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Modelling of solar photovoltaic mppt system by using p & o algorithm

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Abstract
In this project Modelling of solar photovoltaic MPPT system by using P&O algorithm is implemented. Solar cells convert sun light into electricity, but have the major drawbacks of high initial cost, low photo-conversion efficiency and intermittency. The current-voltage characteristics of the solar cells depend on solar insulation level and temperature, which lead to the variation of the Maximum Power Point (MPP).Here to improve photovoltaic (PV) system efficiency, and increase the lifetime of the battery, a microcontroller-based battery charge controller with maximum power point tracker (MPPT) is designed. Hence it gives effective outcome.

1.INTRODUCTION

The Photovoltaic power could be considered among the renewable energy resources as the most essential resource with the greatest development potential, so it attracts human attention because of it is ubiquitous, cost reduction, clean energy, continuity and reliability, and there is plenty of solar radiant free energy. Researchers have the best understanding of PV working principles because of the continuous updating of the mathematical modeling of solar PV cells [1]. However, the variation of the PV power generation with different atmosphere circumstances is the main challenge for the PV system applications and it is the main case that must be taken into account. Therefore, it is important to increase the efficiency of the PV system, which must operate at its maximum power point, so the maximum power point tracking MPPT is a process that responsible for obtaining the information about the highest PV power usage in the design of the console [2].

The solar cell's efficiency depends on many factors such as irradiance, temperature, shadow, dirt, spectral characteristics of sunlight, etc. The changing in insolation on PV panels due to rapid climatic changes such as an increase in ambient temperature and cloudy weather can reduce the PV panels output power. In another word, each photovoltaic cell produces energy related to its operational and environmental conditions [3]. The maximum power of the PV module generates at a single operating point. On the other hand, the operating point of the PV system can be controlled by adjusting the output power or voltage of the PV system. The output voltage and power of the PV system can be controlled by a power electronic converter which is the most common method, which in turn is controlled by a specific control algorithm to drive this procedure [4].

Therefore, most environmental factors such as ambient temperature and solar radiation greatly determine the amount of energy that can be produced. So, an MPPT is required with a control unit to reach the maximum power generated from the resulting PV array [5], and also as the characteristics of P–V and I–V curves are non-linear and time-varying as in Figure 1, it is necessary to implement a"maximum power point tracking MPPT" system to chase the on the P–V curve, so that maximum power output can be gained from the PV array system [6]. Two MPPT algorithm methods are proposed in this literature; Perturb and Observe (P&O) and Incremental Conductance (INC). For the representation of the MPPT, the PV system needs to have a DC–DC converter, the DC–DC converter can be either boost converter or buck–boost converter, they are usually used because of their efficiency high [7]. The boost converter is used in this paper to track the MPP.

Solar energy is one of the most important renewable energy resources because it is inexhaustible and eco-friendly, and has been used to provide light, heat and electricity [1, 2]. Solar PV modules have two major problems of low efficiency and intermittency, i.e. their efficiency of converting sun light into electric power is generally less than 17%, and the generated electric power changes with weather conditions.

2. Existing System

In Figure 1, the general block diagram of the existed work is illustrated. The current (I) and voltage (V) obtained from the solar PV tree are given to the MPPT algorithms for tracing the optimal point, and they produce the appropriate duty-cycle for the DC–DC boost converter. This paper proposes a unique solar PV tree structure in which the panels are located at the different.

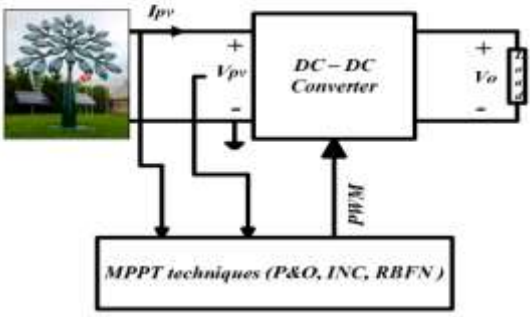

Fig. 1: EXISTED SYSTEM

The performance of the proposed system is evaluated with the three different conventional MPPT methods of P&O, INC, and the RBFN-NN to obtain the optimum. Power from the individual module of the solar PV tree. A few attempts have been made in the solar tree concept, but none of them have tried to implement the MPPT techniques so far. Therefore, authors have made an attempt to implement the three different conventional MPPT algorithms with the proposed solar tree structure in this article. The proposed System (solar PV-tree concept) is examined with the constant irradiance and varying irradiance conditions.

The three different algorithm values are compared with each other to corroborate that the proposed solar PV tree with RBFN-NN provides the best solution in all the climatic conditions The different MPPT techniques have been reported. The existed configuration of the solar tree structure with the RBFN MPPT technique provides enhanced output power during the partial shading condition. This MPPT strategy requires less time to reach the maximum peak point, which increases its efficiency and makes it highly robust in the non-linear application

3. Research Methodology

Proposed system

The renewable energy sources, especially solar cells are attracting the interests of researchers worldwide due to their direct conversion of light into electricity. However, the high-cost, low photo-conversion efficiency and intermittency are still need to be addressed. The case study involves the design of MPPT charge controller using DC/ DC buck converter and microcontroller. A prototype MPPT charge controller is tested with a 200W PV panel and lead acid battery. The as-designed MPPT controller improves the efficiency of the PV panel when compared to conventional charge controllers.

An off-grid PV system usually consists of PV modules and batteries, which are connected through charge controllers. To improve system efficiency, an MPPT charge controller has been introduced as shown in the block diagram in Fig. 3. The MPPT charge controller is connected between the PV module and battery to extract maximum power from the PV module and deliver to the battery.

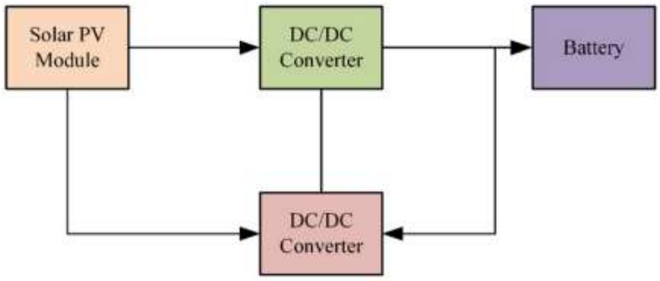

Fig. 2: PROPOSED SYSTEM

DC/DC converter

DC/DC converters convert one level of DC voltage to another. In the designed project, a buck DC/DC converter is used which step down the voltage and step up the current. The basic components used in the converter are a power semiconductor switch (M1), an inductor (L), a diode (D) and a capacitor (C). A buck DC/DC converter has two operation modes associated to switch M1 being closed and opened, respectively. When the switch M1 is closed at time t = 0, the input power is supplied to the load through inductor L.

During this period inductor L is charging. At time t = t1, switch M1 opens and the energy stored in the inductor is delivered to the load through diode D which becomes forward biased. The diode remains in forward biased until M1 switch is closed. During one switching cycle, the average inductor voltage vL is zero under steady state. Since there are two states of vL, both having constant voltage.

To harvest maximum power from the PV panel a charge controller with MPPT capability is proposed in this paper. The two broad categories of MPPT techniques are the indirect techniques and direct techniques. Indirect techniques include the fixed voltage, open circuit voltage and short circuit current methods. In this kind of tracking, simple assumption and periodic estimation of the MPPT are made with easy measurements. For example, the fixed voltage technique only adjusts the operating voltage of the solar PV module at different seasons with the assumption of higher MPP voltages in winter and lower MPP voltages in summer at the same irradiation level. This method is not accurate because of the changing of irradiation and temperature level within the same season.

Typically, P&O method is used for tracking the MPP. In this technique, a minor perturbation is introduced to, cause the power variation of the PV module. The PV output power is periodically measured and compared with the previous power. If the output power increases, the same process is continued otherwise perturbation is reversed. In this algorithm perturbation is provided to the PV module or the array voltage. The PV module voltage is increased or decreased to check whether the power is increased or decreased. When an increase in voltage leads to an increase in power, this means the operating point of the PV module is on the left of the MPPT. Hence further perturbation is required towards the right to reach MPP. Conversely, if an increase in voltage leads to a decrease in power, this means the operating point of the PV module is on the right of the MPP and hence further perturbation towards the left is required to reach MPPT.

After measuring the battery voltage, it determines whether the battery is fully charged or not. If the battery is fully charged (12.6 V at the battery terminal) it stops charging to prevent battery over charging. If the battery is not fully charged, it starts charging by activating the DC/DC converter. The microcontroller will then calculate the existing power Pnew at the output by measuring the voltage and current, and compare this calculated power to the previous measured power Pold. If Pnew is greater than Pold, the PWM duty cycle is increased to extract maximum power from the PV panel. If Pnew is less than Pold, the duty cycle is reduced to ensure the system to move back to the previous maximum power. This MPPT algorithm is simple, easy to implement, and low cost with high accuracy

4. Results

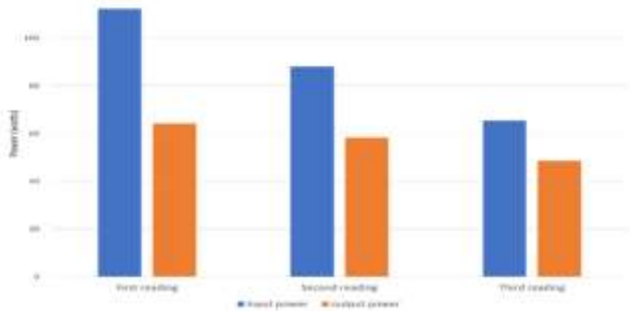

Fig. 3 INPUT AND OUTPUT POWER: WHEN CONVENTIONAL PWM CHARGE CONTROLLER IS CONNECTED

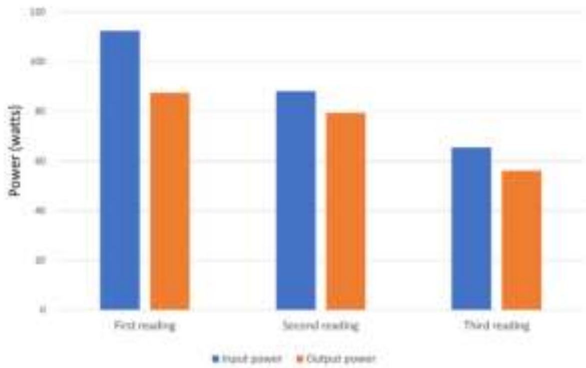

Fig. 4: INPUT AND OUTPUT POWER WHEN: MPPT CHARGE CONTROLLER IS CONNECTED

CONCLUSION

To harvest maximum power from a PV module, MPPT based on modified P&O algorithm is implemented in this paper. The hardware consists of a high efficiency DC/DC buck converter and a microcontroller based MPPT controller, and is tested for battery charging. A conventional charge controller and the designed charge controller are compared when charging a 12 V battery from a 200 W solar PV module. It shows that the modified P&O algorithm provides an efficient and reliable maximum power tracking performance under rapid change in irradiance and temperature conditions. The experimental results show that the proposed system is more efficient than the conventional design.

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