MAXIMUM POWER POINT TRACKING USING PERTURB AND OBSERVE METHOD

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ABSTRACT

This paper highlights the tracking of maximum power point using perturb and observe method. The main disadvantage of solar panel is high cost and low efficiency due to weather conditions and irradiance. Therefore, maximum power point tracking method is used here to derive the point at which maximum output power can be obtained. Without Maximum power point tracking (MPPT) effectuation the solar cells are found to be dissipating more heat implying that the panel does not produce the maximum power possible. There are many types of MPPT for obtaining maximum power efficiency. In this paper, we use perturb and observe method. This method is simple, low cost easy to implement and provide high efficiency compare to other methods. Using Perturb and Observe method, 84.90% maximum power point tracking efficiency is obtained.

INDEX TERMS: *Solar cells (PV cell), Maximum Power Point Tracking (MPPT), Perturb and Observe method (P&O), High efficiency.*

1. INTRODUCTION

The production and consumption of electricity is highly balanced and maintained in the electrical system. Electricity shortage is due to the increase in power demand and insufficient production of power. Solar Energy is most important renewable resources that is highly required for our environment. Solar photovoltaic has gained tremendous importance due to technological advancements in achieving efficient energy. However, the solar PV arrays cannot deliver the maximum power automatically and it showed non-linear dynamic behavior, thus it has non-linear I-V curve. Therefore, maximum power point tracking method is used to track the maximum power point in I-V curve of photovoltaic arrays. An on-line tracking of the maximum power point of a PV array is an essential part of a PV system. There are many MPPT techniques discovered by researches and this paper proposes Perturb and Observe method which is simple and easy to implement.

1.1 Maximum Power Point Tracking

Nowadays, battery based renewable energy resources need charge controller to control the output power. An MPPT charge controller (fig 1.1) is always more economical when the whole power system is considered. The MPPT method is used in both wind and solar renewable energy sources. This method is very useful in tracking the maximum point where the maximum power output can be determined. It also increases the performance of the solar PV array panels. The maximum power point tracking systems are built using microprocessors that can interpret electrical inputs such as current and voltage in a circuit. The concept of maximum power point tracking is to monitor the terminal voltage and current continuously and to update the values if it is not matched with the reference values. If this process continues then the maximum power point is obtained. Two sensors, voltage and current sensors are connected to the output of PV panel to determine the output voltage and current, a boost converter is connected between the photovoltaic panel and the load. This boost converter consists of the MPPT algorithm used to extract maximum available power.

Fig: 1.1 MPPT controller

1.2 Perturb and Observe (P&O)

The Perturb and Observe method is simple, common and most widespread MPPT algorithm. The implementation of this algorithm is inexpensive while being effective and robust. The P&O algorithm operate by periodically perturbing i.e incrementing or decrementing the array terminal voltage and comparing the PV output power with that of the previous perturbation cycle. If the PV array operating voltage changes and power increases, the control system moves the PV array operating point in that direction; otherwise the operating point is moved in the opposite direction. In the next perturbation cycle the algorithm continues in the same way.

In Fig 1.2 (a), if the operating voltage of the PV array is perturbed in a given direction and dP/dV > 0, it is known that the perturbation moved the array's operating point toward the MPP. The P&O algorithm would then continue to perturb the PV array voltage in the same direction. If dP/dV < 0, then the change in operating point moved the PV array away from the MPP, and the P&O algorithm reverses the direction of the perturbation. In Fig 1.2 (b) the flow chart of P&O algorithm is explained.

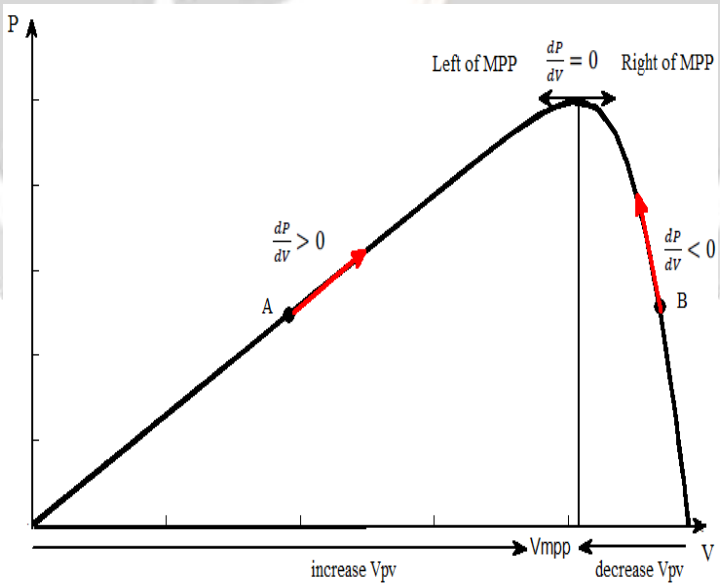

Fig: 1.2 (a) dP/dV at different positions on power characteristics

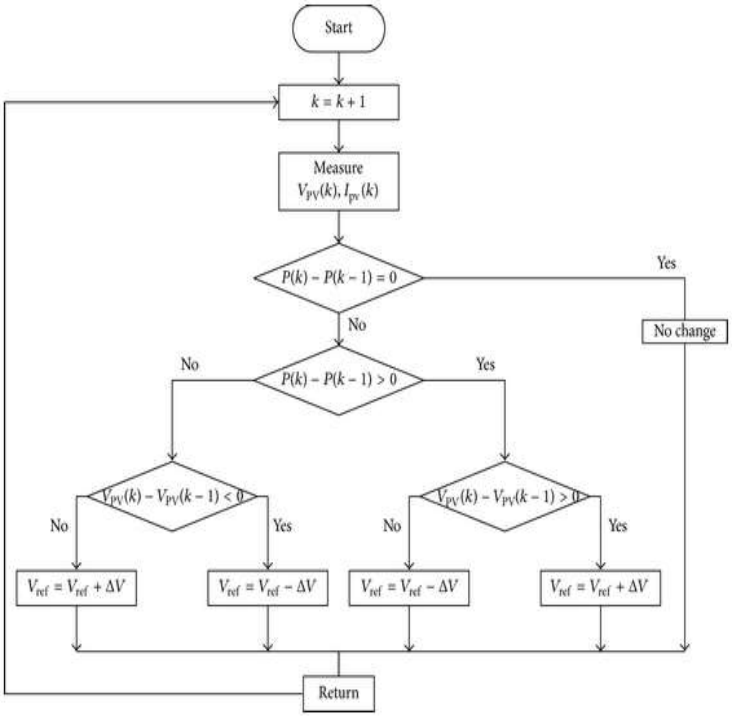

Fig : 1.2 (b) Flowchart of P&O algorithm

2. EQUIVALENT CIRCUIT & CHARACTERISTICS OF PV PANEL

The commonly used simplified electrical equivalent model of a solar PV cell composes of a photocurrent source and a diode connected across the current source with the internal series resistance (Rs) and the shunt resistance (Rsh) as shown in fig 2.1. Due to forward biasing of the parallel diode, the semiconductor junction giving limited output voltage and power then the output characteristic of each cell is nonlinear.

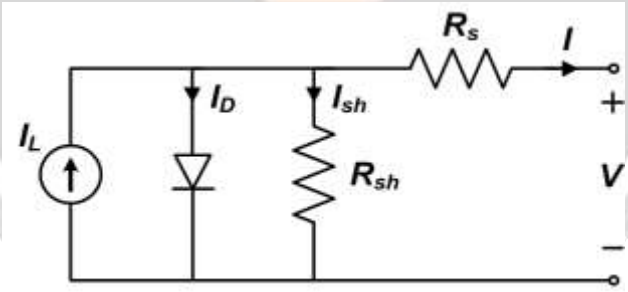

Fig: 2.1 Equvialent circuit of PV panel

Insolation (irradiance) and operating temperature are two important factors incorporating the characteristics of solar cell. The rating of a PV module can be estimated by the maximum power produced by a module under standard test conditions. Standard test condition represent a cell temperature of T= 25^{O}C and insolation level of S=1.0 KW/$metre^{2}$` However, typical P-V output characteristic curve of PV module are nonlinear and have one maximum power point (MPP).

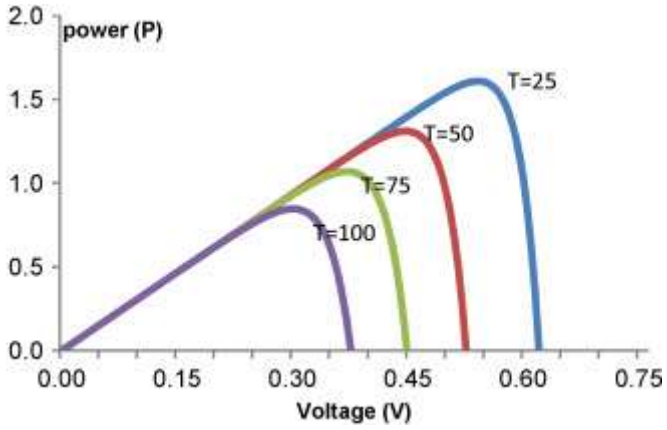

Fig 2.2 p-v characteristics of PV panel

3. PROPOSED SYSTEM

The main block diagram of Maximum Power Point Tracking using Perturb and Observe method is illustrated in figure 3.1. Due to irradiance and temperature changes the Maximum Power Point (MPP) is tracked by changing the output voltage of PV panel continuously which is the input voltage of boost converter. A boost converter is dc-dc power converter that steps up voltage from its input to its output. The P&O perturbation step-sized used in any MPPT technique plays a significant role in determining the accuracy and speed with which the operating point moves toward the MPP.

For a given perturbation interval, the larger the perturbation steps the faster the operating point can be driven to the MPP. However the larger the perturbation step size, the larger are the intrinsic oscillations around the MPP in steady-state. These oscillations would reduce the effectiveness of the PV power conversion because of the larger error and lost opportunity to generate power. A smaller perturbation step size reduce the magnitude of oscillation around the MPP and increase the energy conversion effectiveness once the MPP has been achieved. To maintain the output voltage of the boost converter, duty ratio D is varied.

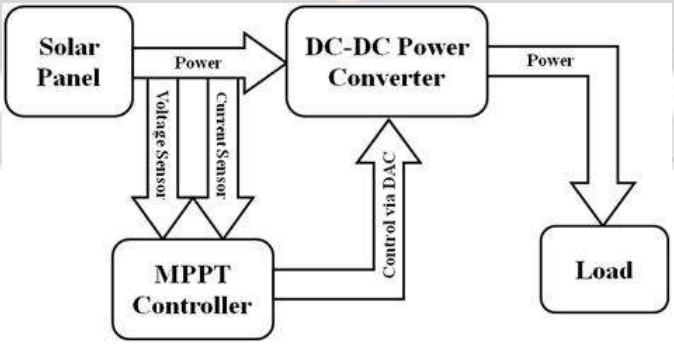

Fig: 3.1 Main block diagram

4. SIMULATION AND EXPERIMENTAL RESULTS

This section deals the simulation and experimental results of the PV power response under a series of step-down changes of illumination. Although, there is slight difference in the magnitude of the PV power oscillations, the response from the PV panel is closely matched with the practical results. In addition, the transient after each step change of illumination settles quickly. However, the tracking maximum power point process continues until the duty ratio becomes constant and bring it to steady state condition. The simulation results are compared with the theoretical PV values. When we multiply the PV voltage and PV current the PV power is determined.

Talking about the efficiency, the normal solar panel outcome is less compared to solar PV panel using MPPT technique.

5. CONCLUSIONS

The increasing industrialization of democracy and unpredictable green circumstances has influenced us to raise our passion for renewable energy's just as solar energy. Solar PV power formation from solar light is validated by way of MPPT for adequate tracking. In this paper, P&O method is proposed for tracking the Maximum power point for solar PV system. P&O algorithm is the most frequently used method for MPPT due to its simplicity and low cost implementation. In conclusion, non-conventional energy sources of energy will dominate the conventional sources of energy in the near future and here one uses the greatest renewable energy of all, the sun's energy

6. FUTURE WORK

We have planned to implement the artificial intelligence based on MPPT algorithm because under non uniform and partially shading conditions, power and current characteristics of PV cells are more complex and it is also more difficult to track MPP. Artificial intelligence can produce appropriate solutions for any environmental conditions.

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