Development and Performance Analysis of Small Scale Proto type Model for Hybrid Power Generation

Intakhab Alam Laghari[#1], M. Ali Tunio[*2], Rameez Shaikh[#3] , Noman Khan[#4]

[#1]*Researcher Department of Electrical Engineering, MUETSZAB Khairpur Mirs' Sindh, Pakistan.*

[*2]*Assistant Professor Department of Electrical Engineering, MUETSZAB Khairpur Mirs' Sindh, Pakistan.*

[#3] *Assistant Professor, Department of Electrical Engineering, Sukkur IBA University.*

[#4] *Technician Department of Electrical Engineering, MUETSZAB Khairpur Mirs' Sind, Pakistan.*

Abstract

All the conventional energy resources are depleting day by day. So we have to shift from conventional to non-conventional energy resources. In this work, hybrid power generation unit based on a two different renewable energy sources (i.e. solar energy with MPPT and wind energy) is developed. Both sources combine with each other and connected with battery supply with hybrid control unit. It also uses an inverter circuit which converts DC in to AC Load. This process reviles the sustainable energy resources without damaging the nature. We can give uninterrupted power by using hybrid energy system. This research work is the performance analysis of the developed experimental setup for hybrid power generation at variable AC load conditions.

Keywords — *Solar, Wind, Hybrid, MPPT, Inverter and AC Load comma.*

I. INTRODUCTION

Now a day's energy demand in grid connected or isolated application is gradually rising, therefore it is valuable to compete the gradually increasing energy demand. Moreover there is a social benefit for environmental circumstances such as green-house effects and lessening in fossil fuel resources [1]. Solution for these problems can be inspect from latest research and progress of alternative energy resources such as wind, photovoltaic, hydro, biomass cogeneration etc.[2]

Non-conventional energy resources trend has gained much progressed as compared to other one.There is a growing awareness that renewable energy such as photovoltaic system and Wind power have an important role to play in order to save the situation. To enhance the performance of renewable resources and its influences on power quality is evaluated by hybrid energy system. Usually a hybrid power system comprises of two or more renewable sources and it provide improved efficiency along with more balanced energy of the system [6].

Hybrid system generally consists of non-conventional energy element i.e. PV that is stabled through another form of generation or storage such as a fuel cell or battery storage system, diesel generator set. Hybrid systems provide sufficient electrical power to remote areas. Upcoming achievement of these schemes relies on the continual research, progress and illustration of renewable resources technologies, highlighting better-quality operating performance, cost lessening and improved continuity of power. [9] The importance of hybrid systems has grown as they appear to be the right solution for a clean and distributed energy production [10].

II. LITERATURE REVIEW

In past literature J Godsonetal In this work a Solar PV Wind Hybrid Energy System was implemented. A portion of the energy requirement for a private house, farm house, a small company, an educational organization or an apartment house dependent on the need at the spot where used has been supplied with the electricity generated from the wind and solar power. It decreases the dependence on one single source and has improved the reliability. Hence we could recover the efficiency of the system as compared with their separate mode of generation.[1]

M. Srikanth et.al. PV-Wind hybrid energy system is the most upcoming alternative for power generation in place of fossil fuels generators. This work will give the Matlab simulation modelling of PV-wind hybrid energy system. The particular model will give the key details of each portions of PV-wind hybrid system. In this model there will be parts they are a photovoltaic energy subsystem wind energy subsystem, an inverter and a battery backup. The photovoltaic energy is converted to AC using inverter and wind energy by turbine, the energy produced is stored in the battery and when necessary it discharges. This hybrid is valuable for both industrial and domestic purposes. This will decrease

the requirement on one source because it has multiple sources [2].

Soro Sielle Martin a new renewable energy laboratory concept based on the combination of wind, solar and biodiesel energies sources was existing. The hybrid power system, the laboratory physical environment, the laboratory virtual stage and the e-learning impression were demonstrated. The solar power system, the wind power system and the biodiesel generator working principle and their dimensioning and simulation were shown. The simulation results specifies that both the solar panel and wind turbine are non-linear system and MPPT controller needs to be implemented to sustain them working at the extreme power point so as to rise their efficiency. Moreover, the solar system and WECS currents evolution show that the battery is of energetic significance in renewable energy system because it can store energy in high construction period of renewable sources and feed the load in low production period.[6]

Yavuz koca Bahaduretal has performed isolated distributed off-grid hybrid system comprising FC, solar, and wind is proposed for the reliability of electrical energy by using battery backup. In this proposed system, the important elements which influence the energy control are power capture from renewable resources. Also PLC is used to improve the efficiency for the electrical energy generation.
P. Indhumathi et.al. this paper deals with the arrangement of two renewable energy systems solar and wind is known as hybrid renewable energy (HRES). This type of standalone hybrid energy system is suitable, for the accessibility of energy throughout the year in rural areas where grid connection is not possible. In this work a solar PV module radiation level for altered conditions using Incremental Conductance (IC) Method MPPT algorithm and wind speed governor of PMSG Generator using a PI controller has been planned and analyzed independently and interconnected as a hybrid system with energy back up to store extra energy and a both system are connected using a inverter to RL load which is a standalone system is designed and analyzed using MATLAB/SIMULINK. [5]

Vishal Wawge etal we conclude that, the Solar-Wind Hybrid System is best generation system. Where the management is unable to reach and transmission is difficult. To decrease the transmission cost we can straight install the hybrid system. in this study will helpful for implementation of hybrid system in future To rise the construction we can take more numbers equipment's and also we can found good output power by applying shunt capacitor bank to recover the power factor. The graph is helpful to understand annual generation of generated power throughout the year in India by various power generating systems.

Raj Singhetalh as presented this work contain solar photovoltaic and wind hybrid power generation system in this system wind turbine can be used to produce electricity when wind is obtainable and solar panels are used when solar radiations are obtainable .power can be generated by both sections at the same time also. The procedure of batteries is to provide uninterrupted power supply .this system consist of 20W solar panel, 3W wind turbine/generator system voltage 48v, battery is 12v, and inverter rating (VA) 25 output ac wave form sine wave and output ac 230V/ac frequency 50Hz [10].

III. MATERIAL & METHODS

In this work, hybrid power generation unit based on a two different renewable energy sources (i.e. solar energy with MPPT and wind energy) is developed. Both sources combine with each other and connected with battery supply with hybrid control unit. It also uses an inverter circuit which converts DC in to AC Load. The performance analysis of the developed experimental model for hybrid power generation at variable AC load conditions.

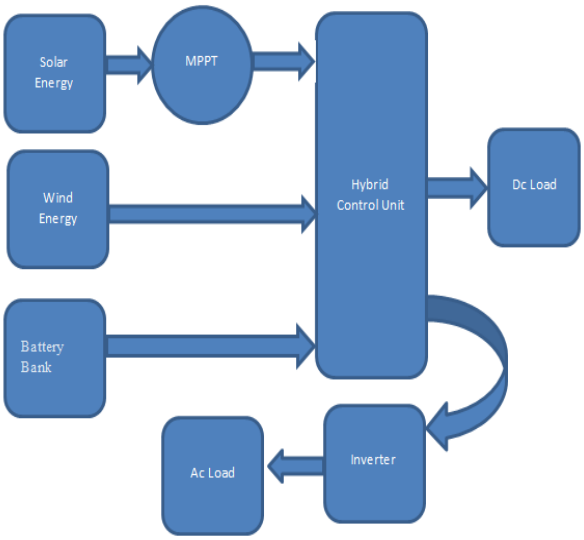

Fig1 Schematic Diagram of Experimental Setup

A. Components Details & Description of Developed Experimental Setup Details)

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TABLE I
Description of components

Component Description	Specification details
Solar (Photovoltaic)	Model No: SYM 90P Power: 90W
Lamp for photovoltaic solar trainer	Manufactured SIMSUN 1*230Vac
Wind Turbine Unit.	ManufactureDC-540 low wind permanent magnet alternator 12volt Battery 2000rpm
Power Electronic Universal Supply	Manufacture: MottaLivenza (TV) Model No.AEP-1/EV V:400 VA :3000 Hz: 50
Hybrid Units	Hybrid 001 400watt
Batteries	Manufacture: GEL 12v97Ah C/20
VA Meters	Manufacturer: Gw Instek Model No. GDM-360
LED Bulb	Philips LED Bulb E27 Power 12W
Function Generator	Manufacture: Gw Instek Model No.GFG-8015G Power 16w
Oscilloscope	Manufacture: Gw Instek Model No.GDS-1062A Power :18w

IV. EXPERIMENTAL RESULTS AND DISCUSSION

This research work is the performance analysis of the developed experimental setup for hybrid power generation at variable AC load condition. Due to intermittent nature of input source of solar and wind energy, the reliability of the system is affected, it needs to be combine them with each other as well as with the other energy sources to maintain continuous and reliable electric power supply. The performance analysis of the developed prototype model is conducted to test the experimental setup & ensure the reliability and continuity of electric power.

Figure 2: shows the bus current are increased while ac load increased because inverter is connected on bus bar and whenever load increased on inverter the currents are increasing simultaneously on bus bar.

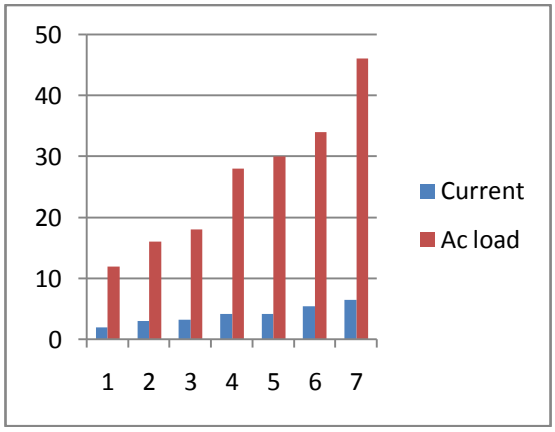

Fig2 Bus Bar current verses Load

Figure 3: the first five steps wind current are zero because wind speed is very slow and after a while wind speed will increases then wind current will increase. Because Due to generated voltage less then Bus voltage the major current will not produce as well MPPT is not so that received voltage of Bus Bar will low.

Figure 4: the Generated Voltage by wind very peak point will increase the frequency of wind increase. Because the behavior of wind generator is simultaneously linear with Hz and VPP. so where excess VPP speed and Hz linearly increases

Figure 5: the bus current are increased while ac load increased because inverter is connected on bus bar and whenever load increased on inverter the currents are increasing simultaneously on bus bar.

Figure6: With the Passage of Time the Battery Terminal Voltages will increase. Because continuous of energy sources the battery will charge timely, so the terminal voltages increase with the passage of time.

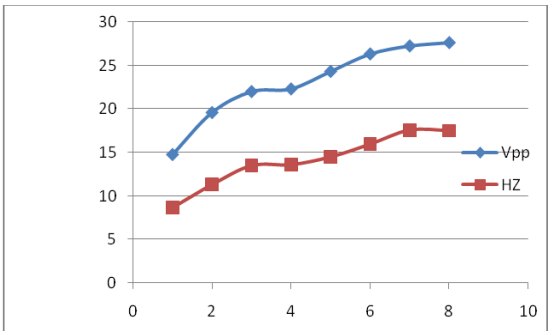

Fig3 Peak Voltage verses Frequency

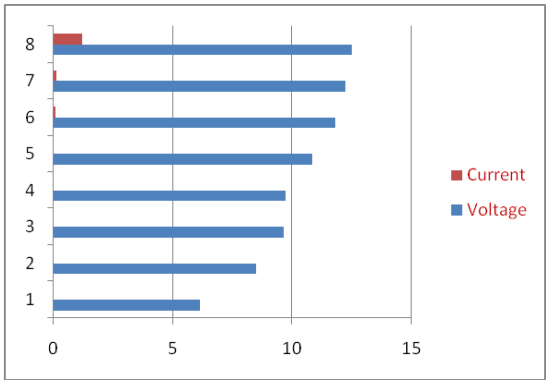

Fig4 Bus current verses AC load

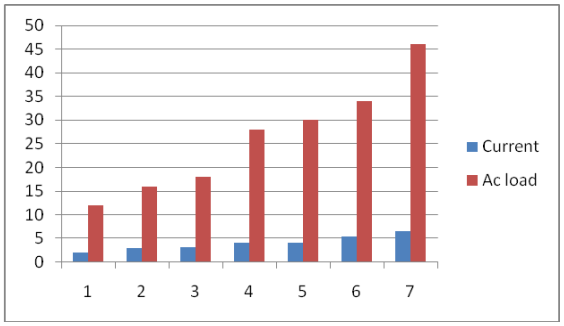

Fig5 Bus current verses AC load

Figure 7: Due to Current the Battery Terminal Voltages will increase. Because the rate of charge current and the time connecting in Battery charge

Figure 8: the continuous power generation after 21mints we get 25 watt, and in 1hour we get 75wattapprox.

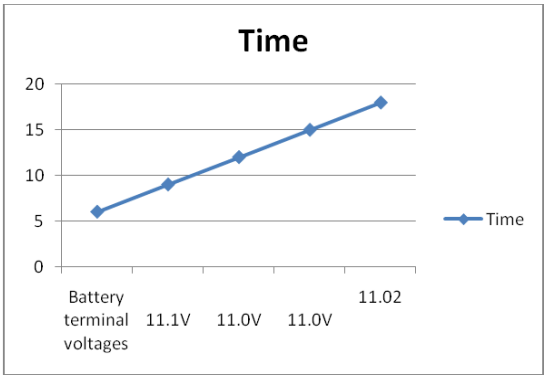

Fig6 Battery terminal voltage verses time

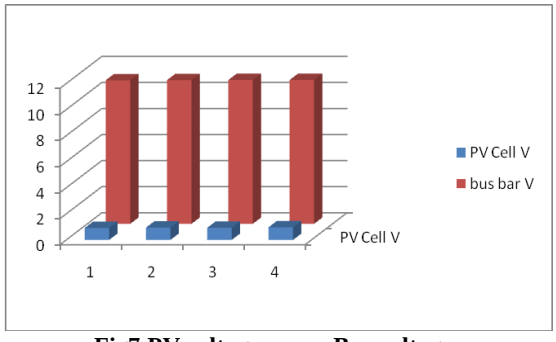

Fig7 PV voltage verses Bus voltage

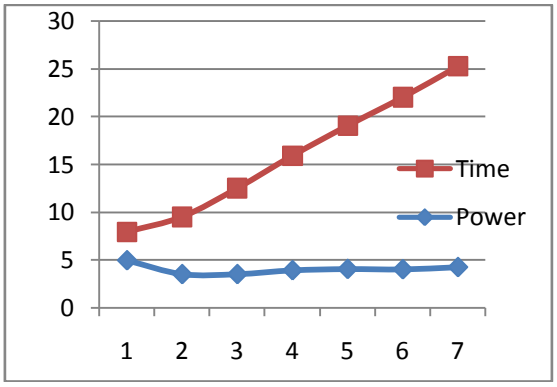

Fig8 Time Verses power

Figure 9:the bus current are increased while ac load increased because inverter is connected on bus bar and whenever load increased on inverter the currents are increasing simultaneously on bus bar.

Figure 10: initially solar current will increase then wind current because wind speed will low and after some time wind speed increase then wind current will also increase.

In our case solar energy is constant and wind speed is variable therefore ultimately solar panel current are higher than wind but after while wind speed increased and also current increased then solar panel.

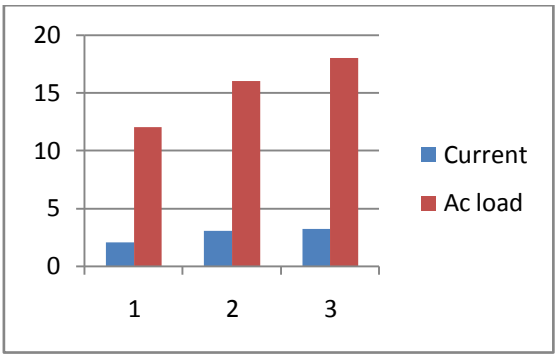

Fig9 Current Verses AC load

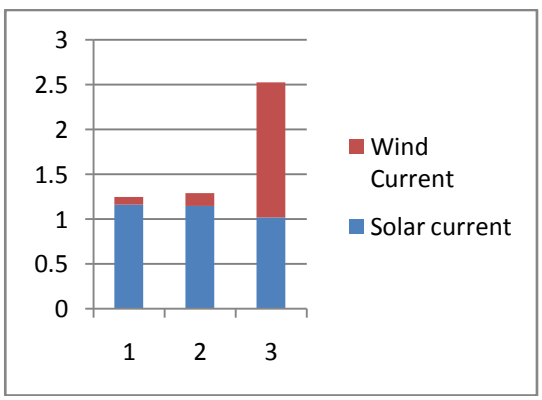

Fig10 Wind Current verses Solar current.

V. CONCLUSION

In this work, hybrid power generation unit based on a two different renewable energy sources (i.e. solar energy with MPPT and wind energy) is developed.
Both sources combine with each other and connected with battery supply with hybrid control unit. It also uses an inverter circuit which converts DC in to AC Load.

The performance analysis of the developed experimental model for hybrid power generation at variable AC load conditions is lead to test the model to ensure the reliability and continuity of supply.

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