MPPT Techniques for PV Connected BLDC Motor Drives

Abhilash Nilkanth Jadhav[1] Dr. V. A. Kulkarni[2]
[1,2]Department of Electrical Engineering
Government Engineering College Aurangabad, India

Abstract— Today the need of energy increased day by day. we need to overcome the energy demand. India becomes planned to produced 20 GW of solar power by the year 2020-22. Solar energy plays an important role in Developing country. In this work, an attempt has been a review on a photovoltaic system with MPPT Techniques and interleaved converter for BLDC motor drive. MPPT is required to track the maximum power of solar photovoltaic energy. Under this paper, an MPPT techniques is used to increase in the Output from a solar panel with Converter and this power is used to drive the BLDC motor.

Key words: Maximum Power Point Tracking, P and O, Incremental Conductance, Solar PV System, Boost Converter, Interleaved Boost Converter, Brushless DC Motor

I. INTRODUCTION

The consumption of Nonconventional energy resources is the request of today also need of tomorrow. One of the most important reasons for renewable energy resources is Depleting fossil fuels is very quick.it is important to attention on Nonconventional energy resources like wind, solar, tidal, etc. the energy is getting clean and which is freely obtainable on all over the earth. The earth surface is irradiated by the sun with varying sunlight so radiation of sun falling on earth surface needs to concentrate on collected for PV system used. The output of solar cell depends upon the condition of the weather like partial shading, temperature, and irradiation. Due to Nonlinearity in the power generation from PV system we need to work the solar module at maximum power point for extract maximum power from the solar panel then delivered the maximum power to load. There are many types of MPPT control technique have been developed and implemented such as Fuzzy Logic Technique, Perturb and Observe (P &O) technique, incremental conductance technique. The P and O is the simplest technique for maximum power point also provide high efficiency. If the efficiency is increased then the power extraction is also increased. P and O are generally used because it is easy to execute. [1]

A. Solar Photovoltaic System

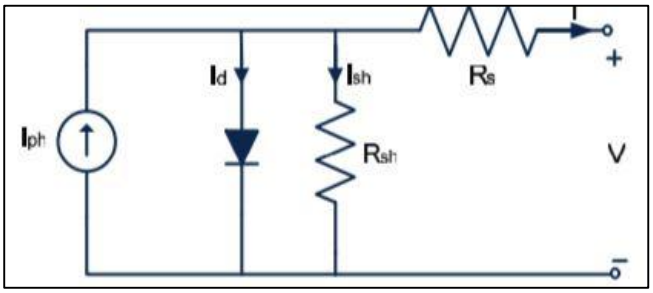

Fig. 1 Solar cell

Figure 1. shows the circuit diagram of the solar cell. In which is diode is parallel in connected with source current for to developed solar PV cell. The solar panel is used to generate DC power from solar energy. In which there is a P-N junction semiconductor is used for power generation because when solar light falls on the solar panel, dc power will be generated and these powers linearly vary with solar irradiance. the solar cell connected in series for increase output voltage and connected in parallel for the increase in current

$$I = np\ Iph - np\ Irs\left[\exp\left(\frac{q}{kTA}\frac{v}{ns}\right) - 1\right]$$

Where above equation I is the current of PV panel; np is no. of cell connected in series, Iph is phase current of the solar panel, Irs is the reverse saturation current of cell, q is electron charge; k is a Boltzmann's constant, ns is the no. of cell connected in series, v is voltage of solar panel, A is the ideality factor of the p-n junction and have ranged from 1 to 5.

II. REVIEW OF MPPT ALGORITHMS

A. P & O Algorithm

The P and O are moderately simple, yet most dominant technique to track the maximum power. Maximum Power Point Tracking is a method which is forced the PV module to generate maximum power as a demand of the load. The Voltage and Power generated by the solar panel are measured and this voltage and power are compared with previously power and voltage which is stored in memory.in this method, a current power is compared with previous power against a predefined constant. The controller operates periodically because there is an increase or decrease in voltage. Slightly perturbation is take placed in the system. Due to this, solar power changed. If the power is increased due to perturbation then it will be continued in the same direction. Then after the peak power point is tracked; the power at next instant time decreases so the perturbation is reverse. at peak power point the duty cycle remains the same until the conditions of solar irradiance are change. This method should constantly vary in duty cycle. In this method generated power oscillates around to the peak power. [2]

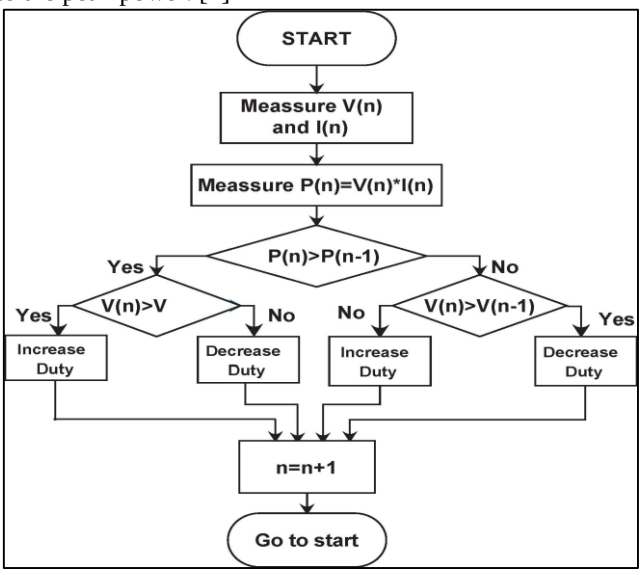

Fig. 2: P&O Flowchart

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B. Incremental Conductance

In this method Controller measure incremental variations in current and voltage of PV array and protect from the change in solar of the solar panel. below figure show's the incremental conductance flow chart.

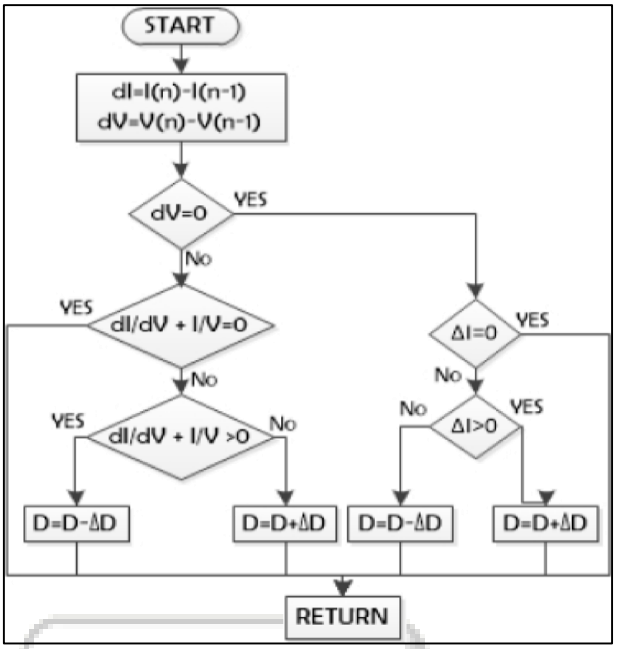

Fig. 3: Incremental Conductance flowchart

In incremental conductance technique changing conditions can track high rapidly than the other MPP tracking method. but incremental conductance required more computation in the controller. It produces oscillation in power output. In the method incremental conductance (dI/dV) of the solar panel to calculate the change in power with respect to voltage (dP/dV). This technique calculates MPP by comparing incremental conductance(dI/dV) with panel conductance (I/V). when the parameter remains the same (I/V=dI/dV); so the system will reach maximum power point.

III. FUNCTIONAL BLOCK DIAGRAM

Fig.4 shows the working block diagram of the recommended system. In which contain PV cell panel to receives the solar power from the sun and then converts into electrical power. The output from this photovoltaic module is provided to the converter for increased the output voltage and is provided to the motor. The maximum power point tracker is applied to maximum solar energy track from the photovoltaic panel.

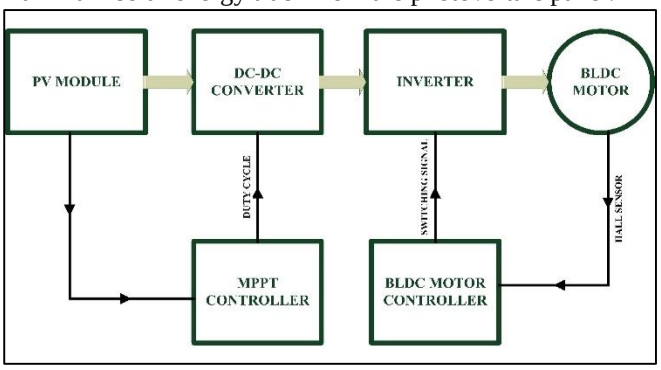

Fig. 4: Implementation block diagram of the proposed system

Power including current from a solar PV cell is given as input for MPPT(p and o method). In p & o algorithm the controller is applied to change in the duty cycle of the converter to work at the maximum power output from the solar PV system. Switching pulse to the inverter is made according to the back emf. MPPT algorithm is generate switching pulse for a converter- stator winding of DC motor are energized by an inverter in sequence with dc link capacitor which is connected after the converter and before the inverter to generate and maintain the fixed voltage at the input of inverter to obtain the ripple free power at the output of a system. The hall sensor finds out the rotor speed of the BLDC motor. the feedback signal generates from the hall sensor is provided to the inverter for switching purpose for control the speed of the motor. [3]

IV. INTERLEAVED BOOST CONVERTER

DC to DC converter is mostly used in renewable energy source like a solar photovoltaic power station, fuel cell storage system. A dc to dc IBC converter is connected between low voltage (panel output) and high voltage bus for output load operation. The high voltage ratio high turn ratio will not be favored due to high inductance leakage so we need to high switching frequency to the reduced size of passive component. Soft switching is needed for high switching frequency [4].

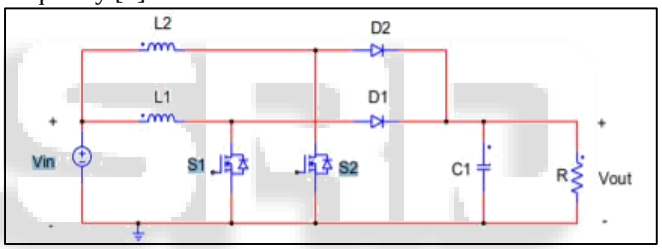

Fig. 5: Interleaved Boost converter

This paper refers to an interleaved boost converter. In the interleaved boost converter technique, there is two or more boost converter connected in parallel with having the same frequency and same phase shift. It is consisting of two-stage switches are connected in parallel S1, S2; diodes D1, D2; inductor L1, L2; load resistor R with an input source (Vin); capacitor C.

The Study of the proposed converter is followed

- Vin – I/p voltage; Vo – O/p voltage
- L1, L2 - Inductor; C1 - Capacitor
- Ts – Switching period;
- R – Load resistance,
- Fs = (1/Ts) – Switching frequency;
- D – Duty cycle.

There are two modes of operations

1) Mode 1 – (S1 closed, S2 opened)

In mode1, S1 is closed and S2 is opened and diode D1 is reverse biased and D2 is forward biased. Due to this input energy supply to the inductor L1, then the current in inductor L1 is rise linearly.

2) Mode 2 – (S1 – opened, S2 – closed)

In mode2, S1 is opened and S2 has closed also diode D1 is reverse biased so there is no current flowing through D1 and D2 is forward biased so the current flowing through D2 is supply energy to the inductor L1. The interleaved converter

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is used to reduce the input as well as output current ripple. In the interleaving technique each cell is handled more power so the stress on switch is reduced also improvement in efficiency. An interleaved boost converter saves energy and improvement in power conversion from low voltage to the high voltage without affecting the efficiency of the system. Interleaved boost converter save energy and improvement in power conversion from low voltage to the high voltage without affecting the efficiency of the system. Almost zero or less input ripple current from inductor has occurred at 50% duty cycle. The capacitor at the output has to filter only ripple current produce from inductor of the system. [5]

V. BRUSHLESS DC MOTOR

BLDC motor nowadays mostly used in the industrial, commercial sector. Due to the construction of BLDC motor suitable any safety and critical uses. They have many advantages as compared with other motors like DC motor AC motor (induction motor). Mechanical commutation is absent in BLDC motor due to this life of BLDC is increased. Brushless DC motor also called a permanent magnet synchronous motor. This motor widely used because of brushless motor have a swift response, size of motorless over another motor. The efficiency of BLDC motor should be high, also the maintenance cost of these motor is very low as compared with other dc motor and induction motor. In the proposed system feedback controller is connected to the inverter to give the rotor position BLDC motor and error should be found and give the information to the controller. Hall sensor is used to measure rotor position also the speed of BLDC motor for desirable output. Brushless dc motor is a rotating electric machine which is consisting of armature stator and permanent magnet rotor. In the BLDC motor, there is no use of brushes so the life of motor should long and zero noise operation. The permanent magnet used in rotor so high ratio between motor size and torque. BLDC motor required hall sensor for rotor position find out but the hall sensor has increased the cost of the system. [6]

VI. BOOST CONVERTER

The boost converter is dc to dc converter. In which step up the voltage at the output as compared with the input of boost converter.it consists of a diode or transistor and inductor, capacitor. The supply for the converter is provided from suitable DC sources like PV panels. The boost converter is also called a step-up converter because the output voltage of the boost converter is higher than the input voltage which is provided to the boost converter. A technique that changes dc voltage from one level to different voltage level that is called dc to dc conversion. Mostly MOSFET is used for switching purpose.

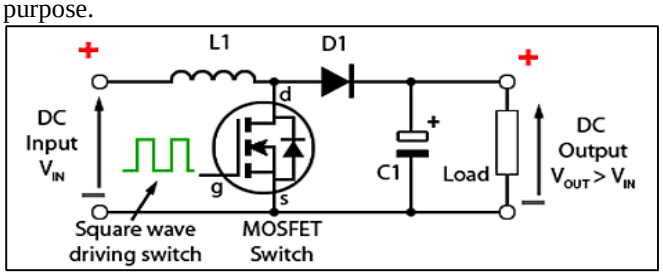

Fig. 6: Boost Converter

Vout = Vin/1-D

In the above figure we have seen; D which is the duty cycle of the dc to dc converter. The duty cycle of dc to dc converter is controlled by PWM. Which is the output of the MPPT controller? If the solar irradiance is changing so then controller changes a duty cycle of the boost converter to get maximum power from solar energy. There are some losses take placed in switching and passive elements but the efficiency is more than 90 percent. Boost converter having is more flexible and good performance so boost converter used in this paper. Current flowing in boost converter is constant this is one best the advantages of boost converter than a buck converter. [7]

VII. CONCLUSION

we have discussed a relative report study on boost converter as well as an interleaved boost converter for PV connected BLDC drives So, found that The Interleaved boost converter will help to be good solutions for the BLDC motor applications. Also, we have discussed MPPT Techniques in Solar. Since the BLDC motor has played an important role in the present system. The interleaved boost converter has an only reason for reduced ripple component from the system. The future work of this paper covers checks the operating performance of a dc motor with an interleaved boost converter and conventional boost converter. Interleaved boost converter mostly used to Improvement in the efficiency of solar energy.

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