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A Comparative Study of Maximum Power Point Tracking (MPPT) Of a Solar Powered Ups Using Dc-Dc Boost Converter

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Abstract

This paper deals with the design and experimental implementation of a MPPT system of a solar powered UPS using DC-DC boost converter technology. The DC-DC boost converter is able draw maximum power from the PV panel for various solar radiation level and temperature. The output voltage of the PV panel is given to the DC-DC boost converter in order to step up the PV panel output. The solar power is a pure and precious resource and no more impure outlets other disadvantages as like high initial cost. But the economical status may be improved in future but we may not have resource to generate power sometimes. So cost criteria can be meeting out in future to generate power from solar energy. The proposed PV system is composed of novel single axis tracking system, DC-DC boost converter and PWM voltage source inverter. Here DC-DC boost converter technology output is compared with the conventional method output and this method prescribes boost converter technology only gives more output voltage than the conventional method.

Key Words: SPV panel UPS, Tracking system, boost converter, PWM inverter.

1. INTRODUCTION

The use of electrical energy plays a very important role in our daily life. On the other hand, the conventional grid supply in a grid connected area has become standstill due to the rapid depletion of raw material resources and its future appears to be break due to various technical, political and economic reasons. Alternative renewable energy sources like solar etc., with energy storage device i.e., battery are thus being thought of as a standalone power source or in a purely solar powered converter which of course may turn out to be very expensive. Besides due to varying solar insulation, the battery, may not get enough time to charge from a single PV source to its full capacity and hence the solar power system need to be integrated with supplementary backup sources. The conventional backup power sources like diesel generator, wind etc., may add further cost to the systems. Therefore, the use of grid resources as a back up source is proposed.

This research work suggests the use of solar powered UPS to meet the needs of sophisticated applications especially in areas where the grid supply is frequently switched off. C.Cavallaro et al have discussed the use of photovoltaic system for Smart photovoltaic UPS system suitable for domestic applications (1).The application of utility interactive photovoltaic power generation system for UPS by Sokutaro Nonaka et al have brought out the application of photovoltaic system for UPS using a novel single phase PWM voltage source inverter(2).A solar photovoltaic in line UPS system controlled using space vector modulation technique has powered a single –phase-line interactive inverter operated as an UPS (3).Multilevel inverter topologies for stand alone photovoltaic system by Sergio Deher et al(4) have discussed the compilation of the most common topologies of multilevel converters and found to implement suitable inverters for stand alone applications in the ranges. A single phase grid connected inverters for photovoltaic modules by S.B.Kytar et al has availed the use of a high frequency transformer embedded in D C-DC or D C- A C converter to avoid D C current injection problem, but it has been found to carry disadvantages like size, weight and cost.(5).

This paper proposes the performance analysis of conventional photovoltaic tracking method with the applications of PV system by using DC-DC boost converter. After the comparison of this approach the effective output is used as UPS system for home appliances.

2. PV SYSTEM

PV system and its related technology in recent appears to steal the light for domestic application as well as in large central power stations. PV systems are advantageous because of their abundant availability, pollution free feature and the fact that they are distributed through the earth. The only drawback is that the initial installation cost may be considerably high. So this research work proposes the “Investigations on the performance of intelligent tracking

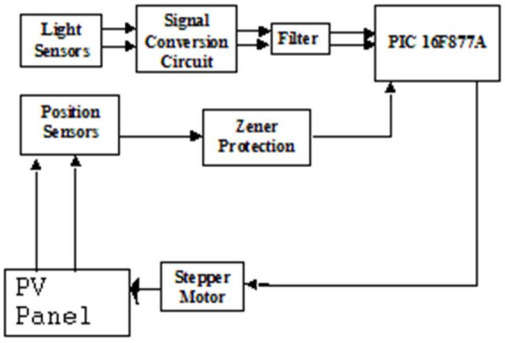

Figure1.PV Panel Block Diagram

systems of a solar powered UPS" This tracking technique is usually associated with a DC/DC converter, where the utility power sources should provide the peak power to the load. The energy provided by PV arrays can alleviate the burden of utility power sources. This work presents a methodology to integrate a PV power source with energy storage battery backup device and generate power through an innovative solar power converter.

3. CONVENTIONAL TRACKING METHOD

The figure 1 shows the block diagram of the proposed conventional solar power generation system. In this conventional method tracking of the sun's light is done in order to generate power very effectively. For that purpose 5 LDRs are used for sensing the light from the sun. So that sun's path can be divided into six columns of 180^{O} (East-West). The LDR outputs have been compared and the sun's angle is traced. Hence the solar panel is moved towards the sun's angle with the help of microcontroller by using stepper motor. In this operation the signal from the light sensor is given to the signal conversion circuit and then it is filtered before passing in to the microcontroller.

Once the solar panel is completely moved to the west it will be automatically turns into East direction for the next day using position sensors. In this operation the signal from the position sensor is given to the zener circuit in order to protect the PIC IC from the over voltage before passing in to the microcontroller. Through this method of the solar tracking system, panel generates voltage up to the maximum value of 9.3 volts. In this paper both the position sensor and solar panel is kept in the mechanical model. In order to rotate the solar panel the stepper motor has been used. The generated power has been stored in the battery separately and it will be charged fully after 6 hours. The charged battery can be utilized during the absence of sunlight.

4. MEASUREMENT RESULTS

The output waveforms are shown in Fig No:2 in various solar radiations.

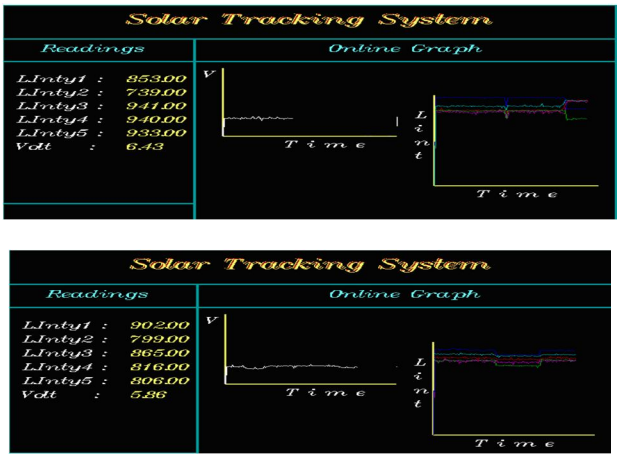

Figure. 2 Conventional method output

From the Graph of fig no:2, Even though the LDRs are used to track the maximum sun's energy to generate the maximum output voltage there was a variations in the output voltage due to cloudy sky or temperature variations in the surroundings.

Since the LDRs are used to extract the maximum output from PV panel, it doesn't give constant maximum output power. So the DC-DC boost converter is used here to step up the DC output getting from PV panel by changing the duty cycle. Then the constant maximized output voltage is stored in the battery for the further usage. In the proposed system, the output is inverted again for ac loads because of the effectiveness than conventional method.

5. PROPOSED APPROACH

A. Block Diagram

The whole system of the proposed scheme is shown in fig no:3. Since the power generated by an array of PV panels is direct-current, it may be transformed, either into a power with constant voltage for dc applications or into ac power. In both cases it is important to draw as much energy as possible from the PV panel.

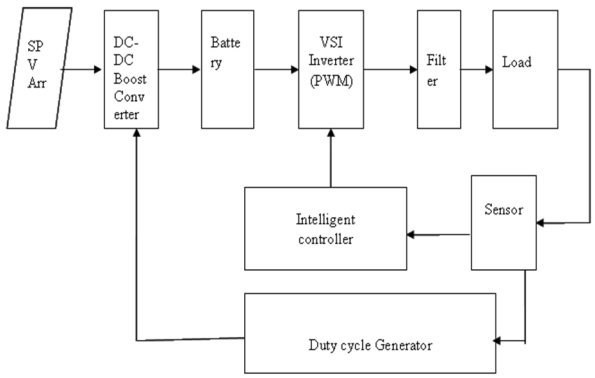

Figure.3 Block diagram

The output power of PV generators varies extensively with the weather conditions such as solar insulation, temperature and cloudy skies. To obtain the maximum power from such an array under any weather condition it is necessary to connect the PV array to a boost converter that can adapt itself to the changing V-I characteristic of the PV generator.

B. DC-DC Boost Converter

DC-DC Boost converter simulink circuit using Matlab software is shown in fig.no.4. It is designed in order to maximize the PV panel output voltage by changing the duty cycle of the converter.

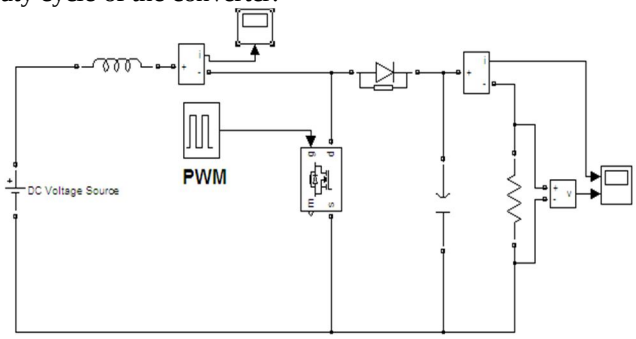

Figure.4 DC-DC Boost Converters

The duty cycle of the converter is changed by using pulse width modulation techniques. Here the output of the converter becomes twice that of PV panel output. The output of converter is shown in fig no:5

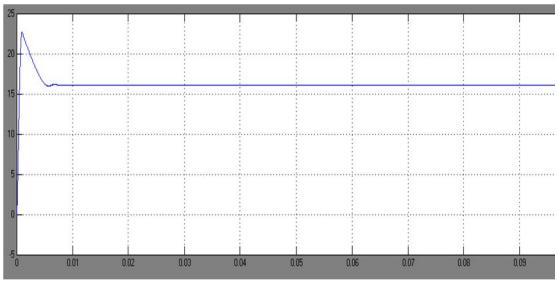

Figure. 5 Output voltage of Boost converter.

C. PWM Inverter

The next main part of this system is Inverter**. T**he battery is usually charged at the Maximum Power Point. The goal of the system illustrated here is to supply three as well as single phase loads of any art with constant amplitude sinusoidal voltage and constant frequency.

The inverter provides three primary functions in the UPS. Among all power converters, the pulse-width modulated **(**PWM) inverter appears to be used in most widespread applications in industry, such as power supply, phase-controlled rectifier, and adjustable speed ac servo drives. Besides, the closed- loop controlled PWM inverter with LC filters has a special application in uninterruptible power supply (UPS). The basic function of an UPS is to convert the dc voltage of batteries to sinusoidal ac voltage with specified frequency and amplitude in the case of utility power failure.

Since the PWM inverter plays an vital role in converting the dc voltage source to an ac voltage source, the quality of the output waveform of an UPS is highly dependent on the performance of the PWM inverter. To reduce output harmonics, output filters are necessary. Fuzzy logic control is proposed to regulate the voltage and frequency besides aiding the PWM generator to produce pulses for the power switches in the inverter. The variables of the fuzzy logic controller are voltage and frequency variation sensed by using sensors. Zero crossing detectors also used to compute the corresponding delay required to trigger the power switches in the PWM inverter.

6. RESULT AND DISCUSSION

In this paper the output of conventional method used here and proposed DC-DC Boost converter output is compared and tabulated at various solar radiation levels. The comparative output result is shown in Table no.1.

Output Volt. At various solar radiation / Methods	I	II	III	IV
Conventional method(in volts)	8.5	6.5	5.6	9
DC-DC Boost converter(in volts)	18	18	18	18

Table 1. Comparative Output voltages

From the above table it is clear that the out from the conventional method various according to the sun's direction and radiation levels and also it makes costlier since it needs more components. But in the DC-DC boost converter technology power semiconductor devices only used so that the cost is reduced. Moreover this method produces output which is almost twice the input getting from PV panel. Here the output of the boost converter is always maintained constant by controlling the duty cycle of the converter circuit.

7. CONCLUSION

In this paper solar powered UPS is designed using DC-DC boost converter and PWM inverter to maximize standalone solar power generation and it is compared with the conventional method. Boost converting technology is having superior performance than the conventional MPP tracking methods. This work will motivate consumers to use solar powered UPS especially consumers in remote areas and improve the efficiency effectively.

REFERENCES

1. Cavallaro, C.; Musumeci, S.; Santonocito, C.; Pappalardo, M. "**Smart photovoltaic UPS system for domestic appliances"**Clean Electrical Power, 2009 International Conference on Volume,Issue,9-1June2009Page(s):699-704
2. Sakutaro Nonaka and Katsuhiko Harada,"Application of utility interactive photovoltaic power generation system for UPS"
3. Dehbonei,H.;Nayar,C.;Borle,L.;Malengret,M.,"**A solar photovoltaic in-line UPS system using space vector modulation technique"**Power Engineering Society SummerMeeting, 2001.IEEEVolume1, Issue,2001Page(s):632-637vol.1
4. Sergio Daher, Jurgen Schmid,and Fernandol.M.Antunes,"Multilevelinverter
5. Topologies for standalone PV systems", IEEE transactions,Vol.55,No.7,july2008.
6. Sachin jain and Vivek Agarval," A single stage grid connected inverter topology for solar PV systems with maximum power point tracking", IEEE transactions on power electronics, Vol.22,No.5,Sep2007
7. B. M. T. Ho and H. S.-H. Chung, "An integrated inverter with maximum power tracking for grid-connected pv systems," *IEEE Trans.Power Electron.*, vol. 20, no. 4, pp. 953–962, Jul. 2005.
8. F. S. Kang, S. Cho, S. J. Park, C. U. Kim, and T. Ise, "A new control scheme of a cascaded transformer type multilevel PWM inverter for a residential photovoltaic power conditioning system," *Solar Energy*, vol. 78, no. 6, pp. 727–738, 2005.
9. B. Sahan, A.N. Vergara, N. Henze, A.Engler, P. Zacharias, "A Single-Stage PV Module Integrated Converter Based on a Low-Power Current-Source Inverter", IEEE Transactions on Industrial Electronics, Vol. 55, No. 7, July 2008.