

Unmanned Solar Powered Street Lighting System

Ansho PM¹, Divya Jothi P²

¹Assistant Professor, Department of EEE, Annai Vailankanni College of Engineering, Kanyakumari District, Tamil Nadu, India

²UG student, Department of EEE, Annai Vailankanni College of Engineering, Kanyakumari District, Tamil Nadu, India

ABSTRACT

Nowadays energy sources are regulated and renewable energy sources are being used to meet the increase in energy demand. Because the price can be reduced by using the easily available energy. Besides the project is based on the minimum loss of available energy and the maximum utilization. During the daytime the solar cell will be collect the available solar energy and it is stored in battery. The stored energy is used to illuminate the street lamp at nighttime. This system provides an energy saving activity by the method of using automation. The automation method is based on sensors. The “ON”/“OFF” switch can be automated by using the sensors when a dark sensor and a light sensor provides the automatic “ON/OFF” facility to the automatic street lights. So that it will be glowing automatically when it is required. It is used again for auto intensive algorithm has applied with the help of microcontroller to control the intensity of lights as per the required. It can avoid energy loss due to the unwanted glow of the automatic street lights.

Keywords: Solar panel, Battery, Microcontroller, LDR(light dependent Resistor), LED(Light Emitting Diode), Solar Energy, IR sensor, Photovoltaic cell.

I. INTRODUCTION

The system is designed to provide an automated control facility. Solar energy is used worldwide and it is increasingly popular for generating electricity. A variety of technologies convert sunlight into usable energy for many purposes. A solar street lighting system is a great way to reduce power consumption and carbon-di-oxide impact on the environment. On average during sunny days 1kilowatt of solar panels generates the 4 kWh (units) of electricity in a daytime. The street lights to turn “ON” automatically in the

evening by using the dark/light sensor and also automatically turn “OFF” in the morning. The PV is one of the fastest-growing renewable energy technologies. It converts sunlight directly into electricity and this energy is stored in a rechargeable battery. When it detects light from a source such as the sun, it can be loaded with electricity. The solar street lights are powered by PV panels. The project is mainly based on the time control method, in which the light will be glow automatically from time to time automatically controlled intensity. Therefore, using a

time control method can prevent unnecessary energy wastage.

II. FEATURES OF UNMANNED SOLAR STREET LIGHT:

The main features of a solar street light that provide the power-saving facility are,

- Solar energy
- Photovoltaic cell
- Automatic ON/OFF algorithm
- Intensity control
- Microcontroller
- LED light

And brief discussion about each of the above is given below

SOLAR ENERGY:

When solar power is converted into usable energy it is known as solar energy. Solar radiation is the most important and largest renewable energy source. It is naturally unlimited, renewable, and pure energy. This energy does not provide any hazardous gas and product that pollutes the earth. Every day the earth produces energy directly from the sun. Solar energy can be converted into electrical energy by using the semiconductor devices such as silicon, also known as a solar cell or photovoltaic cell and it is a method of generating electrical energy from solar radiation. These PV modules are more and more attractive for getting 'green' electricity because of their flexibility and ease of installation.

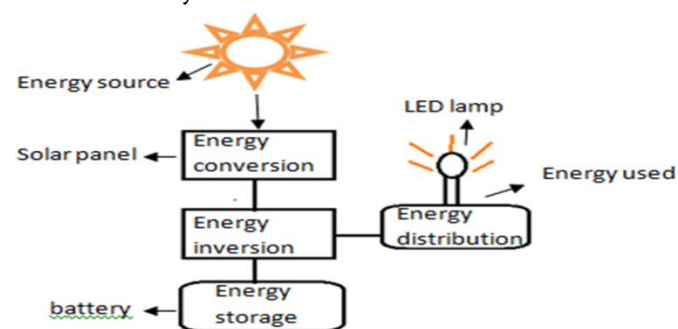


Figure1: Flow chart of solar energy

The above picture represents the entire energy flow of process carried out within an automatic solar

powered street lighting system. The energy conversion and inversion are done by the PV solar panel. During the day, the solar panel absorbs more radiation and it converts into electrical energy. The intensity of solar energy reaching the earth is about $1\text{kw}/\text{m}^2$. The direct current coming from the solar panel is used to induced and charge the battery. If any AC load is to be operated, an inverter is used to supply the AC. The energy of light converted into electrical energy by the PV module is stored in a battery and the stored energy supplied to the load when it is needed. A stored energy in the battery will be used to operate a load. Thus maintenance cost is reduced and energy is properly utilized.

PHOTOVOLTAIC CELL:

The photovoltaic cell is also called as solar cell. A photovoltaic cell is an electrical device that converts the energy of solar light into electricity. A typical single-junction silicon solar cell can produce a maximum value of 0.5 to 0.6 volts in open circuit voltage. Solar panel: The individual solar cell devices can be combined to form modules.

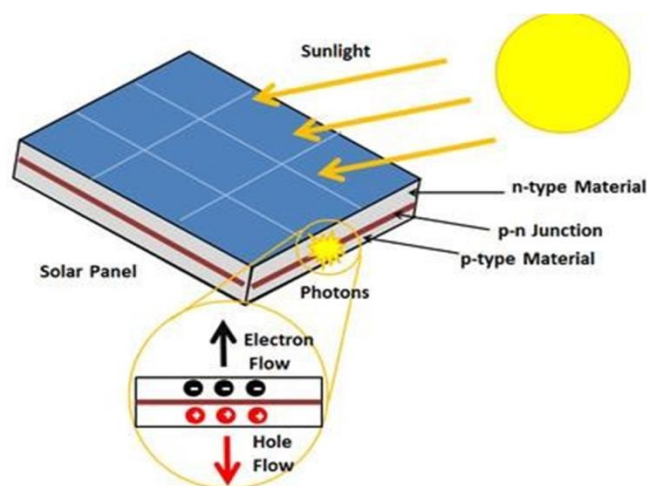


Figure2: solar cell

The solar panel and solar module is a combination of several solar cell is connected in series to generate usable voltage. The Solar power has 46,655 solar street lighting installations in India. The solar cells are based on the principles of the photovoltaic effect.

Photovoltaic effect: The generation of voltage across the PN junction in a semiconductor due to the

absorption of light radiation is called the photovoltaic effect.

There are two types of solar panels commonly used in solar street lights first one is monocrystalline solar panel and second one is polycrystalline solar panel. The conversion rate of mono crystalline solar panels is much higher than their polycrystalline counterparts. Solar panels also vary in wattage systems.



Figure3: Monocrystalline solar panel

To form cells for monocrystalline panels, silicon is cut into flakes to form cells



Figure4: Polycrystalline solar panel

To form cells for polycrystalline panels, silicon pieces melted together to form scales.

AUTOMATIC“ON/OFF” ALGORITHM:

Automation refers to a system that automatically executes a continuity of operations without human input. We use this method in solar street lights. The lights should be illuminating when there is darkness and in presence of the day these should remain off, that is the essence of it. The relay switch, two transistors, and LDR are primarily used in this process.

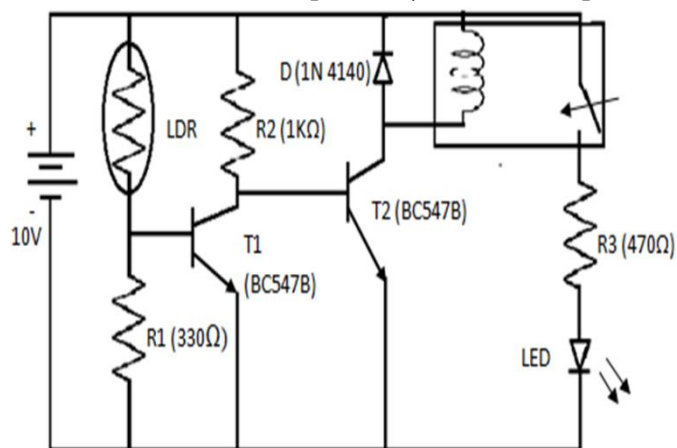


Figure5: Automatic street light Switching circuit

The two transistors T1 and T2 are bi-stable states. That is one of the transistor T1 is in “ON” state and other transistor T2 will be “OFF” state. The sunlight of sufficient intensity falls on the LDR, which provides a guiding path for its resistance fall and for the incoming current. No current flows through the coil when the current enters the base of T1 it become a forward bias, and its making a base-emitter junction. The LED will not glow because as the relay switch is open, so no current will flow through the LED. When during the night time falls down the resistance of LDR increase to make the voltage across the resistor decrease below 0.6V.

During the nighttime, no current will pass through the Light-Dependent resistor, hence transistor T1 will be “OFF”. Also some current passes through the transistor T2 because the circuit current will pass through the coil so it will be “ON” state. The magnetic flux is generated that attracts the relay switch when the current passes through the coil. Thus LED will be glow.

INTENSITY CONTROL:

The intensity control of street lights is automatically controlled based on the sunlight conditions. This intensity control mechanism is achieved by using a microcontroller. The extreme control is not necessary for the lights to illuminate with same intensity at all the time. High-intensity light also consumed more energy than a light glowing with a relatively low intensity, so some more energy savings can be achieved by controlling the intensity. The street light automatically controls to the intensity of the surrounding lights. The street lights are controlled manually in the olden days. These days automation of street lights has emerged. But one can notice that in the absence of traffic and even in the early morning hours more intensity is not required. By reducing the intensity during these periods, energy can be saved to some extent.

MICROCONTROLLER:

Microcontroller is used to analyze the intensity of light and to generate a control signal, which in turns the transistor "ON" or "OFF" and which energize the relay to turn the street light "ON" or "OFF". Automatic control of street lights is designed to turn "ON" and turn "OFF" street lights automatically.

LED LIGHT:

The lifetime of LED (light-emitting diode) is usually up to 50,000 hours. The LED provides much higher lumens than lower energy consumption, in an integrated light-emitting diode (LED) light fitted material that is used for street lighting system. An LED based on 901 miliwatt output can typically generate the same amount of luminosity as a traditional light bulb, but require only half the power consumption. LED lights usually does not fail, but rather decrease in output until it needs to be replaced. The energy consumption of the LED material is at least 50% lower. So the lamp used here saves up to 50% of energy compared to the traditional street light.

III. AUTOMATIC SOLAR STREET LIGHT:

An automatic street lighting system is a easy concept that uses a transistor as a switch. Manual works are completely eliminated by this system.

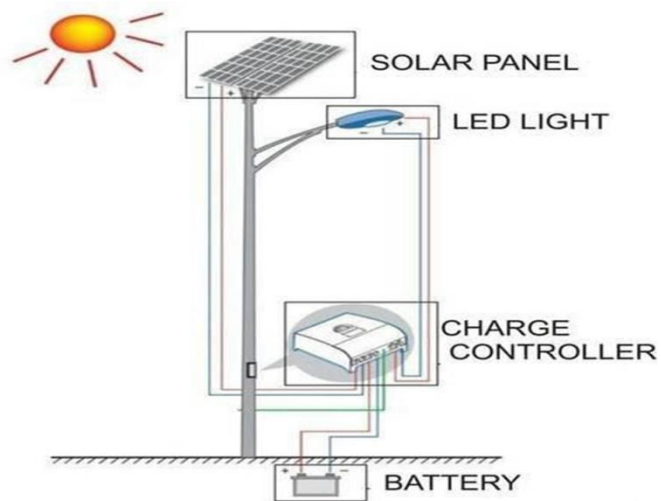


Figure6: Solar street light

From the diagram, the sunlight falls on the solar panel in the whole day which consists of PV modules. The solar panel converts into electrical energy which is stored in the battery. The current produced by the module flows through a charge controller before charging the battery. To prevent overcharging and to protect the battery from overvoltage. Which could reduce the battery life because we used a charge controller. The stored energy illuminates the street light at night from the battery.

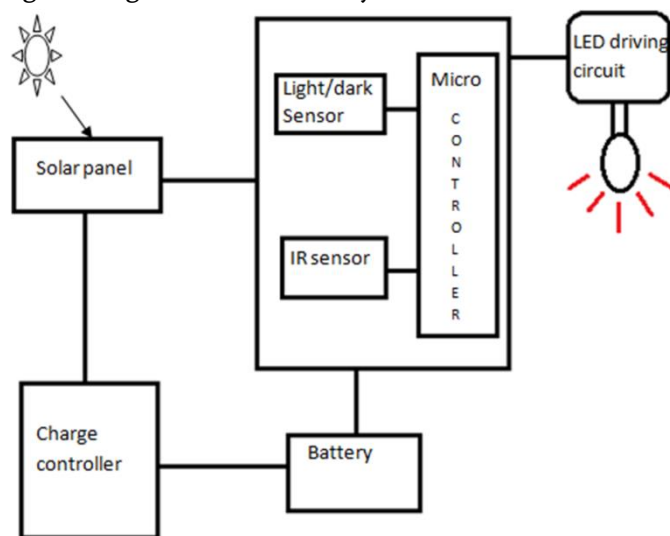


Figure7: Auto intensity control of solar street light

A light / dark sensor is used to detect the intensity of ambient light and send information to the microcontroller, so that it can be determining whether the street lights should be turned "ON" or "OFF". The LED is used for the driving circuit to illuminate the LED lights and the LED drivers are electrical devices that prevent damage to the LEDs. By changes with temperature by controlling the forward voltage (Vf) of the LED, avoiding heat flow while supplying a constant current to the LED.

The IR sensor is also known as a vehicle detector or road user sensor. This sensor is activated for a particular period of time, after which it detects the presence of an object and sends information to the microcontroller, which turns the lights "ON" and "OFF" automatically when the object crosses the road. This sensor can be used if an IR sensor is required. The light will be glow when after the LED driving circuit and charge controller process.

IV. CONCLUSION

After the installation, no payment is to be given regarding electricity. And also the automatic street lighting system is completely noiseless and free from fire hazards. It is not only the way to save energy but also an idea to make a proper utilization of available solar energy which is radiating every day without being used. Automatic street lighting system requires less maintenance than standard street lights, reducing the probability of overheating the automatic street lighting system and reducing the risk of accidents. The automatic street lighting system do not have moving parts and it is eco-friendly. Hence helps in reducing the carbon footprint. That generation of energy for solar street lights entirely depends upon the climatic conditions.

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