ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 4, April 2016

Enhancing the Efficiency of Solar Power System with Perturb and Observe Method

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ABSTRACT: In this paper, for extracting maximum power from photovoltaic panel to charge battery.There are number of maximum power point tracking (MPPT) methods available to operate the PV system at maximum power point. The proposed system has used Perturb and Observe (P and O) MPPT algorithm for the design and implementation. A simulation study of maximum power point tracking (MPPT) for photovoltaic systems using perturb and observe algorithm. Maximum power point tracking (MPPT)is used in photovoltaic (PV) systems to maximize the photovoltaic array output power.

KEYWORDS: Solar PV System, MPPT, P and O Algorithm, buck DC to DC converter, PIC Micro-controller.

I.INTRODUCTION

Solar energy is one of the most important renewable energy sources that have been gaining increased attention in recent years. Solar energy is freely available in nature. Solar energy does not produce pollutant or byproducts which are harmful to nature. solar panel is fundamental energy conversion component of photovoltaic system. Maximum power point tracking is most popular for small scale system for economic reason. [4] Maximum power will be detected by MPPT technique. Maximum power point is used to increase the efficiency of solar panel. MPPT charge controller can Transform power from high voltage to low voltage. By using MPPT system operate at maximum power point. Thus MPPT improve the efficiency reducing the cost of system.There are various methods that have been widely implemented to track maximum power. [5] the algorithm that are most commonly used are the perturb and observe method, which is simple and easy to implementation of the buck-boost converter appropriately we can match the source impedance with that of the load impedance.

II.MPPT METHODS

There are some methods for MPPT. Seven of them are listed here. These methods include:
1. Constant Voltage method
2. Open Circuit Voltage method
3. Short Circuit Current method
4. Perturb and Observe method
5. Incremental Conductance method
6. Temperature method
7. Temperature Parametric method

The choice of the algorithm depends on the time complexity the algorithm takes to track the MPP, implementation cost and the ease of implementation.

III.PERTURB AND OBSERVE METHOD

A typical solar panel converts only 30 to 40 precents of the solar energy into electrical energy. Maximum power point tracking technique is used to improve the efficiency of the solar panel [2]. According to Maximum Power Transfer

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technique, the output power of a circuit is maximum when the source impedance equal to the load impedance. In the source side a buck converter is connected to a solar panel in order to improve the output voltage. By changing the duty cycle of the buck converter appropriately by PWM signal the source impedance is equal to that of the load impedance. There are various types of MPPT techniques. Among those methods, the perturb and observe (P and O) and incremental conductance (INC) methods are widely used although they have some problems such as the oscillation around MPP and confusion by rapidly changing atmospheric conditions. In this method the controller adjusts the voltage by a small amount from the array and measures power, if the power increases, further adjustments in the direction are tried until power no longer increases. This is called P and O method.

IV.PERTURB AND OBSERVE MATLAB SIMULATION

SIMUIATION MODEL Of TOTAL P AND O METHOD

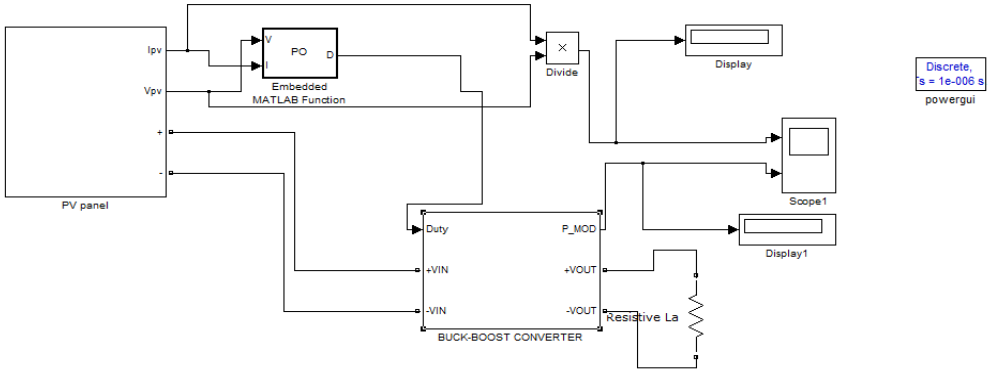

Figure 1: Matlab Simulation Of Perturb And Observe Method

SIMULATION MODEL OF SOLAR PANEL

The solar cell consists of a 0.1 ohm series resistance and an 8 ohm parallel resistance. This was modeled using the Sim Power System blocks in the MATLAB library. The Simulink model is as shown in fig5.2. A controlled current source is utilized to drive the solar cell. The control signal is provided by the buck boost converter unit[s3]. The buck boost converter takes into account the number of series connected, number of parallel connected solar cells and the temperature to determine the input signal from the solar cell[1].

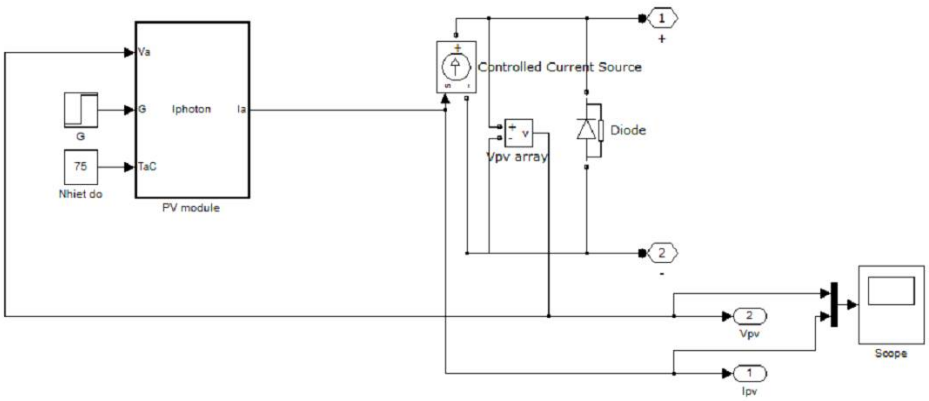

Figure 2: Matlab Simulation Model Of Solar Panel

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SIMULATION MODEL OF BUCK-BOOST CONVERTER

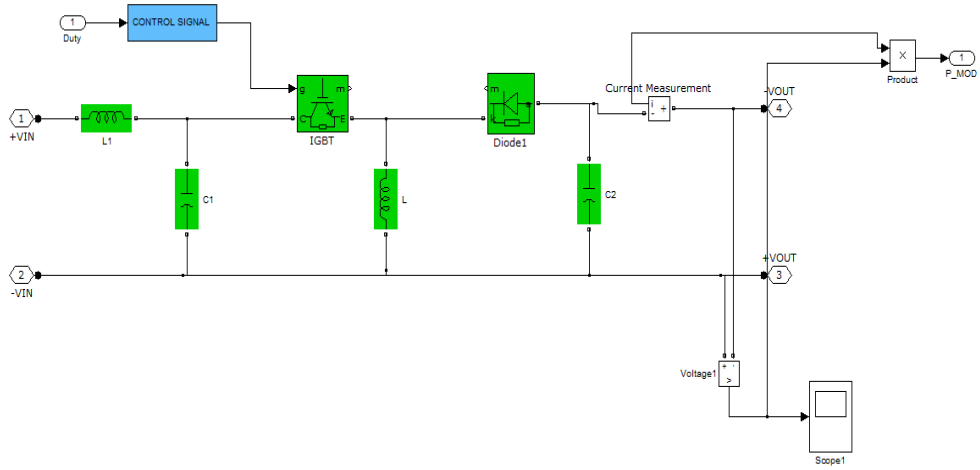

Figure 3: Matlab Simulation Of Buck-Boost Converter.

It provides an output voltage that may be less than or greater than the input voltage hence the name buck-boost; the output voltage polarity is opposite to that of the input voltage. This regulator is also known as an inverting regulator During Mode 1, IGBT is turn on and diode D is reversed biased. The input current, which rises, flows through inductor L and IGBT .During mode 2,IGBT is switch off and the current ,which was flowing through inductor L, would flow through L,C , diode and the load .The energy stored in inductor L would be transferred to the load and the inductor current would fall until IGBT is switched on again in the next cycle.

V.SIMULATION OUTPUT RESULTS

SIMULATION OUTPUT RESULT OF SOLAR PANEL

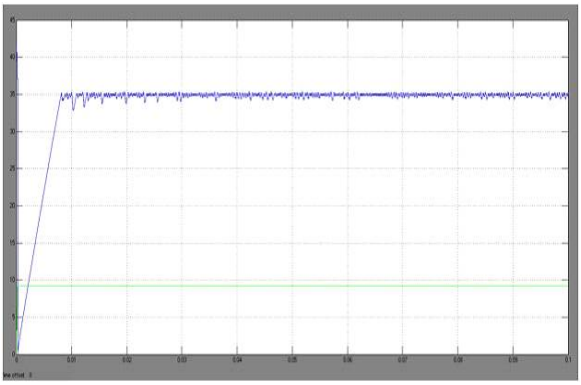

Figure 4: Simulation Output Result Of Solar Panel

This is output result of solar panel which shows the output voltage of solar panel varies with respect to time. that is voltage is changes with time of day. For getting maximum output we use perturb and observe method of MPPT techniques.

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SIMULATION OUTPUT RESULT OF BUCK-BOOST CONVERTER

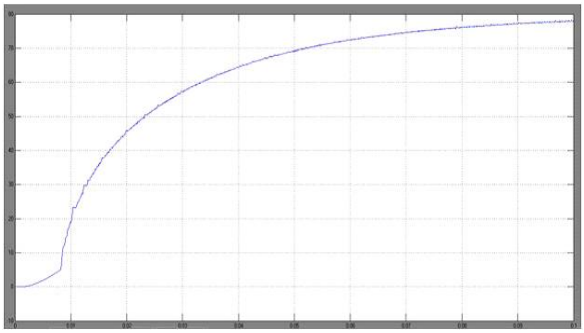

Figure 6: Simulation Output Result Of Buck-Boost Converter

Buck boost converter provides an output voltage which may be less than or greater than the input voltage. Figure shows the graph of output voltage of buck boost converter with respect to time. Varies according to time of day.

SIMULATION OUTPUT RESULT OF P AND O MODEL

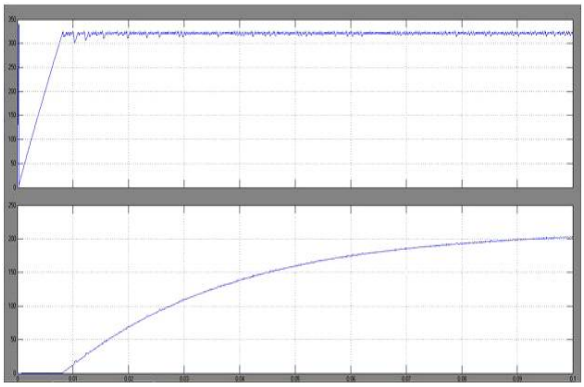

Figure 5: Simulation Output Result Of PAnd O Model

This graph shows the output voltage of total P and O model and output current of P and O model with respect to time .In this graph both output voltage of solar panel and buck boost converter are considered.

VI.ADVANTAGES

Solar energy is renewable energy source on the earth, it is life time available.
One time investment but lifetime use.
Pollution free.
We can expand the capacity of the generation by adding more panels in future.
Life solar panels are very large, minimum 90 precents output up to 10 years and 80 precents output after 25 years.

VII.DISADVANTAGES

Capital cost is more.
If solar panels will have shadow on it, then solar output will drastically decreased by 10 precents of actual output.
Storage of energy devices required is very costly.

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VIII.CONCLUSION

P and O method is the most frequently used algorithm to track the maximum power due to its easy implementation. This method finds the maximum power point of PV modules by iteratively perturbing, observing and comparing the power generated by the PV modules. Perturb and Observe (P and O) is the simplest method. In this method we use only one sensor, that is the voltage sensor, to sense the PV array voltage and so the cost of implementation is less and hence easy to implement. The time complexity of this algorithm is very less but on reaching very close to the MPP it doesn't stop at the MPP and keeps on perturbing on both the directions. When this happens the algorithm has reached very close to the MPP and we can set an appropriate error limit or can use a wait function which ends up increasing the time complexity of the algorithm.

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