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Comparision of Perturb and Observer and Incremental Conductance MPPT Based Solar Tracking System.

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Abstract: This paper presents a detailed analysis of the two most well-known hill-climbing maximum power point tracking (MPPT) algorithms: the perturb-and-observe (P&O) and incremental conductance (INC). The purpose of the analysis is to clarify some common misconceptions in the literature regarding these two trackers, therefore helping the selection process of MPPT

Keywords—Perturb and Observer, Incremental Conductance, Microcontroller, DC Servo motor. Maximum Power Point Tracking (MPPT)

I. Introduction

A photovoltaic system is a system which uses one or more solar panels to convert solar energy into electricity. The solar cell is the basic unit of a PV system. An individual solar cell produces direct current and power typically between 1 and 2 W, hardly enough to power most applications. It consists of multiple components, including the photovoltaic modules, mechanical and electrical connections and mountings and means of regulating and or modifying the electrical output. PV cells are made of semiconductor materials, such as silicon [2]. For solar cells, a thin semiconductor wafer is specially treated to form an electric field, positive on one side and negative on the other.

II. Material and Methodology

Design Of Perturb and Observer and Incremental Conductance

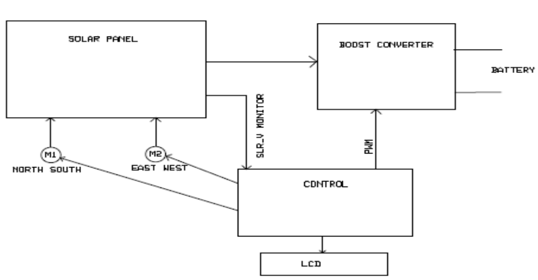

Fig1. System Block Diagram

In this project I have used a 37 watt peak power solar module with a short circuit current of 2.24 Amps. With an open circuit voltage of 21.89 volts, a boost converter is needed to charge the 24-volt battery. As shown in Figure 3.1. In order to ensure that solar panel operates at its maximum power point, we measure and monitor both the current and voltage of the solar panel. This will be accomplished by a high side current monitor and simple resistor divider on the solar panel's output voltage. In order to control the output power of the solar panel, we manipulate the panel's output current vide a software algorithm for which way to manipulate the current, e.g. whether the current out of the solar panel should be increased or decreased. To make the Maximum Power Point Converter work, the functions of the boost converter need to be merged with the solar panel's output load. The boost converter is either storing current in the boost inductor (switch closed) or it is delivering current from the boost inductor to the load (switch opened). When the boost inductor is storing current, the current comes from the solar panel. In essence, the boost inductor is the solar panel's load. By making the current stored in the boost inductor programmable, the load of the solar panel becomes programmable. This is the principal on how the maximum power point converter works. The maximum power point converter combines a boost converter, a programmable current oscillator and a software algorithm to maximize the power out of a solar panel.[1]

Mechanical System

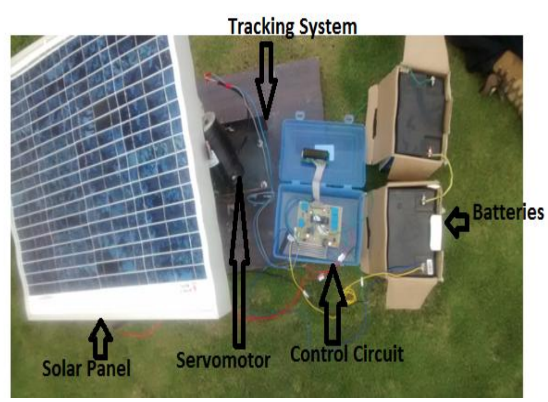

Fig 2. Actual solar tracker design

After the solar panels and other components were selected, the overall structural design of the solar tracker was fabricated. The entire structure was fabricated using the mild steel plates as shown in fig. 2 The pillar holding panel is aligned to the centre of the panel for better flexibility during the panel rotation [4]. The tracker is designed to have a multi-axis rotation (East-west and North-South), and the motor is mounted in such a way that the tracker systems have a multi-axis freedom of rotation. The solar tracker consists of the PV cells, the charge controller and the battery. Other subsystems such as the PIC microcontroller-16F877A were also used. The electrical energy is then stored in the lead-acid battery that is later used to power the respective component [8]

Time of the day	Voltage (V)	Current (A)	Power (W)
9 am	13.47	0.65	8.75
10 am	15.25	0.75	11.44
11 am	15.75	1.10	17.32
12 pm	18.11	1.35	24.45
1 pm	18.75	1.45	27.18
2 pm	17.65	1.33	23.47
3 pm	15.78	1.08	17.04
4 pm	13.32	0.86	11.45
5 pm	12.04	0.45	5.42

Table no.1Solar output of PV panel in tracking mode (Perturb Observer)

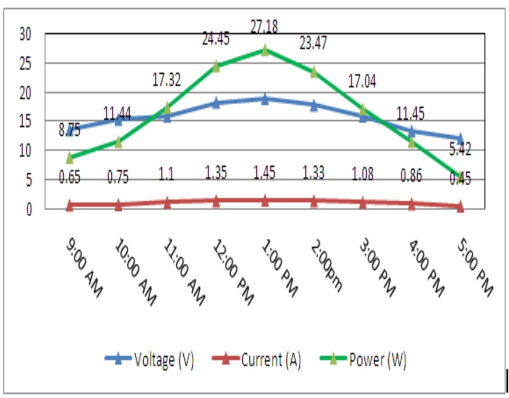

Fig.3 waveform of perturb and observer

Time of the day	Voltage (V)	Current (A)	Power (W)
9 am	14.08	0.69	9.71
10 am	15.42	0.80	12.33
11 am	16.03	1.22	19.55
12 pm	18.92	1.49	28.19
1 pm	19.10	1.52	29.03
2 pm	17.66	1.41	24.90
3 pm	16.87	1.03	17.37
4 pm	14.95	0.85	12.70
5 pm	14.19	0.47	6.67

Table no.2 Solar output of PV panel in tracking mode (Incremental Conductance)

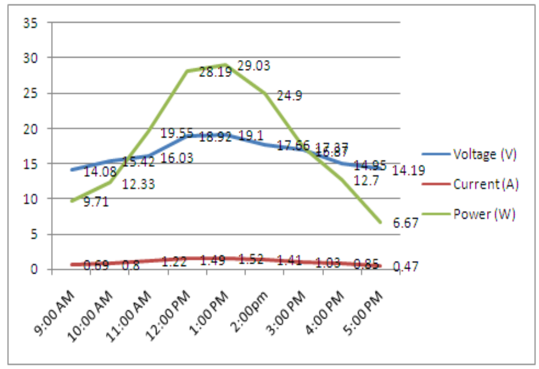

Fig.7.waveform of incremental conductance

III. Conclusion

After examining the information obtained in the data table section and in plotted graph, It has been shown that the incremental conductance method can collect maximum energy than perturb and observer method and high efficiency is achieved through this mppt tracking system.

Acknowledgement

The method implemented it is simple, easy to maintain and requires no technical attention for its operation. The software developed for this work can be used outside the mechanical part, thus it is flexible for future modification.

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