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MODELING OF PSO-FLC PV-WIND HYBRID SYSTEM FOR VOLTAGE REGULATED INVERTER

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ABSTRACT

Renewable energy sources i.e. energy generated from solar, wind, biomass, hydro power, geothermal and ocean resources are considered as a technological option for generating clean energy. But the energy generated from solar and wind is much less than the production by fossil fuels, however, electricity generation by utilizing PV cells and wind turbine increased rapidly in recent years. This project presents the Solar-Wind hybrid Power system that harnesses the renewable energies in Sun and Wind to generate electricity. System control relies mainly on micro controller. It ensures the optimum utilization of resources and hence improves the efficiency as compared with their individual mode of generation. Also it increases the reliability and reduces the dependence on one single source. This hybrid solar-wind power generating system is suitable for industries and also domestic areas. This project also implemented with FLC-PSO technique for better improvement in PV and Wind System.

I. INTRODUCTION

Wind and solar energies have a good promotion as these two energies are widely available and cost efficient compared to other sources. Almost 30 of the nations are using the electricity based on the renewable energies with 20% of the contribution. These energies can improve the status level, which can give a new trend with the technologies being used. With the provision of renewable electricity, there is a decrease in the energy with much more electrification.

There are benefits with these like electricity conversion to heat with less losses and also greater temperature compared to fossil fuels, and thus can convert to mechanical energy, at greater efficiency and at consumption point, it is clean with the point of electrification, there is a reduced usage of primary sources as the electrification gives much more efficiency as most of the renewable energies does not have a good steam cycle.

The replenishment of sources are these renewable energies which have sources like solar, wind, tides etc. which occur naturally. Some forms of energy occur from within the earth or from sun directly. In inclusion with the defined form, from the sun, the heat generation from the wind, solar, ocean hydropower,and biomass are obtained from RES. Only few countries concentrate on these renewables which exists over a wide range of area and also on the basis of energy efficiency, which is a significant opportunity for the energy. There is an economical barrier beneficial with the technology and also the diversification which results in advantageous area. There is also a reduction in the environmental pollution and get to the acknowledgement of health issues.

II. WIND TURBINE SYSTEM

Wind turbines can operate with either fixed speed (actually within a speed range about 1 %) or variable speed. For fixed-speed wind turbines, the generator (induction generator) is directly connected to the grid. Since the speed is almost fixed to the grid frequency, and most certainly not controllable, it is not possible to store the turbulence of the wind in form of rotational energy. Therefore, for a fixed-speed system the turbulence of the wind will result in power variations, and thus affect the power quality of the grid. For a variable-speed wind turbine the generator is controlled by power electronic equipment, which makes it possible to control the rotor speed.

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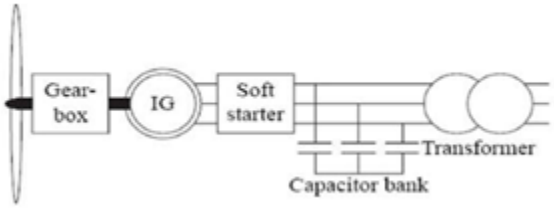

Fig-1: Wind turbine with fixed speed in addition with Induction Generator

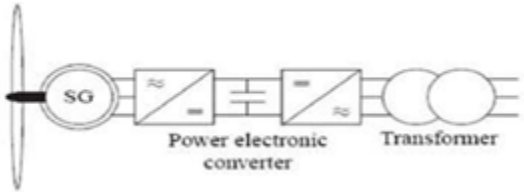

Fig-2.4: Variable-Speed direct-driven (gear-less) wind turbine with a synchronous generator (SG)

III. PHOTOVOLTAIC TECHNOLOGY

Photovoltaic is the field of technology and research related to the devices which directly convert sunlight into electricity using semiconductors that exhibit the photovoltaic effect. Photovoltaic effect involves the creation of voltage in a material upon exposure to electromagnetic radiation.The solar cell is the elementary building block of the photovoltaic technology. Solar cells are made of semiconductor materials, such as silicon. One of the properties of semiconductors that makes them most useful is that their conductivity may easily be modified by introducing impurities into their crystal lattice. For instance, in the fabrication of a photovoltaic solar cell, silicon, which has four valence electrons, is treated to increase its conductivity.

When the electrons diffuse across the p-n junction, they recombine with holes on the p-type side. However, the diffusion of carriers does not occur indefinitely, because the imbalance of charge immediately on either sides of the junction originates an electric field. This electric field forms a diode that promotes current to flow in only one direction [3].Ohmic metal-semiconductor contacts are made to both the n-type and p-type sides of the solar cell, and the electrodes are ready to be connected to an external load. When photons of light fall on the cell, they transfer their energy to the charge carriers. The electric field across the junction separates photo-generated positive charge carriers (holes) from their negative counterpart (electrons). In this way an electrical current is extracted once the circuit is closed on an external load.

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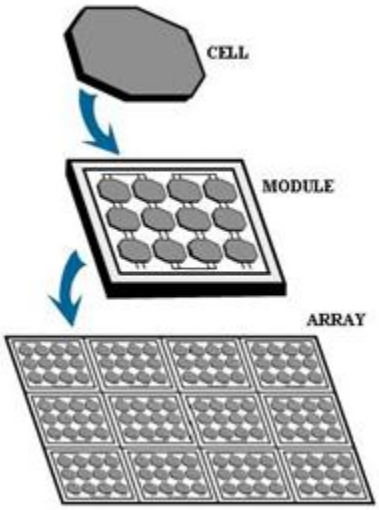

Fig-3: Electrically connected cells

IV. PV GENERATION SYSTEM

In electrical wonder (PV) framework, photovoltaic cell is that the essential component. PV exhibit is nothing however solar cells zone unit associated nonparallel or parallel for increasing required current, voltage and high power. It delivers the streams once light-weight ingested at the intersection, by the electrical wonder result. Figure three shows at a protection yield power trademark bends for the PV exhibit [4].It is seen that a most divider attachment exists on each yield power trademark capacity. The Figure three demonstrates the current with voltage and power with voltage attributes those of the PV cluster at very surprising star intensities.

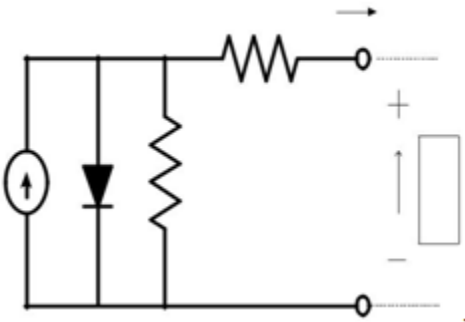

Fig-4: PV module Electrical Circuit

V. MAXIMUM POWER POINT

The potency of turbine, electrical device is improved by MPPT after they set to control at purpose of most power. In several techniques MPPT the foremost in style techniques are: progressive electrical phenomenon technique, Perturb and Observe, symbolic logic, neural networks [5]. Initial electrical phenomenon array reference voltage and therefore the rotor speed for generator and for the turbine area unit modified if the 2 systems output powers area unit doesn't match to their most powers.

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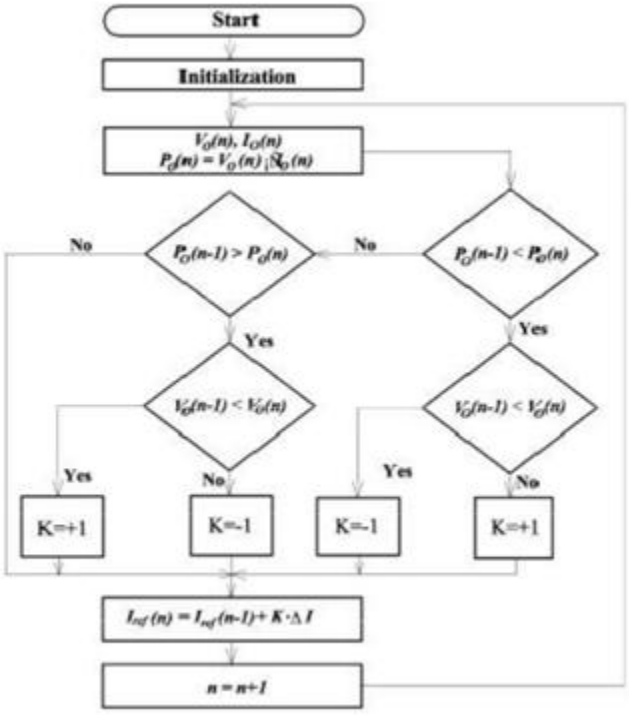

Fig-5: Algorithm for P&O based MPPT

VI. PARTICLE SWARM OPTIMIZATION AND CONTROL STRUCTURE

In computer science, particle swarm optimization (PSO) is a computational method that optimizes a problem by iteratively trying to improve a candidate solution with regard to a given measure of quality. It solves a problem by having a population of candidate solutions, here dubbed particles, and moving these particles around in the search-space according to simple mathematical formulae over the particle's position and velocity.

PSO is originally attributed to Kennedy, Eberhart and Shi [2] and was first intended for simulating social behavior,[3] as a stylized representation of the movement of organisms in a bird flock or fish school. The algorithm was simplified and it was observed to be performing optimization. The book by Kennedy and Eberhart [4] describes many philosophical aspects of PSO and swarm intelligence. An extensive survey of PSO applications is made by Poli.[5][6] Recently, a comprehensive review on theoretical and experimental works on PSO has been published by Bonyadi and Michalewicz.[7]

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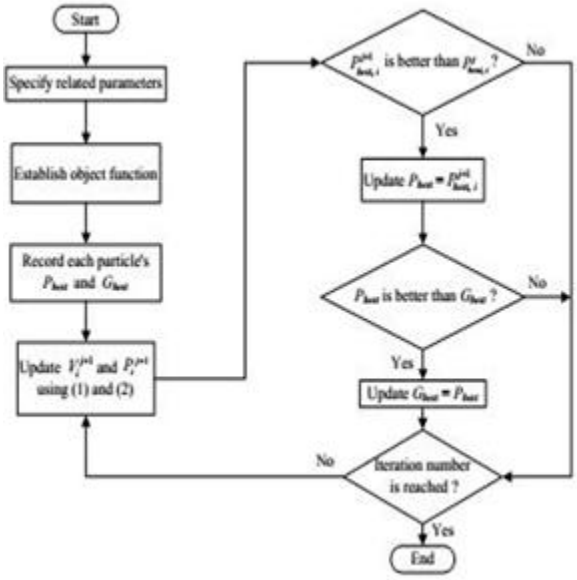

Smart grid is a system consists of three layers: the physical power layer, the control layer and the application layer. And according to, Katherine Hamilton [1], smart grid has to be dynamic and have constant two-way communication, as Modeling and Control for Smart Grid Integration of Solar/Wind Energy Conversion System shown in Fig.1. So, for example, with PV panels on the roofs, intelligent building system will generates, store and use their own energy. Hence, as active buildings they become part of the smart grid. This could save energy and increase reliability and transparency

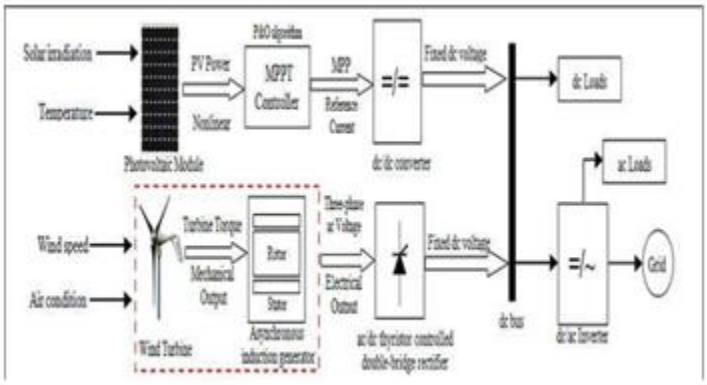

Fig-6: Basic architecture of Hybrid System

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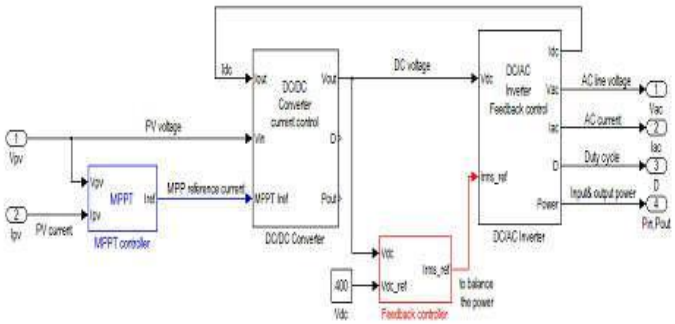

Fig-7: Implementation of PV system

VII. SIMULATION DIAGRAM AND RESULTS

The figure below depicts simulation diagram of a turbine which has input being controlled by a pitch angle. The pitch angle subsystem has been designed in order to maintain a constant input velocity.

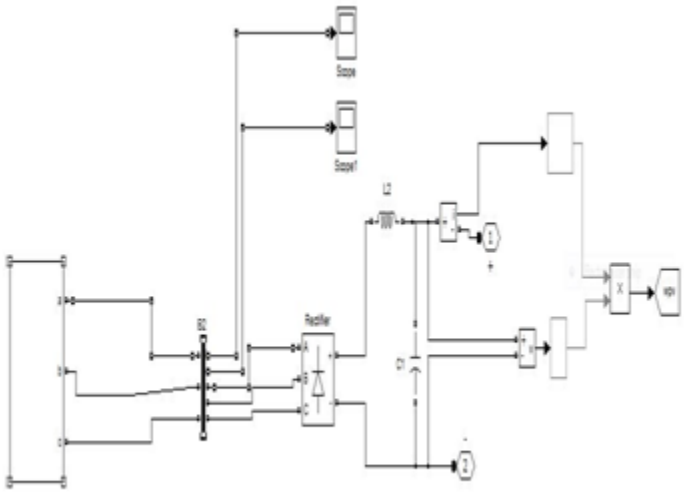

Fig-8: Simulation Diagram of Wind Turbine

The equivalent circuit shows the connection of the solar panel in connection with the converter dc - dc which is the boost, i.e step-up converter in order to boost up the voltage. Input to the PV panel is the irradiance which is a constant here given in the circuit. Irradiance is the temperature constant tracked with the help of an MPPT technique.

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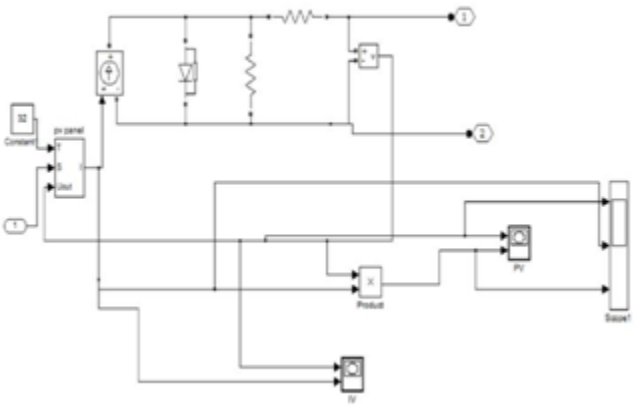

Fig-9: Simulation Diagram for solar cell equivalent circuit

The below figure shows the simulation results without FLC-PSO technique and in this simulation results we can observe the Wind power, PV Power, Solar Irradiance, PV DC Voltage, Wind DC Voltage and PV Current waveforms.

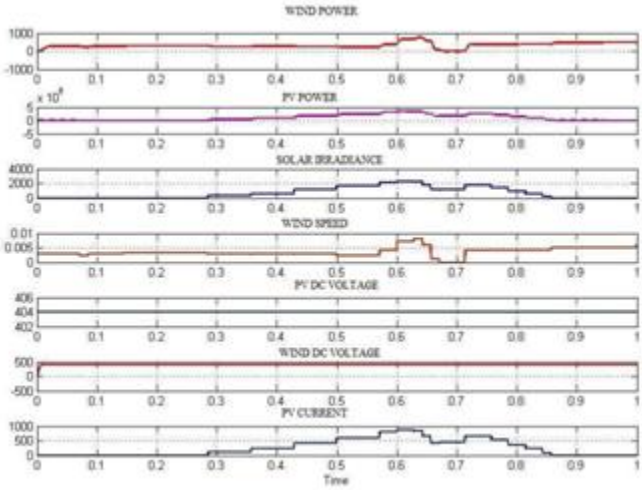

Fig-10: the output wave forms with without FLC-PSO technique

The below figure shows the simulation results with FLC-PSO technique and in this simulation results we can observe the Wind power, PV Power, Solar Irradiance, PV DC Voltage, Wind DC Voltage and PV Current waveforms.

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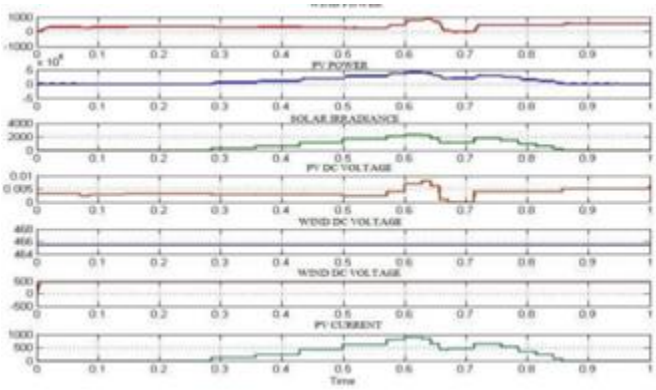

Fig-11: shows the simulation results with FLC-PSO technique

VIII. CONCLUSION

In this paper, a novel PV/WT hybrid power system is designed and modeled for smart grid applications. The developed algorithm comprises system components and an appropriate power flow controller. The model has been implemented using the MATLAB/SIMULINK software package, and designed with a dialog box like those used in the SIMULINK block libraries. The available power from the PV system is highly dependent on solar radiation. To overcome this deficiency of the PV system, the PV module was integrated with the wind turbine system. And also a PSO based MPPT techniques were proposed for both PV & Wind in order to improve the system performance. The dynamic behavior of the proposed model is examined under different operating conditions.

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