SOLAR BASED WATER PUMP EMPLOYING Z-SOURCE INVERTER

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Abstract - Now a day's renewable energy sources are receiving great attention due to competitive prices in the market. It is due to technology advancement and government support. Solar photovoltaic system is developed as a mature green technology with low maintenance requirement, less installation time and grid parity. Solar PV supply system is classified in terms of its conversion stages. The boost converter is the traditional converter used as an intermediate power conversion circuit to obtain the maximum solar generated power.

A Z-source inverter (ZSI) replaces the VSI for variable speed drive system to overcome the aforementioned problems. The ZSI is considered as a single-stage buck-boost inverter. In the buck mode it operates like a traditional VSI, with six active vectors and in boost mode it includes an extra switching state, defined as shoot-through state by using an impedance Z-network. The impedance network, boost DC link voltage at the required level and considered as an attractive solution for various applications.

This Project proposes a ZSI based single stage solar power conversion system for 3Phase AC drive coupled with water pumping load.
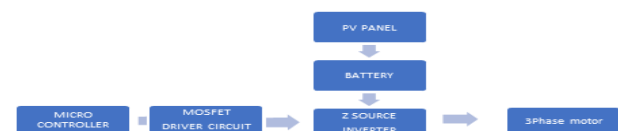
Key Words: MOSFET, PV PANEL, Z SOURCE INVERTER, MICROCONTROLLER, LEAD ACID BATTERY

1. INTRODUCTION

The solar energy (renewable source of energy) converted into electrical energy through solar panels. It produces DC where it can be stored in a battery. This project employs z-source inverter to convert DC to AC to run the motor. Alternate current runs the electric pump which helps in decreasing the losses of the pump. This project aims to run the three-phase water pump using a z-source inverter. For this purpose, PV panel, Boost converter, z source inverter, Microcontroller are used in this proposed model. This project involves 5V and +15V DC supply. Then, step-down transformer is used to get the 15V AC supply from 230V AC supply. And bridge rectifier is used to convert the AC supply to DC supply and capacitor is used for filtering the AC signals and 7667 and 6N135 regulator IC are used to regulate the DC supply. Thus, we can get +5V and +15V DC supply. This power supply is common for all the circuits. PV panel is used to get the DC supply form the sun light. This supply will be small and variable. To increase the power source, we made use of Boost converter, which means this

circuit is convert low voltage to high voltage. In this circuit, we are using MOSFET for switching purpose. By giving frequency through MOSFET we energize the inductor for getting high voltage. When the MOSFET is ON and OFF for particular time period, the inductor coil energizes and de-energize accordingly. By doing this method, we can get high voltage. And also, Z source inverter is used to invert the DC supply into AC supply by using the MOSFET. By switching ON the 6 MOSFET in time period we can get the AC supply where in the inverter circuit 3 MOSFETs for switching the +ve supply and other 3 MOSFET are switching the –ve supply. And MOSFET driver circuit is used to trigger the gate of the MOSFET. In this model, we are using Opto-coupler IC for the isolation of the high voltage DC and low voltage signal from the microcontroller. And MOSFET Driver IC is used to trigger the gate of the MOSFET by giving the +15V pulse. Then, Microcontroller PIC16F877A is used to generate the frequency to boost the supply from the PV panel and also switching the MOSFET in the sequence by invert the DC supply to AC supply.

2. METHODOLOGY

3.DESCRIPTION OF THE COMPONENTS

   PV panel

   Lead acid battery

   Z source inverter

   Microcontroller

   MOSFET drive circuit

   Three phase induction motor

3.1. PV Panel

A photovoltaic (PV) module is a packaged, connect assembly of generally 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in marketable and domestic operations. Each module is rated by its DC affair power under standard test conditions (STC), and generally ranges from 100 to 365 Watts (W). The effectiveness of a module determines the area of a module given the same rated affair – an 8 effective 230 W module will have twice the area of a 16 effective 230 W module.

3.2. Lead acid battery

They're simple and affordable to manufacture. Having been used over further than 140 times, they're dependable, mature secondary batteries, encyclopedically manufactured and thus a extensively understood technology. They're durable and reliable when used correctly. Their tone-discharge is among the smallest of rechargeable battery systems. They're environmentally sound in that they're reclaimed at an incredibly high-rate moment, 98 of lead-acid batteries are reclaimed. They've low conservation conditions, including no memory and no electrolyte to fill on the sealed interpretation.
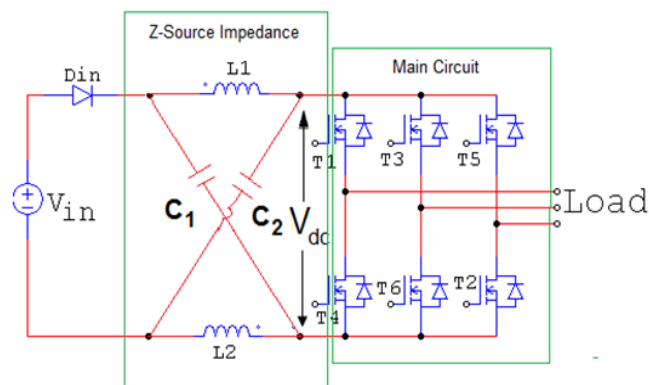
3.3. Z source inverter

Fig -1: Z SOURCE INVERTER CIRCUIT

A Z- source inverter is a type of power inverter, a circuit that converts direct current to interspersing current. It functions as a buck- boost inverter without making use of DC-DC motor ground due to its unique circuit topology. Impedance (Z-) Source networks give an effective means of power conversion between source and cargo in a wide range of electric power conversion operations (dc – dc, dc – ac, ac – dc, ac – ac). It's also used to boost the voltage.

3.4. Microcontroller

PIC microcontroller, a RISC based microcontroller fabricated in Complementary metal oxide semiconductor or CMOS, which uses separate bus for instruction and data allowing simultaneous access of program and data memory.

Microcontrollers offer different kinds of memories such as EEPROM, EPROM, FLASH, etc. PIC16F877 is build using flash technology, so that data is retained even when the power is switched off. Programming and Erasing are easier in PIC16F877.

3.5. MOSFET DRIVE CIRCUIT

Opto coupler section:

An opto-isolator (otherwise called as optical isolator) is a device that uses a short optical transmission path to transfer a signal between elements of the circuit, generally a trans-receiver, while keeping them isolated – since the signal goes from electrical to optical and back to an electrical signal, the path is broken along the circuit.

Current boosting section:

Current source, a device that delivers or absorbs electric current. A current source is the binary of a voltage source The term constant-current sink is sometimes used for sources fed from a negative voltage supply.

3.6. Three phase induction motor

Therefore, from the **working principle of three phase induction motor**, it may be observed that the rotor speed should not reach the synchronous speed produced by the stator. If the speed is equal, relative speed does not exist which in turn induce no emf in the rotor, and current flow becomes zero, and therefore no torque would be generated. Consequently, the rotor will not achieve its synchronous speed. The rotation of the magnetic field in an induction motor has the advantage that no electrical connections need to be made to the rotor.
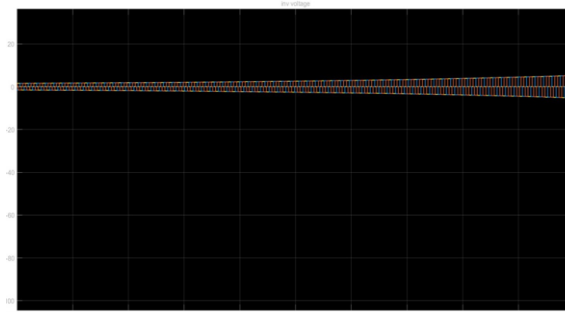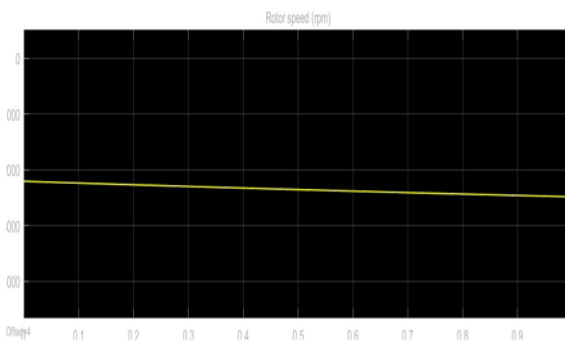
4.WORKDONE

SIMULATION CIRCUIT
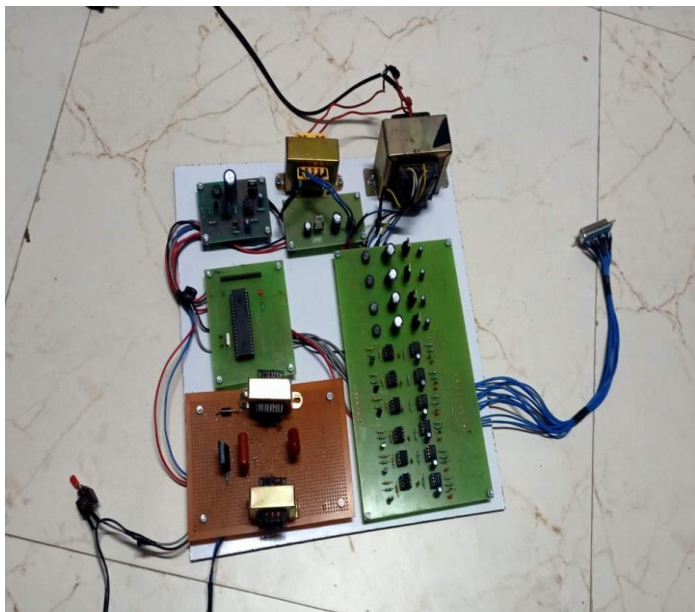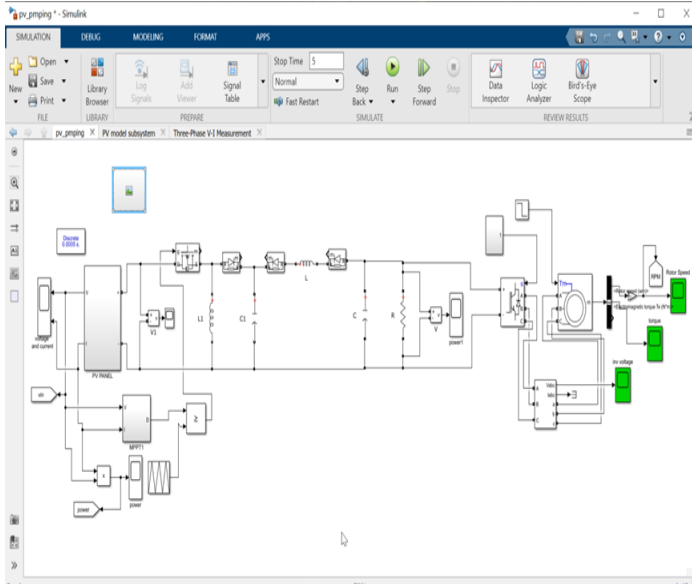
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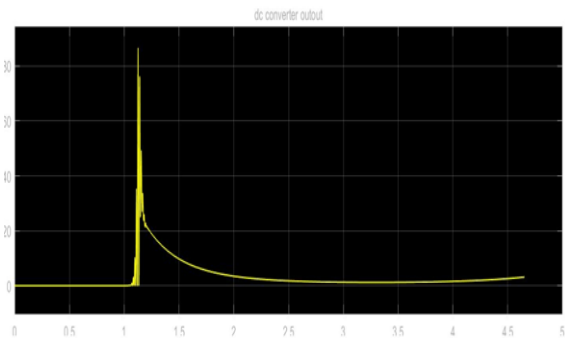
DC CONVERTER OUTPUT

INVERTER VOLTAGE

ROTOR SPEED

6. CONCLUSION

The PV panel supplied ZSI based Induction motor has been modeled and controlled for 3Phase AC motor system. The based simple boost control is used for ZSI. In comparison of conventional two stages power conversion, the proposed system has employed single stage ZSI for maximum power extraction of PV array and driving a 3Phase AC motor system for various

operating conditions. The developed system provides excellent control with short response time, low switching losses, good steadiness capability and considered energy efficient under wide range of solar radiation.

7.FUTURE SCOPE

The Below listed are the main future scope of this project

1. Will help to provide green energy and pollution free power source for future generation

2. The Z source inverter used in the system using PV is highly effective to provide boosted output.

3. This Overall System will help to meet Energy demands and save energy for future.

4. This System is Cost effective, Efficient and user Friendly in its operation.

REFERENCES

1. R. Foster, M. Ghassemi and A. Cota, Solar Energy Renewable Energy and the Environment, CRC Press, New York, 2010.

2. F. Z. Peng, A. Joseph, J.Wang, M. Shen, L. Chen, Z. Pan, E. Ortiz-Rivera, and Y. Huang, "Z-source inverter for motor drives," IEEE Trans. Power Electron., vol. 20, no. 4, pp. 857–863, Jul. 2005.

3. R. Antonello, M. Carraro, A. Costababer, F.Tinazzi and M. Zigliotto, "Energy–Efficient Autonomous Solar Water–Pumping System.

4. Liang, Xiaodong; Ilochonwu, Obinna (Jan 2011). "Induction Motor Starting in Practical Industrial Applications". IEEE Transactions on Industry Applications

5. Marek Adamowicz, "LCCT-Z-source inverters", in 10th International Conference on Environment and Electrical Engineering (EEEIC), 2011