Stability Enhancement of Grid Synchronization with a possible configuration of Motor-Generator pair for Renewable energy integration by using ANFIS

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Abstract—Recent days, renewable energy plays a vital role on generation of Power by grid synchronization. Due to this high penetration, there is a lack of generation and attains failure of grid synchronization, instability of grid which results in reducing the use of renewable energy for power generation. So, as to enhance the grid stability, Motor-generator pair(MGP) is implemented with the renewable energy (solar, wind and fuel cells) and also maintaining the grid synchronization by distributing power to AC grids, THD value is also reduced by using ANFIS Control in this proposed scheme. The simulation results by using MATLAB/Simulink software shows the SMGP operation with AC grid, Load variation between AC grid and load.

Keywords- motor-generator pair, Grid synchronization, AC grid, Total Harmonic Distortion.

INTRODUCTION

The generation of Power through renewable energy can be broadly classified into two types by the IRENA report [1]. They are Dispatchable energy and Non-dispatchable energy. Dispatchable energy, which depend on ready for production upon demand like Hydro, Geothermal, Biomass power. Non-dispatchable energy like solar, wind and fuel cell, which depends on meteorological conditions and/or on time of the day. This non-dispatchable energy is also known as Variable renewable which is suitable for Distributed power generation systems, produce Power close to demand side[2]. To know about the requirement of demand of Power, Demand side management is implemented.

This non-dispatchable energy are volatile and intermittent sources, which improves the flexibility of system. To procure this the balancing capacity which isststic or dynamic can be predicted by using some machine learning algorithms[3]. So, the Power balancing can be ensured by implementing the machine algorithm for renewable energy integration in specific countries.

For the renewable energy integration, the variable renewable energy(VRE) into grids improves the existing grid flexibility have some following conditions[5].,

1) For distributed power generation which is mainly aimed for ensuring the grid stability allow the power to flow from various grid interfacing system.
2) To maintain the effective demand management system for the quick response of peak-load demand, increasing the flexibility.
3) When power generation exceeds the demand, the energy storage unit is also introduced to store them and used when it needed.

PROPOSED METHOD WITH SIMULATION RESULT ANALYSIS

The converter, Synchronous generator does support for the major problems like high fault current, grid instability condition, reduced frequency response, inertia is also get affected while grid synchronization. To overcome this, the Synchronous Motor-Generator pair is implemented for the improving the efficiency. When the grid synchronization is done, inertia is also important for frequency response. So to maintain the inertia, SMGP is implemented. Then three phase inverter is also used for grid synchronization technique.

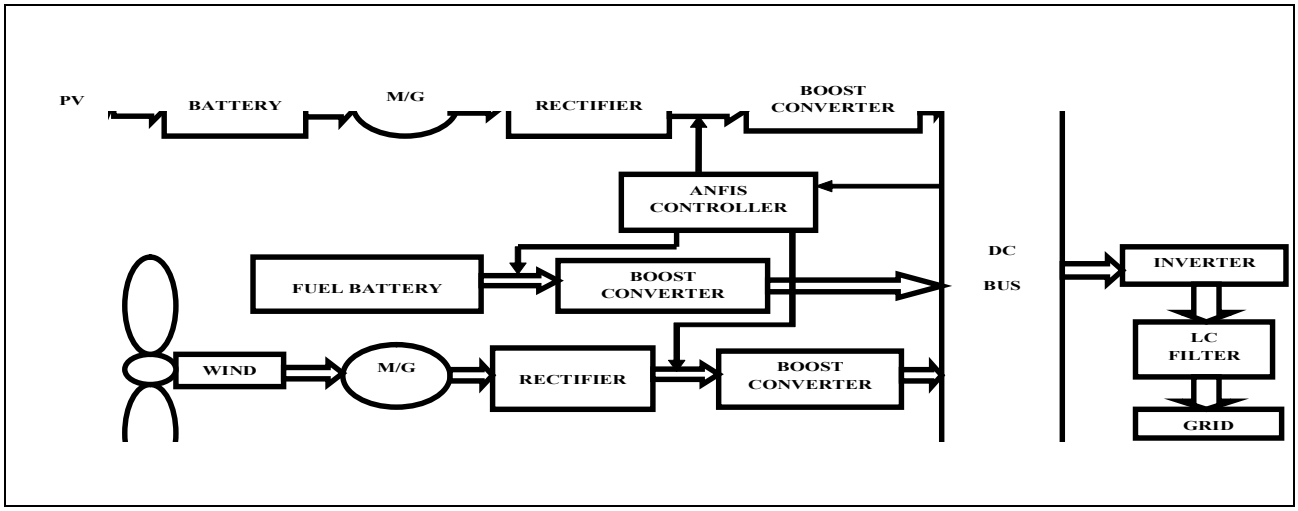
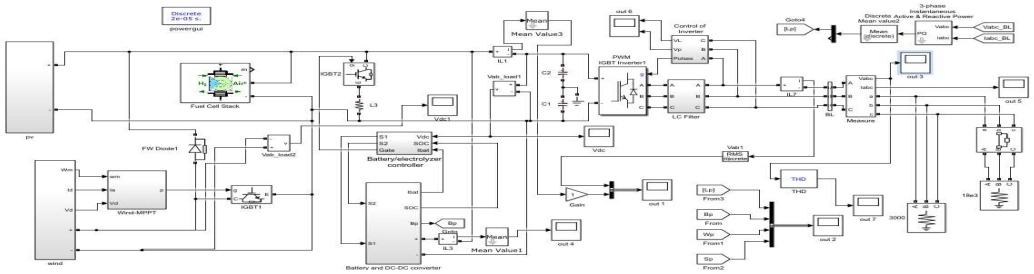


Fig 3: **proposed** block diagram

B. SIMULATION CIRCUIT DIAGRAM:

The simulation diagram for the proposed method is explained. It explains about the grid connection way, operation of Synchronous Motor-Generator pair which is connected with solar wind and fuel cell separately. The ANFIS control technique will be used here for regulation of grid connected inverter, operating frequency of the grid, generation of DC voltage from the renewable energy resources (solar, wind and fuel cell).



C. OUTPUT WAVEFORM FOR WITH MOTOR-GENERATOR PAIR

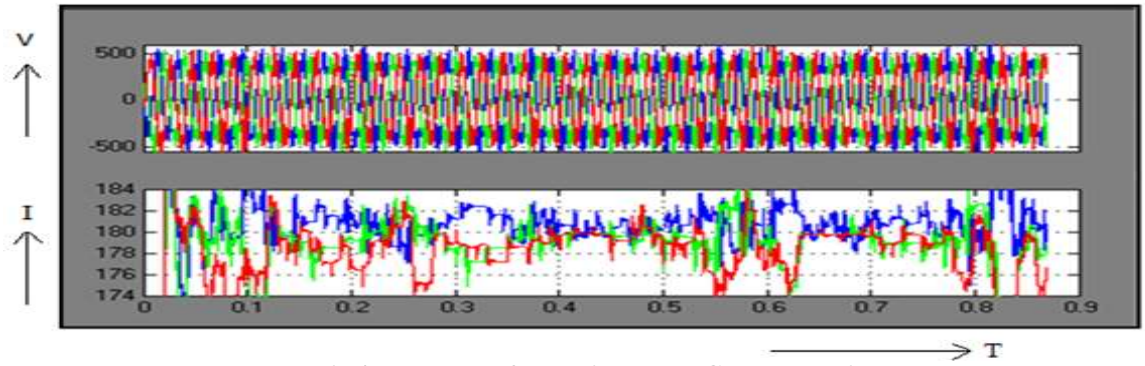


Fig 4 output waveform With Motor-Generator pair

The simulation result is the output waveform of renewable energy integration with motor-generator pair. On using this combination for the proposed system, fluctuations faced by the Grid system not get affected. So, the grid stability is enhanced, Efficiency also improved.The output waveform shows the characteristics of voltage value with respect to time and current value with respect with to time without any deviation in the waveforms.

D. OUTPUT WAVEFORM OF WITHOUT MOTOR-GENERATOR PAIR

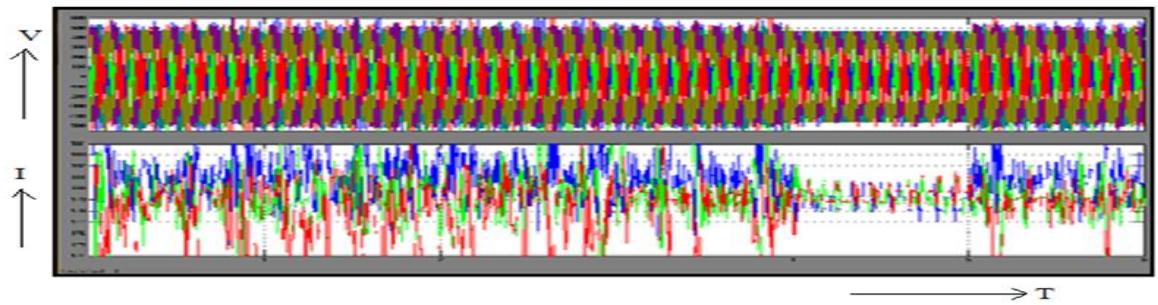


Fig 5 Output waveform Without Motor-Generator pair

The simulation result is the output waveform of renewable energy integration without Motor-Generator pair. Fluctuations faced by the Grid system get affected. The output waveform shows the characteristics of voltage value with respect to time and current value with respect with to time without using Motor-Generator pair. Because of fluctuation during load demand, deviation is represented in the output waveform.

E. OUTPUT WAVEFORM OF PV SYSTEM

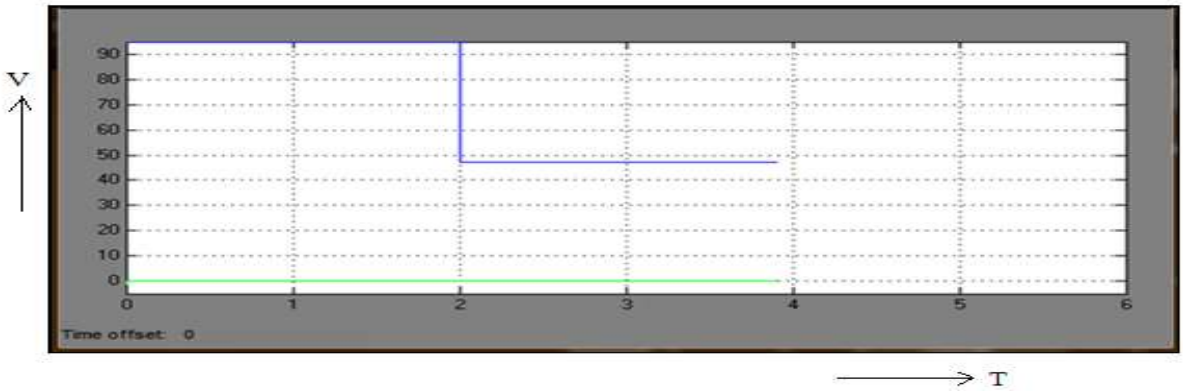


Fig 6 output waveform of PV system

F. V-I & P-I CURVE OF PV SYSTEM

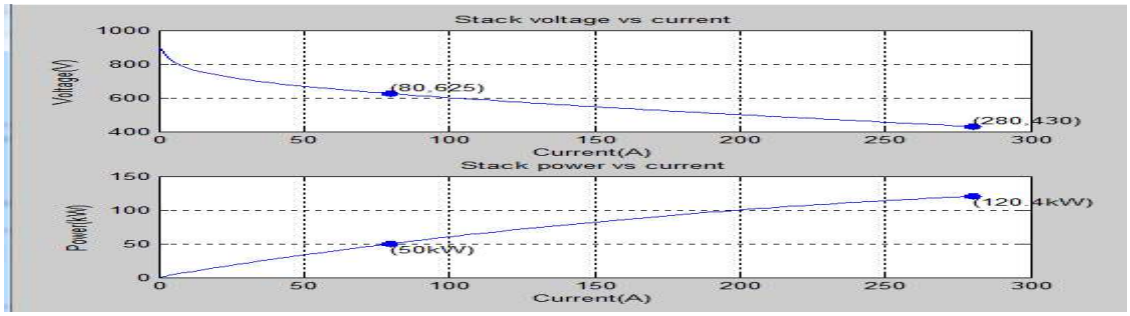


Fig 7 V-I & P-I curve of PV system

G. OUTPUT WAVEFORM OF WIND SYSTEM

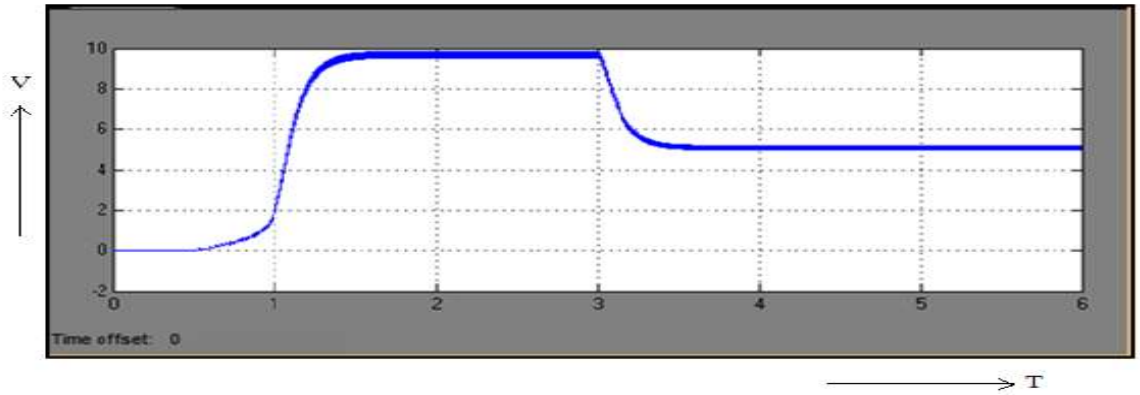


Fig 8 Output waveform of Wind system

H. OUTPUT WAVEFORM OF FUEL SYSTEM

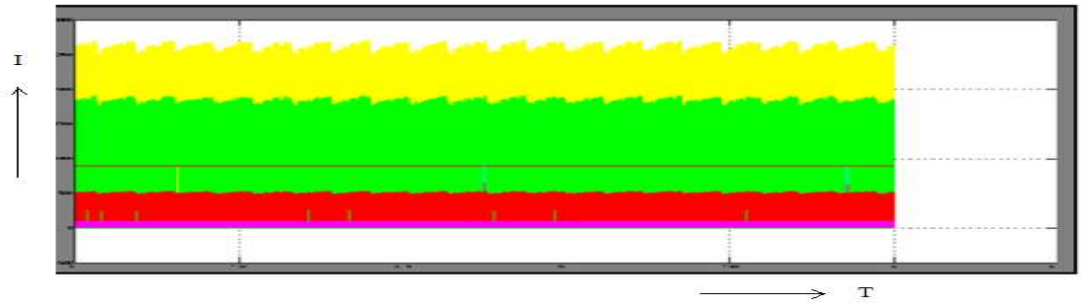


Fig 9 Output waveform of Fuel cell system

I. OUTPUT WAVEFORM OF THD

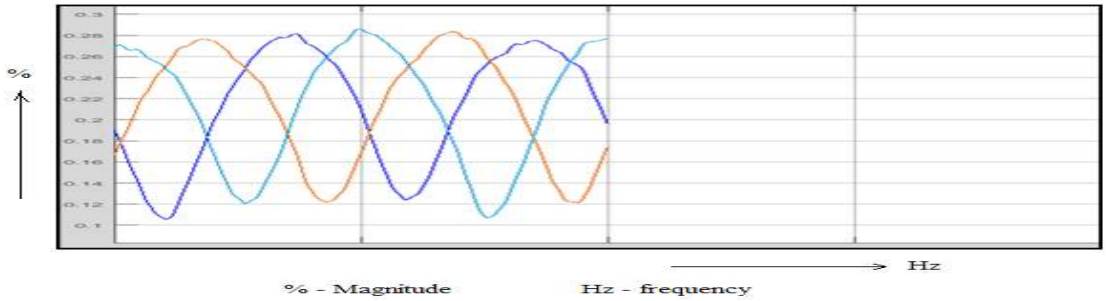


Fig 11 Output waveform of THD

J. OUTPUT WAVEFORM OF AC GRID

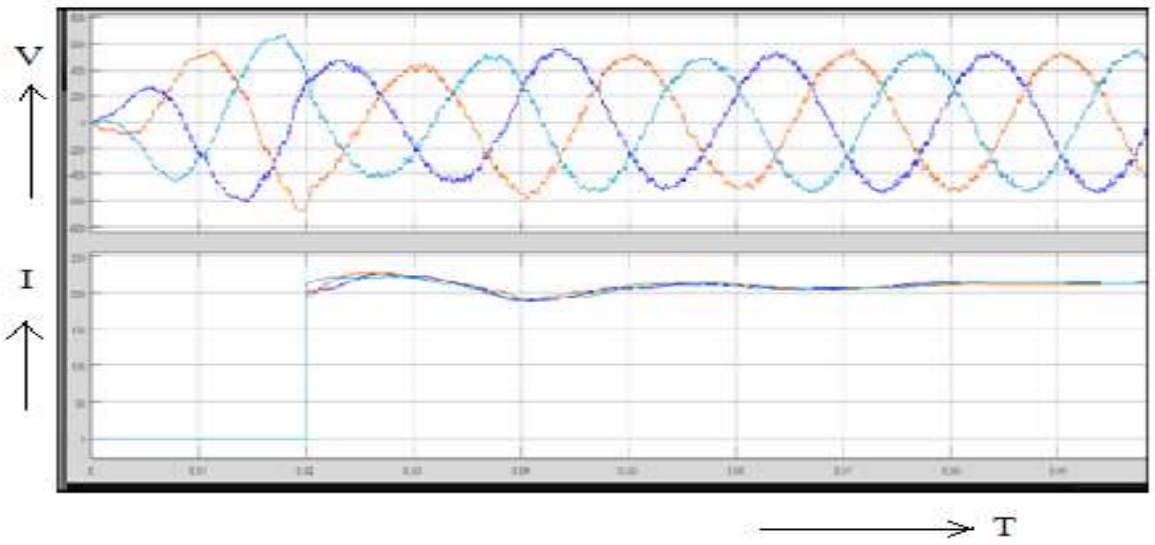


Fig 12 Output waveform of AC Grid

The simulation result for ac grid output shows the generation of power source from renewable energy integration and synchronized with the grid.The power flow to the AC Grid shows that there is no fluctuation occur in the grid supply due to the load demand.This output waveform shows both voltage and current characteristics with respect to time.

K. OUTPUT WAVEFORM OF EFFICIENCY IMPROVEMENT

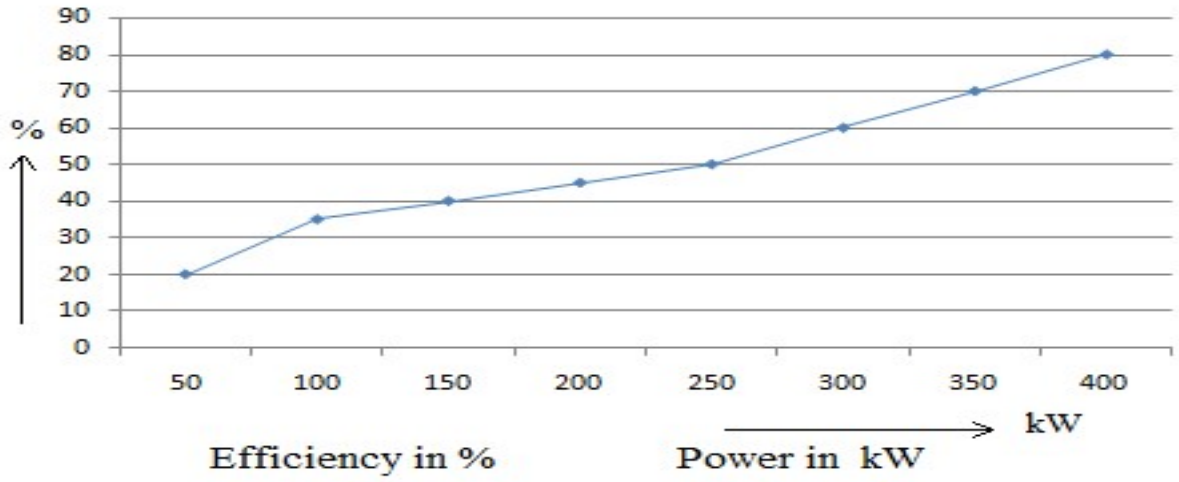


Fig 13 output waveform of efficiency improvement

CONCLUSION

Thus renewable energy penetration is increases day by day, the grid stability can be enhanced by using the synchronous motor-generator pair with the effective controller. In this paper, the ANFIS controller is implemented for the enhancement of grid

stability, marinating less value of THD, frequency variation may be corrected and its performance is shown by the simulation results using MATLAB/Simulink. Finally concluded that ANFIS technique is better one for the future grid without get any variation by renewable energy penetration.

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