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A Review of Improvement of Power Quality of Grid Interactive PV System with Harmonic using MPPT For Distribution System

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ABSTRACT-

Photovoltaics (PV) is a method of generating electrical energy by directly converting sunlight into electricity, using semiconductor materials that exhibit the photovoltaic effect. A photovoltaic system uses solar panels composed of multiple solar cells to provide useful solar energy. Directly converting sunlight into electricity without any moving parts or environmental emissions during operation. The purpose of this study is to aggregate the energy used by various power sources and calculate the total kilowatt-hours per day over four seasons. Based on the high energy consumption of split during the four seasons, grid-connected photovoltaic systems will be developed to supply 20% of the power. The design and analysis of a three-phase grid-connected transformer are thoroughly discussed in this article. The performance of the proposed stabilization scheme is evaluated on a three-phase grid-connected photovoltaic system. By using a controller, the total harmonic distortion (THD) can be reduced and the overall system performance can be improved.

Keywords- Photovoltaic cells; MPPT device; MATLAB.

1. INTRODUCTION

This is well proven, as photovoltaic systems have been used in specialized applications for over fifty years and grid-connected photovoltaic systems have been used for over twenty years. Maximum power point tracking (MPPT) is an electronic system that controls photovoltaic (PV) modules in such a way that the modules can produce electricity at their full potential. MPPT is a fully electronic system that changes the electrical operating point of the module so that the module is able to deliver the maximum available power. The excess energy collected from the module is then made available as an increased battery charging current.

This study has the following advantages:

1 Energy consumption in the network system is reduced by 20% and hence, electricity bills are reduced.

2 The production capacity utilization method includes the period when household appliances are not used in the department at any time of the year, i.e. 7.44 kW during summer in this project.

3 Provide 33% and 28% of the required load in winter and spring and autumn, respectively.

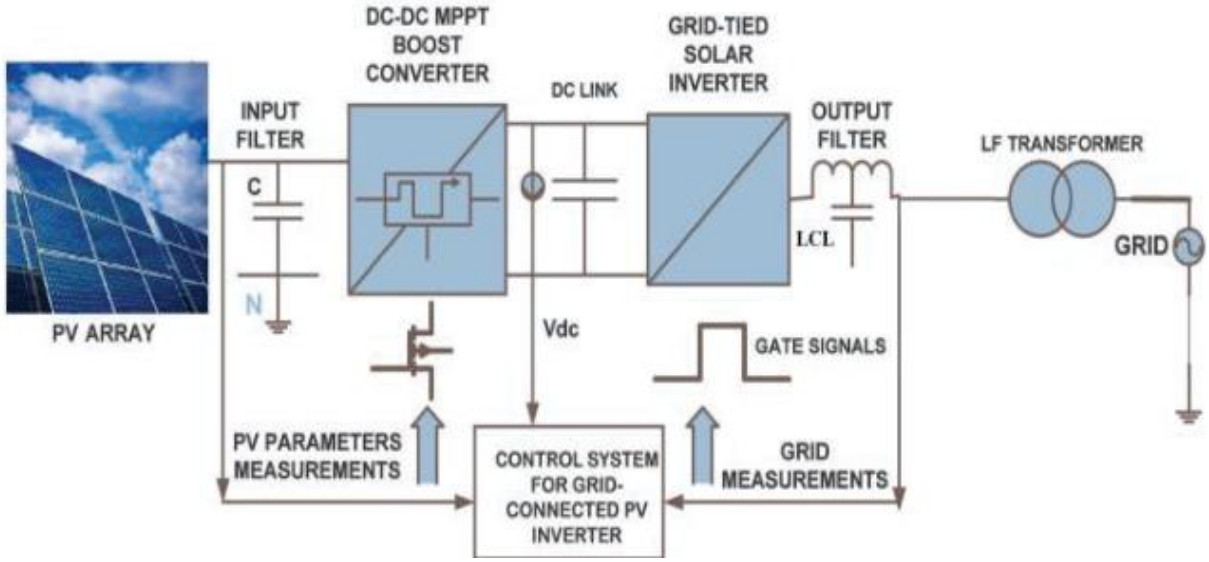

Figure 1 Grid Interactive PV System

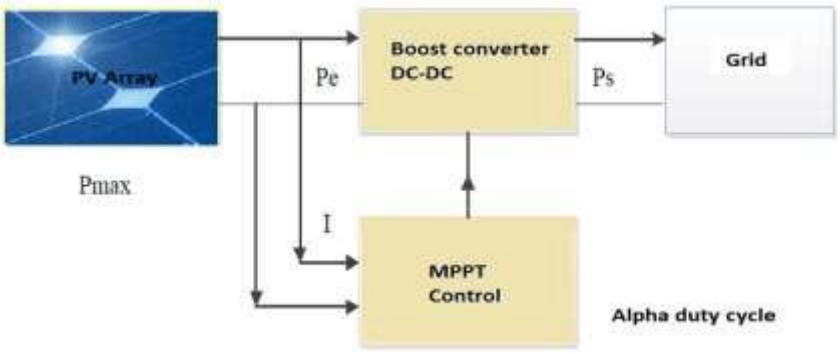

Figure 2 Grid Interactive PV System with MPPT

2. LITERATURE REVIEW

Liming Liu et al. The principle of energy distribution between PV and SES is defined by a vector diagram. Similarly, a complex power distribution strategy has been developed to distribute power between PV and SES based on a new Fourier transform (DFT) phase-locked loop (PLL) method. Nilesh Shah, al. Photovoltaic (PV) cell components are not very consistent in providing a single maximum power point (MPP) for the P-V curve under inconsistent conditions. The properties and hence the MPP point varies with different intensities and temperatures. To maximize the power of the PV array, a low-level MPP tracking algorithm is proposed. The algorithm takes a single input which is the slope of the P-V curve. Maximum power point tracking (MPPT) is used in photovoltaic systems to maximize the photovoltaic power regardless of temperature, irradiance conditions and electrical load characteristics. A new MPPT system is being developed with a DC to DC converter controlled by a unit supported by a microcontroller. When the battery's state of charge (SOC) reaches a certain level, a flexible pulse-current charging system is used to determine the charging current by the interrupter profile. **Prashant V. Tagore et al.** Using solar energy, different technologies are required to convert the energy. The principles of PV are image (light) and voltaic (electricity), where sunlight emits free electrons from the panel atoms and creates a difference in electrical energy. Since PV panels convert sunlight into electricity in the form of direct current (DC), while most residential electrical appliances require alternating current (AC), DC-AC power conversion is required. According to Mohammad H. Rashid, Al Current, India needs to generate more electricity to maintain economic growth of 8-9%. Currently, renewable energy (RE) systems and technologies are gaining momentum in the world. There are different types of RE technologies. Denisor Cruz Martins et al (2019), an ideal energy source located in our region, is rapidly getting rid of related due to its irrational use by humans. This uncontrolled release of natural energy will inevitably lead to instability in our natural system. It is important to note, that in the event of recovery this system may not be possible.

Hossein Madadi Kozabadi discussed precise current control with minimal distortion and harmonic noise; however, it requires more calculations and needs to be tuned to system parameters. With the availability of powerful microcontrollers based on low-cost digital signal processors (DSPs), digital controllers for single-phase and three-phase voltage source inverters were proposed. For inverter-based distributed generation systems, inverters are connected to the existing grid, so the voltage cannot be regulated. Hysteresis controllers are used to compare the generated current to the reference current.

Youssef et al. In this article, the multilevel inverter is one of the preferred inverters, used for solar photovoltaic applications. Although this inverter is capable of producing the total harmonic distortion (THD) of the output voltage waveform, the AC output voltage waveform is very high. In this article, four switching system techniques for single-phase multilevel inverter (SPBM) are discussed. Their effects on THD on the output voltage and component current were evaluated and compared. The system used produces the output voltage waveform with the highest fundamental frequency. This has been demonstrated in solar photovoltaic systems. The multilevel inverter is used to produce the output voltage waveform with the minimum THD. Borougaoui et al. The article presents an investigation of the complexity of modeling the same inverter with different LCL filter parameters connected to a parallel grid. Microgrid is usually a system that includes LCL filters based on inverters with different inductive and capacitive parameters. Therefore, simulations were carried out to perform both frequency analyses. Its use is required to produce electric power with acceptable quality by filtering out high-frequency harmonics in voltage and current signals. The L filter is characterized by its large inductance which leads to a large inductor MG. However, with the L-filter, the MG can be stabilized and easily controlled. To reduce voltage harmonics, LC and LCL filters can be used, which are characterized by their small inductance and ability to help regulate voltage.

Haitao, This article looks at power quality issues in distribution networks. It is necessary to check the power quality of the distribution network with photovoltaic access and monitor its power quality from time to time. Based on this, this article introduces the power quality analyzer now widely used. Through inspection and analysis, it is found that the voltage imbalance and frequency deviation are within acceptable limits, but there are small voltage harmonic problems and large current harmonic problems. The power quality and low voltage of the transformer are checked at its workstation using HIOKIPW3198 Power Quality Analyzer.

M.B. Marzuki et al. In this article, the first mode of electrical power supply to the load is single mode of operation and the next mode of electrical supply to the network is network-connected operation mode. This article focuses on the design and implementation of controllers in grid-connected photovoltaic systems to adjust the power supply in power distribution systems. The first step is to match the components of the photovoltaic system, specifically; photovoltaic sources, DC-DC converters and optical grid converters with suitable filters. PSCAD was used to simulate this study. Then the proposed controller is built. Designing a control strategy to connect photovoltaic systems to the power distribution network is a challenging problem. Recommended operating conditions are suggested to evaluate the performance of the controller. T. G. Habetler, PV systems with grid power supply and nonlinear loads were used in the application. Various control techniques have been developed to improve power generation and power quality using solar energy conversion systems. A PV system operates in MPPT (maximum power point tracking) mode and is connected to a built-in three-phase grid with a shunt active power filter (APF). In this work, photovoltaic generators are operated to produce power from solar arrays and feed the utility network. At the same time, APF is employed to enhance the power quality of the studied PV system using D-Q theory. A series and shunt inverter system was developed for low harmonic distortion.

Francello, L.G. discussed photovoltaic panels, which convert sunlight into direct current (DC) electricity, while most household appliances require alternating current (AC), which converts alternating current (AC) power into direct current. Maximum power point tracking (MPPT) is used in photovoltaic systems to maximize the power produced by the photovoltaic panel regardless of the temperature, irradiance conditions, and electrical characteristics of the load. A new MPPT system has been developed, which consists of a DC-to-DC converter controlled by a microcontroller-based unit, but using the microcontroller, the total harmonic distortion is high. Thus, a capacitor is used in the present study to reduce the total harmonic distortion.

Aggarwal, A simulation of 20 kV/400 V distribution feeder is carried out to analyse the effect of indirect loads on harmonic distortion levels and feeder losses. Electrical power and control systems are used to improve power quality. This research work looks at various recently used devices such as remote terminals, digital signal processors and microcontrollers. In the current study, a 4700 microfarad capacitor bank is used to reduce harmonics. S. J. Park et al., This article presents research done on power quality and a study of the FLUKE 435-ii series used to analyse power quality behaviour. There are many power quality problems such as voltage drop, voltage surges, parallelism, frequency fluctuations, voltage unbalance, poor power factor etc. We use DC to DC converter in the control system, The most commonly used renewable energy source is solar energy as it has no noise and is clean due to this photovoltaic system is very important in the current scenario. **Robert A. (2021),** Maximum power point tracking (MPPT) is used in photovoltaic systems to increase the output power of photovoltaic panels regardless of the temperature, irradiation conditions, and electrical characteristics of the load. The disadvantages associated with photovoltaic systems are that the required solar energy will not be available 24 hours a day, solar panels require additional equipment such as inverters and charge controllers, and the cost of land required to install solar panels will be high. The current-voltage is adjusted according to the irradiation intensity and ambient temperature in both modes of operation. DC/DC boost converter, inverter, part of photovoltaic system. A PI controller is used to control the voltage of a three-phase grid-connected photovoltaic system. The operation of the control unit is explained.

3. PROCEDURE

PWM control technique is used for the inverter and the dc link capacitor voltage is constant at 500 V. The VSI converts the 500V dc voltage to 260V ac voltage output. The VSI controller circuit consists of 2 main control loops i.e. external and internal control loop. The internal control loop is used to control the grid output current and hence is called current control loop; and the external control loop is employed to control the voltage and hence is called voltage control loop in 3-phase GCPV systems. The voltage control loop controls the DC link capacitor voltage, while the internal current loop controls the reactive and active components (Iq and Id) of the grid current. The current Impp obtained from the MPPT controller is used as the reference current ‘Id’. The reference current ‘iq’ is set to zero value to maintain the reactive power which is injected into the utility grid at zero value. So that the power factor (PF) in the utility grid is close to unity.

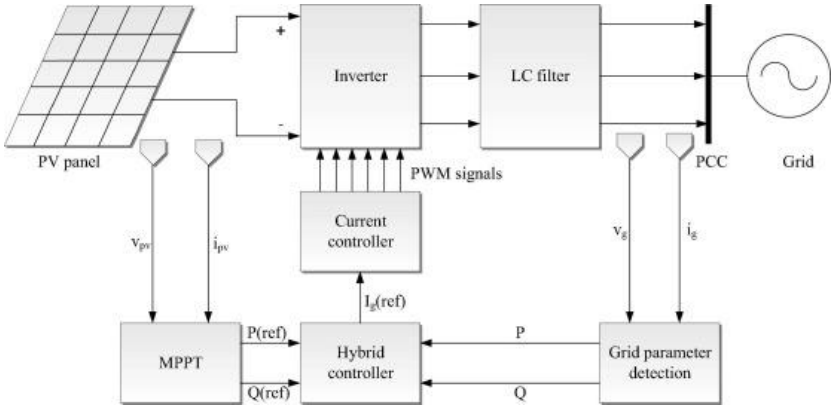

Figure 3 PV system in the grid-connected mode of operation

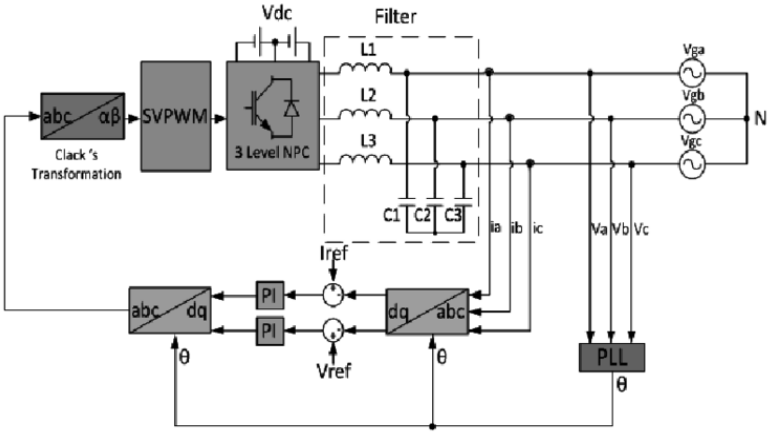

Figure 4 Grid-Connected Inverter

4. PV SYSTEMS

The various components of a photovoltaic system are photovoltaic panels, DC-DC converters, MPPT controllers, DC-AC converters and filters. Since the generated output voltage is variable and low, the DC-DC boost converter boosts the generated DC voltage to the desired voltage level. The resulting photovoltaic power generation depends on the weather conditions. There is an operating point on the I-V curve, PV curve where the output power generated by the PV panel is maximum and is represented by Pmax. The MPPT controller keeps track of this unique operating point and operates the PV system at this point. The DC-AC converter i.e. inverter converts the rising DC voltage to AC voltage

5 CONCLUSIONS

Grid-connected solar inverters are designed to generate power at unity power factor, which means they only have the ability to generate active power. The reactive power requirement of the load is met only by the grid. This paper presents a grid-connected photovoltaic inverter system with reactive power compensation features. To improve the power quality and system efficiency, a double-tuned parallel resonance circuit is proposed to reduce the second and fourth order harmonics on the DC side of the inverter. In this case, a modified carrier-based modulation technique was proposed for the current source inverter by shorting one leg of the bridge converter to magnetize the DC-link inductor after each active switching cycle. Herein, a method for selecting LCL filter parameters and controlling a three-phase PV grid-connected inverter was studied.

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