Solar Power Generation System Model Integrated With Network Connected Battery Electricity

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Abstract

The use of solar energy as a clean and renewable energy source via a solar power generation system connected to the general electricity grid, such as the State Electricity Company, has become a major concern for previous researchers. The most recent update This grid general electricity system is integrated with an energy storage system to maintain the power system's stability and reliability. This paper presents a grid general electricity model that is more stable, effective, cost-effective, and dependable than the existing system areas that support environmental conservation. The method used in this paper is a literature review to study and learn about the development of existing systems. The following step is to perform optimal topological design, modeling, simulation, and analysis for an integrated general electricity grid system with a battery-like energy storage system. The power converter between the battery and the power grid is a two-way system that is developing a new system-based coordinating control strategy intelligent fuzzy logic controller in the grid general electricity system work system.

Keywords: General Electricity Grid, Battery, Electricity Network

Introduction

Conventional energy sources, namely fossil fuels, are rapidly depleting and having a widespread negative impact on the environment; therefore, clean and renewable energy can be considered the best option for long-term energy supply (Elkholy, 2019). The use of solar energy as a clean, environmentally friendly, abundant, and renewable energy source via a solar power generation system has become a major focus for researchers.

In general, the grid general electricity system lacks an energy storage system. Equipment If the grid system is in a normal state, the electrical power or inverter of this system works. The system inverter will not operate if the power grid fails. As a result, the use of solar energy is also ineffective. Another issue is the fluctuation of solar energy caused by weather and other environmental factors. For example, if every member of a high-density population, such as a city, realizes this system, the fluctuation problem will arise. When all of the grid's general electricity is simultaneously supplying electrical energy, the voltage in the area's distribution system rises. Another issue is the increased distortion of harmonic currents from many systems on the general electricity grid. As a result, this issue may have an impact on the quality of electrical power from the distribution network.

The main issue with PV systems in general is their reliance on solar irradiation. If there is no solar irradiation, the distribution system in the affected area will experience a voltage drop, causing many electrical devices to malfunction. To address this issue, several previous researchers proposed the concept of a general electricity grid equipped with energy storage. The battery, in general, is used for energy storage. When the power at the network connection point fails, the power from this battery is used to power the backup power provider and the media storage. A battery is also required to help with stability and dependability as a power supply.

The development of the grid general electricity system by using energy storage batteries as an energy buffer so that the energy obtained can be used to supply the building's electrical load and the electric utility grid to the greatest extent possible. The system requires precise energy management. By increasing supervision and management in the BPE's filling and discharging operations, as well as further development, it is possible to achieve optimal and flexible use of renewable energy sources. This paper intends to develop a new control strategy for the grid general electricity system that is based on a fuzzy logic controller and an artificial neural network. Furthermore, the purpose of this paper is to present an optimal topology for the grid general electricity system with battery energy storage system. Odel presented it. It is hoped that an integrated the grid general electricity model with more energy storage systems that are stable, effective, cheap, and reliable will be obtained, thereby supporting environmental conservation areas.

Method

The proposed system design consists of two stages: Development is the first stage. The grid general electricity system scheme was integrated with batteries as energy storage. Model the grid general electricity system components that are integrated with the energy storage system / battery using a common topology, as shown in Figure 1. Verifying individual model components and integrating them into the grid general electricity system from image 1 using MATLAB / Simulink software. Models of various components such as PV arrays, battery storage, power converters, filters, transfer switches, and control mechanisms are available. In general, PI-based control mechanisms.

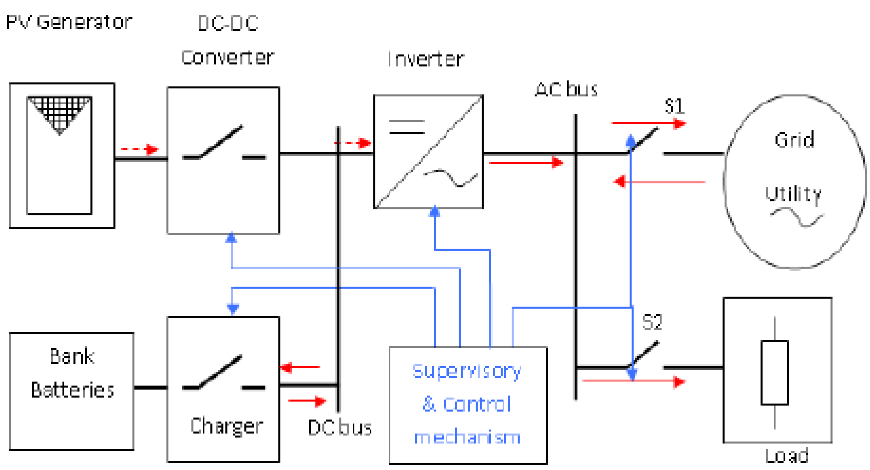

Figure 1. *PV system configuration that is grid-connected and integrated with the system Energy storage.*

Analyze and evaluate the performance of the simulated power generation system system with battery storage. Designing a new optimal network topology based on Figure 1's topology and recent literature. Evaluate the new network topology by running simulations with the MATLAB / Simulink software. The traditional PI method is used as the control system in this topology. Comparing new topology performance to common topologies and topologies from recent literature, but with a traditional PI-based control system (Njiri, 2016).

Phase II consists of the creation of a new control strategy for a new network topology. Using Fuzzy logic controller technology, create a control strategy for the general electricity grid that is integrated with the energy storage system / battery. Create a control system using the programming languages C/C++ and Matlab/Simulink. Integrating a new topology model and a control system based on a fuzzy logic controller in a single simulation framework allows you to test the performance of the control system (Kabalci, 2013).

Evaluating and contrasting the performance of a Fuzzy logic controller-based control system with a conventional PI control system and some recent literature. Repair the system's standard Fuzzy logic controller control to improve system performance (Nourai, 2009). A good performance indicator is the grid general electricity system's response to sudden changes in changing environmental conditions, electrical power system disruption, load changes, and fluctuations in the amount of electricity on the main power grid. Modifying the best Fuzzy logic controller model based on new literature resulted in improvements. Evaluate the effectiveness of new control-based strategies. Improved Fuzzy logic controller for general electricity grid with energy storage / batteries. Based on new literature, compare the performance of the new system with some of the existing systems.

Results

The grid state electricity generator is operational, and the battery is typically fully charged by the grid state electricity generator through a two-way inverter. A larger load is also supplied by the state electricity generator via the meter. The upper and lower limits of the battery's state of charge are considered and maintained in order to avoid overcharging or undercharging the battery (Martinez, 2010).

While the public electricity network is disrupted or islanding, the power generation system operates. The public power grid went down, causing the inverter to go into standby mode even though the power generation system panels were producing electricity. Local load supported by battery bank in stand-alone mode via Sunny Backup 2200. While a larger load is turned off. The system is waiting for the public grid to be restored. When the public network is restored, Sunny Backup will automatically reconnect to the grid and charge the battery without interruption. Furthermore, the inverter will supply electricity to the public network and local loads generated by solar power generated by the power generation system panel system. Overcharged batteries have a local load that can always supply electrical energy. The power generation system has been turned off, and the public electricity network is operational as usual. If not, there is electricity from the PV mini-grid and a larger load supplied by the public network (for example, at night). Despite this, Sunny Backup 2200 continues to fully charge its battery supply local loads (Subiyanto, 2012).

The power generation system and public electricity networks are both inoperable. When all resources are turned off. Only local load from a storage source (battery), such as operating mode B, is supported. The inverter is also turned off in this mode. In terms of capacity battery bank (30 Units @ 100 Ah, 12V), the battery can power a 3 kW local load continuously for 10 hours. As shown in Figure 3, the grid general electricity system with battery is simulated using MATLAB / Simulink. The grid general electricity simulation results with energy storage battery with MATLAB / Simulink are as explained below. The PV output power simulation is affected by solar irradiation. The variation in PV output power corresponds to the variation in solar irradiation. Figure 4 depicts the combination of variations in solar irradiation and variations in power generated by the PV system with MPPT. Figure 5 is the same variation image as Figure 4, but the PV system is not equipped with MPPT.

Discussion

The results in Figures 4 and 5 demonstrate the effectiveness of using the MPPT controller in PV system operation. As a result, when the MPPT is used, the PV output power is always greater. As illustrated in Figure 4, the maximum power generated by the system PV is nearly 3 KW and as low as 600 watts. The highest power produced in image 5 is 2.3 kW, and the lowest is around 400 watts. The use of MPPT is a critical step that must be taken in a PV system. This is done to increase the yield.

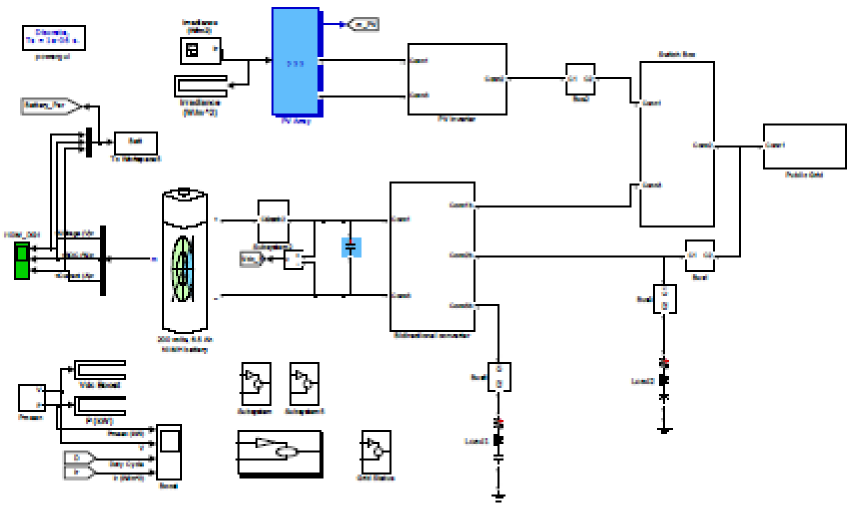

Figure 3 *A grid-connected PV system with backup batteries is fully simulated.*

Figure 6 depicts the simulation results of the DC link behavior in a general electricity grid with batteries. This performance has a 300 volt constant DC voltage and a modulation index of 350.

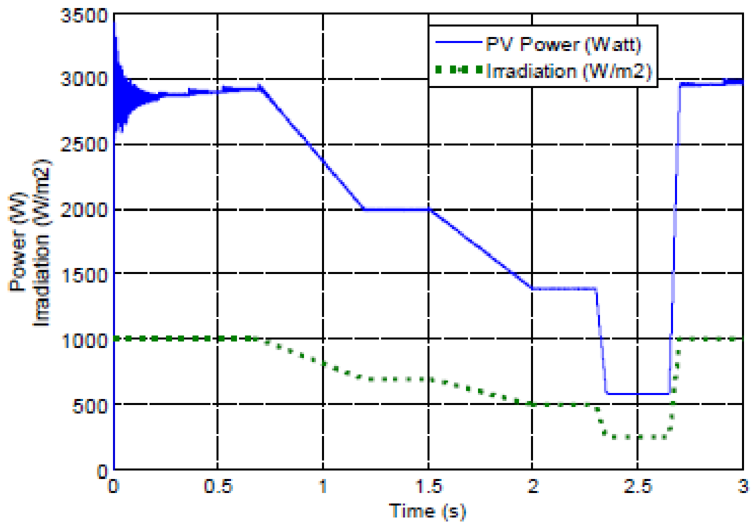

Figure 4. *Irradiation of solar light vs. PV mini-grid power with MPPT*

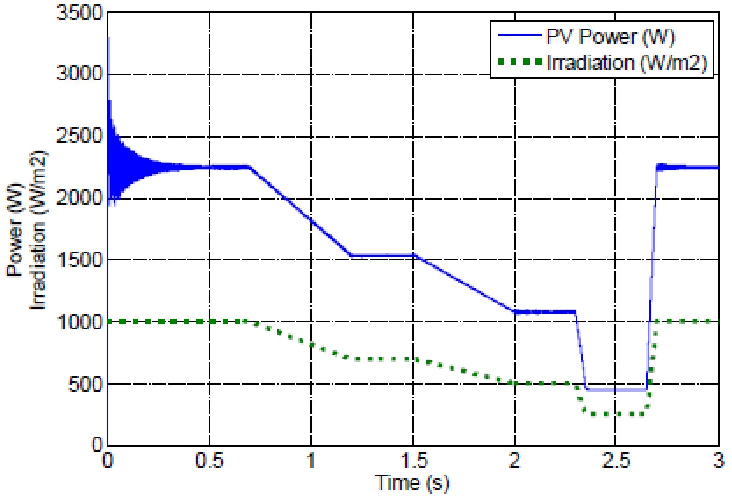

Figure 5. *Solar radiation versus PV mini-grid without MPPT*

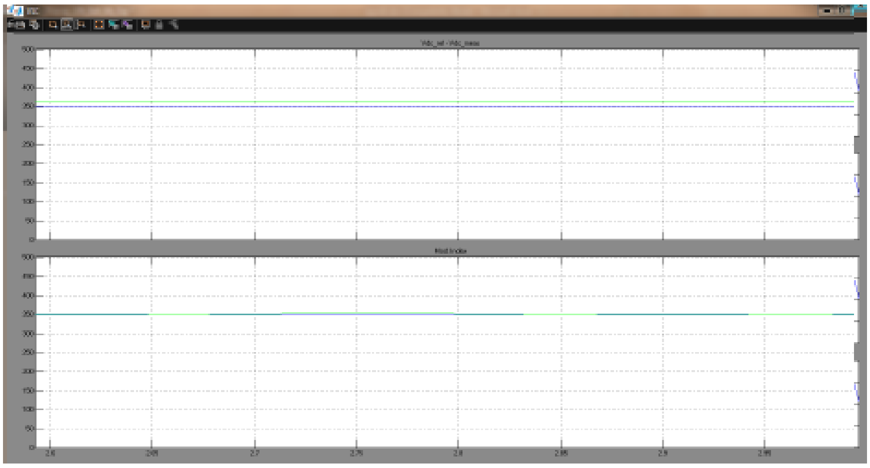

Figure 6. *Inverter DC-Link Voltage and Bidirectional Inverters (top and bottom*)

Figure 7 depicts the discharging process from the battery in the grid general electricity system. Figure 8 depicts the associated battery charging process. The discharge process occurs when PV systems produce no or very little power, while the load requires a large amount of energy and the public power grid is not operational.

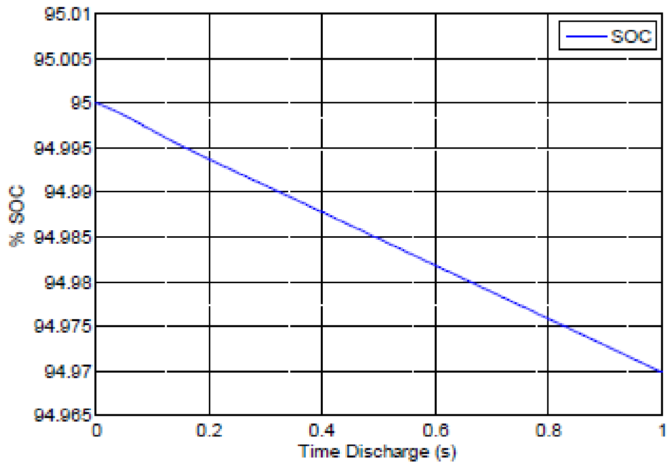

Figure 7. *The battery system is being discharged*

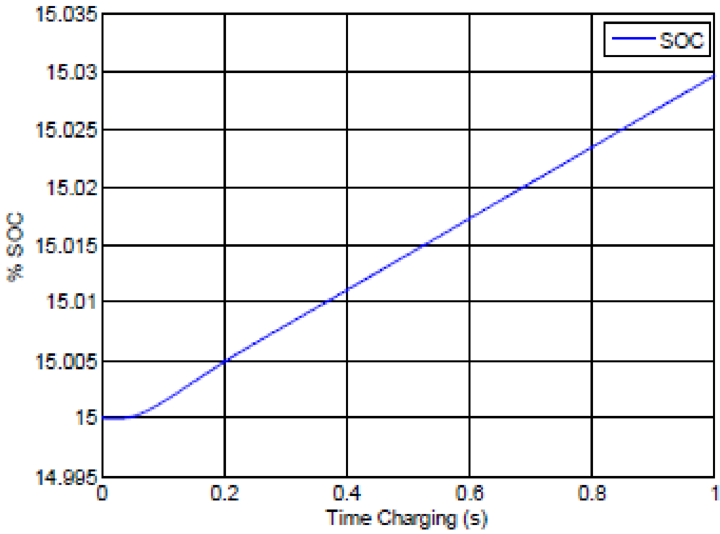

Figure 8. *Battery charging system*

Figure 9 depicts the voltage profile of each power generation system inverter, Bidirectional inverter, load, and network or nets from top to bottom for phase 1. The voltages appear to be in-phase and equally large. Figure 10 depicts a snapshot of the general electricity grid's phase 1 wave. As shown in Figure 10, the current 0.1s time the load increases and the grid current phase changes by 1800 at the same time (Gollou, 2017). When this happens, the network flow changes in size. The network current becomes zero due to islanding at 0.2s - 0.3s, and the load current equals the PV inverter current. The system returns to normal connected grid general electricity operation at time 0.3s, and the current profile is the same as the time interval 0.1 - 0.2s. Finally, the load current increases as the load increases after 0.4s. Figure 11 depicts the total harmonic distortion of currents and voltages. The picture clearly shows that the THD voltage is very low (Kundur, 1994). Next A Fast Fourier analysis was performed to evaluate the quality of the inverter's output voltage (Hammons, 2000). The total harmonic distortion at the common coupling point, which is the point between the inverter and the grid, is calculated in the analysis, and the harmonic frequency spectrum is obtained, as shown in Figure 12. According to the FFT analysis, the output voltage THD inverter is 0.06%. It also falls below the standard THD limit of 5%. (Kasera, 2012).

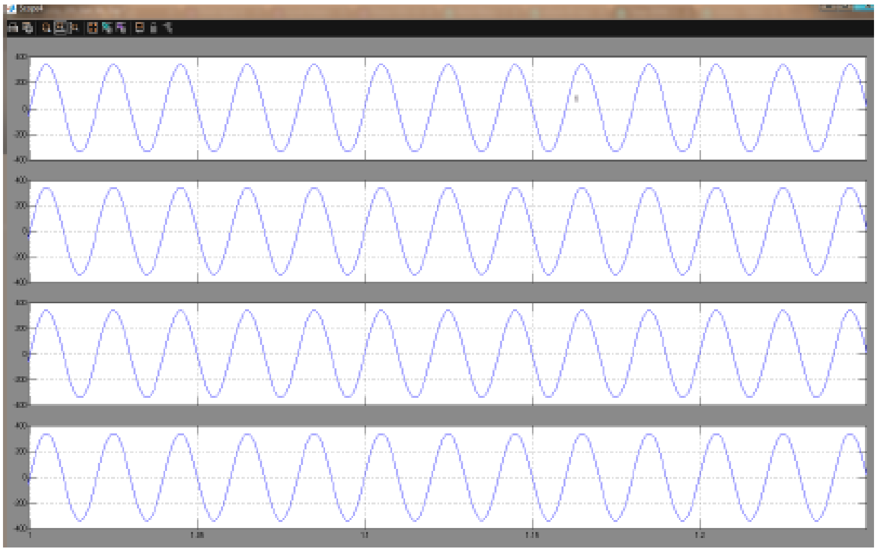

Figure 9. *From top to bottom, the voltages of the PV mini-grid inverter, bidirectional inverter, load, and network general electricity are shown.*

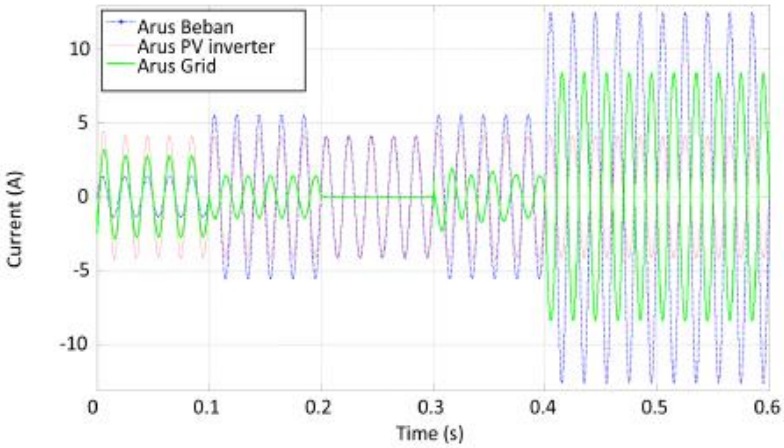

Figure 10. *Current power generation system profile*

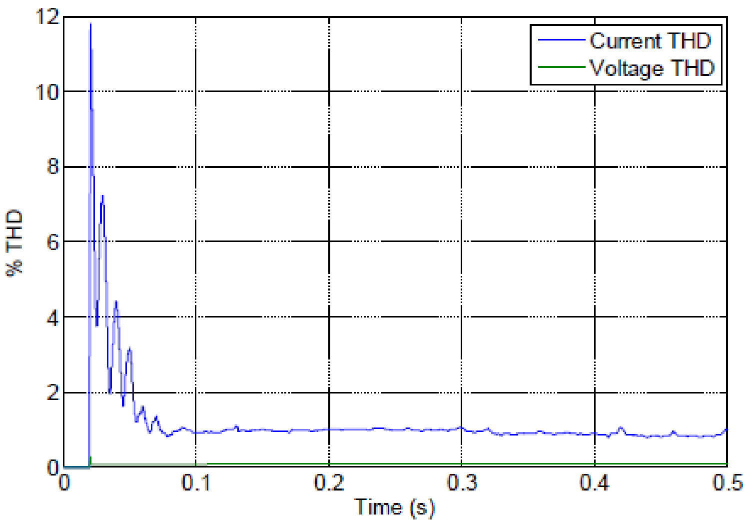

Figure 11. *Power generation system total harmonic currents and voltages*

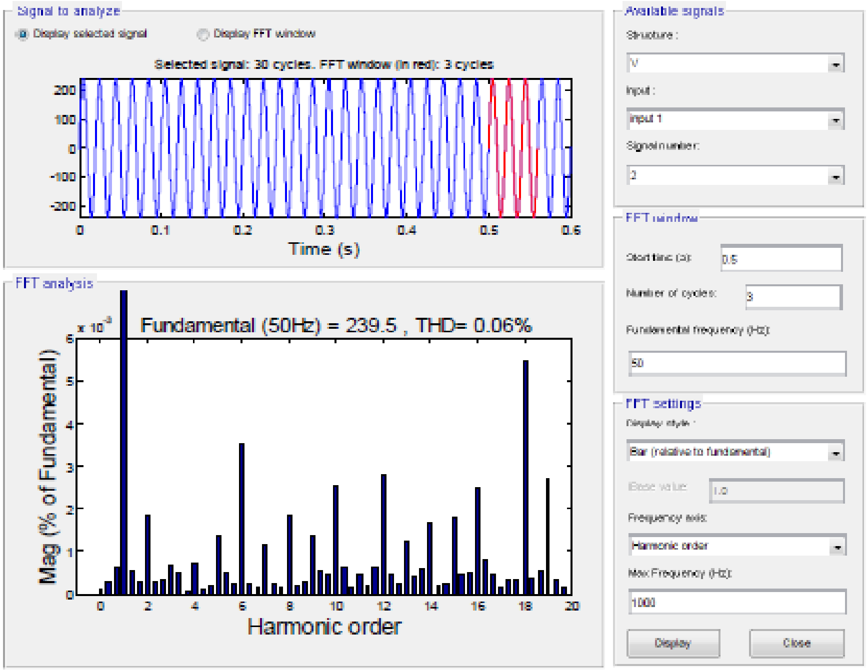

Figure 12. *Harmonic spectrum total in phase 1 inverter*

Conclusion

This paper presented a strategic model for controlling a solar-connected electricity grid integrated with battery storage. In general, grid general electricity does not include energy storage or batteries. To function properly, inverters in the grid general electricity system require a supply / connection to the general power grid. If no network power is available, the inverter does not operate. The supply from the common power grid is critical to system reliability. Recently, the grid general electricity with spare batteries has become a popular solution to this problem. When power causes overvoltage at the connection point, this battery is used for backup power and storage media. A battery is also required to assist in getting started.

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