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A Five-Level Quasi Z-Source Based NPC Inverter for PV Applications

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ABSTRACT: DC-AC five level converter for VSC-SC technology has a significant influence on the performance of the entire power transmission system. This project introduces a new dc-ac five level converter composed of submodules and series IGBT switches. The basic idea of this hybrid solutionis to shape the ac voltage by submodules, but per half cyclereconnect them to different electrical points by IGBT switches. This concept can help to reduce the quantities of submodules thereby reducing the energy storage requirement significantly. Another advantage is that the IGBT switches can be soft-switched by utilizing the high controllability of the submodules. This brings extra benefitof power losses reduction. In this paper, the operatingprinciple of this hybrid five level converter is explained. Its performances are also presented in detail and compared with those popular VSC dc-ac five level converters. The feasibility of the new concept is also verified by simulation and experimental results.

I.INTRODUCTION

The changing scenario of the power demand of the world has led to the development of various new power converters and new power semiconductor devices. One of them is the five level converter technology that has been basically introduced for industrial application having medium voltage and high power requirement. In the power industry, the medium voltage is in the range of 2.3 kV to 6.6 kV and high power range is considered to be 1-50 MW. Five level inverters includes an arrays of power semiconductors switches and DC voltages sources, the output of which generates voltage with stepped waveforms .In recent days, five level power conversion technique has been considered as the key element in power electronics field development .In comparison with the conventional two level inverter, the incriminating process of DC voltage sources leads to more qualified output waveforms with lower harmonics content. The main advantage of five level inverter is high power quality, lower order harmonics, lower switching losses and better electromagnetic interference. Three main structures of five level inverters have been presented: Diode clamped five level inverter, flying capacitor five level inverter and cascaded five level inverter. Out of these three structure, cascaded MLI its doesn't requires clamping diodes and flying capacitors and it require the lowest number of semiconductors switches to produce particular leveled waveform. These cascaded five level inverter has two broad categories i.e. Symmetric MLI with same DC voltage source amplitude and asymmetric MLI with the different DC source magnitude. Asymmetric structure produces higher number of levels comparing with symmetric structure.

Unfortunately, MLI structures have some disadvantages. Larger number of levels increases the number of switching levels that must be controlled. Therefore, a new topology developed to increase the number of generated output levels with the aid of lower switches. At the first step, single basic unit is developed. By series connection of several proposed units, a new proposed topology is developed, which will produce only positive levels at the output. In addition to the basic series connected unit, H Bridge will be added at output to produce positive negative output levels. Four different algorithms are proposed for measuring DC voltages. The proposed five level inverter is compared with the other MLI topologies. Based on these comparisons, developed cascaded inverter requires minimum number of power switches, diodes, driver circuits and DC voltage sources. The experimental results prototype model and simulation have demonstrated the feasibility and practicality of the proposed inverter.

This project is based on the performance of the Switched Reluctance Motor (SRM) drives using Z-Source Inverter with the simplified rule base of Fuzzy Logic Controller (FLC) with the output scaling factor (SF) self-tuning mechanismare

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proposed. The aim of this paper is to simplify the program complexity of the controller by reducing the number of fuzzy sets of the membership functions (MFs) without losing thesystem performance and stability via the adjustable controller gain. ZSI exhibits both voltage-buck and voltage-boost capability. It reduces line harmonics, improves reliability, and extends output voltage range. The output SF of the controller can be tuned continuously by a gain updating factor, whose value is derived from fuzzy logic, with the plant error and error change ratio as input variables. Then the results, carried out on a four-phase 6/8 pole SRM based on the Dspac EDS1104 platform, to show the feasibility and effectiveness of the devised methods and also per practical operation mechanism isthe FLC. It has been shown that fuzzy control can reduce hardware and cost and provide better performance than the classical PI, PD, or PID controllers Recently, fuzzy control theory has been widely studied, and various types of fuzzy controllers have also been proposed for the SRM to improve the drive performance further Performance of the FLC are scaling factor (SF) tuning, rule base modification, inference mechanism improvement, and membership function redefinition and shifting.

A three-port dc–dc five level converter integratingphotovoltaic (PV) and battery power for high step-up applications is proposed in this paper. The topology includes five power switches, two coupled inductors, and two active- clamp circuits. The coupled inductors are used to achieve highstep-up voltage gain and to reduce the voltage stress of input side switches. Two sets of active-clamp circuits are used to recycle the energy stored in the leakage inductors and to improve the system efficiency. The operation mode does not need to be changed when a transition between charging and discharging occurs. Moreover, tracking maximum power pointof the PV source and regulating the output voltage can be operated simultaneously during charging/dischargingtransitions. As long as the sun irradiation level is not too low, the maximum power point tracking (MPPT) algorithm will be disabled only when the battery charging voltage is too high. Therefore, the control scheme of the proposed five level converter provides maximum utilization of PV power most of the time. As a result, the proposed five level converter has merits of high boosting level, reduced number of devices, and simple control strategy. Experimental results of a 200-W laboratory prototype are presented to verify the performance ofthe proposed three-port five level converter.

II.EXISTING SYSTEM

A DC-to-DC five level converter is an electronic circuit or electromechanical device that converts a source of direct current (DC) from one voltage level to another. It is a type of electric power five level converter. Power levels range from very low (small batteries) to very high (high-voltage power transmission). In continuous mode, the amount of energy required by the load is small enough to be transferred in a time smaller than the wholecommutation period. In this case, the current through the inductor falls to zero during part of the period. The only difference in the principle described above is that the inductor iscompletely discharged at the end of the commutation cycle. If the current through the inductor L never falls to zero during acommutation cycle. The five level converter is said to operate incontinuous mode. In buck boost five level converter operates in discontinuous mode when low current is drawn by the load, and in continuousmode at higher load current levels. The limit betweendiscontinuous and continuous modes is reached when the inductor current falls to zero exactly at the end of the commutation cycle.

III.PROPOSED SYSTEM

We were assigned this project as a part of our college curriculum for the time interval August to November, 2017. Thanks to this project, we got a chance to get familiar with MATLAB Simulation, electronics components, hardware fabrication and learnt about design and control of Seven Level Convertor by giving DC as input and obtaining modified sine wave as output. The project covers particularly the operating principle, physicalfabrication, gate firing circuits, of inverter with Cascaded H- Bridge topology. The H-Bridges will be made using MOSFETs for hardware fabrication while IGBTs for MATLAB simulation.The project is presented in two domains -

- MATLAB Simulation - It is used to compute the values of parameters like firing angles of IGBTs for different H Bridges used in inverter associated with model and to safely debug it before implementing on hardware.
- Hardware Model - The hardware model has been developed on the basis of simulation done earlier. The Cascaded H- topology is used as this method helps to form different output voltage levels, increasing the total inverter output voltage and also its rated power and reducing the Total Harmonic Distortion(THD) in the output waveform. The method will be brought in use with the use of MOSFETs for switching purposes. The modulation and firing pulses will be issued using Arduino microcontroller.

In the development of this model, our main intent had been to enhance our knowledge about inverters as the generation frommost of the renewable sources is in the form of DC for examplesolar and wind power plants.

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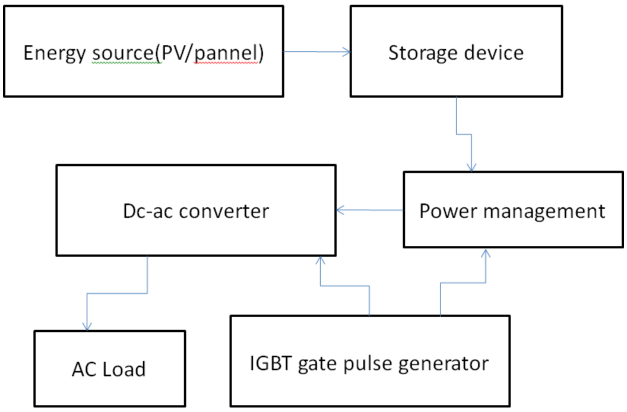

Figure.1. Block Diagram

IV.RESULT AND DISCUSSION

The proposed work of simulation result by usingProteus software. Simulink, a companion program to MATLAB, is an interactive system for simulating nonlinear dynamic systems. It is a graphical mouse-driven program that allows you to model a system by drawing a block diagram on the screen and manipulating it dynamically. It can work with linear, nonlinear, continuous-time, discrete-time, multirate, and hybrid systems. Block sets are add-ons to Simulink that provide additional libraries of blocks for specialized applications like communications, signal processing, and power systems. Real-Time Workshop is a program that allows you to generate C code from your block diagrams and to run it on a variety of real-time systems. State flow is an interactive design tool for modeling and simulating complex reactive systems. Tightlyintegrated with Simulink and MATLAB, State flow provides Simulink users with an elegant solution for designing embeddedsystems by giving them an efficient way to incorporate complexcontrol and supervisory logic within their Simulink models. With State flow, you can quickly develop graphical models of event-driven systems using finite state machine theory, state chart formalisms, and flow diagram notation. Together, State flow and Simulink serve as an executable specification and virtual prototype of your system design.

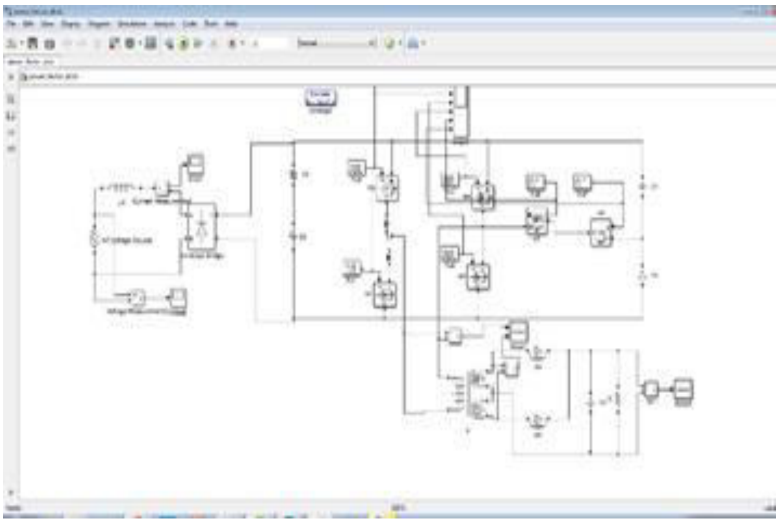

Figure.2.Simulation Results

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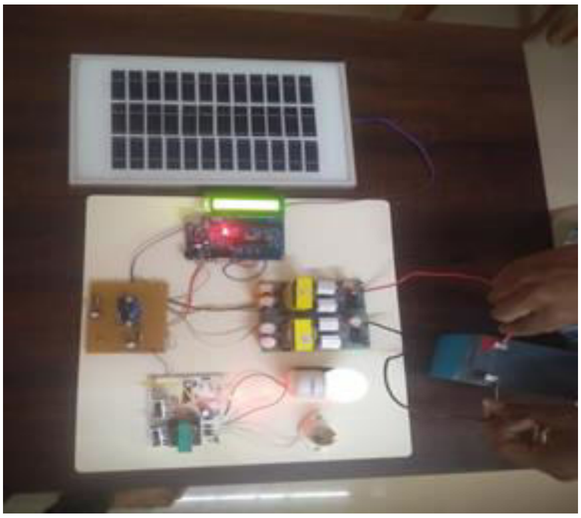

Figure.3.Hardware Implementation

The ability of the proposed inverter is confirmed by mat lab simulation and scaled prototype structure. IGBT used in the prototype are. The microcontroller has been used to generate all the switching sequences. In the simulation and hardware implementation, R load is assumed with R=100 OHM. The simulated output voltage and current waveforms. Also the harmonic spectrums of the proposed and other topology. The ability of the proposed inverter is confirmed by mat lab Simulation and scaled prototype structure. IGBT used in the prototype is .The microcontroller PIC 16F887 has been used to generate all the switching sequences. In the simulation and hardware implementation, R load is assumed with R=100 Ohm. The simulated output voltage and current waveforms. Also the harmonic spectrums of the different five level inverter topologies and the proposed inverter from the mat lab simulation systems are shown in fig 10.From the table III it's concluded that the proposed inverter has the minimum THD limits.

V.CONCLUTION

In this paper, a new cascaded H-Bridge MLI topology is proposed. This proposed system produces only positive voltage levels at the output side. Therefore H-Bridge is added at the output side to generate both positive and negative voltage levels. Several comparisons are made between the proposed one with other topologies. From this comparative study, it's concluded that the new developed topology requires less no of IGBT'S, diodes and driver circuits and DC voltage sources. This developed system has better performance. The performance of new developed system checked out by implementing with scaleddown experimental hardware setup.

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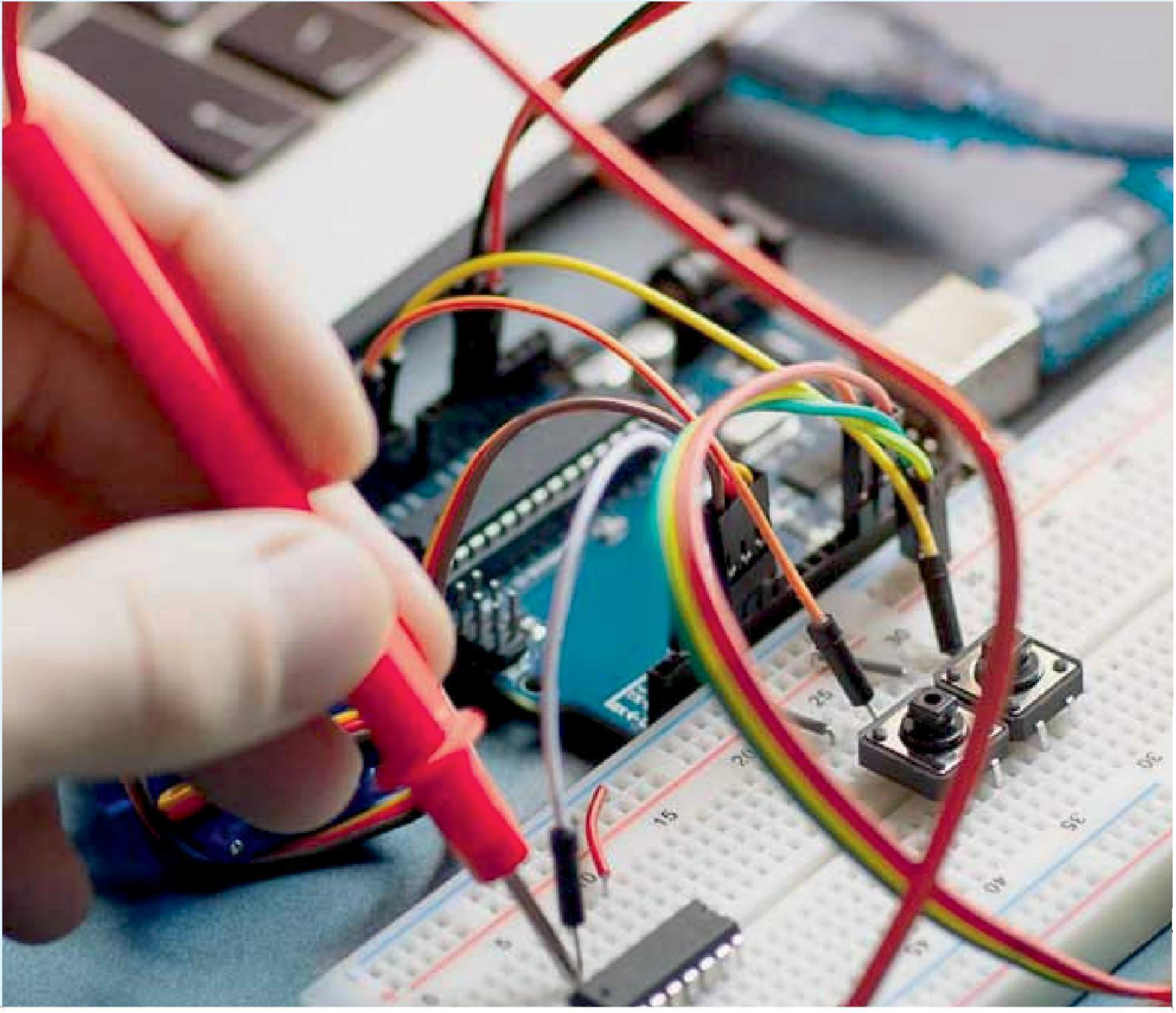

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