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A Review on Maximum Power Point Tracker (MPPT) for Photovoltaic (PV) Systems

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ABSTRACT

Maximum Power Point Tracking (MPPT) is a modified feedback Technique where operating point of power converter connecting source to load is constantly dithered by a small amount. In general, the output impedance of energy harvesting sources varies with input level, temperature, often input frequency, and other parameters. Matching the resulting impedance deterministically is virtually impossible, so a technique called MPPT is developed. This paper presents a literature survey on various techniques used in achieving the Maximum Power Point (MPP) and the algorithms used in it.

Key words: MPPT, P&O algorithm, Photovoltaic, MOSFET

INTRODUCTION

Energy is essential for life as well as economy. Nowadays, the need for energy has increased exponentially. As the country develops, the demand in the energy also increases. The most commonly used source of energy, today, are fossil fuels such as petroleum, coal etc. But these resources cannot be replenished at the rate at which they are being consumed. This puts extra pressure on the conventional sources of energy and leads to the problem of Energy Crisis and in turn leads to Economic Crisis in the country. The solution to this problem is found in the use of Renewable or Non-conventional energy sources.

The recent upsurge in the demands of PV systems is due to the fact that they produce electric power without hampering the environment by directly converting the solar radiation into electric power. However, the solar radiation never remains constant throughout the day. The need of the hour is to deliver constant voltage and maximum power to stand alone systems. For this the concept of MPPT is implemented, that results in appreciable increase in efficiency of the PV systems.

LITERATURE SURVEY

A lot of literature is scanned by us and some of the papers in from of review are presented here. In [1] Lim and Hamill have proposed a new method for tracking the maximum power point (MPP) of the solar modules. Most of the present MPP Trackers use Perturb and Observe approach to track the maximum power point with the help of microcontroller. The system is based on nonlinear dynamics to track the MPP. The technique presented makes the system uncomplicated and cheaper. The response of the system is increased when the MPP moves abruptly. Though the circuit shown is simple, its dynamics is pretty complex. In [2] Patil and Mahadik reported the MPPT system which tracks the MPP using microcontroller. A Single Ended Primary Inductor Converter (SEPIC) circuit is used to both step up and step down the Solar panel voltage for charging the battery. The inductor current helps in providing better efficiency. The P&O algorithm is used in microcontroller for its simplicity and good performance. The PWM is used to control the switching of MOSFET in the SEPIC circuit. The system is costlier than today's analog charge controllers.

Pandey et al [3] have discussed the limitations of Perturb & Observe algorithm for MPP tracking due to continuously changing environmental conditions. The power versus Voltage curve was evaluated and the drift was minimized. A variable-step-length algorithm is also proposed in this paper. A fast and accurate MPPT algorithm is proposed by Yuvrajan and Shoeb [4] for PV panel using open circuit voltage and short circuit current of PV panel. The algorithm was developed using the mathematical equations that describe the V-I characteristics of PV the panel. The verification of the algorithm was done using MATLAB and the results were very close to the theoretical values. The complete derivation of MPPT algorithm is presented in this paper.

The comparative study of widely adopted MPPT algorithms is done on the basis of simplicity, convergence speed, cost, digital or analogical implementation, sensor requirements and other aspects by Faranda and Leva [5]. The performance of these algorithms is evaluated on energy point of view. Khaehintung et al [6] offered a modified P&O algorithm in their paper. An improved variable-step-length P&O algorithm is realized and implemented using Very High Speed Hardware Description Language (VHDL). The performance of this modified algorithm is much better than the conventional controller in terms of tracking speed and output power in steady conditions.

In [7], Hua et al have analyzed and simulated solar array characteristics. The Buck converter used is operated continuous-current mode under PWM control. The system is implemented using Texas DSP controller TMS320C25. The simulation results showed the system to be unstable without PI compensator. The system efficiency stays higher than 90% under variations. In [8] Harish and Prasad proposed a microcontroller based MPPT system. The algorithm used in microcontroller to acquire the peak power is P&O algorithm. The system contains RS485 standard interface to communicate to the remote location or data logging. The inverter in the system provides the functionality of DC to AC converter for the household appliances or on-grid connection. Hiwale et al [9] proposed a MPPT charge controller using ATMEGA 16 AVR processor along with Buck converter. The algorithm used is P&O algorithm. The system ensures fast and safe battery charging in varied environmental conditions.

CONCLUSION

It is seen that Perturb & observe algorithm is the most popular algorithm for Maximum Power Point Tracking as compared to other algorithms. P&O algorithm is little better than Incremental conductance in terms of efficiency, and sensor requirements. Although there are analog MPPT chargers available, the digital MPPT systems are preferred in spite of the relatively higher cost. Use of MPPT charger system ensures that solar PV output is increased at least up to 90% and sometimes even more.

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