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Solar Power Generation System Based Implementation of Single Phase Seven Level Inverter

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Abstract: -In this paper a new solar power generation system is presented which consists of dc-dc power converter and a new seven level inverter. Two independent voltage sources which multiple relationship is obtain by converting the output voltage of solar cell array by integrating dc-dc boost converter . The capacitor selection circuit and a full bridge converter is connected in cascade to configure the seven level inverter. The two output voltage sources of dc-dc converter is converted into three level dc voltage by the capacitor selection circuit. This three level dc voltage is further converted into seven level ac voltage by the full bridge power converter.

Keywords: Grid-connected, Multilevel inverter, Photovoltaic system, Maximum Power Point Tracking

I. INTRODUCTION

The fossil fuel usage leads to green house emissions. As the fossil fuels are depleted they are too expensive. But, the solar energy which is found in abundance is pollution less becomes the main part in generating power. As the cost of fossil fuels is rising then the cost of solar arrays decreases. The power generation by using solar energy is widely used in residential applications[1] [2].

In the grid connected solar power generation systems a power conversion interface is important. The solar cell array generates a dc power and the inverter circuit converts the ac power and feeds this ac power into the grid. The output voltage of the solar cell array is low, the dc-dc power converter is used to boost the output voltage of the solar cell array[3]-[6].

The inverter circuit is a combination of a active devices and passive devices are reduce a power loss. The power losses due to active devices include both conduction losses and switching losses[7]. The switching loss is proportional to the voltage and current changes for each switching and switching frequency. The process of the filter inductor is used to switching harmonics of an inverter, so the power loss is proportional to the amount of switching harmonics [8]. The multilevel inverters are designed with higher voltage levels to improve the conversion efficiency and to reduce harmonics and electromagnetic interference (EMI) [9][10].

II. CIRCUIT CONFIGURATION

Fig.1 shows the proposed seven level inverter. The proposed solar power generation system is composed of a solar cell array, a dc–dc power converter, and a new seven-level inverter. The solar cell array is connected to the dc–dc power converter, and the dc–dc power converter is a boost converter.

This new seven-level inverter is composed of a capacitor selection circuit and a full-bridge power converter, connected in a cascade. The power electronic switches of capacitor selection circuit determine the discharge of the two capacitors while the two capacitors are being discharged individually or in series. Because of the multiple relationships between the voltages of the dc capacitors, the capacitor selection circuit outputs a three-level dc voltage. The full-bridge power converter further converts this three-level dc voltage into a seven-level ac voltage that is synchronized with the utility voltage.

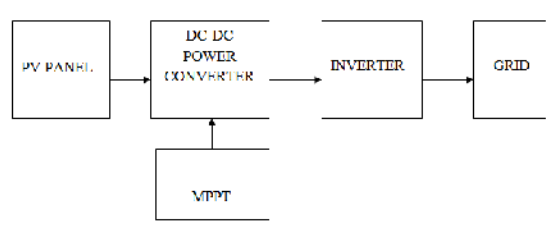

Fig.1. Block diagram representation of seven Level inverter

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II. DC-DC POWER CONVERTER

The boost converter output voltage is greater than input voltage. The boost converter is also called a step-up converter because step-up the voltage without transformer.

Due to single transistor, it has high efficiency. This converter is used in battery powered devices, where the electronic circuit requires a higher operating voltage than the battery can supply.

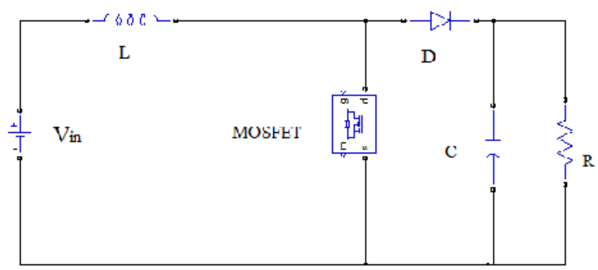

Fig.2. Basic Boost Converter

III. MAXIMUM POWER POINT TRACKING

The environmental condition under which a solar power system operates can be wide, as shown in I-V curves in Fig.3. In terrestrial applications, In morning condition , where the sun just rises reflects the Low Irradiance, Low Temperature (LILT) condition. A High Irradiance, High Temperature (HIHT) condition might represent a condition near high noon in a humid area.

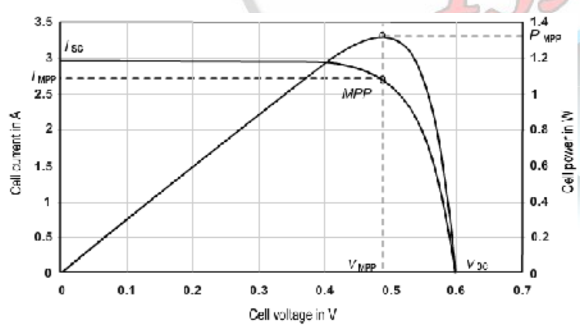

Fig.3. I-V Characteristics of PV cell

The main technical requirements in developing a practical PV system include (a) an optimal control that can extract the maximum output power from the PV arrays under all operating & weather conditions, & (b) a high performance to cost ratio to facilitate commercialization of developed PV technologies. Since the PV array has a highly nonlinear characteristics & its performance changes with operating conditions such as isolation or ambient temperature. This can be designed using an MPPT controller. MPPT is a fully electronic system that varies the electrical operating point of the modules, so that the modules are able to deliver maximum available power.

IV. PERTURB AND OBSERVE METHOD

In this project the P&O algorithm is used. The P&O is one of the most used MPPT method, because it can be easily implemented. The algorithm is looking at the variation of the panel power versus voltage. When the variation of voltage gives dp/dv>0, then the algorithm perturbs the PV voltage in the same direction; that means it moves the operating point towards the MPP. If dp/dv<0 then the algorithm reverses the direction of perturbation. A simple flowchart of the algorithm is presented in Fig..4.

The main advantage of the method is the low implementation complexity having only one multiplication and few sums and comparison besides the MPPT doesnot depend on the PV module characteristics. Incase of operating point variations, the method determines in which direction it must perturb the system.

A P&O MPPT technique is that, at steady state, the operating point oscillates around the MPP giving rise to the waste of some amount of available energy. Several improvements of the P&O algorithm have been proposed in order to reduce the number of oscillations around the MPP in steady state, but they slow down the speed of response of the algorithm to changing atmospheric conditions and lower the algorithm efficiency during cloudy days.

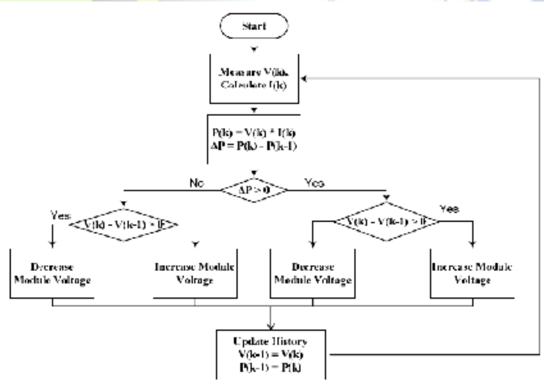

Fig.4. Flowchart of P&O Algorithm

The operating point has moved toward the MPP and, therefore, the operating voltage must be further perturbed in

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the same direction. Otherwise, if the power drawn from the PV array decreases, the operating point has moved away from the MPP and, therefore, the direction of the operating voltage perturbation must be reversed. This analysis allowing the optimal choice of the two main parameters characterizing the P&O algorithm is carried out. The key idea underlying the optimization approach lies in the customization of the P&O MPPT parameters to the dynamic behaviour of the whole system composed by the specific converter and PV array adopted.

V. Seven Level Inverter

The output current of the seven-level inverter is also positive in the positive half cycle of the utility. The operation of the seven-level inverter in the positive half cycle of the utility. The output voltage of the seven-level inverter has the voltage levels are $V_{dc,}$Vdc/3, 2Vdc/3,0, -Vdc, -2Vdc/3, -Vdc/3.

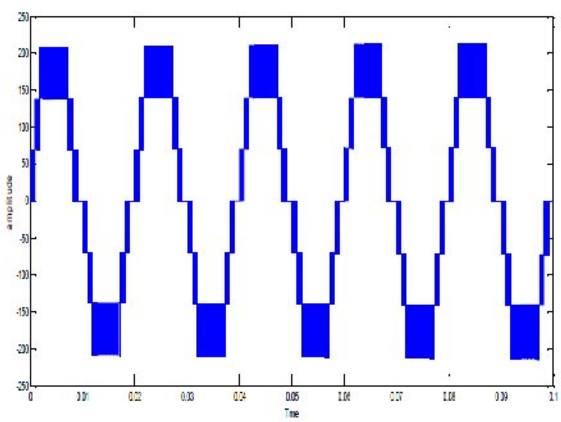

Fig.5. Seven level inverter

VI. Simulation Results

The combination of solar cells are connected in series or parallel. The simulation model of solar panel is shown in Fig.6. The ten solar cells are connected in series to obtain an output voltage of 70V.If the current requirement is high, the cells are connected in parallel.

Fig.6. Output of Solar panel

Table 1 PARAMETERS OF DC-DC POWER CONVERTER

PARAMETER	*VALUES*
Input voltage	*70V*
Inductor	*1Mh*

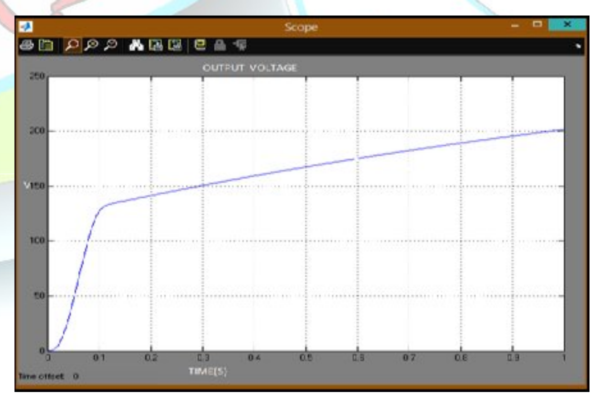

Fig.7. Output of DC-DC Converter

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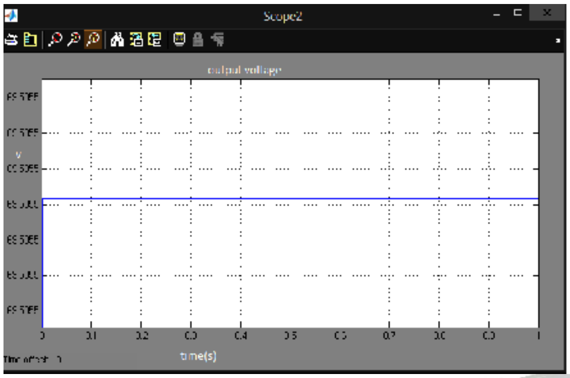

Fig.8. simulation of MPPT controller

The operation of seven level inverter can be divided into the positive half cycle and the negative half cycle of the utility. The power electronic switches and diodes are assumed to be ideal while the voltages of both capacitors C1 and C2 in the capacitor selection circuit are constant.

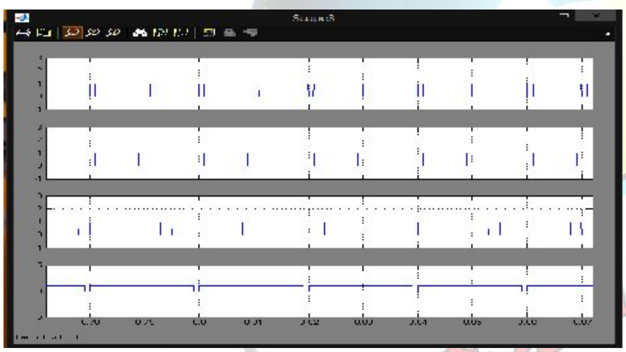

Fig.9. pulses for seven level inverter

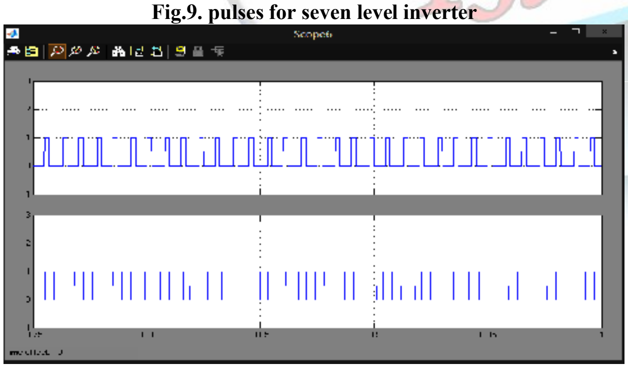

Fig.10. pulses for seven level inverter

VII. CONCLUSION

The design of solar panel and DC-DC Converter is performed in MATLAB. The solar panel has been designed to obtain an output voltage of 70v. A DC-DC Converter has been designed to obtain an output voltage .The MPPT controller has been designed and simulated. The seven level inverter contains six power electronics switches are used. This reduces the switching power loss and simple circuit.

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