SOLAR LIGHTING SYSTEM

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ABSTRACT

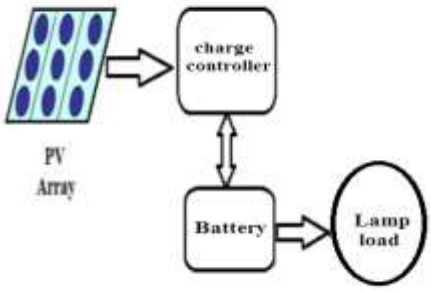
In order to optimization of renewable energy resources especially solar energy many researches are undergone. The main aim of this project is to generate electricity from the solar energy for optimum utilization. This solar lighting system consists of a PV array, charge controller, battery and lamp load. The system has a PV array to collect the sun's energy. The charge controller circuit which protect the battery from charging when exceed a set high voltage level. The lamp load of 40 W is supplied from by a constant rating output voltage of battery. This system can be used for small scale lighting applications in remote areas that are for away from the power grid

Keyword : *Charge controller, Battery, Solar panel, lamp load.*

1. INTRODUCTION

In the world, energy sources like the fossil fuels and nuclear fission are widely used for electric power generation. But burning fossil fuels like oil, coal and natural gas emits nitrogen oxide, sulphur dioxide, and mercury and other toxic metals into our atmosphere, directly causing increasing incidents of lung disease, polluting soils and waters, damaging crops. Nuclear fission produces radioactive waste, material that will remain deadly for thousands of years. So we need alternative source like renewable energy sources for electric power generation. Energy from the sun is one of the promising options option for electricity generation as it is available everywhere. Street lighting in most of the towns and cities in India are poor maintained and energy inefficient. There is tremendous potential for the improvement in maintenance practices and for the energy conservation.LED luminary maintains minimum light levels across all spacing while significantly increasing overall uniformity.

2. BLOCK DIAGRAM



2.1 Block Description

The solar panels are mounted on the top of the pole and will collect energy from the sunray and convert it to a usable electrical energy which will be stored in a lead acid battery through a charge controller.

The charge controller will ensure healthy life of the battery by preventing over charging and over discharging of the battery.

The supply of lamp load is drawn from constant output of the battery for hours.

2.2 Component Description

❖ Solar Panel

Solar power is energy captured from the sun. The tremendous energy discharged by the sun each day is harnessed using various solar technologies available today. Solar energy systems can be either active or passive. A photovoltaic module or photovoltaic panel is a packaged interconnected assembly of photovoltaic cells, also known as solar cells.

The photovoltaic module, known more commonly as the solar panel, is then used as a component in a larger photovoltaic system to offer electricity for commercial and residential applications.

The primary difficulty with solar power and indeed with its cousin wind power has been one of efficiency. There is more than enough energy hitting the earth in the form of solar radiation to meet power needs of our species. Estimates indicate that there is foretime's as much wind energy available for our use as the species uses every year.

Solar power is even more dramatic, the sun showers the planet with more energy every day than we use in a year. So the difficulty has never been the availability of sun and wind, they are readily available.

A Solar Panel is basically a module that converts light energy (photons) from the sun to generate electricity in direct current (DC) form. Two types of solar panels are

1. Crystalline
2. Thin-film types.

Types of crystalline solar panels are as follows

- Poly-crystalline Solar Panel
- Mono-crystalline Solar Panel

Thin-film type solar panels are,

- Amorphous Silicon (a-Si)
- Cadmium Teluride (Cd-Te)
- Copper Indium Gallium Selenide (CIGS)
- Dye-Sensitized Solar Cell (DSC)

❖ **Battery**

Batteries are used to store the electricity generated by the solar panel. During the day, electricity generated by the solar panels is supplied to the battery and/or the load. When the load demand is higher than the energy received from the solar panels, these batteries will provide stable energy to the load. Solar power applications typically use deep-cycle batteries because they can persist repeated and deep discharges. Few types of rechargeable batteries, which are:

(i) Lead-Acid (LA) Battery

Lead acid batteries are the most commonly used in solar powered systems due to its maturity in technology and low pricing. They can only be used with low Depth of Discharge (DOD) in order to extend its lifespan. Its DOD ranges from 60%-80%. There are two types of Lead-Acid batteries, i.e. flooded and Valve Regulated Lead Acid (VRLA) batteries which are maintenance free batteries.

(ii) Nickel-Cadmium (Ni-Cad) Battery

Nickel-Cadmium (Ni-Cad) batteries are expensive and disposing of Cadmium is hazardous. Even though they have several advantages over Lead-Acid batteries, such as longer life span, and tolerance for higher discharge, Ni-Cd batteries is not commonly used in solar powered systems due to its high cost and limited availability.

(iii) Lithium-Ion (LI) or Lithium-Polymer (LP) Battery

Lithium based batteries are considered the future of batteries used in solar powered systems. This is due to a number of factors such as high specific energy, high DOD, and higher number of charging cycles. However, due to its higher cost compared to LA type of batteries, they are still not very widely used.

Battery is used to convert chemical energy into electrical energy used for storage purpose. The energy obtained from solar panel is used to charge the battery and this energy is discharged during night time for the illumination of the lamp.

As they are inexpensive compared to newer technologies, lead acid batteries are widely used even when surge current is not important and other designs could provide higher energy densities. Large format lead acid designs are widely used for storage in backup power supplies in cell phone towers, high availability settings like hospitals, and stand-alone power systems

- **Charge controller**

Charge controllers stop charging a battery when they exceed a set high voltage level. Since the output from solar panels are variable and needs adjustments, charge controller fetches the variable voltage/current from solar panels, condition it to suit the safety of the batteries. The main functions of charge controller are to prevent over-charging of batteries from solar panels, over-discharging of batteries to the load and to control the functionalities of the load.

Charge controller is basically dc-dc converters, where PWM or MPPT technique is used to regulate the switches of the controller. There are three general types of charge controller, mainly:

- Simple on/off controller
- Pulse width modulated (PWM) controller
- Maximum power point tracking (MPPT) controller

Most charge controller operate at three stages to complete the charging cycle of the batteries. These stages vary according to different times and battery voltages. PWM can be employed to control the charging at the stages:

- Bulk stage
- Absorption stage
- Float stage

- Charge controller circuit

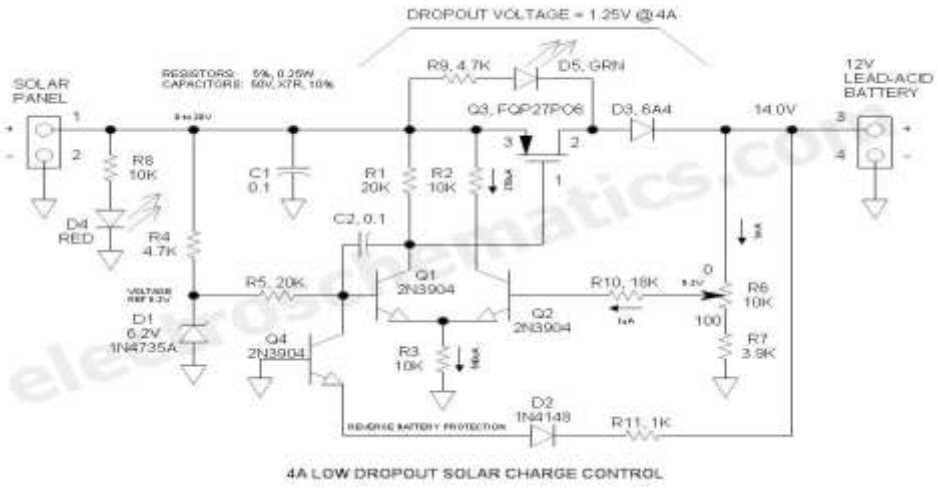


Table I: Solar Panel Specifications

Maximum power (Pmax)	35 watts
Open circuit voltage (Voc)	21.60 volts
Short circuit current (Isc)	1.85 amps
Max power voltage (Vpm)	18 volts
Max power current (Imp)	1.67 amps

Table II: Battery specifications

Battery type	Lead acid
Nominal voltage	12 volts
Cycle use voltage	14.4 volts
Float use voltage	13.6 volts
Nominal capacity	20 Ah
Charging current	< 6 amps

3. DESIGN CALCULATION (FOR ONE LAMP)

Lamp power (load) = 14 watts

Current I = 14W ÷ 12V = 1.167A

Total working hours =12 hours

Battery capacity = 1.167 × 12 = 14.004Ah (20Ah)

4. HARDWARE DESCRIPTION

In this project we use polycrystalline solar panel with power rating 35 watts. We are using Lead acid battery of 20Ah capacity. 14 Watts LED DC lamp is used for output display. The charge controller is of supply 12V, 5A. The main purpose of this charge controller is regulation of voltage in output. If the input is 8V, we obtain an output of 12V. If the input is increased to 20V, we get the same output, i.e., 12V. Thus, we prove that, although the input is varied, the output is regulated.

5. CONCLUSION

The solar energy is one the important major renewable sources of energy and has also proven it useful functioning of application in street light. Expectations are increasing for solar powered LED lighting to become the environmentally friendly outdoor lighting solution for the 21st century. It clearly tackles the two problems that world is facing today, saving of energy and also disposal of incandescent lamps, very efficiently.

6. REFERENCES

1. R.Mangu, K.Prayaga, B.Nadimpally and S.Nicaise, Design, Development and Optimization of highly efficient solar cars: gato Del ol I-IV. Green Technology Conference, IEEE. pp.1-6. (2010).
2. Nasser Alnunu, Samer Said, Sami Al-Sharman, Ahmad AlIbrahimi Ahmed AbdulAziz, Mohammed Al Hellabi, Farid Touati, Saud Ghani, El-Sadig Mahdi and MohieddineBenammar. Design of Qatar University's First Solar Car for Shell Eco-Marathon Competition International Conference on Renewable Energies and Vehicular Technology, IEEE. (2012).

3. Sansjana Ahmed, Ahmed HosneZenan, Mosaddequr Rahman. A Two-Seater Light-Weight Solar Powered Clean Car: Preliminary Design and Economic Analysis. 3rd International Conference on the Developments in Renewable Energy Technology (ICDRET). (2014).

4. David Menasce, Michael Grobler, Pieter Janse van Rensburg. High Power Electrical Systems Design for a Solar Car Designing and building the solar car IlangaI.I. Africon IEEE Conference, Sept. 2013, pp.1-5. (2013).