Designing a charge controller with a maximum power point tracker using a particle swarm optimization method

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ABSTRACT

Energy demand is growing rapidly and the use of renewable energy sources plays an important role in reducing the gap between supply and demand. The introduction of multiple power electronics and non-linear loads is added to the network and causes power quality problems. The problem of lack of energy and the problem of the quality of energy can be solved at the same time using the inverter connected to the renewable sources grid system. This research work presents the design and implementation of a hybrid renewable energy system that allows a cost-efficient and sustainable energy supply of the loads. The integration of the solar system with the network is rather complex and expensive. With this construction proposal, however, it is not only possible to create an economical and simple hybrid system, but also a reliable, efficient and economical system. A charge controller is designed with a maximum power point tracking technique using a particle swarm optimization method

Key words- Renewable Energy system, PV Array, Wind System

1. INTRODUCTION

The stand-alone wind power system cannot meet the constant load requirements from hour to hour throughout the year due to large fluctuations in wind speed amplitude. Therefore, energy storage systems are necessary for each of these systems to meet the performance requirements. Usually, the storage system is expensive and the size must be kept to a minimum so that the renewable energy system is profitable. Hybrid power systems can be used to reduce the need for energy storage.

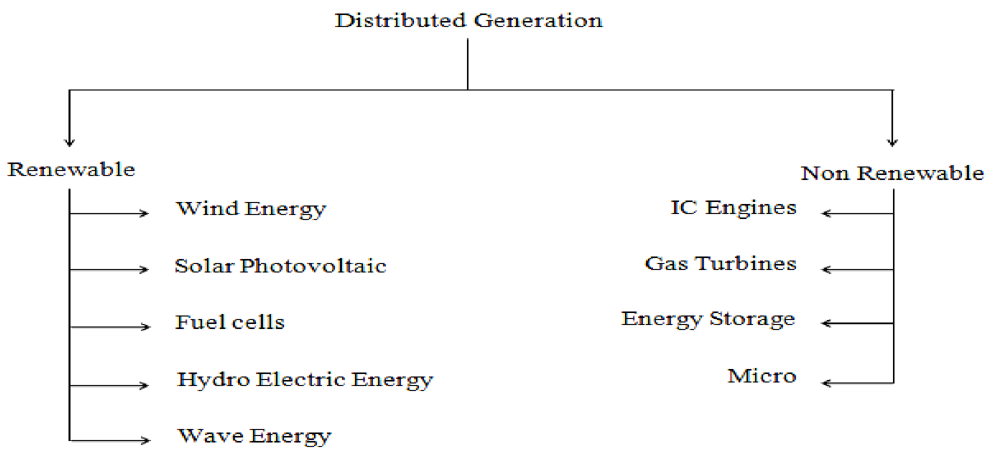
1.1 DISTRIBUTED GENERATION

The first power systems were DG systems designed to meet the needs of local areas. The development of technology and the increase in energy demand have led to the development of large centralized networks linking regions and entire countries. Full load DG applications showed greater benefits in terms of power and performance as well as reducing transmission losses. GDs are very suitable for a specific location and for specific applications because they require a short construction time and require little investment. It is defined on the basis of the size of the plant, which can vary from a few KW to MW

(10-50 MW). GD options can be classified as renewable or non-renewable sources from fuel sources.

The DG, defined as a generation in or near the distribution centers, is recognized as an environmentally responsible, reliable and safe energy source, which not only has minimal negative social impacts, but also promotes the environment. Welfare. In recent years, for economic, environmental and political reasons, the traditional feeding system, characterized by the centralized production of mass energy and long-distance and long-distance transmission networks, supports the DG. For a sparse rural area, decentralized generation systems, which generate electricity for consumers and thus avoid transmission and distribution costs, are a better solution. The concept of DG was seen as production and distribution of decentralized energy, especially in rural areas.

According to sources used for production in distribution centers or in the vicinity, they are classified as renewable and non-renewable.



1.2 MODELLING OF PV ARRAY

The photovoltaic system connected to the grid is a more reliable solution to increase the demand for energy. The network connection of a photovoltaic power generation system has the advantage of more efficient use of the generated energy. The PV systems are connected to the grid via the inverter, which converts the DC energy generated by the PV modules into alternating current. The inverter technology is very important to ensure a reliable connection and safe operation of the photovoltaic network. In general, inverters with controlled voltage sources are used to connect the RES to the network. This penetration of power electronic converters can create a danger to the network in terms of energy quality problems such as harmonics. These harmonics can cause the protection relays and other control devices to malfunction. Therefore, harmonics must be reduced. Active shunt power filters have been recognized as the most efficient harmonic compensation technique.

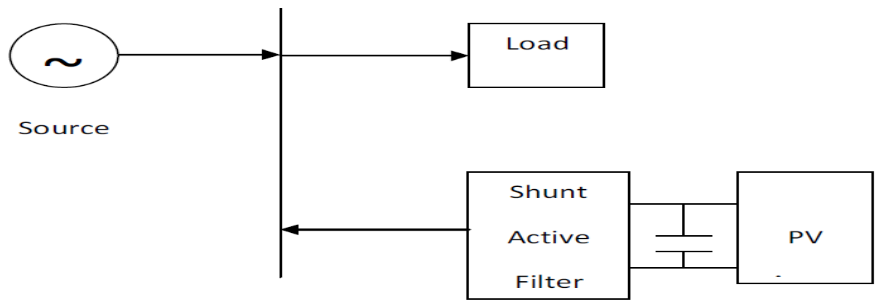


Fig-1 Photovoltaic Interactive Shunt Active Power Filter System

2. SOLAR-WIND RENEWABLE ENERGY GRID SYSTEM

Grid connected wind-solar hybrid renewable energy system is simulated and analyzed in this research work. The overall block diagram of the system under discussion is shown in Fig. 2. A conventional inverter is used for interfacing the renewable energy system with the grid. Here, inverter not only acts as an interfacing system for real power flow to the grid, but acts as a power quality improving device also. Control methods used for the system plays an important role in the performance of the inverter.The PV and wind system produces dc output voltage. For grid-connection of these two sources, different power electronic interfaces are required. The DC-shunted grid-connected hybrid PV /wind power system is used in this work. In the system under study, the output of DC sources are connected to DC/DC boost converter and the dc link voltage is regulated. AC output voltage of wind energy system is rectified using uncontrolled rectifier in the first stage and then a DC/DC boost converter is used to control DC link voltage.

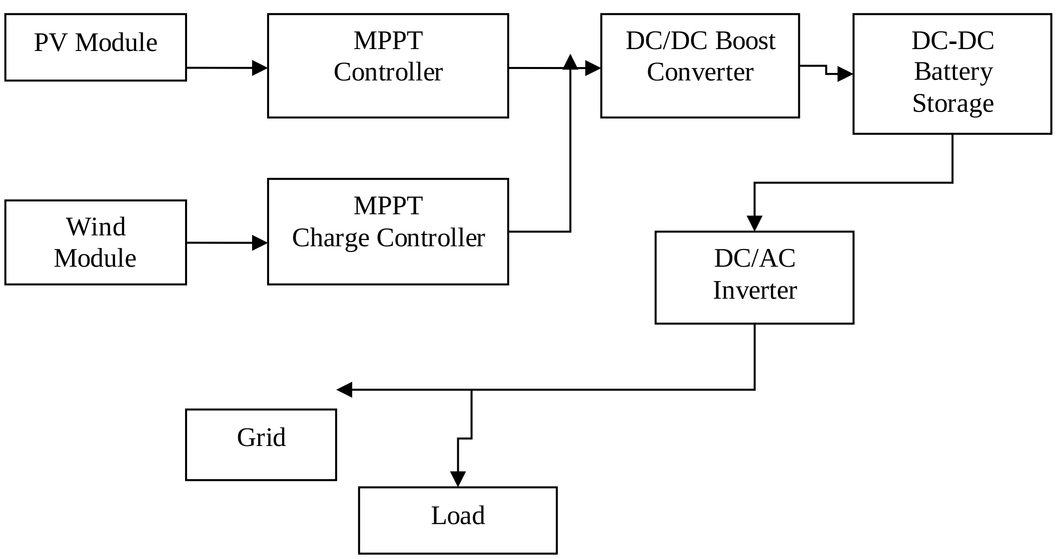


Fig-2 Solar-Wind RE System

3. HYBRID RENEWABLE ENERGY GRID SYSTEM WITH PSO-MPPT AND PI INVERTER CONTROLLER

Grid connected hybrid renewable energy system is simulated and analyzed in this research work. The overall block diagram of the system under discussion is shown in Fig. 3. The system consists of a solar panel, wind system and fuel cell system with particle swarm optimization with maximum power point tracking charge controller, battery packs, AC/DC converter (output voltage can be varied) and PI controller for power improvement. In this system, the load has been supplied by DC, not AC. Such as, grid synchronization, where Information about phase angle of the grid voltage is required to transfer the power from converters.In this research, the photovoltaic system realized consists of a single conversion stage in which the photovoltaic generator is connected directly to the inverter connected to the grid. The algorithm used to execute MPPT is based on the PSO method. In other words, the proposed PSO-MPPT technique is used to trace the global maximum power point (GMPP) of the photovoltaic array as they improve the overall performance of the photovoltaic system.

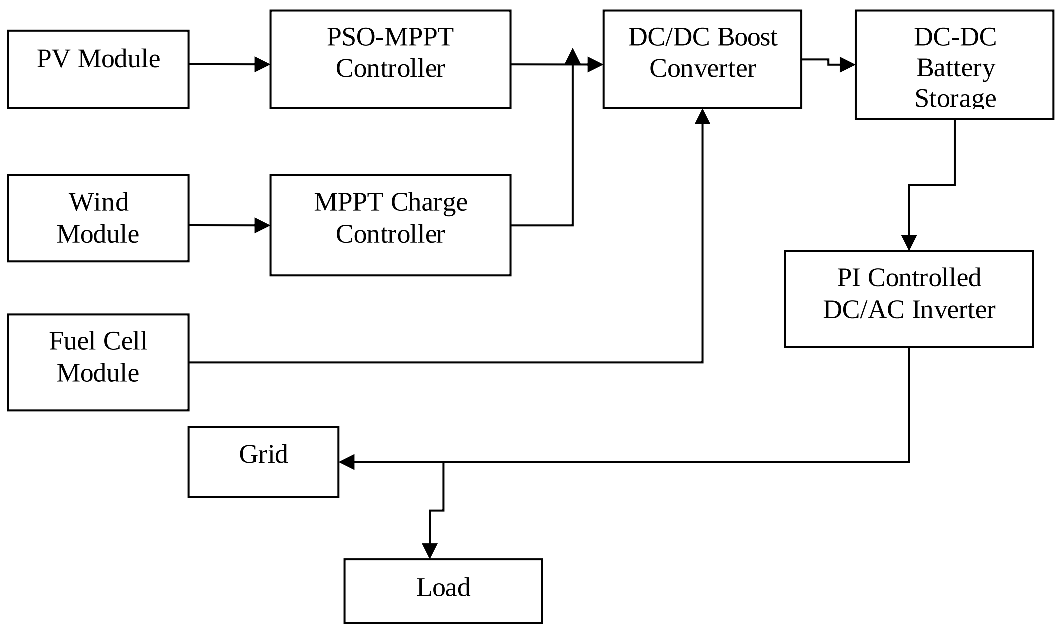


Fig-3 Hybrid RE System with PI Controlled Inverter

4. RESULTS

The proposed system presents power-control strategies of a grid-connected hybrid generation system with versatile power transfer. This hybrid system allows maximum utilization of freely available renewable energy sources like wind and photovoltaic energies. For this, an MPPT algorithm will be used for the system. Also, this configuration allows the two sources to supply the load separately or simultaneously depending on the availability of the energy sources. The turbine rotor speed is the main determinant of mechanical output from wind energy and Solar cell operating voltage in the case of output power from solar energy. Permanent Magnet Synchronous Generator is coupled with wind turbine for attaining wind energy conversion system.

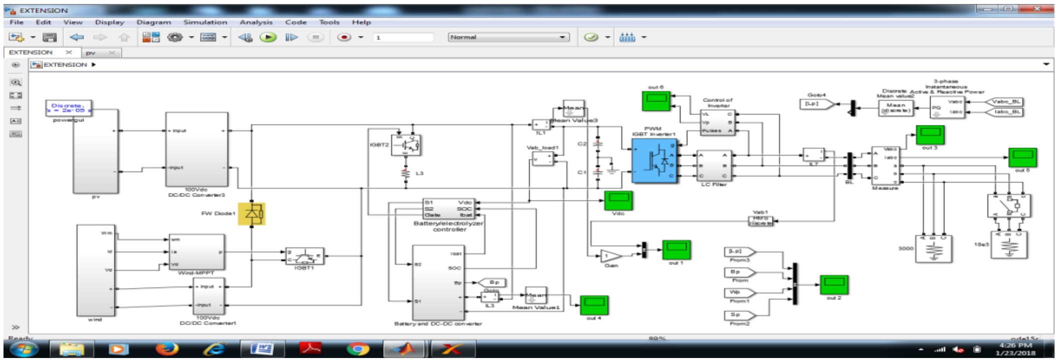


Fig-4.1MATLAB Simulink Model of Solar-Wind RE System with PI Controlled Inverter

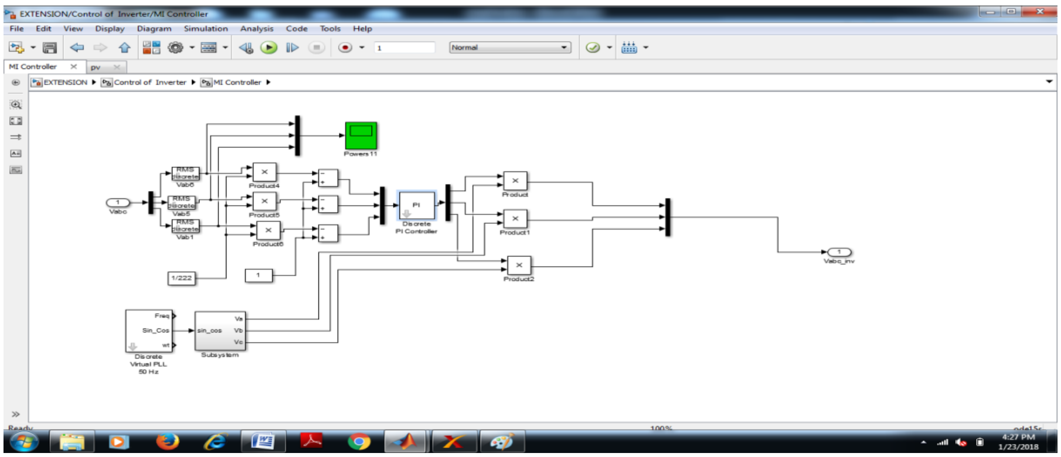


Figure 4.2: MATLAB Simulink Model of Controlled Inverter for Solar-Wind RE System

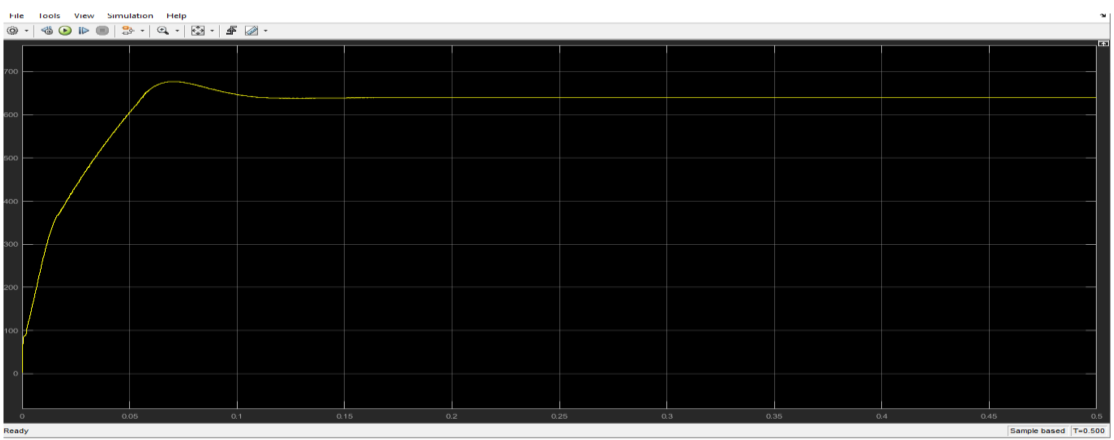


Figure 4.3: DC Voltage obtained in Solar-Wind RE System

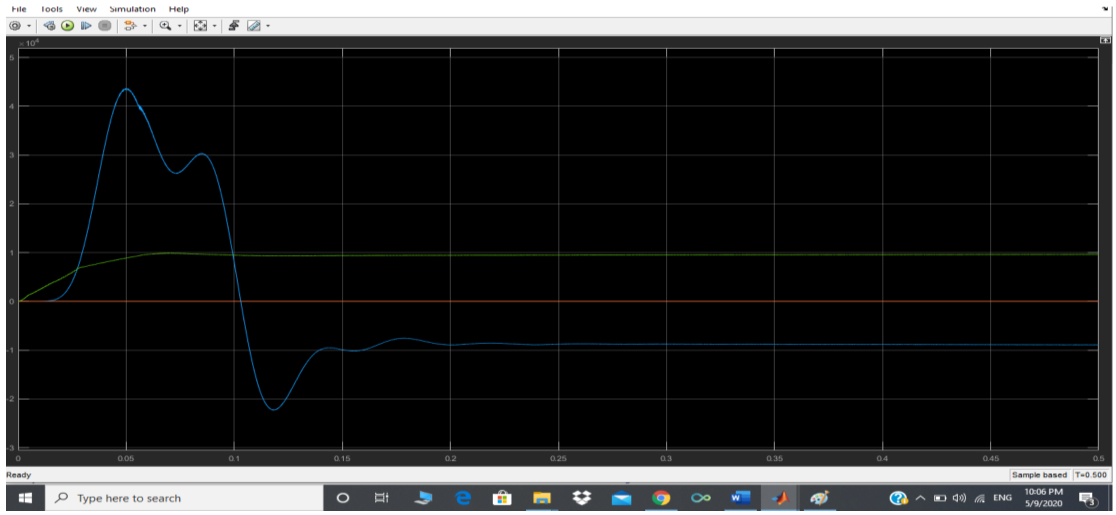


Figure 4.4: Power Obtained in Solar-Wind System RE System

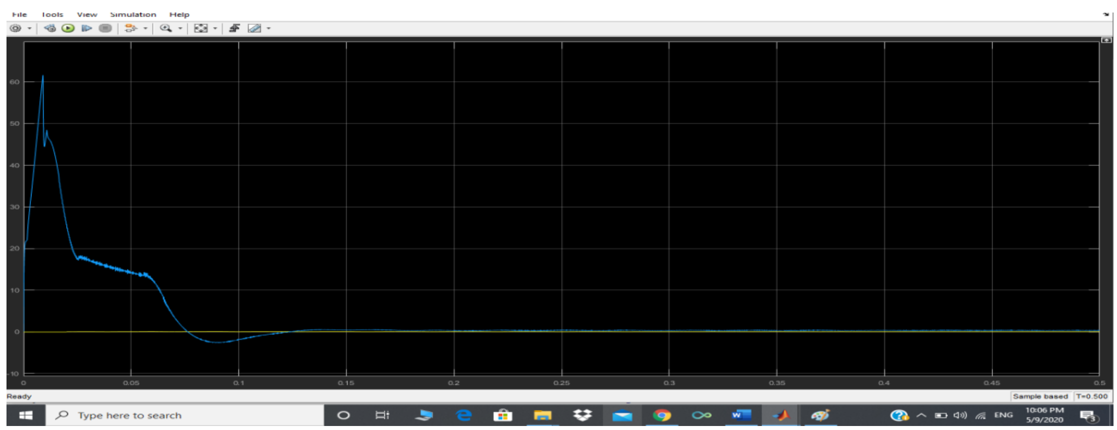


Figure 4.5: Current Obtained in Solar-Wind System RE System

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