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Advanced SEPIC Converter with Fuzzy Logic Controller Based MPPT for Standalone System

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ABSTRACT: In this new era, the recent technological invasions have propelled the development of the entire world to its new heights. These development have to be transformed the world into its new dimensions through technology aspect & impact. This is the main reason for the increase in the power demand. The rate of the world development in geometric ratio catalysis the need of extracting power from renewable energy resources and another reason is that the availability of conventional energy resources is only up to 60-70 year. This causes a higher demand to electric power management system. Therefore, it has a great theoretical significance to study the Advanced SEPIC converter with fuzzy logic controller based MPPT for standalone systems. The design has to be simulated and verified using Mat lab R2010a

KEYWORDS:MPPT (Maximum Power Point Tracking), SEPIC (Single Ended Primary Inductor Converter).

I. INTRODUCTION

Out of the renewable energy resources like Wind, Geothermal, Solar, Ocean Biomass and Chemical resources, the solar resources have its advancement due to its reliability and simplicity etc. Due to the frequent variations in the availability of these resources, the hybrid concept for power generation gains importance.Solar is an inexhaustible renewable energy source and they are widely available. This has the good application prospect in terms of the development. The Solar hybrid power system can increase reliability of power supply and reduce the system cost according to load characteristics of residential use and local environment condition. The production of pollution free electrical energy can be done and the advantage may extend up to the benefits of economics and developments.

II. PROPOSED TOPOLOGY

The goal of this project is to present an advanced sepic converter with fuzzy logic controller based maximum power point tracking in the standalone systems. The Renewable energy source chosen for this project is a solar energy. Various studies was undertaken to determine the capabilities of the PV Module to transfer efficiently the solar energy to the load with the help of bidirectional double boost converter with high conversion ratio. The development of renewable energy has been an increasingly critical topic with the growing problem of global warming and other environmental issues. With a greater research, alternative renewable sources like wind, water, geothermal and solar

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energy have become increasingly important for electric power generation.Although the photovoltaic cells are certainly nothing new, their use has become more common, practical, and useful for people worldwide.The most important aspect of a solar cell is that it generates solar energy directly to electrical energy through the solar photovoltaic modules, this is to be made up of silicon cells. Although each cell outputs a relatively low voltage (approximately 0.7V under the open circuit conditions), if many are connected in a series, a solar photovoltaic module is to be formed. Then although the price of such cells is decreasing, when making the use of a solar cell module still requires substantial financial investment. Thus, to make a PV module useful, so it is necessary to extract as much energy as possible from such a system. the PV modules is used efficiently only when it operates at a operating point. Unfortunately, the performance of the given solar cells depends on the several variables.

At any moment the operating point of a PV module depends on varying the insulation level, sun direction, irradiances and the temperature, as well as a load of the systems. The amount of the power that can be extracted from a PV array also depends on the operating voltage of that array.As we observe, a PV's Maximum Power Point (MPP) will be specified by its voltage-current (V-I) and voltage-power (V-P) characteristic curves.Solar cells have relatively low efficiency rating thus, operating at the MPP is desired because it is at this point that the array will operate at the highest efficiency. With the constantly changing atmospheric conditions and the load variables, so it is very difficult to utilize all of the solar energy available without a controlled system for best performances. It becomes necessary to force the system to operate at its optimum power point.The solution for such a problem is a Maximum Power Point Tracking system (MPPT). A MPPT is normally operated with the use of a Bidirectional Buck-Boost Converter. The converter is responsible for transferring maximum power from the solar PV module to the load. The simplest way of implementing an MPPT is to operate a PV array under constant voltage. This will keep operation constant at or around the Maximum Power Point.There have been many of different solutions presented for methods of Maximum Power Point tracking.Our goal is to develop such a system with the purpose of obtaining as much energy from a solar cell as possible. Our secondary goal will be to create such a system that operates with the optimum efficiency as well. Implementing such a design will be useful in the future because solar cell use is limited greatly by efficiency limitations and cost factors. If manufacturers took advantage of MPPT systems, it is without a doubt that solar cells will become more commonly used.

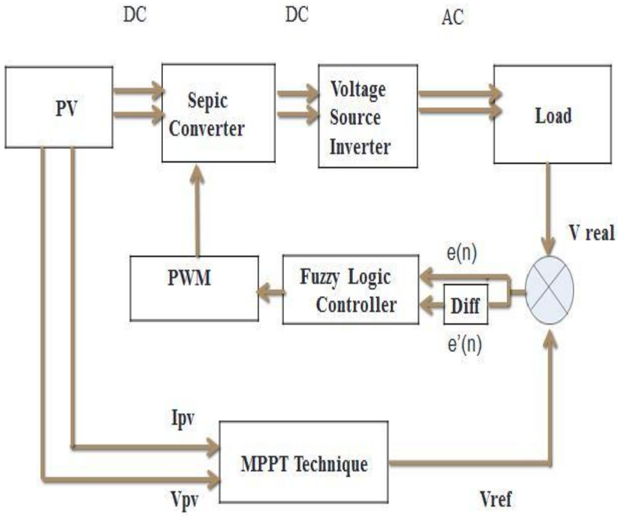

Figure 1- Proposed Block Diagram

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The Figure-1 Describes the proposed block diagram

PV Panel

The Mono crystalline Photovoltaic panels are used. 40 cells are connected in series to form a single module. the Voltage of single cell is 0.6V so the voltage of a single module is 24V. In this proposed method 3 modules are used.

SEPIC Converter

The buck boost feature of the SEPIC widens the applicable PV voltage and thus increases the adopted to the Photovoltaic module the flexibility. Among all the available converters, SEPIC has the merits of non-inverting polarity, easy to drive the switch, and low input current pulsating for high precise MPPT that makes its integral characteristics suitable for the low power PV charger system.SEPIC converter can raise the output voltage to the suitable range, the supply an isolation route to isolate the input and the output terminals after terminating the charging. But this circuit has two disadvantages; one is low efficiency and the other needs two inductors. Here the efficiency is not the major factor when charger is designed and use of coupling inductor solves the other disadvantage. Hence the SEPIC is a good choice for constant current converter design.

Fuzzy Logic Controller

Fuzzy logic (FL) is defined as multi-valued logic which deals with problems that have fuzziness or vagueness. FL is a problem-solving control system methodology that lends itself to implementation in systems the range from a simple, small, embedded micro controller to the large, networked, multi-channel PC or workstation-based data acquisition and the control systems. This is to be implementing in hardware, software, or a combination of the both. Fuzzy logic provides a simple way to arrive at a definite conclusion based upon a vague, ambiguous, imprecise, noisy, or missing the input information. Fuzzy logic is the approach to control problems mimics how a person would make a decisions, only much faster.The control algorithm of the process that is based on Fuzzy Logic Controller (FLC) or Fuzzy inference systems (FIS) is defined as a fuzzy control.

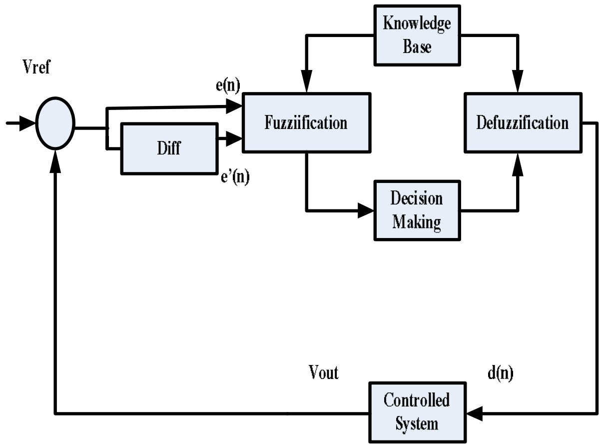

Figure 2- Structure of the proposed FLC

The Figure-2 Describes the proposed structure of FLC

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The basic concept behind FLC is to utilize the expert knowledge and experience of a human operator for designing a controller an application process. Whose input-output relationship is given by a collection of fuzzy control rules using linguistic variables instead of a complicated dynamic model.

III. SIMULATION RESULTS

OUTPUT OF PV PANEL

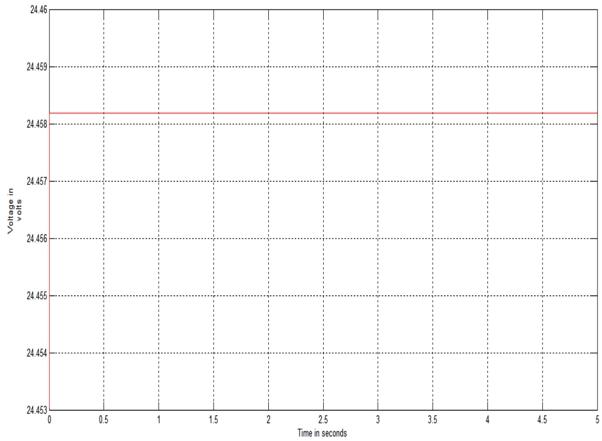

Figure 3- PV panel output voltage

Figure: 3 Describes the output voltage of a PV panel obtained from a solar panel is around 24V DC which is given to the sepic converter for conversion process.

OUTPUT OF SEPIC CONVERTER

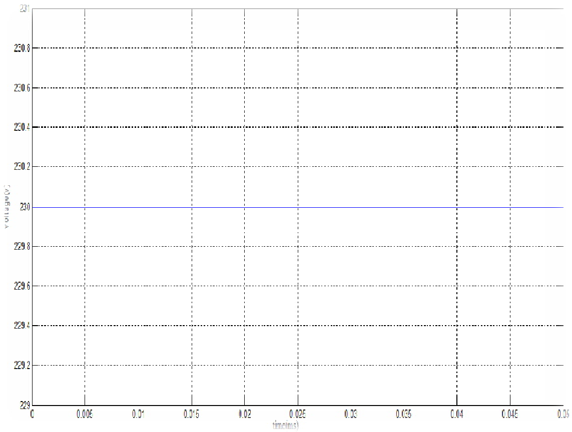

Figure 4- SEPIC converter voltage

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Figure: 4 Describes the output voltage of SEPIC converter further converts the 24V DC from solar panel to 230V DC.

OUTPUT OF INVERTER

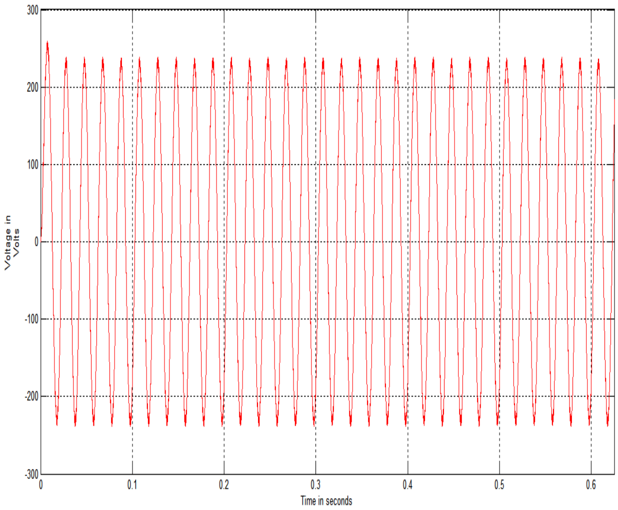

Figure 5- Inverter output voltage

Figure: 5 Describes the output voltage of inverterconverts 230V DC to 230V AC

IV. CONCLUSION

The solar system unit provides power of the requirement, improves reliability, sustainability and environmentally friendly system thus improving the economic attributes of the power source. It can be applied to various geographic locations and the remote areas, where there is no electricity. The use of these alternative sources of energy has a positive impact on the environment. It reduces combustion of fossil fuels and consequently Co2 emission which is the principle cause of greenhouse effect and global warming. It is expected that with this realization of this system, an essential increase of the life quality in village will be obtained. This design work aims to be a modest contribution for an eventual onsite implementation of such a system. In this proposed technique, the output voltage is constant under normal or shaded conditions of solar panel using Fuzzy logic based and to obtain the maximum power from the PV module with the Maximum Power Point Tracking (MPPT) algorithm implemented on SEPIC converter using MATLAB/SIMULINK 2010.

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