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A PATH FOR HORIZING YOUR INNOVATIVE WORK

MPPT FOR PHOTOVOLTAIC APPLICATION USING ARDUINO

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Abstract- A maximum power point tracking algorithm is absolutely necessary to increase the efficiency of the solar panel as it has been found that only 30-40% of energy incident is converted into electrical energy. Due to the growing demand on electricity, the limited stock and rising prices of conventional sources (such as coal and petroleum, etc.), photovoltaic (PV) energy becomes a promising alternative as it is omnipresent, freely available, environment friendly, and has less operational and maintenance costs. Therefore, the demand of PV generation systems seems to be increased for both standalone and grid-connected modes of PV systems. This paper proposed the perturb and observed MPPT method using Arduino.

Keywords:- Photovoltaic, maximum power point tracking (MPPT).

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INTRODUCTION

Maximum Power Point Tracking, frequently referred to as MPPT, is an electronic system that operates the Photovoltaic (PV) modules in a manner that allows the modules to produce all the power they are capable of. MPPT is not a mechanical tracking system that "physically moves" the modules to make them point more directly at the sun. MPPT is a fully electronic system that varies the electrical operating point of the modules so that the modules are able to deliver maximum available power.

Two existing drawbacks encountered while generating power from PV systems are: the first one that the efficiency of electric power generation is very low, especially under low radiation states, and the other drawback is the amount of electric power generated by solar arrays is always changing with weather conditions, i.e., irradiation and temperature**.** it can be observed that the output power characteristics of the PV system as function of irradiance and temperature is nonlinear and is crucially influenced by solar irradiation and temperature. The Maximum Power Point (MPP) of the PV array changes continuously; consequently the PV system's operating point must change to maximize the energy produced. Therefore, an efficient maximum power point tracking (MPPT) technique is necessary that is expected to track the MPP at all environmental conditions and then force the PV system to operate at that MPP point. MPP refers to PV's unique operating point delivering maximum power giving highest efficiency of array. It varies with solar in isolation and temperature & needs to be monitored through tracking techniques. As per Maximum Power Transfer Theorem, Maximum Power is delivered to load when source internal impedance matches load impedance.

For determining MPP appropriate Tracker is introduced between PV system and load. It is to be designed that gives good performance, fast response, and less fluctuations. Since the efficiency of the PV is affected by the panel's irradiance and temperature which are stochastic and unpredictable. For this reason, it is not possible to connect the load directly to the PV to obtain the maximum power, so it is necessary to include a balance of system (BOS).

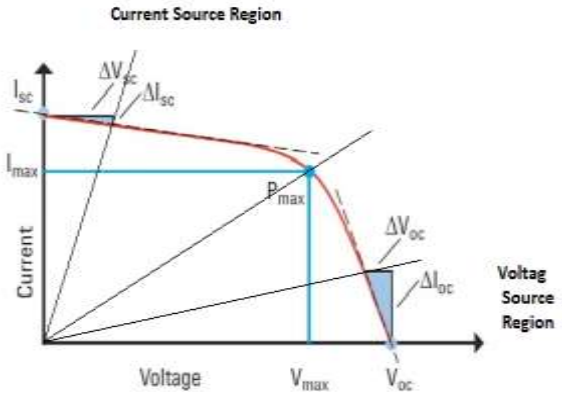

Figure 1. Voltage Current & Power Voltage Characteristics

Typically this BOS is a DC-DC converter to adjust the properties of the load. This converter has the advantage of managing the power delivered to the load. DC/DC converter is responsible for transferring maximum power from the solar PV module to the load. This

acts as adjustment to match impedance of source & load. MPPT is normally operated with the use of a dc-dc converter (step up or step down). The location of the MPP is not known, but can be located, either through calculation models or by search algorithms.

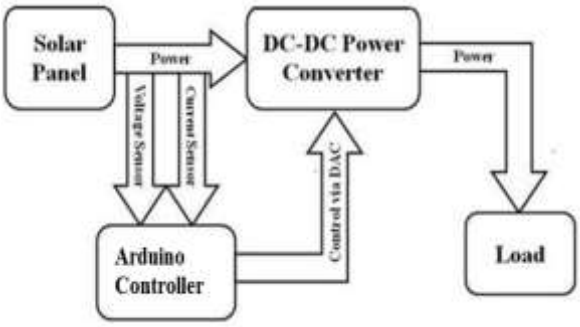

Figure 2. Block Diagram of MPPT System

2. LITEARTURE SURVEY

1. Safari A., Mekhilef S. presented a paper about that the basic structural unit of a solar module is the PV cells and PV module characteristics comprehensively discuss which indicates an exponential and non-linear relation between output current and voltage of PV module. It gives an idea about the significant points on each I-V curve: open circuit voltage, short circuit current and the operating point where the module performs the maximum power (MPP).
2. Mohamed Azab presented his paper "A New Maximum Power Point Tracking for Photovoltaic Systems" in the International Journal of Electrical and Electronics Engineering 3:11 2009, discussed the pv equivalent circuit & equation, the different MPPT Techniques,simulated result of MPPT method.
3. Ainah Priye Kenneth presented his paper "Design of Dc-Dc Converter with Maximum Power Point Tracker Using Pulse Generating (555 Timers) Circuit for Photovoltaic Module" in International Journal of Scientific & Engineering Research Volume 3, Issue 6, June-2012 ISSN 2229-5518, great described the working of dc-dc converter,the duty cycle to control gate using the IC555.
4. Chandani Sharma, Anamika Jain " MAXIMUM POWER POINT TRACKING TECHNIQUES: A REVIEW", described a good mean of MPPT,MPPT techniques and comparisons of different MPPT Techniques.

3. OPERATION OF PHOTOVOLTAIC SOLAR CELL

Photovoltaic effect is a phenomenon in which solar energy is converted directly into electrical energy through the use of a solar cell. Therefore, cells produce current and voltage, the amount of current produced depends on the area of the cell whereas the amount of voltage produced does not depend on the cells area. Both the voltage and current are affected by the resistance of the circuit the cell is present in. The light level and the temperature available to the cell affect the amount of current and voltage produced respectively, which will have a direct effect on the power output.

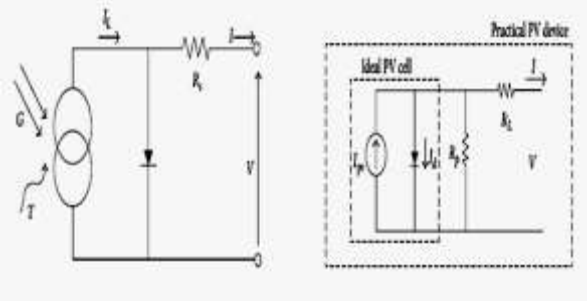

Figure 3. Equivalent Circuit of PV Cell

The basic equation that describes the (I-V) characteristics of the PV model is given by the following equation:

$$I = I_L - I_o\left(e^{\frac{q(V+IR_s)}{kT}} - 1\right) - \frac{V + IR_s}{R_{sh}}$$

Where:
I is the cell current (A).
IL is the light generated current (A).
Io is the diode saturation current.
q is the charge of electron = 1.6 x 10^{-19} (coul).
K is the Boltzman constant 1.38064852 × 10^{-23} (j/K).
T is the cell temperature (K).
Rs , Rsh are cell series and shunt resistance (ohms).
V is the cell output voltage (V).

4. DC-DC CONVERTER

The designed DC-DC boost converter is connected between the photovoltaic module and the load so as to enable the module operates at maximum power at all time. Boost converter is made of up four elements as shown below in figure1, they include the inductance, diode, capacitor and M0SFET. As the name of the converter implies , it steps up the input voltage which makes the output voltage greater than the input voltage. The converter is control through the MOSFET which act as a switch. The ON and OFF of the switch (MOSFET) controls the output voltage by changing the voltage of the inductance so as to enable the photovoltaic module power the load at maximum voltage.

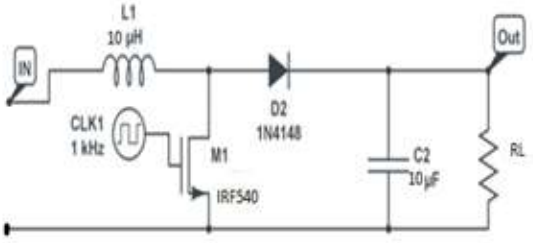

Figure 4. DC-DC Converer

5. MPPT Techniques

The large number of methods proposed can make it difficult to determine the best technique to adopt when implementing a PV system. The methods all vary in complexity, number of sensors required, digital or analogue implementation, convergence speed, tracking ability, and cost effectivenessFor this reason, follow summaries the most popular MPPT techniques in use today. Two promising methods are then highlighted for consideration when implementing a system which needs to cope well over a wide range of irradiance conditions.

DIFFERENT MPPT TECHNIQUES

Indirect Methods

MPP is estimated from Voltage, Current, The irradiance, Using empirical data, Mathematical expressions of numerical approx. The estimation is carried out for a specific PV generator installed in the system.

1. Constant Voltage
2. Open Circuit Voltage
3. Short Circuit Current
4. Temperature Parametric

Direct MPPT Method

Direct MPPT Method Use voltage and/or current which sense from the current and voltage sensor. Information Prior knowledge of PV panel is not required, Independent of isolation, temperature and degradation levels, Computational intensive

1. Perturb and Observe
2. Incremental Conductance
3. Fuzzy Logic Control
4. Slide Control Method

Perturb and Observe (P&O) method of MPPT

This is an algorithm which is used as a method of MPPT. The P&O tracking process is carried out by observing the array output power and determining the next action, either to increase or decrease the array operating voltage. In recent times this method has been widely used to achieve the maximum amount of power from a solar panel. The presence of multiple local maximum power points, these occur when an entire PV array do not receive uniform solar irradiance, due to partial shading, reduce the effectiveness of this method greatly. If the operating voltage of a PV array is perturbed in a given direction and if the power drawn from the PV array increases, this means that the operating point has moved towards the MPP and therefore, the operating voltage must be further perturbed in the same direction. Otherwise, if the power drawn from the PV array decreases, the operating point has moved away from the MPP and therefore, the direction of the operating voltage perturbation must be reversed.

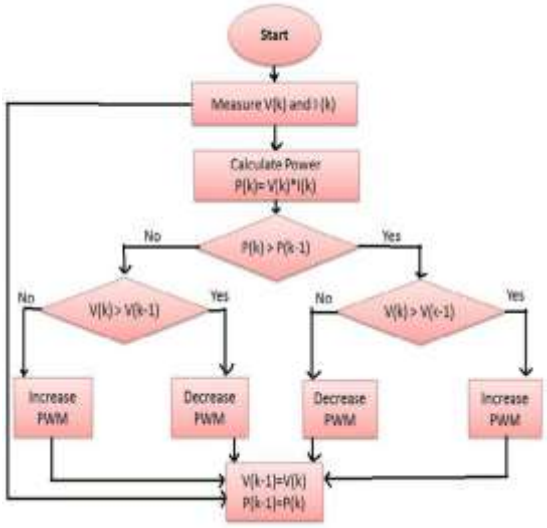

Figure 5. Perturb & Observed Alogrithm

6. CONTROL OF PWM FOR DC DC CONVERTER USING ARDUINO

The microcontroller to be used to implement the required algorithm is the Arduino. The Arduino is relatively simple and is perfectly able to implement the type of algorithm that is used. Arduino has inbuilt DAC & ADC so we no need to be use the IC such IC555 to generate the PWM and to read the voltage & current not need to use ADC.

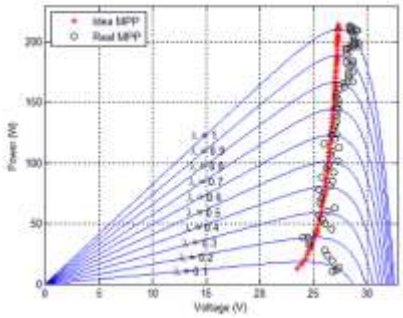

Figure 6. MPPT curve

7. CONLCUSION

A maximum power point tracking algorithm is absolutely necessary to increase the efficiency of the solar panel as it has been found that only 80-90% of energy incident is now converted into electrical energy. Furthermore, the MPPT should be capable of minimising the ripple around the MPP. Therefore, the two techniques stages—incremental conductance (IC) and perturbation and observation (P & O) algorithms are suitable. These two methods have been evaluated by simulating a standalone PV system, utilising a DC-DC boost converter to connect the PV panel to the load.

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