DESIGN AND IMPLEMENTATION OF NINE LEVEL MULTILEVEL INVERTER

K.Dhineshkumar¹ C.Subramani²*
¹Department of EEE, Agni college of Technology, Thalambur, Chennai-600130
²Department of Electrical and Electronics Engineering, SRM Institute of Science and Technology, Kancheepuram 603203, India
*csmsrm@gmail.com

Abstract: In this paper the solar based boost converter integrated Nine level multilevel inverter presented. It uses 7 switches to produce nine level output stepped waveform. The aim of the work to produce 9 level wave form using solar and boost converter. The conventional inverter has multiple sources and has 16 switches are required and also more number of voltage sources required. The proposed inverter required single solar panel and reduced number of switches and integrated boost converter which increase the input voltage of the inverter. The proposed inverter simulated and compared with R load using Mat lab and prototype model experimentally verified .The proposed inverter can be used in n number of solar applications.

1. Introduction.
Multilevel inverters are utilized generally in the regular applications due to the high voltage capacity and it delivers the multilevel with low composition with least concern in the exchanging gadgets. Contrasted with the traditional single scaffold inverter the multilevel inverter lessens the music due to the multi exchanging. The multilevel inverter produces distinctive voltage levels by shifting the exchanging grouping of the inverter. In multilevel inverter as the quantity of voltage levels expanded the sounds delivered in the yield waveform diminishes moderately. The straightforwardness of fell H connect multilevel inverter has a tendency to utilized as a part of numerous applications discussed in [1].The function and great execution of the anticipated multilevel inverter have been checked by the reenactment aftereffects of a solitary stage nine-level symmetric and 17-level asymmetric multi level inverter and trial consequences of a nine-altitude and 17- stage inverter. Subsequently the recommended structure prompts diminishment of establishment territory and cost and has straightforwardness of control strategy represented in [2].This topology can build the quantity of yield
energy stage by utilizing lesser amount of energy electronic gadgets, for example, switch, thyristor family, driver circuit and dc electrical energy sources that prompt decrease in establishment gap and rate of the inverter with various Calculation explained in [3]. Proposed SOP method licenses multilevel inverter to work at a normal gadget changing recurrence constrained to evaluated key recurrence without trading off on consonant twisting are discussed in [4]. This survey considers accomplishing the base aggregate symphonic mutilation (THD) or recurrence biased THD (WTHD) of the stairway -regulated yield voltage of single-stage multilevel inverters are explained in [5]. This survey deals with the suitable balance plot has likewise been proposed for low exchanging recurrence operation of the proposed topology. In addition, a 15-level inverter with awry source setup has been likewise examined for charge adjust control utilizing the proposed tweak plot is mentioned in [6]. Expanding requests for control supplies have added to the number of inhabitants in high recurrence air conditioning (HFAC) control conveyance framework (PDS), and keeping in mind the end goal to build the power limit, multilevel inverters (MLIs) often times filling in as the high-recurrence (HF) source-organize have acquired a conspicuous improvement was discussed in [7]. Fell multi level inverter (MLI). Every module is comprised of H-and semi extensions, two detached equivalent dc source and a two directional assistant track. One crutch of the H-connect and the half -connect are hack and the comparing incurable are associated with the two finishes of an equivalent divide dc source are represented in [8]. In this survey , it has been outlined the upside of incorporating into the controller plan of a hilter kilter nine-level inverter, when consonant current moderation targets are sought after, a point by point investigation of its non-direct unique conduct. discussed in [9]. The commitment can be separated into three sections, specifically, For three-stage lattice associated applications, PV confuses may present uneven provided control, prompting unequal framework current. To illuminate this issue, a control conspire with adjustment pay is additionally proposed. A trial three-stage 7-level fell H-connect inverter has been fabricated using 9 H-connect modules are represented in [9].

2. Sinusoidal Pulse Width Modulation
The sinusoidal pulse width modulation as shown in the figure 1. It consists of two signal one is reference signal and other one is carrier signal. By comparing these two signal the PWM output voltage can be obtained as shown in the figure1. Here the reference signal is sine wave and the carrier signal is Triangular wave as mentioned. The figure represents in time period vs Amplitude of the signal . The sinusoidal pulse width modulation is used in the 9 level multilevel inverter . The resonance of the inverter can be lessen by Sin Pwm Technique. Heartbeat width is tweaked with a specific end goal to get controlled yield voltage and lessened reverberation.
SPWM is the most commonly used method for motor control and inverter applications. To generate the SPWM signal, conventionally, carrier triangle wave is compared with the sine wave of operating frequency is expressed in [8]. The PWM strategy is progressively utilized for AC drives in perspective of the diminished symphonious current and the level best yield voltage to drive the store. The essential attempt in all PWM method acting is to pass on the required plentifulness and rehash of the fundamental while lessen the estimation was analyzed in [9].

3. PV system
This multilevel inverter uses DC supply from solar panel. for example 10 watts panel has voltage of 17.6 at current of 0.56 A Respectively. Basic unit of a solar PV component is a solar cell. Assemblies of solar cells are used to make solar module. Numerous of solar modules make solar panel and gathering of sun based board. Photovoltaic module equivalent circuit is shown in Fig.2

![Equivalent circuit of solar panel](image-url)
The vitality can be gathered through a sun powered exhibit, which comprises of an arrangement association of sun oriented cell. This sun oriented cell is not specifically associated with the inverter and the diode associated in parallel. This is said current source parallel with the diode and shunt resistance. The yield current of the sun oriented cell is communicated as

\[ I_d = I_s \left( \exp \left( \frac{qV}{KT} \right) - 1 \right) - I_{ph} \]  

\[ I_d \text{ – Diode current, } I_s \text{ - dispersion current, } T \text{- incompressible temperature-Boltzmann consistent (1.3805×10}^{-23} \text{J/K)}, \text{ Charge } q = 1.6 \times 10^{-19} \text{ C} \]

Considering the create incidents, the indistinguishable way of the PV chamber contains two resistances Rs and Rp are connected in proportional, where Rs addresses the setbacks due to the contacts and relations and Rsh talks in the diode for the spillage streams as determined and spoke to in [10]. Photovoltaic's source are used today in numerous application, for example, battery charging, home power supply, dehydrogenate monoxide pumping and satellite power frameworks and so on. Photovoltaic system is ending up noticeably progressively foremost as an inexhaustible source since it is taken a toll free, contamination free and commotion free. PV modules still have relative low change effectiveness due to continually transmuting with climate conditions like sunlight based light and temperature.

4. Different Schemes of Multilevel Inverter.
4.1 EXISTING SYSTEM

Figure 3. Single phase cascaded full bridge Inverter
Number of level obtained = \( 2^n - 3 \) –––(2)
The fell multilevel inverter the Four H Bridges are connected in back to back connected in series with separate source as structure as appeared in the figure 3. A cascaded multilevel inverter uses 16 switches to produce 13 level waveform. The switching pulse for the inverter are sine PWM technique. The multilevel inverter output is more than the number of inputs of the inverter. The output voltages are 4V, 3V, 2V, 0V, -2V, -3V, -4V are obtained. Cascade is termed as symmetrical cascade, an individual Full bridge voltage source inverter has 4 switches. So more number of voltage source required and switches required and subsequently add up to cost of the circuit increments and which brings about Increased Total Harmonic Distortion and Switching misfortunes is discussed in [10].

4.2 PROPOSED SYSTEM

![Figure 4 Solar based Nine level Multilevel inverter](image)

Number of level obtained = $2^n - 1$ \[\text{(3)}\]

The new sun oriented based nine level inverter investigated and created from fell 9 level inverter. The proposed inverter comprises of fundamental H-connect inverter alongside Three bidirectional switches, and a four capacitor go as voltage cutter as said in figure 4. This changed topology utilizes sun based power rather than DC voltage and which utilizes fewer switches and voltage sources. The proposed inverter can be broke down for various load are R, RL, and enlistment engine stack. The inverter utilizes operation as clarified in nine exchanging states framed by sine PWM system. This can be checked in Matlab Simulation for a various load. The Prototype model of an inverter can be shown utilizing PIC Microcontroller which customized by Embedded C. The beat width of the IC changed by changing the codes of the Programming utilizing Dubbing Technique which utilized door beat frame Driver circuits. The proposed inverter exchanging state as clarified in the underneath table.
Table 1. Switching states of proposed inverter

| VO  | S1 | S2 | S3 | S4 | S5 | S6 | S7 |
|-----|----|----|----|----|----|----|----|
| Vdc | 1  | 0  | 0  | 1  | 0  | 0  | 0  |
| 3Vdc/4 | 0  | 0  | 0  | 1  | 1  | 0  | 0  |
| Vdc/2 | 0  | 0  | 0  | 1  | 0  | 1  | 0  |
| Vdc/4 | 0  | 0  | 0  | 1  | 0  | 0  | 1  |
| 0  | 1  | 0  | 1  | 1  | 0  | 0  | 0  |
| 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  |
| (-)Vdc/4 | 0  | 1  | 0  | 0  | 1  | 0  | 0  |
| (-)Vdc/2 | 0  | 1  | 0  | 0  | 0  | 1  | 0  |
| (-)3Vdc/4 | 0  | 1  | 0  | 0  | 0  | 0  | 1  |
| (-)Vdc | 0  | 1  | 1  | 0  | 0  | 0  | 0  |

The distinctive exchanging conditions of proposed inverter The table 1. The full voltage got by activating switch 1 and 4, the 0.75 Vdc voltage acquired by the switch 1&5. 0.5 Vdc % of info voltage got by activating Switch 4&6. Zero voltage got by either switch 2 or switch 1,3&4. Amid that period different switches are in OFF mode. The -0.25 Vdc % negative voltage acquired by setting off the switches 1&5. The half negative voltage got by setting off the switches 2&7. The -0.5 Vdc negative voltage acquired by setting off the switches 2&8. The full negative voltage got by setting off the switches 2&3. As such The Negative voltage got by rearranging alternate changes regarding the positive voltage and comparing negative voltage are gotten.

5. Results and Discussions
5.1 Simulation of Nine level inverter with R-load
The simulation of PV based boost integrated 9 level inverter with R Load using MATLAB as shown in the figure.5. The output to be measured through scope as indicated in the different colours.
5.2 Simulation of Input voltage Nine level inverter

The figure 6 demonstrates the input voltage of the inverter from the PV board which shows the steady voltage got from the sun powered board at all periods.

5.3. Output wave forms for Simulation of Nine level inverter with Resistive- load

The output voltage of the Nine level multilevel inverter With Resistive stack as appeared in figure 7. The above waveform comprises of the era in X-pivot and ventured yield voltage of the inverter in the Y hub.
5.4. THD of proposed multilevel inverter with R load

The Total consonant Distortion of the proposed inverter R stack dissected from FFT examination as shown in the figure.8
5.5 Experimental Results

Figure 9. PV based Nine Level Inverter with R load

The figure 9. Shows the experimental setup of 9 level inverter with R load and the output measured form digital CRO. The experimental was implemented with respect to the prototype model.

5.6 Output voltage of the wave form of the proposed inverter.

Figure 10. PV based Nine Level Inverter with R load

The 9 level inverter output voltage waveform obtained from Digital CRO as shown in the Figure. 10. and is connected in channel 2.

6. Conclusion

In this paper the sun power-driven based boost synchronized Nine level multilevel inverter are simulated and reenacted and confirmed utilizing various load which uses sin PWM technique.
The traditional inverter utilizes 7 switches to distribute 9 level wave contours together with sources where as conventional structure uses 16 switches. The proposed inverter requires single sunlight based board and diminish number of switches and incorporated lift converter which increment the info voltage of the inverter. The proposed inverter mimicked and contrasted and R, RL, RLE stack utilizing Mat lab. The archetype model uncertainly confirmed.

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