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A Simplified Multi level Inverter Topology for Grid Interconnection of PV Systems

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ABSTRACT: Non-conventional energy sources (NCES) very important in now days because they are pollution free, easily accessible and enormous. Among NCES, Photovoltaic systems are mostly used as they are light, clean and easily installable. Normally PV cells converts sunlight into electricity in the form of dc. A suitable converter is usually needed to convert the dc power into ac power, which is then connected the power grid. The Multilevel Inverters [MLI] can be used to convert the Dc power Ac power for integration of renewable energy sources into the conventional grids. But the conventional MLIs such as Neutral point Clamped (NPC) MLIs requires extra diodes in with the active switches, Flying capacitor MLIs requires extra Capacitors whereas the Cascaded H-bridge MLIs requires separate dc sources . This paper proposes a simplified multi level Inverter which required less number of switches and lower THD as compared to conventional multilevel Inverters. The proposed Inverter can be used to integrate the Photovoltaic system into Grid, with satisfying the grid requirements such as phase angle, frequency and amplitude of the Grid voltage .Here Thirty three level proposed MLI is simulated using Matlab/Simulink by using equal area criteria which is very simple technique for generation of pulses to the switches and the results are presented.

KEYWORDS: Non-conventional energy sources (NCES), Multilevel inverter (MLI),Total harmonic distortion (THD).

I.INTRODUCTION

Non-conventional energy sources are alternatives to our conventional energy sources such as oil, coal, gas which are not renewable. The conventional energy sources are limited and they can be exhausted. Renewable energy sources are solar, wind, biomass, hydro, geothermal and ocean power. Among these solar energy is the more advantage because no pollution to the environment So, Photo voltaic (PV) systems are more useful.The basic element of a PV system is the solar cell .A solar cell is directly converts the solar energy into electrical energy in the form of direct current(DC). A typical PV cell consists of a p-n junction Diode as shown in the figure 1.

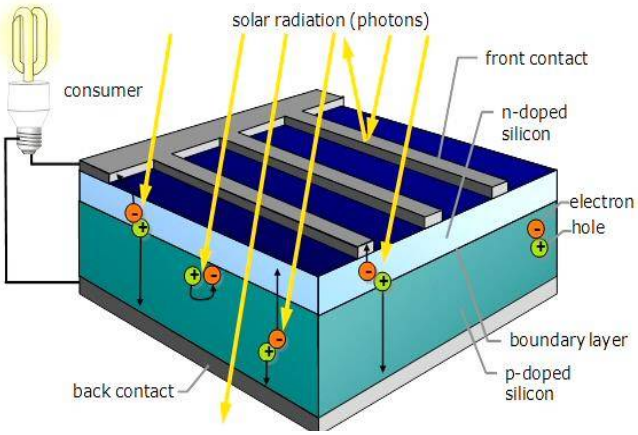

Fig.1. Basic Structure of a Solar cell

Grid interconnection of PV system requires an effective converter system to converter the DC power into AC power. The conventional H-bridge inverter produces a square wave output voltage, which contains higher harmonics but

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Normal PWM inverter can reduces the THD, but increases the switching losses. As the importance of multilevel inverters [MLI] has been increased .The simplified types of multilevel inverters are suitable for high voltage and high power application because of their ability to generate waveform nearer to sine wave with less THD .Multilevel inverters are classified into three types: they are I .Diode Clamped or neutral point(NPC) 2. Flyingcapacitor.3.Cascaded H-bridge. NPC require large number of clamping diodes as the level increases .In flying capacitor requires no of capacitors, as the level increases the cost is also increases. Cascaded H-bridges are mostly preferably used [6] for high power applications. But it requires isolated DC sources this increases the complexity of the topology In order to overcome this disadvantages, this paper proposes a simplified type of multilevel inverter which requires less number of DC sources and switches as compared to Cascaded H-bridge multilevel inverter, THD of the output voltage can be achieved which is to the IEEE standard By using this topology we can efficiently integrate the PV panel into the conventional power grid

II.PROPOSED TOPOLOGY

The structure of proposed simplified multilevel inverter is shown in the figure 2.

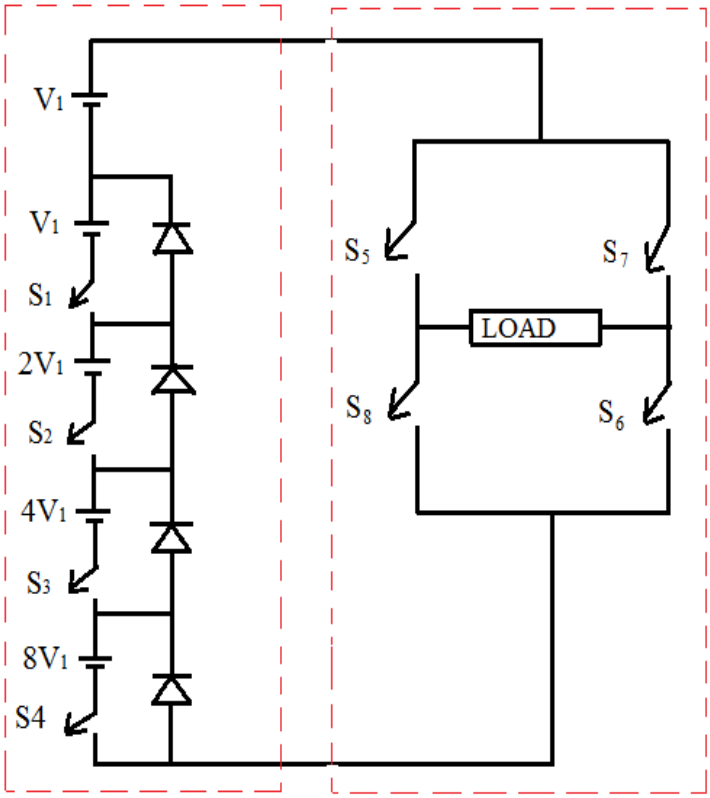

Fig.2. General Structure of proposed new multilevel inverter

III. THIRTY THREE LEVEL PROPOSED MULTILEVEL INVERTER

The thirty three level proposed inverter uses only eight switches and five separate dc sources with asymmetrical having the ratios as,V1:V1:2V1:4V1;8V1.Here V1 is the minimum voltage.

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SL.NO	S1	S2	S3	S4	S5	S6	S7	S8	OUTPUT VOLTAGE
1	1	1	1	1	1	1	0	0	16V1
2	0	1	1	1	1	1	0	0	15V1
3	1	0	1	1	1	1	0	0	14V1
4	0	0	1	1	1	1	0	0	13V1
5	1	1	0	1	1	1	0	0	12V1
6	0	1	0	1	1	1	0	0	11V1
7	1	0	0	1	1	1	0	0	10V1
8	0	0	0	1	1	1	0	0	9V1
9	1	1	1	0	1	1	0	0	8V1
10	0	1	1	0	1	1	0	0	7V1
11	1	0	1	0	1	1	0	0	6V1
12	0	0	1	0	1	1	0	0	5V1
13	1	1	0	0	1	1	0	0	4V1
14	0	1	0	0	1	1	0	0	3V1
15	1	0	0	0	1	1	0	0	2V1
16	0	0	0	0	1	1	0	0	V1
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	1	1	-V1
19	1	0	0	0	0	0	1	1	-2V1
20	0	1	0	0	0	0	1	1	-3V1
21	1	1	0	0	0	0	1	1	-4V1
22	0	0	1	0	0	0	1	1	-5V1
23	1	0	1	0	0	0	1	1	-6V1
24	0	1	1	0	0	0	1	1	-7V1
25	1	1	1	0	0	0	1	1	-8V1
26	0	0	0	1	0	0	1	1	-9V1
27	1	0	0	1	0	0	1	1	-10V1
28	0	1	0	1	0	0	1	1	-11V1
29	1	1	0	1	0	0	1	1	-12V1
30	0	0	1	1	0	0	1	1	-13V1
31	1	0	1	1	0	0	1	1	-14V1
32	0	1	1	1	0	0	1	1	-15V1
33	1	1	1	1	0	0	1	1	-16V1

Table 1 Switching sequence for proposed thirty three levelinverter

The output waveform has levels: ± 16V1, ± 15V1, ± 14V1, ± 13V1, ±12V1, ±11V1, ±10V1, ±9V1, ±8V1, ±7V1, ±6V1, ±5V1, ±4V1, ±3V1, ±2V1, ±V1and 0.

IV.PROPOSED GRID CONNECTED PV SYSTEM

The proposed PV system directly converts the solar energy into electrical energy in the form of DC. The voltage generated by the PV is converted into AC using the proposed multilevel inverter. The proposed inverter is connected to the power grid with satisfying the grid requirements such as phase angle, frequency,power factor and amplitude of the grid voltage.SPUE: In this attack, an attacker's objective is to maximize its own spectrum usage. When selfish attackers detect a vacant spectrum band, they prevent other secondary users from competing for that band by transmitting signals that emulate the signal characteristics of primary user signals. This attack is mostly carried out by two selfish secondary users. The system is shown in figure 3.

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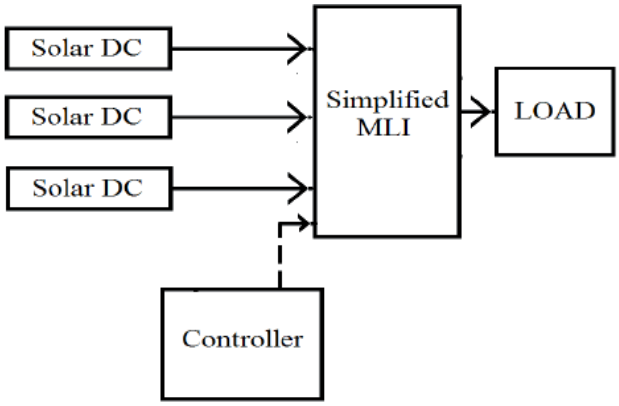

Fig .3 Grid tied photovoltaic system (PV)

V. SIMULATION RESULTS

The Simulation model for the proposed topology is shown in figure 4

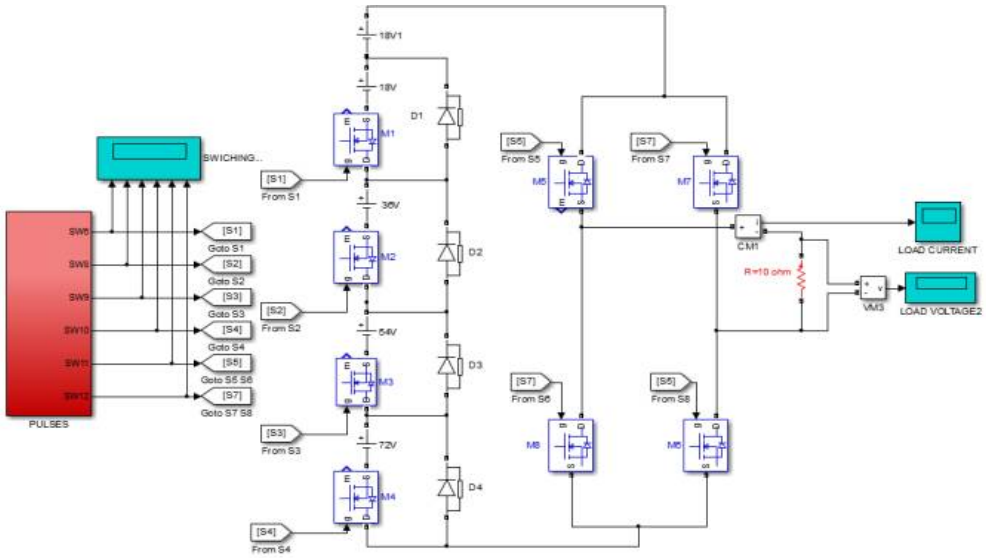

Fig.4.Matlab/Simulink diagram of proposed thirty three level MLI

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The output voltage obtained for thirty three level multilevel inverter using equal area criteria is shown figure 5

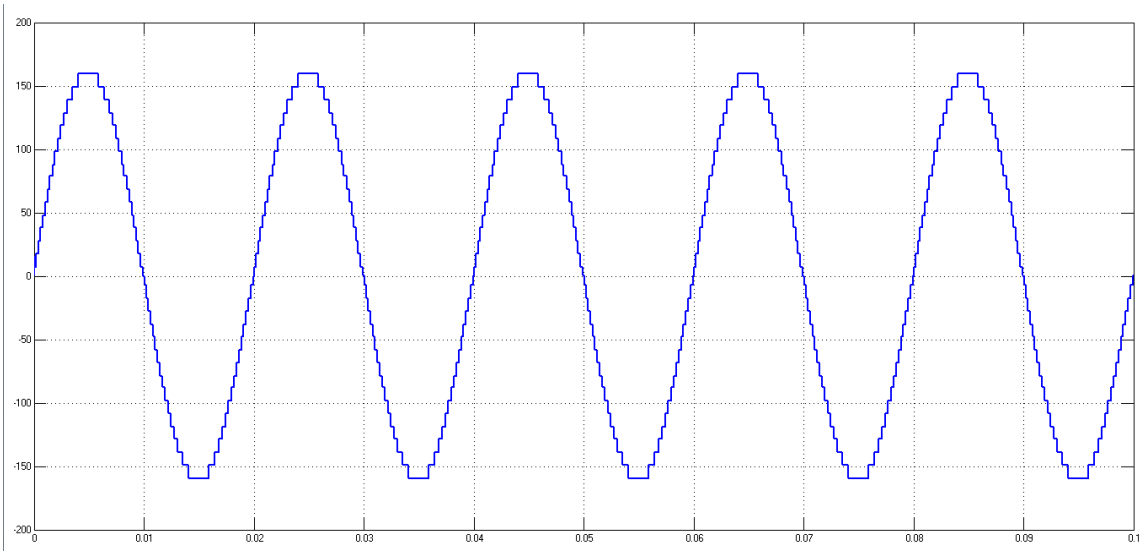

Fig.5. Output voltage wave form of proposed inverter

The figure 6 shows the spectrum analysis (FFT) for proposed multilevel inverter and the THD of the proposed thirty three level inverter is 2.25%.

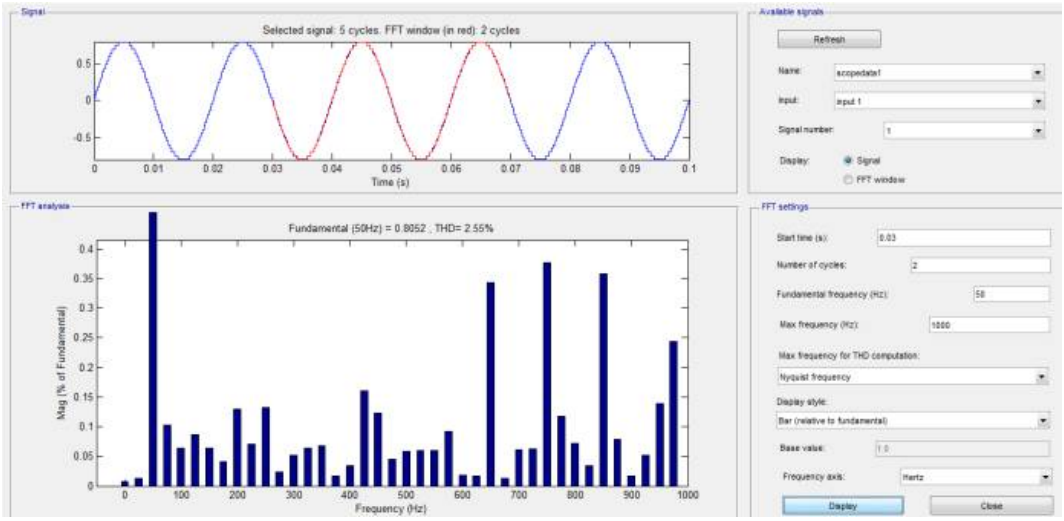

Fig.6. FFT analysis of proposed inverter

The following figure shows the grid voltage and current and it is observed that they are in phase. Hence the power factor is nearly equal to unity.

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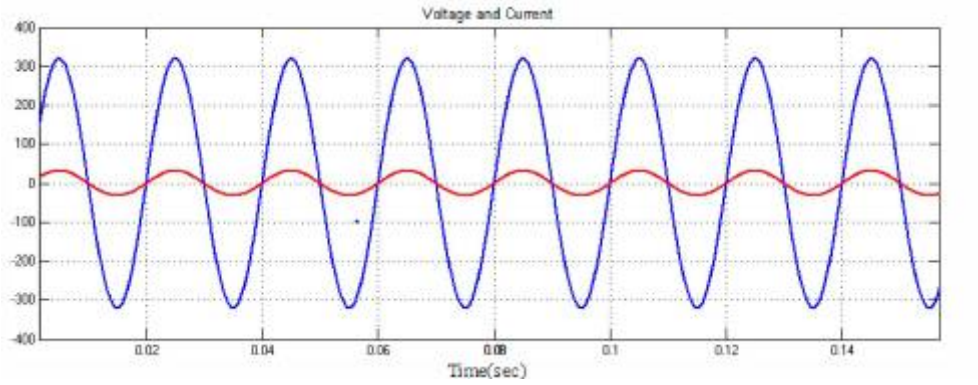

Fig.7. GRID VOLTAGE AND CURRENT

VI.CONCLUSION

This paper proposes a grid connected PV system by using simplified multilevel inverter with less number of switches and the method used for generation pulses is equal area criteria (EAC) is very simple with lower THD as compared to other methods like NR,SHE .Hence the output voltage has lower order harmonics because the filtering is complex.so the voltage and current are in phase

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