

Energy Management system for Hybrid RES with Hybrid Cascaded Multilevel inverter

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ABSTRACT

In this paper, we propose an energy management system with hybrid solar and wind renewable energy system (RES) with Multilevel inverter to give a lossless power to load. This system continuously receives the battery storage and power consumption after it checks the these value with default value if power consumption is exceeds default value means it turn off the loads. We are assigns the priority to the loads in order to overcome the user inconvenient. To increase PV module output MPPT is used. The existing system uses only boost converter, in our paper boost converter is combined with buck converter used because the PV module can produce high voltage than DC-bus voltage. Buck converter used to step down purpose. In this system on-line configuration check and buck-boost mode transition will be presented. Experimental results measured from three-string MPPTs with EMS the maximum power level of 10 kW are used to verify the analysis and discussion with hybrid cascaded multilevel inverter.

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1. INTRODUCTION

The gap between the generation of electricity and the demand for it is bound to widen. To produce the electricity we are using the non renewable energy source such as coal, Natural gas, Uranium. This non renewable resource produces the stable output in all weather condition. But these resources are polluting the environment then create health problem to human, animals. Now a day's power shortage is the big problem because lacking of these resource to overcome these problems large installation of renewable energy source. Some renewable resources are Solar, Wind, Ocean Energy, Tidal power, Wave power and Hydroelectricity etc. From these renewable source solar and wind are highlighted because their advantage and installation feature is high compared with other resources. Some advantages of solar and wind turbines are no polluting particle emissions, no carbon dioxide emissions, no fuel disposal issues. Atmospheric heating from transmission beam should be less than 10% of heating from ground-based nuclear or fossil fuel power plants. So many of research and companies are focusing the generation of power using renewable energies and creation of innovative electronic components based on renewable energy. But they are not focusing on the energy efficiency that means proper utilization of input to produce an output without wasting energy. So energy should be managed in order to ensure the energy efficiency. The existing system uses the smart grid. But this method is only focus on power control not improve the energy efficiency. However, it is not easy to be connected to commercial electricity in these kind of generating systems, because each type of renewable energy such as solar and wind power also solar and wind hybrid system used to produce sufficient in all the weather condition [1].

The renewable energy system cannot produce the stable output in all session. Solar panel produces the high energy during the middle of the day. But in morning and evening sunlight hits the panels at an acute angle and reduces the total amount of electricity which can be generated each day. Another one problem in solar system is producing the high power in summer. Wind mill produce the high power in winter session. And it produces the high energy in morning and evening compared with middle of the day. In smart grid method a high-efficiency Multilevel inverter [14] and a high-capacity energy storage system maintain the output voltage and frequency stably on equal terms with the power grid network. Therefore, high-efficiency Multi Level inverters and the high-capacity energy storage systems are necessary to connect to the power grid [11]. In this paper hybrid wind-solar system [8] is used to produce the sufficient power in all the session. Since, we can generate sufficient power by using hybrid system. In exiting system if PV modules produce low power means boost converters are used to step up the PV module output [3]. PV module may produce high output power to control the high power boost converter combined with buck converter with Energy Management system and hybrid cascaded multilevel inverter [12]

2. RESEARCH METHOD

Eco-friendly power generation is the best feature of renewable energy systems. Renewable energy systems emit no pollution into the atmosphere when they generate electricity. However, most power plants such as thermal power generation and nuclear power generation plants have produced most of the power supply. Thermal power plants emit the carbon dioxide into the atmosphere, and nuclear power plants have potential danger and discharge nuclear wastes. On the other hand, renewable energy systems are very clean. India has a vast supply of renewable energy resources. Solar energy can be captured by solar panels. These panels transform the solar radiation directly into electricity. The efficiency of solar photovoltaic cells with single crystal silicon is about 13 % - 17%. High efficiency cells with concentrators are being manufactured which can operate with low sunlight intensities. And wind mill produces the power from the wind. The energy consumed to manufacture and transport the materials used to build a wind power plant is equal to the new energy produced by the plant. Wind generation systems [3] with the capacity to produce up to 50 kW of electrical power. It has the lowest gestation period as compared to conventional energy to improve the production of power by using the horizontal wind turbine [10]. The main objective is to manage the power consumption to maximize the energy efficiency. Energy management system [2] is used to monitor the weather condition and energy stored in battery system it manage the power consumption according to environmental condition and battery status. And then produce the sufficient energy in all the session. Next increase PV module output using MPPT it combines the boost converter and buck converter. This MPPT increase the PV module output upto 10KW.

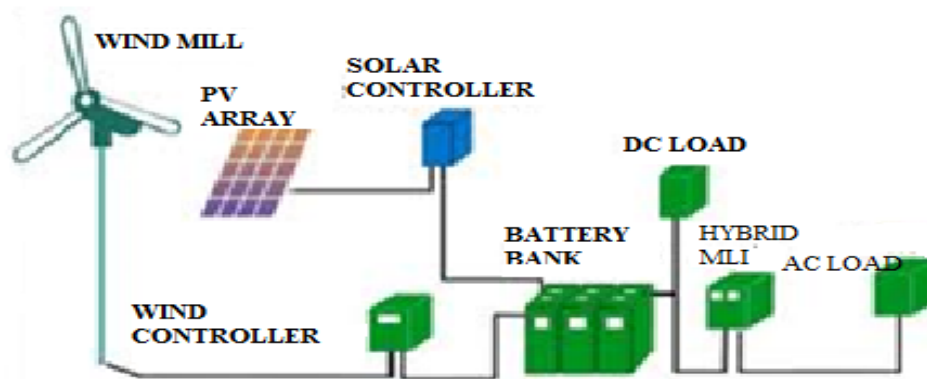


Figure 2. Block diagram of proposed method

The proposed is uses the energy management system the most important purpose of the energy distribution management system is to determine how efficiently generated power from solar panels can be used. For this purpose, system checks the status of a solar batteries charge [3] and infers future power consumption by using specific methods to use solar power. This system decides the time to use stored energy in a battery by using power information, the residual amount of stored energy, and web information. For example, Considers weather, which affects the efficiency of photovoltaic panels [2], and power consumption,

which is changing every hour, and decides the best time to use the stored energy. In this paper, we propose a energy management system with hybrid solar and wind.

This system continuously receives the battery storage and power consumption after it checks the these value with default value if power consumption is exceeds default value means it turn off the loads. We are assigns the priorities to the loads in order to over come the user inconvenient. To increase PV module output MPPT [4] is used. The existing system uses only boost converter in paper boost converter is combined with buck converter used because the the PV module [5] can produce high voltage than DC-bus voltage. Buck converter used to step down purpose. In this system on-line configuration check and buck-boost mode transition will be presented. Experimental results measured from three-string MPPTs with the maximum power level of 10 kW are used to verify the analysis and discussion.

3. ENERGY MANAGEMENT SYSTEM

Wind and solar hybrid system used to produce sufficient energy in the winter session. Wind speeds are often low in summer, when the sun resources are at their best. The wind is often stronger in winter seasons when there are less sun resources. Solar and wind produced the DC power then stored in battery then converted into AC power by using inverter then applied to the load. The micro controller continuously receives the power consumption and battery status using DC voltage and DC current measurement. Then these values are send to the PC using zigbee [6]. PC is checks the these value with default value if power consumption is exceeds default value means it turn off the loads. We assigns the priority to the loads in order to over come the user inconvenient.

4. PERTURBATION AND OBSERVATION METHOD

Flowchart of the perturbation and observation method. The controller will first determine the recent operation mode of the proposed MPPT. When the MPPT is operated in boost mode, inductor current i_{LM} is equal to PV-panel output current i_{pv} , so the output power of PV panel can be expressed as follows:

$$PPV_{boost}(n) = VPV(n) \times i_{LM}(n) \quad (1)$$

On the other hand, when the proposed MPPT is operated in buck mode, inductor current i_{LM} is equal to output current i_o , so the output power of PV panel can be expressed as follows:

$$PPV_{buck}(n) = VO(n) \times i_{LM}(n) \quad (2)$$

Since the output power of PV panels can be determined properly, the proposed controller can track the maximum power point with the algorithm of perturbation and observation method [4] more correctly and effectively.

5. ONLINE PV STRING CONFIGURATION CHECK

In order to track the maximum power point correctly and effectively, the algorithm of on-line PV string configuration check is proposed. A flowchart of the check algorithm is shown in flowchart Fig.2. First, the MPPT will check if there does any PV string exist. If there exists a PV cell, the MPPT will check VPV five times continuously to make sure VPV being higher than 150V. If VPV is higher than 150V, the controller will determine that a new PV module plugs in. On the other hand, if there is no PV string, the MPPT will check VPV five times continuously to make sure VPV being lower than 150V, and determine that a PV module is removed.

The proposed MPPT module, of which its converter topology is a boost converter combined with a buck converter and with a shared inductor to cover a wide input voltage range from 0 V to 850 V. The proposed controller can check the PV strings either connected independently or in parallel every switching cycle shown in Figure 3. If the PV strings are connected independently, the MPPTs will calculate their PV output power and vary their active-switch duty ratios individually. On the other hand, if the PV strings are connected in parallel, the MPPTs will sum up their PV currents to determine the PV output power for MPPT tracking and to distribute their currents to the MPPTs equally based on an average current control result shown in Figure.7.

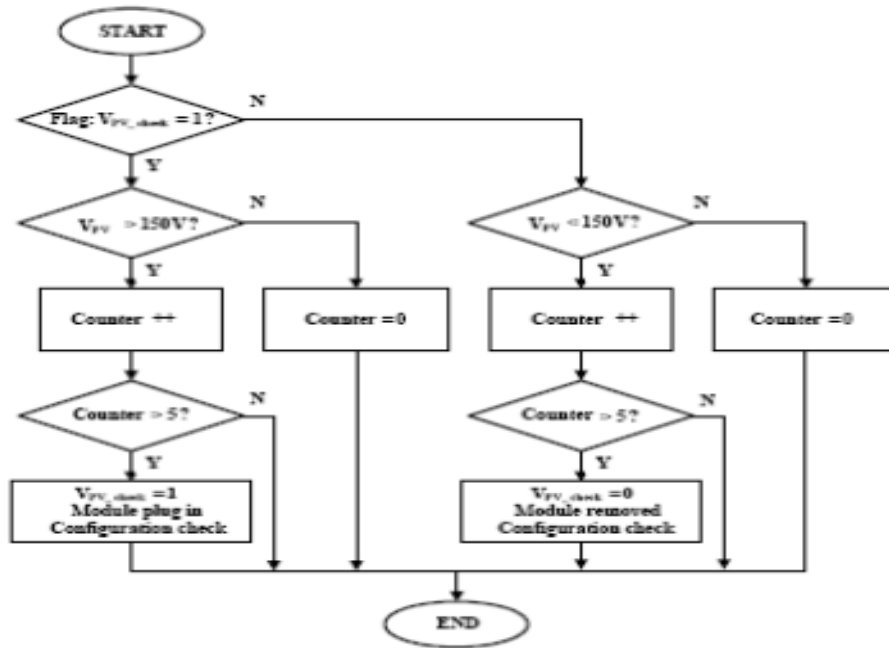


Figure 2. Online PV String Check Algorithm Flow Chart

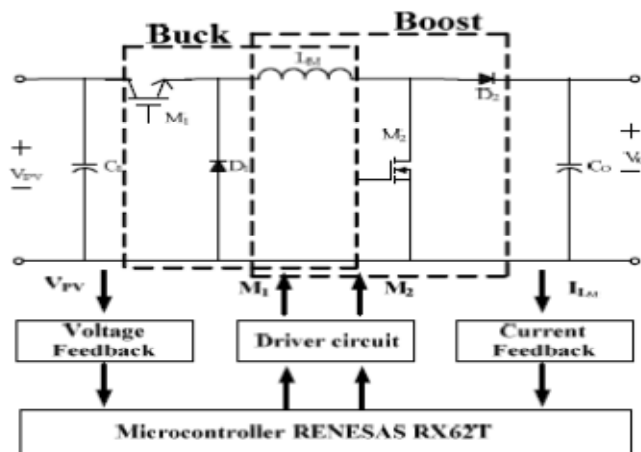


Figure 3. Buck – Boost converter with Microcontroller and Feedback

6. HYBRID CASCADED MULTILEVEL INVERTER

A different converter topology is introduced here, which is based on the series connection of single-phase inverters with separate dc sources. Figure 4 shows the power circuit for one phase leg of a Five-level inverter. The resulting phase voltage is synthesized by the addition of the voltages generated by the different cells. Each single-phase full-bridge inverter generates three voltages at the output: $+V_{dc}$, 0 , and $-V_{dc}$. This is possible by connecting the capacitors sequentially to the ac side via the six power switches. The resulting output ac voltage with nine levels, and the staircasewaveform is nearly sinusoidal, even without filtering. In order for the inverter output voltages to be added up, the inverter outputs of the three modules need to be synchronized with a separation of 120 between each phase. For example, obtaining a three-level voltage between outputs a and b , the voltage is synthesized by. The phase between and is provided by and through an isolated transformer. With three inverters synchronized, the voltages, are all in phase; thus, the output level is simply tripled. Let us describe the multilevel inverter simulation diagram which done by the simulink which shown in Figure 4.

For converting from DC grid to AC consumer here in this paper described about the thirteen level multilevel inverter for AC output without harmonics and losses by increasing the number of staircase waveform with reference to the sinusoidal waveform and filter component is also not necessary by using the Five level cascaded Hybrid Multilevel inverter. The Control signal for the hybrid cascaded multilevel inverter is shown in Figure 5.0 The modulation methods used in multilevel inverters can be classified according to switching frequency. Methods that work with high switching frequencies have many commutations for the power semiconductors in one period of the fundamental output voltage. A very popular method in industrial applications is the classic carrier-based sinusoidal PWM (SPWM) that uses the phase-shifting technique to reduce the harmonics in the load voltage [14], another interesting alternative is the SVM strategy, which has been used in three-level inverters [10]. Methods that work with low switching frequencies generally perform one or two commutations of the power semiconductors during one cycle of the output voltages, generating a staircase waveform. Representatives of this family are the multilevel selective harmonic elimination, [12] and the space- vector control (SVC) [11].

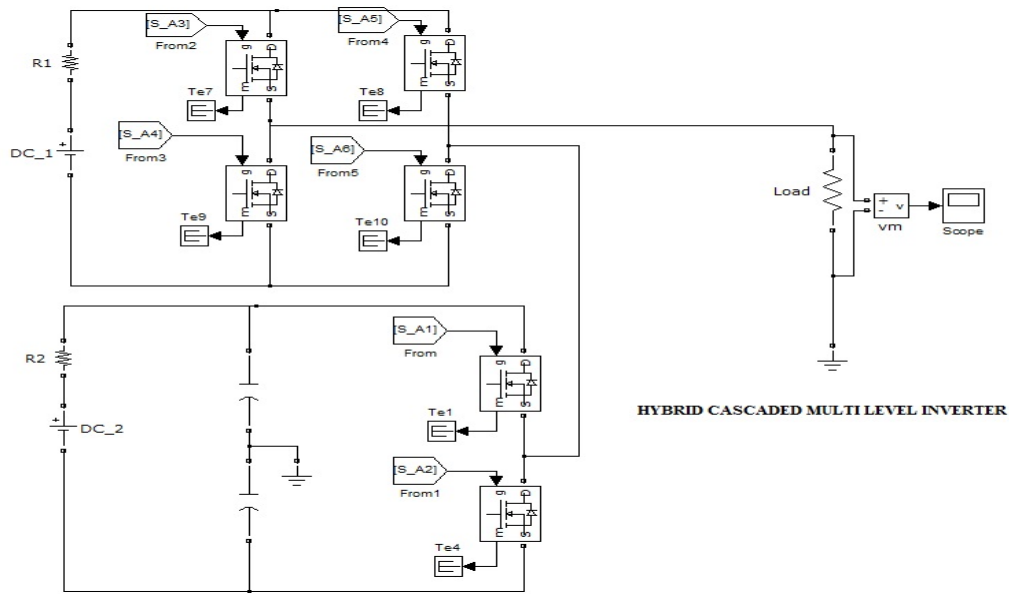


Figure 4. Hybrid Cascaded Multilevel inverter

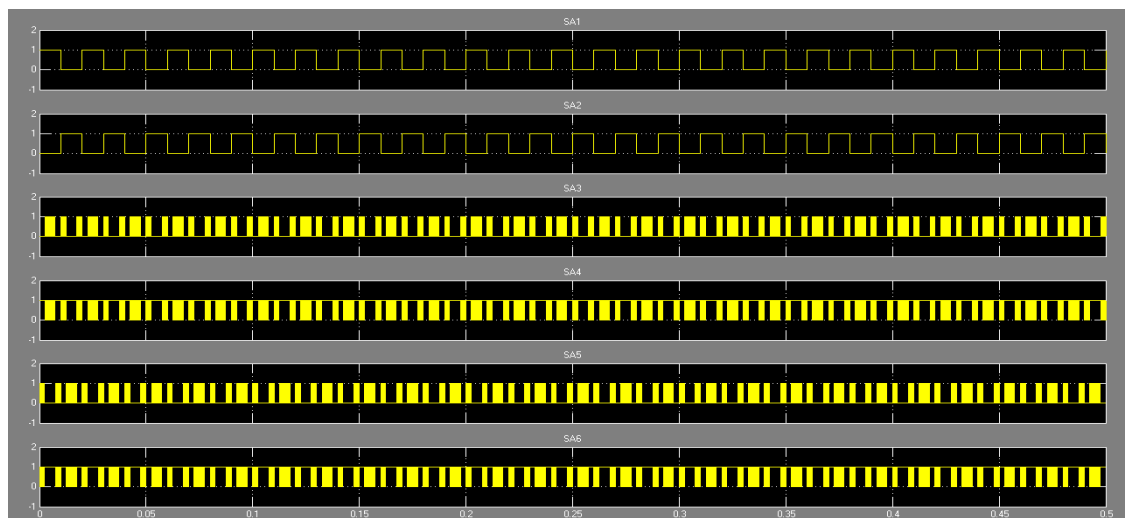


Figure 5. Control Signal for Hybrid Cascaded Multilevel inverter

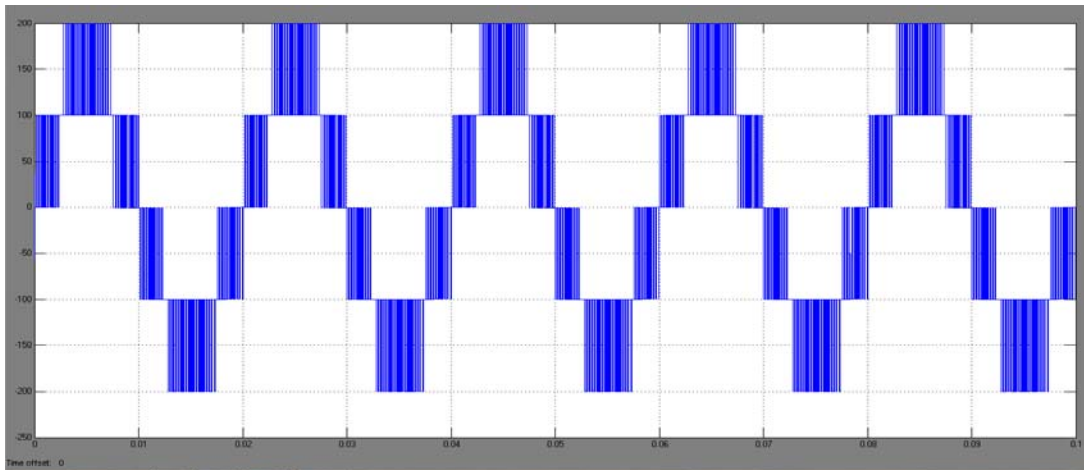


Figure 6. Output waveform for 5 Level Hybrid Cascaded Multilevel inverter

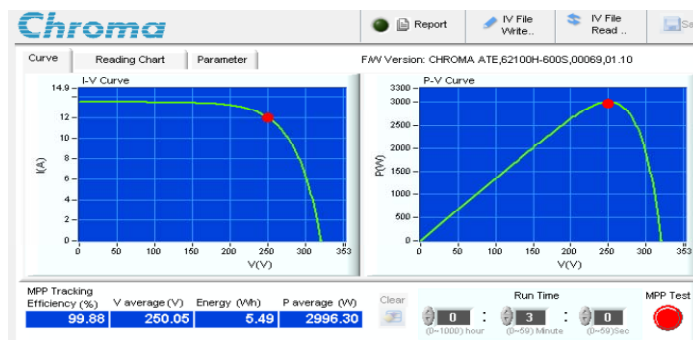


Figure 7. Measured tracking accuracy of the proposed MPPT under 3 kW

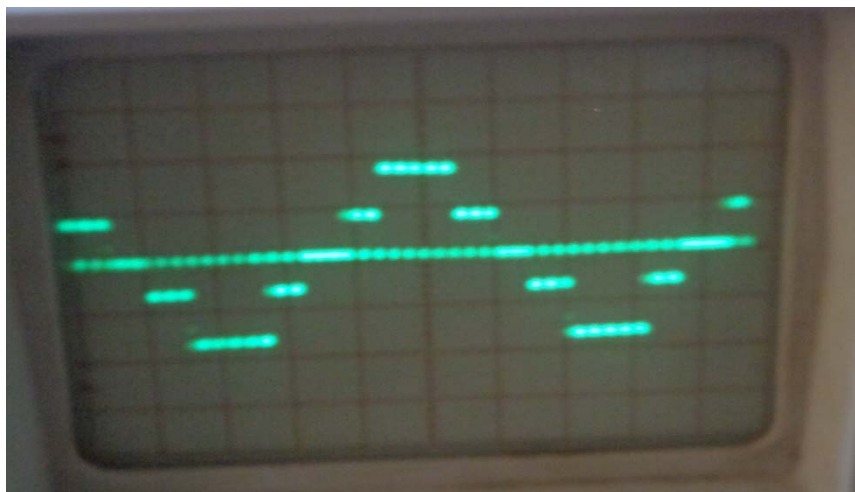


Figure 8. Hardware Result of 5 Level Hybrid Multilevel inverter

7. CONCLUSION

In this paper, the proposed system gave improved energy efficiency compared with a normal utility interactive system. If the limited storage capacity and the number of installation of solar panels are improved, the Energy management system shows better performance. Improving the PV module output power upto 10kw using multi powerpoint trackers by combining the boost converter and buck converter with online

checks and giving an AC load with Hybrid Cascaded Five Level Multilevel inverter. The conversion efficiency of the MPPT is higher than 98.25% in both buck- and boost-mode operations, and its tracking. The Output AC Load from an Renewable energy system with energy management system with Hybrid Cascaded Multilevel Inverter gives an high Efficiency.

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