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A Fuzzy Logic Controller Based Five Level Inverter for Pv Applications

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ABSTRACT

A fuzzy logic controller based five level inverter for solar application is presented in this paper. This five level inverter consists of DC-DC boost converter, dual buck converter and H bridge inverter. In this proposed system, three level output voltage generated by dual buck converter and other two levels are generated by two level inverter. Perturub and observe maximum power point technique is used for obtaining maximum power from the solar panel. The proposed five level inverter analyses by using with filter and without filers. Finally, obtained results are verified using MATLB/Simulik.

Keywords- *Five Level Inverter, Fuzzy Logic Controller (FLC), Total Harmonic Distortion (THD)*

INTRODUCTION

The renewable energy is most predominant energy in this world particularly solar energy. Solar energy is available in the form either DC voltage or current and should be converted in to alternating quantity by using inverter [1-3]. For converting DC quantity into AC quantity, different kind's inverters are used. But, the conventional inverter is being generating both switching and conduction losses. Hence, multilevel inverters have been used for converting DC voltage in to AC voltage and also it is used to improve the efficiency [4]. There are three types of multilevel inverter such as diode clamped MLI, capacitor clamped MLI and cascaded MLI [5]. There are many different types of Maximum power point techniques have been proposed by researcher [6]. Among the techniques have been applied in this paper for extracting maximum power from the photovoltaic panel because less number of sensor required and easy to implementation [7]. In this paper, fuzzy logic controller has been proposed for controlling of the inverter. The proposed fuzzy logic controlled five level inverter is verified through Mat lab/Simulink.

1. PROPOSED INVERTER SYSTEM

Figure 1a and 1b shows the general block diagram of the proposed fuzzy logic based five level inverter system and inverter respectively. It consists of solar panel, fuzzy logic controller, DC-DC converter, dual-buck converter, H bridge inverter, L type filter and load.

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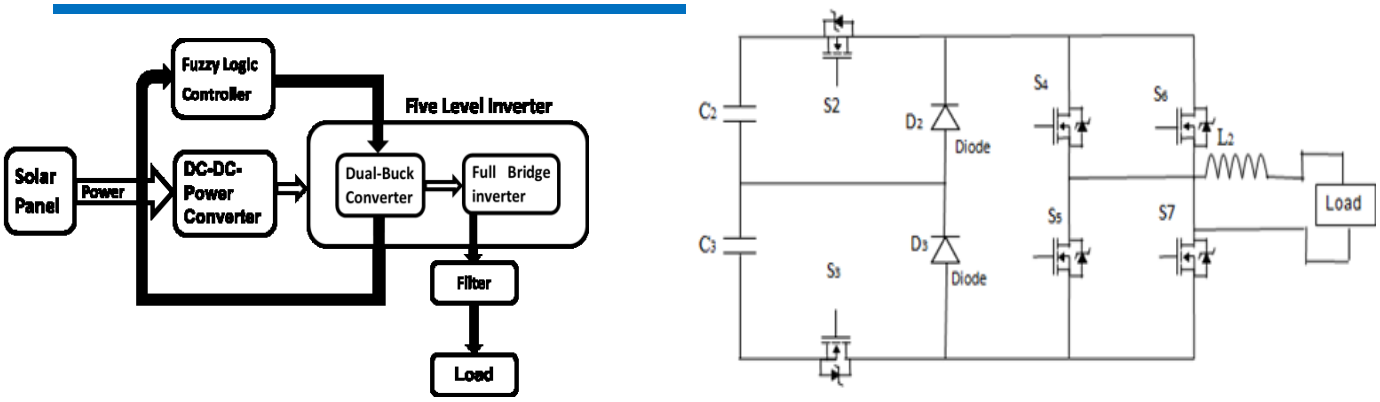

Fig. 1. A) General block diagram of the proposed inverter system b) Circuit diagram

The proposed fuzzy controlled five level inverter is consists solar panel, DC-DC converter and five level inverter. The solar panel is a semi conductor device which converts light energy in to electrical energy. The available power at solar panel is extracting by using Perturb and Observe (P&O) maximum power point algorithms. The extracted power from the solar panel is given to the input of the DC-DC converter. The purpose of the DC-DC converter is to enhance output voltage of the solar panel. Here it is a boost converter, and it performs the functions of maximum power point tracking (MPPT) and boosting the output voltage of the solar cell array. The voltage output from the boost converter is V_{dc}= 88.6V.The output of the DC-DC converter is given to the input of the inverter. Here two capacitor C1 and C2 acting as energy buffers between five level inverter and DC-DC converter. The output of the dual buck converter is given to the inverter and it converts DC in AC voltage with desired voltage and frequency. An inductor is connected at output of the inverter for form filter which is used to filter out harmonics presented at output of the inverter. Fig. 2 shows over all configuration of system. This circuits is referred [8-9].

3.1 Modes of Operation

Mode 1: S2 of the dual buck converter is ON and S3 is OFF. The voltage of the C2 capacitor is discharged through switch S2, S4, filter, Load, S7 and D3. Hence total output voltage is Vdc/2. Mode 2: S2 of the dual buck converter is OFF and S3 is ON. The voltage of the C3 capacitor is discharged through switch D2, S4, filter, Load, S7 and S3. Hence total output voltage is Vdc/2. Mode 3: Both of switches of dual buck converter are OFF (S2 and S3). The flowing path is S7, D3, D2, and S4. Hence output is zero.Mode 4: Both of switches of dual buck converter are ON (S2 and S3). The voltage of the C2 and C3 are discharged through S2 and S4, filter, load, S7 and S3. Hence output is Vdc. Mode 5-8:The output voltage of the five-level inverter for modes 5–8 will be $-V_{dc}/2$, $-V_{dc}/2$, 0 and $-V_{dc}$ respectively.

3.2 Fuzzy Logic Controller

It is based on human decisions. Here the mamdani minimum inference theorem is used for mapping input and the output variables. It is based on set of rules and membership functions. The If-then rules in which antecedent are the approximate representation of state of the system and provides range of potential response. The fuzzy control rule base membership function relates input and output variables.

4.SIMULATION CIRCUITS & RESULTS

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The proposed Fuzzy Logic Controller based five level inverter has been designed for PV applications and their results are verified using MATLAB/ Simulink. The fig. 2 and 3 shows output voltage of solar panel (42V) boost converter output voltage (176V) respectively. Fig. 4 showsinverter five output voltage.

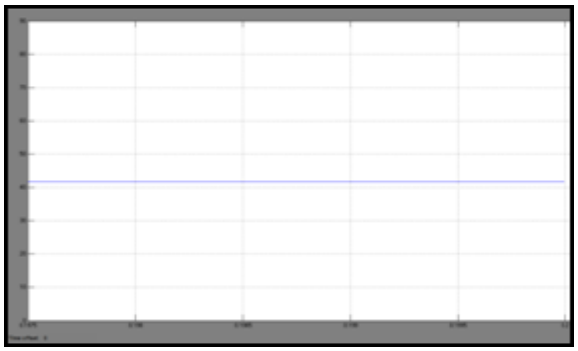


Fig. 2. Output voltage of the solar cell array

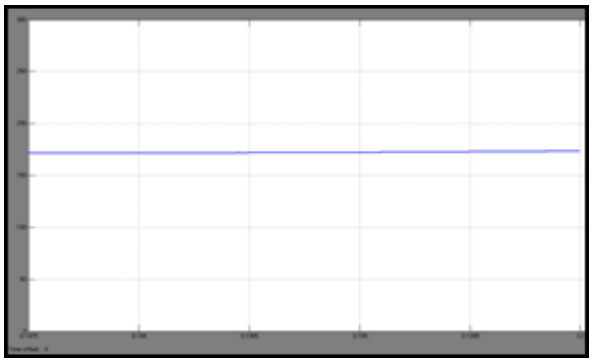


Fig. 3. Output voltage of the boost converter

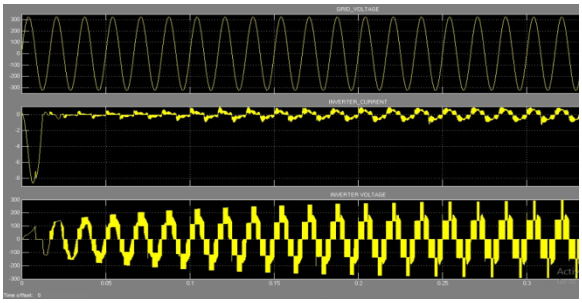


Fig. 4. Output of the five level inverter with FLC controller

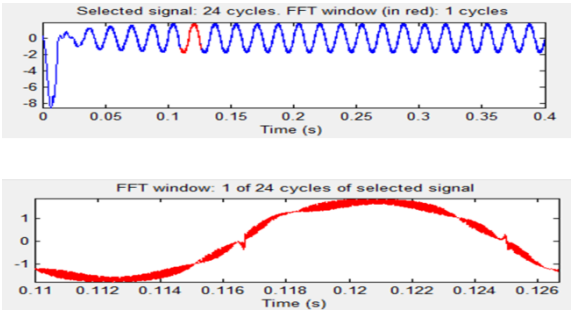


Fig. 5. Waveform for current with Filter

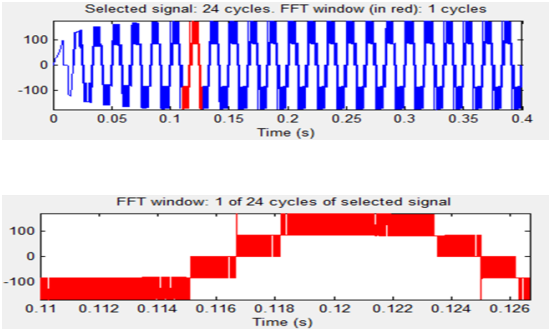
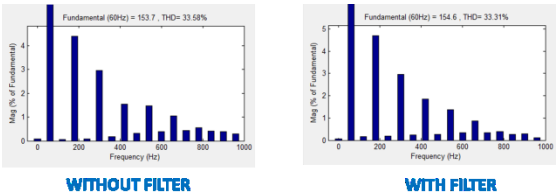


Fig. 6. Waveform for voltage with Filter



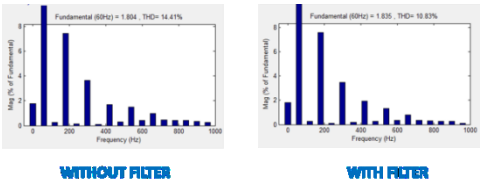


Fig. 7.Voltage THDFig. 8.Current THD

Table 1.Result for Fuzzy Controller

Parameters	Without filter	With filter	Total THD reduction
Voltage THD	33.58%	33.31%	0.27%
Current THD	14.41%	10.83%	3.58%

7. CONCLUSION

The Fuzzy Logic Controller (FLC) based five level inverter system has been designed for PV applications. The proposed system has been controlled using fuzzy logic controller. PV panels were acted as input DC source. The proposed system offer good performance compared to PL controller interms of THD. A THD performance of the system has been analyzed by using with filter and without filters. The results of the proposed are obtained by using MAT LAB/Simulink.

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