Review of Stand Alone Solar Powered Quick Battery Charging System by MPPT

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Abstract

This review proposed a system in which the maximum energy is harvested from the photovoltaic (PV) panel to charge the particular connected batteries. In hilly region it is not economical to establish the distribution network in such condition the stand alone photovoltaic system is one of the good option. The output energy obtained from the PV Panel is tracked with the help MPPT technique. For this Maximum Power Point Tracking (MPPT), the Perturb and Observe method (P&O) is used to control converters circuit. Also, a Three-Stage Charging (TSC) method is used to quick and safely charging of the battery. The certain work proposed power management technique between the maximum power point tracking and the power charging processes. Also the power management of MPPT method and maximum charging of the battery should be attempted together.

Keywords: *Photovoltaic (PV); Three-Stage Charging (TSC); Maximum Power Point Tracking (MPPT); Perturb and Observe (P & O) method, Particle Swarm Optimization (PSO) method, incremental conductance (INC), and fractional open- circuit voltage (FVOC).*

INTRODUCTION

A renewable energy is one of the forms of energy use in the most of applications one of them is photovoltaic (PV) panel which provides endless clean energy. The PV panel has to extract power for maximum efficiency under varying atmospheric condition. The Maximum Power Point

Tracking (MPPT) is the method to extract the maximum value of energy which is necessary to keep the system running at maximum power point of the PV panel. Thus the maximum power is generated when load and source's impedance are adopted. For this purpose dc-dc converter is required between PV and battery. While considering the MPPT control there are many factors that affect such as temperature, light intensity and load. The temperature and light intensity are changed by the change of environment. If the light intensity is changed, it will directly affect the current that is produced by the PV panel. Also if the temperature is changed, it will directly affect the voltage of the PV panel and the MPP is changed. If the load connected to the PV panel is changed, the MPP will also get changed.

The energy from a PV panels is available for limited time, which is also depends on few conditions like the duration of sunlight, weather, and environmental conditions in each season. Due to which the system may not be reliable if it does not receive the maximum power from the PV panel. As the result, the power will not be constant. To improve the system reliability, a battery is added which helps in two ways: to store energy when there is sunlight and supply power back to the system when there is no sunlight.

However, having single huge battery may affect the systems reliability and results in low efficiency. The power to charge the battery will take longer time and many steps which may not consistent with the period of sunlight and Weather. Therefore the battery charging control process is needed to quickly charge the battery and also to prevent the overcharging or the undercharging due to which the decrease in the battery lifetime or permanent damage of the battery. Thus, the MPPT control and the battery charging control processes are combined in same the system, to make the system more reliable and efficient. If the battery is fully charged, the remaining energy of the PV panel under the charging condition becomes an loss of power. The system must harvest the solar energy for utilizing all available energy and to make the system more reliable.

MPPT is the technique which will be controlled at every moment along with the process of charging the battery. Hence an auxiliary battery is use to solve the problem of losing energy. Also controls the charging process, so that remaining

power, from PV panel, will be stored by the auxiliary battery.

OBJECTIVES AND SCOPE OF THE STUDY

1) The use of PV panel at maximum power point (MPP) of PV panel.

2) To achieve a quick complete and safe charging process of the lead acid battery. The method was implemented in most practical ways of three stages charging (TSC) which is divided into three stages of charging.

3) The MPPT control and battery charging control processes are combined in the same system for more reliable and efficient operation.

LITERATURE REVIEW

Authors suggested the stand alone model for energy harvesting system by using MPPT Technique and quick battery charging process by using three Stage Charging (TSC) Method. The perturb and observe method is used to control the converter using for MPPT technique. The P&O method can efficiently track the maximum power from solar panel and the Three Stage Charging (TSC) method is one of the efficient methods for controlling the charging process. The power management of MPPT method and maximum charging of the battery should be attempted together; Author gave a brief data for three stages charging which is helpful for charging the batteries as per need. [1].

The research work shows the review on the widely used MPPT technique for PV application. In which he shows how to increase or to maximize the output power of photo-voltaic system with the help of Maximum power point tracking (MPPT) techniques. The author gave the brief comparative analysis of three MPPT algorithms are perturbs and observes (P&O), incremental conductance (INC), and fractional open- circuit voltage (FVOC) [2].

Authors show how to take out power from photovoltaic (PV) system. MPPT algorithms is used due to which the maximum power point occurs from the PV curve also gives the comparative study between perturb and observe (P and O) which is the one of the most conventional method and the Particle Swarm Optimization (PSO) method. The researcher compared these two methods on the same load and a weather condition so as to study both the methods is an efficient data for my review [3].

This Author suggested the recent trends in the renewable energy sources for generation of electricity, with the help of Photovoltaic (PV) systems. Also shows the work how the PV system has nonlinear nature while considering the output power of solar irradiance and ambient temperature, and due to this non linear nature he used the maximum power point tracking (MPPT) techniques with certain comparisons. Among various MPPT techniques, Perturb & Observe (P&O) and Incremental- Conductance (IC) efficient by using MATLAB & Simulink [4].

This Author presents comparison between the maximum power point tracking (MPPT) methods with the help of simulation and programming. Due to which both the methods i.e. perturbs & observes (P&O) and incremental conductance (IC) methods give the implemented model of the photovoltaic array of both the methods together with MPPT controls is applied. This research gives mi brief information about the methods that are simulated with MPPT algorithms with different solar radiation [5].

The author describes the Software based simulation model which helps to mi analyze of the actual performance of PV panel. The PV based system is connected with the converter called as DC-DC boost converter. Due to the application of the converter circuit the performance characteristics obtained is smooth. The I-V characteristics and P-V characteristics of PV module are shown with different temperature and irradiation level is necessary data also the simulation of mathematical model for Photovoltaic (PV) module and DC-DC boost converter is described [6].

Here author described that Photovoltaic (PV) panels are considered as the major source of producing clean and safe renewable form of energy. However, PV panels do not operate at efficient level as they have certain nonlinearity in their output current-voltage characteristic. These are due to irregular temperature level and irradiance intensity. So to avoid such issues researcher suggest the maximum-power point tracking i.e. MPPT techniques so as to keep the PV system operating at the Maximum power output point. Due to which system gives maximum efficiency. He also a reviewed the Characteristics of PV panel, the tracking of maximum power point using MATLAB programming, and its generation [7].

This research presents how the Maximum Power Point Tracking (MPPT) is used to extract maximum energy from the Photovoltaic (PV) Systems. As these system has benefits such as it requires less maintenance and environmental advantages and requirement of any kind of fuel. Also the author suggested two major barriers for the use of PV systems; PV panel has low energy conversion efficiency and high initial cost.

Hence to improve the particular energy efficiency, it is important to work with PV system always at its maximum power point i.e. MPPT techniques are useful in such condition. Hence the author presents the details implementation of Perturb and Observe method which is one of the methods of MPPT by using buck and buck-boost Converters. And finally results in the form of current, voltage and output power are obtained with the help of the simulation in software of MATLAB [8].

Here author suggested how the maximum power point tracking (MPPT) algorithm is efficient to track the maximum power from the PV panel. For detail review he took perturb and observe (P&O) technique for is to track maximum power point (MPP) under varying atmospheric condition. Also a new data is related with the MPPT algorithm using bisection method for PV module is proposed by the author. With the help of the algorithm which detects the voltage of the PV module and then it calculates the output power obtained at the maximum power point. Also the latest MPPT algorithm has been compared with the conventional P&O technique so as to study the used of the verification that how it reaches to the maximum power point as compare to the conventional P&O also all the system is simulated in the MATLAB software [9].

This researcher presents how Maximum power point tracking is useful in photovoltaic (PV) systems so as to increase the output power obtaining from the photovoltaic panel with certain change in the temperature and radiation conditions and also the load electrical characteristics in certain photovoltaic system. Also he gives the simulation of MPPT techniques for photovoltaic systems. For certain research he used perturbs and observes method. The obtaining maximum power point is then controlled with the help of the dc/dc converter. All this simulations work is done in certain Simulink [10].

Author gives the Design of a (BESS) i.e. battery energy storage system in which the certain battery capacity is studied. He

shows the computational procedure is specified to determine the BESS capacity Numerical Procedure to determine vdc is obtained. Author shows the battery modeling with detail procedure of battery charging its voltage and current equations which is beneficial one for further research [11].

The Author focused on the improvement of the charging method by using a simple battery charging algorithm for this certain IC (UC3906) is used. He gave the result on the basis of three stage charging(TSC) which shows how the designed circuit based on the algorithm is effective during overcharging and supports the steady charging concept without consuming access charges. The Author proposed the battery charging algorithm which is very simple to understand.

The result obtained shows how the designed circuit is capable of keeping a fixed voltage at the end and ensure efficient current consumption. However, the mention that the present circuit can be further enhancing with suitable mechanism to detect chemical quantity and charge density, Also the Author has tested, the present circuit only for 12volt battery. This research helps me a lot regarding the three stages charging of battery [12].

PROPOSED MODELLING

A renewable energy is one of the forms of energy use in the applications one of them is photovoltaic (PV) panel which provides endless clean energy of the use of PV panel. The PV panel has to extract power for maximum efficiency under varying atmospheric condition. The Maximum Power Point Tracking (MPPT) is the method to extract the maximum value of energy which is necessary to keep the system running at maximum power point of the PV panel. Thus the maximum power is generated when load and source's impedance are adopted. For this purpose dc-dc converter interface is required between PV and battery.

Photovoltaic solar cells:

Photovoltaic solar cells convert the suns radiant light directly into electricity. With increasing demand for a clean energy source and the sun's potential as a free energy source, has made solar energy conversion as part of a mixture of renewable energy sources increasingly important. As a result, the demand for efficient solar cells, which convert sunlight directly into electricity, is growing faster than ever before.

Photovoltaic (PV) cells are made almost entirely from silicon that has been

processed into an extremely pure form of an crystalline which absorbs the photons from sunlight and after that it releases them as an electrons, due to which it causes an current to flow as the photoconductive cell is connected to an load on external side.

Maximum Power Point Tracking (MPPT):

MPPT is algorithm that included in charge controllers used for extracting maximum available power from PV module under certain conditions. The point at which the value of a voltage at which PV panel can produce maximum power is called 'maximum power point' (or peak power voltage). Maximum power point may be varies as the solar radiation, an ambient temperature and temperature of solar cell.

A typical PV panel produces power at maximum power & voltage point of around 17 V when measured it at a cell temperature of 25°C, the voltage drop will be around 15 V on a very hot day and it can also rise to 18 Von a very cold day.

The major principle of MPPT is to extract the maximum power from PV panel by making them operate at the most efficient voltage level (i.e. on maximum power point). MPPT checks output of a PV panel, compares it to battery voltage then fixes which is the best power point that PV panel can produce so as to charge the battery and converts it to such voltage level so as to get maximum current into the battery. It can also supply power to a DC load, which is connected directly to the battery.

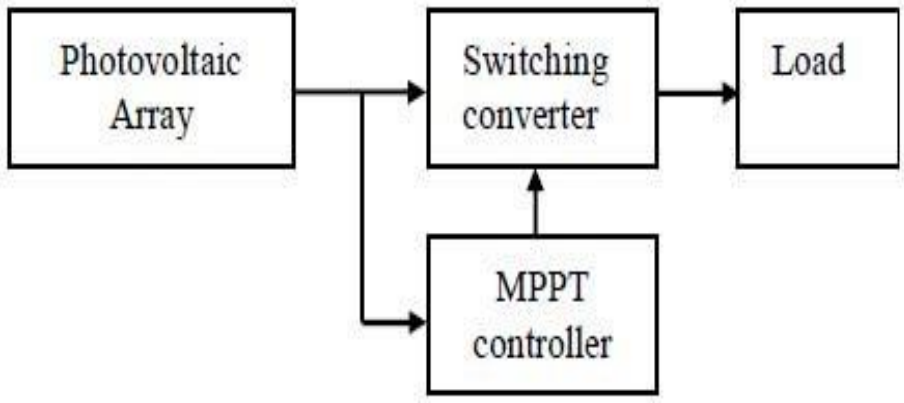

Figure 1. Block diagram of a MPPT controlled PV system

CONCLUSION

As many research and experiments made in designing and developing of the MPPT Techniques. The MPPT techniques are used to trap the maximum power which can be obtained by using three states charging. Also in this proposed review various methods schemes to modulate MPPT are discussed. Every result varies from each other in the case of PV system which having nonlinear nature while considering the output power of solar irradiance and ambient temperature.. But by over reviewing all the methods in most of the paper the researchers used MATLAB for modeling which gives best results.

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