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An Efficient Hybridisation of Multi Source Energy Rectifier Stage Topology System with MPPT

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Abstract: *Environmentally friendly solutions are becoming more prominent than ever as a result of concern regarding the state of our deteriorating planet. This paper presents a new system configuration of the front-end rectifier stage for a hybrid wind/photovoltaic energy system. This configuration allows the two sources to supply the load separately or simultaneously depending on the availability of the energy sources. The inherent nature of this Cuk-SEPIC fused converter, additional input filters are not necessary to filter out high frequency harmonics. Harmonic content is detrimental for the generator lifespan, heating issues, and efficiency. The fused multi input rectifier stage also allows Maximum Power Point Tracking (MPPT) to be used to extract highest power from the wind and sun when it is available. An adaptive MPPT algorithm will be used for the wind system and a standard perturb and observe method will be used for the PV system. Operational analysis of the proposed system will be discussed in this paper. Simulation results are given to highlight the merits of the proposed circuit*

1. Introduction about the Project

Natural energy based power generation systems are commonly equipped with storage batteries, to regulate output fluctuations resulting from natural energy variation. Therefore, it is necessary to prevent battery overcharging. As for the utility connected hybrid generation system consists of a wind power, a solar power, and battery, the dump power is able to control to prevent overcharging the battery without dump load because of dump power transferred into the utility.The individual power generation system, it is considered that a PV system featuring low cost and simple control, which incorporates maximum power point tracking control that makes use of diode characteristics, or a PV system which features output stability with a multiple-input DC-DC converter capable of controlling the output of different power sources in combination, or a cascaded DC-DC converter PV system.

which features good efficiency along with low cost, or a wind turbine system which features output stability with a combination of an electric double-layer capacitor and storage battery, is suitable for use with hybrid power generation systems to stabilize power supply. In contrast, the standalone hybrid system is mainly composed of natural energy sources (i.e. wind power, solar power), and a storage battery; and in some cases, a diesel engine generator may be incorporated into the system as well. However, there is a tendency that the greater the system sophistication, the more suitable the power control techniques are required to be. A DC-DC converter is mounted in both wind power and solar power generation systems.

The two systems are interconnected at the output sides of individual converters, and are also connected to the storage battery. In such a configuration, each DC-DC converter is capable of monitoring the current and voltage of the storage battery, and optimally controlling battery charging, to supply power to the load. In most cases where converters and storage batteries are setup at a centralized location, the storage batteries are commonly installed adjacent to the wind- and solar-power generation systems; therefore there is generally no freedom to install the batteries on flat ground or in places with good vehicular access for easy maintenance and replacement. In a hybrid system with a centralized inverter setup, the output of DC-DC converters is sent to an external DC-AC inverter to supply AC power to load

Features:

1) Dispersed installation of different power sources which are interconnected in parallel

2) Elimination of dump load by using a unique dump power control aimed at prevention of battery overcharging

3) No need for dedicated high-speed line for battery current/voltage status data transmission and

4) Easy capacity expansion through parallel connection of additional power sources to cope with future load increases.

2. EXISTING SYSTEM

2.1.1 Standalone system of solar and Wind System

Standalone or autonomous system is not connected to the grid. Some standalone system known as pv system or island system, may also have another source of power, wind turbine, bio-fuel or diesel generator, etc.

A standalone system varies in shapes and type, but 20WP-1KWP is common. Thestand-alone systems are known as off grid system.

A off grid system vary widely in size and application from remote areas to spacecraft.in many standalone system the battery used as storage system and charge controller used for overall control operation.

2.1.2 Drawbacks of Stand-alone pv and wind system

1. The solar and Wind sources are intermittent in nature and unable to meet the load demands.

2. The converter topology will not supply high step up buck or boosted voltage operation.(Dc-Dc conversion is less)

3. The stand-alone system unable to connect to grid operation

4. Inefficient control and no utilization of maximum power from sources.

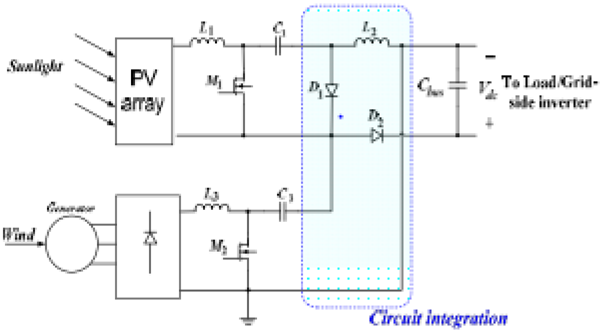
2.2 Proposed System

In order to eliminate the problems in the stand-alone pv and wind system and meeting the load demand, The only solution to combine one or more renewable energy sources to meet the load demand. so the new proposed input side converter topology with maximum power point tracking method to meet the load and opt for grid connected load as well as commercial loads. The implementation of new converter topology will eliminate the lower order harmonics present in the hybrid power system circuit.

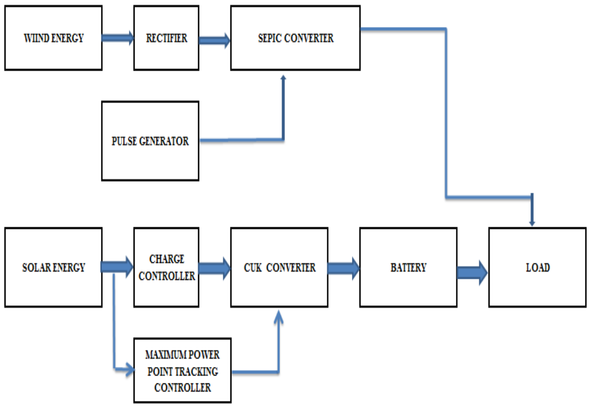
2.3 Merits of Proposed System

1. The maximum power can be track from the inputs solar and wind.
2. Eliminate the lower order harmonics and avoiding the filters.
3. Improved Economics
4. Increased Reliability
5. Design flexibility
6. High power quality

2.4 Circuit Diagram

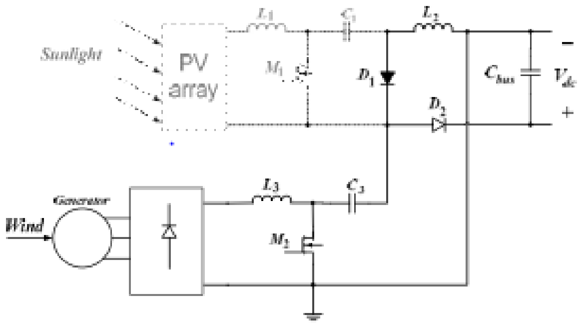


2.5 Block Diagram:



2.6 Mode of Operation of the Converter Topology

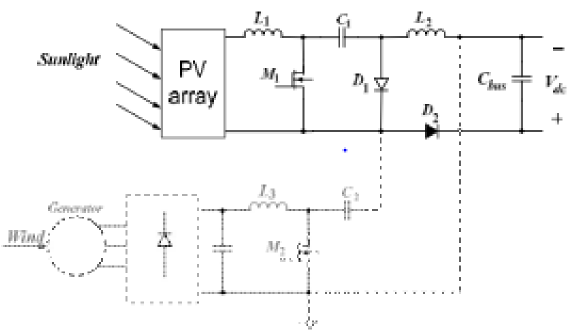
2.6.1 Mode 1: When M2 Is on and M2 Is Off (Sepic Operation)



When M2 is on condition, in the hybrid system, Wind energy will meet the load by a sepic converter operation. The wind energy will produce the Ac power, the Ac power further converted to dc power by using the rectifier.

The converted dc power will stored in battery, and feed the load. Normally the sepic converter will triggered at 50% of the duty cycle to meet the load demand.

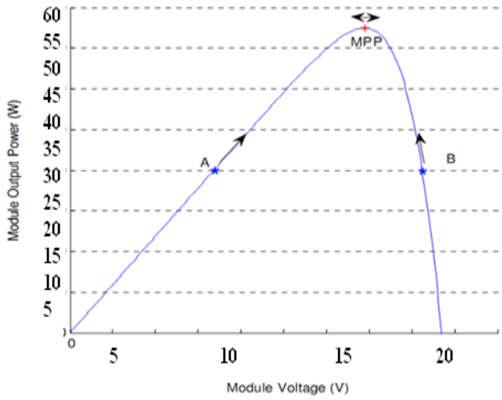
2.6.2 Mode: When M1 Is on and M2 Is Off (Cuk Operation)



When M1 is on condition, in the hybrid system, solar energy will meet the load by a cuk converter operation. The solar energy will produce the dc power; the dc power will stored in battery, and feed the load. Normally the sepic converter will triggered at 50% of the duty cycle by using the maximum power point tracking controller to meet the load demand. The maximum power point tracking controller which contains the maximum power point algorithm for varying the duty cycle D .In this project deals with the perturb and observation algorithm for varying duty cycle by using the voltage and current as reference.

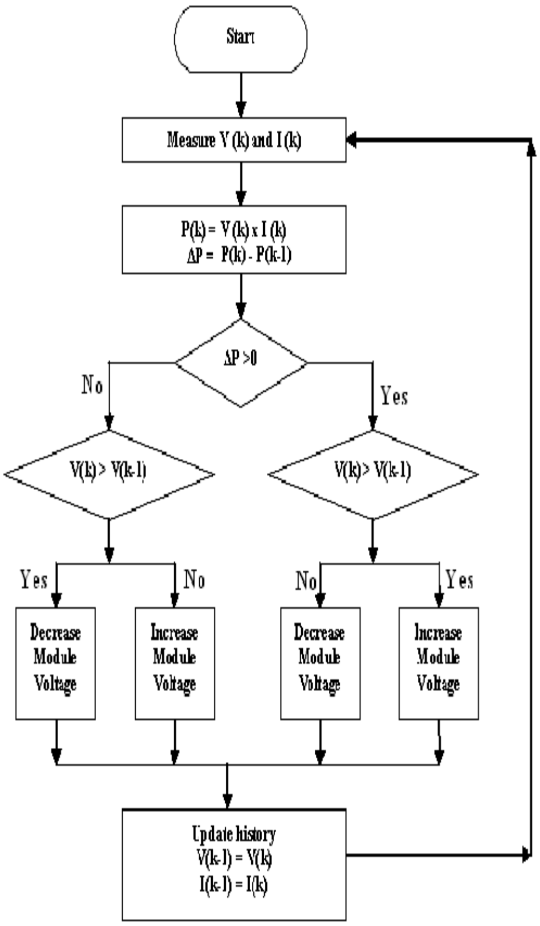
Perturb & Observe Algorithm

The Perturb & Observe algorithm states that when the operating voltage of the PV panel is perturbed by a small increment, if the resulting changes in power ΔP is positive, then we are going in the direction of MPP and we keep on perturbing in the same direction. If ΔP is negative, we are going away from the direction of MPP and the sign of perturbation supplied has to be changed [9].



MPP Tracking using P & O Algorithm

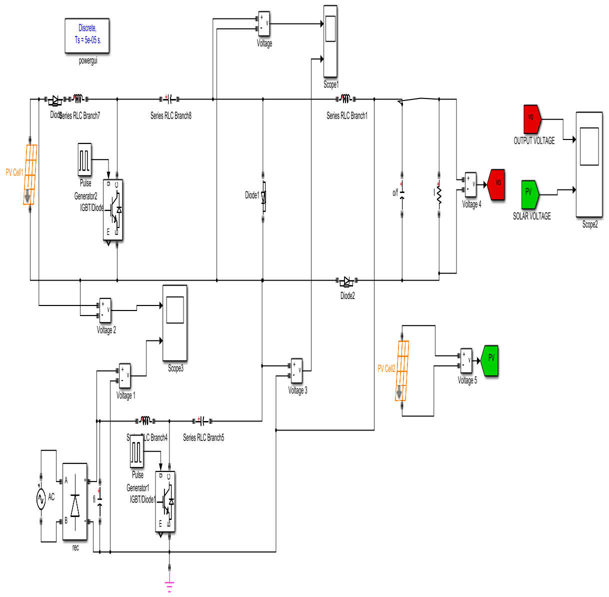
Figure shows the plot of module output power versus module voltage for a solar panel at a given irradiation. The point marked as MPP is the Maximum Power Point, the theoretical maximum output obtainable from the PV panel. As shown in the figure above, Consider A and B as two operating points the point A is on the left hand side of the MPP. Therefore, we can move towards the MPP by providing a positive perturbation to the voltage. On the other hand, point B is on the right hand side of the MPP. When we give a positive perturbation, the value of ΔP becomes negative, thus it is imperative to change the direction of perturbation to achieve MPP. The flowchart for the P&O algorithm [9] is shown in Figure



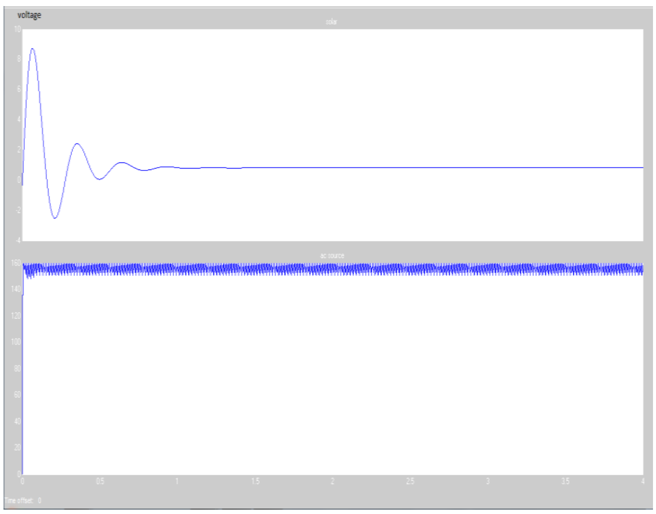
Flowchart of P&O Algorithm

3. Simulation Model and Results

3.1 Open Loop Model:

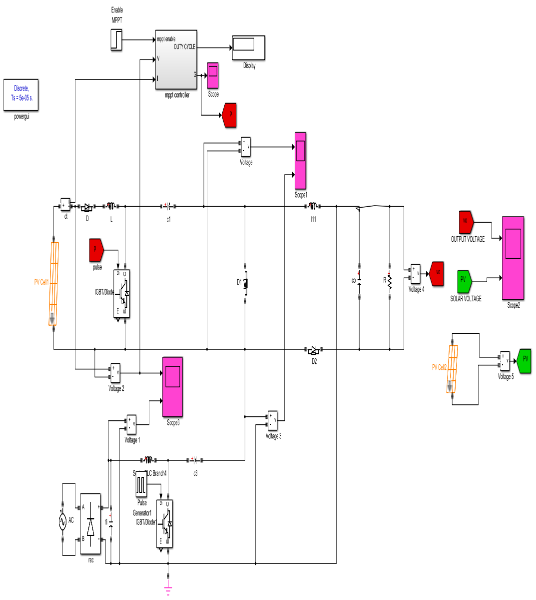


3.1.1input Voltages of Solar and Wind Source

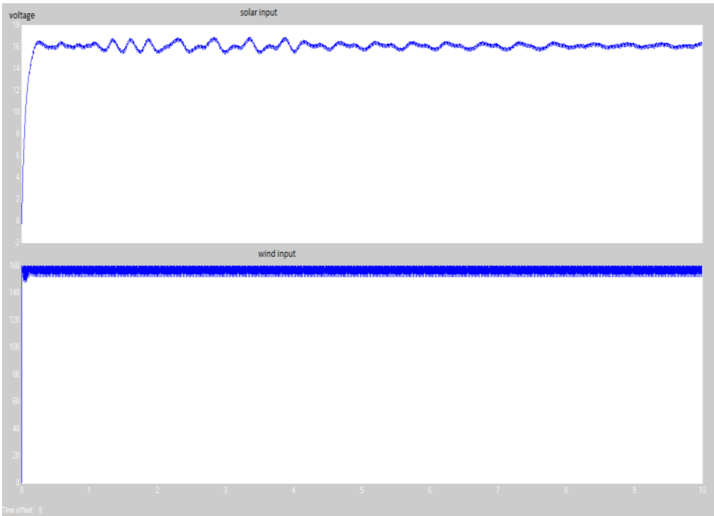


3.1.2 Open Loop Maximum Power Point Input and Output Voltage

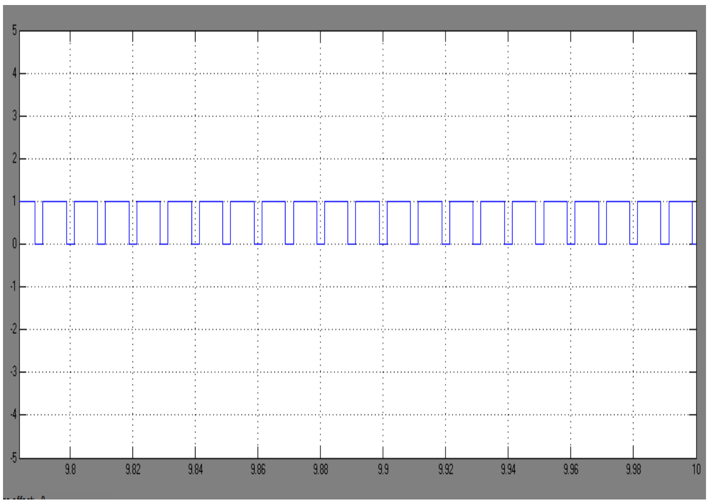
3.2 Closed Loop Model with Maximum Power Point Tracking



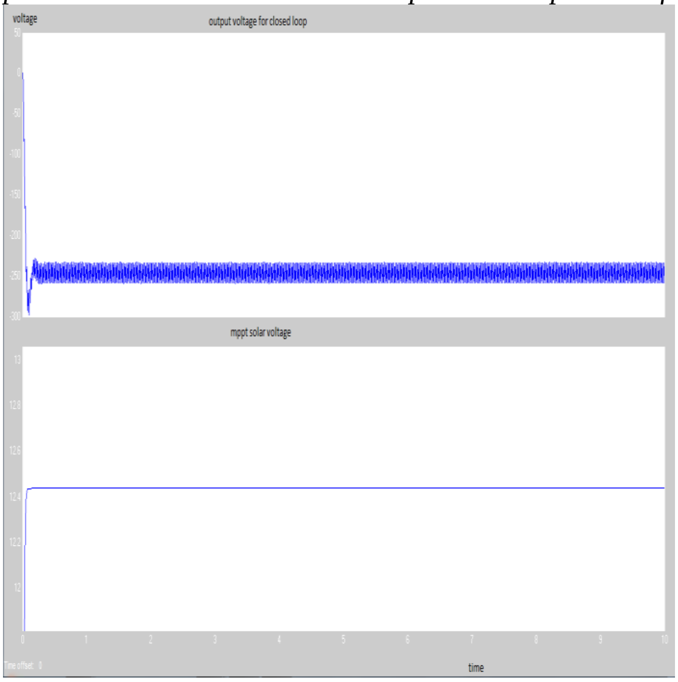
3.2.1 Closed Loop Input Voltages of Solar and Wind



3.2.2 Pulse Generation Pattern



3.2.3 Closed Loop Output with Maximum Power Point Input and Output Waveform



4. CONCLUSION

In this project a new multi-input Cuk-SEPIC rectifier stage for hybrid wind/solar energy systems has been presented.

The features of this circuit are:

1) Additional input filters are not necessary to filter out high frequency harmonics;

2) Both renewable sources can be stepped up/down (supports wide ranges of PV & wind

3) MPPT can be realized for each source;

4) Individual and simultaneous operation is supported. Simulation results have been presented to verify the features of the proposed topology. And the proposed an efficient hybridisation of multi-source energy system with maximum power point tracking has been successfully simulated using Mat lab/Simulink Software.

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