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Dual axis solar Tracking System Using MPPT Controller with self-cleaning Mechanism

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Abstract: The solar tracking system is the most common method of increasing the efficiency of solar photo module. This study presents the efficiencies of energy conversion of photo module with solar tracking system. The capability of photovoltaic (PV) panel to generate energy approximately follows the intensity of the sunlight on the panel. The proposed automatic tracking system controls elevation and orientation angles of solar panels such that the panels always maintain perpendicular to the sunlight. We mainly observe that most of the solar panels are positioned at fixed angles. In order to maximize the amount of solar radiation collected by a solar panel, we use solar tracking device whose function is to follow the sun orthogonally throughout the day which enhances the energy capacity of the system. This paper comprises of development and design of dual axis solar panel tracking system & experimental study of dual axis solar tracker compared to fix position solar panel in terms of performance enhancement. By using Maximum power tracking converter. We can increase the power generation as compared to Dual Axis and single axis power generation.

Keywords: Maximum Power Point Tracking System, Dual Axis Solar Tracking, Solar Power Efficiency.

I.INTRODUCTION

Solar energy refers to the conversion of the sun's rays into useful forms of energy, such as electricity or heat. A photovoltaic cell, commonly called a solar cell or PV, is the technology used to convert solar energy directly into electrical power. There are mainly two types of solar trackers on the basis of their movement degrees of freedoms. These are single axis solar tracker and dual axis solar tracker. Again, these two systems are further classified on the basis of their tracking technologies. Active, passive, and chronological trackers are three of them. Previous researchers used single axis tracking system which follows only the sun's daily motion. In active tracking or continuous tracking, the position of the sun in the sky during the day is continuously determined by sensors. The sensors will trigger the motor or actuator to move the mounting system so that the solar panels will always face the sun throughout the day. If the sunlight is not perpendicular to the tracker, then there will be a difference in light intensity on one light sensor compared to another. This difference can be used to determine in which direction the tracker has to be tilted in order to be perpendicular to the sun.

II.OVERVIEW OF MPPT BASED SOLAR TRACKING SYSTEM

This paper includes the working of Dual axis solar tracking system using MPPT controller with self-cleaning mechanism. The solar panel tracking is done by using for LDR sensors which are detecting the light intensity also two servo motors are used which are implemented for the rotation of solar panel follows to sun path. The MPPT is a Maximum Power Point Tracker which an electronic DC-DC converter.

The MPPT is optimize the match between solar panel output to the battery bank. Also, the self-cleaning mechanism is implemented which is helps to clean the solar panel and keep it free from dust. Cleaning mechanism is implemented by using the DC motor-based water pump which spray the water on solar panel after the end of the day or the complete rotation of 180 Degree. The Maximum power point tracker is improving the efficiency of solar panel output. Which is 35-40 % more than the static or single axis solar tracker system.

III.MAXIMUM POWER POINT TRACKER

An MPPT, or maximum power point tracker is an electronic DC to DC converter that optimizes the match between the solar array (PV panels), and the battery bank or utility grid. To put it simply, they convert a higher voltage DC output from solar panels (and a few wind generators) down to the lower voltage needed to charge batteries.

Solar cells are neat things. Unfortunately, they are not very smart. Neither are batteries - in fact, batteries are downright stupid. Most PV panels are built to put out a nominal 12 volts. The catch is "nominal". In actual fact, almost all "12-volt" solar panels are designed to put out from 16 to 18 volts. The problem is that a nominal 12-volt battery is pretty close to an actual 12 volts - 10.5 to 12.7 volts, depending on state of charge. Under charge, most batteries want from around 13.2 to 14.4 volts to fully charge - quite a bit different than what most panels are designed to put out.

Here is where the optimization or maximum power point tracking comes in. Assume your battery is low, at 12 volts. An MPPT takes that 17.6 volts at 7.4 amps and converts it down so that what the battery gets is now 10.8 amps at 12 volts. Now you still have almost 130 watts. Ideally, for 100% power conversion you would get around 11.3 amps at 11.5 volts,

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but you have to feed the battery a higher voltage to force the amps in. And this is a simplified explanation - in actual fact, the output of the MPPT charge controller might vary continually to adjust for getting the maximum amps into the battery. Using a non-MPPT charge controller is like connecting the battery directly to the solar module. A traditional charge controller may charge a battery with the voltage that is dictated by the battery. By nature, the voltage of a fully-charged battery is higher than that of a discharged-battery. Consequently, the power drawn by an empty battery is usually lower than that of a full battery.

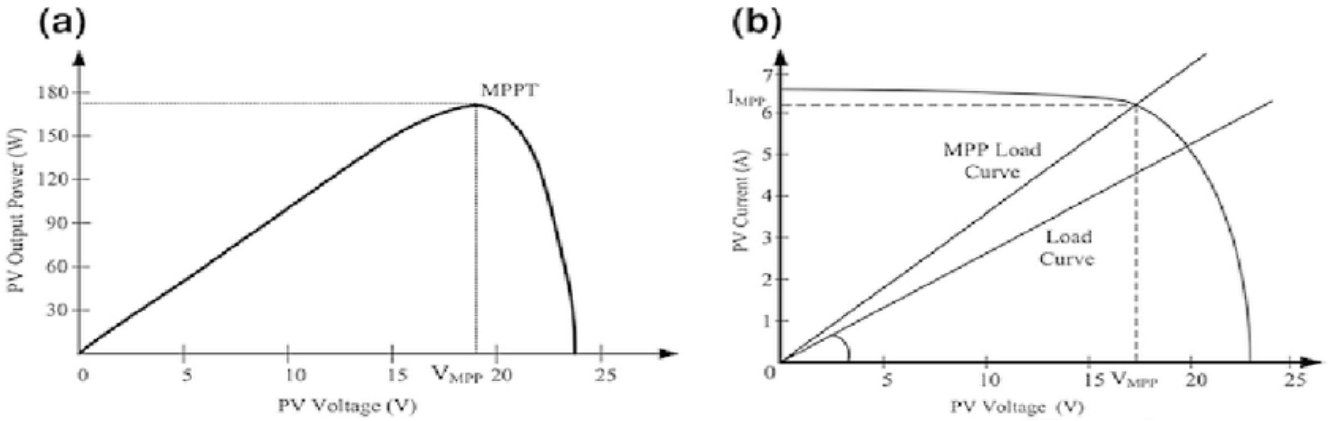

Fig a: Maximum power point tracking converter waveforms

IV.METHOD OF MPPT ALGORITHMS

Maximum power trackers (MPPTs) are used to get maximum strength after these frames. In these applications, the heap may require more power than the PV frame. This includes a variety of case-based investigations that span multiple buildings using basic voltage connections.

Perturb and Observe Method:

With this technique, the controller marginally change voltage relative to power then measures the power. If the force increases, further modifications are attempted along the way until the force stops increasing. It is called the P&O strategy. It is the most widely used MPPT technique because of its ease of use.

In Fig. b: the voltage of a cell is first extended; as the output power increases, the voltage continues to expand until the output power begins to decrease. As the output power begins to decrease, the voltage across the cell decreases until MPPT is reached.

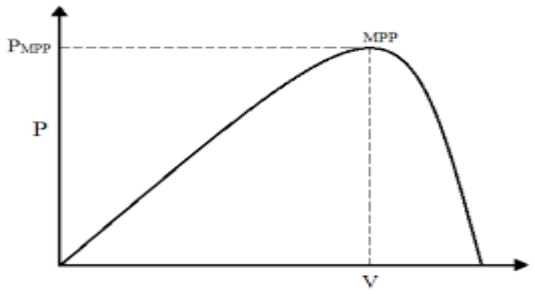

Fig. b: The Slope of P&O method

This result is the oscillation of the efficiency yield curve as a component of the voltage with constant irradiation and constant temperature of the module, whereby it is accepted that the photovoltaic element is hampered by small increase and subsequent variation of the P force is monitored. If P is negative, the operating point moves away from the MPP, and the interference process must be reversed to return to the MPP.

Benefits:

P&O is very popular and is the most used.

1. Algorithm is simple.
2. It is easy to implement.
3. It has Low cost

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V.PARTS USED FOR IMPLEMENTATION

- Arduino Uno:

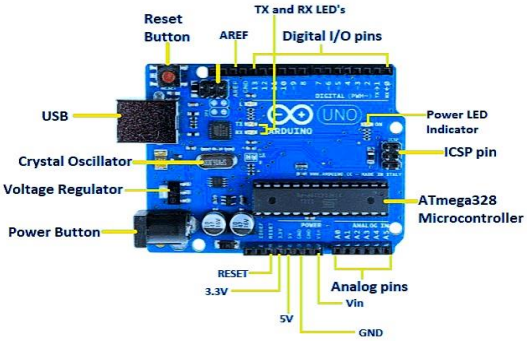

Fig. C: Arduino Uno Microcontroller

Arduino UNO consist ATMega328p-PU microcontroller is used. It is also called as Microchip. It consists of various digital input/output and analog input/output pins. Supply can be given to the Arduino by using USB cable. It is same as Arduino Nano and Leonardo. It can be supplied by using 5V adopter and also by using regulator ranging between 7 to 20V.It is very easy for using in hardware and software.

- Servo Motor:

A Servo motor is a rotary actuator that allows for precise control of angular position, velocity and acceleration. Servos are found in many places, from toys to home electronics to cars and airplanes. Servos also appear behind the scenes in devices we use every day. A servo motor works as part of a closed loop system providing torque and velocity as commanded from a servo controller utilizing a feedback device to close the loop.

- LDR Sensor

Fig. D: LDR Sensor

Light dependent Resistor LDR. It also called as photoresistor and photo-conductive cell. It is a passive device. Its main function is sensing the light intensity and it is electronic component. When the light intensity changes there is change in resistance.

LDR is made by semiconductor materials which has high resistance. Resistance and sensitivity of LDR is dependent upon semiconductor material. LDR's are used in Night lighting, streetlamps, Alarms, etc., The understanding of light-dependent resistors or photoresistors also differs with the wavelength of the occurrence light.

- Solar Panel:

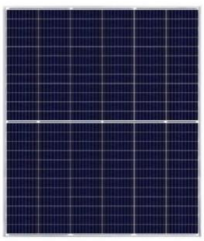

Fig. E: Solar Panel

Solar panels are made up of many solar cells . This cells are like a semiconductor which is made by silicon . There are two layers in PV cells, one is positive layer and another one is negative layer. When sun rays falls down to the solar panel,

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particals of energy called photons is there. That photons looses their energy that is electrons. As one know there is two layers one is positive and one is negative and it form a a electrical circuit. The electrons flows into that circuit is nothing but electrical energy. This energy can be used to power a load. A load may be a light.

Advantage of MPPT Based Dual Axis Solar Tracking System:

1. Maximizing the solar system energy production and consequential up to 45% more energy
2. The solar tracker delivers a rational solution in circumstances of limited power capacity of the assembly to the grid.
3. 3.This is efficient and energy saving.

VI.CONCLUSION

Dual axis solar tracking system is additional effective than the single axis solar tracking system. Mechanical system along with electrical system that is MPPT controller is provided in the design of DC-DC boost converter. It is providing with self-cleaning technique which is insured cleaning on solar panel at consistent intervals. It is also maximizing the energy generation, so it improves the overall efficiency of system.

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