Hybrid based Small Wind Generator with Boost Converter System

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Abstract--- *Design of boost converter integrated with solar panel system and small wind generator based on hybrid techniques are presented in this paper. In a wind turbine, with full-bridge DC to DC converter, they are implemented. Converter performance is enhanced by adding DC to DC converter with passive filter. In DC to DC converter, medium frequency transformer's voltage stress is minimized effectively by this passive filter. Also presented a dc to dc converter based wind turbine control in a dc –grid system. MATLAB is used for the implementation proposed system. On DC-DC Boost Converter, enhancement in power is indicated by the results of simulation. In MATLAB/SIMULINK environment, simulated the proposed system.*

Keywords--- *PV, Wind, Boost Converter, MPPT, Matlab.*

I. INTRODUCTION

In upcoming power generation world, each and everybody can generate as well store power. By 2025, there will be no need of big central electricity generator. Dependency of fossil fuel is reduced in lot of countries around the world. In 2035, there will be dominance of consumption of fossil fuel as stated by international Energy Agency's world Energy Outlook 2013. Part of Government budgets are invested to motivate the use of renewable sources of energy like wave, tidal, wind, solar, hydropower, geothermal, biomass.

Renewable energy technologies are growing fast in recent days. In worldwide, various remote, off-grid and grid application uses this and they are cost competitive. In two various forms, clean power systems are utilized. One way is to cogenerate and energy injection to line. Load power requirements are supplied by main power centrals because of this.

In another way, in batteries, energy produced by generating system can be stored for future use. In past decades, there is rapid decease in cost of green technology. In space mission, it is started to appear from 1958. There is a continuous reduction is cost of its production. This enables the development and increased usage of renewable energies like wind generator and solar panel. Ability of manufactures and industry in reducing cost defines future of generation of wind power. As per The Cost of Wind Energy survey conducted between, 1980s to 2000s, there will be notorious reduction in energy source installation budget cost.

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In intelligent and mechanical control, prediction of wind speed, generators of wind turbine, there are lot works are undergoing.

Most commonly used renewable source is wind generation. But it has various disadvantages like discontinuities in structure, surges of wind speed, cracks, leakages, and corrosion. There is an increased investment of this.

Proposed Methodology

Since early 1980's, study of renewable power source's usage has attracted a lot of researchers. In cogeneration and electrical power generation, enormous advances are shown by wind turbines and solar plants. In darkness, there will be no generation of solar power. If speed of wind is greater than rotor's ability, there wont be any generation of wind power. These are the major disadvantages of it.

Design of boost converter integrated with solar panel system and small wind generator based on hybrid techniques are presented in this paper. For load, sufficient energy is given by this and it rectifies the drawbacks of these systems. In order to maintain a constant energy, there will be switching between these two system. Battery life is enhanced by this.

II. Literature Survey

Arnab Ghosh et al.,(2018), proposed a Multilevel Output Voltage system with high Gain DC-DC Step-Up Converter for implementing up DC-DC converter topology. In continuous conduction mode it can be operated and very high voltage gain characteristic is shown by this. Two level of DC voltage can be maintained by this proposed converter. When compared with transformer less self-lift Boost converter, less number of high voltage capacitors are used by this method to produce same gain of voltage. Size of the system is also reduced by this.

High voltage level is maintained by using low duty ratio due to its high voltage. Complexity of control can be reduced by using single control signal for controlling converter switches. For same voltage gain, it used less number of passive components, when compared with self- Boost converter while maintaining all the advantages. MATLAB/Simulink simulation is used verify and analyze the operation converter.

Maidi Saputra et al., (2018), proposed a hybrid system which had control and solar-wind power monitoring. In battery, in order to save energy, solar panels and wind turbines are combined. In order to maintain a constant energy, there will be switching between these two system. Battery life is enhanced by this.

Applications requiring stable source energy can use hybrid systems. In application area like self and smart sustainable buildings, communication installations, rural medical facilities there won't be any grid access and it requires a backup system. Wireless communication system can be used perform remote monitoring via internet of things in future.

Porselvi.T et al., (2018), proposed a Single Switch High Gain dc-dc Converter. Because of continuous source current, it can produce input current stress as a minimum one. Without high duty ratio, voltage gain of around 10 can be produced by this system. There is a less complexity on control of converter, as it used single switch. With Continuous Conduction Mode, in steady state, proposed converter can work. Using various duty ratio, analysis of simulation results are carried out. High gain is produced with a duty cycle value higher than 0.5.

Ligade Gitanjali Vasant et al., (2017), proposed a Hybrid Energy System Using MPPT. It combines wind and solar energy for enhancing qualities. Power can be produced by using this natural resources in an optimum way. On conventional power generation sector, power demand can be reduced by this. with Maximum Power Point Tracking (MPPT) in Solar-Wind Hybrid System are used to generate power via different methods.

For transferring power, used a constant voltage method. Energy can be generated using two sources. Controller stage is given with combined output. Input voltage is controlled by PIC 18F452 controller in controller stage. At output side, constant voltage is produced by this. Problems of individual energy sources in generating energy are rectified by this hybrid system.

Alexander Bubovich et al(2017), The Comparison of Different Types of DC-DC Converters in Terms of Low-Voltage Implementation clarifies with in various parts of the structure of a seaward wind ranch have been tended to than the yield of the dynamic converters at the turbines. Along these lines, an alternate displaying approach for control electronic converters has been exhibited. This permits a straightforward control and evades correspondence, which are two favorable circumstances for such a brutal situation with constrained upkeep ability like in a seaward wind ranch.

III. PROPOSED METHODOLOGY

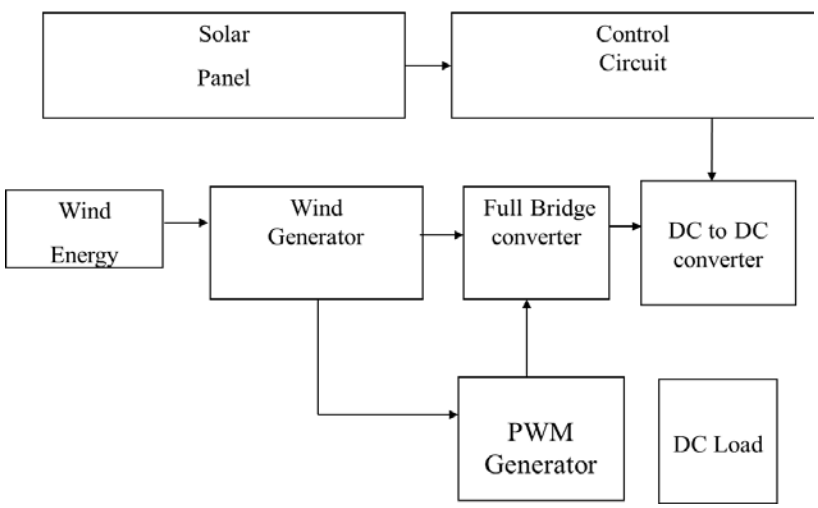

Figure 3.1: Proposed System's Block Diagram

In hybrid system, load decides operating point, if input side has solar PV module. Throughout the day, there will be a variation in solar radiation. According to this, operating point also changed. Figure 3.1 shows the proposed system's block diagram. At output side, for transferring maximum power, Maximum Power Point Tracking (MPPT) technique is used which is a special one. An electronic circuit and algorithm are used by Maximum Power Point Tracking method. From renewable sources like wind energy, solar, extracted Maximum power point (MPP).

Algorithm is given with solar module output power as input. Solar photovoltaic (SPV) system efficiency can be increased by using a Maximum power point tracking (MPPT) method. High reliability is exhibited by proposed system. Speed control is required in MTTP. Rotor side converter's vector control is used for realizing this speed control.

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Algorithm for MPPT

For transferring maximum power, MPPT algorithm has various method. Ripple correlation method, system oscillation method, modified hill climbing method, constant voltage method, incremental conductance method and hill climbing method are the examples of it. For MPPT, this methodology uses hill climbing method.

Maximum Power Point Tracking

From one or more photovoltaic devices like panels, maximum possible power can be obtained by solar battery chargers, grid connected inverters and other devices via tracking of maximum power point method. Same method is used in transmission systems of optical power. Between total resistance, temperature, solar irradiation, there exist a complex relation in solar cell. Due to this non-linear output

For a given conditions of environment, maximum power can be obtained by applying proper resistance using MPPT system. Cells outputs are sampled by this MPPT. Electric power converter systems are integrated with MPPT devices. Filtering, load regulation of motors, batteries, power grids and current or voltage conversion are provided by this.

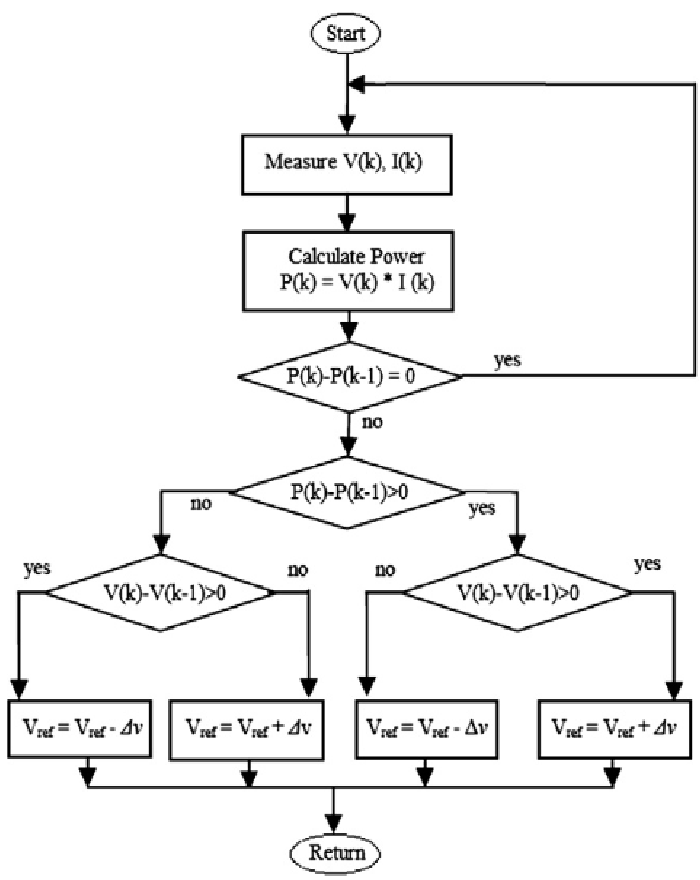

Figure 3.2: Flowchart of P&O MPPT Algorithm

Classification of Algorithm in MPPT

Array output power can be optimized by controllers via any one of following three methods. Various algorithms can be implemented using maximum power point tracker. Based array's operating conditions, they can be used.

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- Perturb and observe
- Incremental Conductance
- Constant voltage

1) Comparison of Methods

For array's operating condition, power's local maximum can be computed by incremental conductance and observe and perturb method. These methods are examples of hill climbing. True maximum power point can be provided by these methods. Under steady state illumination, around maximum power point, oscillations may be produced by observe and perturb method.

Oscillation eliminated maximum power point can be produced by incremental conductance technique. This is a major advantage of it, when compared with observe and perturb technique. With high accuracy, under rapid varying irradiation condition, tracking of maximum power point can be performed by incremental conductance technique. Under rapidly changing conditions of atmosphere, erratic performance and oscillations are produced by incremental conductance technique. Reduction in sampling frequency leads to increased time of computation. Compared with P&O techniques, algorithm is very complex.

Open circuit voltage is measured by setting photovoltaic array current to zero momentarily in open voltage or constant voltage method. After this measuring, it is set around 76% of measured voltage, which is a predetermined one. During time, when current value is set to zero, energy is wasted. It is not necessary to have 76 % of MPP/V_{OC} ratio. With low cost and easy implementation, array efficiency may be reduced by interruptions. Actual maximum power point may be computed accurately due of this. But it has 95% of efficiency.

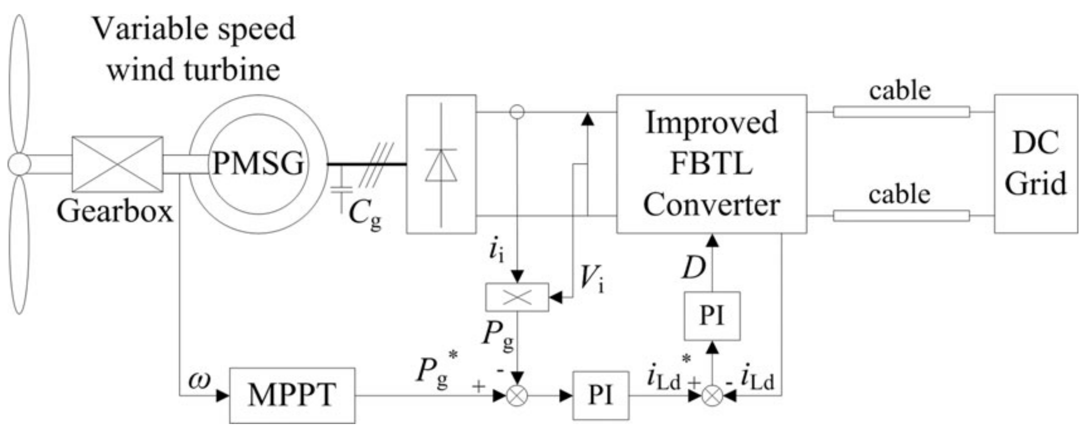

Figure 3.3: Controlled IFBTL Converter

Control of an IFBTL Converter-Based Wind Turbine

IFBTL dc/dc converter and PMSG based wind turbine with variable speed is proposed in this work. DC grid is connected with this wind turbine. Maximum power point tracking technique is used for producing optimum power P of wind turbine with speed ω. Current reference iLd is produced by using power controller. Here power controller corresponds to PI regulator. For IFBTL converter, duty cycle D is produced by using a current controller of other PI regulator. VSWT's optimum power is followed by this.

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IV. Matlab Model And Waveforms

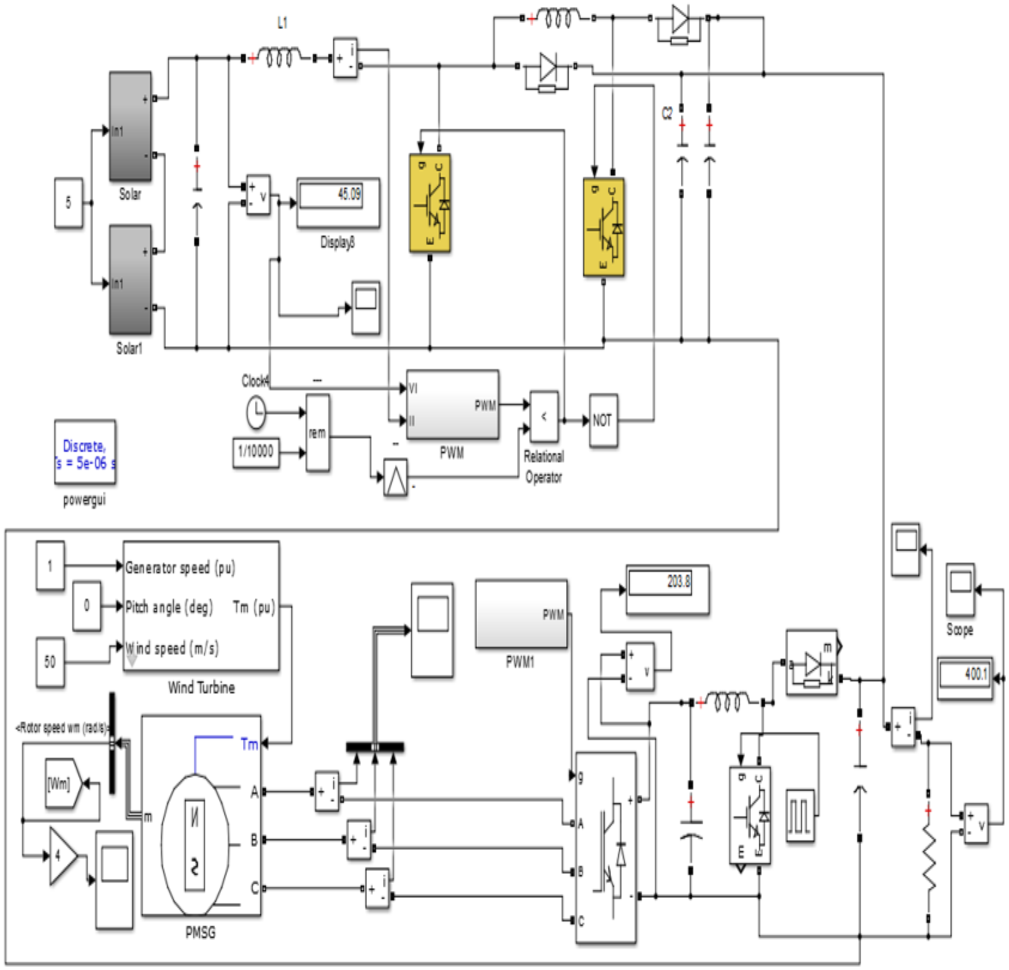

Figure 4.1: Simulation Model of Proposed System

V. Simulation Model Description

DC to DC converter circuit is shown in figure 4.1. Solar panel and turbine are integrated with it. Output power with three phase is generated by wind generator based on speed of wind. Generated AC power is converted into DC power by feeding it to a controlled rectifier unit. Firing angle of gate is used to control output power. Based on vector control, PWM generator, generates this firing angle. High output voltage is generated by giving DC of rectifier to boost DC to DC converter. Load is given with this generated voltage.

From output of wind generator, three phase reference is taken depending on PWM. One steady state error out is generated by PI controller, which is given with two various error input. Vector control block is given with this error. Gate of controlled rectifier is controlled by vector block according to this input value. Output voltage is controlled by alpha value of gate. Solar panel output voltage is boosted by a DC to DC boost converter. For Boost Converter, in PWM signal generation, used MPPT coding. For DC-DC Boost Converter, gate signal is generated by this. Boost Converter voltage is improved by this and leads to maximum output of solar panel.

OUTPUT WAVEFORMS

In Solar panel output is shown in figure 4.2. In simulation circuit, solar panel is used. Maximum value of solar panel output is maintained because of MPPT algorithm usage.

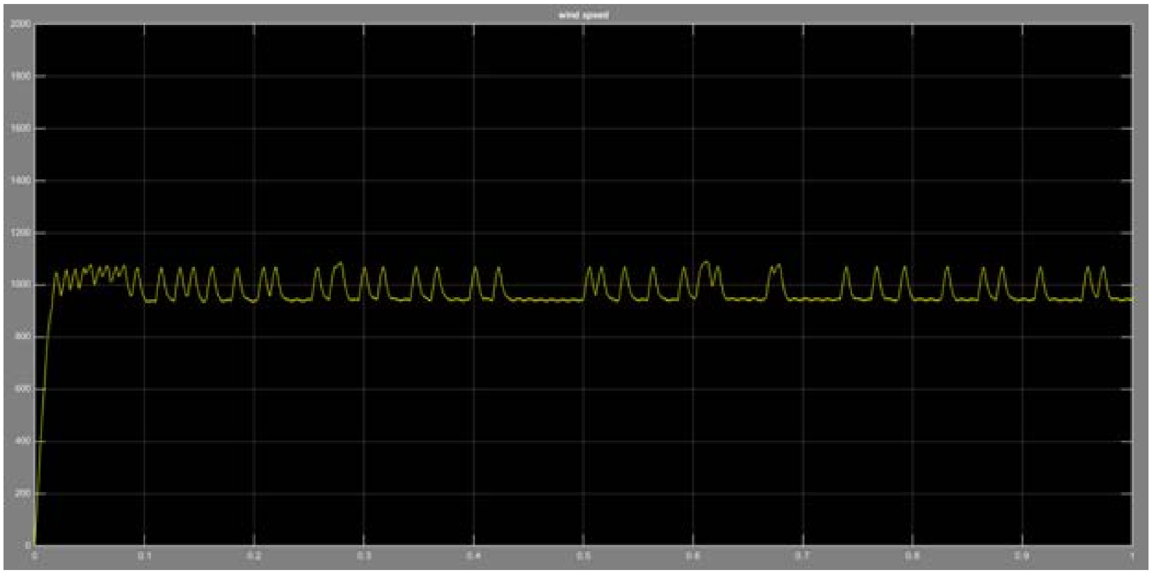

Figure 4.2: Output Waveform of Solar Panel

Wind turbine output voltage is shown in figure 4.3. It is obatined through siulation. Input for the simulation corresponds to wind parameters like turbine speed, speed of wind.

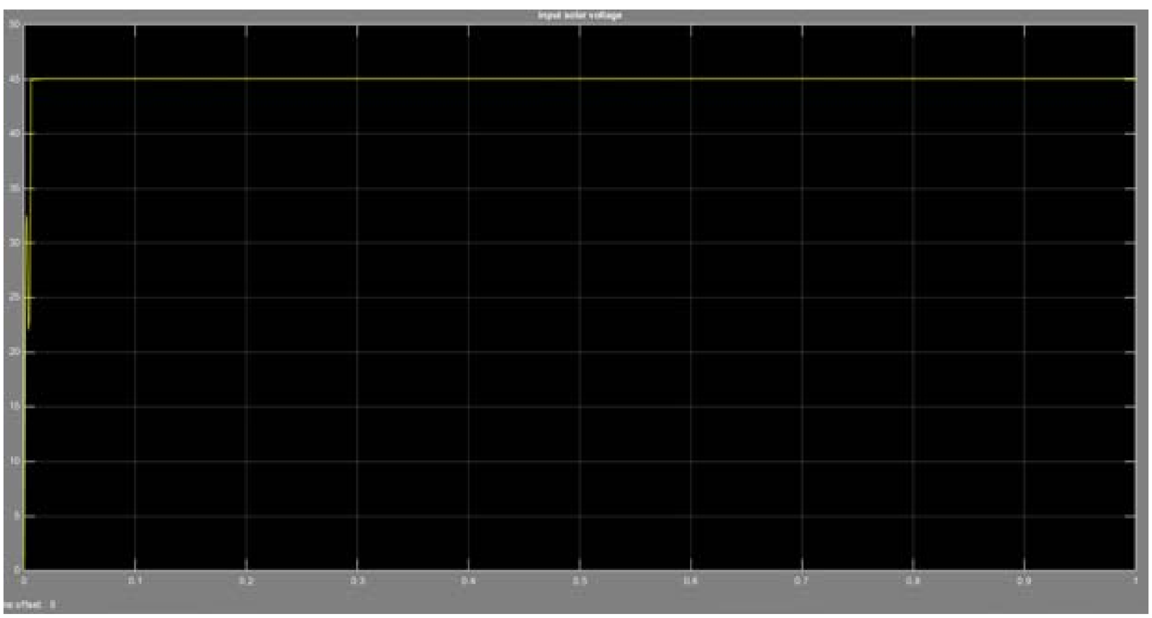

Figure 4.3: Wind Speed Output Waveform

Boost converter output volage is shown in figure 4.4. Solar aand wind power are combined to form this output. Maximum value of output power is maintained by uspins MPPT. Stabe ouput current and volatge is provided by compensating lead and lag in the output.

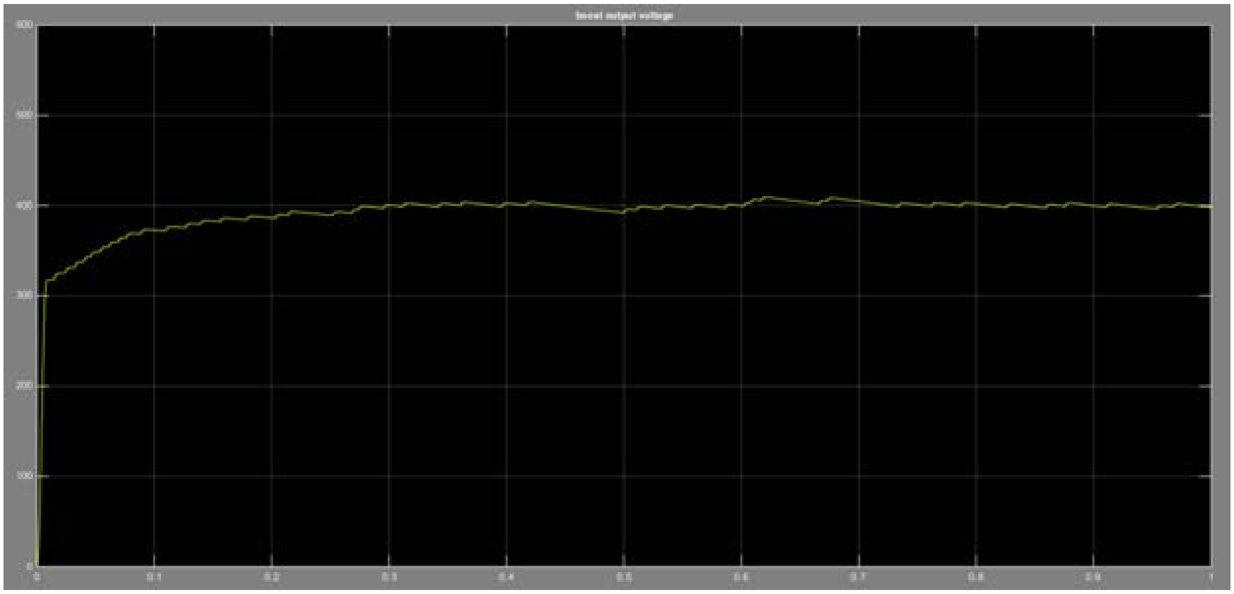

Figure 4.4: Boost Converter Voltage Output Waveform

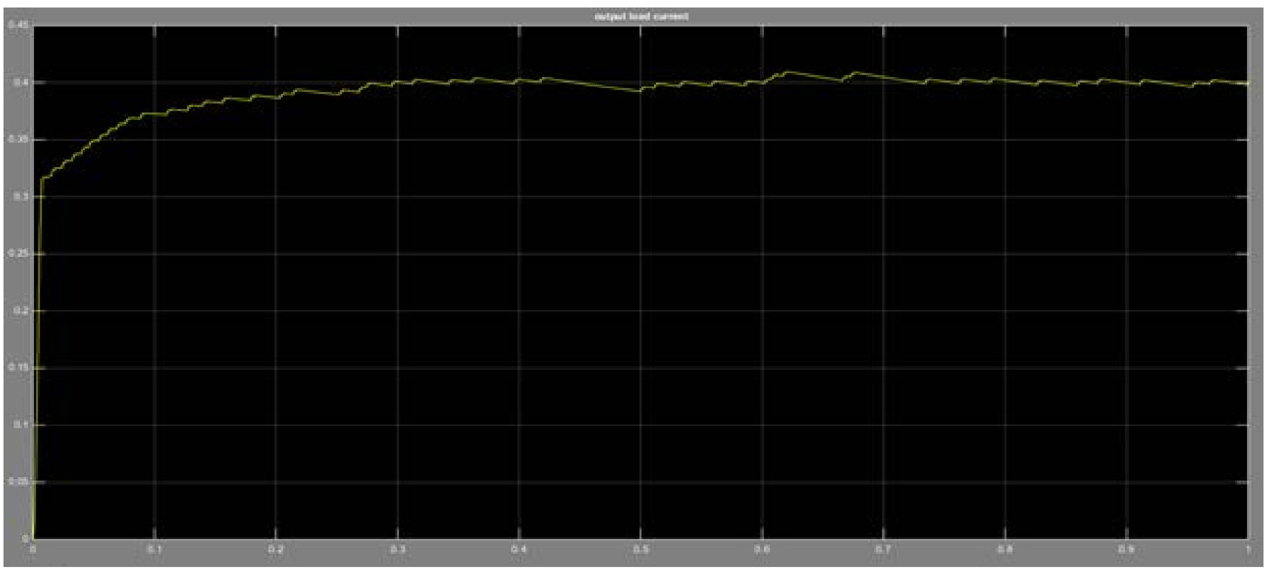

Figure 4.5: Boost Converter Current Output Waveform

VI. CONCLUSION

Working of system as per block diagram description is shown by results of simulation. Two various sources of energy generation are managed by this and drawbacks are rectified. There are multiple ports of input and output in system. So, more renewable sources can be included in the system. More than two power supplies of same source or different source can be controlled using relays. From solar panel, output power is boosted using solar MPPT.

At all time, load is energized as shown by results of outcome. Applications requiring stable source energy can use hybrid systems. In application area like self and smart sustainable buildings, communication installations, rural medical facilities there won’t be any grid access and it requires a backup system. System’s hardware implementation can be done in future.

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