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Solar PV Based Interleaved Converter

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Abstract: ***In this modernized world change is inevitable. The main objective of the project is to design a solar powered water pumps are the perfect alternative for rural regions as these have a low maintenance cost and ensure a long product life. This project describes the development of photovoltaic applications with highly reliable and efficient converter and inverter equipped with advanced control strategies. We have designed a interleaved boost converter in place of a ordinary converter that feed the energy to the load. Reason behind the usage of interleaved converter is to improve efficiency, reduce ripple, and shrink capacitor and inductor size in boost converters, the multiphase approach. The converter module is energized by solar PV. The interleaved boost converter characteristics is controlled by using Maximum Power Point Tracking (MPPT) technique. This project also includes ATmega8 microcontroller unit for the contol of traction of maximum power from solar panel in a programmed manner. The system proposed can eliminate losses incurred by AC as we make use of DC pump. Thus it will improve the overall efficiency of the pump system and thereby make the green energy used in a better way.***
Keywords: Solar water pumps, Interleaved converter, MPPT, ATMega8

I. INTRODUCTION

Now a days, with the cost of diesel and electricity rising constantly. Conventional electrical power generation based on coal-fired power plants introduces carbon emissions which cause air pollution to be released into the Earth's atmosphere. Renewable energy is employed as an alternative mode of electrical power generation to solve this problem. Photovoltaic solar power is getting more and more popular now-a-days due to its inexhaustible nature. Solar powered water pumps are the perfect alternative for rural regions as these have a low maintenance cost and ensure a long product life. Our solar powered water pumps are a low cost solution to prevent water scarcity for agricultural lands . We took a first initiative step and developed a solar based pump system which is the project Solar PV based Interleaved Converter. Interleaved boost designs become a powerful tool to keep input currents manageable and increase efficiency, maintaining good power density. The aim of this project is the design of interleaved converter fed by solar photovoltaic array for DC pump system. Here we use interleaved boost converter for this process, which will boost the output power. We designed this project for the common household usage, where 50W panel is used to power up dc sources. The major objective is to bring out a product to provide a continuous and ripple free current to load fed by power from the photovoltaic array.

II. LITERATURE SURVEY

This project deals with the solar photovoltaic based interleaved converter, after studied through a quite lot of research papers to get basic ideas, this project is implemented . Among them, the paper entitled "Design of a Charge Controller based on Sepic and Buck Topology using Modified Incremental Conductance MPPT" published by Syed R Hussain,Taohid Latif . This paper projects a fast, efficient and cost effective charge controller for Photovoltaic (PV) System is presented. To harness maximum power from the PV panel, the charge controller is equipped with Maximum Power Point Tracking (MPPT) feature**.** The paper entitled "DC to DC Converter in Maximum Power Point Tracker" published by V.C. Kotak, Preti Tyagi-IEEE Members. DC to DC converters are widely used in photovoltaic generating systems as an interface between the photovoltaic panel and the load, allowing the follow-up of the maximum power point . To extract the maximum power, you must adjust the load to match the current and voltage of the solar panel. The converter must be designed to be connected directly to the photovoltaic panel and perform operation to search the maximum power point.

A. Components Required

The components used to develop this model is given below:

1) Solar Panel
2) Charge Controlling Unit
3) Interleaved converter circuit
4) Stepdown transformer
5) Voltage Regulator circuit

6) ATMega8 Microcontroller
7) DC Pump
8) Connecting Wires And Cable

III.BLOCK DIAGRAM

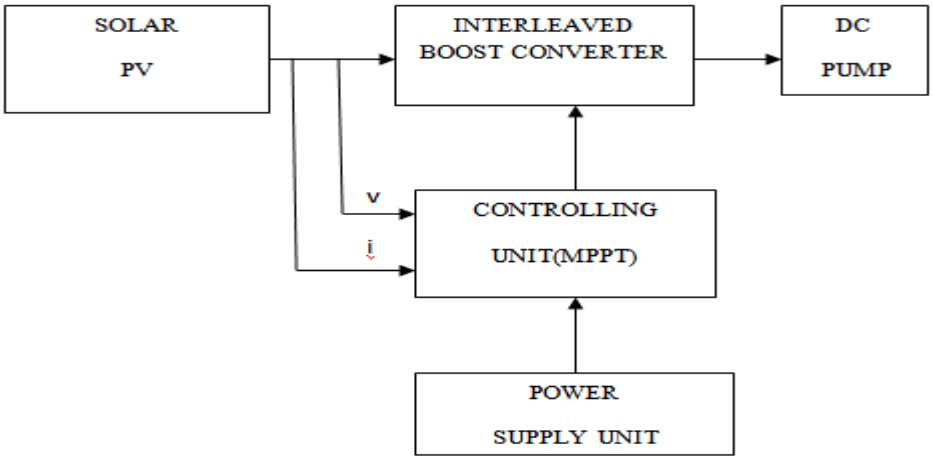

Figure 1 Block Diagram of Solar PV Based Interleaved Converter

IV. WORKING

Solar PV Based Interleaved Converter has an important role of interleaving. Interleaving technique is premeditated depending on the distribution of input current between parallel converters which in turn increase the risk of maintenance, dissipation of heat, oscillation between consistency and fault tolerance. In interleaved converters, the input current and output voltage waveforms comprises the lower ripple amplitude and lower harmonic contents. A conventional boost converter cannot provide high voltage gains because of the narrow duty cycle. Boost converters with higher voltage gains can be realized with an extreme duty cycle design and application. Such high voltage gains, however are hard to achieve for many reasons, like the voltage stress on the power switches, large current ripples of inductance. Interleaved boost converter is used in high power application. The important role of designing boost converter is to handle high current and voltage at input and output. 2 Phase Interleaved Boost Converter. The input current and output voltage ripple of interleaved boost dc-dc converter can be minimized by virtue of interleaving operation. The controlling unit is ATMega 8 that will be programmed for Maximum Power Point Tracking from solar photo voltaic array.

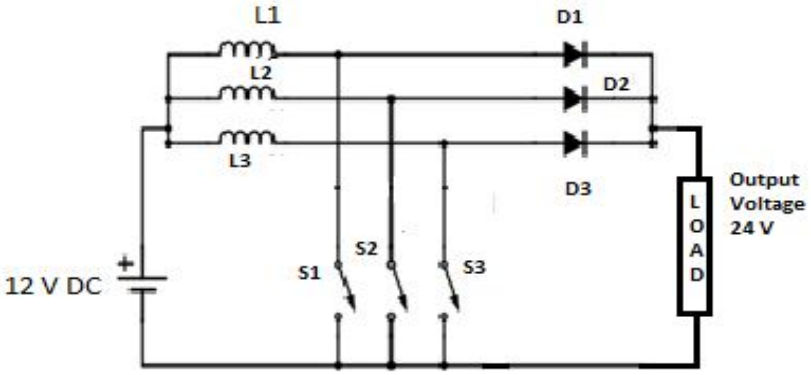

Figure 2 Interleaved Boost Converter

By using the individual soft-switching circuit, cost and circuit complexity gets increased. Number of soft-switching methods is designed for the interleaved boost converters. In this converters, the turn on and/or off process are carried out under ZVS and/or ZCS in short interval of time .The design configuration is inherently simple and compact. The converter is suitable for the high-power applications

V. SIMULATION MODEL OF INTERLEAVED CONVERTER

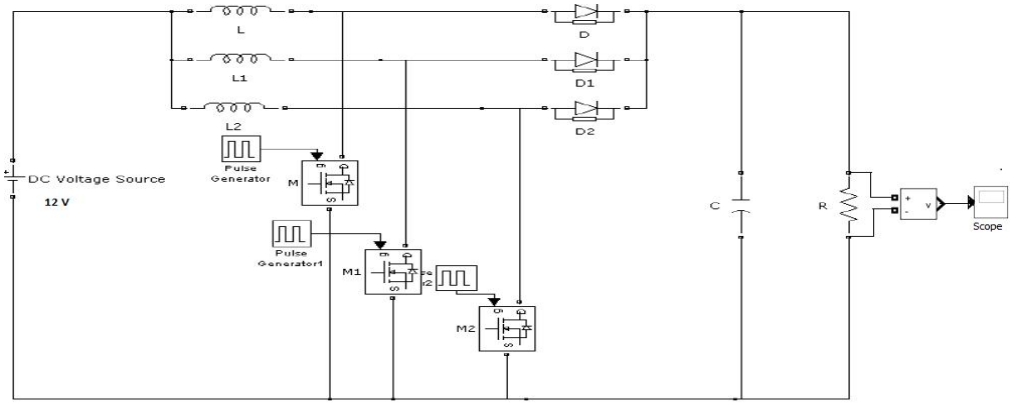

Figure 3 Simulation of interleaved converter using MATLAB

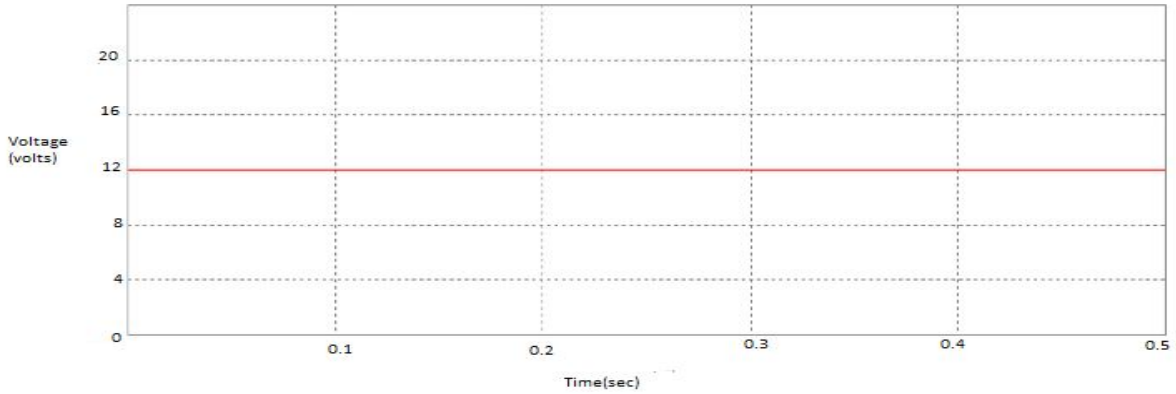

Figure 4 Input Waveform of Interleaved Boost Cconverter(12 V)

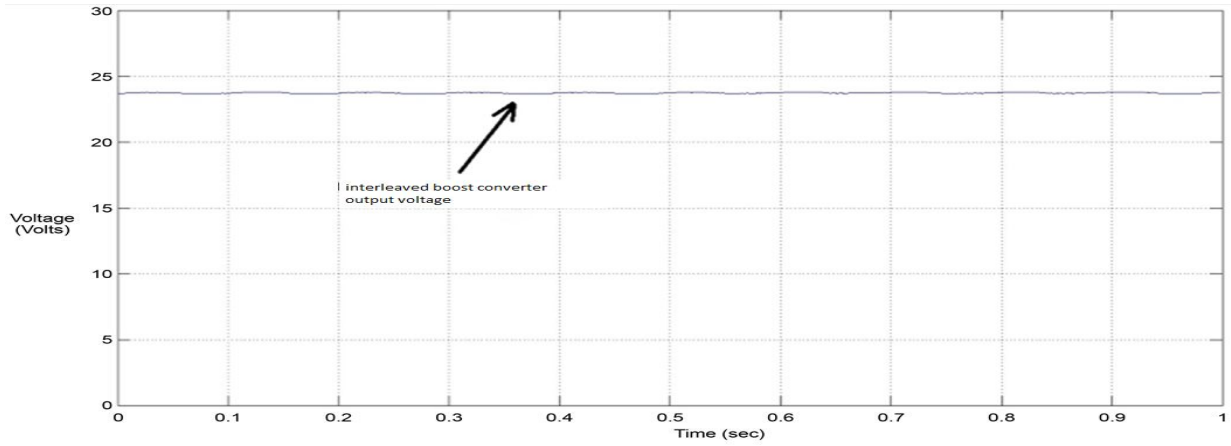

Figure 4 Simulation Output Voltage Waveform of interleaved boost converter

VI. HARDWARE SETUP

The hardware setup of the Solar PV Based Interleaved Converter is shown in the Figure 5.The solar photovoltaic array output is connected to step down transformer circuit .The voltage regulator circuit is used to provide 5v supply to microcontroller ATMega8 .The microcontroller has the program of providing switching pattern to interleaved converter switches. The converter circuit has three inductor, diodes, mosfet and capacitor to boost the voltage from 12v to 24v DC. This project is executed by using DC pump that will pump water from tank.

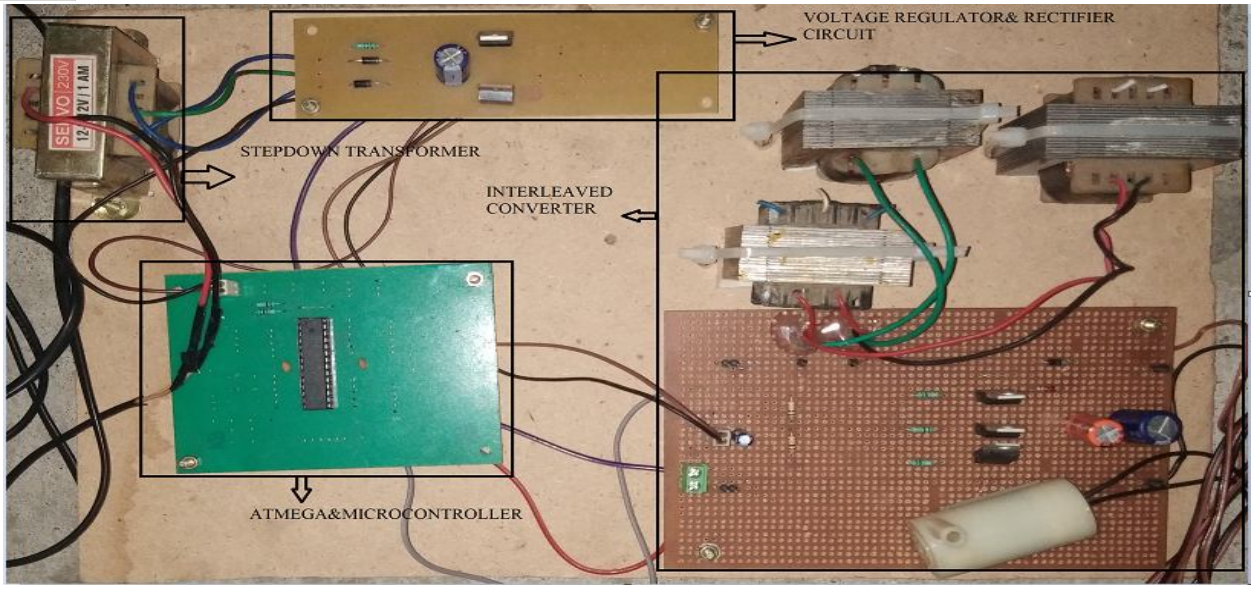

Figure 5 Solar PV Based Interleaved Converter

VII. CONCLUSION

Thus this project has successfully implemented the solar cell and to use sunlight efficiently. Interleaved converters are used for the boost operation of electrical quantity taken from solar pv. But, the fact is that 100% energy cannot be extracted from the solar cell by the conventional DC-DC converters. Though, many technique have been invented and implemented still, there is a lag and restrictions in the research of boost converters. While commencement of interleaving technique in the converters being an evolving technique, it can be a solution for the before mentioned problem.

VIII. FUTURE SCOPE

The future scope of solar pv based interleaved converter is to make use of the closed loop system is controlled using Fuzzy Logic Control. The closed loop system may be controlled using ANN. The hardware is implemented using PIC16F84. The hardware may also be implemented by using DSP Processor.

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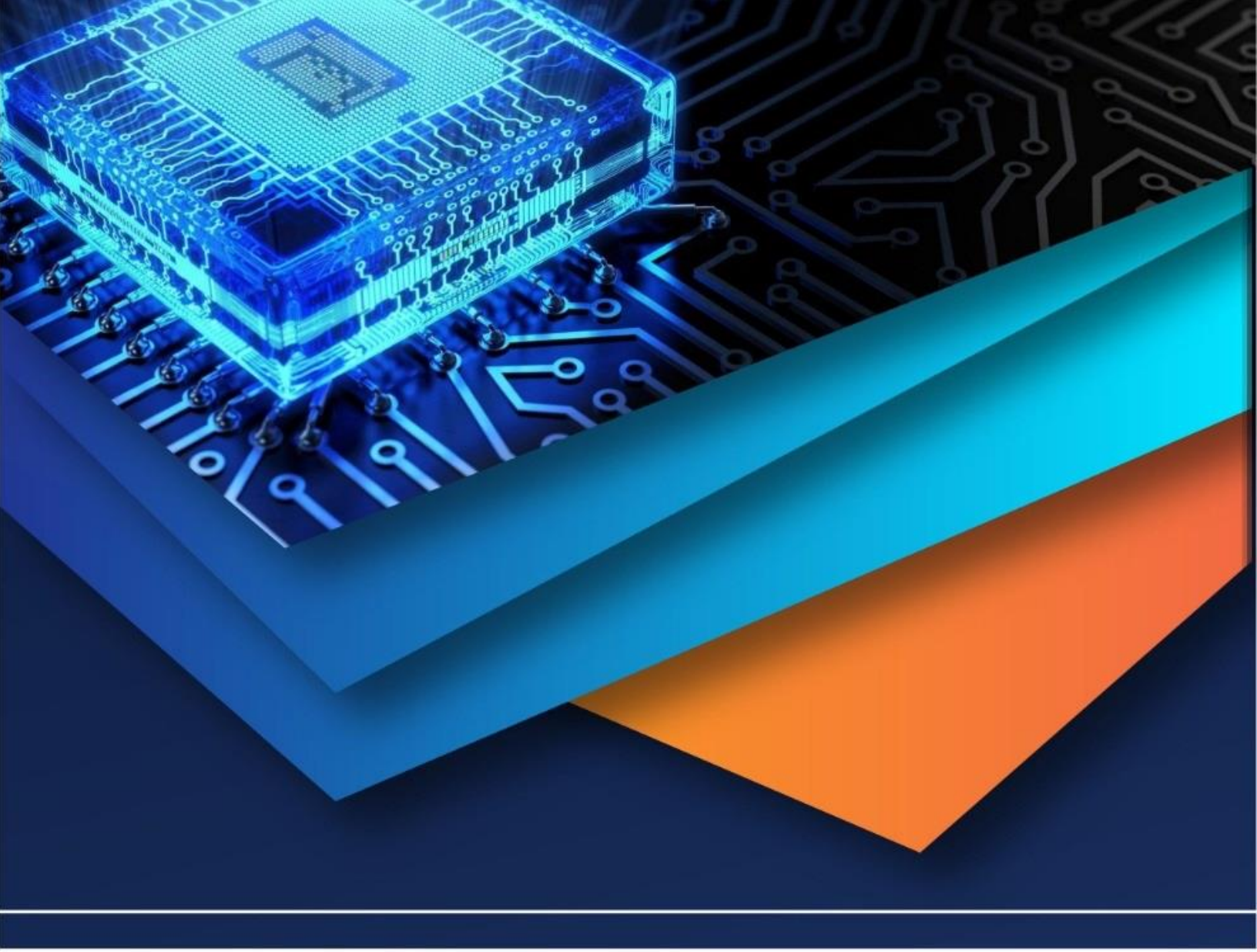

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