of money. We show the calculation briefly in data table on below.

5.2 Results

Table 1

Charging Value

Time	V_{panel}	$V_{Battery}$	I
10 am	10.3 V	8.9 V	185 mA
11 am	11.56 V	10.16 V	193 mA
12 pm	11.33 V	9.93 V	191 mA
1 pm	12.32 V	10.92 V	204 mA
2 pm	12.26 V	10.86 V	201 mA
3 pm	10.4 V	9.00 V	187 mA
4 pm	9.92 V	8.52 V	175 mA

Average Charging Current, I=190.86 mA

Battery=1.2 A

So, require hour to charge = 1.2A/0.19086A

= 6.287 Hours.

Table 2

Discharging Value

$V_{Battery}$	I		
	3 lights on	2 lights on	1 lights on
8 V	159 mA	152 mA	145.7 mA
8 V	160 mA	153 mA	146 mA
8 V	158.7 mA	152.5 mA	145.2 mA
8 V	158 mA	153.5 mA	145 mA
8 V	157.8mA	153.7 mA	146.2 mA
8 V	158 mA	152.2 mA	144.9 mA
8 V	157.5 mA	151.7 mA	145.2 mA

So, when 3 lights ON, required hour to discharge the battery = 1.2A/0.15843A

= 7.57 Hour

When 2 lights ON = 1.2A/0.15266A

= 7.86 Hour

When 1 light ON = 1.2A/0.14546A

= 8.25 Hour

5.3 Cost Allocation

NAME	MODEL/VALUE	QUANTITY	PRICE IN TK
Resistor	15k	1	1
Resistor	330k	9	6
Resistor	120k	3	2
Capacitor	47u	1	2
Capacitor	10u	1	2
Capacitor	0.1u	1	1
Integrated Circuits	7805	1	10
Diode	1N4007	4	4
Diode	1N4738A	1	2
Diode	LED-RED	1	2
Diode	LED	9	18
Diode	IR RCV	3	15
Diode	IR LED	3	15
Microcontroller	Arduino Pro Mini	1	230
Solar Panel	12v	1	500
Battery	8v	1	180
Variable Resistance	100k	3	3
Variable Resistance	10k	1	1
Wires			50
Others			50

Total Cost = 1094 TK

5.4 Cost Comparison

Features	Traditional System	Our System
Load	10.8 Kw	7.8 Kw
No Of Battery Needed	7	5
Battery Cost	140000Tk(20000 Per Battery)	100000Tk
Power Require	2025 W	1462 W
Solar Cost	101250Tk(50Tk per Watt)	73100Tk
Others Cost	50000Tk	40000Tk
Total Cost	291250Tk	213100Tk

So, traditional system – auto intensity control = (291250-213100) =78510Tk.

We can save 78510Tk by Auto Intensity Control of Street Light.

5.5 Summary

Though our country faces energy crisis this system is very valuable for our government and our people as our country is victim in poverty. It is very helpful to consume energy and reduce the energy cost. So our government as well as power division should imply this method soon.

CHAPTER 6

CONCLUSIONS

6.1 Conclusions

The solar energy is one of the important and major renewable sources of energy and has also proven it useful in functioning of applications like street lights.

Solar powered automatic street light control is one of the applications of electronics to increase the facilities of life. The use of new electronic theories has been put down by expertise to increase the facilities given by the existing appliance. Here the facility of ordinary street light is increased by the making it controlled automatically.

The change control is necessary in order to achieve safety and increase the capacity of the battery. In cities currently thousands of street lights are operated and the yearly electricity maintenance cost is very high.

The initial cost and maintenance can be the draw backs of this project. With the advances in technology and good resource planning the cost of the project can be cut down and also with the use of good equipment the maintenance can also be reduced in terms of periodic checks.

It saved around 40% of electricity from per street light. So throughout the world if we use this concept then it will eliminate the energy crisis to a larger extent. It is eco-friendly and utilizes the renewable source of energy very well.

6.2 Future Scopes of the work

The solar powered LED streetlight with Auto Intensity Control can control the electric charge and intensity of lights.

This project can be enhanced by using with timer based products and photo sensor based products.

We can use solar tracking system for fast charging.

In monsoon season solar light is more difficult so that we use extra batteries in series to save more power. To improve lighting we use LED panel.

6.3 Summary

Since our country has electricity shortage, if we use this concept then it will eliminate the energy crisis to a larger extent. Not only intensity control of street light but also using of timer based products and photo sensor based products, we can save lots of energy as well as energy cost. Solar is also play an important characteristics to save energy. Then the use of solar and auto intensity control based products should be increased.

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Appendix

Programming Uses the Micro-controller

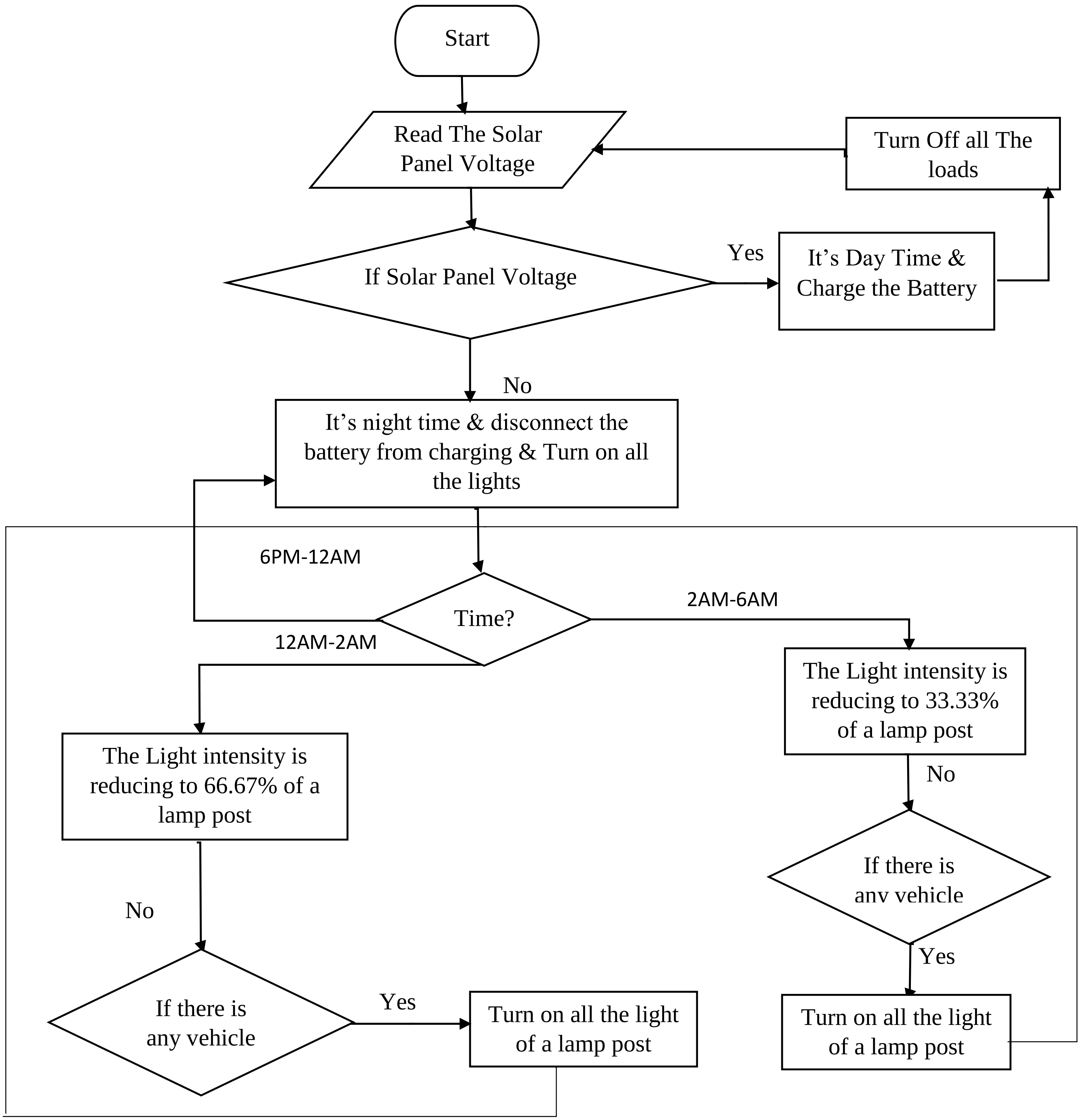
```
#define dayNightSensor_pin  A0
#define on                  true
#define off                 false



//object for lamp post
class lampPost {
private:
        byte sensor_pin=0;
        byte light1_pin=0;
        byte light2_pin=0;
        byte light3_pin=0;

public:

        lampPost(byte light1_pin, byte light2_pin, byte light3_pin, byte sensor_Pin);
        int sensorRead(void);
        void light(bool light_1, bool light_2, bool light_3);

private:
        void pinSetup(void);
};

lampPost::lampPost(byte light1_pin, byte light2_pin, byte light3_pin, byte sensor_Pin){
        this -> light1_pin=light1_pin;
        this -> light2_pin=light2_pin;
        this -> light3_pin=light3_pin;
        this -> sensor_pin = sensor_Pin;
        pinSetup();
}

void lampPost::pinSetup(void){
        pinMode(light1_pin,OUTPUT);
        pinMode(light2_pin,OUTPUT);
        pinMode(light3_pin,OUTPUT);
}

int lampPost::sensorRead(){
        return analogRead(sensor_pin);
}

void lampPost::light(bool light1_on_off, bool light2_on_off, bool light3_on_off){
        digitalWrite(light1_pin,light1_on_off);
```

```
        digitalWrite(light2_pin,light2_on_off);
        digitalWrite(light3_pin,light3_on_off);
}



// to create lamp post object
lampPost lampPost_1(12,11,10,A1);
lampPost lampPost_2(9,8,7,A2);
lampPost lampPost_3(6,5,4,A3);

int timeCunt=0;
int sec = 0;
int cunt=0;

int lampPost_1_cunt = 0;
int lampPost_2_cunt = 0;
int lampPost_3_cunt = 0;

bool lamPost_1_flag = true;
bool lamPost_2_flag = true;
bool lamPost_3_flag = true;


void setup(){
        Serial.begin(9600);

         Timer1.initialize(100000); // set a timer of length 100000 microseconds
         //(or 0.1 sec - or 10Hz => the led will blink 5 times, 5 cycles of on-and-off, per second)
         Timer1.attachInterrupt( timerIsr );


}
bool t=false;
// The loop function is called in an endless loop
void loop(){

        if(dayNightSensor()>300){ // In day time all lamp posts are off

                        lampPost_1.light(off, off, off);
                        lampPost_2.light(off, off, off);
                        lampPost_3.light(off, off, off);
                        //Timer1.stop();
                        timeCunt=0;
                        sec=0;

                }else{ // In Night time

                        timeCunt=0;
                        sec=0;
```

```
//Timer1.restart();
Serial.println("Night");
delay(1);
while(1){



    Serial.println(sec);
    //delay(100);
    if(sec < 10){// evening to 12 AM
        Serial.print("Lamp 1: ");

Serial.println(lampPost_1_cunt);
        lampPost_1.light(on, on, on);
        lampPost_2.light(on, on, on);
        lampPost_3.light(on, on, on);//Serial.println("5to12");
        lamPost_1_flag = true;
        lamPost_2_flag = true;
        lamPost_3_flag = true;
    }else if(sec >= 10 && sec < 20){// 12AM - 2 AM
        Serial.print("Lamp 2: ");

Serial.println(lampPost_2_cunt);
        if(lampPost_1_cunt<=0)lampPost_1.light(on, on, off);else
lampPost_1_cunt--;
        if(lampPost_2_cunt<=0)lampPost_2.light(on, on, off);else
lampPost_2_cunt--;
        if(lampPost_3_cunt<=0)lampPost_3.light(on, on, off);else
lampPost_3_cunt--;

    }else if(sec >= 20){// 2AM - Morning`
        Serial.print("Lamp 3: ");

Serial.println(lampPost_3_cunt);
        if(lampPost_1_cunt<=0)lampPost_1.light(on, off, off);else
lampPost_1_cunt--;
        if(lampPost_2_cunt<=0)lampPost_2.light(on, off, off);else
lampPost_2_cunt--;
        if(lampPost_3_cunt<=0)lampPost_3.light(on, off, off);else
lampPost_3_cunt--;
    }



    if(lampPost_1.sensorRead()<800){
        lampPost_1_cunt=300;   // (100 = 1sec)
        lampPost_2_cunt=300;
        lampPost_1.light(on, on, on);
        lampPost_2.light(on, on, on);
    }if(lampPost_2.sensorRead()<80){
```

```
                        lampPost_2_cunt=300;   // (100 = 1sec)
                        lampPost_3_cunt=300;
                        lampPost_2.light(on, on, on);
                        lampPost_3.light(on, on, on);
                    }if(lampPost_3.sensorRead()<800){
                        lampPost_3_cunt=300;   // (100 = 1sec)
                        lampPost_3.light(on, on, on);
                    }

                    if(dayNightSensor() > 400){
                        return;
                    }
                    //sec++;
                    delay(10);
                }
            }//*/



}


int dayNightSensor(void){
    return analogRead(dayNightSensor_pin);
}

void timerIsr()
{
    if(timeCunt>=10){
        sec++;

        timeCunt=0;
    }
    //Serial.println(timeCunt);
    timeCunt++;
}
```

Flowchart


Start
Read The Solar Panel Voltage
Turn Off all The loads
If Solar Panel Voltage
Yes
It's Day Time & Charge the Battery
No
It's night time & disconnect the battery from charging & Turn on all the lights
6PM-12AM
Time?
2AM-6AM
12AM-2AM
The Light intensity is reducing to 33.33% of a lamp post
The Light intensity is reducing to 66.67% of a lamp post
No
If there is anv vehicle
No
Yes
If there is any vehicle
Yes
Turn on all the light of a lamp post
Turn on all the light of a lamp post

Cost Comparison:

Traditional Street Light

Each lamp post has 3 LED lamp of 30 watt

So, load in each lamp post = 90 watt

For 10 lamp post 10x90 = 900 watt

Light load = 900 watt = 0.9 Kw

Let, the night hour 6pm-6am = 12 h

Total energy consumed by load = 0.9x12= 10.8 Kwh =10800wh

Capacity = 150%

= 10800x1.5 = 16200wh

=16.2 Kwh

Battery configuration = 12v/190Ah tubular

Cost of each battery= 20000Tk

Load current = 16200/12 =1350Ah

Number of battery required = 1350/190 = 7 battery

So, battery cost = 20000x7= 140000Tk

Solar power= 16200/8=2025 W (8 hour day time to charge)

Solar panel cost=50tk/w

Total solar cost=2025x50=101250tk

Others cost=50000tk

Total cost=140000+101250+50000 = 291250tk

Our system (auto intensity control of LED Street light)

We divided a night in 3 slot like,

(1) 6pm-12am = 6h – all 3 light ON

(2) 12am-2am = 2 - light ON 1light OFF

(3) 2am-6am = 4h -1 light ON 2 light OFF

(1) Energy consumed for 1st load (6-12) =6h

1 lamp post = 90x6 = 540wh = 0.54Kwh

So, for 10 lamp post = 540x10=5400w=5.4Kwh

(2) 12am-2am = 2h (2 ON 1 OFF)

1 lamp post = 30x2h=60wh

60wx2 = 120wh (2 ON)

So, for 10 lamp post = 120x10 = 1200wh = 1.2 Kwh

(3) 2am-6am = 4h (1 ON 2 OFF)

1 lamp post = 30x1=30w

30wx4=120wh=0.12Kwh

So, for lamp post = 120whx10 = 1200wh = 1.2 Kwh

So total power consumed = 5400+1200+1200

= 7800wh = 7.8Kwh

So, required load = 7800wh = 7.8Kwh

Capacity = 150 % = 7800wh x 1.5 = 11700wh = 11.7 Kwh

Battery = 12 V

Current = 190Ah

Cost = 20000tk

Total load current = 11700/12 = 975 Ah

Num. of battery = 975/190= 5.13 = 5battery

Total battery cost = 20000x5 = 100000tk

Solar panel = 11700/8 = 1462w

Panel cost = 1462x50 = 73100tk

Others cost = 40000tk

Total cost = 100000+73100+40000

= 213100tk

So, traditional system – auto intensity control system = (291250-213100) =78510Tk.

We can save 78510Tk by Auto Intensity Control of Street Light.