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MPPT Controller based Nine Level Inverter using Solar Power Generation System

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Abstract: ***This project proposed a solar power generation system is used for the MPPT (maximum power point tracker) controller in a nine-level inverter. The selection of the capacitor circuit is configured using nine-level inverter and a cascade-connected to the full-bridge power converter. The nine-level inverter contains seven powers. Electronic switches simplify the configuration of the circuit system. A single electronic power switch is switched to the high frequency at any time to generate a nine-level output voltage. The output of the photovoltaic solar panel system will be fed into an MPPT algorithm to obtain a maximum amount of energy from a photovoltaic system, and this technique is used for the generation of residential renewable energy. The output voltage of a photovoltaic solar system is completed by the use of the DC-DC power converter with independent voltage sources for an inverter and reduces the harmonics generated. The nine-level inverter reduced with switches in power generation.***

Keywords: DC-DC boost converter, Nine level inverter, Multilevel inverter, PWM, Solar panel, MTTP Controller.

I. INTRODUCTION

Today, energy production based on renewable energies plays an essential role in the electricity sector. Electrical energy is mostly obtained from the wind and solar energy compared to all other renewable resources such as tidal energy, biomass, etc. Among all one of the most abundant and available resources are renewable solar energy. Solar panels are used to convert the energy from light into electrical energy, and it is stored in the batteries. An inverter technology, the electrical energy stored in the battery is linked to the AC networks. The efficiency of the solar power plant is mainly decided by the efficient storage of electrical energy in the battery. Today the main problem in this solar electricity production involves designing a suitable charge controller to store electrical energy in the battery and efficient solar panels for very good energy conversion. The manufacturing of an effective panel is complete depending on the type of technology and quality of materials.

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The maximum efficiency in the panel is to design the appropriate MPPT controller with a powerful algorithm. The solar localization system has been used in previous research to obtain maximum power and efficiency from the panels. But this system has a poor response when sunlight is absent and in low, light conditions. The difficulties mentioned previously can be overcome by placing the appropriate MPPT controller between the solar panel and the battery. A MPPT algorithm, the maximum power is extracted by the solar panel, and the charge regulator output voltage is adjusted to avoid battery overcharging and obtaining the best use factor of the panel. The basic block diagram of interfacing solar power generation and MPPT technique is shown in Fig.1.

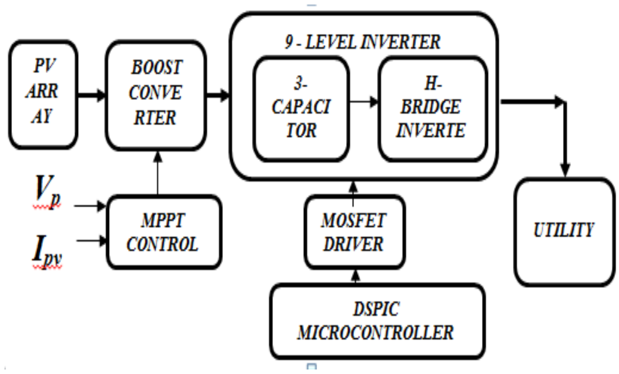

Fig: 1 Block Diagram of Proposed System

II. NINE LEVEL INVERTER OPERATION

The nine-inverter levels contain seven electronic switches, which simplifies the configuration of the circuit system. An electronic power switch is switched to the high frequency at any time to generate a nine-level output voltage. A proposed nine-tier solar energy system, as shown in Figure 2.

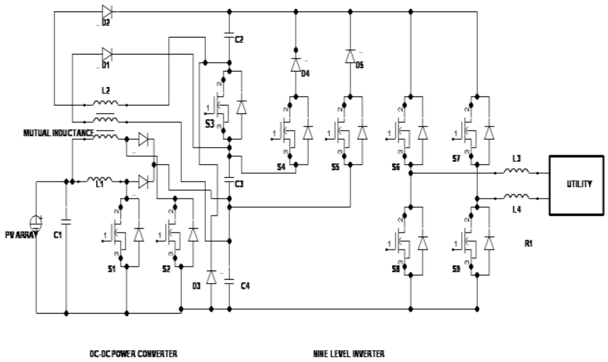

Fig: 2 Proposed Nine Level Solar Power Generation System

III. SOLAR PANEL MPPT ALGORITHM

An MPPT algorithm automatically detects the panel operating voltage allowing maximum output power. A typical voltage and current graph of a solar panel fig. 3 shows the open circuit voltage of the maximum power point. The maximum power point detection is an algorithm included in the charge regulators used to extract the maximum power from the photovoltaic solar energy under certain conditions. The voltage that can produce the PV modules is called the "maximum power point". The maximum power varies with the solar radiation, the ambient temperature, and the temperature of the solar cell. The solar charge controller with maximum power point detection is electronic monitoring and has nothing to do with mobile panels with a mechanical solar tracker. The controller examines the output of the panels and compares them to the battery voltage. The MPPT controller calculates the best power from the solar panel can emit to charge of the battery, convert it to the best voltage of the battery amps. Thus, the technology name is called an electronic buck-boost power converter.

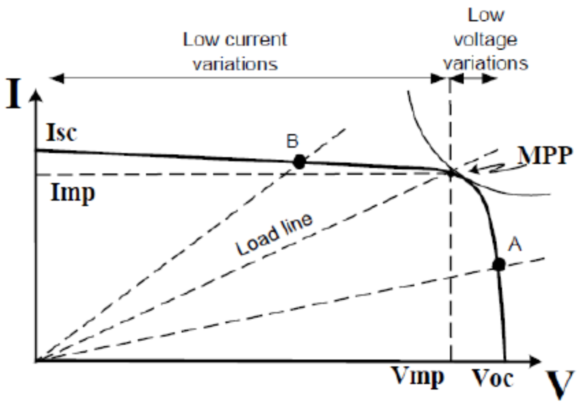

Fig 3 Graph with Voltage and Current

IV. PULSE WIDTH MODULATION TECHNIQUE

In PWM, the pulses represent a successive sampling value of s (t) that has constant amplitude but varies over time in direct proportion to the sample value. The pulse duration can be changed from the fixed start to the end edges fixed pulse center. This allows to time-division multiplexing. The maximum pulse duration is limited to the fraction of the sample time. There are several techniques that vary with the investor's profit. The most effective method of controlling gain, i.e., the output voltage is to incorporate a pulse width modulation control into the inverters.

4.1. Modes of Operation

4.1.1 Mode 1

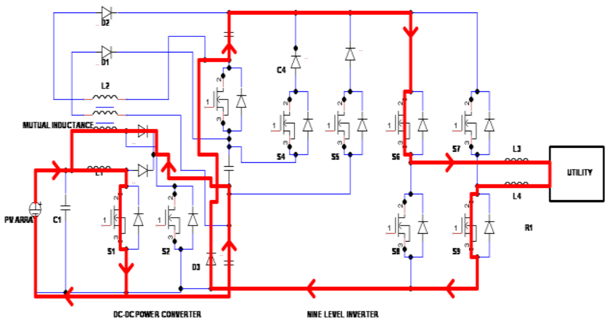

Fig 4.1 Mode 1 Operation

In this figure 4.1, switch S1 dc to dc converter is turned ON, inductor L1 and capacitor C4 are charging while capacitor switches S3, S4, and S5 are switched off. The capacitor C2 is delivers energy stored to the load. Voltage source inverter is operated in a positive half cycle; the output voltage of Vdc/4 is produced.

4.1.2. Mode 2

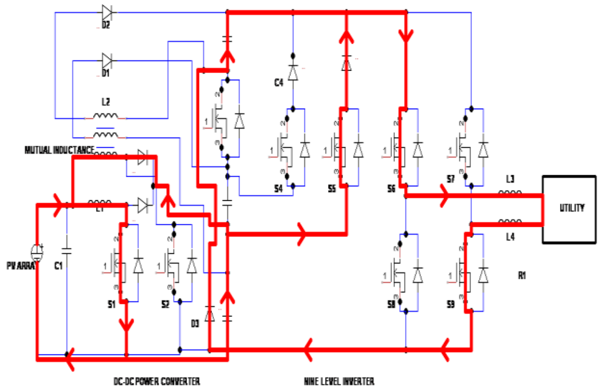

Fig 4.2 mode 2 operation

During this mode 1 and mode 2 is switch, S5 is turned ON. So the output voltage is getting Vdc/2 as shown in figure 4.2.

4.1.3. Mode 3

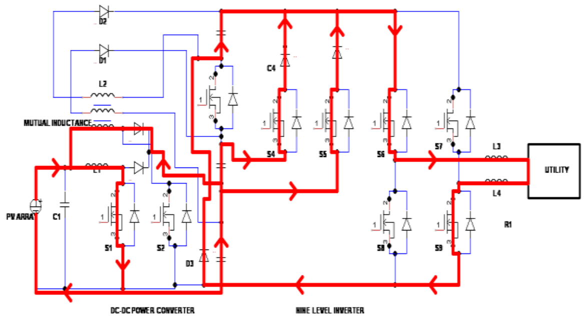

Fig 4.3 mode 3 operation

By additional mode 2 switched S4 is turned ON, during this mode, the Capacitor C3 is delivered energy to store in the load. The ouput voltage 3Vdc/4 is produced as shown in figure 4.3.

4.1.4. Mode 4

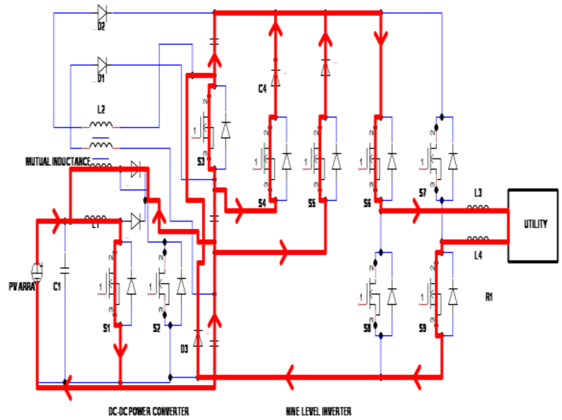

Fig 4.4 modes 4 operation

In this figure 4.5, dc to dc converter switch S1 is turned OFF, and switch S2 is turned ON, inductor L1 and coupled inductor discharging the energy and restore the energy in capacitors C2, C3, and C4. Switches S7 and S8 are turned ON, the negative half cycle is generated in the ac load. DC to DC converter operates the capacitor switching three modes i.e., Mode 2, Mode 3, Mode 4 respectively. The switches are switched ON S7 and S8 instead of S6 and S9.

OUTPUT VOLTAGE LEVEL

During the positive half cycle, the output voltage of nine level inverter is **Vdc/4, Vdc/2, 3Vdc/4, and 0.** During the negative half cycle, the output voltage is negative. The capacitor output voltage is inverted to the full wave bridge converter, the negative half cycle is the same as the positive half cycle, so the output voltage of the nine level inverter has four level is **-Vdc,-2Vdc/3,Vdc/3 and 0.** The output voltages of the nine level inverter are **Vdc/4, Vdc/2, 3Vdc/4, 0, -Vdc/4, -3Vdc/4, and -Vdc.**

V. HARDWARE LAYOUT DIAGRAM

The nine level inverter contains seven switches in the power electronic circuits, which simplifies the configuration of the circuit contains seven switches and three circuits for alternating current. The selection of the nine-level inverter circuit has developed a prototype and tested to verify the performance of the solar power generation system, as shown in figure 5.

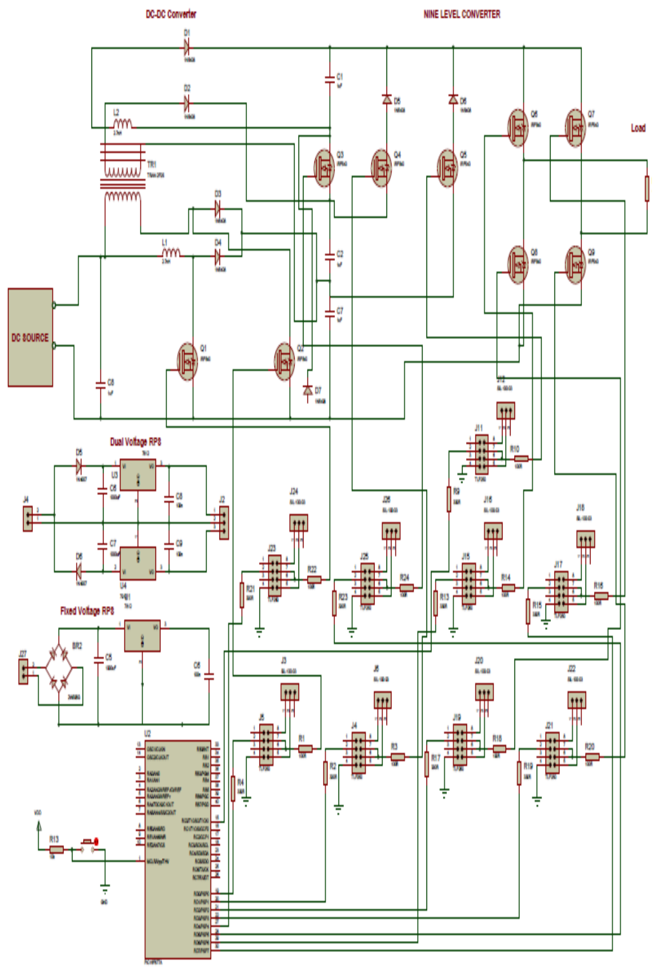

Fig 5 Layout diagram of nine level inverter

VI. MPPT SIMULATION RESULTS

MATLAB software is designed and implemented for MPPT algorithm and the results were taken. The Simulink diagram of the battery charging system and results were displayed in the diagram below. Figure 6 shows the overall block representation of nine levels inverter with table 6 represents the parameter of the circuit. Figure 6.2 shows the input circuit voltage and boosted voltage in DC-DC converter as shown in figure 6.3.

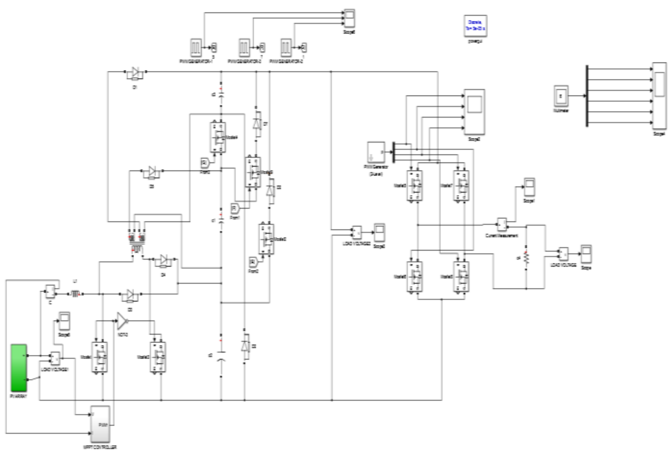

Fig 6.1 Proposed Nine Level inverter power System

Table 6: Parameters of nine level inverter

Input voltage	115V
Load resistance	1000ohms
Load inductance	10mh
Modulation index	0.4
Capacitance 2	1000 mf
Capacitance 3	4700 mf
Capacitance 4	10000 mf
Output voltage	400V

6.1 Input Voltage of the Circuit

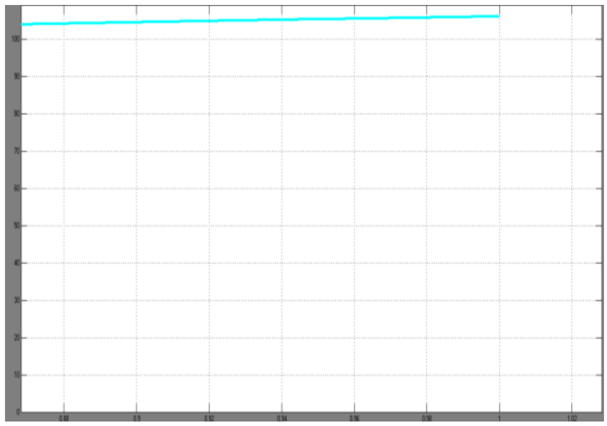

Fig 6.2 Input Voltage of the Nine Level Inverter Circuit

6.2 DC to DC Converter Voltage

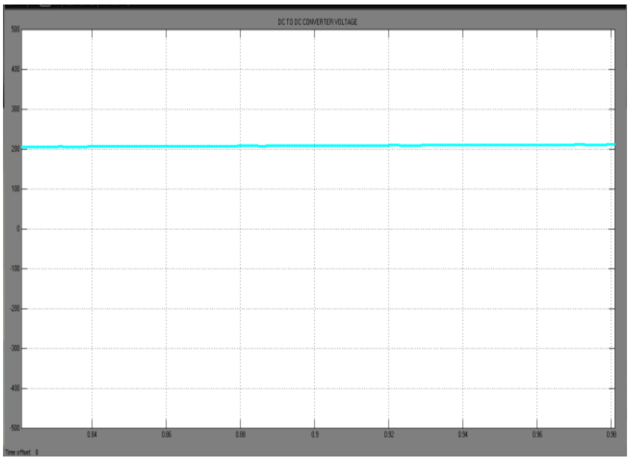

Fig 6.3 Boosted Voltage In DC-DC Converter

6.3 OUTPUT VOLAGE OF FOUR LEVEL

The graphical representation of output voltage level of the four level inverter as shown in figure 6.4.

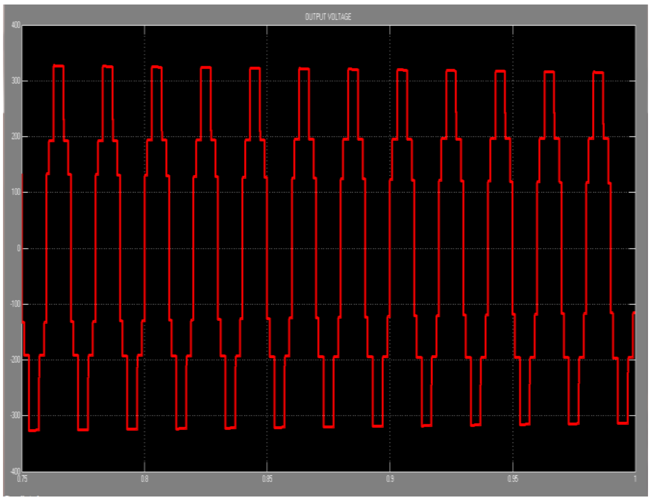

Fig 6.4 Output Wave Form of Four Level Waveform

6.4 SIMULATION RESULT

Thus the output waveform of proposed nine level inverter system using CRO as shown in figure 6.5.

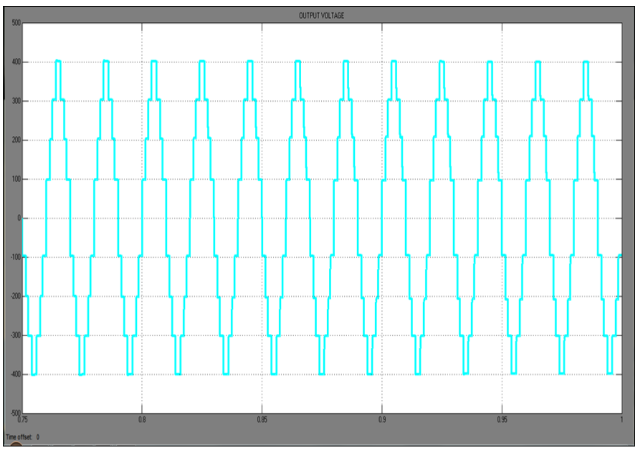

Fig 6.5. Proposed Nine Level Output Waveform

VII. HARDWARE SETUP OF NINE LEVEL INVERTER SYSTEMS

The output of the photovoltaic solar panel system will be introduced into an MPPT algorithm to obtain a maximum amount of energy from a photovoltaic system. The MPPT technique for the generation of residential renewable energy, the output voltage of photovoltaic solar energy is supplemented by the use of the DC-DC power converter. The final outcome of the solar power generation system with a nine level inverter system is shown in Fig.7.1.

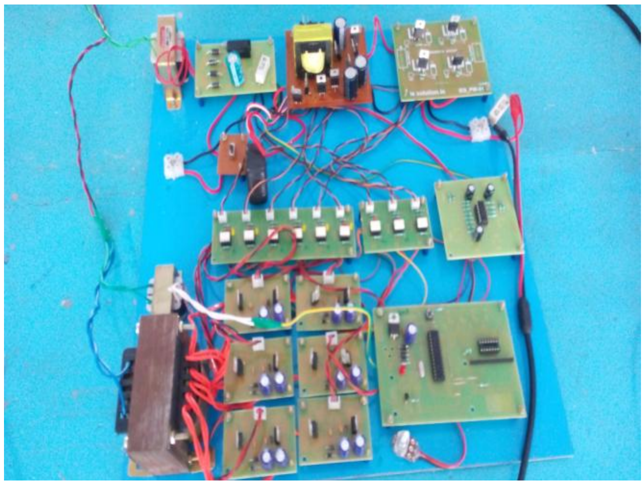

Fig 7.1 Hardware setup of nine level inverter system

7.1 OUTPUT VOLTAGE OF NINE LEVEL INVERTER

The required gate pulses for the MOSFET switch are given by using microcontroller .The experimental output required voltage of nine level inverter output voltage of system which is obtained from the CRO as shown in fig.7.2

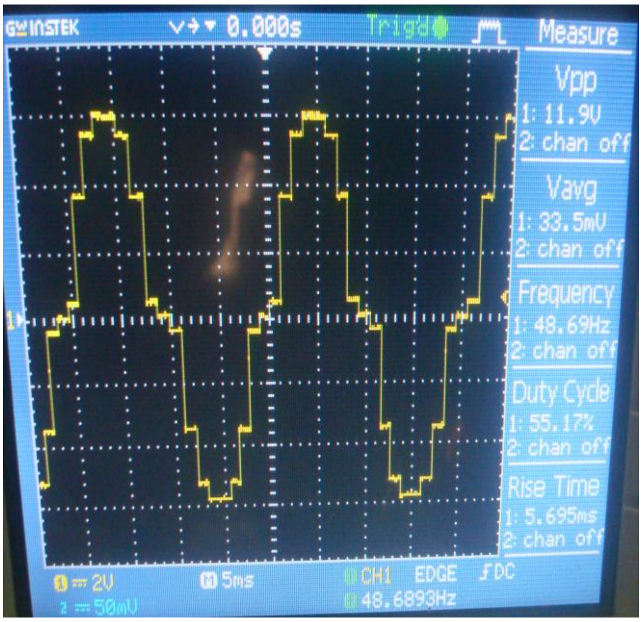

Fig. 7.2 Output voltage of nine level inverter

VIII. CONCLUSTION

This project proposed a solar power generation system which is converts in to direct current generated by solar cell into alternating current which is supplied to the consumers. The proposed solar energy consists of a DC-DC power converter by using nine-level inverter. The nine-level inverter consists of six electronic power switches, which is used to simplify the circuit configuration. This circuit reduces the power losses and improves efficiency. The nine-level inverter is automatically balanced so that the control circuit is simplified. The experimental results of the solar power generating system an output voltage at nine levels inverters and generate a sinusoidal current in phase with the grid voltage, producing a unity power factor.

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Mrs.P.M.KALPANA received her B.E in Electrical and Electronics Engineering and M.E in Embedded System Technologies from Anna University. She worked as an Assistant Professor in various Engineering colleges. Now currently she is working as an assistant professor in R.M.D Engineering College. She has been in the teaching profession for the past 7 years and has handled UG programmes. She has published papers in various international journals and conferences. She organized various technical events, workshops under the sponsorship of college events. She has attended many workshops & FDPs sponsored by AICTE. Her current research interest includes embedded system, electrical machines, electronic, power system, Drives and control.

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