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A REVIWE ARTICLE OF PHOTOVOLTIC POWER BOOSTING TECHNIQUE

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ABSTRACT

Energy, especially alternative source of energy is vital for the development of a country. In future, the world anticipates developing more of its solar resource potential as an alternative energy source to overcome the persistent shortages and unreliability of power supply. In order to maximize the power output the system components of the photovoltaic system should be optimized. For the optimization maximum power point tracking (MPPT) is a Promising technique that grid tie inverters, solar battery chargers and similar devices use to get the maximum possible power from one or more solar panels. Among the different methods used to track the maximum power point, Perturb and Observe method is a type of strategy to optimize the power output of an array. In this method, the controller adjusts the voltage by a small amount from the array and measures power, if the power increases, further adjustments in that direction are tried until power no longer increases. In this research paper the system performance is optimized by perturbs and observes method using buck boost converter. By varying the duty cycle of the buck boost converter, the source impedance can be matched to adjust the load impedance to improve the efficiency of the system. The Performance has been studied by the MATLAB/Simulink.

KEYWORDS: Maximum power point tracking, Photovoltaic system, Buck boost converter, Perturb and Observe method, Direct current, Photovoltaic Panel.

I. INTRODUCTION

The rapid increase in the demand for electricity and the recent change in the environmental conditions such as global warming led to a need for a new source of energy that is cheaper and sustainable with less carbon emissions. Solar energy has offered promising results in the quest of finding the solution to the problem. The harnessing of solar energy using PV modules comes with its own problems that arise from the change in insulation conditions. These changes in insulation conditions severely affect the efficiency and output power of the PV modules [1-3].A great deal of research has been done to improve the efficiency of the PV modules. A number of methods of how to track the maximum power point of a PV module have been proposed to solve the problem of efficiency and products using these methods have been manufactured and are now commercially available for consumers [1-3]. As the market is now flooded with varieties of these MPPT that are meant to improve the efficiency of PV modules under various in solation conditions it is not known how many of these can really deliver on their promise under a variety of field conditions. This research then looks at how a different type of converter affects the output power of the module and also investigates if the MPPT that are said to be highly efficient and do track the true maximum power point under the various conditions [1]. A MPPT is used for extracting the maximum power from the solar PV module and transferring that power to the load [4, 5]. A dc/dc converter (step up/ step down) serves the purpose of transferring maximum power from the solar PV module to the load. A dc/dc converter acts as an interface between the load and the module figure 1 [5]. By changing the duty cycle the load impedance as seen by the source is varied and matched at the point of the peak power with the source so as to transfer the maximum power [5]. Therefore MPPT techniques are needed to maintain the PV array's operating at its MPP [6]. Many MPPT techniques have been proposed in the literature; example are the Perturb and Observe (P&O) methods [4, 6-9], Incremental Conductance (IC) methods [7], Fuzzy Logic Method [2, 4, 6], etc.

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II. STRUCTUTRE OF PHOTOVOLTAIC CELL

The principle of the photovoltaic effect is simple: The ray of light, assimilated to photons, passes through the top layer (N doped) of the photovoltaic cell. Then, electrons capture the photons' energy and help them to cross the potential barrier of the PN junction, which generates current. So there is a strong relation between the solar irradiance and the amplitude of the generated current, as in (1). As the solar cells characteristic is close to a semiconductor diode, a classical model can be found in literature [5].

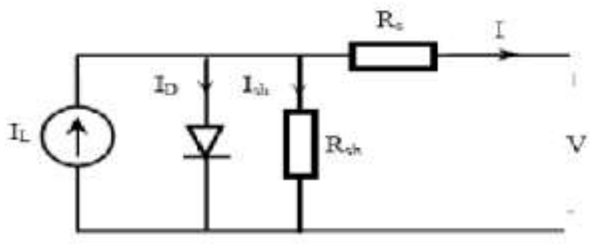

Fig.(1.1) Diode principle circuit.

This model is based on classical assumptions:

- All the photovoltaic cells have the same v(i) characteristics;
- There is no partial shadow on the PV panels;
- Temperature is homogeneous on panels.

Hence, performances of PV technologies are really dependent on the sunshine, the cloudiness, the solar incidence and the temperature.

III. V-I CHARACTERISTIC OF PV CELL MODEL

The Current – Voltage characteristic curve of a PV cell for certain irradiance at a fixed cell temperature is shown in fig.2. The current from a PV cell depends on the external voltage applied and the amount of sunlight on the cell. When the PV cell circuit is short, the current is at maximum and the voltage across the cell is zero. When the PV cell circuit is open, the voltage is at maximum and the current is zero. 2.3. Power – Voltage curve for PV cell The Power – Voltage curve for PV cell is shown in fig.3. Here P is the power extracted from the PV array and V is the voltage across the terminals of the PV array. This curve varies due to the current isolation and temperature. When isolation increases, the power available from PV array increases whereas when temperature increases the power Available from PV array decreases.

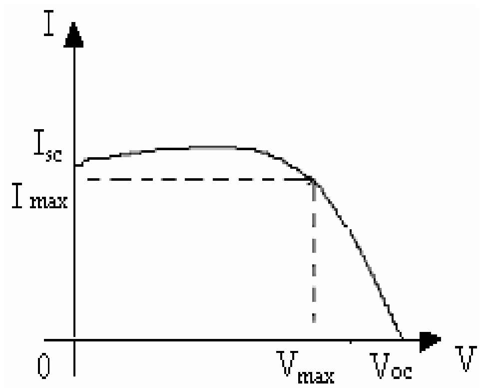

Fig.(2.a) VI Characteristics in PV Cell.

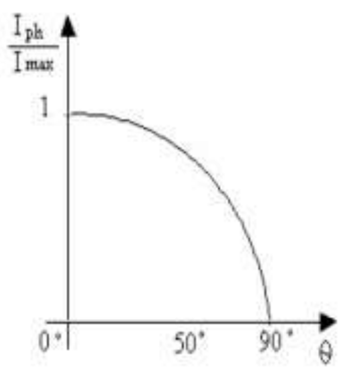

Fig.(2.b) Current variation.

IV. DIFFERENT TYPE METHODE OF BOOST CONVERTING SYSTEM

A. MPPT Techniques

The motivation behind developing the various maximum power point tracking techniques was to increase the efficiency of the PV system at power stage i.e. an improvement in power efficiency. By considering this factor, different MPPT methods were proposed by the researchers. Each method is having their own features but some of them faces difficulties while tracking during rapidly change in the environmental condition. Maximum power point plays an important role in photovoltaic system because they maximize the power output from a PV system for a given set of conditions, and therefore maximize the array efficiency. There are different methods used to track the maximum power point are

1. Perturb and Observe method
2. Incremental Conductance method
3. Parasitic Capacitance method
4. Constant Voltage method

Among the different methods used to track the maximum power point, Perturb and Observe method is the most widely used method in PV MPPTs and is highly competitive against other MPPT methods.

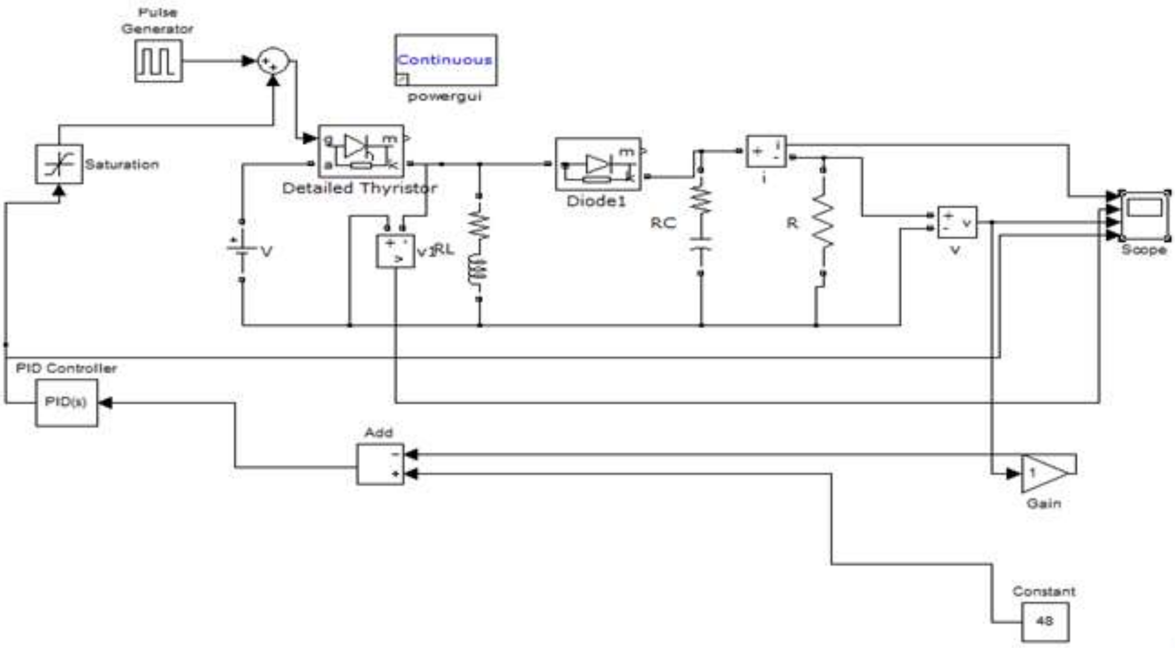

Fig .(4.1) MPPT technique.

P&O method [3], [4], [9] is the most frequently used algorithm to track the maximum power due to its simple structure and fewer required parameters. This method finds the maximum power point of PV modules by means of iteratively perturbing, observing and comparing the power generated by the PV modules. It is widely applied to the maximum power point tracker of the photovoltaic system for its features of simplicity and convenience.

According to the structure of MPPT system shown in Fig. 1, the required parameters of the power-feedback type MPPT algorithms are only the voltage and current of PV modules. Shown in Fig. 2 is the relationship between the terminal voltage and output power generated by a PV module. It can be observed that regardless of the magnitude of sun irradiance and terminal voltage of PV modules, the maximum power point is obtained while the condition $dP/dV = 0$ is accomplished. The slope (dP/dV) of the power can be calculated by the consecutive output voltages and output currents, and can be expressed as follows,

B. Boosting power of boost converter

As photovoltaic cells are only able to produce more than 2V a cell, series and parallels are used in PV Array. But in order to reduce the losses in the energy transfer, it is better to boost the PV voltage using a DC-DC converter. Figure 1 shows a schematic of a classical Boost Converter, using the Sim Power Systems Toolbox from the Matlab software:

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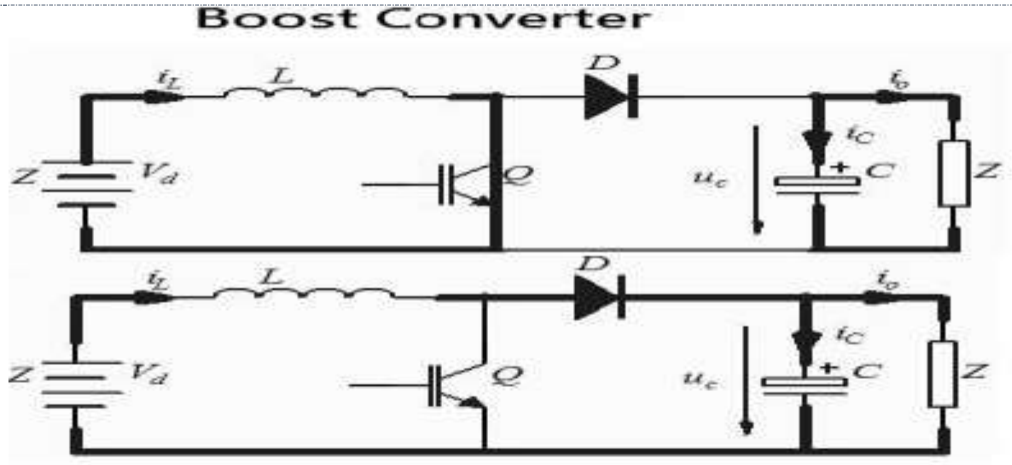

Fig (4.2) Power converter circuit.

The principle of the Constant Voltage (CV) Method is simple: the PV is supplied using a constant voltage. Temperature and Solar Irradiance impacts are neglected. The reference voltage is obtained from the MPP of the P(i) characteristic directly. Here, the MPP voltage is about 16.3V for the studied PV. Figure 6 shows the CV algorithm and the code of the Matlab embedded function.

The CV method requires the PV voltage measurement only. The Matlab embedded function is evaluated with a 1 kHz frequency. This Constant Voltage Method cannot be very effective regarding Solar Irradiance impact and certainly not regarding the temperature's influence. Thus, some enhancements of the CV methods exist.

- The Open Voltage (OV) Method is based on the CV method, but it makes the assumption that the MPP voltage is always around 75% of the open-circuit voltage *vOC*. So mainly, this technique takes into account the temperature. But it requests a special procedure to regularly disconnect the PV and to measure the open-circuit voltage. Besides, this technique can partially take into account the cell's aging.
- The Temperatures Method is also an improvement of the OV Method: the open-circuit voltage is now considered to be related to the temperature by a linear function. Then, with a temperature sensor, the open-voltage measurement is no more necessary, because its value can be identified from the temperature value directly.

Short-Current Pulse (SC) Method

The principle of the Short-Current Pulse (SC) Method is based on a simple relation: the MPP current is proportional to the Short-circuit current *iSC*, with some temperature and solar irradiance conditions. To simplify the *iSC* estimation, it is often considered as constant, even if the temperature varies between 0 and 60°C. The determination of the Short-circuit current *iSC* is in fact, done just before connecting the PV systems to the grid.

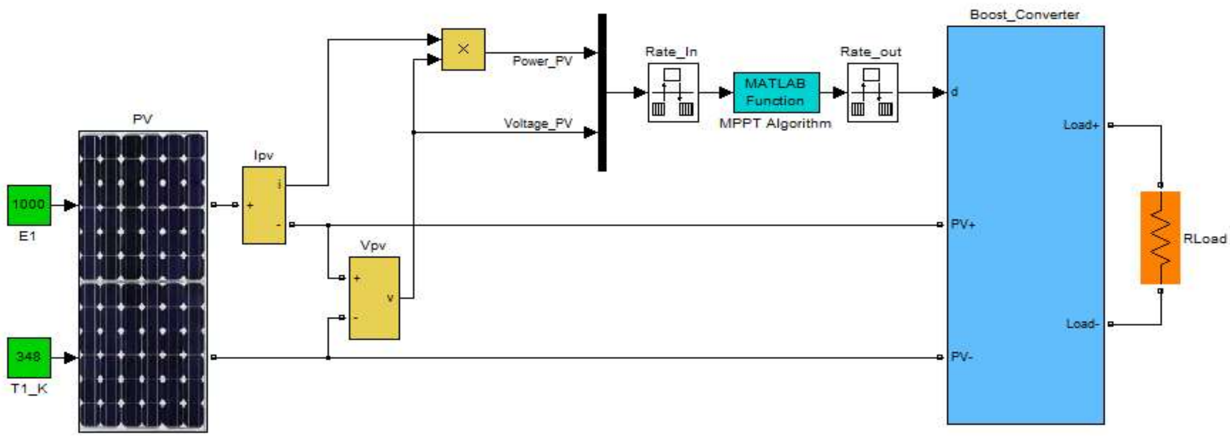

Fig (4.2) Simulink basic modeling.

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In this paper, the simulation model is developed with MATLAB/SIMULINK. The simulation model of the proposed method .and the waveforms are shown in fig .6. The proposed circuit needs independent dc source which is supplied from photovoltaic cell. The inputs are fed by voltage and current of the PV terminals, while the output provides duty cycle for the buck boost converter. The input voltage is 24V and the output voltage after being buck boosted up is 48.2V and shown in fig.6. Buck Boost converter controls the output voltage by varying the duty cycle *k,* of the switch and the value of k is 0.67 which is calculated using the formulae **Vo = Vs*k / 1- k.** If we vary the pulse width of the pulse generator various voltage ranges at the output can be obtained. Once the buck boost converter injected the power from the pv panel and the PID controller starts function, it varies the value of duty cycle which will change the input value that is sensed by the PID controller. By using the PID controller the error has been minimized in the system and the efficiency is improved. Below shows the output values for PV panel.

V. PREVIOS RESULT AND SIMULATION

The PV cell temperature is maintained constant at 25 degree Celsius and the solar intensity is varied in steps up to the rated value of 1200W/meter square. That the current slightly increase with increasing intensity thereby increasing the power output of the solar cell.

VI. CONCLUSION

In the Present Work, the maximum power point tracking is successfully carried out by this research using perturb and observe method. The PV module working on photovoltaic effect actually improves the system efficiency. Compared to other methods of maximum power point tracking, the perturb and observe method seems to be easy for the optimization of the photovoltaic system using buck boost converter. By varying the duty cycle of the buck boost converter, the source impedance can be matched to adjust the load impedance which improves the efficiency of the system. The Performance has been studied by the MATLAB/Simulink. In future, the maximum power point tracking could be carried out without the use of controllers in order to reduce the cost and complications of hardware can be removed.

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