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Grid Connected Solar PV Energy System with Improved Power Quality

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ABSTRACT: The expansion of the spread of solar photovoltaic power generation systems is fraught with challenges related to the low efficiency and performance of these systems in light of the change in the surrounding weather conditions and the disturbances associated with the loads, which weakens the electrical energy productivity of these photovoltaic systems due to energy loss. To overcome and reduce these challenges as much as possible, it is considered the use of controllers that track the maximum power point of photovoltaic systems is the ideal solution to increase their efficiency and improve the quality of their electrical power, in order to obtain the maximum productive capacity from these systems, and this will be reflected in achieving an optimum benefit from the available solar energy and thus reducing the loss of unused energy in the absence of the control system. This paper presents a study, analysis and simulation of the actual behaviour of the grid-connected solar photovoltaic system model by means of the program. The performance of Fuzzy Logic Controller is then evaluated to track the path of the maximum power point, and its work is based on tracking techniques that use the direct control method to control the operating cycle of the DC commutator, which in turn performs by feeding the inverter with the maximum output power from the solar photovoltaic system. A tracking technology was selected that relies on the method of artificial intelligence, which is the technique (fuzzy logic controller), and a fuzzy logic controller of the type (Mamdani) was used. The most suitable for tracking the maximum power point at the steady state of the Grid and under constant and changing weather conditions, as well as choosing the most appropriate controller when transient disturbances occur in the Grid under constant weather conditions only.

I. INTRODUCTION

The disturbance of the voltage of the P.V. arrays during the Maximum Power Point (MPPT) tracking always produces an inherent error produced by power fluctuations on the D.C. side, especially during steady-state operation, which is one of the most important prominent drivers of inter harmonics in P.V. systems. Based on the above analysis, a mitigating method for inter harmonics in P.V. systems is nothing more than randomly altering the MPPT's sampling rate between fast and slow. The solar panel's maximum power production is reached just for one precise working point, and P.V. generating efficiency is determined by the maximum amount of sunlight available. Traditional electric power systems are built to rely on big baseload power plants with limited ability to ramp output quickly or decrease output below a particular threshold. The increased demand variability brought on by intermittent sources like photovoltaic devices creates new challenges for system adaptability. Solar systems have recently gotten a lot of interest since solar energy is everywhere, and the cost of a photovoltaic cell is falling. Photovoltaic systems are inherently intermittent and cannot meet all of the electricity needs throughout the year. As a result, grid-connected P.V. systems with advances are often selected to maintain an uninterrupted power supply. P.V. array, diode, dc-link capacitor, voltage source inverter with harmonic reduction filter, step-up transformer, and power grid make up the system. The dc-link capacitor is charged by the D.C. power generated by the solar array. The grid connection inverter converts D.C. to A.C. power, which has the same frequency as the utility grid and sinusoidal voltage.

Environmentally friendly solutions are becoming more prominent than ever due to concern regarding the state of our deteriorating planet. This paper presents a new 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. With 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 to the generator lifespan, heating issues, and efficiency. The fused multi-input rectifier stage also allows Maximum Power Point Tracking (MPPT) to extract maximum power from the wind and sun when it is available. An adaptive MPPT algorithm will be used for the wind system. A standard perturb and observe method will be Harmonic problem is becoming more common with almost all electronic or magnetic equipment's connected to the utility grid used for the P.V. system. Operational analysis of the proposed system will be discussed in this method, and simulation results are given to highlight the merits of the proposed circuit.

II. LITERATURE SURVEY

2.1 A. BAKHSHAI ET AL., "A Hybrid Wind – Solar Energy System: A New Rectifier Stage Topology" , IEEE Magazine, July 2018.

Environmentallyfriendly solutions are becoming more prominent than ever due to concern regarding the state of our deteriorating planet. This paper presents a new 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. With 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 to the generator lifespan, heating issues, and efficiency. The fused multi-input rectifier stage also allows Maximum Power Point Tracking (MPPT) to extract maximum power from the wind and sun when it is available. An adaptive MPPT algorithm will be used for the wind system. A standard perturb and observe method will be Harmonic problem is becoming more common with almost all electronic or magnetic equipment's connected to the utility grid used for the P.V. system. Operational analysis of the proposed system will be discussed in this method, and simulation results are given to highlight the merits of the proposed circuit.

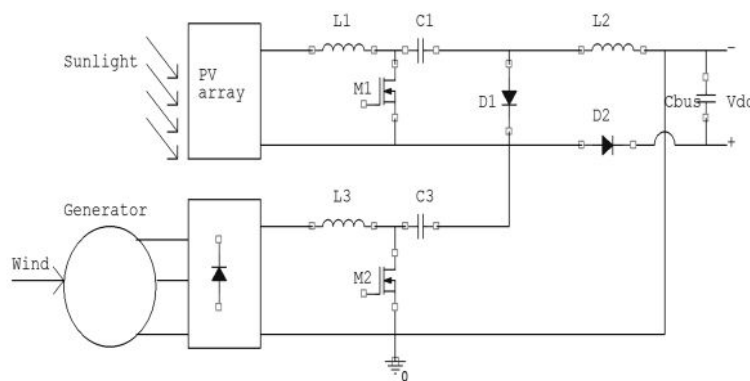


Figure 2.1 A Hybrid Wind Solar Energy System

2.2 R. Bharanikumar And A. Nirmal Kumar, "Analysis of Wind Turbine Driven Pm Generator with Power Converters" , International Journal of Computer And Electrical Engineering, Vol. 2 [4], August2018.

A Wind Generator System that employs a boost chopper and a permanent magnet synchronous generator is studied. By replacing the main circuit of the generator and boost chopper with the equivalent circuit, the power and D.C. output voltage are obtained as a function of the duty ratio of the boost chopper and generator rotational frequency. Wind generator control methods have already been proposed to efficiently utilize wind power prone to fluctuation every moment. The induction type machine has the advantages of robustness, low cost and maintenance-free operation. However, they have the drawbacks of low power factor and the need for an A.C. excitation source. A permanent magnet generator is chosen to eliminate the drawbacks of the induction generator.

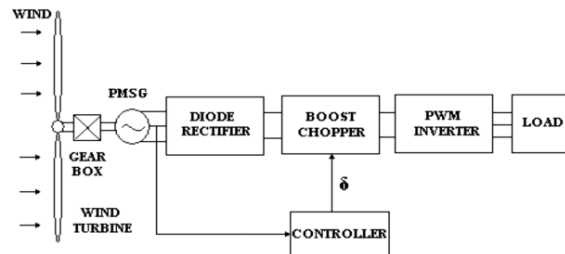


Figure 2.2: Analysis of Wind Turbine Driven Pm Generator

Boost chopper circuit with a single switching device is the choice for power control that provides improved efficiency. The generator and boost chopper are represented by their equivalent circuits for analysis of the above wind generator system. Performance characteristics such as generated output power and D.C. output voltage are expressed as functions of the duty cycle of the chopper and shaft speed of the generator. The power generated varies with load, with the peak occurring at a certain load. evaluation model and applies it to analyse optimum generation expansion of small isolated systems using P.V. and wind energy sources. Considerable attention has been given to renewable energy sources in recent years due to concerns with dwindling fuel reserves and the potential impact of conventional energy systems on the environment.

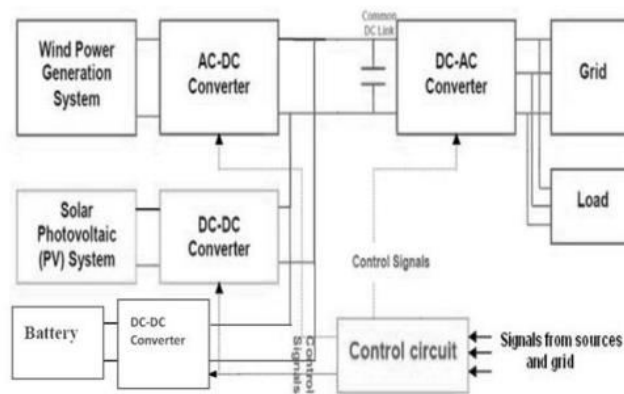


Figure 2.3: Small Isolated Power Systems Using P.V. and Wind Energy

III. EXISTING SYSTEM

In the existing method, Fuzzy Logic Controlled Solar Power Generation using Multi-level inverter Hybridization of several types of renewable energy sources is an interesting alternative to ensure autonomy in a standalone system since it compensates intermittent production of each one. It is an interesting alternative to a standalone system. Maximization of power production can be done with the best economic control strategy. This method outlines a hybrid power system consisting of a solar power system and wind power system and its storage. A hybrid system offers more reliability than another system because the energy supply does not depend entirely on one source. Solar and wind are seasonal, and both may not be available at all times, which causes difficulties in the power generation, reducing the efficiency and consistency in the power generation.

DISADVANTAGES

- It will give only low output
- Maintenance cost increases
- Installation cost is high
- Reliability is less
- Efficiency is low
- It is difficult to calculate the precise location and timing of events.

IV. PROPOSED SYSTEM

The proposed method implementation of MPPT (Maximum Power Point Tracking) for identifying the fault and defects. Voltage and current are maximum tracking's without the negative value while getting the input source of the three P.V. (Photovoltaic) mechanisms are used in this method. The condition analysis status in P.V. and caused by constraints such as low voltage and low backup storages. If any defects of solar panels easily identify while using a centralized MPPT control technique. Better gain of source output and without any lagging are the main working operations of Maximum PowerPoint. Wireless sensor network is the monitoring the voltage and current sensor value in between the P.V. (Photovoltaic) panel via a DC-DC converter. The power produced the estimating values with better efficiency output and tested in Mat lab and Hardware experimental setup.

V. BLOCK DIAGRAM

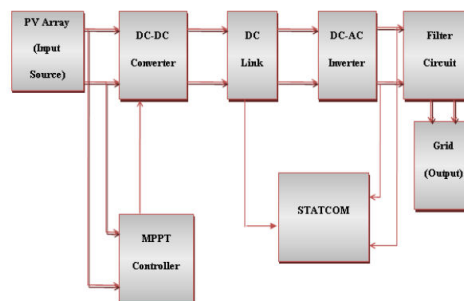


Figure 5.1 Proposed block diagram

VI. CIRCUIT DIAGRAM

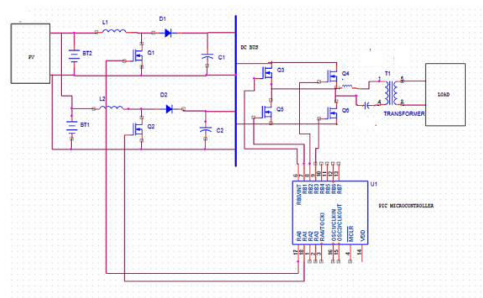


Figure 6.1 circuit diagram

The solar panel is with semiconductors. Since the whole ecosystem on planet earth is dependent on solar energy and it's a huge source of never-ending energy. Solar panels are photovoltaic which, generates electrical energy using sunlight radiations. Depending on the sun's radiation position and intensity, the amount of electrical D.C. energy will produce. For the proposed project specifications and design, a 12V, 150 watts off-grid solar panel is required. The wind is available 24 hours in the earth's ecosystem. Wind turbines have large blades joined to a rotor of the generator, leading to produce electrical energy as moves by a flow of wind. Wind power is also renewable, never an energy source and easily available within the atmosphere. Wind turbine power plants are much more popular, providing much more efficient considering the space of implementation. The inverter is an electronic system; converts direct current into alternating current, i.e., D.C. into A.C. The stored electrical energy in the batteries is D.C. in nature. And it cannot be utilized for various kinds of load. So, delivering A.C. supply to the load inverter system is required. The inverter is either analog or digital kind. The digital inverter is microcontroller-based which increases the buildup cost of the system. Also, it uses MOSFET technology, providing more efficiency. But, considering the financial aspect and resolution, the proposed project designs and builds the inverter analog in nature. Solar panels, which run on semiconductors, provide an endless supply of energy and are essential to the Earth's environment. With the sun's

location and strength dictating the quantity of electrical DC energy produced, photovoltaic panels use solar radiation to generate electricity. The suggested project requires an off-grid solar panel with a voltage of 12V and 150 watts. Around-the-clock, wind turbines generate electricity when the wind blows. Wind energy is abundant and renewable in the atmosphere. Because wind turbines use less area than other power plants, they are efficient and well-liked. Electronic devices called inverters convert direct current to alternating current so that DC electrical energy may be stored in batteries. Figure 6.2: Experiment result layout Figure 6.3: Test result in Wave form The above fig 16 and 17 illustrate the test results and the findings of the proposed system. The load inverter system in the proposed project needs an analog or digital A.C. supply. The digital inverter is planned and constructed analog owing to budgetary concerns and resolution, while using MOSFET technology, which raises system construction costs. The suggested two-step predictive MPPT method uses the error at the subsequent sampling time before applying the switching signal, which increases dynamic performance and efficiency. Because of its quick convergence, it is perfect for situations where external factors like temperature, insolation, or PV array shape change quickly. Especially under partially overcast skies, this method increases the amount of energy that the photovoltaic system absorbs and injects into the grid without the need for costly sensor and communications equipment. A grid-connected photovoltaic system with predictive control is used to feed the grid with the maximum amount of harvested energy, producing high-quality current that is in phase with the grid voltage and has minimal total harmonic distortion. This allows for efficient energy production and grid stability, ultimately maximizing the overall performance of the photovoltaic system. Predictive control is a renewable and ecologically friendly energy source since it also helps to lessen greenhouse gas emissions and dependency on fossil fuels

VII. CONCLUSION

This method improved MPPT (Maximum Power Point Technique) using the error at the next sampling time before applying the switching signal. The proposed two-step predictive MPPT technique is compared both Perturb and observe to improve dynamic performance and efficiency. The technique exhibits fast convergence, which is ideal for rapidly varying environmental conditions such as changing temperature or insolation or changes in the morphology of the P.V. array itself. As a result, more energy will be captured from the P.V. system and injected into the grid, particularly during the partially cloudy sky, without requiring expensive sensing and communications equipment and networks to directly measure the changing solar insolation. The maximized captured energy is fed to the grid through a grid-connected photovoltaic system controlled utilizing predictive control. High-quality current, with low THD (Total Harmonics Distortion) and in-phase with the grid voltage, is achieved and injected into the grid using the proposed predictive controller.

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