Optimising the Use of Energy in A Hybrid Rooftop Wind Production System

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Abstract **- The main purpose of this paper is to assume the model of wind and solar photovoltaic (PV) system for the charging of battery which is simulated by using MATLAB R2018a using Simulink. In this paper, DC-DC converter is used named as Zeta converter fed by wind system and solar photovoltaic (PV) system designed and simulated. The proposed model consists of solar photovoltaic system and wind system together known as hybrid model for the generation of electricity which are most reliable and efficient renewable energy sources as compared to other renewable energy sources. In this project wind turbine/ system is assumed as AC voltage source. Zeta converter is fourth order power electronic converter can be able to operate either in step up or step-down mode. In this paper actually no MPPT technique is used only the concept of how we get maximum power from solar panels and wind turbine with the help of zeta converter is considered. Here we are going to set a input and thereby we get output as it is so with that maximum power i.e. output we can charge the battery for the desired application.**

Index Terms **- Solar Photovoltaic (PV Array), Zeta converter, AC voltage source, 1- phase diode bridge rectifier.**

I.INTRODUCTION

Now a days hybrid energy systems use solar and wind renewable energy sources even though other renewable energy sources are available in the earth crust. Solar energy and wind energy is easily available for all of us in free of cost is most advantageous. The concept of photovoltaic is easily understood and currently many PV based power systems are designed worldwide for the generation of electricity. The PV based power system is environment friendly and no one is getting harmful by this type of power system as compared to other systems. The output of solar system is mainly depends on solar irradiance and temperature. Wind energy is easily available in nature and is free of cost. Renewable energy sources such as solar energy and wind energy have been seen clean, inexhaustible, unlimited, and environmental friendly. The electricity generated from wind system is AC so there is need of conversion which is done by using 1 phase diode bridge rectifier. In this paper, our main objective is to charge the battery using generated electricity of the hybrid system. We are going to analyse this with the help of MATLAB/SIMULINK. Energy generation due to individual energy source problem is eliminated by hybrid system.

II. DESIGN OF PROPOSED SYSTEM

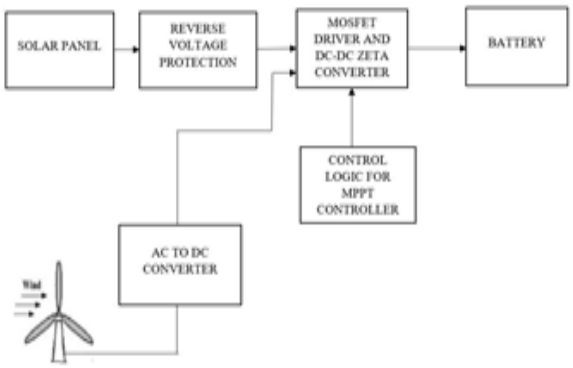


Fig.1 Proposed work Block Diagram

2.1. Design of Solar PV cell

In this system solar PV array is used to generate DC voltage which is boosted at rated value by DC-DC zeta converter. PV array is combination of solar cells connected in series and parallel. Linear variations in dc current are because of sun irradiance variations. The solar panel is modelled using MATLAB/ SIMULINK.

$$P_{mp} = (N_{p*} I_{mp}) * (N_{s*} V_{mp}) = 1.49 \text{ kw}$$

Table No.1-Specifications of solar panel

Solar panel output power	213.15 watt
Solar panel open circuit voltage	36.3 volt

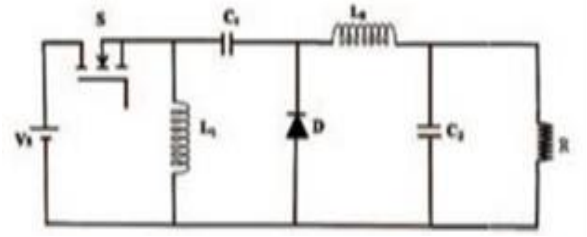
Solar panel short circuit current	7.84 amp
Solar panel voltage at MPP (V_{mp})	29 volt
Solar panel current at MPP (I_{mp})	7.35 amp
Solar array peak power	1.49 kw

2.2. Design of Power Converter

In this paper proposed converter is zeta converter which has advantages like adaptability, low settling time. Power converter is the heart of entire system which play an important role.

Zeta Converter:

Fig 2. Shows the zeta converter consists of two inductors, two capacitors, diode, and switch. Zeta converter is capable of converting input voltage into noninverting output voltage. Zeta converter operates in two mode of operation such as continuous conduction mode and discontinuous conduction mode.



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Mode 1. when the diode (D) is off and Switch(S) is on, continuous conduction mode is achieved. The current through the inductor L1 and L2 are drawn from the source Voltage Vs. The Inductor current iL1 and iL2 increase linearly. This mode of operation is also known as charging mode.

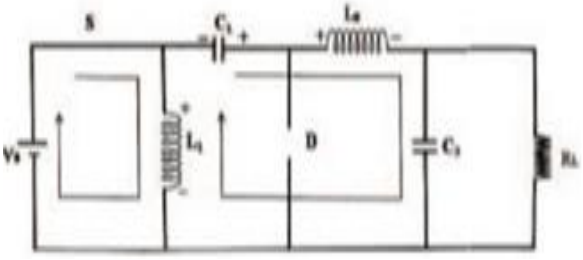

Fig 3. ON state Zeta converter

Mode 2. when the diode (D) is in ON state and switch (S) is off, discontinuous conduction mode is achieved.

In this mode of operation the energy stored in the inductors discharges and transferred to the load (resistive load) and current in the inductors decreases linearly that's why this mode is known as discharging mode.

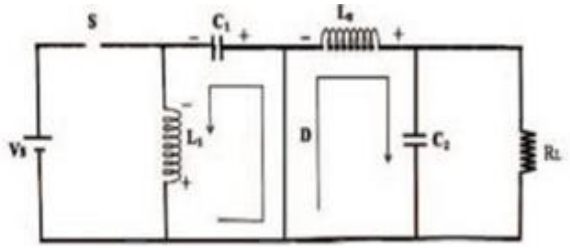

Fig 4. OFF state Zeta converter

The model of zeta converter is designed in MATLAB/SIMULINK as shown in fig.5.MOSFET switching is controlled by using PWM generator and duty cycle. We can take any input voltage range by that PWM generator and duty cycle is adjusted to give output as that of input range. This is concept behind we get desired maximum output.

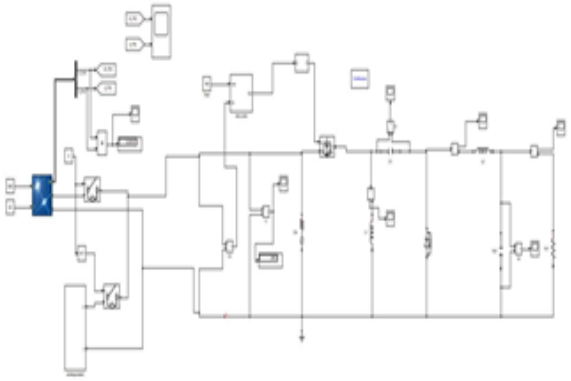

Fig. 5. Simulation of proposed system

Design equations of zeta converter:

Duty cycle when zeta converter operating in continuous conduction mode,

$D = V_o + D / V_{in} + V_o$

Inductor and capacitor equations,

$L1 = L2 = Vin + D / \Delta Il + Fs$

$C1 = D * V_{out} / \Delta Vc1 * R * F_s$

$C2 = (1- D) * V_{out} / 8 * \Delta V_{out} * L2 * F_s$

2.3. Wind Subsystem:

In this paper instead of using wind turbine, we are using AC voltage source which is converted into dc with the help of 1-phase diode bridge rectifier for prototype model.

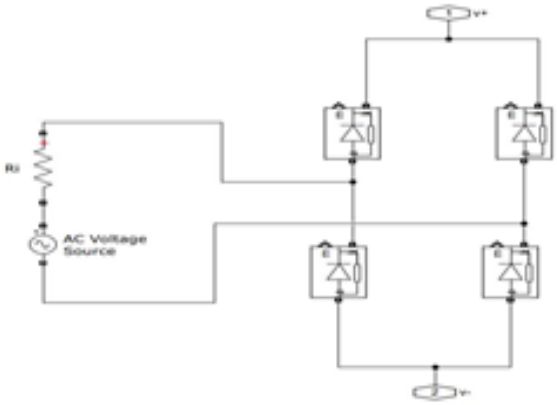

Fig.6. Wind Subsystem

When we have to charge the battery using wind turbine, logic 0 is given to breaker 1 next to PV array and NOT gate so that wind subsystem get logic 1 and thus operation starts, and we can see the output in DC form. When we have to charge the battery using solar panel logic 1 is given to breaker 1 so operation starts, and we see DC output which is used to charge the battery. Lithium-ion battery is used in this project.

III.SIMULATION RESULTS

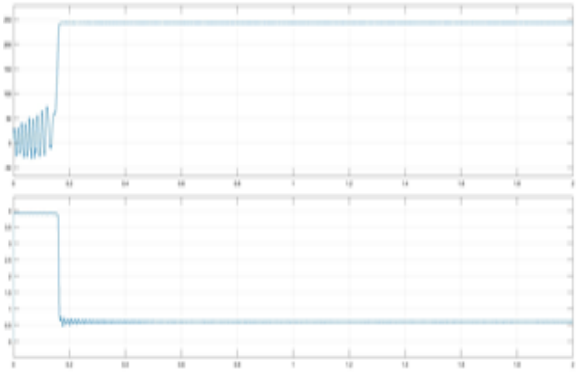

Fig.7. solar panel output voltage and current

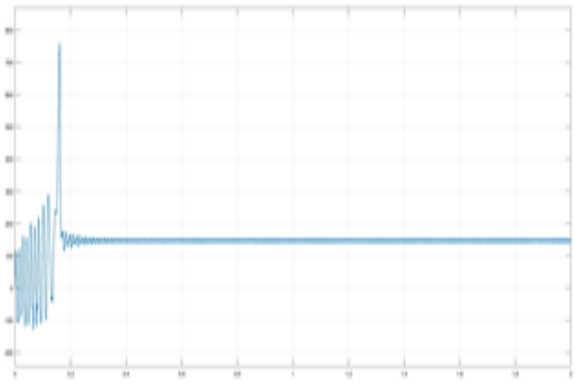

Fig.8. Solar panel power

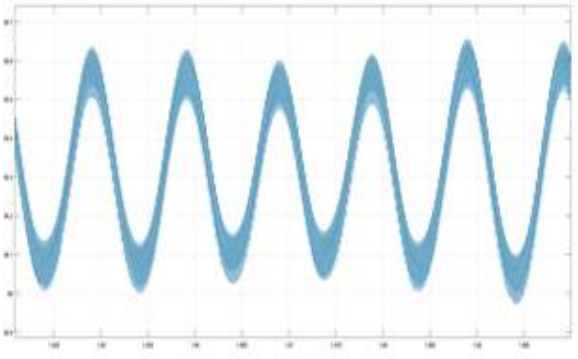

Fig.9. Output Voltage

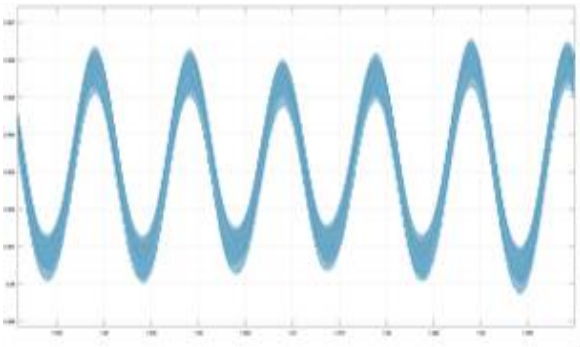

Fig. 10. Output Current

In fig.9. and fig.10., some starting fluctuations are seen because no any system is stable at starting.

IV.CONCLUSION

The hybrid system model of solar system and wind system has been proposed. Under different solar irradiance Zeta converter maintains output voltage as constant and operated in boost mode operation. Zeta converter is controlled with the help of duty cycle. Maximum power is obtained with the help of zeta converter instead of using MPPT techniques.

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