Protection of load and charge using Solar Power Management

Aparna Ojha[1], Chandra Shekhar Singh[2]

Student, Pranveer Singh Institute of Technology, Kanpur, Uttar Pradesh
Assistant Professor, Pranveer Singh Institute of Technology, Kanpur, Uttar Pradesh

ABSTRACT

This paper focuses on the protection of load and charge using solar power management. Solar energy is converted into electrical energy by photo-voltaic cells. This energy is stored in batteries during daytime to be utilized during night time. In fact, the developed project has many advantages as existing devices, as it deals with a controlled charging mechanism that avoids overcharge, deep discharge and under/over voltage of the battery and load. Unless barriers like under/over charge are overcome, maintaining and increasing electricity supplies from solar energy will require continuation of potentially costly policy support.

Keywords: *Solar Energy, Solar Power Management, Protection of Load and Charge.*

1. INTRODUCTION

According to market survey, demand for energy increasing worldwide, a continuous rise on the price of fossil combustibles. In fact, it is expected in future, that the demand for solar energy will grow faster. Out of certain renewable energy options, solar energy is the most potential source for all tropical countries. Solar Energy is the main prerequisite of the life on the Earth. Photoelectric effect in semiconductors, through which we can transform the solar energy in solar cells to power energy. Transformation of solar energy to power energy or electrical energy has wide utilization. Photovoltaic effect which permits to construct photovoltaic (PV) cell, was discovered by A. Becquerel in 1839. Sun radiates about 180 billion MW of energy over Earth. This energy could meet power needs of entire planet for a year just in one hour. India receives about 5000 trillion KWhrs of energy from sun per annum. Solar energy is clean, pollution free and inexhaustible. It is free and in abundance. MNRE, Govt. of India promoting utilization of solar energy for different applications such as household etc since 1980s.

Energy is the key factor for development in all sector i.e.; Industrial, Commercial, Agriculture, Domestic and many others. As per capita energy consumption is one of the indicators of national development status. India is leading at 6th largest country in terms of generation and consumption levels worldwide.

Solar panel or Photovoltaic (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibits the photovoltaic effect. Photovoltaic power generation employs solar panels comprised of a array of cells containing a photovoltaic material. The PV generator is formed by the combination of many PV cells connected in series and parallel to provide the desired value of the output voltage and current.

Nowadays, photo voltaic energy has low efficiency ratio concerning complete distribution chain from production end to consumption end.

Solar Power Charge Controller can be used in different sectors. It can be used in solar home system, Hybrid systems, solar water pump system etc. In this, a solar panel convert's sunlight energy into electrical energy through an electrochemical process know as photovoltaic process. Energy is stored in the battery with the help of solar panel through diode. Energy stored in the battery can be Used even when there is no sunlight as during discharge, chemical energy is converted into electrical energy which in turn illuminates electrical appliances. Hence, it is our need to protect battery form overcharge, deep discharging mode while loads are used or in under voltage as it is the main component in a solar power charge controller.

In this project, indications are provided by a LED for fully charged battery and a LED indicates that battery is charging. Charge controller uses diode as power semiconductor switch to ensure cut off the load in low battery or overload condition. When The battery gets fully charged, LED stops glowing.

Diodes are used to regulate the amount of charge coming from the solar panel in order to protect the battery from getting overcharged. Adding to this, it can also be used to allow different loads and supply appropriate voltage.

In this paper, charge controller used as power semiconductor switch to ensure cut off the load in low battery or under/overload condition.

An experimental prototype was built and field results have proven the good performance of the developed project.

2. BLOCK DIAGRAM
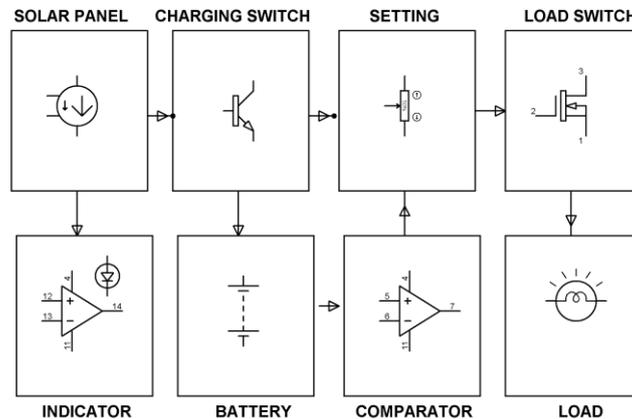
Fig1. Block Diagram of Project

3. COMPONENTS USED

i. Photovoltaic Cells and Solar Panel

Photovoltaic (PV) cells are made from special materials called semiconductors like Silicon. They are used for conversion of solar energy (light) into electrical energy using semiconductor materials that exhibit the photovoltaic effect. When the light strikes the cell, certain amount of light gets absorbed into the semiconductor material which triggers the flow of electrons that causes current to flow.
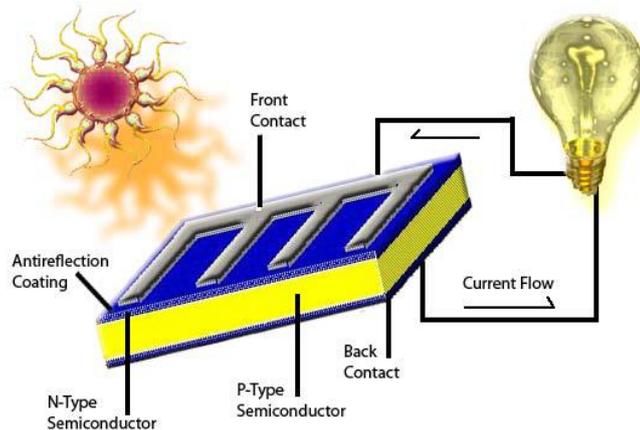

Fig2. Module of solar panel

We can place metal contacts on top and bottom of the cell, through which we can draw current externally.

Solar panel is designed to absorb sun's rays in order to generate electricity or heat. A PV module is a package which consists of solar cells.

Advantages of solar panels-

- It coverts solar energy into electrical energy directly, easily and efficiently.
- They are long lasting and does not require much operational maintenance.

Fig 3. Solar Panel

ii. Battery

In this project, a sealed rechargeable Battery (6V, 5AH) is used in to store energy. A battery converts chemical energy directly into electrical energy comprising of one or more electro-chemical cells. The battery can be used for household, robotics, industrial applications etc.

Fig4. Battery

iii. Diode

A diode is a device which only allows unidirectional flow of current and rated voltage. A diode only blocks current in the reverse direction while the reverse voltage is within a limited range otherwise reverse barrier breaks and the voltage at which this breakdown occurs is called reverse breakdown voltage. A particular arrangement of diodes can convert AC to pulsating DC, hence it is called rectifier.
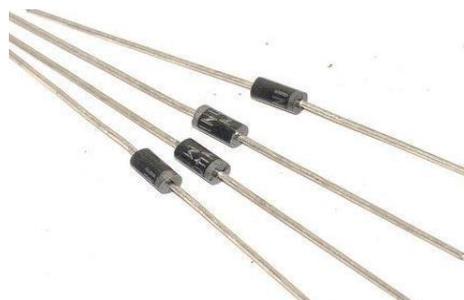
Fig5. Diode

iv. Transistor

A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit. The transistor terminal requires a fixed DC voltage in to operate in a desired region of its characteristic curves.

Fig6. Transistor

v. Resistors

Resistor is a component that resists the flow of direct or alternating electric circuit. Resistors can limit or divide the current, reduce the voltage, protect an electric circuit, or provide large amounts of heat or light. Resistors are designed to have a specific value of resistance.
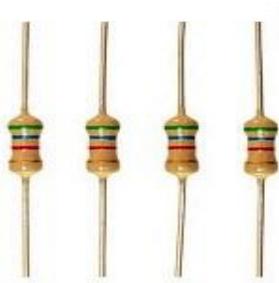
Fig7. Resistor

vi. Light Emitting Diode

A light-emitting diode (LED) is a semiconductor device that emits visible light when an electric current passes through it. The light is not particularly bright, but in most LEDs it is monochromatic, occurring at a single wavelength.
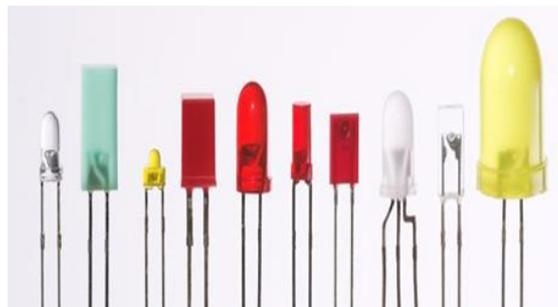

Fig8. LED

4. PCB CIRCUIT
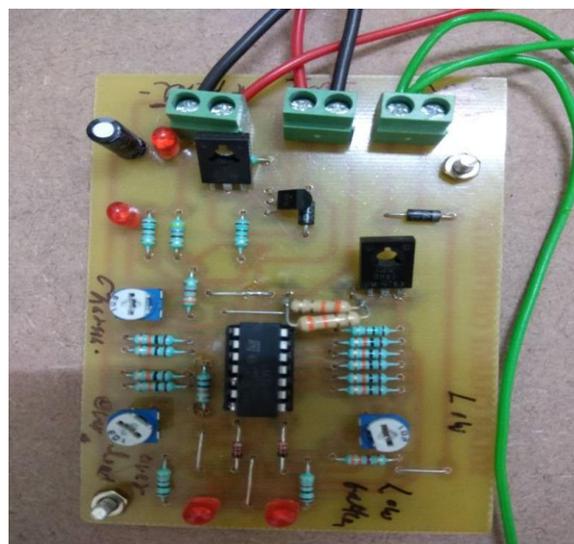
Fig9. Components fitted on PCB

5. SCHEMATIC DIAGRAM
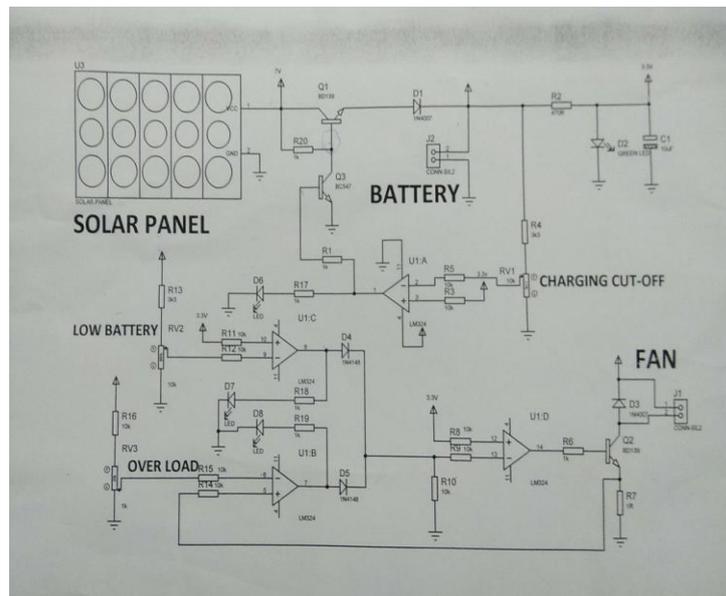

Fig10. Circuit Diagram

6. PROJECT
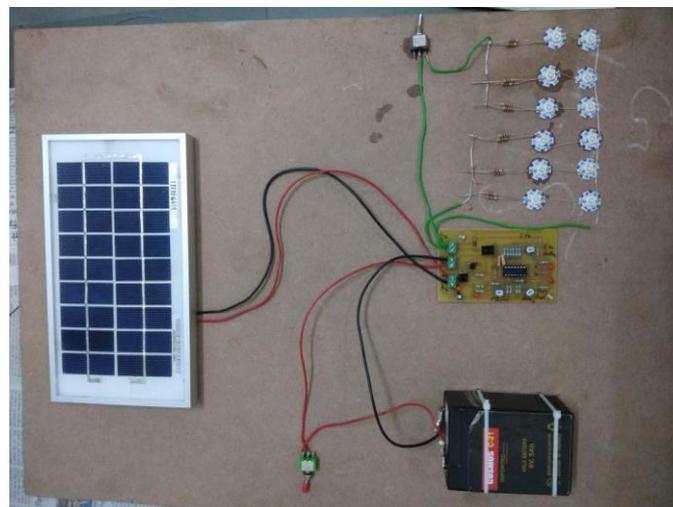
Fig11. Hardware Module

7. CONCLUSION

In this paper, a solar power management is used for protection of load and charge i.e. how rechargeable battery is used to store energy with the help of solar energy. It includes protection methods for the battery in order to curb problems like overcharging, deep discharge or under voltage which harm the life of a battery. The proposed system used solar PV module as an input and load (LED light) as an output. Further, the project can be enhanced by using microcontroller and GSM modem to communicate the status o the system to a control via SMS. This system can also be upgraded to normal UPS, when connected with the solar charger will convert to SOLAR INVERTERS/UPS with solar charge as priority.

8. REFERENCES

[1] DPR on "GRID CONNECTED SOLAR PHOTOVOLTIC (SPV) POWER PLANT", under Rooftop and other Small Solar Power generation Program (RPSSGP) and Jawaharlal Nehru National Solar Mission (JNNSM),by PHTO ENERGY SYSTEM LIMITED.
[2] MARK Z. JACOBSON (2009). Review of Solutions to Global Warming, Air Pollution, and Energy Security.
[3] VIKAS K. SINGH.DPR on "MICROCONTROLLER BAED SOLAR CHARGER", 2009
[4] KHNCHANDANI (2003) edition, POWER ELECTRONICS.
[5] Datasheet of PIC16F876A microcontroller, by MICROCHIP TECHNOLOGIES.
[6] Dr. ULRICH NICOLAI, Dr. TOBIAS REIMANN, Prof. JURGEN PETZOLDT, JOSEF LUTZ: "Application Manual IGBT & MOSFET Power Modules".
[7] Datasheet of CD4047B, by TEXAS INSTRUMENTS.