Multilevel Inverter

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Abstract- *This project presents the hardware implementation of the single phase multilevel inverter using the Cascaded HBridge using Separated DC sources. The main objective of this paper is to increases the number of levels with a lower number of switches at the output without adding any complexity to the power circuit. The main advantages of the proposed method are to reduce the Total Harmonic Distortion, lower order harmonics and electromagnetic interference and to get high output voltage. To minimize the total harmonic distortion equal area criteria (EAC) switching technique is presented and it can enhance the output voltages from proposed work. The Inverter is operated by using Arduino controller which generates PWM pulses. The use of Arduino makes the process of using electronics in multidisciplinary projects more accessible. It is well suited for processing control parameters such as speed of an Induction Motor.*

I. INTRODUCTION

DC-to-AC converter produces some impacts to distribution network. Harmonic problems occur as the inverters have too high capacitance. When harmonic happens, resonance problems will then occur, leading to high harmonic currents and voltages.For DC-to-AC converter, multilevel inverter is a good choice for PV system application. This is because it provides quite a lot of advantages. Therefore, at the end of this paper, 5- level multilevel inverter's simulation output will be compared with 7-level multilevel inverter, focusing on power factor, total harmonic distortion (THD), and its efficiency. Hence, the better level of multilevel inverter will be concluded.For 5-level inverter. This topology consists of a full-bridge inverter, an auxiliary circuit (comprises of one switching element and four diodes) and two capacitors as voltage divider. The multilevel inverter is connected after the dc power supply. The main point of the auxiliary circuit is to generate half level dc supply voltage [3]. It also reduced the layout complexity compared to other multilevel inverter topology such as flying-capacitor topology, diode-clamped topology and hybrid topology, and these topologies can be studied in various papers such as in [4] and in [5]. The operations of the new topology were presented in literature [3], [6] and [7]. The output voltage levels according to the switch on-off conditions were tabulated in Table I. The switch in auxiliary circuit must be properly switched considering the direction of the load current.

II. OBJECTIVE

In this paper, an experimental investigation has been carried out on single-phase multilevel inverter to obtain 5-level output voltage using cascaded four H-bridge units. The proposed system consists of four cascaded H-bridge MOSFET-based voltage source inverters, a microcontroller-based Arduino module, four separate input dc sources and isolating circuit. The gate drive signals for MOSFETs of the four H-bridge inverters are generated by using ATmega 2560 microcontroller-based Arduino board. The microcontroller has been used to reduce the complexity of generating gate drive signals for higher levels of inverter output voltage. Different-level output voltages have been obtained from experimental works. It is found that the proposed system requires less number of power switching devices and total harmonic distortion is reduced with increasing number of levels at the output voltage of the multilevel inverter.

III. PROBLEM STATEMENT

Multilevel converters are mainly utilized to synthesis a desired single- or three-phase voltage waveform. The desired multi-staircase output voltage is obtained by combining several dc voltage sources. Solar cells, fuel cells, batteries and ultra-capacitors are the most common independent sources used. One important application of multilevel converters is focused on medium and high-power conversion nowadays, there exist three commercial topologies of multilevel voltage source inverters: neutral point clamped (NPC), cascaded H-bridge (CHB), and flying capacitors (FCs). Among these inverter topologies, cascaded multilevel inverter reaches the higher output voltage and power levels and the higher reliability due to its modular topology. Diode-clamped multilevel converters are used in conventional high-power ac motor drive applications like conveyors, pumps, fans, and mills. They are also utilized in oil, gas, metals, power, mining, water, marine, and chemical industries. They have also been reported to be used in a back-to back configuration for

regenerative applications. Flying capacitor multilevel converters have been used in high-bandwidth high-switching frequency applications such as medium-voltage traction drives. Finally, cascaded H-bridge multilevel converters have been applied where high power and power quality are essential ,for example, reactive power compensation applications, photovoltaic power conversion, uninterruptible power supplies, and magnetic resonance imaging. Furthermore, one of the growing applications for multilevel motor drives is electric and hybrid power trains.

IV. LITERATURE SURVEY

Komal Satose, et.al. presented an analysis on different multilevel topologies in which it was mentioned that multilevel inverters are very popular and have many applications in electric utility and for industrial drivers. The paper compares three different topologies of inverters (Diode clamped inverter, Flying capacitor inverter and Cascaded H-bridge inverter). The comparison is done with respect to cost, power losses and Total Harmonic Distortion(THD). MOSFETs and IGBTs are used as switching device for analysis

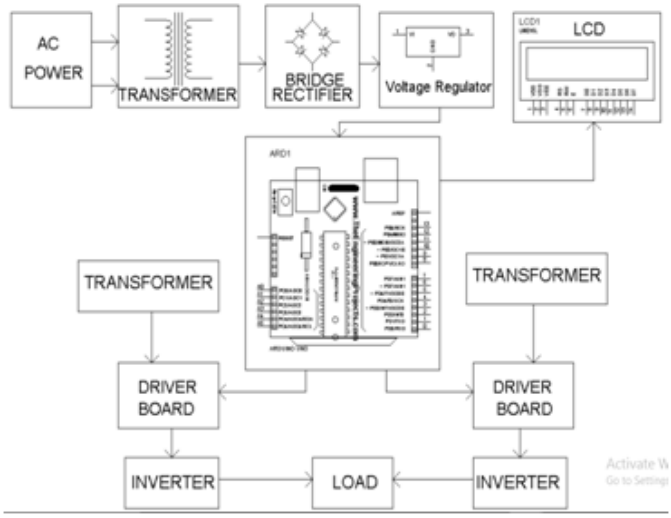
E.S Deepak proposes a simple cost effective multilevel topology for generating high quality sinusoidal AC waveform based on multi-tapped multi-winding transformer switching technique.

Tiirev Sarikurt, presented a paper on A multilevel system design with multi winding transformer. Also a simple multilevel inverter which has fewer switching elements is proposed by taking the same concern, and calculation of switching angles for the multi-level inverter is handled by a trigonometric method in order to reduce output harmonics.

Ehsan Esfandiari , presented a paper on multi winding transformer based diode clamped multilevel inverter The most important difference between this proposed DC-AC-AC structure and basic structure.

Sérgio Daher, presented a paper on Multilevel Inverter Topologies for Stand-Alone PV Systems shows that versatile stand-alone photo-voltaic (PV) systems still demand on at least one battery inverter with improved characteristics of sturdiness and effectiveness, which are obtained by the usage of multilevel topologies.

V. BLOCK DIAGRAM



VI. STRUCTURE

In this project, an experimental investigation has been carried out on single-phase multilevel inverter to obtain five-level output voltage using cascaded four H-bridge units. The proposed system consists of four cascaded H-bridge MOSFET-based voltage source inverters, a microcontroller-based Arduino module, four separate input dc sources and isolating circuit. The gate drive signals for MOSFETs of the four H-bridge inverters are generated by using ATmega microcontroller-based Arduino board. The microcontroller has been used to reduce the complexity of generating gate drive signals for higher levels of inverter output voltage. five-level output voltages have been obtained from experimental works. It is found that the proposed system requires less number of power switching devices and total harmonic distortion is reduced with increasing number of levels at the output voltage of the multilevel inverter.Power electronic converters, especially DC/AC inverters have been extending their range of use in industry because of their numerous advantages. They typically the stair –case voltage waveform (from several dc sources) which has reduced harmonic content. This project aims to extend the knowledge about the performance of five levels Cascaded H-Bridge multilevel inverter topology with Arduino. The pwm pulse will be generated by using Arduino. The output voltage is the sum of the voltage that is generated by each bridge. The switching angles can be chosen in such a way that the total harmonic distortion is minimized.

VII. ADVANTAGES

- Common Mode Voltage.
- Input Current.
- Switching Frequency.

- Reduced Harmonic distortion.

VIII. APPLICATIONS

- Switching High power devices
- Inverter circuits.
- DC-DC converter.
- Control speed of motor.
- LED dimmers or flashers
- High speed Switching Applications

IX. CONCLUSION

From the above all discussion we can conclude that in cascaded multilevel inverter topology with proper switching angle and conduction period derived from the calculation based on fourier analysis we can eliminate considerable amount of harmonics and we can reduce THD and by adding harmonic filter of proper frequency THD can be reduced at further more amount at least in software based s simulation.

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