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Soft Computing Based Harmonic Minimization for Cascade Multilevel Inverter Based On Svpwm Control Strategy

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ABSTRACT:

In this paper hybrid renewable energy based cascaded H-Bridge multilevel inverter with SPWM technique. The multilevel inverter has high power application & low harmonics due to these applications it is used widely in the area of control and energy distribution. This project includes the performance of 5-Level cascaded H-Bridge multilevel inverter concerning many switches, total harmonic distortion, waveform pattern, harmonic spectrum, output voltage, voltage stress across the switch & input DC voltage. The control of the multilevel inverter using CLC and space vector pulse width modulation (SVPWM) controllers based on cascaded H-bridge can observe the effectiveness of the proposed control to reduce harmonic contents of the multilevel inverter output. The high-frequency ripple from the inverters can be removed from the system using low voltage filter.

Keyword:*H-Bridge multilevel inverter with SPWM technique. Space vector pulse width modulation (SVPWM).*

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I. INTRODUCTION

The multilevel inverter is a powerful electronic device widely used for high power utility applications. The main purpose of a multilevel inverter is to provide. Sinusoidal waveforms with low-level harmonic content to reduce distortion in a grid and maximize power efficiency. Three topologies have been proposed for multilevel inverters diode-clamped (neutral-clamped), capacitor clamped (flying capacitors), and a cascaded H-bridge multilevel Inverter (CHML). The CHML has characteristics superior to the other topologies because of its modular and straightforward structure and because it requires the least number of components and fewer power devices. Improving inverter performance means improving the quality of the output voltage. Variable methods have been proposed to reach this goal, including multilevel sinusoidal pulse width modulation (PWM) and space-vector PWM; however, PWM techniques cannot eliminate lower order harmonics. Another approach, selective harmonic elimination (SHE-PWM), has been proposed to suppress specific higher order harmonics, the output voltage of the inverter by choosing the switching angles. The primary challenge associated with SHEPWM is to obtain the analytical solution of the system of nonlinear transcendental equations that contain trigonometric terms, which in turn provide multiple sets of solutions. Delay Introduction, the issue of these filters, is to accept responsibility for the high voltage and high-capacity applications for the hierarchical (ML) inverters are a promising inverter topology. The DC voltage is produced by this type of inverter to deliver a single output release AC, most of which are entirely sine waves.

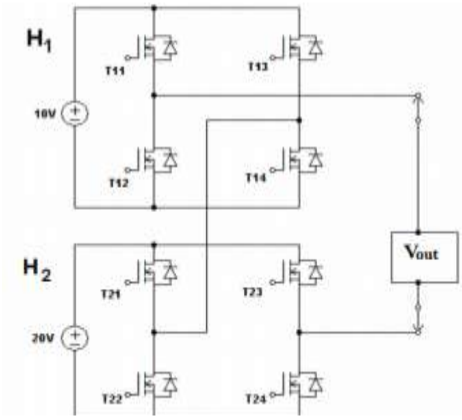

Figure 1: Traditional inverter drive with a motor load.

Reduced DV / Dt Depression, low-voltage of the system ratings for high altitude, low change loss and switching frequency, High Power Standard Wave Forms, Benefits In comparison with 2 level inverter multilevel gives more reliability with low speed. The multilevel inverter will suppress the harmonics which will reduce the filter bulkiness and expense.

II. LITERATURE REVIEW

The cascaded multilevel inverter concept has been influential in the recent years to prepare for the energy conversion show in many voltage steps to gain advanced power quality, low-level losses, better electromagnetic compatibility, and high voltage capacity. However, multilevel inverter major disadvantages include volatile difficulties with random current stress and higher implementation tariff. Multi-level inverters are proposed in the literature of many interpretations, becoming the most popular diode, enclosed flying condenser and H bridge structures [1]. Apart from the other multilevel inverters, the H-Bridge sets one aspect of the energy transition and the ability to use different DC sources in the individual H-Bridge cells as a result amongst higher-voltage lower frequency and lower-voltage higher-frequency inverter. This output provides a multilevel inverter with a single (full bridge) serial connection or three-stage inverter blocks or cells on the AC terminals. This topology comes with photovoltaic (PV) generators, suitable for use in fuel cells and batteries for use in separate DC voltage sources [2]. To develop cascaded multilevel inverter firing sequence is required, which in tum needs n+2 bit counter. The inverter deals with the basic operation of asymmetric cascaded multilevel inverter discuss the digital control technique it deals with the conclusions. The cascaded multilevel inverter has gained much attention in recent years due to its advantages in high voltage and high power with low harmonics applications [3]. A constant binomial hierarchical inverter requires N DC output, n, the number of inverter positions to generate position sources. This paper presents the transparency to control the abstract hierarchical inverter that is accomplished in many DC sources. Using the pulse width (PWM) technique, the exclusion of the work will be activated using a flip-flop to reduce total harmonic distortion (THD) and change losses. To create an abstract mixed multivariate inverter model, their composition makes complete and comprehensive a mixed multivariate inverter design and analysis [4]. This introduces a novel hybrid cascaded multilevel inverter. It is a series connection of two asymmetrical inverters, compared to the traditional cascaded multilevel inverter, the proposed cascaded inverter can produce more output levels using the same switches, and the most number of output levels and modulation strategy are analysed. To reduce the amount of power, the proposed hybrid is improved by replacing partial independent powers with capacitors, the method to improve is analysed, and all is verified by simulation results finally [5]. The Multilevel inverters are mostly used in high power applications for its capacities of lower switching frequency and less harmonics. By now, many multilevel inverter topologies have been proposed Neutral-Point Clamped multilevel inverter which needs additional diodes in parallel with switches and additional capacitors in parallel with DC bus. Proposed flying capacitor multilevel inverter which needs additional capacitors in parallel with both switches and DC bus. Rubicon electrical technology. LTD invented cascaded multilevel inverter which needs independent power supplies. Compared with Neutral-Point Clamped multilevel inverter and Flying capacitor multilevel inverter, cascaded multilevel inverter has no additional diodes and capacitors, needn't deal with the imbalance of capacitor voltage and it can be integrated and maintained easily, and so cascaded multilevel inverter is widely used in SVG, APF and motor driver [6]. Conventional cascaded H-bridge multilevel inverter requires too many power devices and independent power supplies, resulting in a very complex structure and a large volume, limiting its practical application. To solve this problem, many hybrid cascaded multilevel inverters have been proposed; some have different power supplies, and others have different cascaded module proposed a new type of hybrid cascaded multilevel inverter, it's a series connection of asymmetrical inverters, producing more output levels than conventional cascaded multilevel inverter [7]. This proposes a new hybrid multilevel inverter which series are connecting asymmetrical inverters, and method to reduce. This proposed a new hybrid coupled-inductor and cascaded H-bridge (CHB) multilevel inverter. In the proposed topology, one level inductor inverter, combined with many H-bridges, is combined with a combination of the inductor's inverter. The main purpose is to use both the proprietary (combined-inductor and CHB) advantages in one structure. In the level coupled-inductor inverter, the current of switches is reduced to half of the output current making it possible to use low-current switches in this model. In the inverter part, the voltage of the inverter is multiple into several bridges so that low-voltage switches can be used [8]. Also, the proposed topology gives a higher number of voltage levels with a lower number of switches. For example, the proposed level inverter uses only switches while the CHB multilevel inverter uses voltage levels have the same number of switches. The appropriate control method is provided for the proposed topology. Therefore, application of these inverters for higher current loads may be challenging. The parallel inverters have been presented as a solution for high current applications. The parallel inverters are based on inter-phase transformers or current-sharing inductors [9]. These inverters can also produce multilevel pulse width modulated (PWM) output voltages. However, the main problem is that the operation of the parallel inverters depends on the device parameter variations. Small variations in the switch turn-off times and on-state voltage drops can create DC drifts and circulating currents. A balanced, symmetrical operation of parallel connected inverters can be obtained by using interleaved PWM controls In both parallel inverter and coupled-inductor inverter the output voltage is not increased. Besides the parallel inverters, the split-wound coupled-inductor based inverters have been presented; these topologies use a small number of components and have better performance [10].

III. PROPOSED SYSTEM

The proposed system implemented circuit of five-level cascaded full bridge inverter simulation and its results of output voltages are discussed. The input power of the multi-level inverter is obtained from renewable energy sources. The Space Vector Modulation (SVM) technique has gained wide acceptance for many AC drive applications, due to a higher DC bus voltage utilization (higher output voltage when compared with the SPWM), lower harmonic distortions and easy digital realization. The control of the multilevel inverter CLC using and space vector pulse width modulation (SVPWM) controllers based on cascaded. The H-Bridge Multilevel Inverter output can monitor the proposed control capability to reduce contents. The high-frequency ripple from the inverters can be removed from the system using low voltage filter.

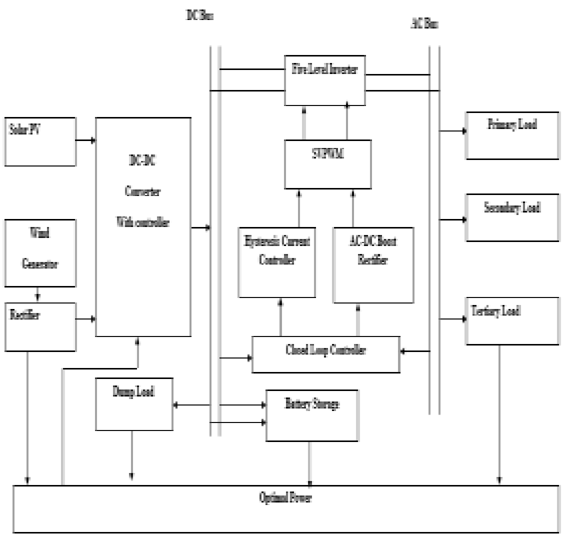

Figure 2: Block diagram

The hybrid method for solar is produced dc voltage into DC-DC converter used to voltage increasing .wind generator is ac voltage which converted to ac-dc rectifier used to DC-DC converter from DC bus. The DC bus into five level inverter used to dc-ac turned from AC bus to AC load. Due to AC load side low voltage output produced to analysis voltage from closed loop controller from AC bus voltage and DC bus current compared to analysis is the closed-loop controller. The closed-loop converter from used hysteresis current controller and ac-dc rectifier to SVPWM. The Space vector pulse with modulation converted from the five-level inverter. The SVPWM method increasing voltage and current due to dc-ac voltage to AC bus produced from AC load.

3.1 Photovoltaic Energy:
The word photovoltaic combines two terms photo means light and voltaic means voltage. Photovoltaic energy is obtained from sunlight in the form of solar energy. The sunlight is made to be focused on solar panels which can convert the solar energy into electrical energy. Solar cells of the solar panel do the conversion of solar energy into electrical energy. A photovoltaic system typically includes a panel or an array of solar modules, an inverter, and sometimes a battery and solar tracker and interconnection wiring.

Figure 3: photovoltaic energy

3.2 Wind Energy:
Wind control is the utilization of wind current through wind turbines to mechanically control generators for electric power. Twist control, as a different option to consuming non-renewable energy sources, is abundant, sustainable, broadly dispersed, clean, delivers no ozone-depleting substance outflows amid task, expands. The impacts on the earth are far less dangerous than those of non-inexhaustible power sources. Wind control gives the variable power which is extremely reliable from year to year yet which has a considerable variation over shorter timescales. It is in this manner utilized as a part of conjunction with other electric power sources to give a dependable supply. Also, weather forecasting permits the electrical power network to be readied for the predictable variations in production that occur.

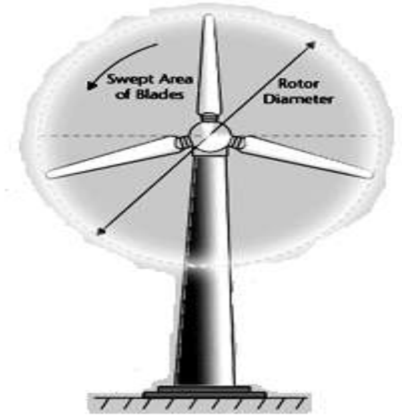

Figure 4: Wind Energy

3.3 Boost Converter Model:
A DC to DC converter is an electronic circuit or electromagnetically device that changes over the input of direct present (DC) starting with one voltage level then onto the next. It is a sort of electric power converter. Power levels go from low (little batteries) to (high-voltage control transmission) Figure. 9: Simple Boost Converter Circuit

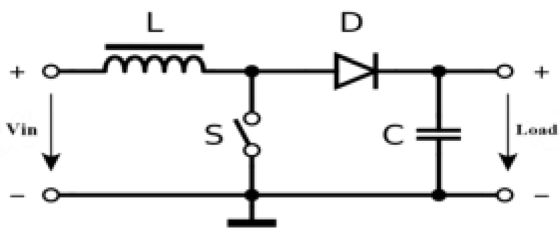

Figure 5: DC TO DC converter

A DC switch to DC voltage is a voltage step from its input (distribution) from its input (during the current end) to a stimulator (step-by-step) of its output (load). It is a modifier, inductor, or combined: Modified Power Supply is a class with at least two semiconductors (a diode and a transistor) with at least one power saving element. Filters generated by capacitors (sometimes in conjunction with stimulants) to reduce the voltage ripple are usually added to the converter output (load side filter) and input (supply side filter). The power switchers, i.e., batteries, solar panels, rectifiers, and DC generators can come from any suitable DC sources. A DC to DC Transfer DC is called a process that changes the DC voltage to different DC voltages. An output voltage shifted to a DC-DC, rather than a source of voltage.

3.4 Five level inverter:

The cascaded H-Bridge multilevel inverter is the most advanced and essential method of power electronic converters that analyses output voltage with some dc sources of input. Compared with the multilevel inverter and flying hierarchical inductor inverter neutrality, the H bridge gradient inverters require a lower number of components high-quality output voltage which is close to a sine wave. By developing the output levels, the output voltage can reduce total synchronization. The number of output AC voltage DC sources required by the H bridge gradient inverter is obtained by artificial intake. H bridge units with a number of DC resources are connected to the number line or layer that produces the H bridge gradient inverter.

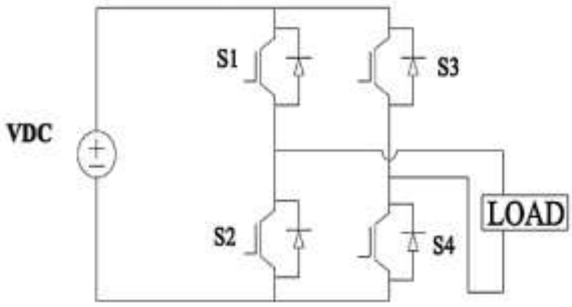

Figure 6: Five-Level Inverter

3.5 Space vector pulse with modulation (SVPWM):

Space vector modulation (SVM) is the control algorithm for pulse width modulation (PWM). It is used to generate alternatives for current (AC) waveforms; In general, AC is driven at speeds vary from DC to multiple-class T amplifiers driven motors. There are variations of SVM that produce different quality and computational requirements. The total synchronization dissociation (THD) in an active areaofdevelopment is the reduction created by rapid swapping in these steps. The desired three-phase Inverter output voltages in a directional vector resistance direction.

3.6 Hysteresis Current Controller:

The current control methods play an essential role in power electronic circuits, particularly in the current controlled PWM inverter is used for a single cyan curve AC production, which is widely used in AC motor drives and continuous AC power supplies.

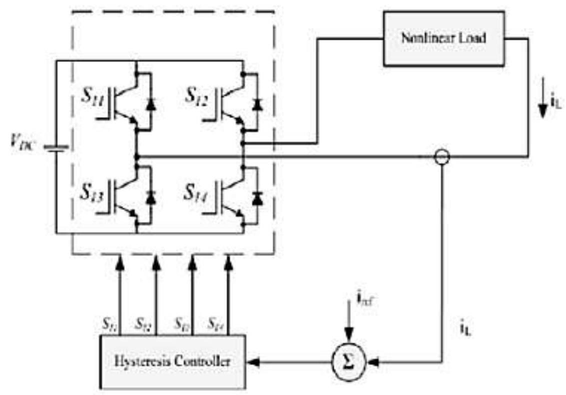

Figure 7: Hysteresis Current Controller

The main task of controlling systems in the current vector inverters is to force the current vector of a three-stage load according to a note travel path. In this method, The current control methods for two histories have been completed with three-stage voltage source inverter (VSI) type (Hexagonal and Square Histories based controls). The constant representation of two controllers (α) is the coordinate system for the current components work.

3.7 Closed Loop Controller:

A closed-loop control system, and its feedback control, also known as a concept control system, uses an open loop system technique, but a control system input of loops (so its name) or paths between its output and its output. The reference to "feedback," simply means that some portion of the output is returned "back" to the input to form part of the excitation of the system. The closed-loop systems are designed to maintain the emerging conditions required by comparing it to the actual level of the voltage level. This creates a distinction between the output and reference input, which creates a bug. In other words, a fully automated control system involves the release of its control in a "closed-loop system" in some way.

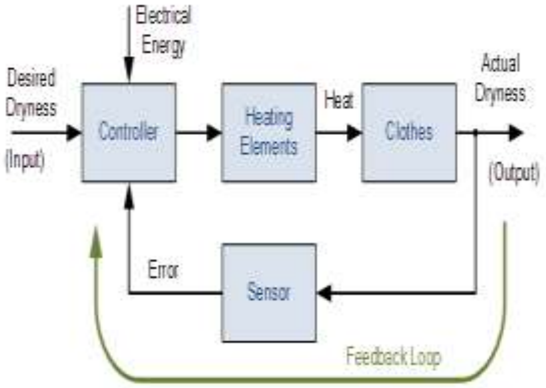

Figure 8: Closed Loop Controller

3.8 Battery storage:

The battery is the storage device of the power plants, and it used uninterruptible power supplies (UPS) are compared to each other, although the former are larger. The batteries are used in many places warehouses or containers. Like a UPS, the problem is that electricity networks are generally driven into current AC voltage alternatives that the electrochemical energy is stored, or stored in direct current DC form. For this reason, additional inverters need to connect battery saving power plants with a high voltage network. This kind of power electronics includes GTO thyristors, and commonly used in the High Voltage Direct Current transmission (HVDC). And different accumulator systems may be used depending on the power-to-energy ratio, the expected lifetime and, of course.

Figure 9: Battery Storage

IV. HARDWARE IMPLEMENTATION:

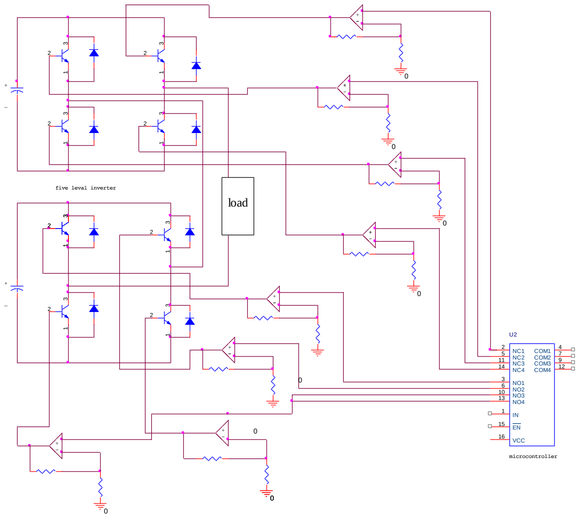

Figure 10: Circuit Diagram

A voltage level of three phase system is considered to be the smallest number in multilevel converter topologies. Due to the bi-directional switches, the multilevel VSC can work in both converter and inverter modes. This is why most of the time it is referred to as a converter instead of an inverter in this dissertation. A multi-level converter can change between the input (or both) of a number (more than two) voltage or current levels. The number of sizes comes in infinity, and the output is closer to THD zero. The number of the achievable voltage levels, however, is limited by voltage-imbalance problems, voltage clamping requirements, circuit layout and packaging constraints complexity of the controller, and, of course, capital and maintenance costs. Three different major multilevel converter structures have been applied in industrial applications: cascaded H-bridges converter with separate dc sources, diode clamped, and flying capacitors. The multilevel inverter structures are the main focus of discussion in this chapter; however, the illustrated structures can be implemented for rectifying operation as well. Although each multilevel.

4.1 Hardware Model:

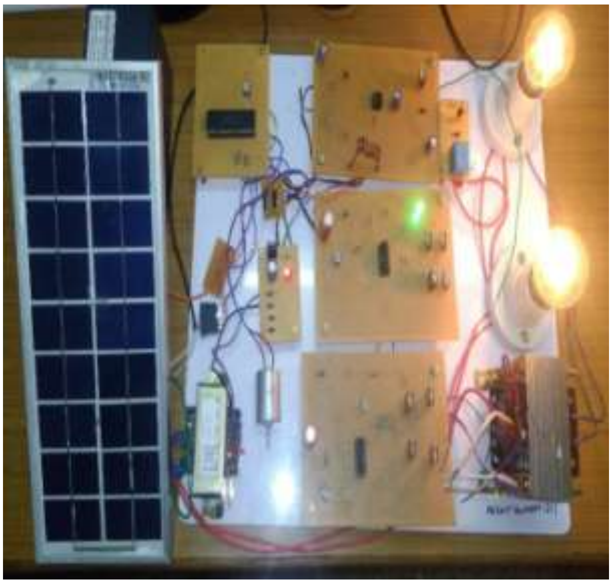

Figure 11: Hardware model for proposed system

- The circuit diagram which represents the Harmonic Minimization for Cascade Multilevel Inverter based SVPWM Control StrategyLoad compensation system. In this system the solar and wind power is given to the system and it connected to the load.
- The solar panel is given the 11.25v DC to this system, and it will boost with help of the DC to DC converter. The boosted voltage is given to the DC bus.

- The wind power is AC voltage so it will convert to DC voltage with help of the rectifier circuit, and the converted DC voltage is given to the DC bus. The DC motor load is also connected this DC bus.
- The DC voltage is converted to the AC voltage and given to the load via isolated circuit. If any load unbalance is occur the controller is analysis and give the proper switching to the inverter and compensate the load in balance condition.

4.2 Hardware Output

Hardware	**Specification**	**Input ranges**	**Output ranges**
Source	Input power	230v	230v
Solar	Input power	11.35v	13.5v
Transformer	Step-down	230v	12v
Rectifier	Input Power	12V AC	12V DC
Battery	Input power	12V	7.5A
DC to DC converter	Regulating power	12V	0-50v
Inverter	Output Power	12v DC	24v AC
Transformer	step-up	24VAC	230VAC
Relay	AC and DC	(0-230)v	Isolate the circuit
Load	Load	230V	3A
Load	Load	230v	2A
Load	DC Load	12V	1000RPM

4.3 ADVANTAGES:

- Harmonic content decreases.
- Higher efficiency.
- The regulation of the inverter is good.
- Switching losses can be avoided.
- Reduction in a number of switches.

4.4 APPLICATIONS:

- The power system (substation, generating station and distribution station).
- Reactive power compensator.
- Utility compatible adjustable speed drives

V. CONCLUSION:

A prototype of the 5-level single-phase multilevel cascaded inverter consists of a single-phase inverter and single H-bridge inverters that it uses separate dc power sources. The control signals are used to give the pulse of the switches are using different pulse width modulation modulated technique. Harmonic analysis carried proposed work of Single phase five level multilevel cascade inverter output voltage total harmonics distortion is reduced and improve the efficiency of the system compare with different topologies of single phase five level multilevel inverter. Pulse modulation is the lowest total harmonization of the pulse modulation, which is confirmed by the Pulse Width Modulation and Stage Layer Comparison of the Inverter Alternative Resistance Pulse Width Modulation Stage.

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