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Research Article

SINGLE STAGE SOLAR PV FED BRUSHLESS DC MOTOR

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A B S T R A C T

In today's world renewable source of energy plays a vital role for producing electricity. Compared to other renewable sources solar is the most developing ways to producing electricity. It does not have any pollution. A single stage solar PV fed brushless DC motor is used for agricultural purpose which can be used in the water pump. It is the standalone system which can be installed in the agricultural field. A single stage solar PV fed energy conversion system eliminates conventional DC-DC converter which increases size, complexity and reduced efficiency. It is done by a simple voltage source converter which feeds BLDC motor-pump. DC link circuits are used primarily to balance the instantaneous power variations between the input source and the output load. The bulky capacitor at the dc link is replaced with a low valued capacitor using pulse width modulation switching of VSI. The capacitor is connected across PV array serves to provide constant voltage to converter circuit. The capacitor carries ripple current. A diode in series with the PV array prevents the flow of reverse current. The speed of the motor can also be adjusted accordingly.

INTRODUCTION

Energy crisis are occurring in the country by using the fossil fuels.This can be recovered by using the renewable energy sources which are readily available. Solar standalone system is installed in many places. The solar standalone pumping system is used for the agricultural purpose. A single stage solar PV fed brushless motor can be applied in the water pump. The brushless DC motor has more efficiency when compared to the induction motors.It also overcome the disadvantages that are caused by the brushes and commutator. A single stage PV fed brushless DC motor means it has only a single stage i.e., it has the DC link capacitor to convert the DC voltage to the AC voltage .The DC link capacitor also gives the constant DC voltage without any interruption. This single stage eliminates the DC-DC converter which normally used. In our paper we can also adjust the speed of the motor.

LITERATURE SURVEY

There are previous works that are done related to the solar PV system and the brushless DC motor. These things helped us to create the new idea of the single stage PV fed brushless motor.

In [1] the project represents the commutation torque of the brushless DC motor which is used to study the details about the brushless DC motor.

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I t also tells about the Cuk converter during the commutation period and normal conduction period are altered by designing a mode selection circuit, which can reduce commutation torque ripple over the entire speed range. The torque characteristics of the brushless Dc motor can be understood by referring [1].

In [2], the brushless DC motor runs by using the energy from the solar PV array. In this we can able to interpret details about the solar PV array and the brushless DC motor which can be used for many applications. By using the brushless DC motor, we can reducelosses which can occur due to the increase in temperature

In [3], it describes the details about the single stage solar photovoltaic which is used to run the switched reluctance motor. It also describes about eliminating the DC-DC converter and the implementation of the DC link capacitor. The DC link capacitor is used to get the constant DC voltage without any fluctuation.

In [4], it interprets the application which can be used for the brushless DC motor using ZETA converter. The application mention in [4] is the water pumping system which can be used for the agricultural purpose.

Proposed Model

The proposed model consists of the DC link capacitor which is replaced by DC-DC converter and an inverter in the normal model. The Dc link capacitor is used to get the constant DC

voltage and also it used to convert DC to AC which is used to give the voltage to the driver circuit.

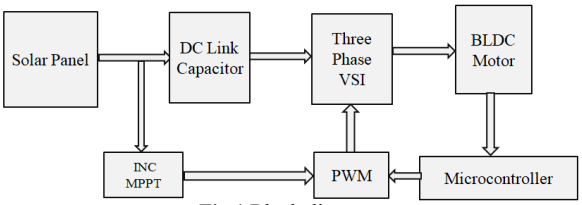

Fig 1 Block diagram

Solar Panel

Photovoltaic (PV) solar panels are made up of many solar cells. Solar cells are made of silicon, like semiconductors. They are constructed with a positive layer and a negative layer, which together create an electric field, just like in a battery. PV solar panels generate direct current electricity.

The solar PV array uses MPPT algorithm to get the maximum voltage from the source. The maximum efficiency is achieved when PV works at its maximum power point which depends onirradiation and temperature. In incremental conductance method the array terminal voltage is always adjusted according to the MPP voltage it is based on the incremental and instantaneous conductance of the PV module

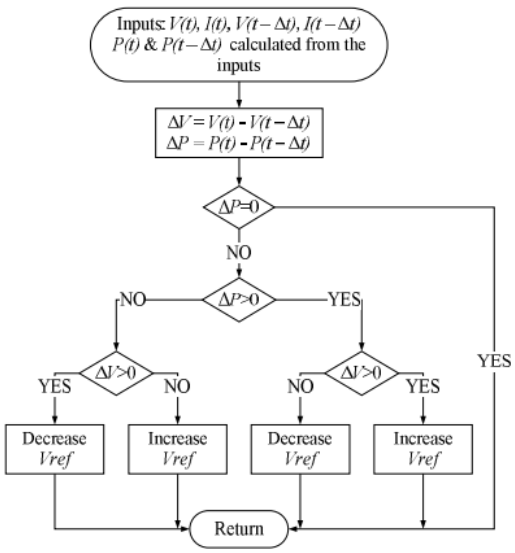

Fig 2 Flow chart of MPPT algorithm

DC link capacitor

DC link capacitor is primarily used to balance the instantaneous power variations between the input source and the output load or a power circuit the example of a switching power supply, AC power is converted to DC without passing through a transformer and fed to a high-frequency power oscillator. The DC link capacitor is applied from positive to negative after rectification. In a power inverter, a DC link capacitor is placed in parallel with the input to minimize the effects of voltage variations as the load changes. The DC link capacitor also provides a low-impedance path for ripple currents generated by power switching circuits.

The capacitor required is given by

$C=(I_c)/(f_{sw}*V_{pv})$

Where $f_{sw}$is switching frequency, I_c is the current in the capacitor and $V_{pv}$is the voltage in the solar PV array.

C) Voltage Source Inverter:

The voltage source inverter is used to convert DC voltage to AC voltage. In voltage source inverter, the MOSFET's are used to give the pulse accordingly to run the brushless DC motor since brushless DC motor is the electronically commutated motor. The opto coupler is used that transfers electrical signals between two isolated circuits by using light. The LED in the opto coupler is used to convert the electrical signal into light which is received by a receiver. The voltage here is stepped upto the level which is needed for the MOSFET driver IC's. The MOSFET must need an IC to trigger the circuit.

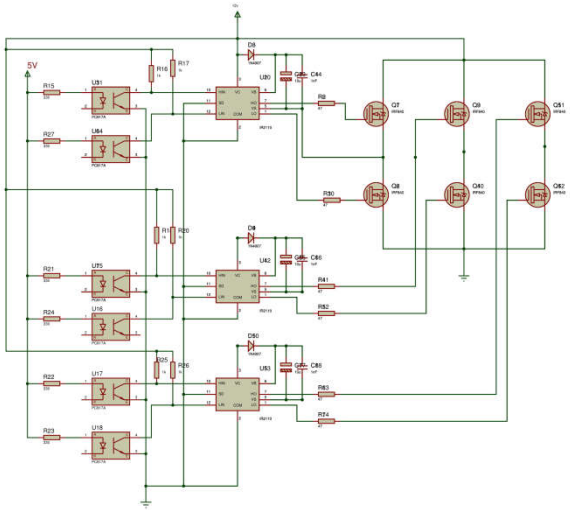

Fig 3 Design of VSI in proteus

By using voltage source inverter, three phase pulse is produced which is given to the brushless DC motor.

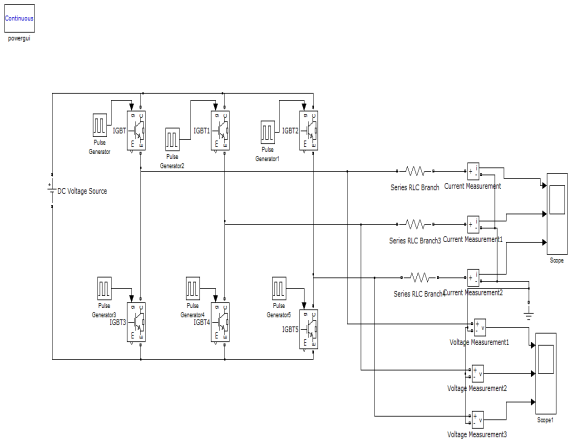

Fig 4 Simulation of voltage source inverter using Matlab

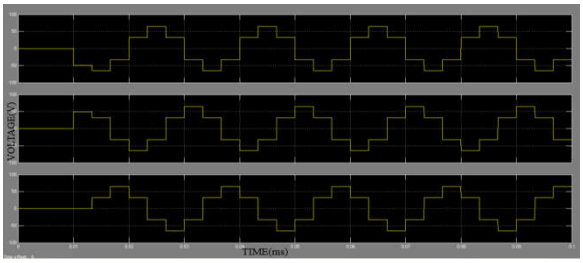

Fig 5 Output waveform of voltage in VSI

Microcontroller

Microcontroller is used to produce pulse width modulation which is given to the voltage source inverter. The microcontroller is programmed such that proper pulse is given to the brushless DC motor.

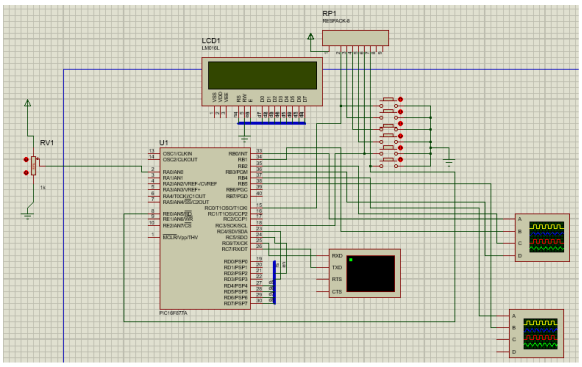

Fig 5 Simulation of microcontroller which produces pulse width modulation in proteus

Brushless DC motor

Brushless DC motor is an electronically commutated motor. It is also called as synchronous DC motors. The controller provides the pulse of the current to the motor windings that control the speed and torque of the motor.

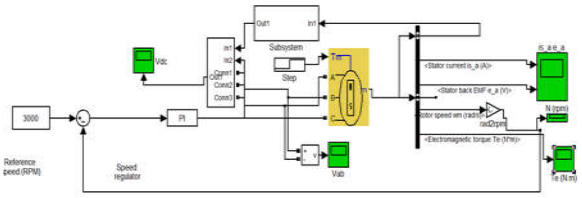

Fig 6 Simulation of brushless DC motor in MAtlab

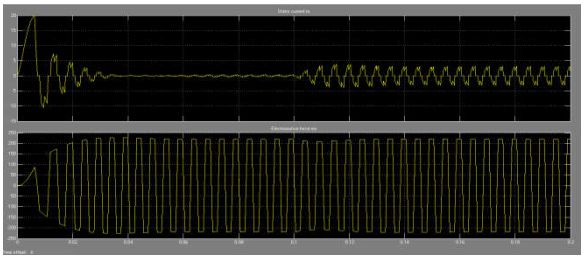

Fig 7 Output of stator current and back emf

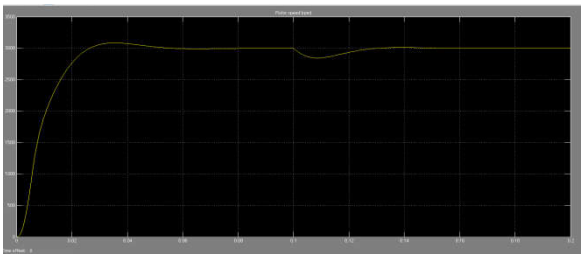

Fig 7 output of speed

CONCLUSION

The BLDC motor driven water pumping based on a single stage solar PV generation has been validated through a demonstration of its various steady state, starting and dynamic performances. The system has been simulated using the MATLAB toolboxes, and implemented on an experimental prototype. The topology of the proposed system has provided a dc–dc converter-less solution for PV fed BLDC motor driven water pumping. Moreover, the motor phase current sensing elements have been eliminated, resulting in a simple and cost-effective drive. The other desired functions are the speed control without any additional circuit and a soft start of water pump. Thus the output is obtained from the brushless DC motor. The load like water pump is connected to the motor which is used for the agricultural purpose.

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