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# MPPT Solar Charge Controller

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**ABSTRACT-**

In this paper Maximum power point tracker battery charger is proposed for extracting maximum power from a photovoltaic panel to charge the battery. The output power of the PV system continuously varies with change in irradiance and temperature. It is very important to improve the efficiency of charger. There are number of maximum power point tracking (MPPT) methods available to operate the PV system at maximum power point. The proposed system have used Perturb & Observe (P&O) MPPT algorithm for the design and implementation. When irradiance and temperature are constant or slowly varying, the P&O method tracks MPP steadily and calculate the operating point at which the battery is capable of producing maximum power. In this method, the controller provides the PWM signal to adjust the voltage, adjustment is done by Buck converter and measures power, if the power increases, further adjustments in that direction are tried until power no longer increase.

## 1. INTRODUCTION

### *1.1 Introduction :*

Solar energy is one of the most important renewable energy sources that have been gaining increased attention in recent years.

The conversion of solar energy into electrical energy has many application fields. Recently, research and development of low cost flat-panel solar panels, thin-film devices, concentrator systems, and many innovative concepts have increased. In the near future, the costs of small solar-power modular units and solar-power plants will be economically feasible for large-scale production and use of solar energy.

In this paper we have presented the photovoltaic solar panel's operation. The foremost way to increase the efficiency of a solar panel is to use a Maximum Power Point Tracker (MPPT), a power electronic device that significantly increases the system efficiency. By using it the system operates at the Maximum Power Point (MPP) and produces its maximum power output. Thus, an MPPT maximizes the array efficiency, thereby reducing the overall system cost. In addition, we attempt to design the MPPT by using the algorithm of a selected MPPT method which is "Perturb and Observe" and implement it by using a DC- DC Converter. We have found various types of DC-DC converter. Among them we have selected the most suitable converter which is "BUCK" converter, for our design.

The objective of this project was to design a Maximum Power Point Tracker (MPPT) to constantly calculate and maintain the maximum amount of power from a solar panel. By using a DC/DC converter, our team was successfully able to create a system to reach this maximum power. The solar panel was modeled using a DC voltage source, which then was connected to the DC/DC converter. A buck DC/DC converter was used to step the voltage down. To test our design, the DC source was adjusted to various voltage inputs, and the maximum power was successfully calculated each time. This project was created using Matlab Simulink software and implemented using a breadboard then solderable board, and a DC voltage source.

## 2. METHODOLOGY

### *2.1. Hardware Implementation :*

This is the procedure of component selection, hardware installation and prototyping design. This project consists of several electronic components. The main components used in this project are MPPT, Solar Panel, Cables, Switching Devices etc.

#### *2.1.1. MPPT Controller:*

MPPT stands for Maximum Power Point Tracker; these are far more advanced than PWM charge controllers and enable the solar panel to operate at its maximum power point, or more precisely, the optimum voltage and current for maximum power output. Using this clever technology, MPPT solar charge controllers can be up to 30% more efficient, depending on the battery and operating voltage (Vmp) of the solar panel.


Fig. 2.1.1 :MPPT Controller

### *2.1.2. Solar Panel :*

Solar panels collect clean renewable energy in the form of sunlight and convert that light into electricity which can then be used to provide power for electrical loads. Solar panels absorb the photons and in doing so initiate an electric current. The resulting energy generated from photons striking the surface of the solar panel allows electrons to be knocked out of their atomic orbits and released into the electric field generated by the solar cells which then pull these free electrons into a directional current. This entire process is known as the Photovoltaic Effect.

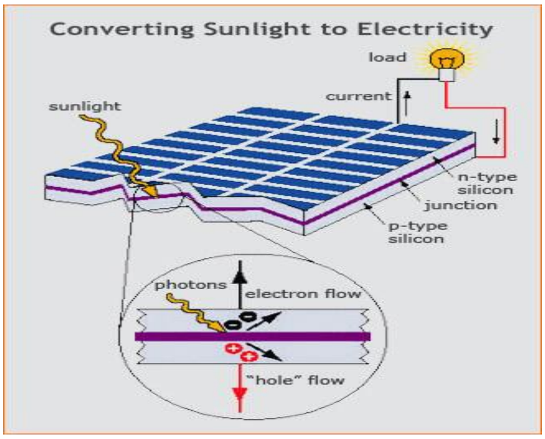



Fig. 2.1.2 :Solar Panel

### *2.1.3. Cables :*

There are various types of cables generally used in daily work. The main purpose of cables are to transfer the electrical energy. It is used to connect two or more devices to transfer the signal or power. Generally in the solar system mostly two core cable is used. There are various core size available in the market such as 1mm,2.5mm,4mm etc. As per our requirement we have used various types.

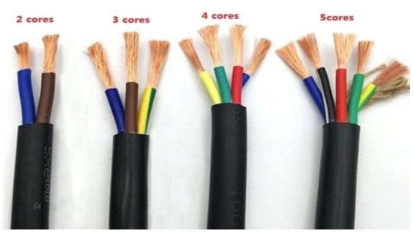



Fig. 2.1.3 :Cables

### *2.1.4. Switching Devices:*

Switching devices is used convert a source of direct current (DC) from one voltage level to another. There are several topologies available for DC-DC converter. Among them buck converter is in an increasingly popular topology, particularly in battery powered applications, as level of the output voltage can be changed with respect to input voltage The commonly used a converter in PV systems is a DC/DC power converter.

Fig. 2.1.4. :**Switching Device**

***2.1.5. Battery :***

A battery can be defined as an electrochemical device (consisting of one or more electrochemical cells) which can be charged with an electric current and discharged whenever required. Batteries are usually devices that are made up of multiple electrochemical cells that are connected to external inputs and outputs.

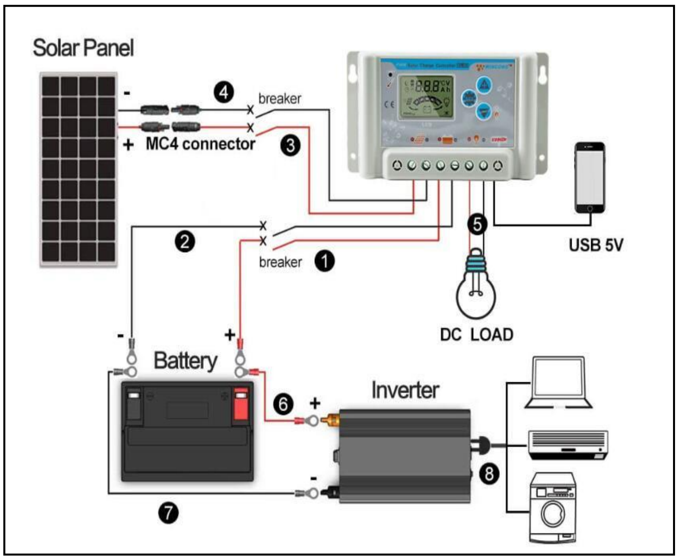

Fig. 2.1.5 –Battery

**2.2. Experimentation :**

The output characteristics of PV System is non-linear and it changes with INSOLATION and TEMPERATURE. When these two factors vary, MPP point varies accordingly. With increase in insolation the MPP shifts to right as shown in Fig.5. For higher magnitude of voltage we get the maximum power. In Fig.6 Current Vs Voltage graph is shown. With increase in insolation the MPP voltage increases and thereby the maximum current also increases. For the insolation level above 300W/m2 the MPP is almost constant design.

## 3. OPERATION

***3.1 Block Diagram :***




PV system is one of the fuming topics in the research. Many advance level works have been done. PV has been used to supply to the grid without any energy source or even with energy source. In this case bidirectional is used as we need power flow in both directions, from PV to the grid and even from the grid to the PV. Many PV's are connected in parallel in the form of generators to supply to the load. This paper proposes a fuzzy-based frequency control method for the Photovoltaic generator in a PV–diesel hybrid system without smoothing of PV output power fluctuations. In one of the papers control strategy has been proposed for the distribution network. It is possible that faults (both temporary and permanent faults) or even transient disturbance can occur . At that time a control mechanism is required so that PV output does not have any effect. This paper describes the mechanism. Another paper elaborates power control design of a battery charger for load following applications in a Hybrid Active PV generator.

***3.2Working :***

The voltage and the current work in the opposite manner. In other words, if the voltage increases, the current decreases, and if the current increases, the voltage decreases. The MPPT charge controller adds resistance to the current, adjusts the voltage to the current ratio, and increases the voltage. With the MPPT solar charge controller, you can expect to increase the current up to 25-30%. An interesting fact to remember is that the 80% discharged battery will get powered up faster than the 50% removed battery. This is because as the battery reduces, the voltage also drops. So, the voltage that a 50% discharged battery can provide is much less than that of an 80% battery. On a broader scale, MPPT has more connection with the solar panels rather than the batteries. For batteries, there's a battery management system.

## 4. Scope of Project

(i) The PV charge controller that designed in thisproject will be implement PIC microcontroller in it.

(ii) This project concentrates on DC-DC Converter.

(iii)This project will use PIC microcontroller to control the voltage and current at certain values that have been set which are act as input of the rechargeable battery and displays all the results of voltage, current, power and percentage remaining rechargeable battery on the LCD.s

## 5. Conclusion and Future Scope

The final project satisfies all the client requirements. Most client specifications are met and addressed. Moreover, the circuit design is based on MPPT algorithm with 95% efficiency. The project is built to have high efficiency and low cost. Figure 13 shows the final design of the 23 solar charge controller. For further improvement, the buck converter can be upgraded to buckboost converter in order to charge batteries from lower voltage sources, also the solar charge controller is designed with extra push button, LED, and four pins on the PCB for futuristic using

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