Rapid Tracking of MPPT with Buck-Boost Converter

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Abstract— **The power obtained from the sun through the solar panel is the research work performed in this paper, to extract the power effectively i.e up to the benchmark of the solar panel capacity, the effective maximum power point technique (MPPT) needs to be implemented. there are three types of algorithms available they are Po, Incremental conductance algorithm . In this proposed work, a combination of linear –approximation and PO Algorithm to achieve maximum-power-point tracking (MPPT) for PV arrays is proposed. The LA is based on that the trajectories of maximum power point varying with temperature are approximately linear. With theLA a maximum power point can be determined very closer. Moreover,. In the paper a corresponding LA is made by coding in the panel design which is simple. As a result, the proposed circuit is cost-effective and can be with PV arrays easily. Therefore the fluctuations in the steady state can be minimized .And by using Buck-Boost converter the voltage has been maintained in the desired level, by having both combination of step-up and step-down process. The proposed MPPT method has advantages of faster tracking fewer fluctuation and higher accuracy over the conventional methods.**

Key words:PVarray,MPPT, LA, Buck-Boost Converter, Mosfet

I. INTRODUCTION

Photovoltaic is the technology that uses solar cells or an array of them to convert solar energy directly into electricity .The power produced by the array of depends directly from the factors that are not controlled by the human being as the cell temperature and solar irradiance. Usually the energy generated by the cell is used to provide electricity to a load and remaining energy is saved into batteries. An efficient Maximum Power Point Tracking (MPPT) algorithm is important to increase the output efficiency of a photovoltaic (PV) generate system. The conventional method have some problems in that it is impossible to quickly acquire the generation power at the maximum power (MP) point, i.e., the efficiency of electric power generation is very low, and the amount of electric power generated by solar cell is always changing with weather conditions. Normally, the different solar cells have different diode factor (n) and reverse saturation current (I_0). MPPT refers to maximum power point technique where the maximum power can be extracted. Here the technique adopted is combination of LA & PO algorithm.

The MPPT maximizes the energy that can be transferred from the array to an electrical system. Its main function is to adjust the panel output voltage to a value at which the panel supplies the maximum energy to the load. Most current designs consist of three basic components: a switch-mode dc–dc converter, a control, and tracking section. The Solar panel has been designed with proper selection of number of series and parallel cells the no of cells to be used is calculated as per the ratings by which solar panel has to be modeled by having the constant values like Energy gap(Eg), Boltzmann constant (K), Electron charge(q) , by having the values of these constant the solar panel has been programmed by giving the temperature and luminance the current has been obtained as output , by having the PowerElectronic circuit the voltage is obtained and is given back to the Solar panel. The solar panel has to be placed in such a way that the maximum area of the panel exposed to sunlight.

II. MANUSCRIPTS

A. Characteristics of Photovoltaic Arrays

Solar cells are basically p-n junction semiconductors which transform solar energy into electricity directly. Figure .1 shows an equivalent circuit of a solar cell , in which Rshand Rsare the intrinsic shunt and serial resistances of the cell, respectively. A current source Iphrepresents the cell photocurrent, which is a function of irradiation Si and PV array temperature (T), and can be expressed

$$I_{ph} = [I_{sso} + K_i(T - T_r)S_i]/100 \qquad 1$$

Where

- $I_{sso}$is the short-circuit current at reference temperature
- $Tr$and reference irradiation (100mW/cm^2)
- $K_i$is temperature coefficient of the short-circuit current
- D_j expresses the p-n junction of a solar cell
- R_j is its nonlinearresistance.
- I_{sat} represents the reversed saturation

$$I_{sat} = I_{rr}\left[\frac{T}{T_r}\right]^3 \exp\left[\frac{qE_G}{K_a}\left(\frac{1}{T_r} - \frac{1}{T}\right)\right] \qquad 2$$

where

- Irris the corresponding reversed saturation current at Tr
- $E_G$is the band-gap energy of the semiconductor in the cell
- q is charge of an electron (1.6×10^{-19}C)
- k is Boltzmann's constant (1.38 ×10^{23}J/ K)
- A is the ideality factor of the p-n junction

characteristic of PV arrays can be represented by the following equations

$$I_{pv} = n_p I_{ph} - \left[\exp\left(\frac{q}{KTA}\frac{V_{pv}+I_{pv}R_s}{n_s}\right) - 1\right] - \frac{V_{pv}+I_{pv}R_s}{R_{sh}} \quad 3$$

$$P_{pv} = V_{pv} I_{pv} \qquad 4$$

B.Proposed Block Diagram

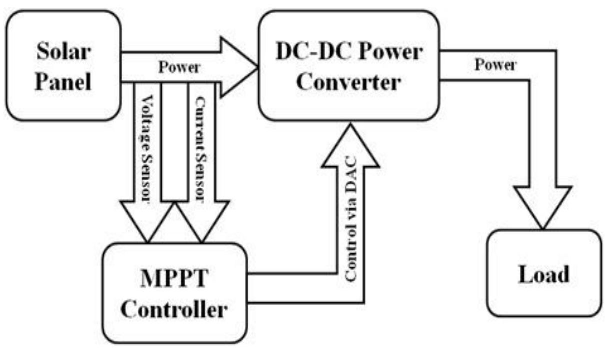

Fig.1Proposed Block Diagram

The Proposed Block diagram denotes the operation of the work proposed in this paper, which is having the details of the components used.The Solar Panel from which the power has to be extracted is modeled as per the requirement; but unfortunately the entire power up to the benchmark of the Solar panel will not be extracted .to extract the power completely, the MPPT Technique has been used. To have the MPPT Design ;the voltage and current from the solar panel has been measured ,by having the voltage and current as the reference the MPPT algorithmwhich is namely Perturbation & Observation has been designed as a programming and from the algorithm, V_{ref} has been obtained . and given to PWM as a Signal and from the PWM the gate Pulses has been given to the Mosfet of the Buck-Boost Converter, according to the gate pulse applied the mosfet will work.

TABLE I
DESIGN SPECIFICATION FOR PROPOSED METHOD

S.No	Particular	Value
1	Maximum Power (Pmpp)	49 W
2	Voltage at Maximum power (Vmpp)	17.3 V
3	Current at Maximum power (Impp)	4.41 A
4	Open - Circuit Voltage (Voc)	21.4 V
5	Short –Circuit Current (Isc)	4.96 A

*C. **Combined L A & PO Method***

The flowchart for the proposed MPPT algorithm is shown in Fig3, which is the combination of LA and P&O methods.First, the approximated line of MPPs can be determined from the electrical parameters of PV arrays. The reference command of current Iref can bedetermined according to the approximated line and the measured PV voltage and current.

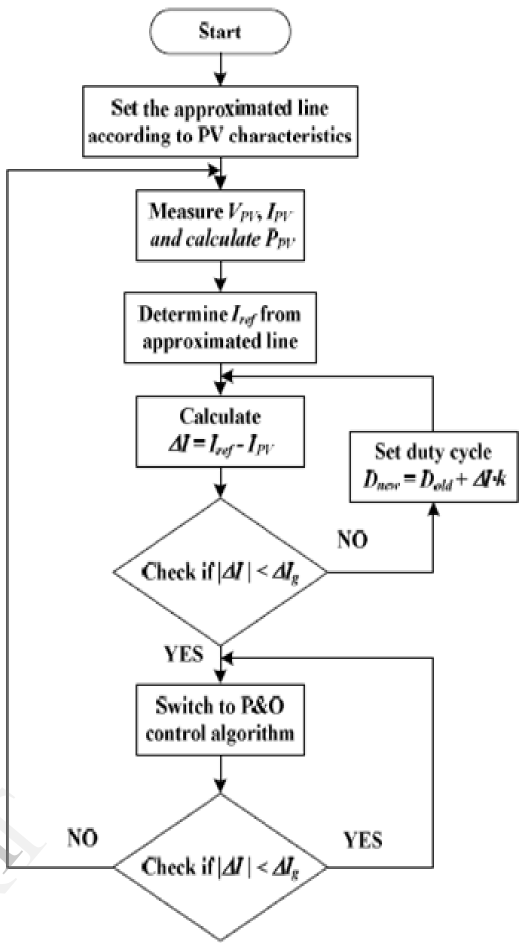

Fig 3:Flow Chart of Combined Linear Approximation And Perturbation and Observation Method

Then, the difference ΔI between PV output current$I_{PV}$and First, the approximated line of MPPs can be determined from the electrical parameters of PV arrays. The reference command of current I_{ref} can be determined according to the approximated line and the measured PV voltage and current. can be calculated to modulate the duty-cycle Dnew of gate-driving signal. When the magnitude of ΔI is small enough, it means the OP is very close to the actual MPP. The control algorithm switches to the P&O method with fine perturbation-steps so that the OP can dynamically track the accurate MPP. If there are rapidly climate changes occurring, the magnitude of ΔI will become large again. Therefore, the control algorithm needs to switch back to the LA method.

D.Simulation Results

Fig 4 shows the waveforms of PV output voltage, currentand power, while the proposed system operates at theconditions of 60mW/cm2 and 50oC. It can be seen that thecorresponding MPP can be rapidly and exactly achieved, whichreally proved the feasibility of the proposed MPPT method.

The graphs obtained at Various temperatures are displayed

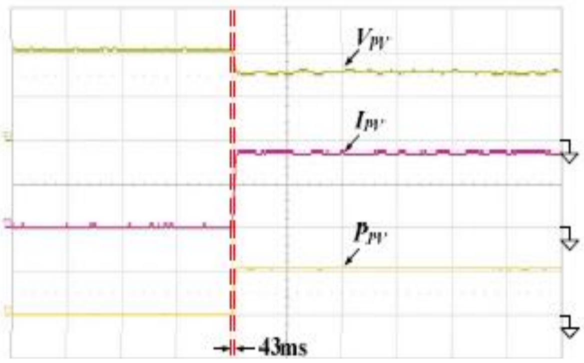

Fig 4 PV output voltage, currentand power, while the proposed system operates at theconditions of 60mW/cm2 and 50^{o}C.

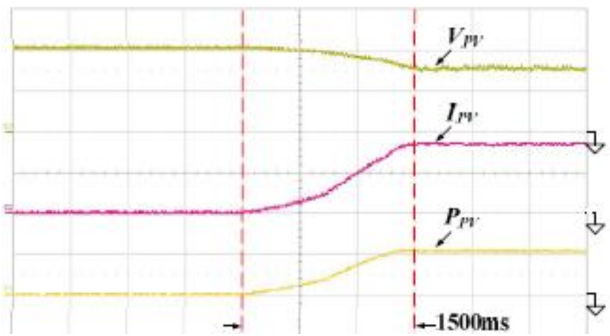

Fig 5: PV output voltage, currentand power, while the proposed system operates at the conditions of 80mW/cm2 and 25^{o}C

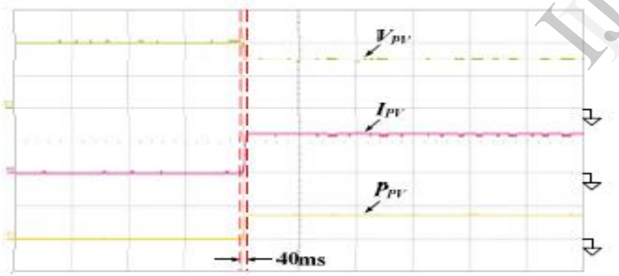

Fig 6: PV output voltage, currentand power, while the proposed system operates at the conditions of 60 mW/cm2 and 50^{o}C

E. Conclusion

The proposed work has been done by using an improved LA and PO methods for photovoltaic system .The LA method rapidly takes the operation point to a rough MPP, and then the P&O method continuously tracks the exact MPP with fine perturbation steps The proposed MPPT method has the advantage of faster tracking fewer fluctuations, and higher accuracy over the conventional methods. By replacing the Boost Converter with Buck-Boost converter the output voltage of the PV array which is dependent of temperature may produce higher or lower voltages, so to have both step-up and step-down processes are done

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