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# Wind Energy Conversion Using Cascaded H-Bridge Multilevel Inverter

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***Abstract:*** ***The main objective of our project is conversion of wind energy by using multilevel inverter with higher efficiency. Multilevel inverter is a new power technology which introduced for high-medium application. Here cascaded multilevel inverter is used as it requires fewer components compared to other multilevel inverter. In this system the use of separate DC source for each H-bridge in cascaded multilevel inverter is overcome by inserting isolation transformer .Wind energy is use here as a source. A pulse width modulation is used to generate multilevel controlled output voltage.***

***Keywords: PWM technique, Isolation transformer , Cascaded H-bridge multilevel inverter technology, Wind enegy conversion system(WECS).***

## I. INTRODUCTION

This project is designed to overcome all these problems. In our project, we use variable speed wind turbine having pitch mechanism and two mass direct driven permanent magnet synchronous generator. The major benefit of using variable speed wind turbine are increased annual energy production (AEP), reduced output power variations, high energy conversion efficiency, improved power quality and reduced mechanical stress and noise. To make wind energy system more attractive and reasonable nowadays diameter of wind turbine is increasing and also related power electronics devices are use.

Nowadays PMSG based two mass direct driven variable speed WECS is popular due to elimination of gear box, no copper loss on rotor, high active/reactive power controllability. There are different ways to control aerodynamics forces on the turbine blades apart from that the most commonly used method is pitch control. Multilevel inverter is used to eliminate bulky transformers, also it has features like high voltage capability, operate with lower switching frequency, lower electro-magnetic interference (EMI). The significant advantage is the reduction of harmonics in the output waveform with an increase in the level of inverter.

## II. BLOCK DIAGRAM OF PROPOSED SYSTEM:

The Fig.1 Shows the block diagram of the proposed system. The block diagram of this system represents the multilevel inverter produces the pure sine wave with reduced harmonics.in this system electricity is produced with the renewable wind source. This system consist of different parameters like Wind turbine, permanent magnetic synchronous generator(PMSG), Rectifier circuit, H Bridge Multilevel Inverter and PWM controller are used and blocks are named. For changing the angle of PWM system controller is used in which programming is used. And all blocks are shown in diagram

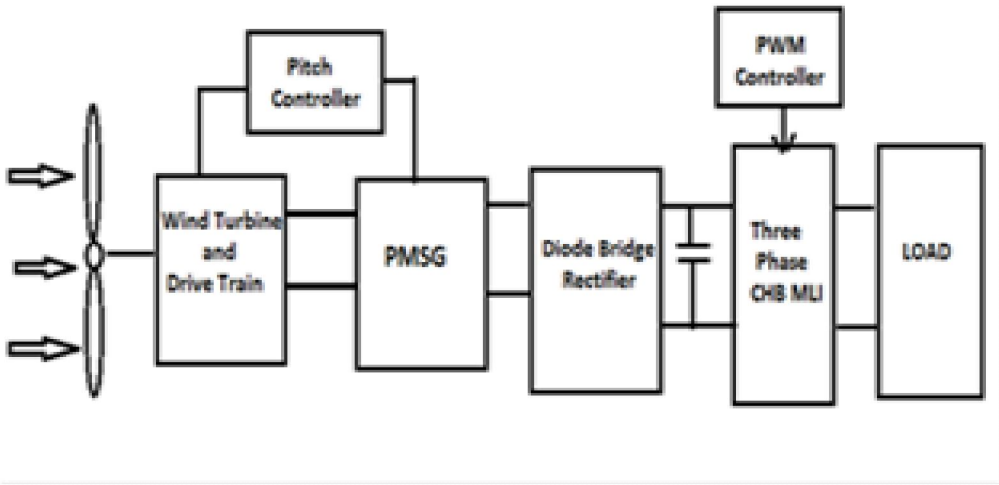


Fig.1: Block Diagram Of Proposed System

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*A. Wind turbine*

Wind turbine is a major performing parameter in a wind energy conversion system. Wind turbines produce electricity by using the power of the wind and drive the generator connected to it. The conversion kinetic energy contained in the wind that passes over the blade to rotational mechanical energy is done by wind turbine.

The power in the air flow is given by

$Pair$ = 12 ρ A $\upsilon$3 (1.1)

Where ρ is the air density (1.25 kg/$m$3),

A is the swept area of rotor in ($m$2) and

υ is speed of the wind in (m/s).

The power transferred to the rotor depends upon power coefficient $CP$.

*B. Pmsg*

In the PMSG, the rotor magnetic flux is generated by permanent magnets in place of electromagnets so therefore this is brushless. Because of the absence of the rotor windings, a high power density can be achieved, reducing the size and weight of the generator. In addition, there is no rotor winding losses and reducing thermal stress on the rotor. However, the drawback of this generator lies in the fact that, permanent magnets are more expensive and prone to demagnetization. In direct driven PMSG, the primary advantage is elimination of gearbox which reduces the maintenance cost. In this configuration, a generator is directly coupled to the rotor of a wind turbine known as Two Mass Model.

*C. Pulse width Modulator (pwm)*

Pulse-width modulation (PWM) or duty-cycle variation methods are commonly used in speed control of DC motors. The duty cycle is defined as the percentage of digital 'high' to digital 'low' plus digital 'high' pulse-width during a PWM period. The average DC voltage value for 0% duty cycle is zero; with 25% duty cycle the average value is 1.25V (25% of 5V). With 50% duty cycle the average value is 2.5V, and if the duty cycle is 75%, the average voltage is 3.75V and so on. The maximum duty cycle can be 100%, which is equivalent to a DC waveform. Thus by varying the pulse-width, we can vary the average voltage across a DC motor and hence it speed

*D. Diode Bridge Rectifier*

The universal bridge or three phase diode bridge rectifier converts the AC power generated by PMSG into the DC power in an uncontrolled way. For filtering purpose a DC capacitor is connected across the output terminal of rectifier.

The DC voltage can be calculated as

$VO$ = 3 √2/n $Vrms$

Where,

$VO$ is the output DC voltage and

$Vrms$ is the input AC line voltage

*E. Cascaded h-Bridge Multilevel Inverter*

Cascaded H-bridge Multilevel Inverter consist of series of modules that performs a desired ac voltage flexible operation.

Fig. shows the structure of single phase seven level cascaded H bridge inverter having three units of H-bridge power cells connected in series. The output AC voltage is the sum of the voltage generated by each H-bridge module. Each half bridge module consists of four IGBT provide With the increase in the level of multilevel inverter. the output voltage waveform become more sinusoidal and Total harmonic Reduction value decreases . Three phase system can obtained by connecting three identical single phase cascaded H bridge MLI in star or delta configuration

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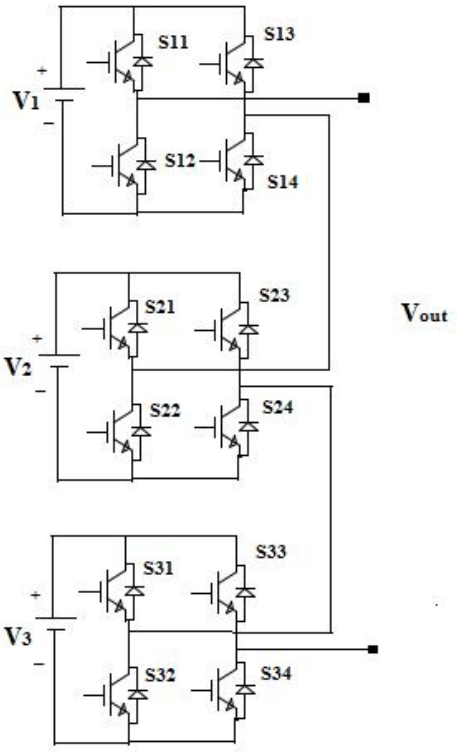


Fig 2: A Single phase cascaded H-bridge MLI

## III. EXPERIMENTAL DESIGN

Fig 3 shows the experimental kit for multilevel inverter. In which external supply is used with the step down transformer andDCsupply unit is designed instead of wind energy or any other renewable source.

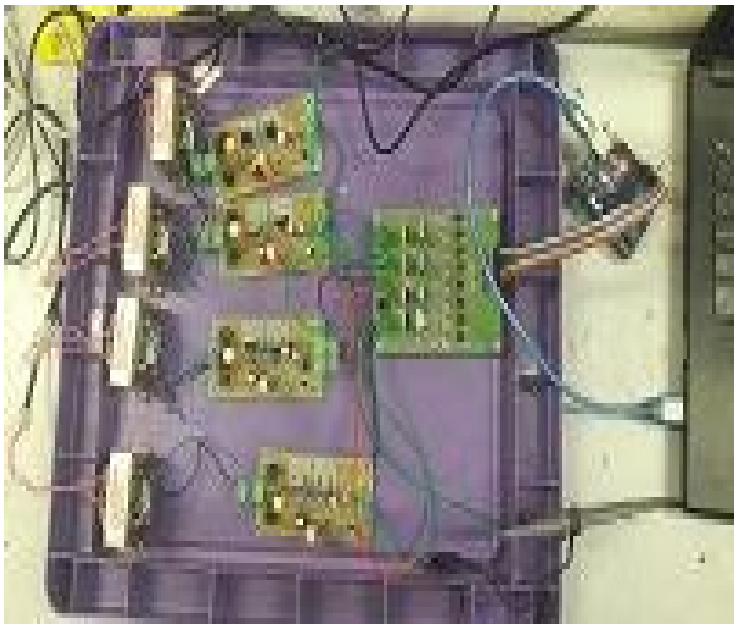

Fig.3 experimental design of project kit

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## IV. RESULT

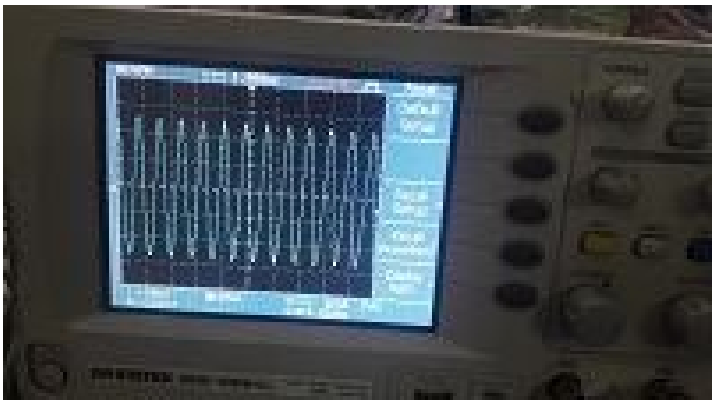

Fig. 3 inverter output with 7 levels

Hence the output wave form of 7 level is purely sine wave. So that means there is reduction in harmonics efficiently and we get pure sine wave.

## IV. CONCLUSION

The seven level cascaded multilevel inverter using single DC source based on isolation transformers is designed to supply power with better output quality. The CHB inverter used in this system is controlled by phase shifted multicarrier PWM; it reduces total harmonic distortion in phase voltage. To get variable speed operation, a power electronics converter interface is used to connect the generator to the grid.

overcome the limitations linked to maximum voltage a blocking capability of existing power semiconductor devices, several new techniques and topologies have been developed, such as diode-clamped inverter, Flying capacitor inverter, and cascaded H-bridge inverter . A number of modulation techniques are used in multilevel inverters. In this Cascaded H-bridge inverter is used as it require least number of components and flexible as compared to others.

## V. FUTURE SCOPE

The future scope of this project is as follows

*A.* By using this technique with the help of sophisticated power electronics devices, we can reduce harmonics in the output waveform with an increase in the level of inverter.

*B.* Another scope of this technique will be in the HVDC power transmission, electric vehicle drives.

*C.* With the help of power electronics devices lot of automation and high speed can be achieved.

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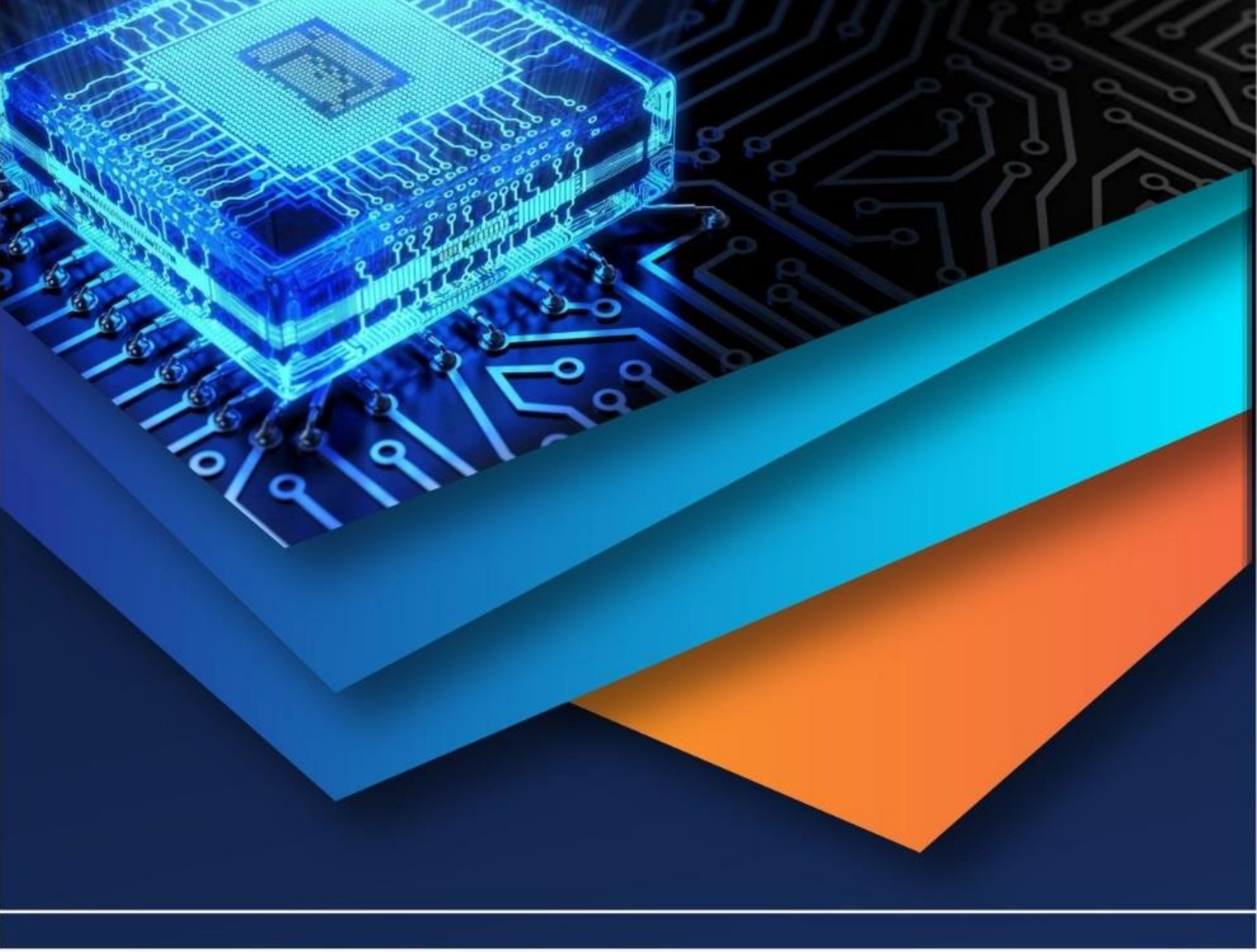

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