DESIGN AND IMPLEMENTATION OF HIGH GAIN CONVERTER USING OFFSHORE WECS.

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ABSTRACT

The project deals with wind energy conversion systems which has become a rising trend due to increased demand for green and secure electricity supply, especially in remote areas. Over the last decade, the penetration of renewable energy sources has been increasing steadily in the power system. The power harvesting from the WECS is increased and additionally expansion of the exploitable wind speed region toward the lower speed range is accomplished. The input voltage from wind energy conversion systems gets boosted into desired output voltage using isolated DC-DC converter with medium frequency based transformer. This proposed system gives robust, effective operation in the system and the obtained voltage gets converted into AC voltage using current source converter for grid systems. The current source converter gets triggered by predictive control which gives accuracy. This is the optimal solution to linear robust control problems besides it carries a low computational cost.

Keyword:-*Off grid, PMSG, Predictive Control, Forward Isolated Converter, Offshore wind.*

1.INTRODUCTION:-

Wind power is process of air flow through wind turbines to mechanically power generators for electric power. Wind power as an alternative to burning fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation, consumes no water, uses little land Offshore wind is steadier and stronger than on land and offshore farms have less visual impact but construction and maintenance costs are higher. Small onshore wind farms can feed some energy into the grid or provide electric power to isolated off-grid locations. Offshore wind is steadier and stronger than on land and offshore farms have less visual impact but construction and maintenance costs are higher. Small onshore wind farms can feed some energy into the grid or provide electric power to isolated off-grid locations. A wind energy conversion system (WECS), or wind energy harvester is a machine that, powered by the energy of the wind, generates mechanical energy that can be used to directly power machinery or to power an electrical generator for making electricity. Denmark generates 40 percent of electricity from wind. Around 83 other countries using wind power to supply their electric power grids. In 2014,global wind power capacity expanded 16% to 369,553 MW. Yearly wind energy production is also growing rapidly and has reached around 4% of worldwide electric power usage,11.4% in the EU.

2. BLOCK DIAGRAM:-

The wind energy conversion system provides the input voltage and using diode rectifier obtained AC voltage gets converted into DC voltage.Then by using medium frequency transformer based DC to DC converter the DC voltage gets boosted into highly reliable DC voltage. The medium frequency transformer based converter helps to make the system robust and reliable in operation. The current source converter converts the achieved DC voltage into AC voltage feeds the load. The predictive control technique has been used to generate corresponding pwm pulses which can provide accuracy and effective output.

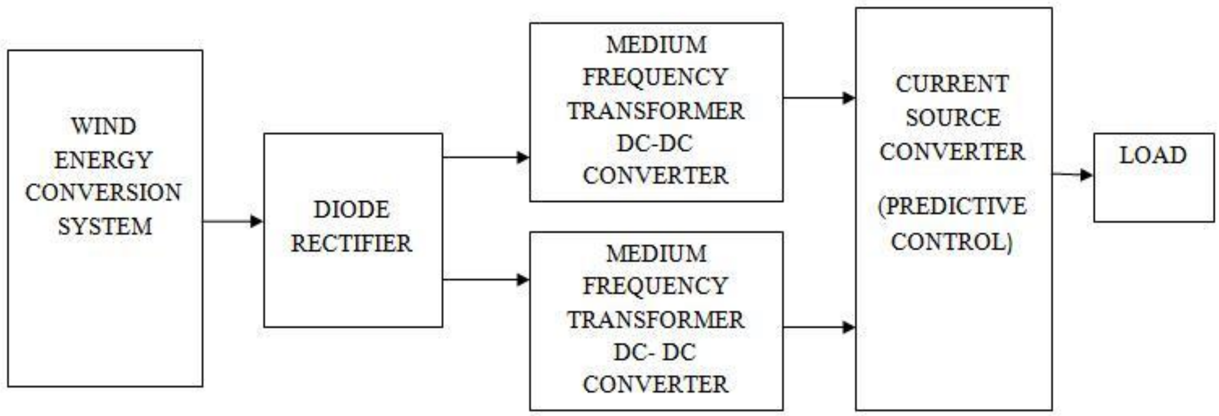

Figure 1 Block Diagram of WECS

2.1 WIND ENERY CONVERSION SYSTEM:-

A wind energy conversion system (WECS) or wind energy harvester is a machine that, powered by the energy of the wind, generates mechanical energy that can be used to directly power machinery (mill, pump,) or to power an electrical generator for making electricity.The term can thus refer to windmills, wind pumps as well as wind turbines. A wind energy conversion system (WECS), or wind energy harvester is a machine that, powered by the energy of the wind, generates mechanical energy that can be used to directly power machinery or to power an electrical generator for making electricity. The energy in the wind turns two or three propeller-like blades around a rotor. The rotor is connected to the main shaft, which spins a generator to create electricity. The wind energy conversion systems provides AC voltage from permanent magnet synchronous generator and mechanical input torque has been obtained from the turbine .

2.2 DIODE RECTIFIER:-

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification, since it straightens the direction of current. Physically, rectifiers take a number of forms,including vacuum tube diodes, mercury-arc valves, stacks of copper and selenium oxide plates, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches.

2.3 MEDIUM FREQUENCY TRANSFORMER DC-DC CONVERTER

The main transformer contributes considerably to losses in traction system (especially in 16,7 Hz systems). Modern power electronics allow for a more efficient and much lighter alternative: the medium frequency transformer operating at (400 – 800) Hz or comparable frequencies. Transformers have high losses at low frequencies. In 16 (2/3) Hz railway systems transformer losses therefore considerably reduce overall traction efficiency. Modern powerelectronics allow for a more efficient and much lighter alternative: the medium frequency transformer operating at (400 – 800 Hz) or comparable frequencies.

2.4 CURRENT SOURCE CONVERTER

The type of current source converter operation in this case is also same here, i.e. Auto-Sequential Commutated Inverter (ASCI). As in the circuit of a single-phase CSI, the input is also a constant current source. In this circuit, six thyristors, two in each of three arms, are used, as in a three-phase VSI. Also, six diodes, each one in series with the respective thyristor, are needed here, as used for single-phase CSI. Six capacitors, three each in two (top and bottom) halves, are used for commutation. It may be noted that six capacitors are equal- The diodes are needed in CSI, so as to prevent the capacitors from discharging into the load. The numbering scheme for the thyristors and diodes are same.

3.SIMULATION DIAGRAM:-

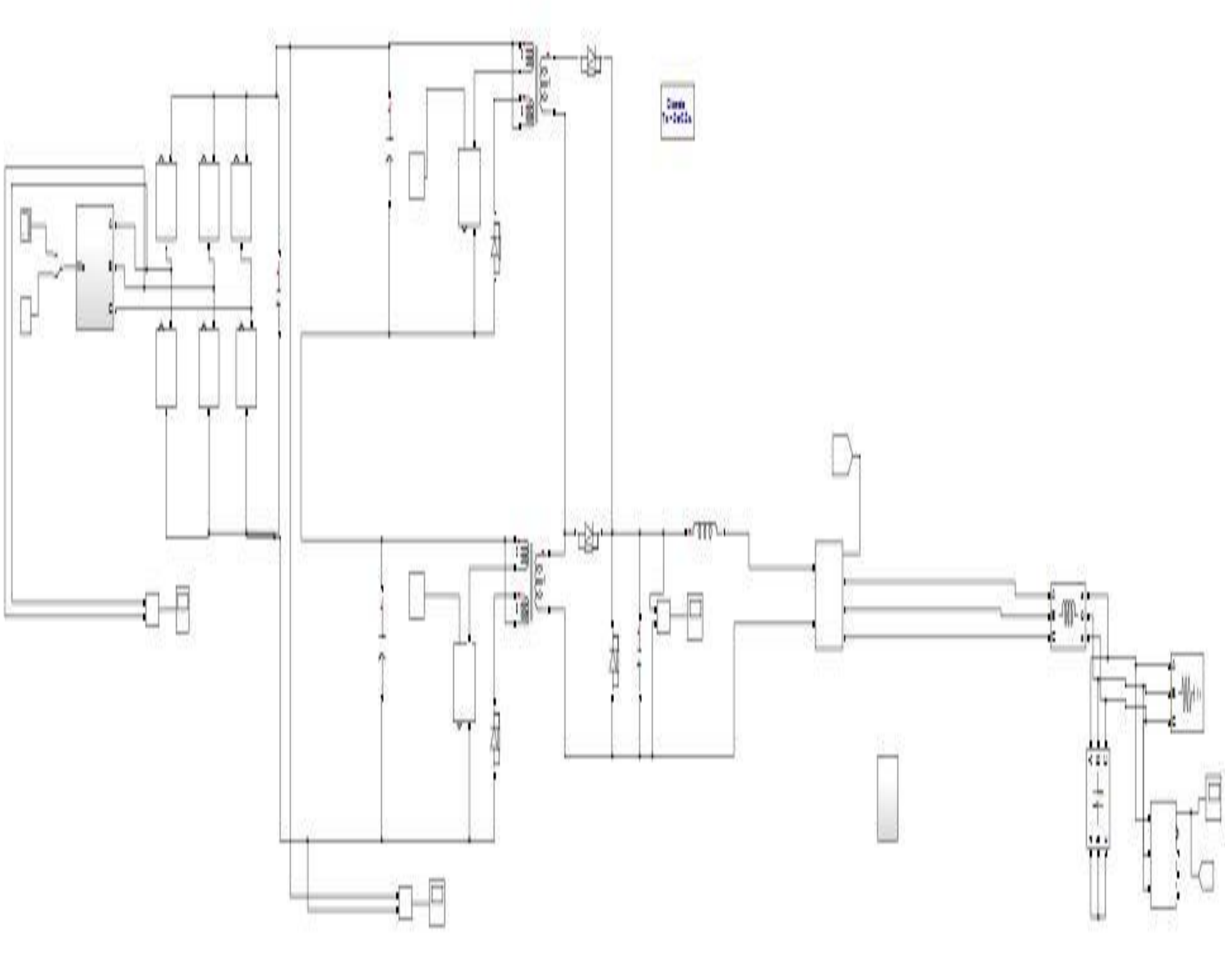

Figure 2 Simulation Diagram of WECS

By using pitch angle torque is varied .Constant value given for the wind speed as 12.Rotor speed depends on the constant value. Electro magnetic torque is produced from the wind turbine output. Final input voltage produced by PMSG is 200V. Fluctuations in dc output voltage is reduced by dc link capacitor.The diode impedance is infinite in off state mode. Fully controlled rectifier converts the AC voltage into DC output voltage .The snubber resistance used here is 500 ohm and snubber capacitance is 250*10^-9. Three phase AC output voltage obtained by the inverter has reduced Harmonics as well as losses. The PI controller produces fast response .The inverter operates by means of predictive control. The High gain voltage obtained at the output of the inverter is 400V.

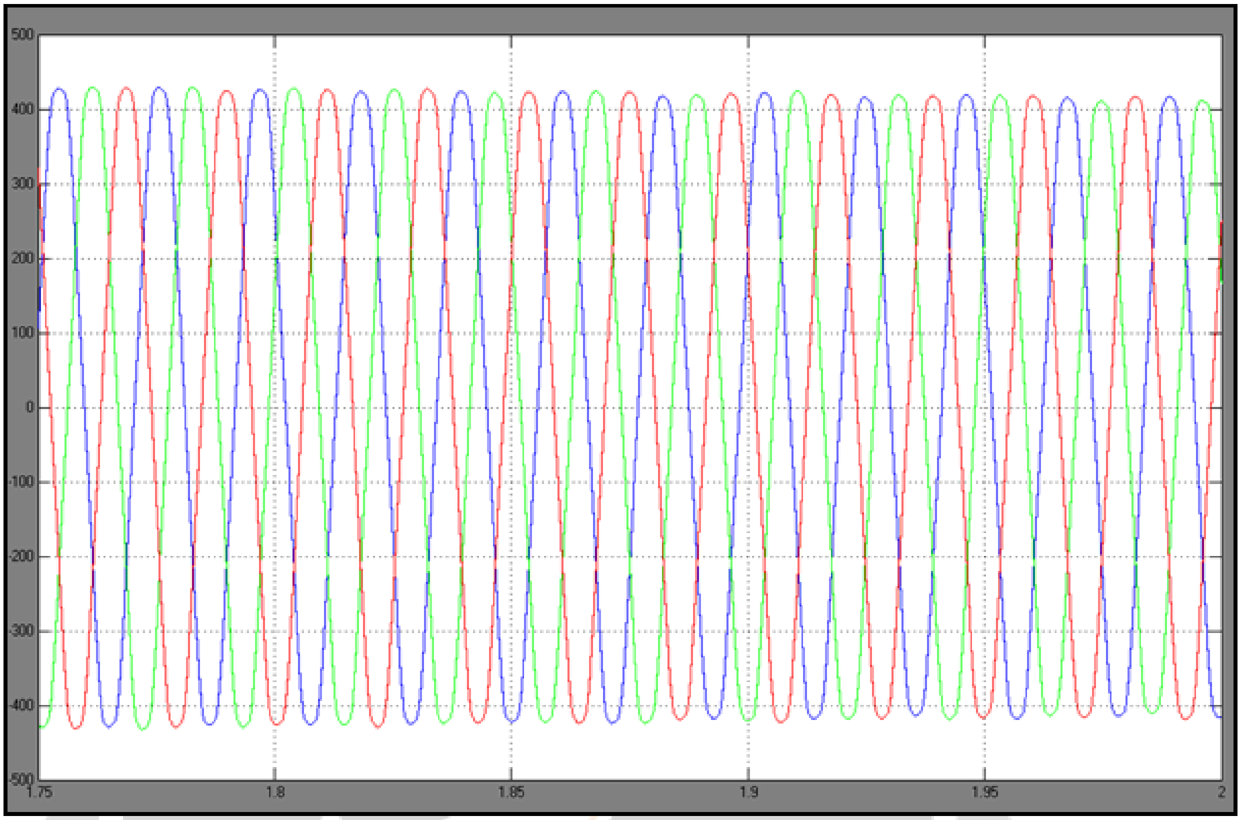

Figure 3 AC output voltage of CSI

4.HARDWARE IMPLEMENTATION:-

4.1HARDWARE CIRCUIT:-

The Hardwarecircuit consists of Power supply unit, Step down transformer, Filtration unit, Voltage regulator, Driver circuit, PIC microcontroller, Rectifier unit,MCT2E optocoupler, Fan7392N.The power supply produces the input voltage which is controlled by means of voltage regulator and is directed towards the PIC Micro controller. It then triggers the rectifier and produces DC voltage. The inverter PWM pulses are triggered by the micro controller and output AC voltage produced is twice that of the input voltage.

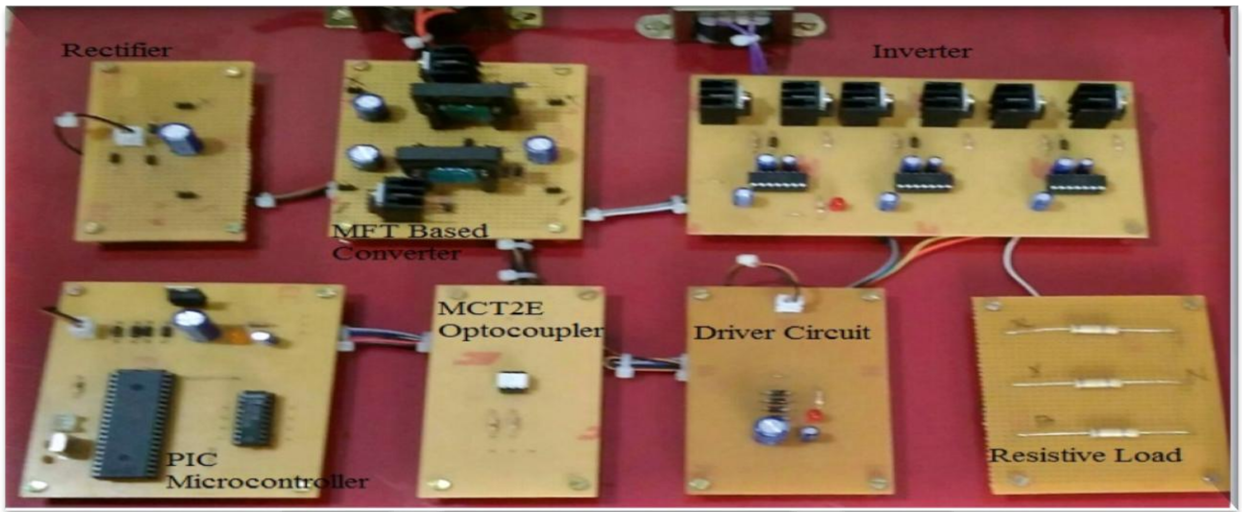

Figure 4 Hardware Implementation

The AC output voltage from the capacitor passes through the full bridge rectifier where it is converted to DC. The voltage is boosted by the MFT based DC-DC converter . The Boosted DC voltage is converted to AC by means of inverter.This then passes through the resistive load.

4.2 OUTPUT:-

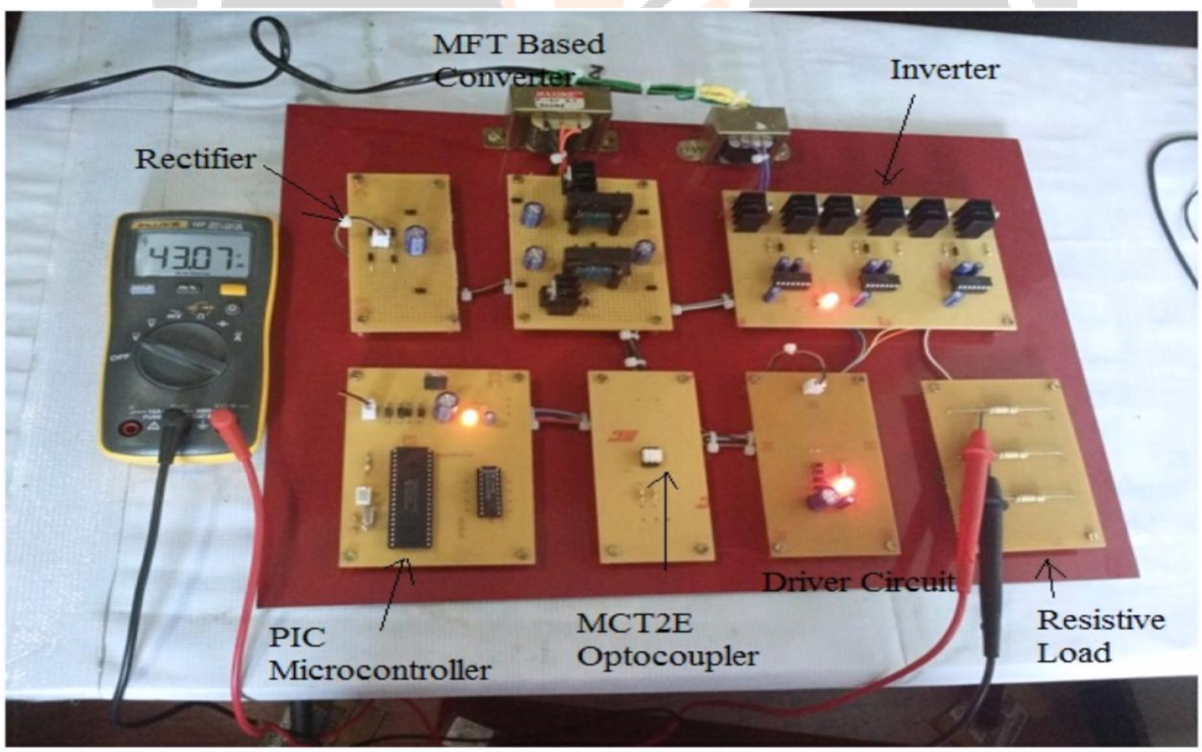

Figure 5 Hardware Output

The output obtained has minimized harmonics and also the output is twice than that of input. The inverter is used to convert the DC into required AC voltage. Predictive control technique operates the PWM pulses. The output High Gain voltage obtained is from 350-400 V.

5.CONCLUSION:-

The wind energy has been used to produce high voltage in order to supply the grid. The design has been tested successfully and it has been concluded that this system is enough to produce output voltage twice that of input voltage with minimum losses. Thus this design has reduced the harmonics to a great extent and also reduced the cost by using less number of filters. This method can be implemented to produce suitable High Gain Voltage.

6.REFERENCES:-

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