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Design of Stand-Alone Hybrid Wind-Photovoltaic System

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ABSTRACT: Renewable technologies are clean sources of energy and optimal use of these resources minimize environmental influence, that produce minimum secondary wastes and are sustainable based on current and future economic and social societal needs. Sun is the source of all energies. The power generated by the system is intended for storage purpose. The reason for utilizing both solar and wind in the recent studies have proven that combined system can be more productive and consistent and other thing is that neither of them can be used for continuous power generation. The solar-wind system provides power frequently which is controlled by electronic methods is used to monitor the power from both the inputs. A solar-wind hybrid stand alone power generation system has been designed and the output voltage, current, power waveforms are obtained. The output power is feed to charge the battery and also by using inverter it is feed to AC load. The power from the sources are utilized depends on the load demand and the rest is stored in the battery for the future use.

KEYWORDS: SWHP, Battery Management, ANN (Artificial Neural Network)

I.INTRODUCTION

Most of the nations rely on fossil fuels like coal, crude oil and natural gas to supply most of their energy needs due to terrific increase in population growth rate. But dependence on fossil fuels presents a big problem and produce greenhouse gases that supply to global warming. Renewable energy is derived from natural processes that obtain directly from the sun, or from heat generated from the earth. Included in the definition is electricity and heat generated from solar, wind, ocean, hydropower, biomass, geothermal resources and bio-fuels and hydrogen derived from renewable resources. SWHP (Solar Wind Hybrid System) has a bright application to face electric demand in the near future. It can raise power supply consistency and decrease the system cost according to local environment condition and load characteristics of residents. For stand-alone SWHP, lead-acid batteries play a vital role as an energy storage unit. As the management of charging/discharging in battery directly affects the superiority of power supply in SWHP since electric energy from wind turbine generator and solar cells has obvious fluctuation.

II.PROPOSED MODEL

The proposed model is made up of solar PV array, wind turbine generator, controller with the combination of ANN, batteries, DC-DC chopper, AC-DC Rectifier, inverter, etc. as shown in Fig.1. Rectifier in the wind Turbine section is to convert AC into DC. Chopper used in Solar PV section is to convert variable DC into constant DC and connected to batteries through charge controller. Batteries charging/ discharging will depend upon power generation from wind and solar PV system.

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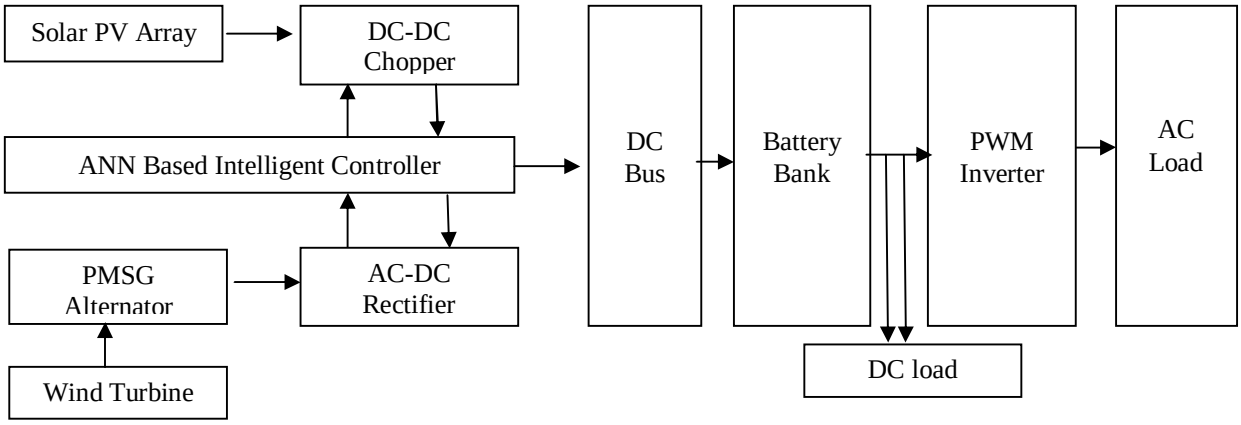

Fig.1. Proposed Model Block Diagram

ANN based controllers are used to monitor and control working state of batteries. Thus the stability and continuity of power supply is improved. PWM inverter is used to convert DC to AC which is supplied to AC Loads.

III.MATLAB SIMULATION AND OUTPUT

MATLAB Simulation Model

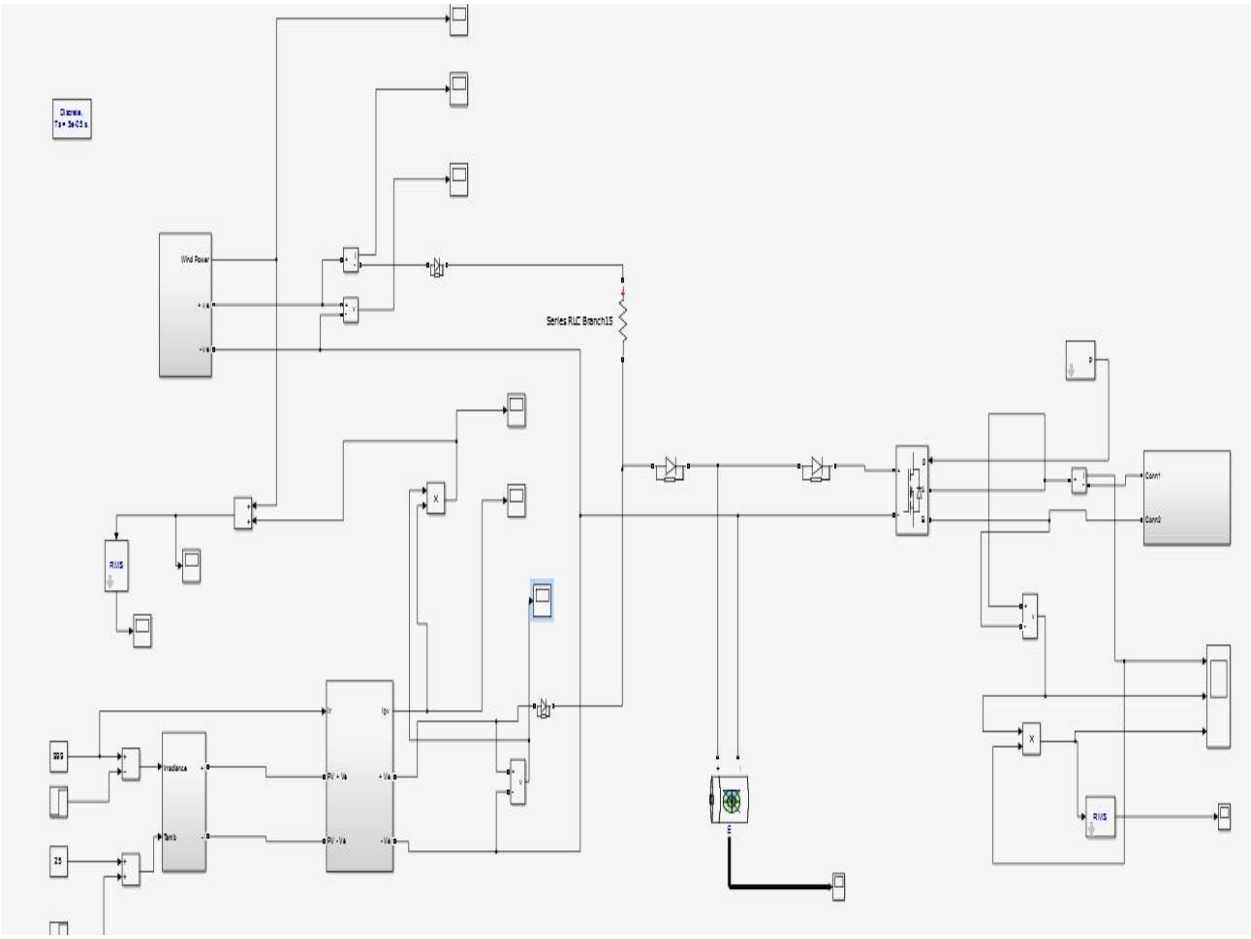

Fig. 2 MATLAB Simulation Model

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The MATLAB simulation model consists of PMSG model and Solar PV model and Battery bank for the continuous power supply to the load. In this Existing model the charge controller is not introduced. So it may lead to overcharging and discharging of the batteries. Battery management is very important in continuous power supply where the battery act as the heart of the power system management. Since the charge controller is not included in this system It results in reduced life time of the batteries. Also the waveforms also shows presence of harmonics which must eliminated in order to get proper charging of the batteries and to have flicker free output. So that the loads will be able to receive pure power supply which improve the life time of the electrical equipment. This can be obtained by introducing a proper charge controller based on ANN (Artificial Neural Network) method which more efficient one when compared to other charge controller methods. The harmonics can be eliminated by introducing proper filters.

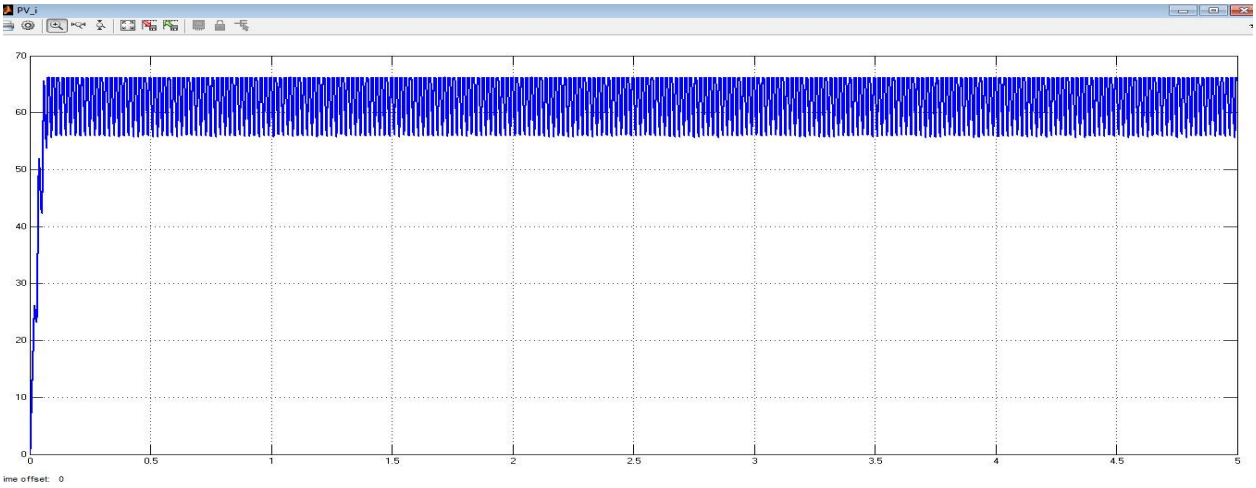

Fig. 3 MATLAB Output Voltage waveform for PV array

The individual output voltage waveform PV cells are shown in fig.3. The voltage is in the range of 58 to 65 v which is feed to the load and also made to charge the batteries. The waveform shows the presence of harmonics which affect the performance of the entire system. So it must be minimized.

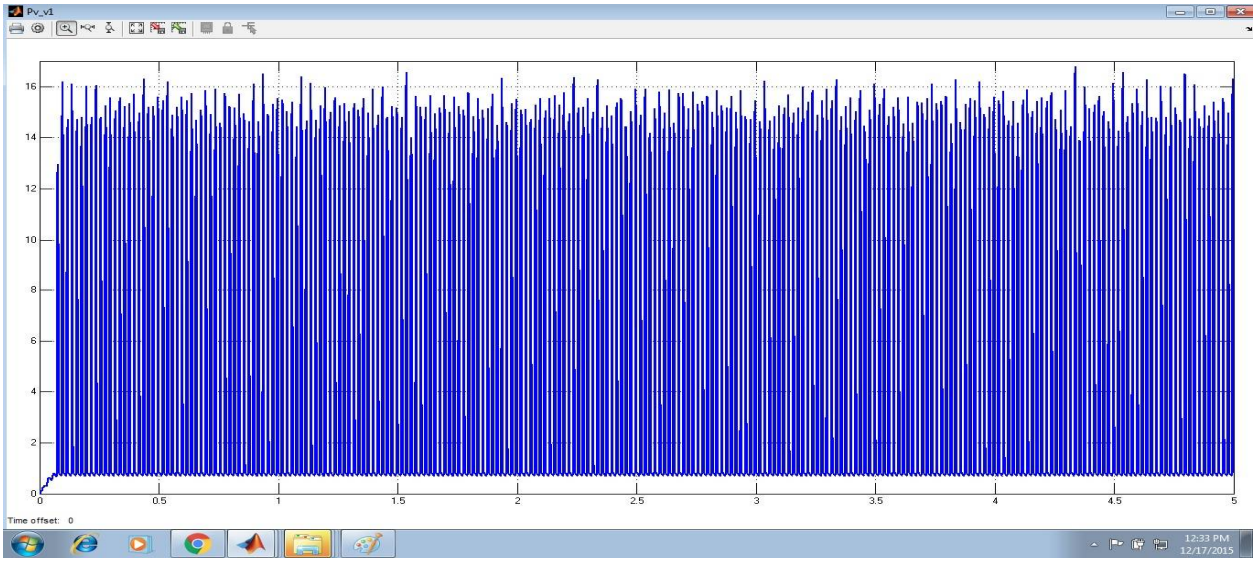

Fig. 4 MATLAB Output Current waveform for PV array

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The individual output current waveform PV cells are shown in fig.4. The current is in the range of 1 to 16 amps which is feed to the load and also made to charge the batteries. The waveform shows the presence of harmonics which affect the performance of the entire system. So it must be minimized.

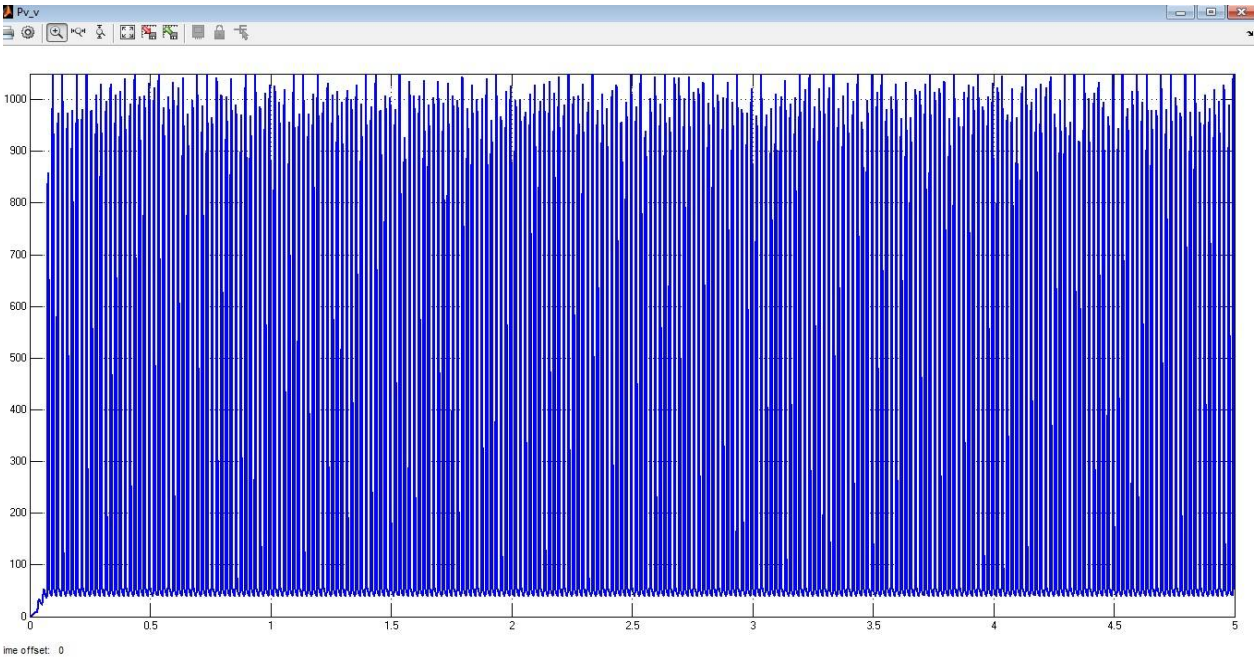

Fig. 5 MATLAB Output Power waveform for PV array

The individual output power waveform PV cells are shown in fig.5. The power is in the range of 50w which is feed to the load and also made to charge the batteries. The waveform shows the presence of harmonics which affect the performance of the entire system. So it must be minimized.

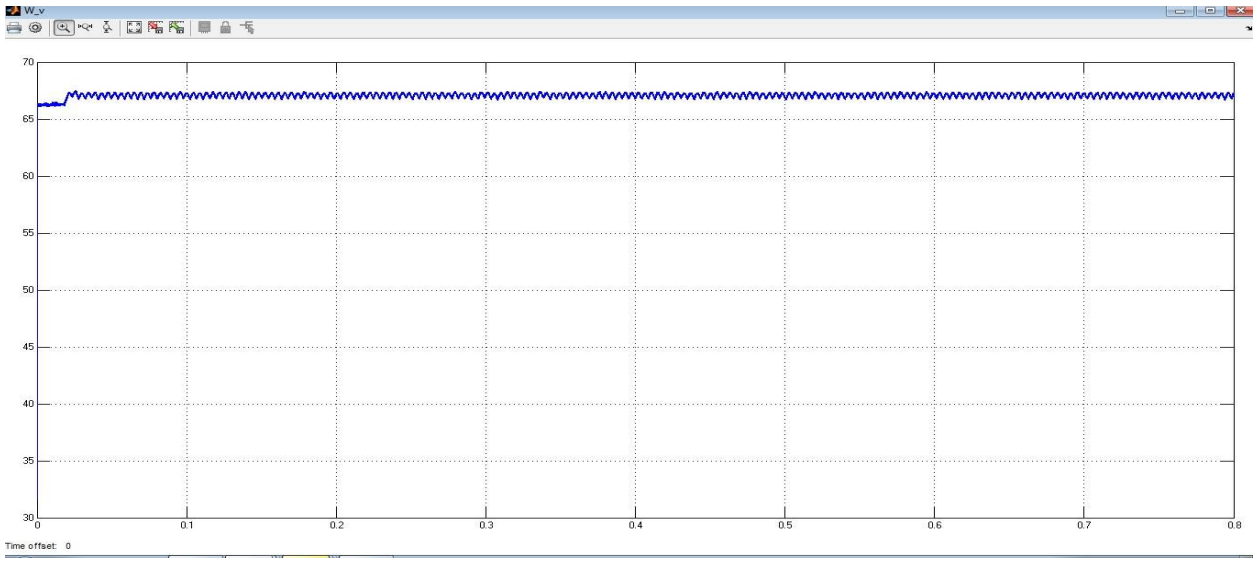

Fig. 6 MATLAB Output Voltage waveform for Wind Power

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The individual output voltage waveform wind energy is shown in fig.6. The voltage is in the range of 68v which is feed to the load and also made to charge the batteries. The waveform shows the presence of harmonics which affect the performance of the entire system. So it must be minimized.

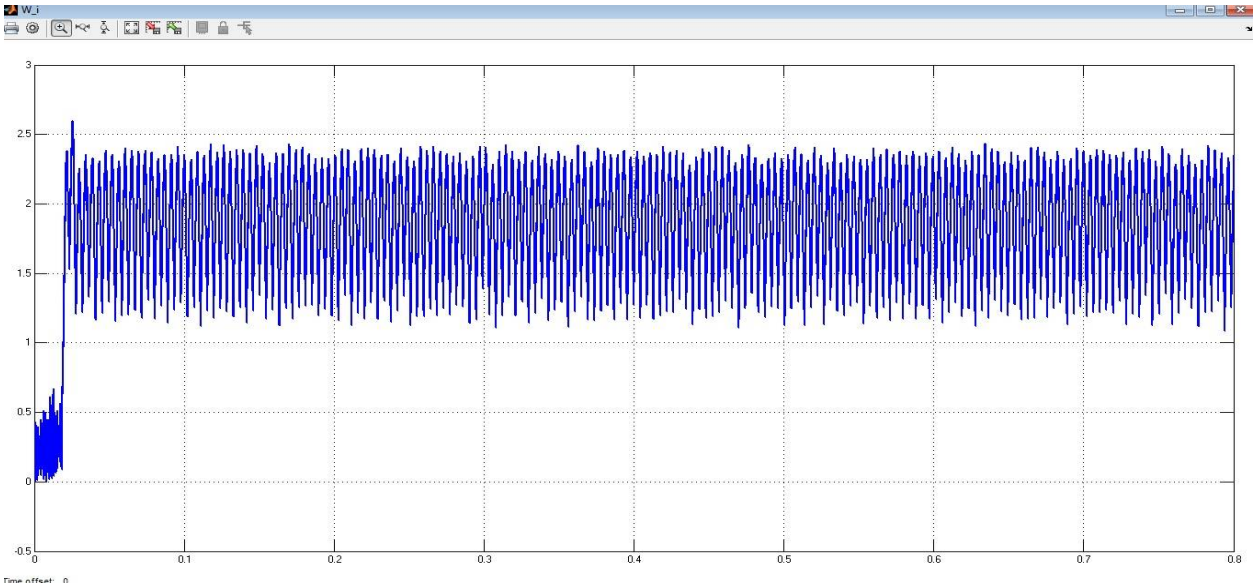

Fig. 7 MATLAB Output Current waveform for Wind Power

The individual output Current waveform wind energy is shown in fig.7. The Current is in the range of 2 amps which is feed to the load and also made to charge the batteries. The waveform shows the presence of harmonics which affect the performance of the entire system. So it must be minimized.

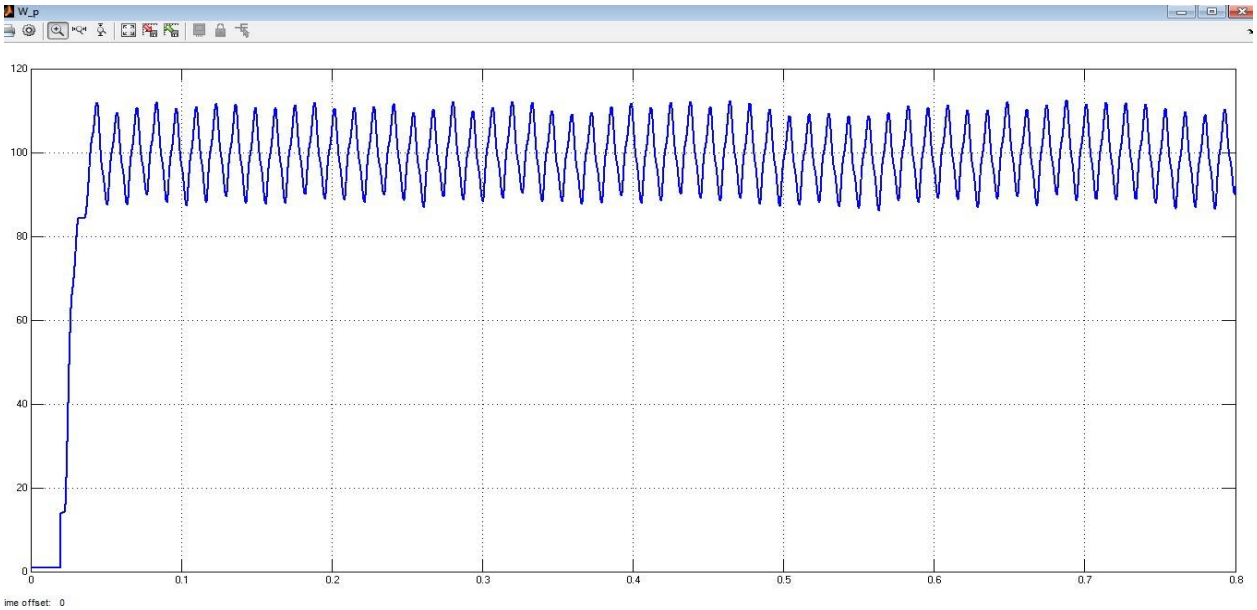

Fig. 8 MATLAB Output Power waveform for Wind Power

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The individual output power waveform wind energy is shown in fig.8. The power is in the range of 85 to 115w which is feed to the load and also made to charge the batteries The waveform shows the presence of harmonics which affect the performance of the entire system. So it must be minimized.

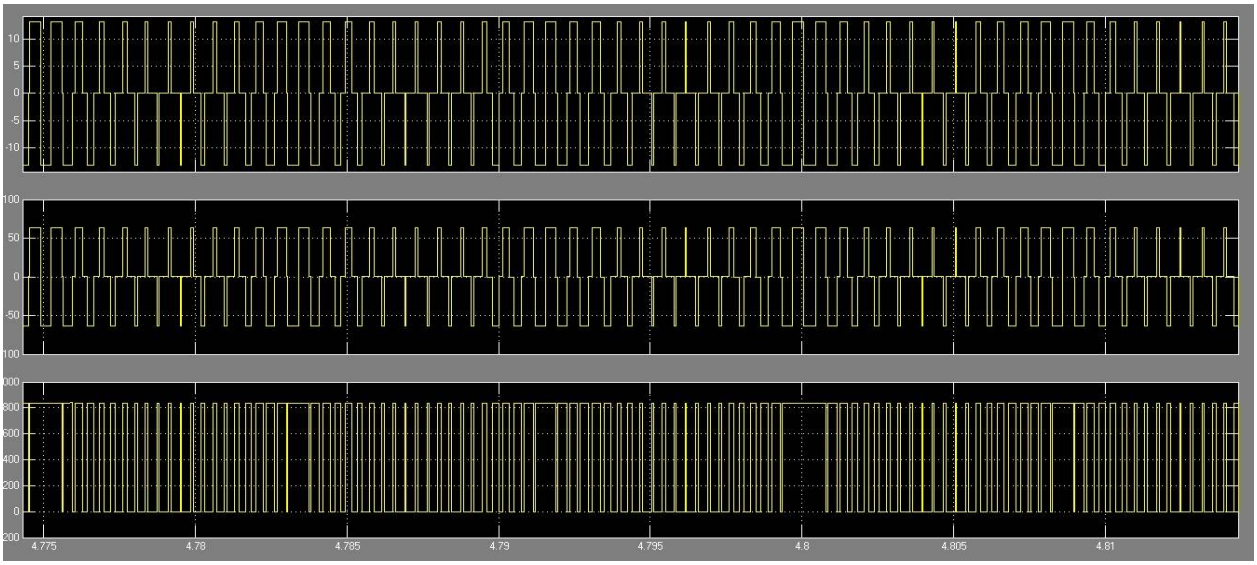

Fig. 9 MATLAB Simulink overall output of Existing System

The simulated per phase current, voltage and power waveform across the load is shown in Fig.9. The waveform shows the presence of harmonics which affect the performance of the entire system. So it must be minimized. Thus in the proposed scheme the necessary filters are introduced to improve the stability of the system.

IV.CONCLUSION

A hybrid power plant consisting of renewable energy sources can be made into operation by proper utilization of these resources in a completely controlled manner. Based on this analysis this solar-wind hybrid system can be used by any domestic use at a place where wind speeds are not that good. It will charge the inverter battery even when there is no grid power. There is lots of space for improvement in this system like Maximum Power Point Tracking (MPPT) or other power enhancement methods. In the existing system the charge controller is not introduced, this lead to overcharging and over discharging of the battery. This reduces the life cycle of the batteries. This improvement can be incorporated without any big increase in the system costing because there is only a little addition to the electronic components to the charge controller circuitry.

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