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Neural Network Based Solar-Wind Energy Using Buck Boost-Sepic Converter

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Abstract

Now-a-days, power demand is increasing day by day. So, Power is not sufficient for us. To overcome from this problem we are going for Renewable Energy (or) Non-Conventional energy which is very useful for the future power development. The solar and wind energy are natural one. It's always available in our earth. The proposed design describes the Hybridization of solar and wind energy using these two sources used to generate the power. It can work individually and also simultaneously. The combination of two sources produces better output compare to others. The Buck Boost converter and SEPIC converter are fused together to eliminate higher order harmonics. The neural network control is introducing in this paper. The MATLAB/ Simulink software is used for the simulation results.

Keywords - Buck Boost Converter, Neural Network Control, Solar and Wind energy source.

I. INTRODUCTION

The Non-Conventional energy is rapidly developing more which protect our earth for the future generation development compared to the conventional energy. Currently, the thermal resource is generating power by burning coal and other materials. It creates lots of problems like pollute the environment, shortage of minerals and coal. The non-conventional energy like solar energy, wind energy, geothermal energy and ocean energy does not affect the environment. The solar and wind energy has been attracted by many peoples, scientists, engineers [9]. They are concentrated on the development

of non-conventional energy. Photovoltaic cells induce the light and heat energy converts into DC electrical energy. The solar radiation received by the earth about 174,000 Terawatt (Tw) at the upper atmosphere. Approximately 30% of solar radiation is reflected back to space and 71% is absorbed by the earth land surface, clouds and oceans. PV advantages over other non-conventional energy such as Noiseless operation, No maintance is required practically and free from pollution and no fuel cost. The wind energy produced by the flow of air to wind blades starts rotates (mechanical energy) into AC Electrical energy. Around 4% of wind power is growing rapidly in world wide. 1064MW current capacity is generated in Jaisalmar Wind Park at India. Wind energy has advantages are pollution free, required small area. The combination of solar and wind system are independent can provide energy source continuously. The unpredictable system of solar and wind produces the higher energy mainly in summer and winter seasons.

The paper is organized as follows: Section II is described the non conventional energy sources. Section III describes converter topology. In section IV block diagram of the proposed technique is described. Section V described the circuit diagram of the proposed system. In section VI describes the implementation of neural network control in the proposed system. Simulation results are shown in section VII. In section VIII, the work is concluded.

II. NON CONVENTIONAL ENERGY

The Hybridization of Non-conventional energy is become more popular in the remote area power generation. The combination of solar and wind energy provides the better power and satisfies the power demand. The petroleum and diesel cost is increased day by day and it causes the noise pollution and air pollution. It affects the atmosphere, the solar and wind energy reduces the unit cost. The hybridization of solar and wind energy produces the stable, sustained and uninterrupted power compared to the individual wind and solar energy [2]. It balances the load and system efficiency is increased. It enhances the system reability. The solar and wind energy minimize the use of non-renewable fuels[8].The motivation of this paper is to extract the maximum output from solar and wind energy by using the Neural Network control.

III. CONVERTER TOPOLOGY

Buck-Boost converter and SEPIC converter are used in this proposed system. These two converters fused together, which has the multiple input sources. The DC-DC converter used to convert unregulated DC input voltage to regulated DC output voltage. The many switching devices are available such as IGBT, MOSFET, BJT and SCR [1]. Here MOSFET is used as switching devices. The turned ON and turned OFF time of MOSFET is lower (in nanoseconds) compared to other devices. It has higher switching speed and lower switching losses. The MOSFET are increasing application in the high frequency and also very popular in switching mode power supply.

a) BUCK-BOOST CONVERTER:

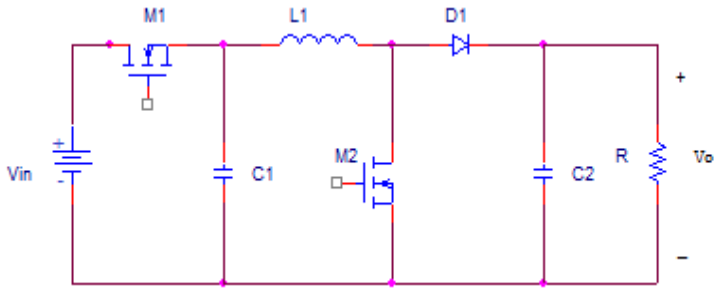

Figure1. Buck-Boost Converter

In the above Fig:1 buck-boost converter M1 switch act as buck stage and M2 switch act as boost stage. In the buck operation output voltage magnitude is lesser than the input voltage magnitude. M1is ON/OFF; M2 is always in OFF state. For boost operation output voltage magnitude is greater than the input voltage magnitude. M2 is ON/OFF; M1 is always ON state. The Buck-Boost converter used for step down and step up the output voltage based on the load requirement. The advantages of the buck-boost converter are lower power but higher efficiency. Even though it has pulsating input current and pulsating output current [4] the losses are less due to the isolation is present.

b) SEPIC CONVERTER*:*

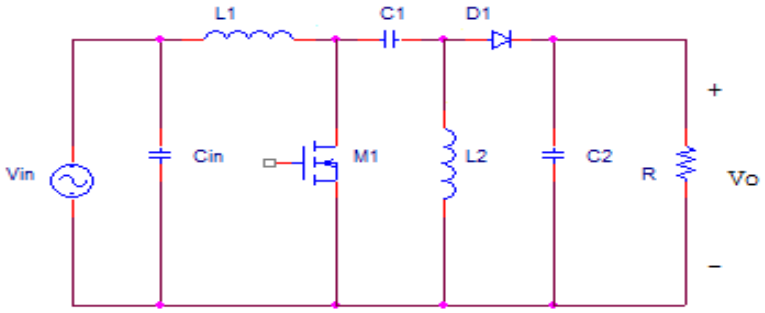

Figure2. SEPIC Converter

In the above Fig:2 describes SEPIC converter. SEPIC is a Single Ended Primary-Inductor Converter. SEPIC output voltage magnitude is lesser than, greater than or equal to the input voltage magnitude [1] which is similar to the buck-boost converter. When the M1 is turned ON the supply from the source to inductor L1 increases the current and C1 starts discharging and increasing the current in L2.When M1 is turned OFF the supply from the source to L1 inductor and capacitor C1 at the same time current through the inductor L2 and diode D1 to the load.

IV. BLOCK DIAGRAM FOR PROPOSED SYSTEM

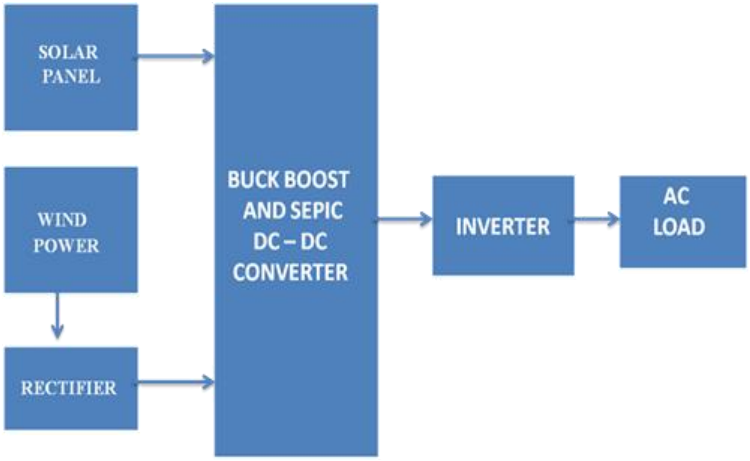

Figure3. Block diagram of proposed buck-Boost and SEPIC Converter

The solar energy generates DC voltage connected to buck boost converter. The wind produces AC voltage and it converted into DC voltage using rectifier which is connected to the SEPIC converter. The buck boost and SEPIC converter are clustered together to eliminates the higher frequency current harmonics present in the wind generator. The input of the inverter is the DC converted into AC voltage. Harmonics are present in the AC voltage. It increases the temperature and losses so filters are used. Here LC act as filters used to eliminates the higher order harmonics.
Power output of PV is given by
$P_{pv} = I_{pv}\ V_{pv}$

The general formula for wind turbine power [3]
$P=1/2\ pACpV^3$
P is air density (kg/m^3)
A is area swept by the rotor blades
V is air velocity (m/s)
Cp is power coefficient of wind turbine.

Tip speed ratio of wind turbine [10]
$TSR\ (\lambda) = \frac{\text{Tip ratio of blade}}{\text{wind speed}} = \frac{\omega_m}{V} R$
R and ω_m = Tip speed of blade (Turbine Radius + Mechanical Angular speed Response)
V= wind speed

The features of proposed system:
1. Based on the load requirement, step up and step down operations are supported.
2. It can support both individual and simultaneous operation.

3. It generates continuous power supply, In summer and winter season the output is higher.
4. Losses are reduced and eliminate the higher order harmonics.

V. CIRCUIT DIAGRAM FOR PROPOSED SYSTEM

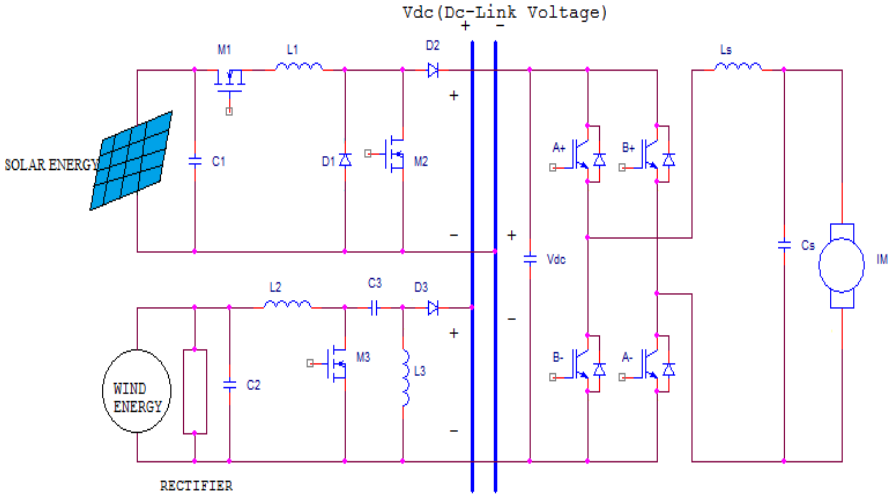

Figure4. Circuit diagram of proposed Buck-Boost and SEPIC converter

VI. IMPLEMENTATION OF NEURAL NETWORK CONTROL

Basically, the artificial neural networks of electronics models are based on the neural structure of brain. A group of cells (100 billions) called neurons. Each neuron connects with other neurons to transfer the information. The input is received by the biological neurons that can be combines with some other way and performs the non linear operation as the final output.

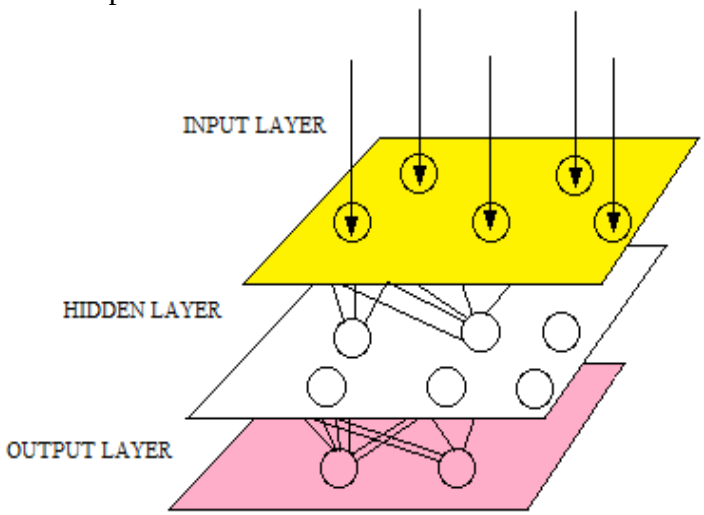

Figure5. Basic Neural network control Diagram

Likewise, the basic neural network implies the 3layers input layer, output layer and hidden layer. The layer of input neurons receives the information from the input files

or directly from the electronic sensor of real time application. It transfers the information to hidden layer present in-between the input layer and output layer. Many hidden layers present in between the two layers. The neurons is clustered together to form the various structures. After neuron performs the operation it transfers to the output layer as a result. The output layer sends information to the outside world. Many transfer functions are used in the neural network they are linear, log-sigmoid, sine, hyperbolic tanget etc.

Back propagation algorithm is used in this proposed design. It has two architectures. They are feed forward architecture and feed backward architecture. Feed forward means there is no connections back between the output and input layer. So, previous output values are cannot store in the activation states. Feed backward means there is a connection back between the output layer and input layer. It keeps the memory of previous states and next states depend on not only input states but also on the previous states in the network. Feed forward architecture is used in the back propagation algorithm. The efficiency can be improved by using back propagation algorithm [11].

VII. SIMULATION RESULTS

The simulation results are performed by the MATLAB/Simulink software. The closed loop system of neural network using error back propagation algorithm can be shown below in Fig:6 The system illustrates where the solar and wind generates the power to the load. Fig:7 illustrate the output voltage of buck-boost operation.Fig:8 The waveform of output current from the inverter after the buck-boost and SEPIC operation. Fig:9 the waveform of output voltage from the inverter after the buck-boost and SEPIC operation. Fig:10 illustrate the induction motor speed waveform.

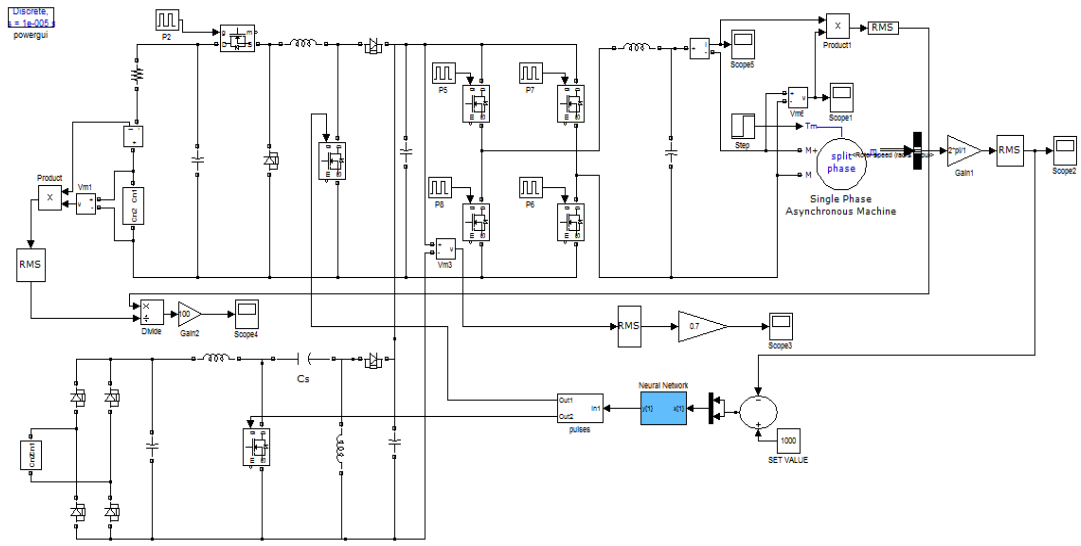

Figure6. Simulation for BUCK-BOOST and SEPIC converter

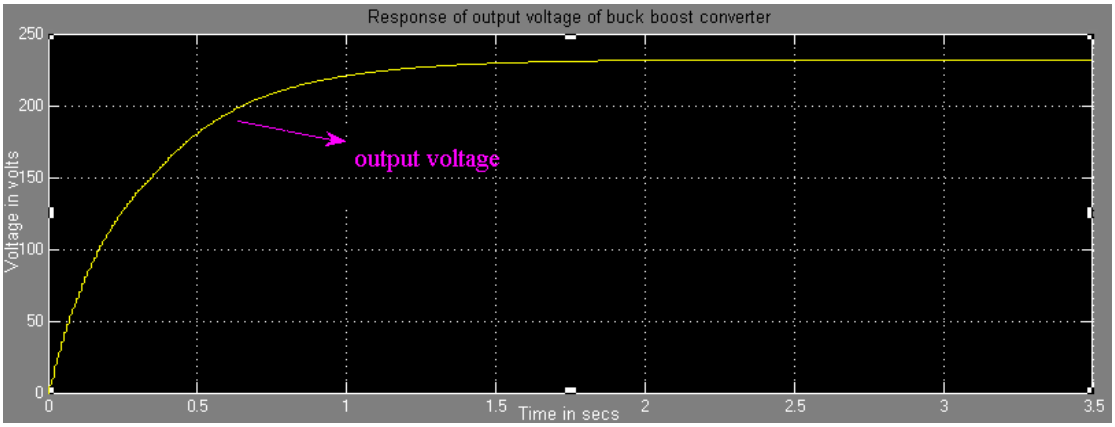

Figure7. Output voltage waveform of Buck-Boost converter operation

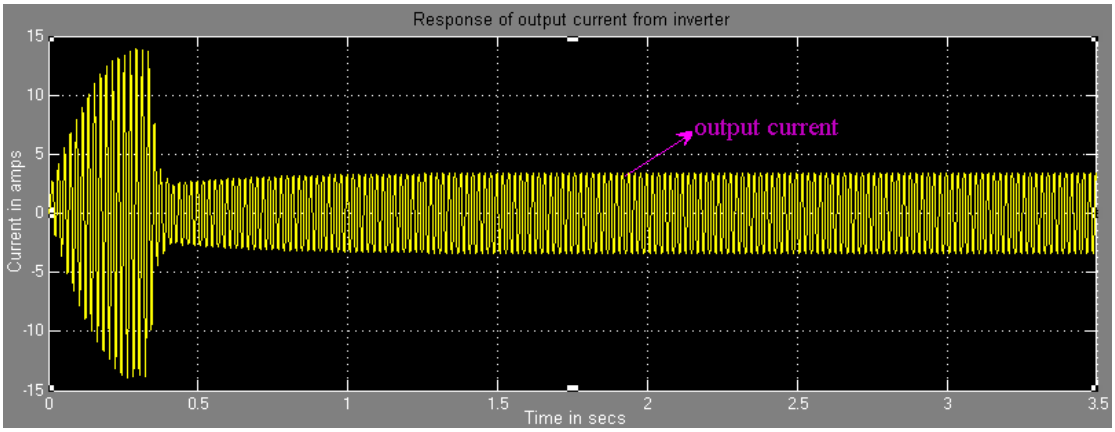

Figure8. Output current waveform of Inverter

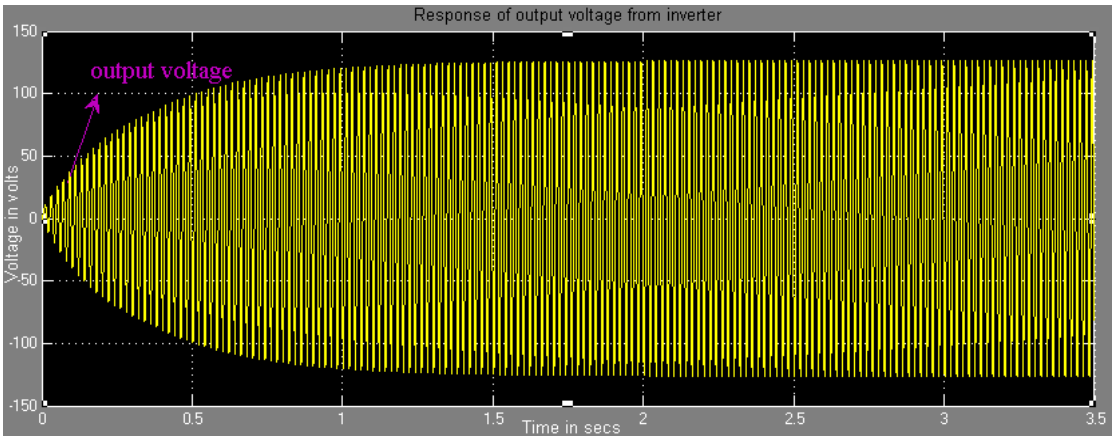

Figure9. Output voltage waveform of Inverter

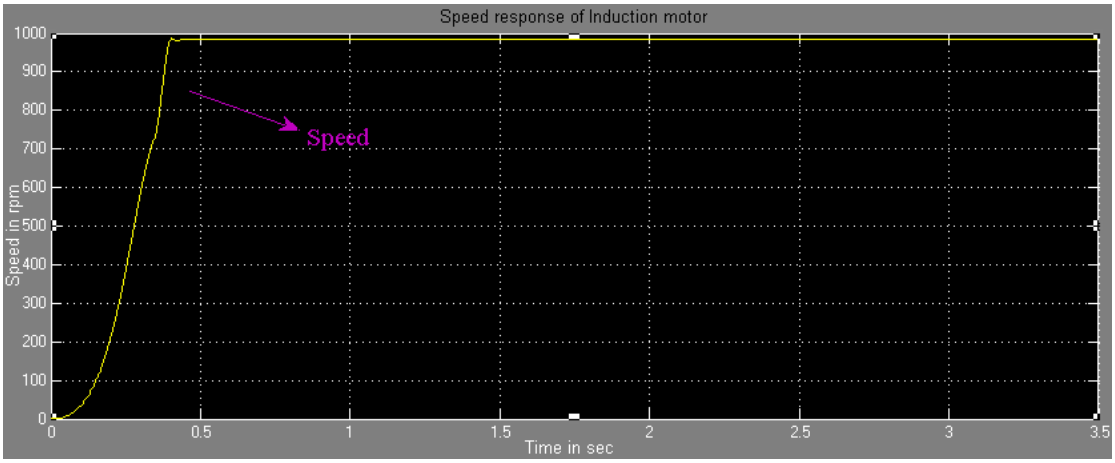

Figure10. Speed waveform of Induction Motor

VIII. CONCLUSION AND FUTURE WORK

The hybrid solar and wind energy using buck boost and SEPIC converter design was proposed and neural network is implemented. The both renewable energy are free from air pollution, Noiseless operation, natural resource. The continuous output is provided by this proposed system. The higher order harmonics are eliminated and maximum output voltage is taken. The system was modeled using the Simulink/MATLAB software. The future enhancement is deal with neuro-fuzzy control method.

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