International Journal for Modern Trends in Science and Technology
Volume: 03, Issue No: 05, May 2017
ISSN: 2455-3778
http://www.ijmtst.com

Improved Performance of Hybrid Bi-Directional DC-DC Converter in Grid Application

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To Cite this Article
N.Rathipriya and N.Rajeswari, "Improved Performance of Hybrid Bi-Directional DC-DC Converter in Grid Application", *International Journal for Modern Trends in Science and Technology*, Vol. 03, Issue 05, May 2017, pp. 94-98.

ABSTRACT

A new topology of a hybrid distributed generator based on photovoltaic and wind-driven permanent magnet synchronous generator is proposed. In this generator, the sources are together connected to the grid with the help of only a single boost converter followed by an inverter. Thus, compared to earlier schemes, the proposed scheme has fewer power converters. Model of the proposed scheme in d-q axes reference frame is developed. Two low cost controllers are also proposed for the new hybrid scheme to separately trigger the DC-DC converter and the inverter for tracking the maximum power from both the sources. The simulation results are given to validate the simulation model.

KEYWORDS: *solar,wind,bi-directional dc-dc converter,inverter.*

I. INTRODUCTION

ELECTRICAL energy consumption has been increasing in recent years,and this fact has been essential to the increase of electrical power generation. With increasing concern of global warming and the depletion of fossil fuel reserves, many are looking at sustainable energy solutions to preserve the earth for the future generations. Alone, wind energy is capable of supplying large amounts of power but its presence is highly unpredictable as it can be here one moment and gone in another. Similarly, solar energy is present throughout the day but the solar irradiation levels vary due to sun intensity and unpredictable shadows cast by clouds, birds, trees, etc.

The common inherent drawback of wind and photovoltaic systems are their intermittent natures that make them unreliable. However, by combining these two intermittent sources and by incorporating maximum power point tracking (MPPT) algorithms, the systems power transfer efficiency and reliability can be improved significantly.

II. CIRCUIT DESCRIPTION

The hybrid system with multi connected boost converter is shown in figure .

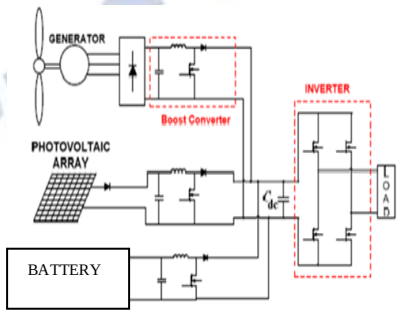


Fig.1 Hybrid system with multi connected boost converter

Advantages covered by the propose system are listed as,

- Overcoming disadvantages of standalone renewable electrical energy generation system.
- Producing much more efficiency as two or more renewable energy generation system working together in the terms of electrical energy generation.
- The system does not have microcontroller or microprocessor the complexity of system testing and understanding became easy in terms of difficulties.
- Renewable energy sources like, sun, wind,. Are utilized so, no waste production.
- Producing clean, friendly to environment, renewable energy.
- Once the system is designed and developed or manufactured, the installation of system is easy.

Boost Converter

A boost converter (step-up converter) is a DC-to-DC power converter that steps up voltage (while stepping down current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element, a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).

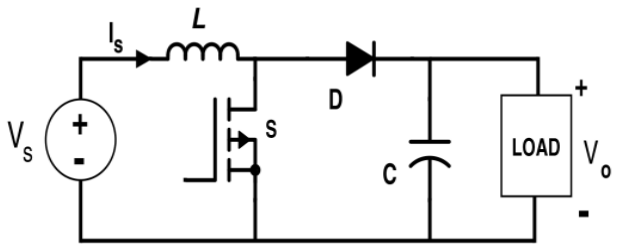


Fig.2 circuit diagram of boost converter

(a) When the switch is closed, current flows through the inductor in clockwise direction and the inductor stores some energy by generating a magnetic field. Polarity of the left side of the inductor is positive.

(b) When the switch is opened, current will be reduced as the impedance is higher. The magnetic field previously created will be destroyed to maintain the current towards the load. Thus the polarity will be reversed (means left side of inductor will be negative now). As a result, two sources will be in series causing a higher voltage to charge the capacitor through the diode D.

III.PROPOSED BLOCK DIAGRAM

A new topology of a hybrid distributed generator based on photovoltaic and wind-driven permanent magnet synchronous generator is proposed. In order to minimize the conduction and switching losses of the devices, it is necessary to have the minimum number of power converters (power conversion stages) and this has been attempted in this paper.

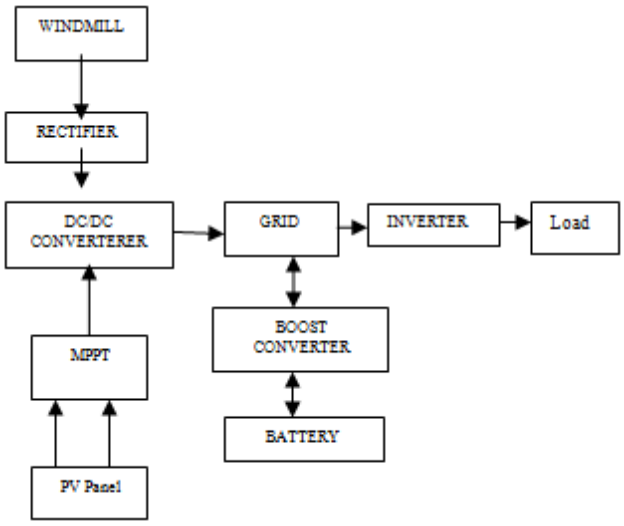


Fig.3 Proposed block diagram

Two new controllers are attempted for the hybrid scheme proposed, in order to achieve the maximum power extraction from both the sources. A *d-q* axes model of the scheme has been developed and validated. Further, the proposed scheme is also for employment by domestic consumers in a smart grid scenario, and hence maintenance free simple operation is envisaged. The proposed scheme is for a grid connected operation and hence battery storage is not necessary.

III. SOLAR AND WIND POWER GENERATION

(A) Solar power generation

A photovoltaic system converts sunlight into electricity. The basic device of a photovoltaic system is the photovoltaic cell. Cells may be grouped to form panels or modules. Panels can be grouped to form large photovoltaic arrays. The term array is usually employed to describe a photovoltaic panel (with several cells connected in series and/or parallel) or a group of panels. Most of time one are interested in modeling photovoltaic

panels, which are the commercial photovoltaic devices .

(B) Wind power generation

Wind power or wind energy is the extracted from wind using wind turbines to produce electrical power, windmills for mechanical power, wind pumps for water pumping, or sails to propel ships. Wind power as an alternative fosssifuels is plentiful,renewable,widely distributed, clean, distributed, clean, produces no greenhouse gas emissions during operation and uses little land.

IV. PROPOSED SYSTEM SIMULATION DIAGRAM

The proposed system consists of bidirectional dc/dc converter,solar generator,wind generator and MPPT

This bidirectional DC-DC converter converts voltage bidirectionally between a high voltage bus and low voltage bus. Generally it is used for charging and discharging application. The boost type of converterhas energy storage on the low voltage side. The following schematic diagram shows the proposed system and output of the proposed system.

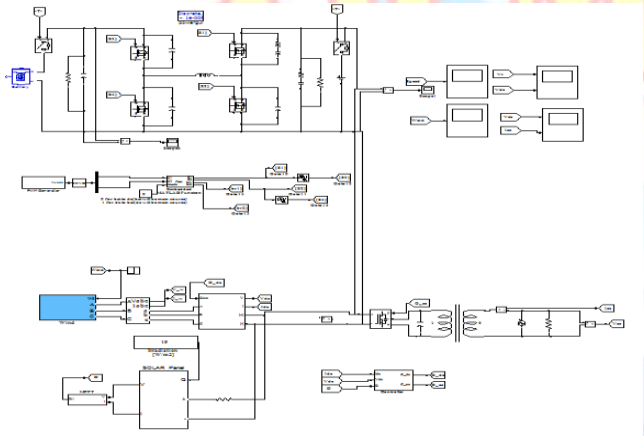


Fig.4 Proposed system simulation diagram

Output of Load Voltage and Load Current

The output voltage value in proposed circuit is around 230v and having frequency of 50Hz is shown in figure 5. It is measured across the load

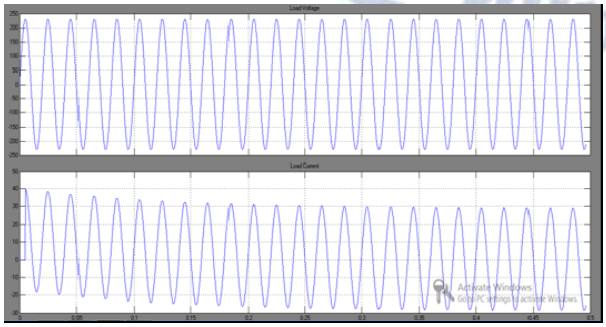


Fig. 5 output of load voltage and load current

V. SIMULINK MODELLING

(A)Bidirectional Dc-Dc Converter

The concept of power flow in both direction for bidirectional dc-dc converter is operation of switching devices realize current flow in each way. Bidirectional dc-dc converter are developed from two unidirectional semiconductor switching devices such as :

MOSFET, transistor and IGBT power switches constructed with parallel diodes.

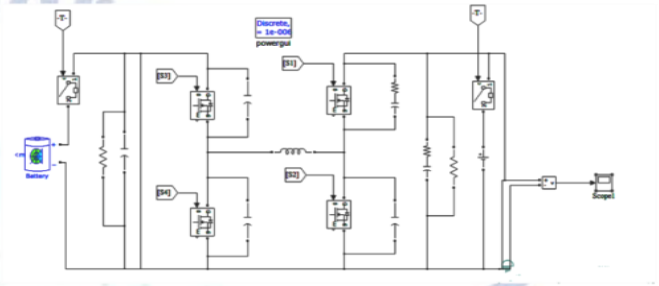


Fig.6 Bidirectional dc/dc converter simulation diagram

OUTPUT

The output voltage value in bidirectional system is around 280v is shown in figure 7. It is achieved by boost converter.

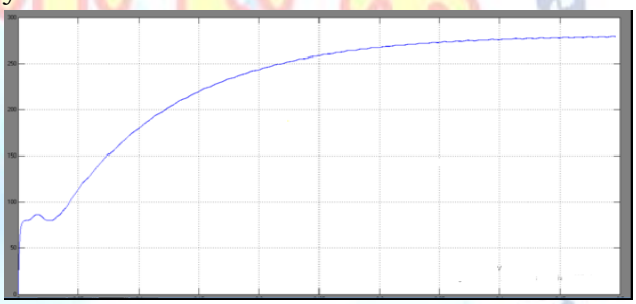
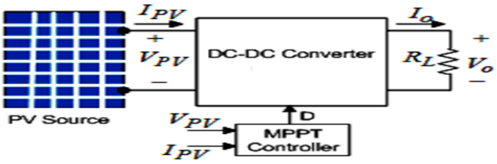


Fig.7 Output of bidirectional dc/dc converter

(B) Solar generation

MPPT

Maximum power point tracking (MPPT) is a technique that charge controllers use for wind turbines and PV solar systems to employ and maximize power output. PV solar comes in different configurations.



.Solar inverters convert the DC power to AC power and may incorporate MPPT: such inverters sample the output power (I-V curve) from the solar modules and apply the proper resistance (load) so as to obtain maximum power.

- MPP(Maximum power point) is the product of the MPP voltage(Vmpp) and MPP current(Impp)

Flowchart Of Modified P&O Mppt

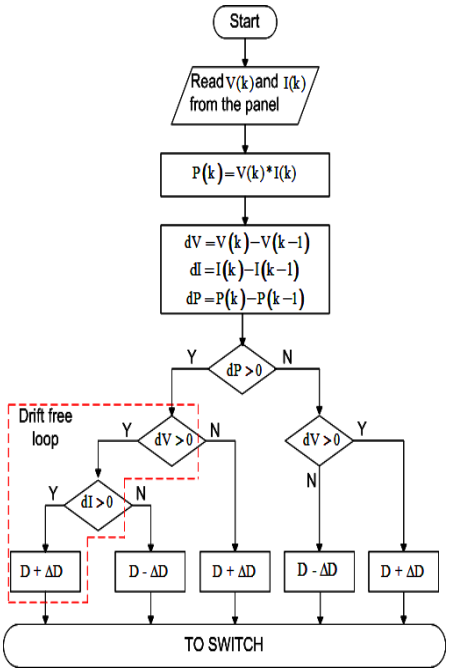


Fig.8 Flowchart of modified p&omppt

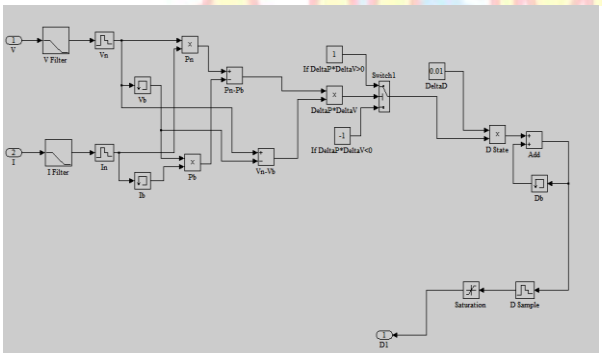


Fig.8 simulation diagram of MPPT

SOLAR

The saturated power from the MPPT is fed to the source through solar panel.

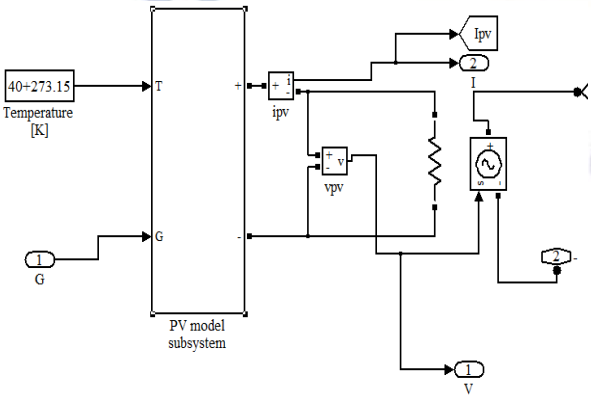


Fig.9 solar generation simulation diagram

OUTPUT

The rectifier voltage and DC voltage waveform of solar are shown in figure 10.The output power from the panel is fed into the grid. The rectifier voltage value is around 280v. the dc voltage value is around 260v.

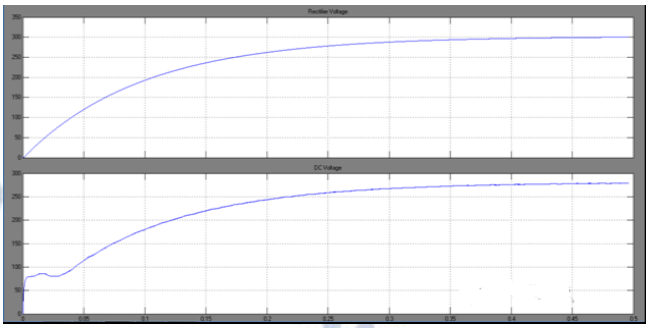


Fig.10 Output Rectifier Voltage And Dc Voltage Of Solar Generation

(C)Wind Generation

The wind turbine rotates with the speed of permanent magnet synchronous motor constant pitch angle and wind speed is also fed into the wind turbine. The torque is produced as output and it is fed into motor again as feedback. The three phase output from the motor is fed to the grid.

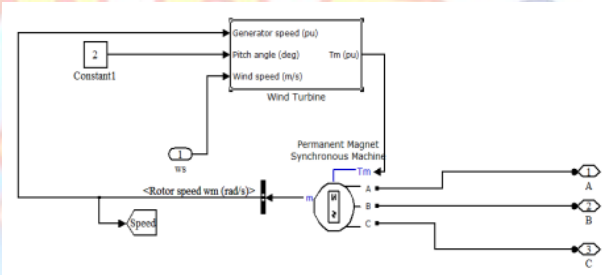


Fig. 11 Wind generation simulation diagram

OUTPUT

The simulation output of wind speed is shown in figure 12.

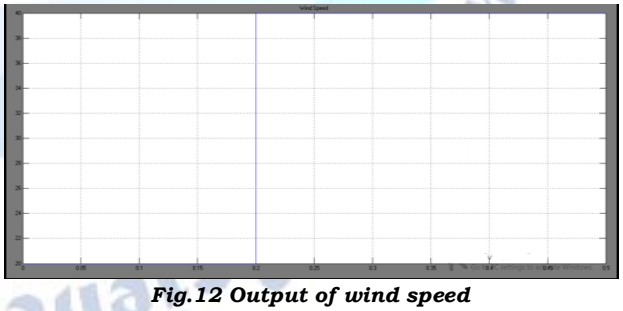


Fig.12 Output of wind speed

VI. CONCULSION

When a source is unavailable or insufficient in meeting the load demands, the other energy compensates for the difference. In this paper a New Multi Input Hybrid Wind/Solar Energy systems has been implemented. . This system was designed to develop a power solution for remote locations such as rural and research areas as well as

improve the general well-being of individuals in developing countries The features of this circuit are additional input filters are not necessary to filter out high frequency harmonics, both renewable sources can be stepped up/down (supports wide ranges of PV and wind input), MPPT can be realized for each source, individual and simultaneous operation is supported. Thus the power was continuously generated to full fill the wide range power of appliances and medical equipment. Simulation results have been presented to verify the features of the proposed topology.

VII. FUTURE WORK

As the awareness of non-renewable sources and pollution causes by them, the clean energy production with renewable sources is widely preferred and day by day implementation of such sources going on, so, research and resources are also increasing for such plants and projects.

As the first time installation cost is higher due to design and manufacturing perspective. The system can be monitories using graphical user interference on computer. So, the whole information will be available to user and/or stored regarding further applications and development.

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