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A Cost Effective Hybrid Power Generation System For Isolated Loads

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Abstract

This paper proposes another topology for mixture wind-sun oriented age framework for detached loads. The principle center is to diminish the span of battery for basic loads and supply non-basic loads specifically from the stator side of DFIG. DFIG is controlled from rotor agree with consecutive associated PWM converters. Vector control plot is being utilized in synchronously pivoting reference outline for Rotor side converter (RSC) and Load side converter (LSC) does not require any exceptional control conspire bringing about the lesser complex control hardware. Receptive power interest for basic, noncritical burdens and acceptance machine will be provided from DC interface capacitor. DC interface voltage will be kept up as steady by DC-DC converter, associated with control battery charging and releasing. Since there are three conceivable alternatives at DC connect (wind, sun based and battery reinforcement), the measure of battery will be lesser. The proposed plot is displayed, recreated and examined in MATLAB.

Keywords

Wind solar generation, DFIG, Rotor side Converter (RSC), Load side converter (LSC), DC-DC Converter.

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Contents

1. Introduction

This is a verifiable truth that the entire world is confronting a noteworthy risk of quick draining petroleum product holds, the familiarity with natural effect have driven the scientists to consider exchange wellsprings of energy for a more secure life on this planet. Accordingly, the entire world is searching for non-modest vitality hotspots for their future. The vast majority of the present vitality request is met by fossil and atomic power plants, however there will before long be a period when we will confront an extreme fuel lack; along these lines now a days scientist's consideration is towards sustainable power sources, for example, sun oriented photovoltaic (PV), wind, power device stack, biomass, tidal vitality, and so forth. Out of these, sun powered PV and wind are most famous sources because of their cleanness and cost adequacy.

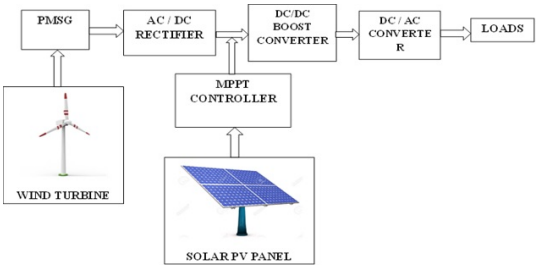


Fig.1. Block Diagram of Proposed system

There are a few spots where association with the utility system is either outlandish or unduly costly. Load request is nearly lower at these spots because of constrained end client gadgets. This requires detached power age frameworks. Photovoltaic (PV) frameworks and wind-electric frameworks among sus-

tainable sources are practical options for the creator of such remote power supplies. Prior autonomous Solar PV age framework and wind electric age frameworks were introduced; however these frameworks have following impediments:

2. Design and Implementation of proposed System

The proposed system is implemented with the data and methods referred in this section. In this section the components used are explained how to be used with standardized technique. This makes this system more reliable and less prone to errors.

2.1 Solar PV generation system

The solar based radiation fluctuates after some time and is subject to natural conditions (temperature, irradiance, and so forth.). In this manner it ends up intense to get a normal age all through. Likewise, during the evening we can't have the sunlight based vitality supply so we need to go for huge size battery stockpiling. In the event that because of the stormy conditions or some other cataclysmic event we don't have sunlight based for adequate time we won't have the capacity to store the battery. Wind Power generation system: The sporadic idea of twist in our nation does not give us a reliable power age, along these lines requires battery stockpiling and diesel generator joining and so on. The normal breeze speed is 3.5-4.5 m/s which aren't adequate for an independent framework. Due to previously mention bad marks, these free frameworks are not extremely proficient and thus look into has turned towards Solar-Wind cross breed frameworks as these two sustainable sources are reciprocal in nature. Despite the fact that sunlight based breeze crossover frameworks, are reliable with control age, there is still some probability of intensity interference as the two sources are condition ward, and some basic burdens like telecom towers, healing centers and so forth can't bear the cost of it, along these lines a nearly little battery back-up is likewise required for these basic burdens.

2.2 Bidirectional DC/AC Converter

Proposed topology requires a trade of intensity from the battery to the DC connection and the other way around. DC transport is controlled through both sun powered and wind control age, which is adapted through a power conditioner to bolster the DC transport. The battery goes about as a vitality stockpiling unit and it is charged when age is more than the heap necessity. On the off chance that age is less battery supplies the abundance stack necessity. A double dynamic scaffold is utilized here to control trade of intensity between the DC connect and the battery.

2.3 Rectifier

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification, since it "straightens" the direction of current. Physically, rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, stacks of copper and selenium oxide plates, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches. Historically, even synchronous electromechanical switches and motors have been used. Early radio receivers, called crystal radios, used a "cat's whisker" of fine wire pressing on a crystal of galena (lead sulphide) to serve as a point-contact rectifier or "crystal detector". Rectifiers have many uses, but are often found serving as components of DC power supplies and high-voltage direct current power transmission systems.

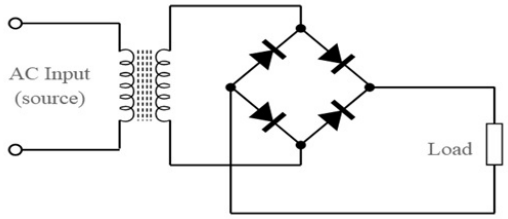


Fig.2. Rectifier general circuitry

Rectification may serve in roles other than to generate direct current for use as a source of power. As noted, detectors of radio signals serve as rectifiers. In gas heating systems flame rectification is used to detect presence of a flame. Because of the alternating nature of the input AC sine wave, the process of rectification alone produces a DC current that, though unidirectional, consists of pulses of current. Many applications of rectifiers, such as power supplies for radio, television and computer equipment, require a steady constant DC current (as would be produced by a battery). In these applications the output of the rectifier is smoothed by an electronic filter, which may be a capacitor, choke, or set of capacitors, chokes and resistors, possibly followed by a voltage regulator to produce a steady current. More complex circuitry that performs the opposite function, converting DC to AC, is called an inverter.

2.4 PMSG for wind generation and solar PV system

This framework utilizes lasting magnet synchronous generator for wind age which is exceptionally effective when contrasted with other breeze generators.

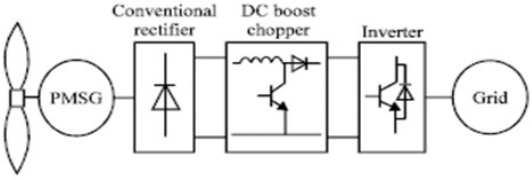


Fig.3. PMSG wind power system

Burdens are provided at steady recurrence utilizing AC/DC and DC/AC converter in arrangement. If there should arise an occurrence of low breeze control, sunlight based PV creates the required power and DC interface capacitor supplies required responsive power, and if there should be an occurrence of low PV age (at evenings or in terrible climate condition), wind age supplements.

2.5 SCIG for wind generator and solar PV system

In this plan, steady recurrence control age is conceivable, at or somewhat not as much as synchronous speed. It doesn't utilize any converter while providing from wind control yet needs a DC/AC converter while providing from sun oriented vitality. The primary hindrance of this plan is the power misfortune in rotor circuit of SCIG and necessity of substantial 3-stage capacitor banks to supply responsive influence request. Likewise, in the event of wind and sun based disappointment, there is no elective alternative for basic burdens. This plan kills the utilization of extensive capacitor banks, and uses a DC interface capacitor between two converters. Sun based power is being provided at DC connect. In this plan additionally, the converters utilized are of full appraising and slip control in the rotor of SCIG results in the copper misfortune. Wind age framework and sun oriented PV framework must have a similar rating in order to supply the heap then again. There is no arrangement for basic loads in the event of wind and sun based disappointment.

3. Simulation of proposed system

The proposed system is simulated in MATLAB/Simulink simulation software. The simulation figure is as shown in the figure 4.

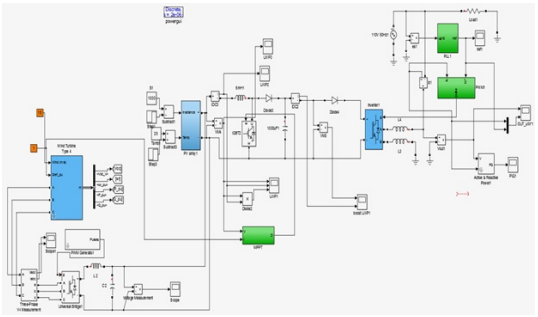


Fig.4. Simulation Diagram of Proposed system

The simulation diagram presented above has wind, solar and all other converter as mentioned in the block representation. The solar PV system is simulated is as shown in the figure 5.

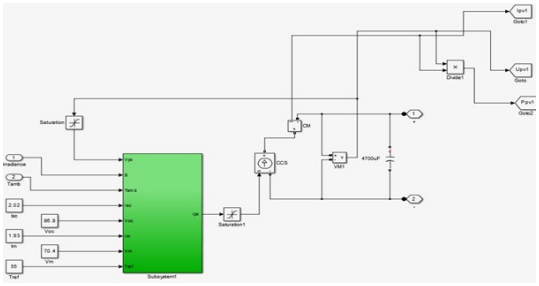


Fig.5. Simulation diagram for solar power generation

The wind power generation is also simulated in this simulation software. The simulation model is modelled is as shown in the figure 6.

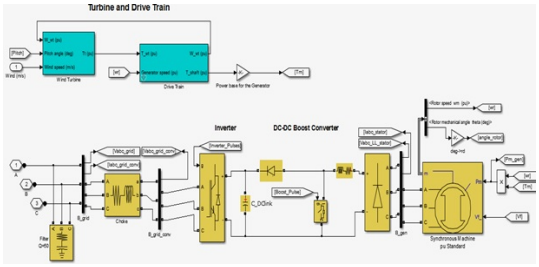


Fig.6. Simulation diagram of Wind power generation system.

The proposed MPPT controller uses PID controller is also simulated is as shown in the figure 7. The MPPT controller uses P and O algorithm for efficient conversion of DC/DC converter. The MPPT algorithm is implemented as mathematical and digital signal model then it is given as gating pulse for the boost converter IGBT semiconductor switches.

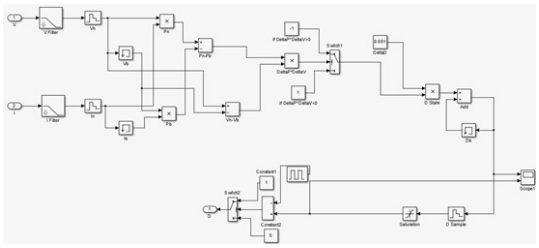


Fig.7. Simulation diagram for MPPT controller for solar power system

The simulation results are discussed in the next section.

4. Simulation output and Results

The proposed system is successfully designed in MATLAB/ Simulink simulation software and it is complied. With the successful compilation the simulation output can be observed.

CASE 1: MPPT Connected With the System

In this case the MPPT is connected in the circuit and the output is verified. The output of solar PV system is as shown in the figure 8.

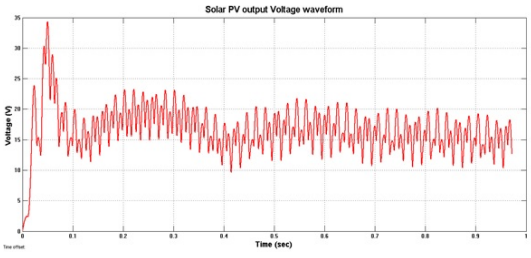


Fig.8. Solar dc output voltage waveform

The wind power output has more distortion is shown in the output simulation result. The figure 9 represents the output graph of wind AC output waveform.

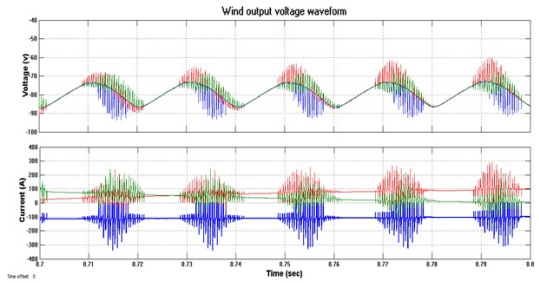


Fig.9. Wind Power AC Output Voltage and Current

The converter ac wind power to dc power, the voltage DC output is as shown in the figure 10.

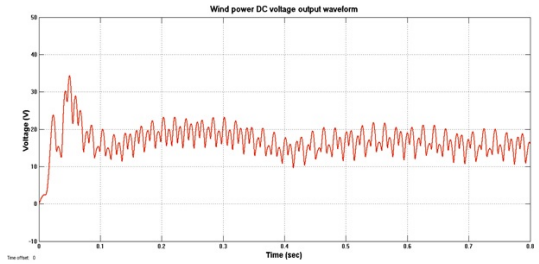
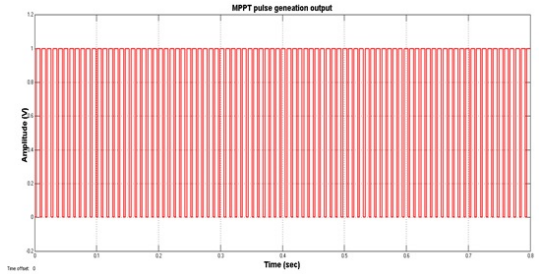


Fig.10. Wind Power Converted DC Output Voltage Waveform

The DC output voltage from wind and solar is coupled into DC/DC converter with MPPT connected with it. The MPPT pulse generation is as shown in the figure 11,



Through the generated pulse the output of the DC/DC boost converter is enhanced. The amplified boost converter output is as shown in the figure 12.

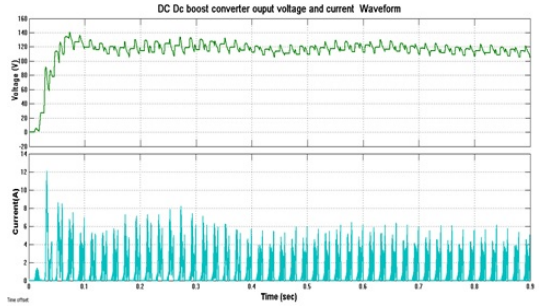


Fig.11. DC/DC converter output Voltage and Current Waveform

The boosted DC output is converted into AC by using inverter circuit to supply AC load. The AC output voltage and current is as shown in the figure 12.

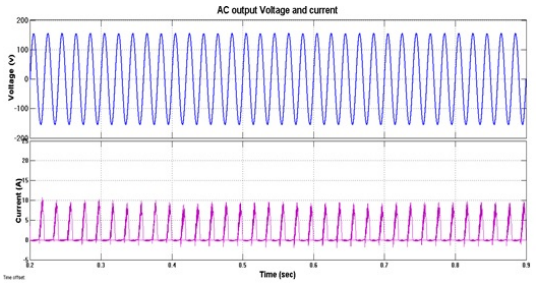


Fig.12. AC voltage and current output from dc/ac converter

The above output waveform is compared with the simulation with MPPT controller removed from the circuit. **CASE 2: Without Connection MPPT**

By removing the MPPT component from the simulation diagram the output is reduced from 120 to 80 voltage DC. The output of DC/DC converter without MPPT is as shown in the figure 13.

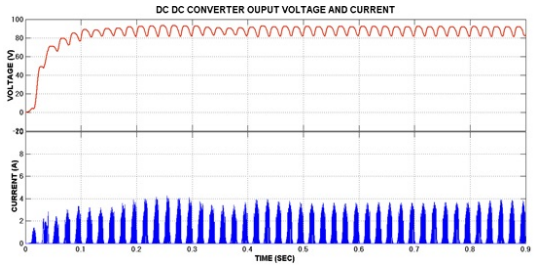


Fig.13. DC DC converterOutput Voltage and Current

The final voltage and current AC is as shown in the figure 14 without MPPT Technique

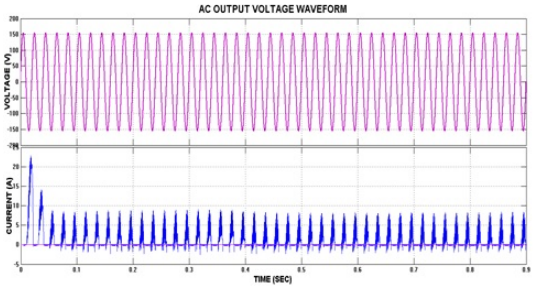


Fig.14. AC voltage and current output from dc/ac converter

From the output generated in this circuit the conclusion are made in the next section.

5. Conclusion

A new hybrid solar and wind renewable energy system coupled with a DC/DC boost converter to amplify the output DC voltage is proposed in this paper. From the results obtained through the simulation from proposed system by using MPPT technique the voltage generated is enhanced. The output simulation results verifies that the proposed MPPT gives better output efficiency when connected to a load. The simulation results has been compared with and without the MPPT technique to prove the proposed system technique.

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