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BLDC Motor Driven Solar PV Array Fed Water Pumping System Employing KY Converter

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ABSTRACT

This paper proposes bldc motor driven water pumping system employing ky converter. Solar panel used to collect the sun rays and incremental conductance method used to track the maximum power. Then the dc voltage given to drive ky converter. Output of ky converter given to voltage source inverter then it will used to operate brushless dc motor. Speed of bldc motor sensed by hall effect sensor. Hall effect sensor has inbuilt encoder it is used to produce hall signals.

Keywords: Bldc motor, Hall effect sensor, Incremental conductance, ky converter and Solar panel.

1. INTRODUCTION

By using solar energy bldc motor will be operated. Solar cells have a complex relationship between temperature and resistance. It will produce nonlinear output efficiency and analyzed based on I-V curve. Controlling the ky converter in an intelligent manner through the incremental conductance maximum power point tracking algorithm offers the soft starting of the brushless DC motor. The incremental conductance MPPT algorithm is used to operate the ky converter such that the SPV array always operates at its MPP and the BLDC motor experience a reduced current at the starting. A three phase voltage source inverter (VSI) is operated by fundamental frequency switching for the electronic commutation of BLDC motor.

By using this method bldc motor will be rotated in constant speed. Due to this constant speed it will be used in water pumping systems like agriculture purpose.

2. SOLAR PANEL

Fossil fuels and artificial sources can be destroyed in some years. Due to this nowadays renewable sources are used widely. It also minimize the amount of pollution. Solar radiation will be obtained daily .Solar panels convert sun radiations into electricity by means of photovoltaic effect.

Solar radiation has pocket of photons. Solar radiation has irregular relationship between temperature and resistance it cause varied output efficiency. To maintain constant output power maximum power point tracking technique is used. In this paper incremental conductance mppt technique use to achieve high efficiency.

Incremental conductance method used to extract the maximum power under all environmental conditions. This technique computes the maximum power by comparison of the incremental conductance (I_Δ / V_Δ) to the array conductance (I / V). When these two are the same (I / V = I_Δ / V_Δ), the output voltage is the MPP voltage. It has high accuracy than other techniques.

3. KY CONVERTER

KY converter has two MOSFET switches S1 and S2 together with anti-diodes DI and D2 one diode D, one energy-transferred capacitor Cb which is used to keep the voltage across itself constant at the value of the input voltage, one output inductor L, and capacitor C.

Principle of Operation

CASE1: Power flowing through the output inductor L is assumed to be from the left side to the right side all the time, which usually happens at heavy loads. In mode 1 switch1is in on condition and switch 2 is in off condition. Voltage across inductor is input voltage across capacitor minus output voltage so that inductor will be magnetized in opposite direction

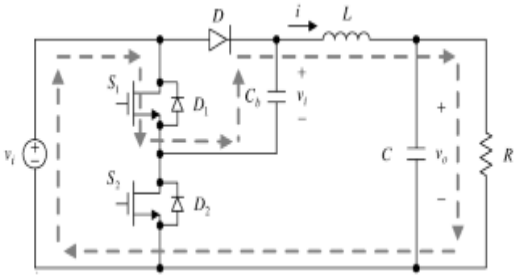

Fig 3.1 Mode 1 operation

$$L\frac{di}{dt} = 2vi - vo$$
$$C\frac{dvo}{dt} = i - vo/R$$

In mode 2 switch2 will be turned on and switch1 will turned off. Voltage across inductor is input voltage across capacitor minus output voltage due to this inductor will be demagnetized in opposite direction.

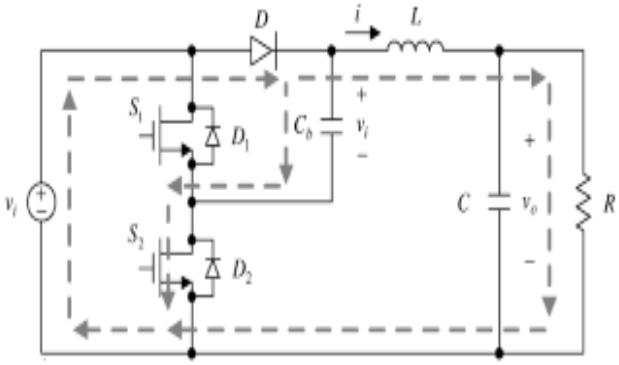

Fig 3.2 Mode 2 operation

$$L\frac{di}{dt} = vi - vo$$
$$C\frac{dvo}{dt} = i - \frac{vo}{R}$$

CASE2: Power flowing through output inductor is assumed to be from the right side to the left side at all times. It is also same as existing case only difference is current flow.

4. BLOCK DIAGRAM

Block diagram of this paper consists of solar panel, ky converter, mppt controller, voltage source inverter, bldc motor and hall sensor.

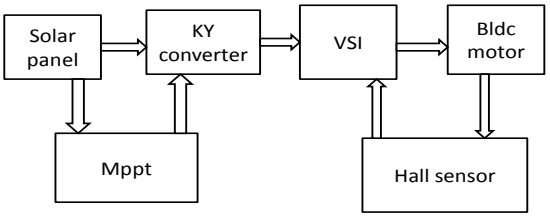

Fig 4.1 block diagram

Solar panel output given to ky converter .By using maximum power point tracking maximum power extracted under all conditions.

Fixed dc obtained by solar panel converted into variable dc using ky converter. KY converter output given to voltage source inverter.

Voltage source inverter convert dc into ac. Finally bldc motor running at constant speed. Hall sensor produce signal to the voltage source inverter by means of inbuilt encoder. Signals are produced based on the position of brushless dc motor.

5. SIMULATION AND RESULTS

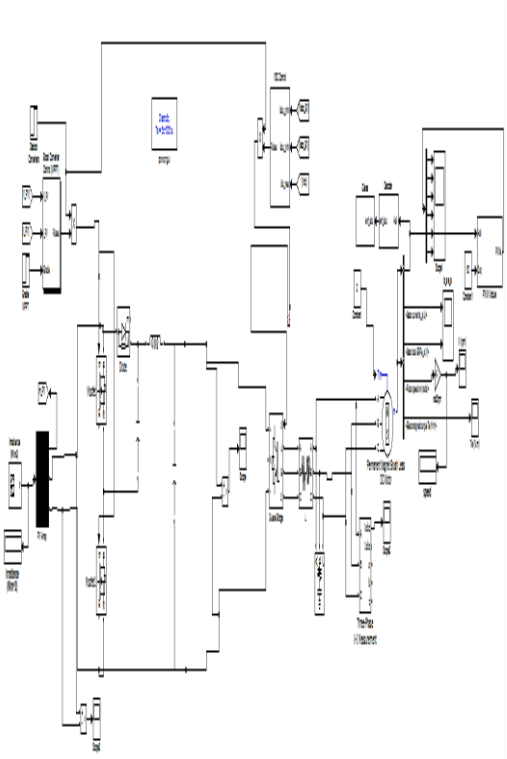

Fig 5.1 Simulation diagram

Input Solar Voltage

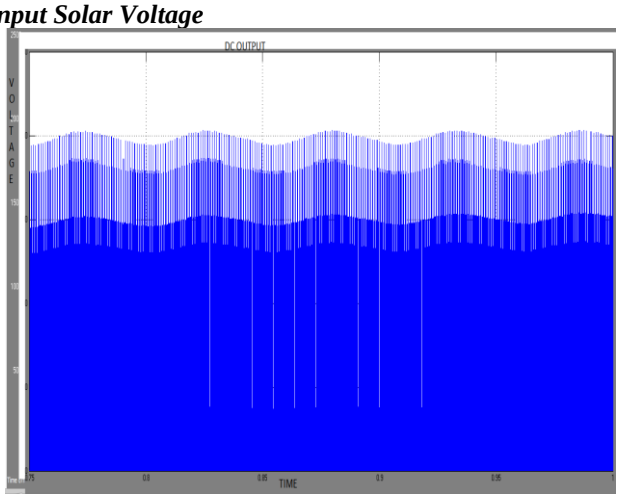

Fig 5.2 Input solar voltage

Inverter Output

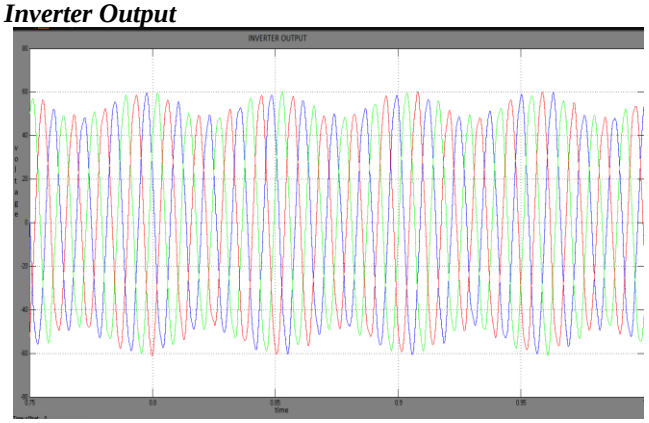

Fig 5.3 Inverter output

Motor Speed

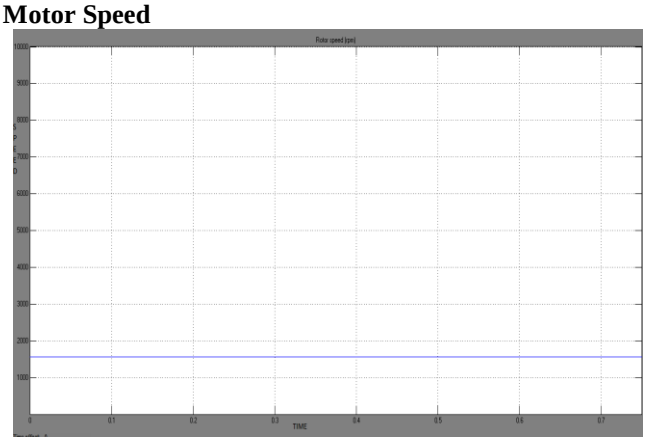

Fig 5.4 motor speed

6. HARDWARE AND RESULTS

Hardware circuit consists of solar panels, ky converter, voltage source inverter, pic micro controller, driver circuit and buffer circuit. Solar panel used to convert solar radiation into electrical energy. Ky converter used to boost the input voltage. Voltage source inverter used to convert direct current into alternating current.PIC microcontroller used to produce the gate signal and signal given to mosfet switches. Buffer circuit used to boost the output voltage and then it will give to load. Bldc motor connect at output side.

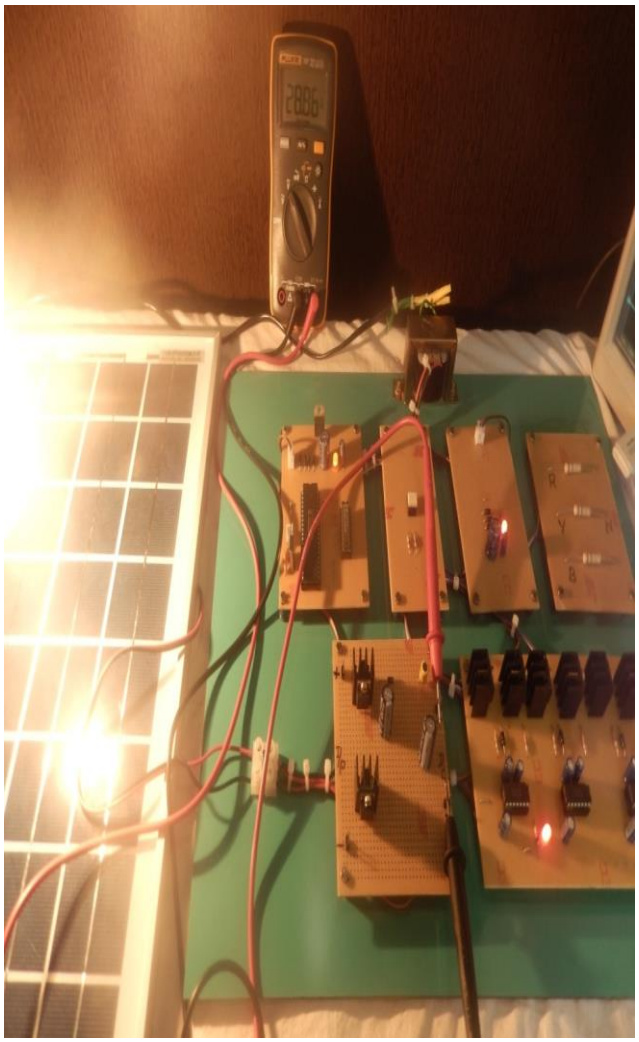

Fig 6.1 Photocopy of hardware

Input Solar Voltage

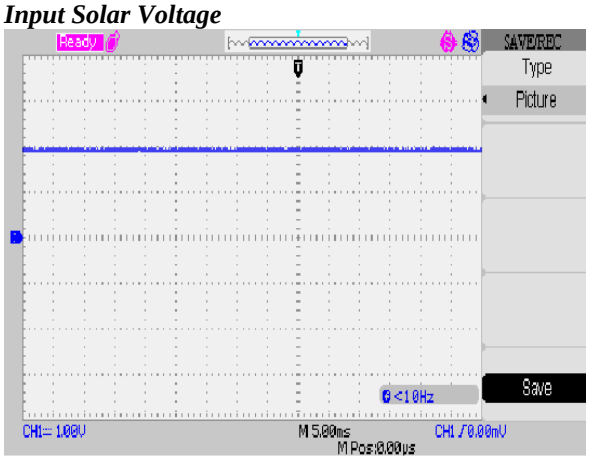

Fig 6.2 Input solar voltage

Line Voltages

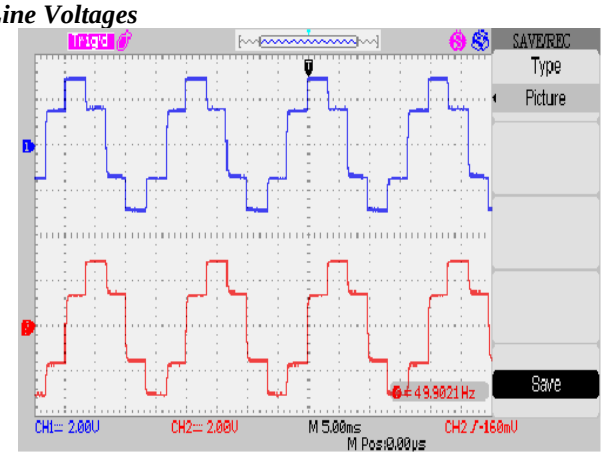

Fig 6.3 Line voltages

Phase Voltages

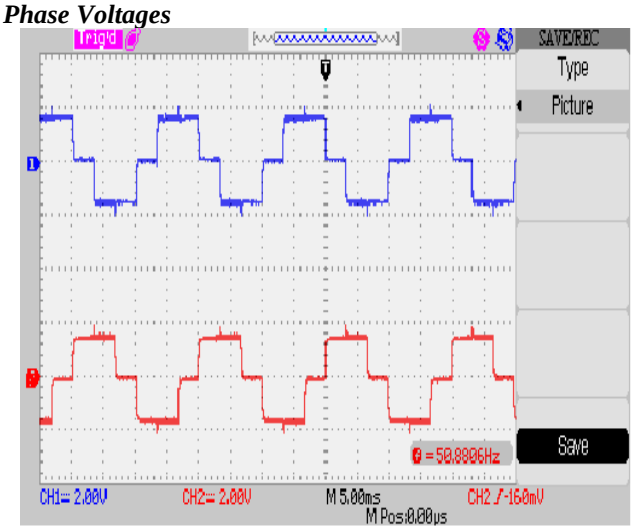

Fig 6.4 phase voltages

7. CONCLUSION

Existing system consists of zeta converter it has more losses. In this paper ky converter used as boost converter. By using solar panel output bldc motor can be rotated. Due to the use of ky converter output voltage and output current ripples can be reduced. Both simulation and hardware results shown in this paper for ky converter.

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