CLOSED LOOP CONTROL OF DIODE CLAMPED MULTI LEVEL INVERTER FOR GRID CONNECTED PHOTOVOLTAIC SYSTEM

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Abstract:

This paper propose an cost effective solar power generation arrangement in an resourceful approach. The photovoltaic systems consist of two converter stations between PV array and to the utility. It composed of Nine level inverter controlled by the fuzzy logic controller. The power generated from the solar panel improved by the boost converter that are connected next to the solar panel. For the transfer of DC to AC, the power generated from the solar panel is DC and that are converted to AC by means of single H-bridge inverter which generate Nine level output. The focal aspire is to shrink the number of switches that are used for generating Nine levels of output voltage as well as current. The DC/DC converter receives input from which the three positive output voltages are generated and the H-bridge inverter performs as a polarity reversal that provides both the positive and negative cycle output. For further enhancement in the output waveform, the filter circuit can be integrated in the output terminal of the H-bridge inverter. The simulations are completed by means of MATLAB Simulink tools.

Keywords— DC/DC boost converter, Fuzzy logic controller, Multilevel inverter, Pulse width modulated (PWM), Solar panel.

1. INTRODUCTION

In numerous rural areas uninterrupted electricity is not accessible from grid. Mostly the grid gets power from hydro power station as well as from thermal power station. As the conservative energy sources are diminishing hasty, in the midst of consequent mount in cost, solar and wind energy offers a superior substitute resource along with free from pollution. The renewable energy resources are profitable and they will not cause any detrimental effects on the surroundings. With the latest investigate, results the expenditure of photovoltaic cells are likely to go down in future. Each cell having 0.7V and that are allied in series or parallel and form solar array. A single phase PV based Nine-level inverter is discussed in paper [9]. The PV power generation is a budding modern trend owing to its various advantages resembling inexpensive, ecological responsive power generation. Multilevel inverter possibly will generate almost sinusoidal output voltage waveform along with output current which will compress the harmonic distortion furthermore improve its power quality [12]. When the level increases, harmonic possibly will decrease however the switches necessary for the conduction of converters may increase. Due to the increase in number of switches, the switching stress may arise that leads towards switching losses. Conventional different multilevel inverters like diodeclamped multilevel inverter [3], flying capacitor multilevel inverter [6] and cascaded multilevel inverter [5] the switches required for the

conduction are improved according to the number of levels. In diode-clamped inverter, additional number of diodes is mandatory to generate the number of levels. For flying capacitor inverter, the charges are stored into the capacitor and for that it needs hefty amount of capacitors consequently the cost of switches is amplified. To prevail over these conventional systems, a novel modified multilevel inverter is projected meant for generating Nine level of output [11]. The planned fuzzy logic controlled solar power generation system consisting of dc/dc boost converter, capacitor selection circuit and Nine-level inverter. This method plays a crucial task in reducing the amount of switches designed for generating Nine level of output. It consisting of no more than six power electronic switches moreover only one switch will activate at high frequency at any instant. The solar panel dc outputs are boost up by means of boost converter along with its switches are embarrassed through the maximum power point technique (MPPT) [2]. In favour of supplying power towards the utility, the dc power is rehabilitated to ac by means of single H-bridge inverter combined in the company of the capacitor selection circuit. The positive cycle of output are fashioned by the three pathways: 1) power from boost converter 2) commencing transformer 3) from single Hbridge inverter. The single H-bridge inverter breed negative half cycle. Ultimately, the proposed topology is simulated and results are obtained. II. OBJECTIVE OF THE WORK AND BLOCK DIAGRAM The isolation level and the intensity of sunlight lying on the earth surface fluctuate; thereby input voltage and current vary. The foremost objective of the project is to attain regulated voltage by the side of the utility.Maximum power is trapped using a dc/dc converter to which fuzzy logic control is applied. As a result, the maximum power point is tracked and produces a stable output voltage. This improves the energy conversion efficiency in view of the fact that more power is generated by photovoltaic array.

2.   DC TO DC BOOST CONVERTER

The dc/dc boost converter effectively designed in favour of boosting the solar power. Since, the power generated from the PV array is small moreover it depends on solar insolation. A boost converter is a dc to dc voltage converter with an output dc voltage superior than input dc voltage.The boost converter attached with the solar array which receives insolation varies due to solar irradiance. Irrespective to the irradiance variation, regular output voltage and current are maintained in the proposed power generation system. The transformer is furthermore used to boost up the voltage level which forms the different levels of output voltages. The charges will be stored in the two capacitors through transformer and boost converter.
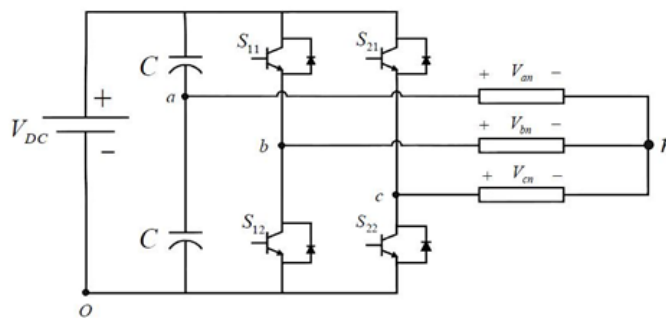

Fig.1.Three phase half bridge inverter

The maximum power is tracked from the PV panel by means of MPPT algorithm [7]. An inverter is installed in the system to convert the DC power generated into AC power for use in appliances. The proposed multilevel inverter shown in figure.1 consists of single H-bridge inverter at which Nine levels of voltages and current are generate. An inverter is essential for grid-connected PV systems. For the negative power flow, this inverter will provide polarity reversal by which the positive and negative cycles are formed. The filter inductor at the load side reduces the harmonic content and maintains the sinusoidal waveform. The PWM signals are given for all the switches present in the boost converter and single H-bridge inverter [8]. Multilevel inverter offers better output waveform and the level of harmonics will be reduced as the number of output level increases. The two capacitors in the capacitor selection circuit storing charges and the two switches are responsible for balancing the charges stored in the capacitors [4]. Balancing the charges stored in the capacitor in difficult in practical system.

3. FUZZY LOGIC CONTROLLER

Fuzzy logic controller is used to reduce the rise time, settling time to almost negligible and also try to remove the time delay and inverted response. It works with uncertain and imprecise knowledge. It provides an approximate but effective means of describing the behaviour of systems that are too complex, ill-defined, or not easily analyzed mathematically. Fuzzy variables are processed using a system called a fuzzy logic controller.
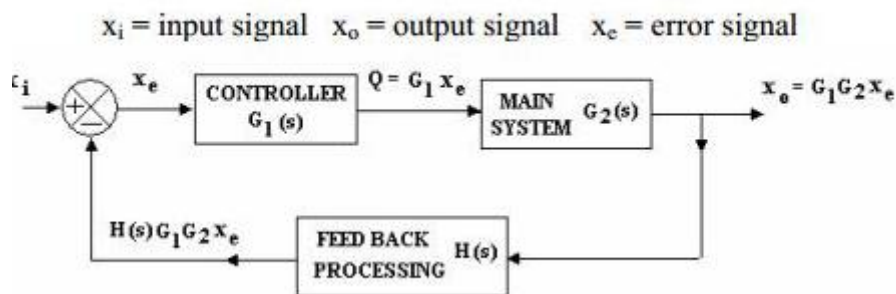

Fig.2.Control system block

It involves fuzzification, fuzzy inference, and defuzzification. The fuzzification process converts a crisp input value to a fuzzy value. The fuzzy inference is responsible for drawing conclusions from the knowledge base. The defuzzification process converts the fuzzy control actions into a crisp control action. Membership function values are assigned to the linguistic variables, using Nine fuzzy subsets: NB (negative big), NS (negative small), ZE (zero), PS (positive small), and PB (positive big). The set of rules designed in fuzzy logic controller are shown in Table 1. Based on the rules framed in the table, the fuzzy logic controller controls the switches present in the dc/dc boost converter and single H-bridge inverter.

4. SIMULATION AND RESULT

Model design and simulation are done in MATLAB SIMULINK, using fuzzy logic toolbox [10]. The Simpower system tool box is essential for the proposed PV power generation system having only six

power electronic switching for generating nine-level of output. As shown in figure.5 the simulation model of entire system along with its subsystem controlled by the fuzzy logic controller. With the lower number of switches the desire output are achieved and system is more compact. The input power may vary based on the PV insolation and according to which the dc/dc converter boost up the voltage along with its transformer. For the switches present in the boost converter and single H-bridge inverter, the PWM
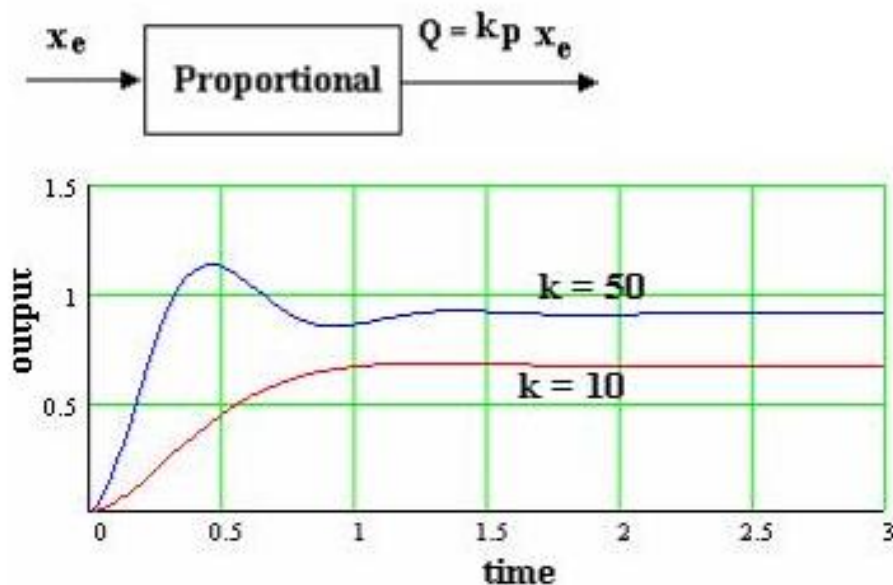

Fig.3.P- controller block diagram

switching pulses are given.The output waveform of proposed circuit is shown in Figure.6. The simulation results show that this system is able to adapt the fuzzy parameters for fast response, good, transient performance, insensitive to variations in external disturbances. The output voltage and current are measured across the single H-bridge inverter with respect to the time.

CONCLUSION

The proposed technique has some features such as it reduces the cost of the overall system, compact size as well as an increased efficiency. With the help of lower number of switches, Nine-level of output voltages are generated and thus it reduces the switching loss and conduction losses. The THD of Nine-level inverter is less compare to the five-level and three-level inverter. The fuzzy logic controller could control the switches present in the boost converter and H-bridge inverter. For the Nine level of output, only six power electronic switches are used and only one switch will operate at high frequency at any time. For further implementation, the inverter level can extend by cascading additional H-bridge inverter. There may be some loss due to the transformer and this can also overcome by providing transformerless connection with its replacement. As the inverter level increases, the filter requirements and harmonic content decreases.

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