Solar energy conversion using modern multi-level inverter for simple lighting system

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***Abstract*—In this paper has large power capability related with less output harmonics and less switching losses because in this type of multilevel inverter less number of switches, capacitors, power diodes are used. The modern multilevel inverter is used to simple lighting system. This paper present a multilevel inverter configuration which is designed by bi directional switched between capacitive voltage sources. This paper the result achieved by 13 levels by using only 9 switches and 6 capacitors only. The modified inverter can produce better sinusoidal by increasing output voltage level. This has been avoided by the flickering effect for the lightning system.**

***Keywords*— photovoltaic (PV) system, multilevel inverter, voltage divider, H-bridge inverter, cascade multilevel inverter.**

I. INTRODUCTION

Photovoltaic (PV) power generation is very desirable since it is renewable and does not contribute to pollution or global climate change. PV is especially attractive for--applications in where sunshine is available for most of the year. This paper presents a DC-DC converter connected to modern multi-level inverter to achieve sinusoidal voltage waveform and output sinusoidal current to the lighting system with a simple and cost effective power electronic solution. One of the advantages offered by renewable energy sources is their potential to provide sustainable electricity in areas not served by the conventional power grid. The growing market for renewable energy technologies has resulted in a rapid growth in the need for power electronics. Most of the renewable energy technologies produce dc power, and hence power electronics and control equipment are required to convert the dc into ac power. Grid connected topologies use a lower amount of panels for each array to improve the global efficiency of photovoltaic generator. This is a result of a reduction in mismatch losses, partial shadows of array etc.

There are several techniques developed to implement MPPT in photovoltaic systems. These methods of MPPT can be classified into three main categories that include; lookup table methods, hill climbing methods and computational methods. The methods vary according to the degree of sophistication, processing time and memory requirements. Usually, these photovoltaic modules consist of a solar array and DC-to-DC converter controlled by a MPPT algorithm. Later, the available energy on DC bus is transferred to grid by means of half-bridge or full-bridge converters. In this research modern Multilevel Inverter Topology is proposed

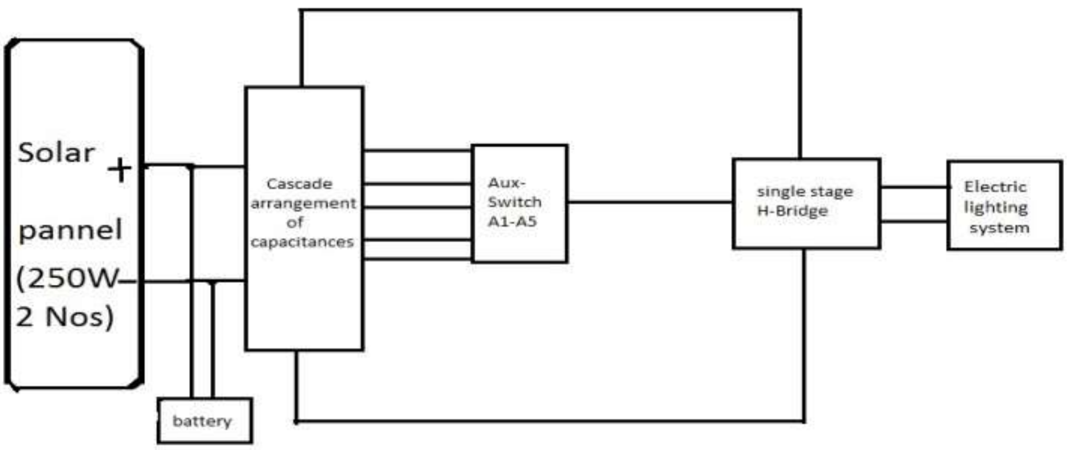

Fig.1. proposed modern lighting system

II.CHARACTERISTICS OF SOLAR CELLS

Solar cells are basically p–n junction semiconductors which transform solar energy into electricity directly. Fig. 1 shows an equivalent circuit of a solar cell [2], in which R_{sh} and R_S are the intrinsic shunt and serial resistors of the cell, respectively. A current source I_{ph} represents the cell photocurrent, which is a function of illumination S_i and solar array temperature T, and can be expressed as follows:

$$I_{ph}= [I_{sso}+K_i(T-T_r)]S_i/100 \qquad (1)$$

where I_{sso} is the short-circuit current at reference temperature T_r and reference illumination (100mW/cm^2), and K_i is temperature coefficient of the short-circuit current.

III.PREVIOUS RESEARCH

The four transformers less multilevel voltage source converters are
Diode clamp
Flying capacitor
Asymmetric cascade
H-bridge

New morden Multilevel Inverter Topology

Multilevel converters offer high power capability, associated with lower output harmonics and lower commutation losses. The new topology produces a significant reduction in the number of power devices and capacitors required to implement a multilevel output. The new topology is used in the design of a five-level inverter; only five controlled switches, eight diodes, and two capacitors are required to implement the five-level inverter using the proposed topology.

Table.1: Comparison between Four Different 13-Level Inverters Topologies

Multilevel inverter type		Morden Multilevel inverter	cascade multi level inverter	Capacitor Clamped	Asymmetric Cascade
Main controlled switches	Number of devices	4	12	16	18
	V_s / V_{sM}	0.6	0.5	0.5	1
	I_{sM} / I_{sM}	1	1	1	1
	$I_{s(AV)} / I_{sM}$	0.31	0.31	0.31	0.31
Auxiliary controlled switches	Number of devices	5	0	0	0
	V_s / V_{sM}	-	-	-	-
	I_{sM} / I_{sM}	-	-	-	-
	$I_{s(AV)} / I_{sM}$	-	-	-	-
Diodes	Number of devices	24	20	8	8
Capacitors	Number of devices	5	4	10	2

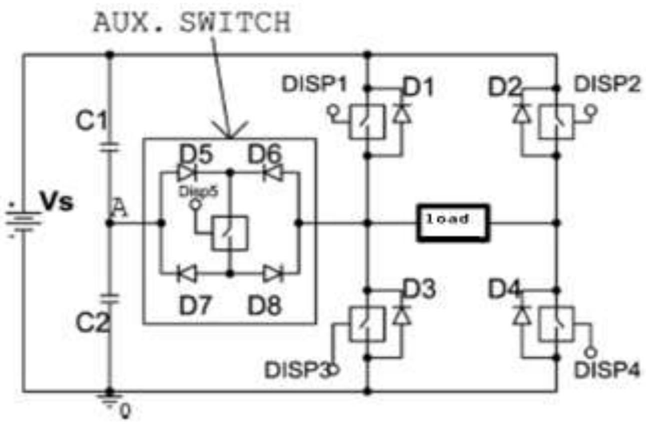

Fig.2: Circuit Configuration for5- level inverter

Table.2: Switching combinations required to generate the five-level output voltage waveform

Disp1	Dips2	Disp3	Disp4	Disp5	V_{RL}
on	off	off	on	off	V_S
off	off	off	on	on	$V_S/2$
off	off	on	on	off	0
off	on	off	off	on	$-V_S/2$
off	on	on	off	off	$-V_S$

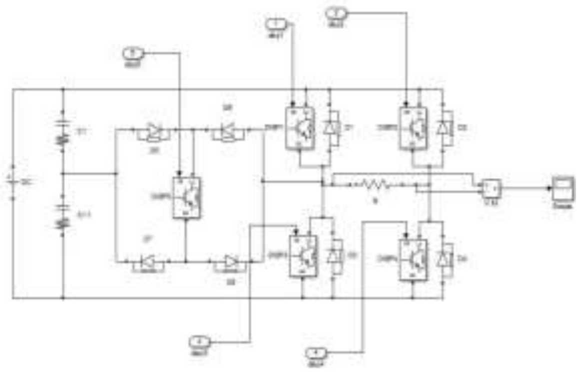

Fig.6.Simulation of 5 level inverter

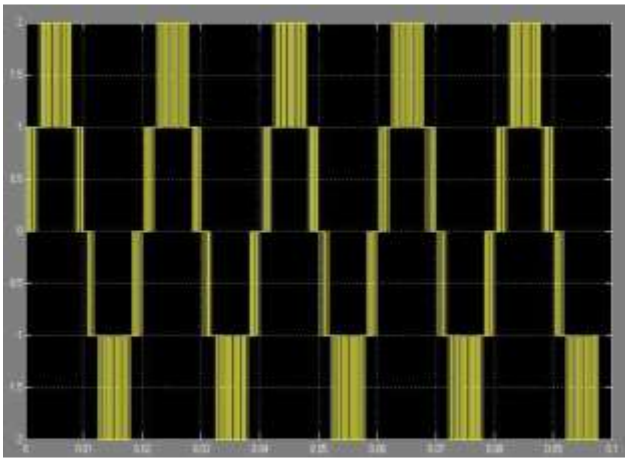

Fig.7: simulation output of 5 level inverter

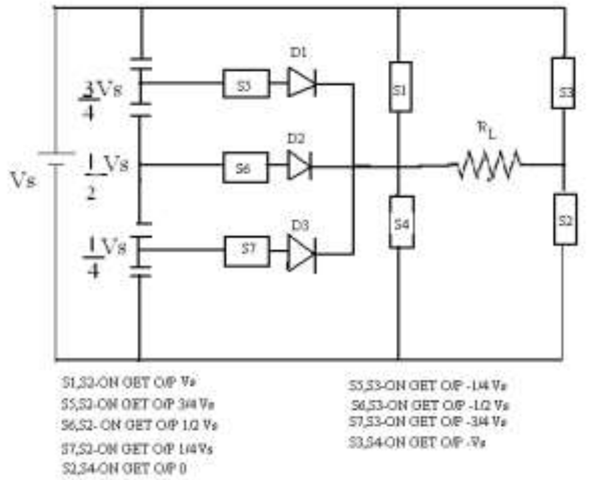

Fig.7: Block diagram of 9 level inverter

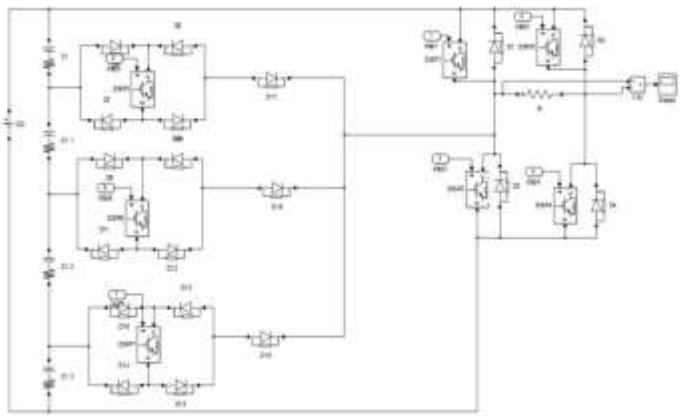

Fig.9.Simulation of 9 level inverter

Table.3: Switching combinations required to generate the Nine-level output voltage waveform

slno	Voltage leval	Turn on switches		S1	S2	S3	S4	S5	S6	S7
1	Vs	S1	S2	1	1	0	0	0	0	0
2	¾ vs	S5	S2	0	1	0	0	1	0	0
3	½ vs	S6	S2	0	1	0	0	0	1	0
4	¼ vs	S7	S2	0	1	0	0	0	0	1
5	0	S2	S4	0	1	0	1	0	0	0
6	-1/4 vs	S5	S3	0	0	1	0	1	0	0
7	-1/2 vs	S6	S3	0	0	1	0	0	1	0
8	-3/4 vs	S7	S3	0	0	1	0	0	0	1
9	-vs	S3	S4	0	0	1	1	0	0	0

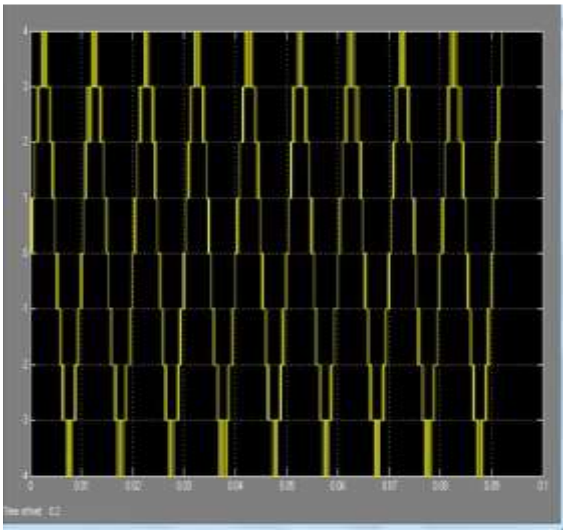

Fig.10: simulation output of 9 level inverter

IV. Proposed system

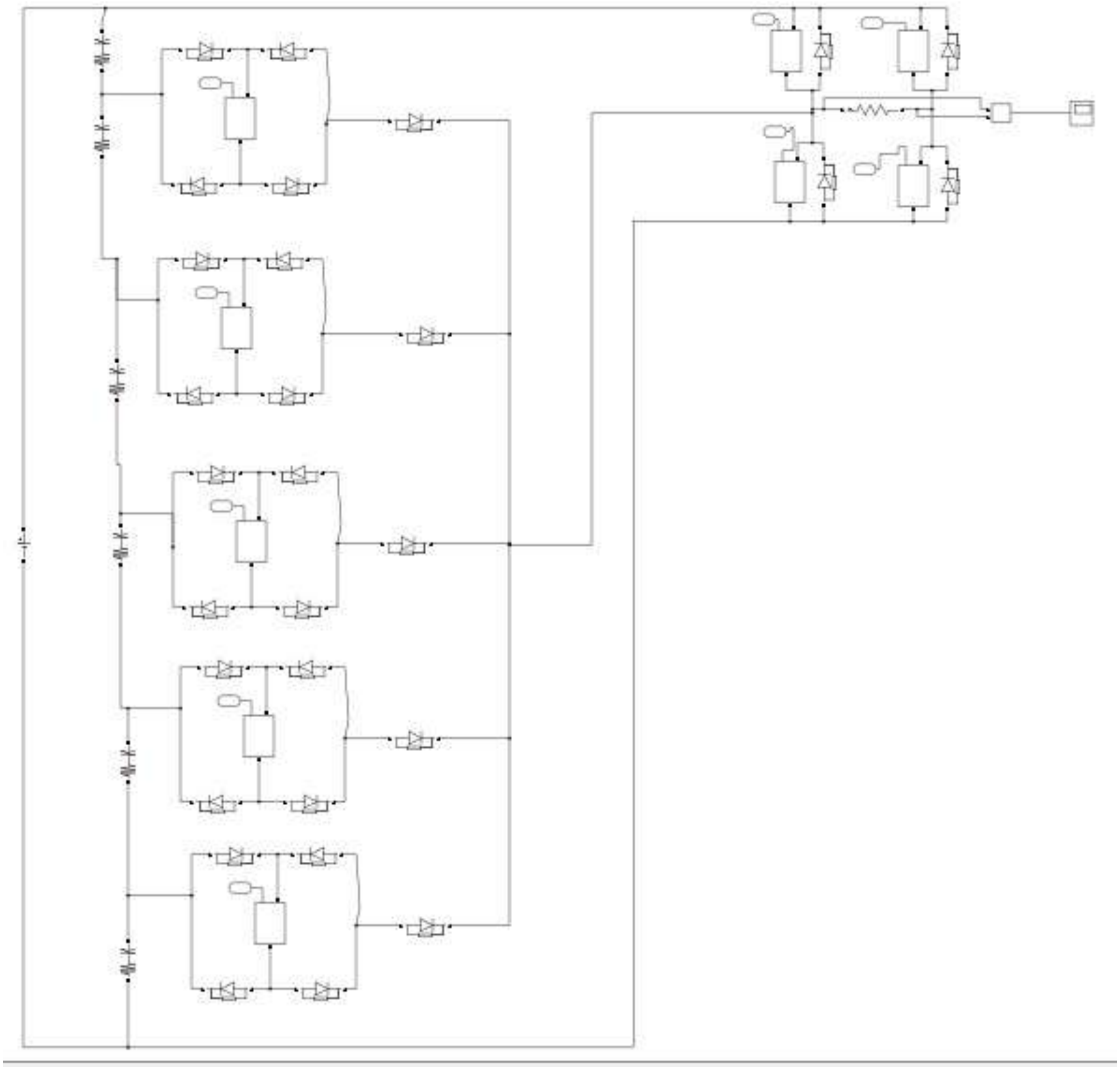

Fig.11.Simulation of 13 level inverter

Table.3: Switching combinations required to generate the 13-level output voltage waveform

slno	Voltage leval	Turn on switches		S1	S2	S3	S4	S5	S6	S7	S8	S9
1	Vs	S1	S2	1	1	0	0	0	0	0	0	0
2	½ Vs	S5	S2	0	1	0	0	1	0	0	0	1
3	¼ Vs	S7	S4	0	1	0	0	0	1	0	0	0
4	1/8 Vs	S5	S2	0	1	0	0	0	0	1	0	0
5	1/16 Vs	S6	S2	0	1	0	1	0	0	0	1	0
6	1/32 vs	S8	S2	0	0	1	0	1	0	0	0	1
7	0	S2	S4	0	0	1	0	0	1	0	0	0
8	-1/32 vs	S8	S4	0	0	1	0	0	0	1	0	0
9	-1/16 vs	S6	S3	0	0	1	1	0	0	0	1	0
10	-1/8 vs	S9	S3	0	1	0	0	0	0	1	0	0
11	-1/4 vs	S6	S3	0	1	0	1	0	0	0	1	0
12	-1/2 vs	S7	S3	0	0	1	0	1	0	0	0	1
13	-vs	S3	S4	0	0	1	0	0	1	0	0	0

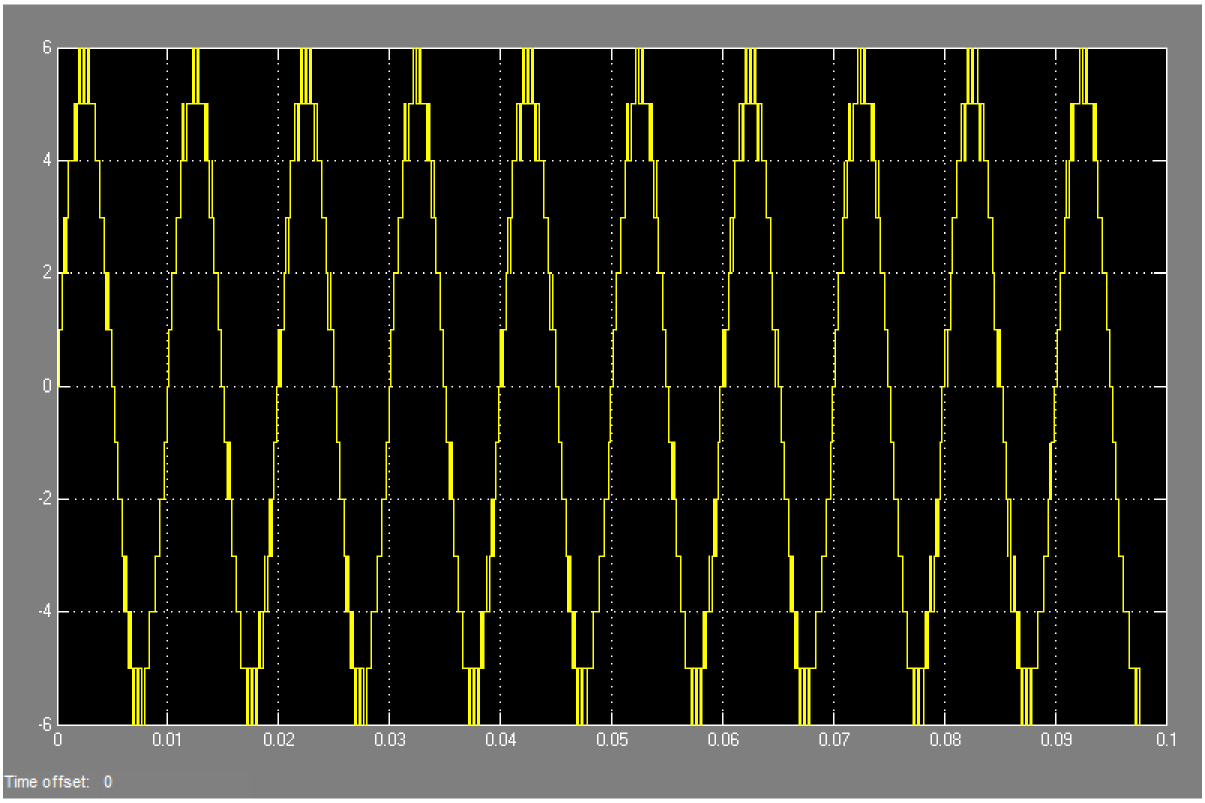

Fig.10: simulation output of 13 level inverter

V.CONCLUSION

Photovoltaic generators will be the most preferred mode of electricity generation once the cost and energy consumed for manufacturing of PV panels comes down and the energy cost comes down to the levels at which energy from fossil fuels is available now. However in remote and inaccessible places this will be the generation source of choice. To take advantage of all the available power, it is necessary to operate photovoltaic generators operating at MPPT and suitable Inverters to interface with the AC system. This paper has presented a modern **Multilevel Inverter Topology** type multi-level inverter which is adequate to interface with the AC system with very low levels of harmonic injection. A further development of the proposed topology, able to be applied to any number of voltage levels within the power switches maximum voltage, is now under consideration.

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