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FIVE LEVEL INVERTER FOR RENEWABLE POWERGENERATIONSYSTEM

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ABSTRACT: The usage of single-stage, single-phase inverters is on the rise among smaller photovoltaic (PV) systems due to regulations about green energy and shifts in the electricity market. Many people find that using transformers with three stages or more significantly increases their efficiency. The research concluded that photovoltaic (PV) systems should use inverters with one stage and five levels. The inverter's output current varies in response to changes in the photovoltaic (PV) grid voltage. The Sinusoidal Pulse Width Modulation (SPWM) architecture is the basis of this control method. Since SPWM simplifies the connection between the generator and the grid and eliminates the requirement for a phase-locked loop, it is finding increasing usage in a variety of technologies. The five-level inverter is demonstrated to function properly using Matlab models.
Keywords*:* Five level inverter, Cascaded H-bridge inverter, PWM, Solar PV array.

1. INTRODUCTION

Climate change and the diminishing supply of fossil fuels have increased the demand for alternative energy sources. Renewable energy sources, such as solar and wind power, are decreasing in price as power technology continues to advance. Photovoltaic (PV) energy sources are booming in popularity due to their low environmental impact and low maintenance requirements. Their versatility stems from their adaptability. The demand for solar energy has been rising at a pace of 20% to 25% year since 1998. With its falling prices and increasing accessibility, solar energy has exploded in popularity. It has been determined that several factors are responsible for this decline.

The importance of efficient solar cells is growing.

This demonstrates the results of larger nations with more rapid economic expansion.

The inverter's primary function in a photovoltaic system is to convert the DC current produced by the PV modules into AC current. This power will be linked to the grid after it is completed. There is less demand for filter capacity and less electromagnetic interference caused by the inverter's switching activity when the output pattern of the inverter has fewer harmonics. Due to its many advantages over conventional three-level PWM inverters, multilayer inverters are currently receiving a lot of attention from researchers and engineers. These devices have a number of advantages, including reduced electromagnetic interference (EMI), smaller filters, improved output waveform quality, and lower Total Harmonic Distortion (THD).

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2. CONFIGURATIONOFPROPOSEDCASCADED H-BRIDGEFIVELEVELINVERTER

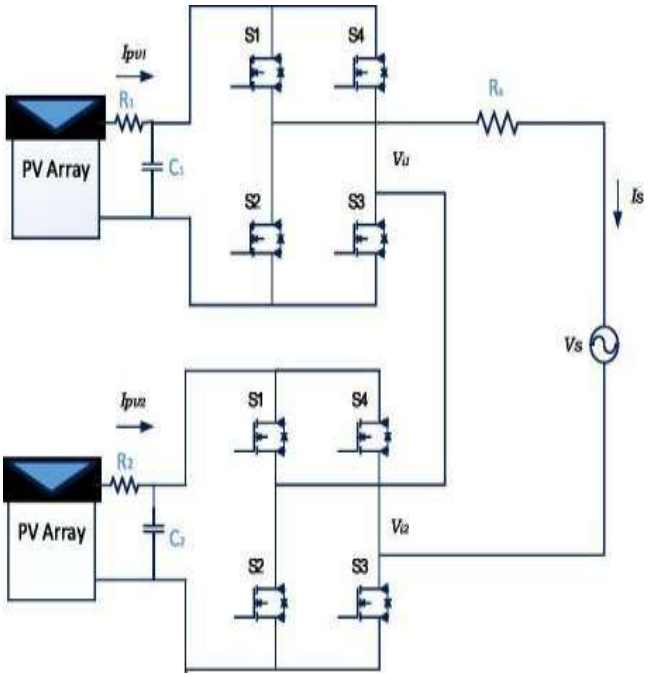

Fig.2 A grid-connected system's topology consists of five tiers.

3. SPWM CONTROLTOPOLOGY

The various advantages of the sinusoidal SPWM control method make it a popular choice. These include simple application, reduced harmonic emissions, and lower switching losses compared to competing systems. Inverters use comparisons between triangle carrier and sinusoidal reference voltage waveforms to determine gate signals for inverter switches. To do this, pulse width modulation (SPWM) with a sinusoidal waveform is employed. There have been numerous proposals for multicarrier technologies to reduce total harmonic distortion (THD) ratios. Among these, you can find modifications to the fundamental sinusoidal pulse width modulation (SPWM) technique as well as triangular carriers.

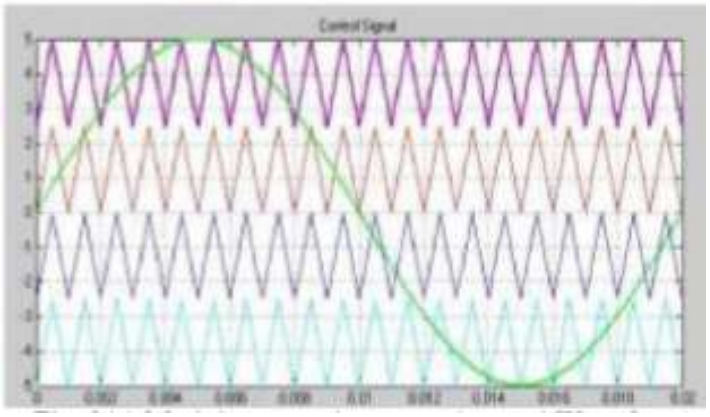

Fig.3(a)The proposed technique is concerned with the implementation of a modular control strategy, with a particular emphasis on the control waveform.

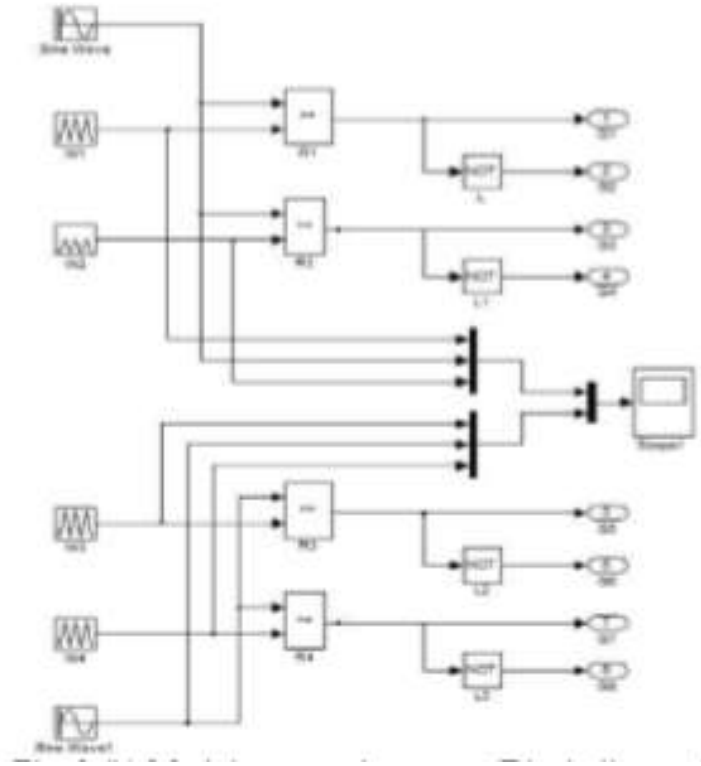

Fig.3 (b) A block diagram depicts the modular control technique.

To compare two signals, a comparator can be either digital or analog. One runs on a higher frequency and transmits data in a triangle shape, while the other modulates sinusoids at a lower frequency. This fundamental principle is the basis of sinusoidal pulse width modulation (SPWM) control. The frequency of the sinusoidal signal's oscillations indicates the amount of line power required by the inverter. An SPWM modulator block is integrated into every H-Bridge as part of the modulation technique. Using this technique, four independent SPWM pulses were generated.

4. SIMULATIONSETUP

To ensure proper operation, a comprehensive MATLAB-Simulink simulation of the proposed cascaded H-bridge five-level inverter is executed. As seen in Figure 3(a), the proposed system makes use of a modular controller. Figure 4 displays the Matlab Simulink model of the system.

Solar radiation with a density of 1,000 watts per square meter is required for photovoltaic (PV) devices to produce electricity. The photovoltaic (PV) grid generates 115 volts of energy when exposed to 1,000 watts per square meter of sunshine. The next step involves a gradual transfer of power via an H-bridge converter. The grid relies on the interconnection of two separate H-bridge transformers. In order to generate 230V AC, a network of H-bridge inverters will be connected directly to the electrical grid. The inverter's output can be adjusted with the help of a flexible control. There is a separate, adaptable controller for each of the two power sources. In Figure 3(b), we can see the components of an inverter, including the modular motor and the IGBT switches. Below you can see the inverter's controller and modeling parameters.

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Solar Insolation: 1000W/m^2
Nominal Solar array voltage: 115 Volts
Resistance R1, R2: 1.5 Ohm, 10 Ohm
DC link Capacitor: 2200 µf
Grid Voltage: 230 Volts
Filter fundamental frequency: 50 Hz

The proposed grid-connected solar system is depicted in Figure 4 as a simulation model. An inverter, which can be adjusted in five ways, is used to transmit power. DC link capacitors C1 and C2, along with resistors R1 and R2, allow the solar panels to communicate with the cascaded H-bridge inverters.

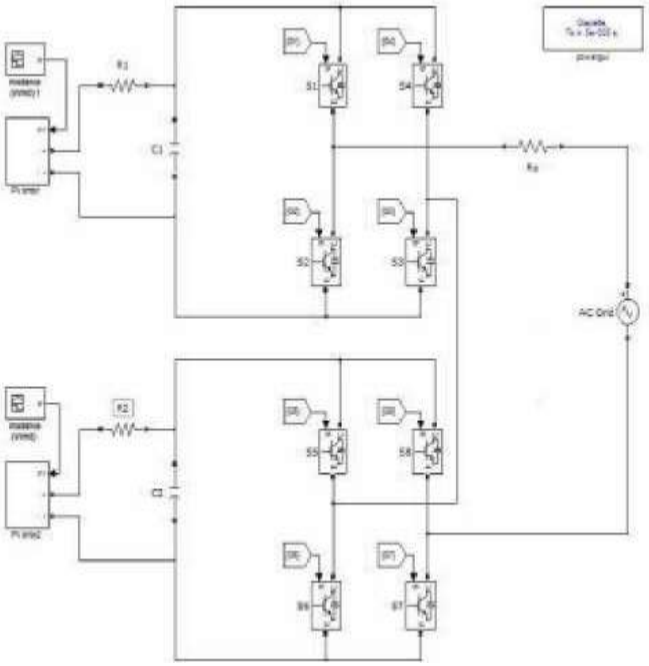

Fig.4 Simulation approaches are used in the suggested system model.

5.RESULTSANDDISCUSSION

You can see the process of creating a five-level inverter model in MATLAB in Figure 4. The DC input voltage is swiftly blended with the solar arrays output before it is supplied to the inverter. Figures 4a–d display the AC grid voltage, output current, DC link voltage, and output voltage as they were simulated. The DC link voltage can be determined with the help of a solar equivalent circuit model. Both the output voltage and current of the five-level inverter stabilize within two to four milliseconds, as illustrated in Figures 4(b) and (c).

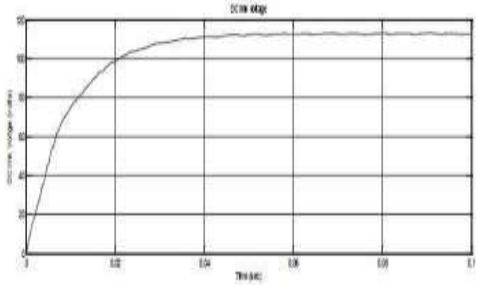

Fig.4(a)DCLinkVoltage

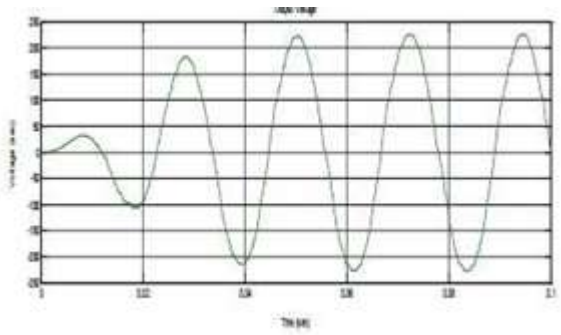

Fig.4(c) OutputcurrentofInverter

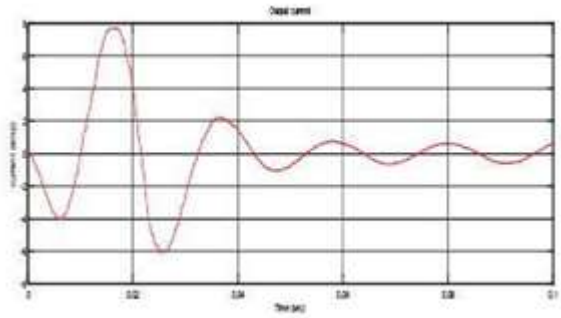

Fig.4(d)GridVoltage

Your photovoltaic (PV) system will require a five-level solar inverter in order to be connected to a single-phase power source. Typically, this procedure takes a couple of milliseconds. Based on these findings, it is crystal evident that the cascaded H-bridge inverter cannot function properly within the solar power grid without manual control of sinusoidal pulse width modulation (SPWM).

6.CONCLUSION

The purpose of integrating solar electricity into the electrical grid, this research details a simplified single-phase H-bridge cascaded five-level inverter. It also reveals the process of its design, construction, and operation. The efficiency of the five-stage generator is tested in Matlab. The voltage waveforms of a conventional single-phase cascaded H-bridge inverter and an innovative multi-phase cascaded H-bridge inverter are compared in this article. Step one is to link up with the grid using Sinusoidal Pulse Width Modulation (SPWM) technology. An PV solar field's connection to the power grid ought to take no more than a couple of milliseconds. In the presence of sufficiently high voltage and enough rapid current growth, the following will transpire.

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