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Smart Grid Interfacing By Using SEPIC Converter and Monitoring With the Help of IOT

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Abstract : In our article, we proposed the system based on iot monitoring system. Here, we use the dc input sources to boost the level of the voltage with the help of Sepic Converter. Sepic Converter boosting part can be considered to determine the input voltage gain shown in the output gain of the system. Those dc output voltage gains again connected in the inverted part to converted ac voltage and then apply grid interjection. In the output side we process two conditions one is grid interjection and the ac load bulb. To monitor and control both the condition with the help of IOT system. At last we monitor both the dc link voltage as well as boost link gain voltage with the help of IOT of the system.

Keyword: IOT System, Monitoring System, Mat lab Simulation, Sepic Converted, Inverted, Ac Load, Dc

1.1INTRODUCTION:

Constantly growing energy demand has made grid-connected photovoltaic (PV) systems are more popular, and many countries have permitted, encouraged, and even funded distributed-power-generation systems. Currently, solar panels are not very efficient with only about 12–20% efficiency in their ability to convert sunlight to electrical power. The efficiency can be drop into further due to other factors such as solar panel temperature and the load conditions. In order to maximize the power derived from the solar panel, it is more important to operate the panel at its optimal power point. To achieve this, a maximum power point tracker will be designed and implemented. It will support for voltage monitoring.

The photovoltaic energy system has the advantages of absence of fuel cost, not affect the environmental, low maintenance and lack of noises and also it is the kind of renewable energy system. So it is a becoming popular in the recent years, as a resource of energy's. Modeling's and simulations of PV array based on the circuit model and mathematical equations are proposed. As the photovoltaic (PV) cell exhibits in the nonlinear behaviors, while matching the load to the photovoltaic modules, DC-DC power converters are needed. There are several converter are configurations such as a Buck, Boost, Buck-Boost, SEPIC, ĆUK, Fly-back, etc. Buck and Boost configurations can be decreases and increases the output voltages respectively, while the others can do the both functions. Buck, Boost, Buck Boost converters as well as interface circuits are proposed and analyzed. When the solar insulation and temperature is varying, the PV module output power is also getting changed. But to obtain the maximum efficiency of PV module it must be able to operate the at maximum power point. So it is Necessary to operate the PV module at its maximum power point level for all irradiance and temperature conditions. For this purpose Modified Perturb and Observe MPPT algorithm is proposed. According to this MPPT output, the duty ratio of the SEPIC converter is varied, that leads to the changes in output voltages. The function of an inverter is to be change a dc input voltage to a symmetric AC output voltage of the desired magnitude and frequency.

1.2 MOTIVATION

The micro grid concept acts as a solution to the enigma of integrating large amounts of the micro generation without disrupting the operations of the utility network. With intelligent analysis of loads and micro-generation, the distribution network subsystem (or 'microgrid') would be a less troublesome to the utility network, than ordinary micro generation. The net microgrid could even provide additional services such as local voltage control. In case of disturbances on the main network, microgrids could probably disconnect and continue to operate separately. This operation remark power quality to the customer. From the grid's perception, the benefit of a microgrid is that can be considered as a controlled entity within the power system that can be functioned as a single aggregated load. Customers can get benefits from a microgrid because it is designed and operated to meet their local needs for the heat and power as well as provide uninterruptible power, enhance local honestly, reduce feeder losses, and support local voltages/correct voltage sag. In inclusion to generating technologies, microgrid also includes storage, load control and heat resumption equipment. The ability of the microgrid to operate when connected grid as well as smooth changeover to and from the island mode is another important function

1.3 OBJECTIVE

The main objective of this work is to study the behavior of the solar PV systems and model the efficient Grid-connected solar power system. The things which are focused are given below

- To implement grid connected DC source using SEPIC.
- To maintain constant output voltage to the load or grid using solar energy based system.
- To incorporate an auto shutdown system with SMS alert by using IOT
- We can able to monitor voltage & current, and also we can able turn OFF & ON by using IOT Application.

2.1 SYSTEM ANALYSIS

Using a segregation transformer in the grid-connected inverter can solve the Problem of the leakage current caused by the earth parasitic capacitance in solar modules. There are two types of grid-connected inverter with an isolation transformer.

a) Line frequency transformer

b) High-frequency transformer

2.1.1 LINE FREQUENCY TRANSFORMER

Fig.2.1.1 shows a grid-connected photovoltaic generation system with a line frequency transformer. The solar modules can be grounded directly and there is no current path for leakage current because the line frequency transformer is isolated. This system supplies no dc current to the grid and has the advantage of a simple control circuit. However, the line frequency transformer's disadvantages are large volume, high weight, and high cost.

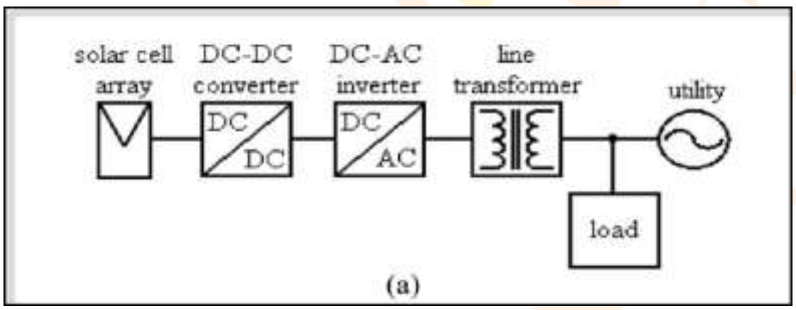

Figure 2.1.1 Existing Grid-connected photovoltaic generation system with an isolation transformer (Line frequency transformer)

2.1.2 HIGH FREQUENCY TRANSFORMER

Figure 2.1.2 shows a grid-connected photovoltaic generation system with a high frequency transformer. The transformer is incorporated in a dc–dc converter and is operated at high frequency to reduce volume and cost. However, the control circuit of this grid-connected photovoltaic generation system is complicated due to the use of a transformer-isolated dc–dc converter. Besides, the high frequency transformer is not placed at the output of the grid-connected photovoltaic generation system, so it cannot prevent the dc current from injecting the grid.

The use of a confinement transformer in the grid-connected photovoltaic generation system should be avoided due to cost, size, and efficiency. In general, the bridge-type dc–ac inverter is used in the grid-connected photovoltaic generation system. However, a conventional bridge-type dc–ac inverter, without a confinement transformer, results in the problem of leakage current because it cannot sustain the voltage of its negative terminal at a constant value. Recently, many dc–ac inverter topologies have been planned to solve the problem of leakage current. This paper appoints a transformer less grid-connected power converter with the help of negative grounding for an photovoltaic generation system.

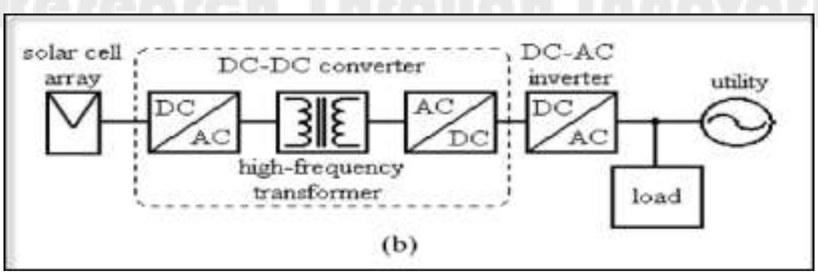

Figure 2.1.2 Existing Grid-connected photovoltaic generation system with an isolation transformer (High-frequency transformer)

2.2 DRAWBACKS OF EXISTING SYSTEM

- Efficiency of the system low.
- Output voltage not constant in utility side.
- Cost of the system increase
- Transformer losses also increase the total losses of the system
- Complex in circuit
- Modes of operation is high

3.1PROPOSED SYSTEM

- First, here, we use the DC Sources of 12 Voltage in Input.
- To boost the input voltage we use the Sepic Converter to process it.
- That boosting voltage connected in inverted to convert dc to ac voltage.
- Ac voltage can be connected in the grid interjection field and the ac load.
- IOT to monitor both Grid as well as the Ac load.(bulb)
- By using IOT Application we can able see load voltage & current usage in the application.
- IOT with the mobile app, to monitor the input voltage as well as gain voltage or boosting voltage of the system.
- The block diagram of the proposed power generation system is shown in figure 3.1.1

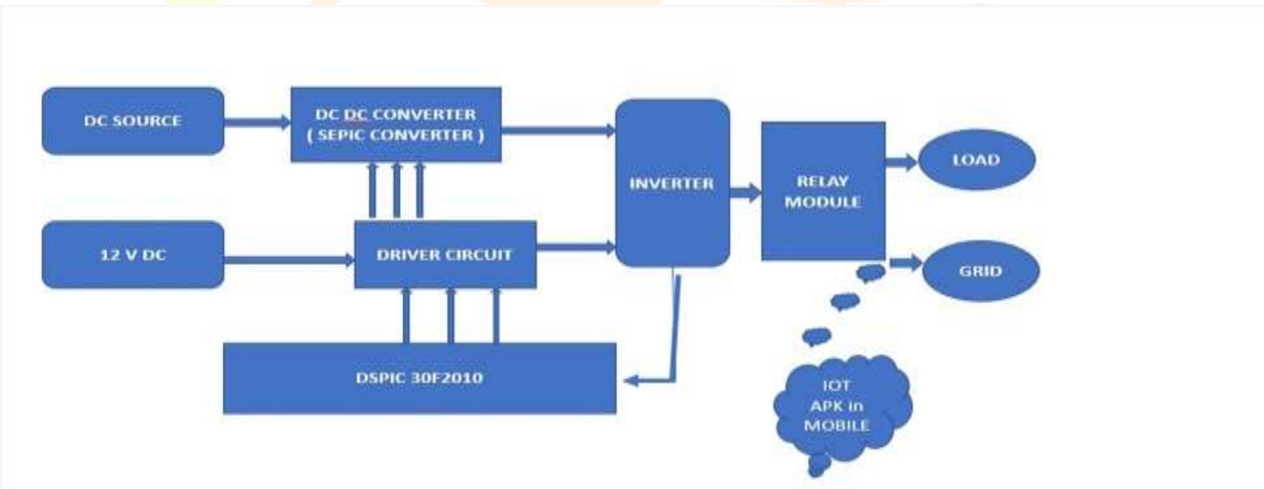

Figure 3.1.1 Proposed system block diagram

3.2 SEPIC CONVERTER

A SEPIC is a cascaded boost/buck-boost converter, with its input stage related to that of a basic boost converter, and its output stage is related to that of a basic buck-boost converter. Overall, a SEPIC function is related to a buck-boost converter, but has the further advantages of having its output voltage of the polarity non-inverted with respect to its input voltage, having a true shutdown mode – i.e. when switch S turns off, the converter's output voltage reduces to 0V, and having confinement between the input and output.

3.3.1BASIC SEPIC OPERATION

The basic SEPIC performs DC-DC voltage conversion through energy exchange between its coupling capacitor and switching inductors (C_{in}, L_1 and L_2). The switch controls the energy exchange amount between the capacitor and inductors. Maximizing energy exchange efficiency and overall converter efficiency requires this SEPIC design operating in continuous conduction mode (CCM).

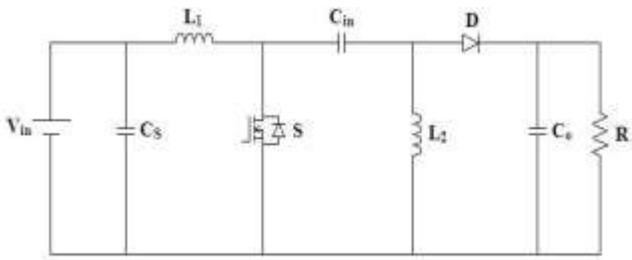

Figure 3.3.1 SEPIC converter

There are two modes of operation in SEPIC. They are

1. Continuous Conduction Mode
2. Discontinuous Conduction Mode

3.3.2Continuous Conduction Mode

In continuous conduction mode of operation, the inductor current will be continuous and never reaches to zero. That means operating the SEPIC in CCM means never letting the currents through L_1 and L_2 reduce to 0A – i.e. never letting L_1 and L_2 completely discharge. When the SEPI Reaches steady-state operation, the average voltage across C_{in} will be equal to that of V_{in}. Additionally, the average current through C_{in} is 0A in steady-state. When this steady-state phenomenon occurs, L_2 is the only source of current to the output load. Thus, L_2's average current equals that of the output load, and is independent of V_{in}.

In CCM, the sum of the average voltages across the SEPIC's energy storage elements (excluding input and output filter capacitors C_s and C_o) equal that of the SEPIC's input voltage described as follows,

$$V_{in} = V_{L1} + V_{Cin} + V_{L2} \qquad (3.1)$$

Since the average voltage across C_{in} equals that of V_{in}, V_{Cin} equals V_{in}, leading to

$$^{V}L1\ ^{V}L2 \qquad (3.2)$$

Under CCM in steady-state, the SEPIC's operation further splits into two operation modes: when switch S conducts and when it does not conduct. Analyzing the SEPIC's entire operation in CCM requires analyzing it in switch S's conduction and non-conduction modes.

When switch is close

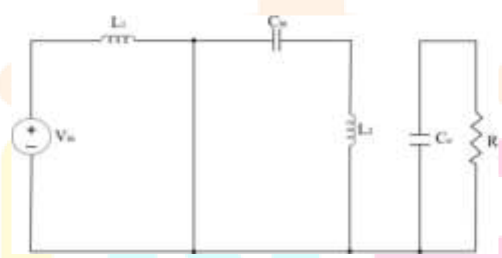

Figure 3.2.3 Switch on condition

Figure 3.2.3 shows the SEPIC operate when switch S conducts. Filter capacitor Cs and Co are assumed to be in steady-state, thus no current flow through these two components until till they can be discharge. Furthermore, Cs and Co are also assumed to be large enough in capacitances such that the SEPIC's input and output ripple voltages can be nearly comes to zero.

When switch S conducts during the first half-switching cycle, the current through L1 boost in the positive direction while the current through L2 boost in the negative direction. Hence L1 charge via Vin, while L2 discharges (acting as an a source) through the Cin. S remains closed for a short time period and during this time period the rapid voltage across Cin equals Vin. Thus, VL1 and VL2 both equal almost Vin in magnitude.

The only difference between the two voltages is that VL2's polarity is reversed (i.e. negative) because L2 is discharging. Cin in turns discharges and supplies current to L2 in order to stores energy in it, so that L2 can supply current to the output load during the next half-switching cycle when the switch S no longer conducts. During this entire half-switching cycle, diode D does not conduct i.e. in other words, it is reversal-biased. Thus Co discharges and hence it is the only component that helps to maintain the output load current when the switch S is conducting. During the second half-switching cycles, switch S turns off.

When switch is opened

Figure 3.2.4 shows the SEPIC operation when the switch is opened. At the end of one half-switching cycle, switch S turns off. The new path for the input current is through L_1 and C_{in}. Because current cannot change instantaneously through an inductor, Inductor Currents do not immediately change. Thus, capacitor current C_{in} equals L_1 current. L_2 continues to discharge, but during this half-switching cycle it discharges into C_o, thus turning on D i.e., forward biased and supplying current to the output load.

However, the direction of L_2 current causes it to add to the input current that already flows to the output load. Thus, when S does not conduct, both L_1 and L_2 supply current to the output load. V_{in} and L_1 charge C_{in} (which discharged during the half-switching cycle when switch S conducted), and L_2 continues discharging to the output load until switch S conducts again at the beginning of the next half-switching cycle (when C_{in} supplies current to charge L_2).

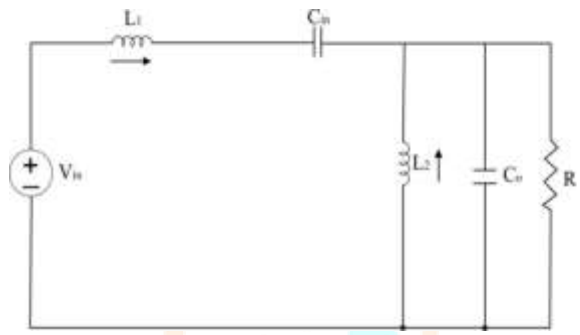

Figure 3.2.4 Switch off condition

Software Requirements

4.1 EMBEDDED C

C is the most widely used programming language for embedded processors/controllers. Assembly is also used but mainly to gadgets those portions of the code where very high timing accuracy, code size efficiency, etc. are prime condition. Initially C was advanced by Kernighan and Ritchie to fit into the space of 8K and to write (portable) operating systems. Originally it is implemented on UNIX operating systems. As it is intended for operating systems advancement, it can manipulate memory addresses. Also, its allowed programmers to write very compact coding. This has given it the influence as the language of choice for hackers too.

4.2 EMBEDDED SYSTEM PROGRAMMING

Embedded systems programming is different from evolution applications on a desktop computers. Embedded devices have resource constraints (limited ROM, limited RAM, and limited stack space, less processing power) Components used in embedded system and PC are different; embedded systems typically used smaller, less power consumption components. Embedded systems are more tied to the hardware. Two salient features of Embedded Program are coding speed and coding size. Coding speed is governed by the processing power, timing restraints, whereas coding size is governed by available program memory and use of programming language. Goal of the embedded system program is to get maximum features in minimum space and minimum time.

4.3 MATLAB SOFTWARE:

MATLAB® is a high-level technical computing language and interactive environment for algorithm development, data visualization, data analysis, and numerical computation. Using MATLAB, you can solve technical computing problems faster than with traditional program languages, such as C, C++, and FORTRAN.

Matlab is a data analysis and visualization tool which has been designed with powerful support for matrices and matrix operations. As well as this, Matlab has excellent graphics capabilities, and its own powerful programming language. One of the reasons that Matlab has become such an important tool is through the use of sets of Matlab programs designed to support a particular task. These sets of programs are called toolboxes, and the particular toolbox of interest to us is the image processing toolbox. Rather than give a description of all of Matlab's capabilities, we shall restrict ourselves to just those aspects concerned with handling of images. We shall introduce functions, commands and techniques as required. A Matlab function is a keyword which accepts various parameters, and produces some sort of output: for example a matrix, a string, a graph. Examples of such functions are sin, imread, imclose. There are many functions in Matlab, and as we shall see, it is very easy (and sometimes necessary) to write our own.

4.5 SIMULATION OUTPUT:

The hardware was tested under laboratory conditions and the output waveforms collected and are shown in the following figures.

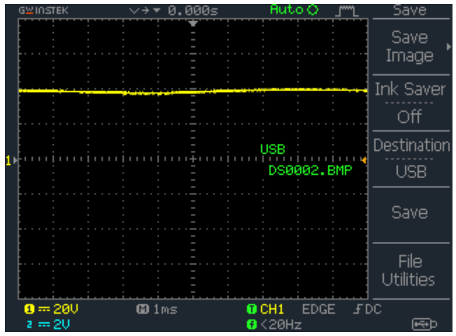

Figure 4.5.1 output voltage waveform of SEPIC

The constant DC output voltage of the SEPIC which is of 90V in amplitude is observed in the fig 4.5.2

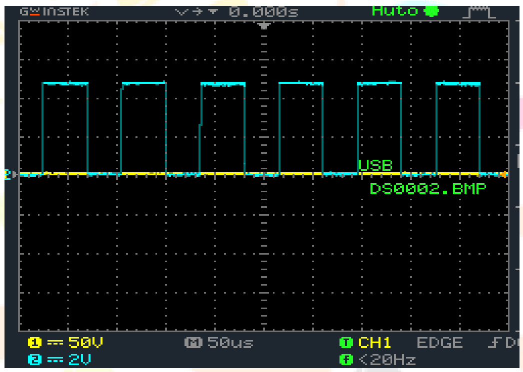

Figure 4.5.2 switching pulse to SEPIC at 60% duty cycle

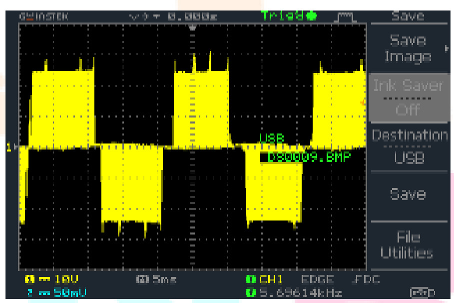

Figure 4.5.3 Inverter output voltage waveform

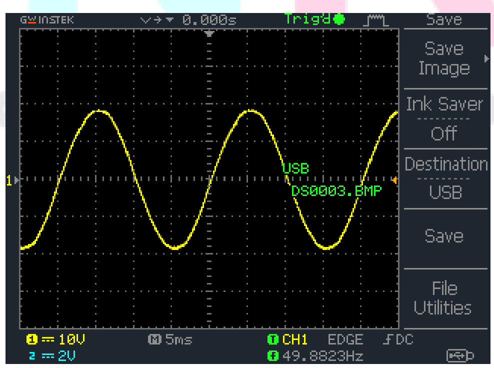

Figure 4.5.4 Filtered sinusoidal voltage waveform

CONCLUSION:

In proposed system where it discussed SEPIC converter based grid integrated PV system. The proposed SEPIC converter has provides constant DC voltage to the single phase three level inverter. The PI controller makes the inverter output voltage is equal to the grid voltage. The proposed system techniques to reduces the grid connected issues like power disturbance, total harmonics etc. This system has lower operating cost and finds applications in remote area power generation, constant speed and variable speed energy conversion systems and rural electrification. In this project will be supported to voltage monitoring.

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