DESIGN OF A CIRCUIT FOR AMBIENT LIGHT DEPENDENT INTENSITY CONTROL OF STREET LIGHT

GROUP MEMBERS→

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➢ Introduction→

The idea of designing a new system for the streetlight that do not consume huge amount of electricity and illuminate large areas with the highest intensity of light is concerning each engineer working in this field. Providing street lighting is one of the most important and expensive responsibilities of a city. Lighting can account for 10–38% of the total energy bill in typical cities worldwide. Street lighting is a particularly critical concern for public authorities in developing countries because of its strategic importance for economic and social stability. Inefficient lighting wastes significant financial resources every year, and poor lighting creates unsafe conditions. Energy efficient technologies and design mechanism can reduce cost of the street lighting drastically. Manual control is prone to errors and leads to energy wastages and manually dimming during mid night is impracticable. Also, dynamically tracking the light level is manually impracticable. The current trend is the introduction of automation and remote management solutions to control street lighting. There are various numbers of control strategy and methods in controlling the street light system such as design and implementation of CPLD based solar power saving system for street lights and automatic traffic controller, design and fabrication of automatic street light control system, automatic street light intensity control and road safety module using embedded system, automatic street light control system, Intelligent Street Lighting System Using Gsm, energy consumption saving solutions based on intelligent street lighting control system and A Novel Design of an Automatic Lighting Control System for a Wireless Sensor Network with Increased Sensor Lifetime and Reduced Sensor Numbers. In this paper two kinds of sensors will be used which are light sensor and photoelectric sensor. The light sensor will detect darkness to activate the ON/OFF switch, so the streetlights will be ready to turn on and the photoelectric sensor will detect movement to activate the streetlights. LDR, which varies according to the amount of light falling on its surface, this gives an induction for whether it is a day-night time, the photoelectric sensors are placed on the side of the road, which can be controlled by microcontroller PIC16f877A. The photoelectric will be activated only on the night time. If any object crosses the photoelectric beam, a particular light will be automatically ON. By using this as a basic principle, the intelligent system can be designed for the perfect usage of streetlights in any place.

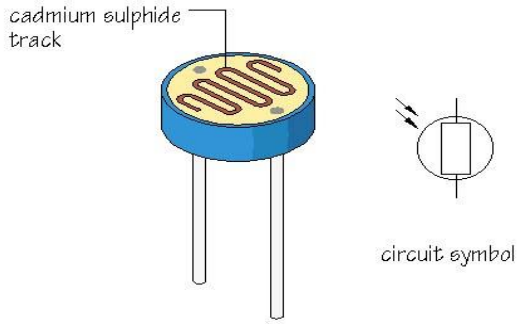
➢ Components→

a) Battery: For 9v power supply we can use 6pcs dry cell or 6F22 9v single piece battery.

b) Switch: Any general-purpose switch can be used. Switch is used as circuit breaker.

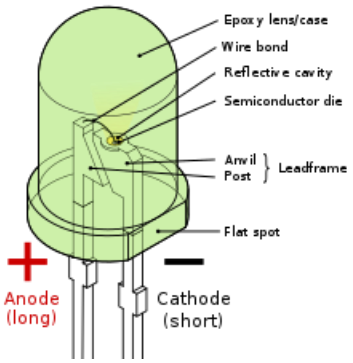
c) L.D.R(Light Depending Resistance):

It is a special type of resistance whose value depends on the brightness of light which is falling on it. It has resistance of about 1mega ohm when in total darkness, but a resistance of only about 5k ohms when brightness illuminated. It responds to a large part of light spectrum.



d) L.E.D(Light Emitting Diode):

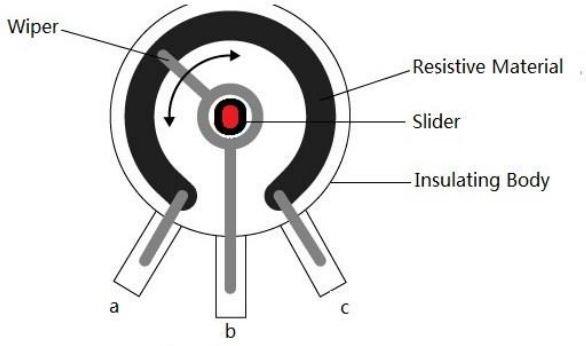
A diode is a component that only allows electricity to flow one way. It can be thought as a sort of one-way street for electrons. Because of this characteristic, diode is used to transform or rectify AC voltage into a DC voltage. Diodes have two connections, an anode and a cathode. The cathode is the end on the schematic with the point of the triangle pointing towards a line. In other words, the triangle points toward that cathode. The anode is, of course, the opposite end. Current flows from the anode to the cathode.



Light emitting diodes, or LEDs, differ from regular diodes in that when a voltage is applied, they emit light. This light can be red (most common), green, yellow, orange, blue (not very common), or infra-red. LEDs are used as indicators, transmitters, etc. Most likely, a LED will never burn out like a regular lamp will and requires many times less current. Because LEDs act like regular diodes and will form a short if connected between + and -, a current limiting resistor is used to prevent that very thing. LEDs may or may not be drawn with the circle surrounding them.

e) Variable resistance (Potentiometer):

Resistors are one of the most common electronic components. A resistor is a device that limits, or resists current. The current limiting ability or resistance is measured in ohms, represented by the Greek symbol Omega. Variable resistors (also called potentiometers or just "pots") are resistors that have a variable resistance. You adjust the resistance by turning a shaft. This shaft moves a wiper across the actual resistor element. By changing the amounts of resistor between the wiper connection and the connection (s) to the resistor element, you can change the resistance. You will often see the resistance of resistors written with K (kilohms) after the number value. This means that there are that many thousands of ohms. For example, 1K is 1000 ohm,2K is 2000 ohm, 3.3K is 3300 ohm, etc. You may also see the suffix M (mega ohms). This simply means million. Resistors are also rated by their power handling capability. This is the amount of heat the resistor can take before it is destroyed. The power capability is measured in W (watts) Common wattages for variable resistors are 1/8W, 1/4W, 1/2W and 1W. Anything of a higher wattage is referred to as a rheostat.

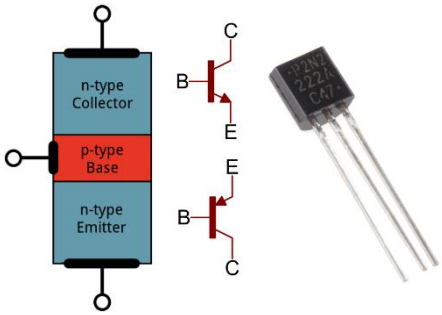


f) Transistor:

A transistor is a type of a semiconductor device that can be used to both conduct and insulate electric current or voltage. A transistor basically acts as a switch and an amplifier. In simple words,

we can say that a transistor is a miniature device that is used to control or regulate the flow of electronic signals.

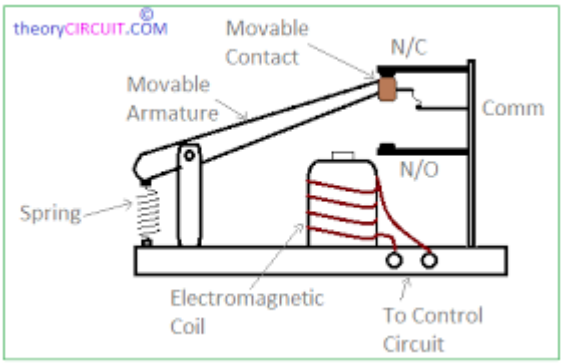
A typical transistor is composed of three layers of semiconductor materials or more specifically terminals which helps to make a connection to an external circuit and carry the current. A voltage or current that is applied to anyone pair of the terminals of a transistor controls the current through the other pair of terminals. There are three terminals for a transistor. They are;



Base: This is used to activate the transistor.
Collector: It is the positive lead of the transistor.
Emitter: It is the negative lead of the transistor.

g) Relays:

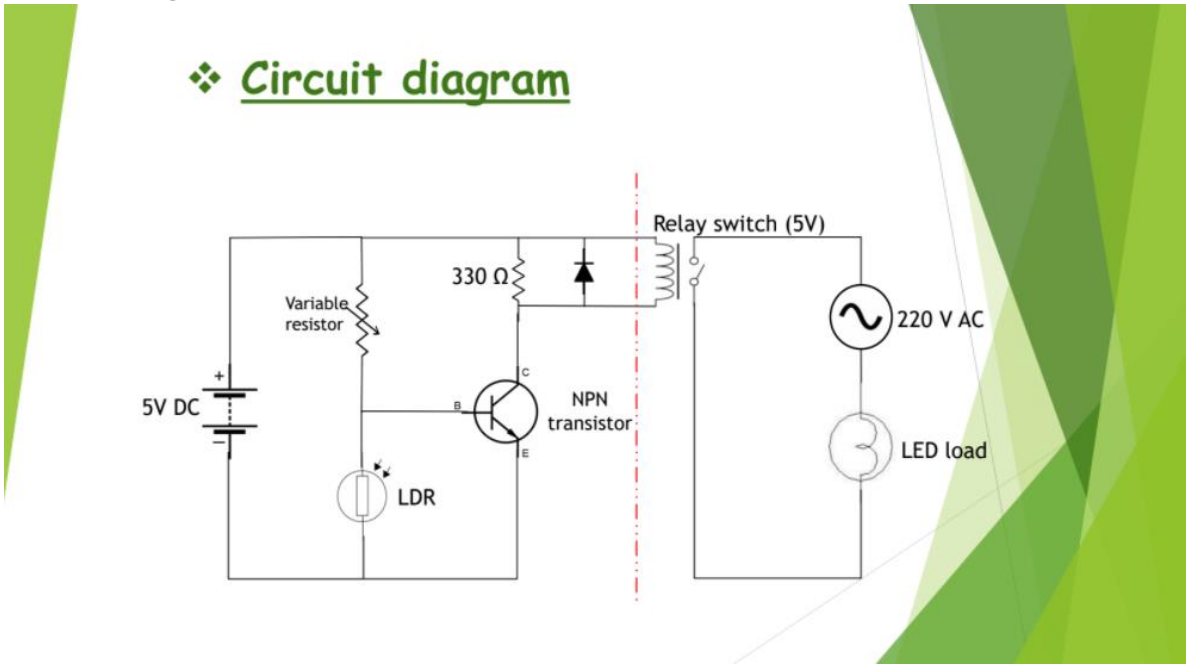
Relays are remote control electrical switches that are controlled by another switch, such as horn switch or a computer as in a power train control module. Relays allow a small current flow circuit to control a higher current circuit. Several designs of relays are in use today, 3-pin, 4-pin, 5-pin, and 6-pin, single switch or dual switches. Relays which come in various sizes, ratings, and applications, are used as remote-control switches. Fig. 5 shows different types of relays. In this paper, the 4-pin relay will be used.



h) Regulated Power Supply:

Usually, we start with an unregulated power supply ranging from 6volt to 12volt DC.

- Circuit Diagram→



- Expected Output→

The circuit diagram present here is that of a street light that automatically switches ON when the night falls and turns OFF when the sun rises. In fact, you can this circuit for implementing any type of automatic night light.

The circuit uses a Light Dependent Resistor (LDR) to sense the light. When there will be light that means when the intensity of the light will be high because of the high energy the electro-hole pair in the valance band will break and the free electrons will form the they will be promoted to the conduction band so conductivity will increase and resistivity will decrease as well & on the other hand when there will be dark or when light intensity will be low then the resistivity will increase. In the circuit we have used the voltage divider concept.

$$Vb = Vcc * Rldr/(Rldr+R1) \ldots\ldots\ldots\ldots\ldots \quad (1)$$

From the above formula we can see in the daylight the resistance of the LDR (Rldr) will become low so the Vb will also become low as Vcc is fixed voltage and the Vb will not be sufficient enough to surpass the 0.7v mark that will turn on the transistor so our relay switch will not work or it will be remain as it was and our LED will remain off. But in the night when intensity will be low then the resistivity (Rldr) will high enough so the Vb will be sufficient enough to turn on the transistor, then current will flow through the collector side and our relay switch will be on. After the relay switch will close the circuit then because of the ac power supply the LED will glow.

Here we've connected a diode across the relay switch because the Relay is made up of coils so when current will pass through the coils then an electromagnetic force will generate and this force will help the relay to turn/off. Because of the electromagnetic force there will be a back emf

generated & that emf will harm the components of the circuit so because of the Freewheeling Diode the current will pass through that and our components will be safe.

➢ Discussions→

By using this system energy consumption is also reduced because now-a-days the manually operated street lights are not switched off properly even the sunlight comes and also not switched on earlier before sunset. In sunny and rainy days, ON time and OFF time differ significantly which is one of the major disadvantages of using timer circuits or manual. This project exploits the working of a transistor in saturation region and cut-off region to switch ON and switch OFF the lights at appropriate time with the help of an electromagnetically operated switch. Automatic Streetlight needs no manual operation of switching ON and OFF. The system itself detects whether there is need for light or not.

The advantages are,

- ❖ we can reduce energy consumption because the manually operated street lights are not switch off properly even when the sun light comes and also not switched on earlier before sunset
- ❖ Cost of operating automatic solar street lights is far less when compared to the conventional street lights.
- ❖ It is an Automated Operation & It consumes less power.
- ❖ Automatic street light system is eco-friendly & hence helping in reducing the carbon footprint.
- ❖ There are lower chances of the automatic street light system overheating & risk of accidents is also minimized.

The disadvantages are,

- ❖ The automatic street light system requires a higher initial investment in comparison to conventional street lights.
- ❖ Rechargeable batteries of the automatic street light system are required to be replaced a few times.
- ❖ If the lighting is not activated by a photo sensor, then it has to have a timer that also keeps track of seasonal variations of sunrise and sunset.

➢ References→