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Design of single PV source asymmetrical diode clamped multilevel inverter

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ABSTRACT

Previously an isolated single sourced multi-output dc/dc converter with a high-frequency link was used feed different cells of the Asymmetrical Cascaded H-bridge (ACHB) inverter. The major disadvantages of the ACHB are that the main H-bridge is commutated with fundamental frequency, passing the majority of the inverter so that noise and high cost problems arises. To overcome this, a diode clamped inverter switching strategy is used and it is based on programmable pluses, transformer circuit is not used anywhere in this project. So this project is done by minimized cost and used any AC applications.

Index Terms: Inverter, Photovoltaic, Diode Clamped inverter, Pic microcontroller, ACHB Inverter.

INTRODUCTION

Now-a-days, in industries, power conversion systems become very popular and are used extensively. The power conversion system includes AC-DC, DC-AC, DC-DC, AC-AC conversions. Many high and medium voltage applications require such power conversion systems. Those applications are HVDC transmission, FACTS, AC/DC drives, renewable energy sources such as PV solar cells, wind, fuel cells etc. This project concentrates on DC-AC conversion (Inverter action). A conventional single phase inverter is able to produce voltage levels of +Vdc, 0, -Vdc, so the output waveform of the inverter is quasi-square wave, which is not advisable to use as an input to any AC system. Hence, to get nearly sinusoidal waveform, multilevel inverter is introduced in 1975. The output of multilevel inverter is a staircase wave, which is nearly sinusoidal. By increasing the number of output voltage levels in multilevel inverter the THD can be minimized. Also ripple content in the output of multilevel inverter is lesser than that of conventional inverter. One more advantage that MLI possesses over the conventional inverter is voltage stress across the individual switch is lesser in case of MLI. Many topologies of MLI are developed and studied.

EXISTING SYSTEM

In Existing method electric fences used to protect the crops from the wild animals. Due to high electricity animals are hurt widely and it is not only affects wild animals it also dangerous to the pet animals and even human beings. The electric fences is used for preventing the crops but in existing method camera was used for detecting the animals which is economically high cost. The indication is available in the system but it sends the message only to the forest officer not to the leaving people in the farmland.

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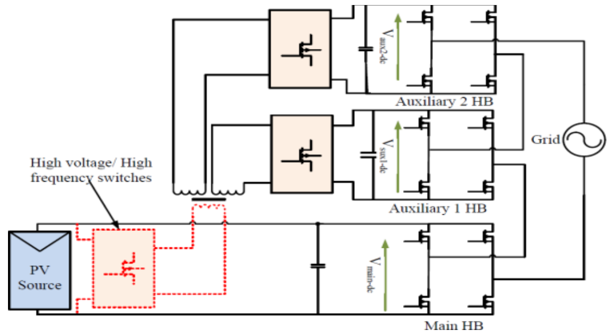
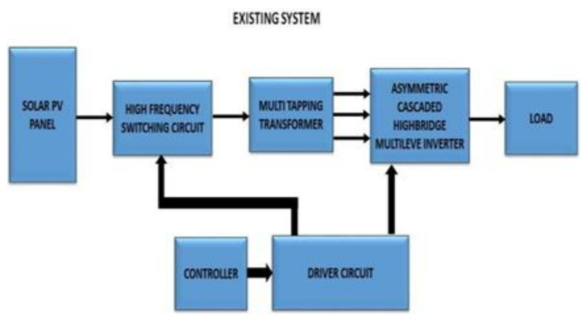
EXISTING CIRCUIT



EXISTING BLOCK

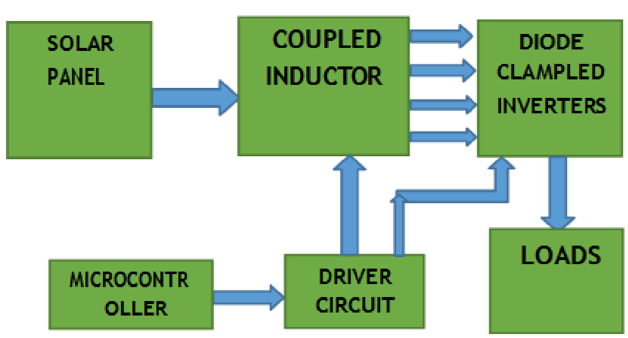


PROPOSED SYSTEM

The proposed single-phase none three-level inverter is developed. It comprises a Single phase conventional H-bridge inverter, three switches, and three voltage sources. The switching devices used here is MOSFET. Since its operating frequency is higher and produces lower switching losses as compared to the other transistors like BJT and IGBT. Also it is small in size and economical.

This H-bridge topology is significantly advantageous over other topologies, i.e., lesser the number of power switches, power diodes, and preferably no capacitors as compared to the inverters of the same number of levels. Proper switching of the inverter can produce nine output-voltage levels from the dc supply voltage. Using this technique any number of levels can be achieved with reduced number of switching devices. But here we are implementing a sixty three level inverter topology.

METHODOLOGY



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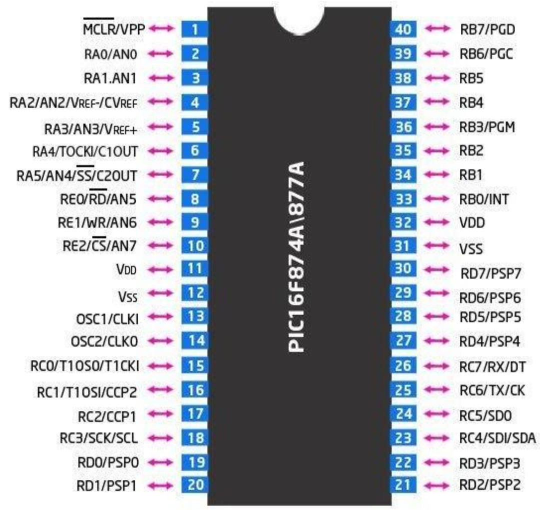
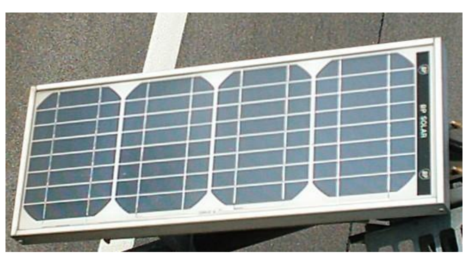
MICROCONTROLLER

The design uses PIC16F877A microcontroller. PIC16F877A is a family of modified Harvard Architecture microcontroller made by Microchip Technology. This is powerful microcontroller with nanosecond instruction execution and easily programmable with only 35 single word instructions. The entire automation of the system is done by this microcontroller. It has an inbuilt Analog to Digital converter. Because of this we do not require any ADC to be connected externally.



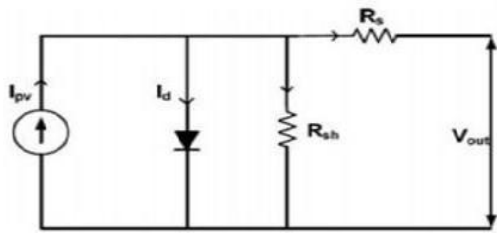
SOLAR ENERGY

In the today's climate of the growing energy needs and increasing the environmental concern, alternatives to the use of non-renewable and polluting fossil fuels have to be investigated. One such alternative is solar energy. An array is the assembly of solar-thermal panels or the photovoltaic modules; these panels can be connected either in parallel or series depending on the design objective. Solar panels are typically find use in residential, commercial, institutional, and light industrial applications.



PHOTOVOLTAIC (PV) MODULE

The photovoltaic cell is the basic structural unit of the photovoltaic module that generates current carriers when sunlight falls on it. The power generated by this photovoltaic cell is very small. To increase the output power the photovoltaic cells are connected in series or parallel to form photovoltaic module. The basic unit of a photovoltaic module is the solar cell, which consists of a p-n junction and that converts light energy directly into electrical energy. The Ipv is the light generated current, where Id is the diode current, Rash is the shunt resistance which describes the leakage current, Rs is the series resistance which describes the voltage drop as the charge carriers migrate from the p-n junction to the electrical contacts [1-5].

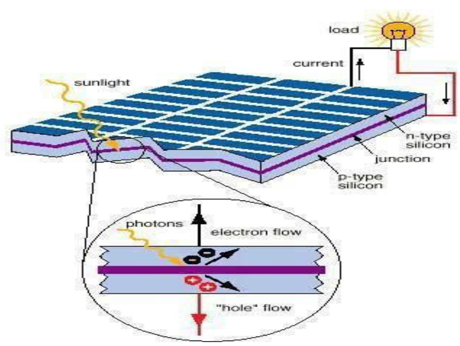


PHOTOVOLTAIC SYSTEM

Photovoltaic modules generate by the DC current and the voltage. However, to feed the electricity to generate the grid, AC current and the voltage are needed. Inverter is the equipment which used to convert DC to AC. There are the different types of inverter configuration depending upon how the photovoltaic modules are connected to the inverter. The decision on what configuration should be used has to make for each case depending on the environmental and the financial requirements. If the modules are not use to identical or do not work under the same conditions, the MPP is different in each of the panel and the resulting voltage power characteristic has their multiple maxima, which constitutes a problem, because Most MPPT algorithms converge to the local maximum which depending on the starting point.

PHOTOVOLTAIC CELL

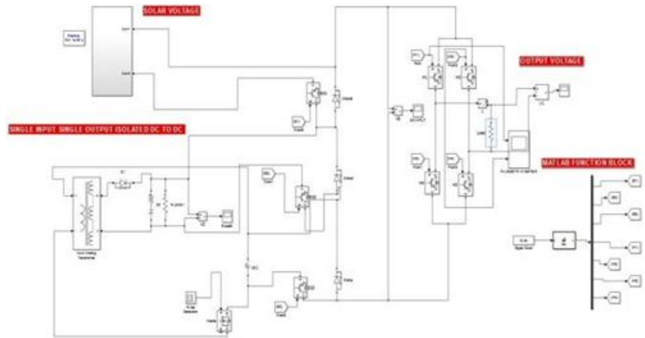
PV cells are made of semiconductor materials, such call as silicon. For solar cells, thin semiconductor water is specially treated to form an electric field that is positive on one side and negative on the other. When the light energy strikes the solar cell and electrons are knocked loose from the atoms in the semiconductor material. If the electrical conductors are attached to the positive and the negative sides, forming the electrical circuit, the electrons can be captured in the form of an electric current that is, electricity. This electricity can then be used to power a load. A photovoltaic cell can either be a circular or square in construction.



PULSE WIDTH MODULATION

Pulse Width Modulation refers to the method which is carrying information on a train of pulses, the information being encoded in the width of the pulses. The pulses have constant amplitude but their duration varies in the direct proportion to the amplitude of analog signal. The output voltage control is easier with PWM than other schemes and can be achieved without any additional components. The lower order harmonics are either minimized or eliminated altogether. The filtering requirements are minimized as the lower order harmonics are used to eliminate and higher order harmonics are filtered easily [6-10].

CIRCUIT DIAGRAM

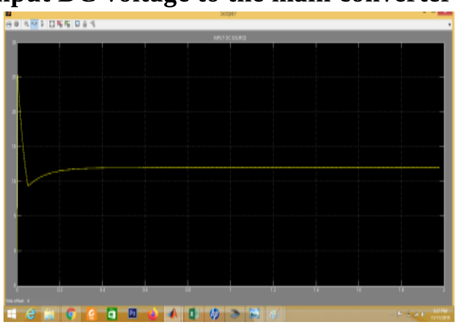


DRAWBACKS OF CASCADED MULTILEVEL INVERTER

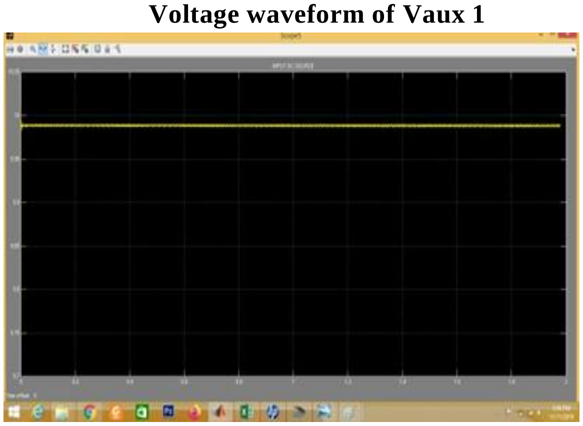
- Cascaded multilevel inverter makes use of large number of switched which makes it bulky.
- Complexities in designing Control logic.
- Number of DC source is increased as number of output level increases switching losses are high compared to diode clamped method
- The above mentioned drawbacks can be minimized by switching over to Diode Clamped Multilevel Inverter. It uses lesser number of switched compared to cascaded multilevel inverter. A diode transfers a limited amount of voltage, thereby reducing the stress on other electrical devices.

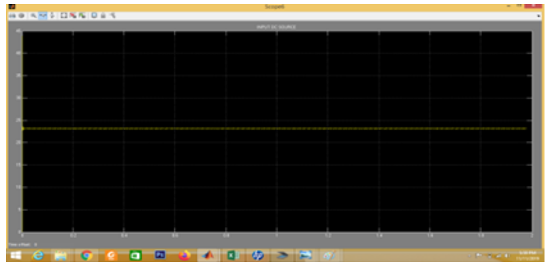
OUTPUT

Input DC voltage to the main converter



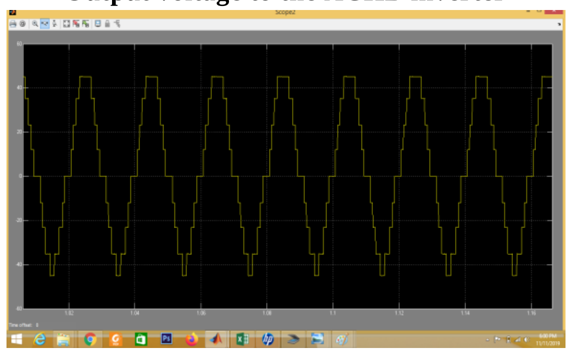
Voltage waveform of Vaux 1





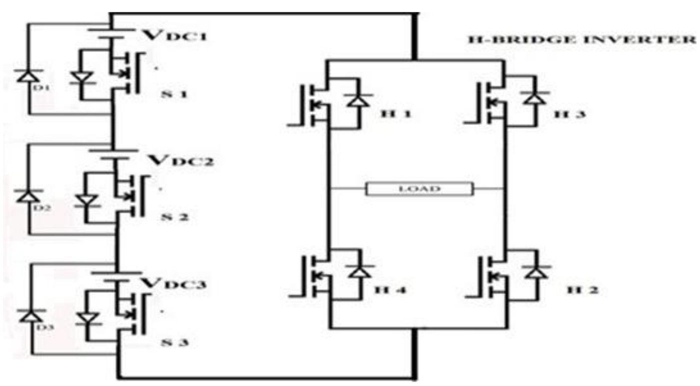
Voltage waveform of Vaux 2

Output voltage to the ACHB inverter



Proposed system simulation output

PROPOSED SYSTEM DIODE CLAMPED INVERTER CIRCUIT DIAGRAM



- **Level_1** positive output (*V*dc): *H*1 is ON; connecting the load positive terminal to *V*dc, and *H2* is ON, connecting the load negative terminal of input supply. The switches S1, S2, S3 are ON the voltage applied to the load terminals is *V*dc.
- **Level_2** positive output *H*1 is ON, connecting the load positive terminal to *V*dc, and *H2* is ON, connecting the load negative terminal of input supply. The switches S1, and S2 are ON
- **Level_3** Positive output *H*1 is ON, connecting the load positive terminal to *V*dc, and *H2* is ON, connecting the load negative terminal of input supply. The switch S1 is ON
- **Level_4** Positive output *H*1 is ON, connecting the load positive terminal to *V*dc, and *H2* is ON, connecting the load negative terminal of input supply. The switch S2 is, ON.
- Zero output: All the switches S1, S2, S3, H1, H2, H3, and H4 are in OFF position.
- **Level_5** negative output (*V*dc): *H3* is ON, connecting the load positive terminal to *V*dc,

and *H4* is ON, connecting the load negative terminal of input supply. The switches S1, S2, S3 are ON the voltage applied to the load terminals is *V*dc.

- **Level_6** negative output *H3* is ON, connecting the load positive terminal to *V*dc, and *H4* is ON, connecting the load negative terminal of input supply. The switches S1, and S2 are ON
- **Level_7** negative output *H3* is ON, connecting the load positive terminal to *V*dc, and *H4* is ON, connecting the load negative terminal of input supply. The switch S1 is ON
- **Level_8** negative output *H3* is ON, connecting the load positive terminal to *V*dc, and *H4* is ON, connecting the load negative terminal of input supply. The switch S2 is, ON.
- The proposed inverter's operation can be divided into 9 switching states, the required 9 levels of output voltage were generated as follows.

LEVEL	S1	S2	S3	H1	H2	H3	H4	VOLTAGE
1	ON	ON	ON	ON	ON	OFF	OFF	V_{DC}
2	ON	ON	OFF	ON	ON	OFF	OFF	$V_{DC1} + V_{DC2}$
3	ON	OFF	OFF	ON	ON	OFF	OFF	V_{DC1}
4	OFF	ON	OFF	ON	ON	OFF	OFF	V_{DC2}
5	OFF	OFF	OFF	OFF	OFF	OFF	OFF	0
6	OFF	ON	OFF	OFF	OFF	ON	ON	$-V_{DC2}$
7	ON	OFF	OFF	OFF	OFF	ON	ON	$-V_{DC1}$
8	ON	ON	OFF	OFF	OFF	ON	ON	$-(V_{DC1} + V_{DC2})$
9	ON	ON	ON	OFF	OFF	ON	ON	$-V_{DC}$

CONCLUSION

This project has demonstrated the possibility of using diode clamped multilevel inverters for AC-power applications efficiently with minimized cost. Due to its special switching pattern, the single-sourced coupled inductor which converts single DC power to 4 levels DC power. The proposed switching pattern enables minimum power the proposed topology has reduced the size and the cost of the transformer. The control strategy is based on programmable firing pluses found by minimizing the THD function for every modulation index.

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