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An Intelligent Fuzzy Logic Based Optimal of Wind Energy Conversion System

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ABSTRACT: This project proposes grid voltage stability using fuzzy logic controller in wind energy conservation systems. The D-Q theory is used to generate reference voltage and current from source and load voltage current for harmonics mitigation. To maintain constant DC link voltage control using Fuzzy logic controller. To compensate the reactive power with D-Q theory. This project is implementated using Matlab simulation and the hardware is developed using DSPIC30F4011 controller.

I. INTRODUCTION

While fossils fuels will be the main fuels for the thermal power there is a fear that they will get exhausted eventually in next century therefore many countries are trying systems based on non-conventional and renewable sources. These are Solar, Wind, Sea, Geothermal and Biomass. Because if we take solar power on earth it is 106 watts.The total world demand is 10 13 watts, If we utilize 5% of the solar energy, it will be 50 times what that world require. If we consider the wind potential it is estimated to 1.6*107 MW, which is same as world energy consumption. So the development of non-conventional energy source is very; economical. While fossils fuels will be the main fuels for the thermal power there is a fear that they will get exhausted eventually in next century therefore many countries are trying systems based

II. WIND SYSTEM

This paper deals with wind power generation and the problems that arise in generation. As energy crisis is very high in case of developing countries like India, there came urgent need to look for other sources of energy that are clean and pollution free as conventional sources cause much pollution. This paved path for non-conventional sources. Of all the renewable energy sources; the one that has matured to the level of being a utility generation source is wind energy .It is estimated that wind potential is 1.6*107 MW which is same as world energy requirement. But the only problem is that wind speed is highly fluctuating. So many problems arise during power generation. So we mainly concentrate on the problems occurred during generation and how they can be rectified. The problems faced are due to local impacts and system impacts. Local impacts deal with the impacts that occur in the vicinity of the wind turbine or wind farm. System impacts are the impacts that affect the behavior of the system as a whole. Using modern power electronics and special type of wind turbines that suit to the conditions can solve local impacts. Designing turbines to withstand voltage variations of certain magnitudes can rectify system impacts to some extent. Controlling the rotor speed by gear mechanism can rectify problems due to high wind or computer aided techniques.

III. EXISTING METHOD

Recently, the sensor less permanent magnet synchronous generator (PMSG) has been widely used in wind energy conversion system (WECS). This system is characterized by the high performance, low inertia, high torque, better network compatibility and relatively low maintenance costs. The maximum power point tracking (MPPT) algorithm calculates the shaft speed of the PSMG based on the current measurements of wind speed and power generation. The implementation of MPPT algorithm in WECS is the control of the power converter by generating a reference signal (shaft speed) for tracking control of PSMGs in order to reach the maximum power output. Thus, adjusting the dynamic

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performance of wind turbines under variable-speed conditions for tracking control with MPPT algorithm is an essential feature of the WECSs. The conventional closed-loop system with the proportional-integral (PI) controller and the speed sensor has been commonly applied to WECS for taking MPPT control under variable-speed conditions. In this system, the PI controller provides zero tracking error of the PMSG speed for a constant reference signal. However, since the PI controller is with low bandwidth, the dynamic performance of the closed-loop system is poor.

The stability analysis of small and large disturbances in a doubly-fed induction generator and PMSG and shows that the stability margin of PMSG is lower than a doubly-fed induction generator especially after a fault in the system on the grid side. On the other hand, the speed measurement with mechanical sensors increases the cost, the complexity of the hardware, the delay in time response and the failure rate of the WECS. Moreover, switching by an inverter leads to disturbance effects in measuring the output signals and electromagnetic interference. These effects can be improved by applying a linear and nonlinear perturbation observers to WECS.

IV. BLOCK DIAGRAM

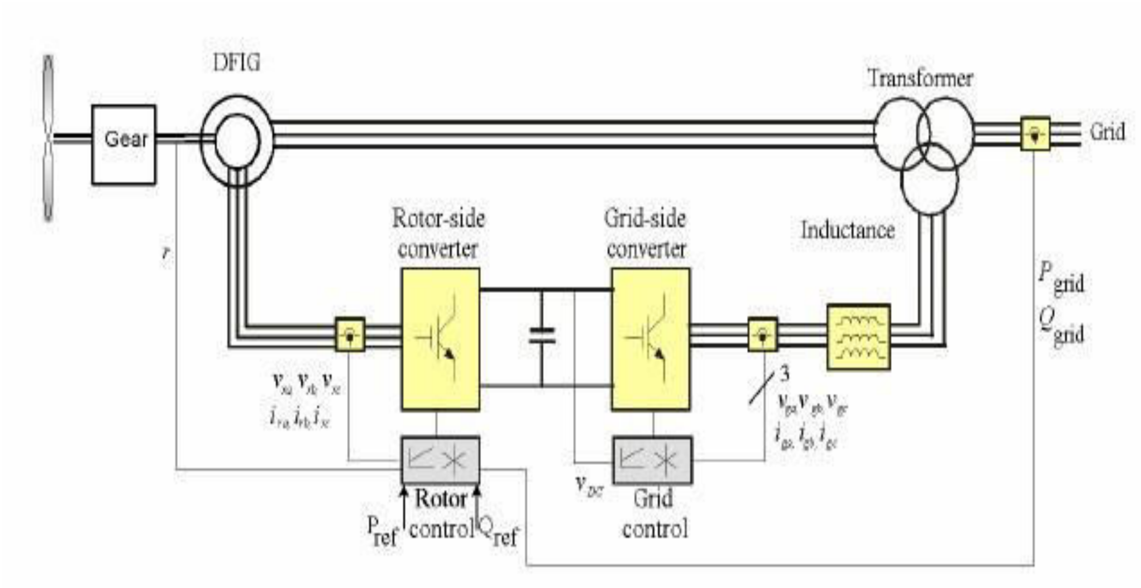

Fig 1 Proposed System block diagram.

BLOCK DIAGRAM DESCRIBTION:

The proposed system consists of a DFIG-based variable speed WECS consisting two back-to-back inverters with a common dc link. The generator-side inverter controls its speed to extract maximum power at different speeds, while the grid side inverter delivers the renewable power to grid with 3P4W nonlinear-load compensation simultaneously. The block diagram of proposed variable-speed WECS is shown in Fig.1

Wind Energy Conversion Systems, WECS, research has focused in wind power autonomous systems and grid connected systems. An autonomous system directly supplies electricity to customers and it is especially appealing in areas with poor accessibility conditions for transmission lines. In autonomous system wind power generation should be complemented with other sources of power because wind is an unpredictable energy source. Hence, it does not ensure continuous power supply. While, a grid connected system have the advantage of ensuring continuous power supply, because when wind energy is insufficient the electrical grid satisfy the demand. WECS is grid connected system it includes the following; Wind turbine ,Generator ,Interconnections, Control system

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V. WORKING PROCESS

The stator is directly connected to the AC mains, whilst the wound rotor is fed from the Power Electronics Converter via slip rings to allow DIFG to operate at a variety of speeds in response to changing wind speed. Indeed, the basic concept is to interpose a frequency converter between the variable frequency induction generator and fixed frequency grid. The DC capacitor linking stator- and rotor-side converters allows the storage of power from induction generator for further generation. To achieve full control of grid current, the DC-link voltage must be boosted to a level higher than the amplitude of grid line-to-line voltage. The slip power can flow in both directions, i.e. to the rotor from the supply and from supply to the rotor and hence the speed of the machine can be controlled from either rotor- or stator-side converter in both super and sub-synchronous speed ranges. As a result, the machine can be controlled as a generator or a motor in both super and sub-synchronous operating modes realizing four operating modes. Below the synchronous speed in the motoring mode and above the synchronous speed in the generating mode, rotorside converter operates as a rectifier and stator-side converter as an inverter, where slip power is returned to the stator. Below the synchronous speed in the generating mode and above the synchronous speed in the motoring mode, rotor-side converter operates as an inverter and stator side converter as a rectifier, where slip power is supplied to the rotor. At the synchronous speed, slip power is taken from supply to excite the rotor windings and in this case machine behaves as a synchronous machine.

DOUBLY FED INDUCTION GENERATOR IN WIND TURBINES

Wind turbines use a doubly-fed induction generator (DFIG) consisting of a wound rotor induction generator and an AC/DC/AC IGBT-based PWM converter. The stator winding is connected directly to the 50 Hz grid while the rotor is fed at variable frequency through the AC/DC/AC converter. The DFIG technology allows extracting maximum energy from the wind for low wind speeds by optimizing the turbine speed. The optimum turbine speed producing maximum mechanical energy for a given wind speed is proportional to the wind speed. Another advantage of the DFIG technology is the ability for power electronic converters to generate or absorb reactive power, thus eliminating the need for installing capacitor banks as in the case of squirrel-cage induction generator.

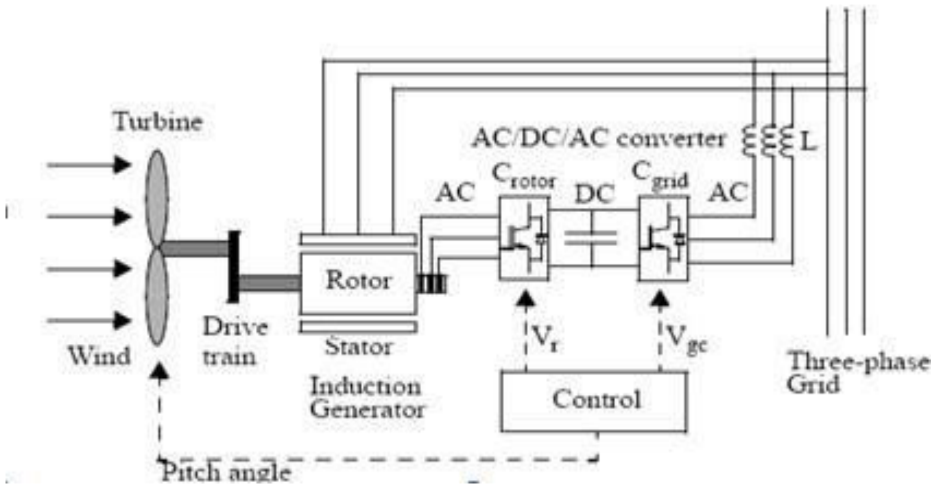

Fig.2 Basic diagram of doubly fed induction generator with converters

Where Vr is the rotor voltage and Vgcis grid side voltage. The AC/DC/AC converter is basically a PWM converter which uses sinusoidal PWM technique to reduce the harmonics present in the wind turbine driven DFIG system. Here Crotoris rotor side converter and Cgrid is grid side converter. To control the speed of wind turbine gear boxes or electronic control can be used.

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HARDWARE DETAILS:

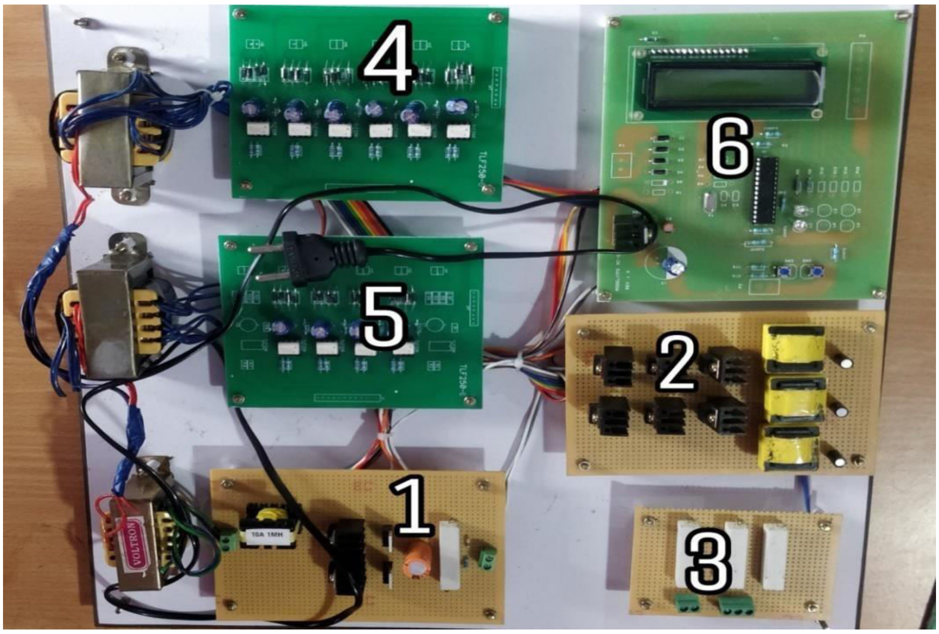

Fig 3 Overview of the Hardware.

VI. RESULT

- A Fuzzy Logic System is flexible and allow modification in the rules as its structure is easy and understandable. Even imprecise, distorted and error input information is also accepted by the system. The systems can be easily constructed. Mostly robust as no precise inputs required. It provides a most effective solution to complex issues Wind energy in India is generally utilized in wind pumps, wind battery charges, wind electricity generators etc This energy has been utilized for pumping water in rural areas and may also be useful in remote villages.

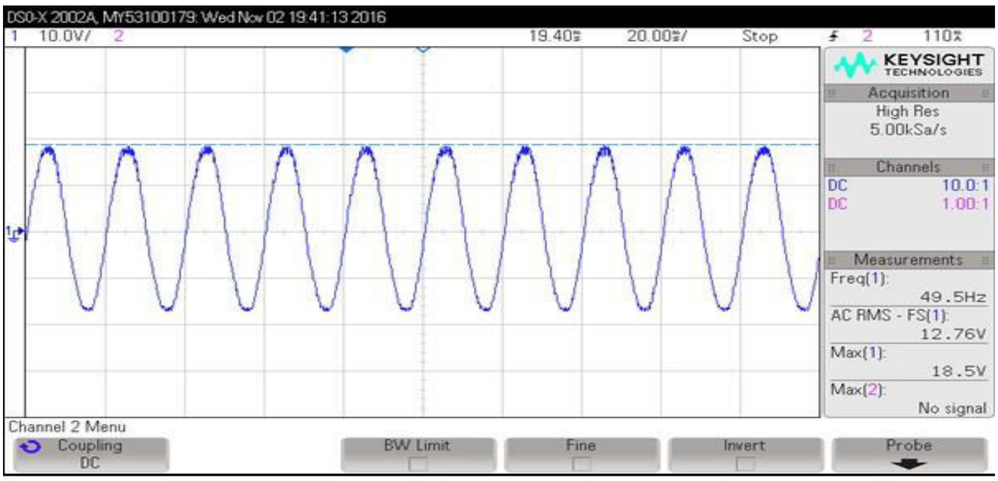

Fig.4 Input AC voltage hardware output waveform

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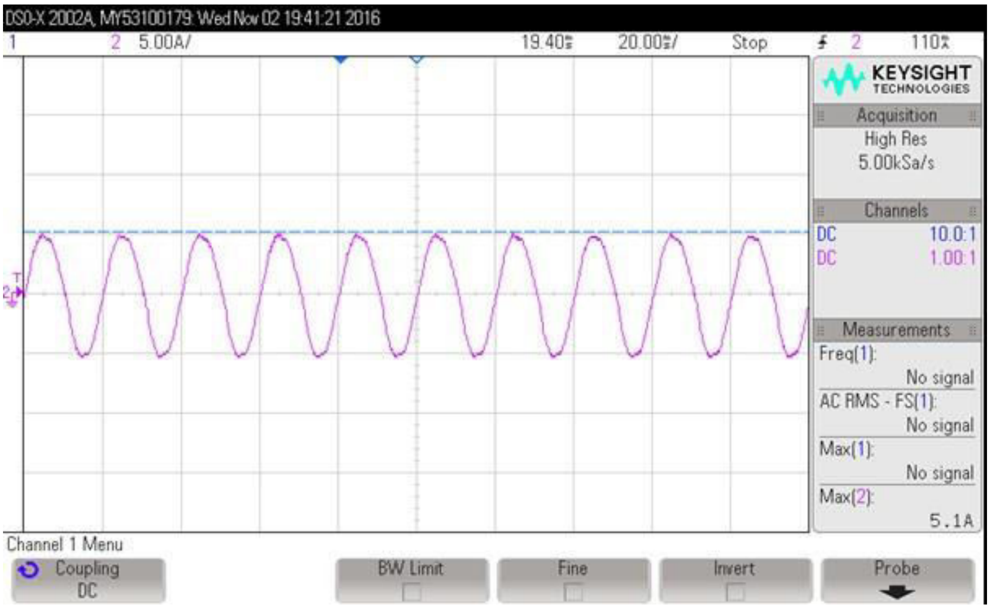

Fig. 5 Input AC current hardware output waveform

VII. CONCLUSION

We have discussed here the basic operation of DFIG and it's controls using AC/DC/AC converter. First we simulated a wind turbine driven isolated (not connected to grid) induction generator. But for best efficiency the DFIG system is used which is connected to grid side and has better control. The rotor side converter (RSC) usually provides active and reactive power control of the machine while the grid-side converter (GSC) keeps the voltage of the DC-link constant. So finally we simulated grid side and wind turbine side parameters and the corresponding results have been displayed.

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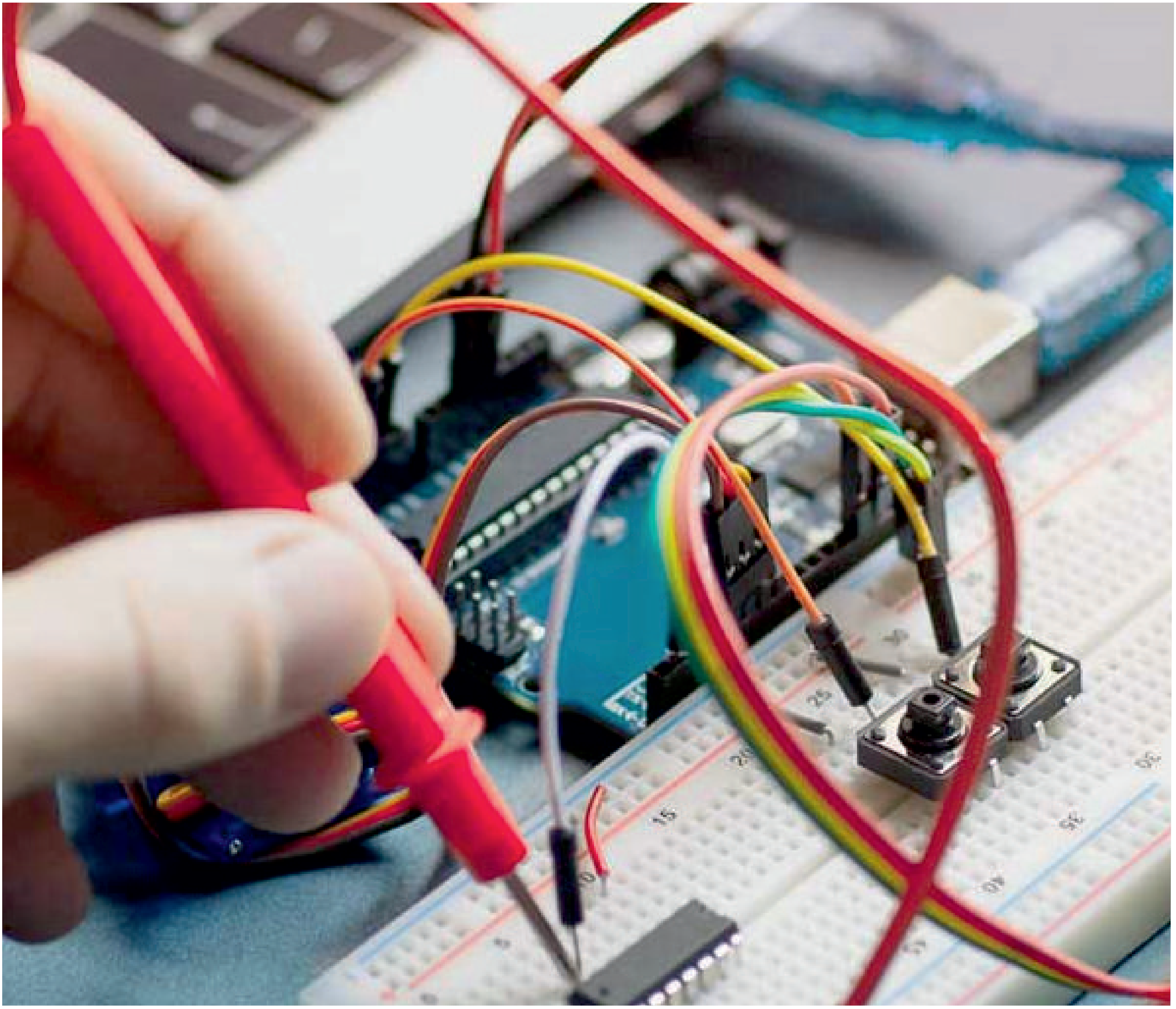

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