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Performance Comparison of Simultaneous Operation of Hybrid Renewable Energy Sources using Power Electronic Converter

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ABSTRACT: A Hybrid Renewable Energy System (HERS) plays a major role in the generation of electricity. Generally, the system consists of Solar Photovoltaic (PV) and Wind Energy (WE) system which is available plenty in nature. It can be designed for both stand-alone and grid-connected systems, for providing electricity in remote areas it is popular to use a stand-alone power system. In this paper, it gives an idea about combining both the system simultaneously. Due to its minimum number of total harmonic distortion, it is guaranteed to use as a practical system. The simultaneous operation can be preceded by connecting both the systems to a common DC bus. A DC bus can come combine number of systems together, thus it offers good efficiency throughout the system. The converters and inverter are designed and simulated using Matlab/Simulink and its performance are analysed.

KEY WORDS: Hybrid Renewable Energy System (HERS), Solar Photovoltaic, Wind Energy system, Converter, Inverter, Harmonic analysis.

I. INTRODUCTION

In modern days, the usages of Hybrid Renewable Energy Systems (HERS) are increased rapidly to satisfy the load demands both in stand-alone and grid-connected system. For this increasing load demands, a single renewable energy source is not enough because of its performance and characteristics. In such cases, this hybrid system will play a major role in power generation. The power generation from the Solar Photovoltaic (PV) and Wind Energy (WE) systems has been increased extensively, it explains briefly in [2], due to its balancing availability nature during a day hours and its output power generation will depend on the availability of solar irradiation from sun, similarly the wind velocity also available respectively. Due to the high penetration of renewable sources in nature, the power developed from these sources leads to constant and desirable voltage is clearly surveyed in paper [4]. This is an effective system for practical implementation because of its minimum value of total harmonic distortion. In this system, the operation can be done with the help of power electronics converters to improve their efficiency and also the comparative analyses were made based on the harmonic analysis.

The combination of the system is made much easier by connecting the converters to a common DC bus. A single DC bus can accept and provide more number of connections in it, is explained in[7]. From the Wind Energy system (WE), the output voltage and current (i.e.) output power is of AC supply. Same way in Solar Photovoltaic (PV), the output voltage and current (i.e.) output power is of DC supply. To connect both the system together an AC-DC converter and DC-DC converter is required which is connected to a common DC bus. From the DC bus the system is connected to an inverter which converts DC source to AC source thus it can easily satisfy the load demands of stand-alone and grid-connected system.

A comparative study is made between over the systems; In this case the both DC and AC supply are connected simultaneously by a rectifier and inverter to satisfy the load demands. The following figure 1 represents the

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circuit diagram of the conventional system. It consists of Solar Photovoltaic and Wind Energy system combination for power generation.

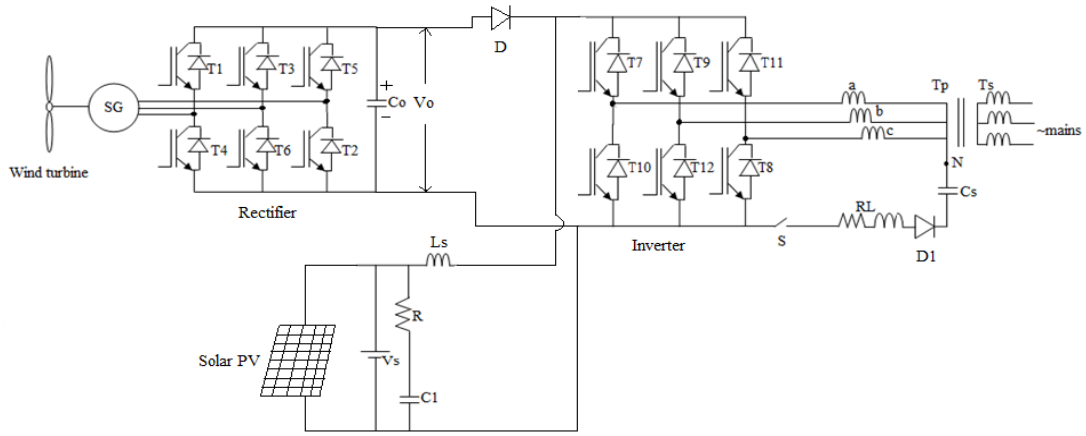

Fig: 1 Circuit diagram of Conventional System

Fig: 1 represents the circuit diagram of solar and wind, which is not connected via common DC bus. The DC supply in this circuit is connected via neutral point of the transformer in the way to balance the voltage. The switch S, in the circuit is connected or forms a closed path to balance the voltage among the phases.

II. SIMULATION AND RESULTS

In this session, the simulation analysis of this paper work with their results is explained. The following circuit is the Matlab simulation circuit diagram.

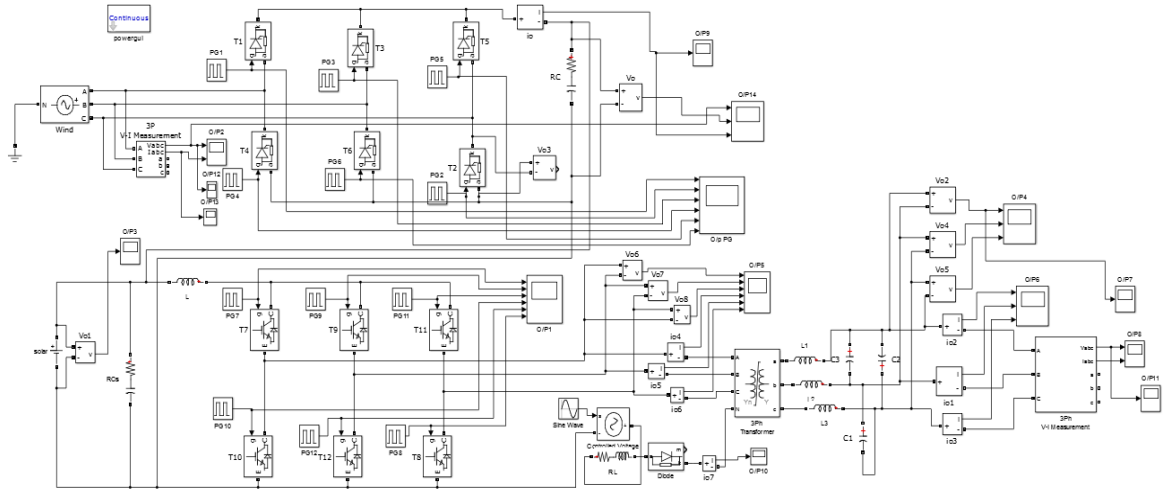

Fig: 2 MATLAB simulation circuit of Conventional system

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Fig: 2 represent the Matlab simulation circuit of the conventional system, the voltage and current values are analysed in each part of the system. More over the FFT analysis i.e. the value of Total Harmonic Distortion (THD) is calculated.

As per the simulation circuit, the results in waveform has been obtained and displayed. The following fig: 3 explain the input voltage and the output voltage and current waveforms of the conventional system.

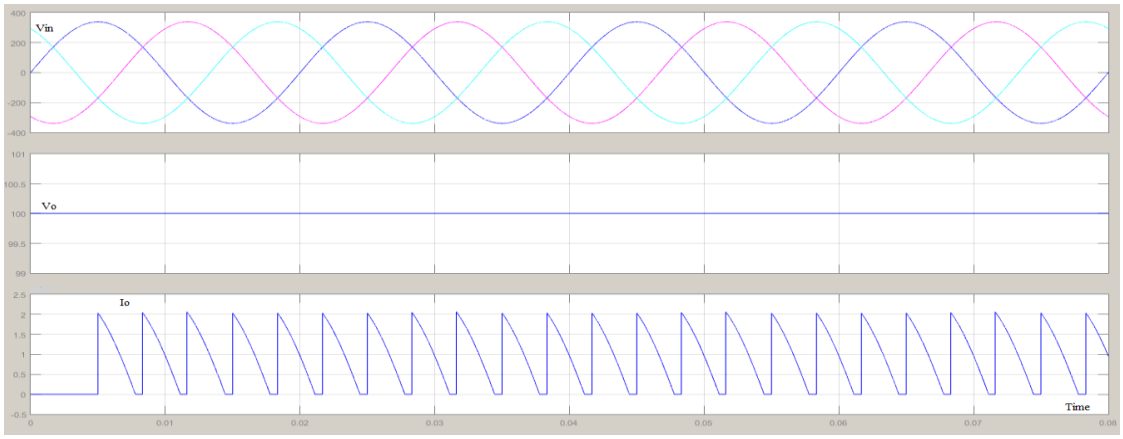

Fig: 3 Input Voltage & Output Voltage and Current waveform

Fig: 4 is the FFT Analysis of the proposed system. The THD value of the conventional system is around 13.07%, which is higher than the proposed system as compared.

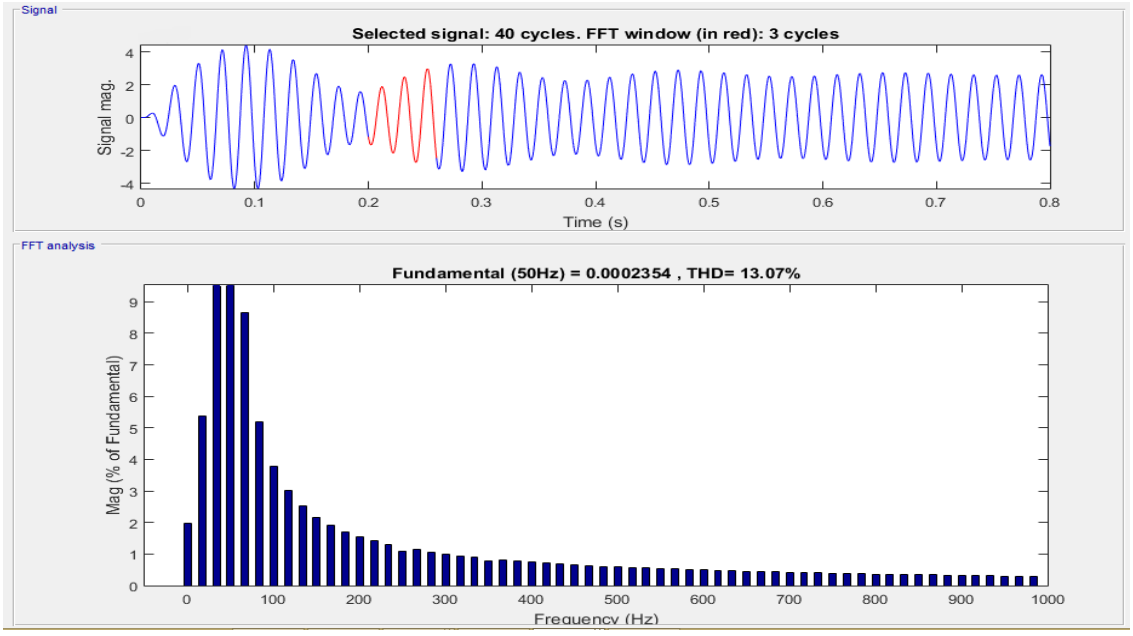

Fig: 4 FFT Analysis of the conventional system

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The upcoming figure fig: 5 is the circuit diagram of the proposed system. In this circuit the solar Photovoltaic and wind is connected in parallel to each other and are connected together by a common DC bus. Thus by this circuit connection more number of renewable and non-renewable systems can be combined.

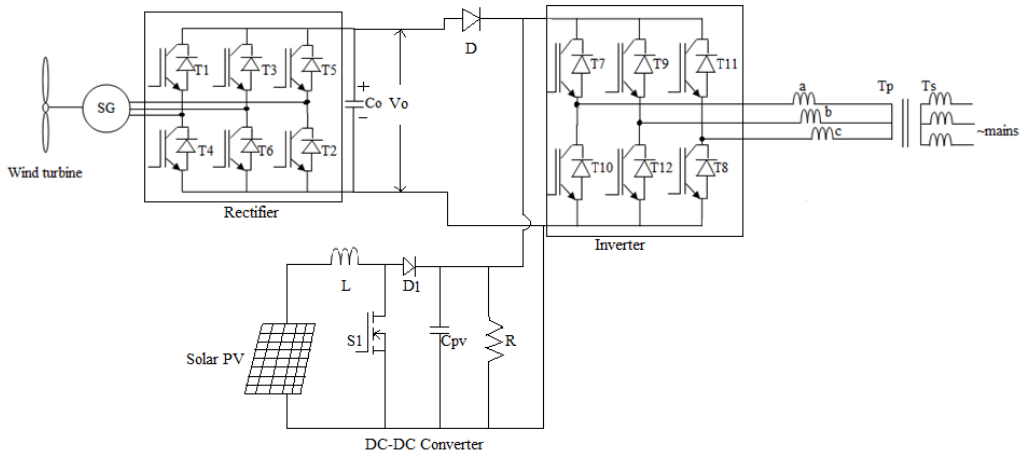

Fig: 5 Circuit diagram of Proposed system

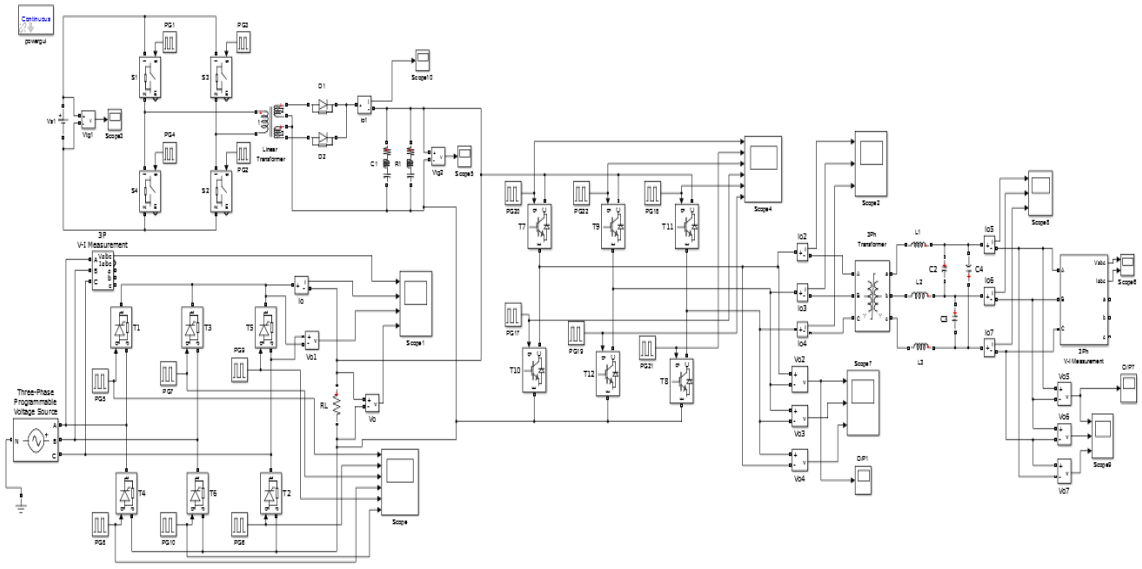

Fig: 6 MATLAB simulation circuit for proposed system

Fig: 6 is the Matlab simulation circuit for the proposed system. It consists of solar and wind energy system connected together by the power electronic converter. The required voltage and current at each part of the system are analysed.

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The forthcoming fig: 7 give details about the Output voltage and current waveforms of the proposed system with respective input values.

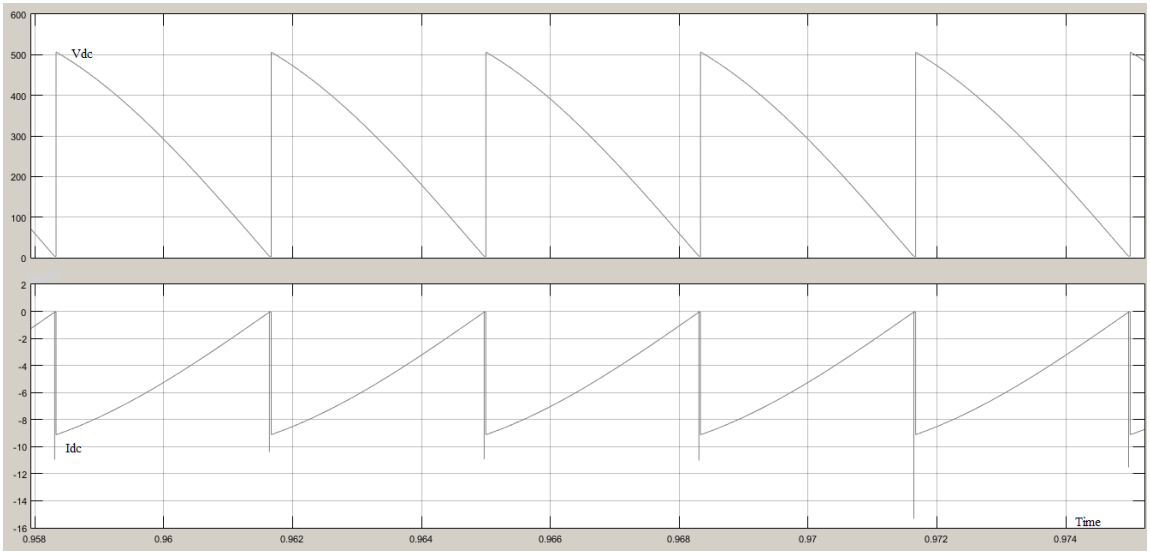

Fig: 7 Output voltage and current waveforms

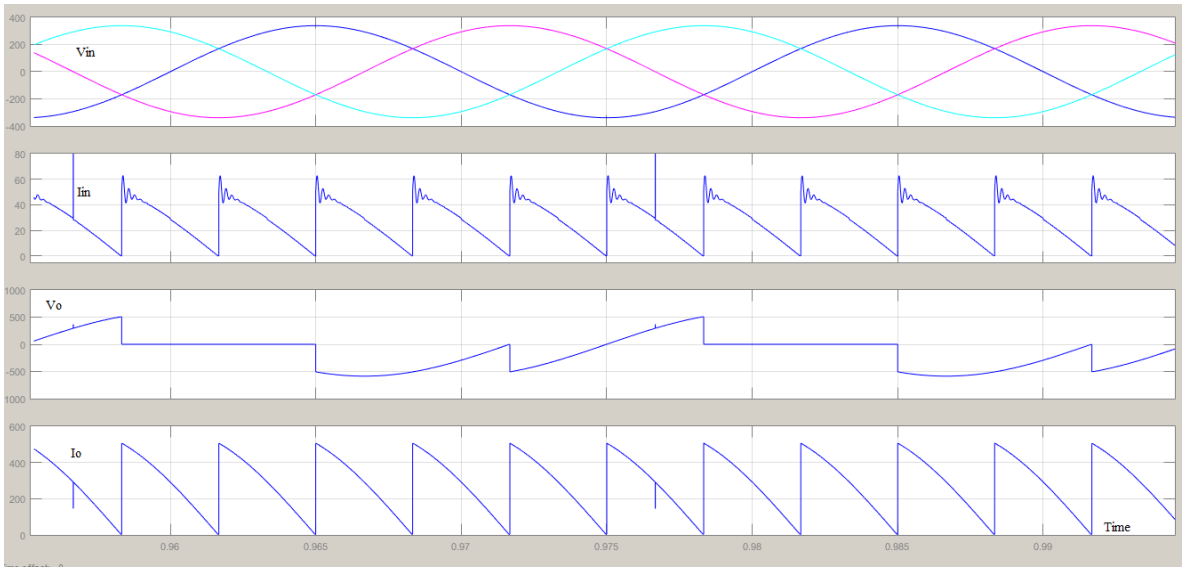

Fig: 8 Input voltage & current, Output Voltage & current waveforms

In fig: 8 the above waveforms obtained for proposed system circuit, the waveform for three phase system along with its current. The 3rd and 4th graph represents the voltage and current waveform for switches used in the circuit.

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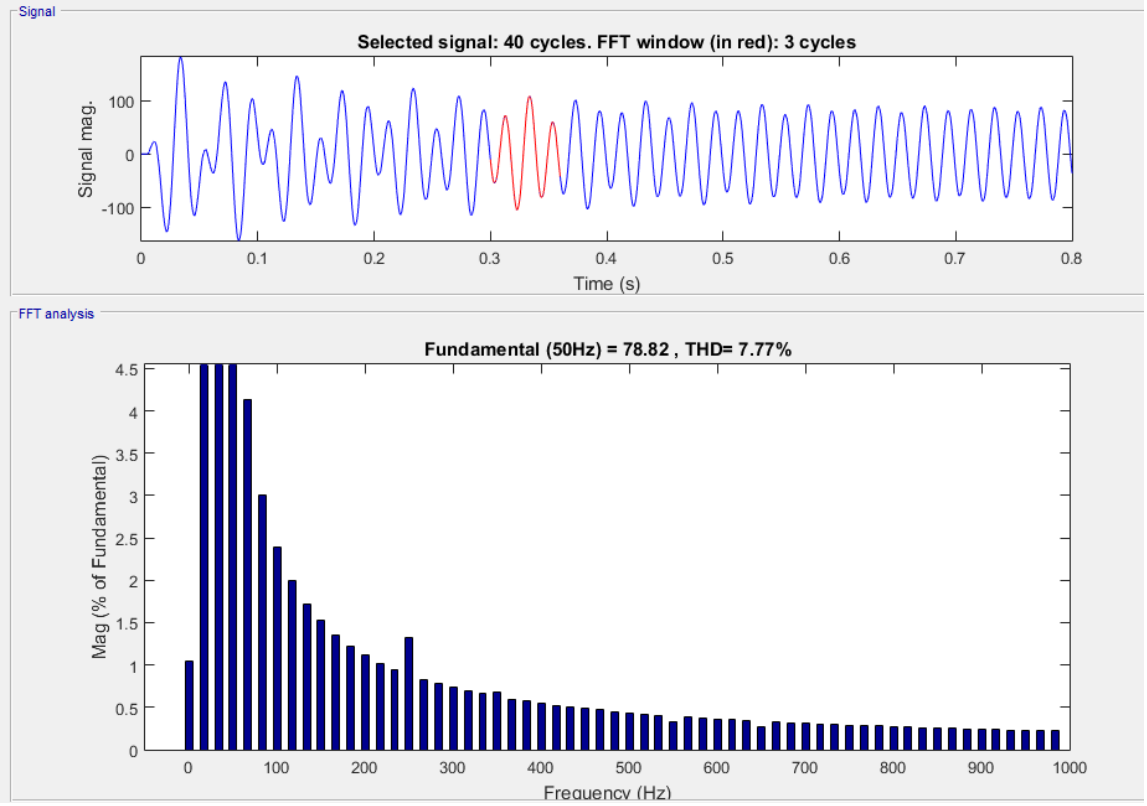

Fig: 9 FFT Analysis of Proposed systems

As similar to the conventional system the THD analysis is made for the proposed system. In fig: 9, it describes the THD analysis of the proposed system the value of THD is around 7.77% which is reduced nearly 50% of the conventional system.

III. CONCLUSION

In this paper, a comparative analysis was prepared along with the FFT analysis. In such analysis it is proved that the present system shows good efficiency, with high efficient power electronic components and with minimum value of harmonics. Many literature analyses were made to obtain the better efficiency. It is concluded that the design of proposed system is suitable for implementation in power generation sectors.

REFERENCES

[1] Kumar, K., N. Ramesh Babu, and K. R. Prabhu. "Design and Analysis of an Integrated Cuk-SEPIC Converter with MPPT for Standalone Wind/PV Hybrid System." *Int. J Renewable Energy Research*, vol. 7, no. 1, pp. 96-106, 2017.
[2] G. Tina, S. Gagliano, S. Raiti. "*Hybrid solar/wind power system probabilistic modelling for long-term performance assessment*". Solar Energy, Volume 80, Issue 5, 2006, pp. 578-588.
[3] Kabalci, Ersan. "Design and analysis of a hybrid renewable energy plant with solar and wind power." *Energy Convers. Manag.*, 72:51-59, (2013).
[4] Baghdadi, Fazia, Kamal Mohammedi, Said Diaf, and Omar Behar. "Feasibility study and energy conversion analysis of stand-alone hybrid renewable energy system." *Energy Convers. Manag.*, vol. 105, pp. 471-479, 2015.
[5] Saravanan, S., and N. Ramesh Babu. "Modified High Step-Up Coupled Inductor based DC-DC Converter for PV Applications." *Gazi Univers. J Sci.*, vol. 29, no. 4, pp. 981-986, 2016.

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[6] Tsorng-Juu, Jian-Hsieng Lee, Shih-Ming Chen, Jiann-Fuh Chen, and Lung-Sheng Yang. "Novel isolated high-step-up DC–DC converter with voltage lift." *IEEE Trans. Ind. Electron.*, vol. 60, no. 4, pp. 1483-1491, 2013.

[7] Nejabatkhah F, Danyali S, Hosseini SH, Sabahi M, Niapour SM. ―Modeling and control of a new three-input DC–DC boost converter for hybrid PV/FC/battery power system. *IEEE Trans.PowerElectron.*, vol. 27, no. 5, pp. 2309-24, 2012.

[8] Li, Shengquan, and Juan Li. "Output Predictor based Active Disturbance Rejection Control for a Wind Energy Conversion System with PMSG." *IEEE Access*, 2017.

[9] O.C. Onara,b,M. Uzunoglua,b, M.S.Alama, "Modelling, control and simulation of an autonomous wind Turbine/photovoltaic/fuel cell/ultra capacitor hybrid power system", Journal "Journal of Power Sources", Journal of Power Sources volume 185, year 2008.

[10] Arul, P.G.Ramachandaramurthy, Vigna K, Rajkumar R.K." Control strategies for a hybrid renewable energy system: A review", Journal "Renewable and Sustainable Energy Reviews", Volume 42, Year 2015.