Hybrid Power Generation Using Solar, Wind and Hydro Energy

[1]Om Patil, [2]Tejas Patil, [3]Prof. Sunita Deshmukh

[1,2]Student, E&TC Engineering, NBN Sinhgad Technical Institute Campus, Ambegaon Bk, Pune, Maharashtra, India
[3]Asst. Professor, E&TC Engineering, NBN Sinhgad Technical Institute Campus, Ambegaon Bk, Pune, Maharashtra, India

Abstract - **At present, expanding the grid is not a viable option for reaching the non-electrified rural populace, as the major stakeholders do not support the connection, nor is it economically feasible. Additionally, conventional energy solutions like fuel-based systems are gradually being dropped from the agendas for rural development due to rising oil prices and the intolerable effects of this energy source on both consumers and the environment. "HYBRID POWER GENERATION USING SOLAR AND WIND ENERGY" is a solution for this issue. The most effective way to provide "high quality" power has been shown to be through hybrid systems.**

Keywords: Hybrid Power Generation, Solar, Wind, Hydro Energy, Power Generation.

I. INTRODUCTION

Many people are looking into sustainable energy alternatives in an effort to protect the environment for coming generations as their concerns about global warming and the depletion of fossil fuel supplies grow. With the exception of hydropower, solar and wind energy have the most potential to fulfill our energy needs? When used alone, wind energy may provide a lot of power, but its availability is very erratic; it might appear one minute and disappear the next. Similar to this, solar energy is there all day long, but the amount of solar irradiation varies depending on the strength of the sun and the erratic shadows created by trees, clouds, birds, and other objects. One fundamental disadvantage shared by photovoltaic and wind power systems is their unreliability due to their intermittent nature.

However, the power transfer efficiency and dependability of the system can be greatly increased by merging these two intermittent sources and adding maximum power point tracking (MPPT) algorithms. The alternative energy source can make up for a shortage or inadequacy in satisfying the demands of the load when one source is unavailable. Numerous MPPT-controlled hybrid wind/photovoltaic power systems have been proposed and addressed in various works. To accomplish the MPPT control for each of the renewable energy power sources, the majority of systems in the literature use a separate DC/DC boost converter coupled in parallel in the rectifier stage. In order to integrate the sources from the DC-end and still achieve MPPT for each renewable source, a more straightforward multi-input structure has been proposed. The buck and buck-boost converters are combined to create the structure that is suggested by. In order to eliminate the high frequency current harmonics that are introduced into wind turbine generators, the systems described in literature need passive input filters. The generator's lifespan is shortened and heat-related power loss is increased when the harmonic content of the current increases. For hybrid wind/solar energy systems, a different multi-input rectifier structure is suggested in this research.

Because of the current state of the environment and the depletion of fossil fuels, conventional energy sources are unable to meet the growing demand for electricity, necessitating more power generation. We must go from conventional to non-conventional energy sources in order to overcome this. In our project, three renewable energy sources—solar, hydro, and wind—combine to create hybrid power that has never been produced simultaneously by any of these sources.

This process provides renewable energy sources without endangering the environment. We can use a hybrid energy system to provide power continuously. Three energy systems have been integrated by us to provide a steady power source. A vertical wind turbine is used to generate electricity from wind power. Solar radiation is converted into electrical power using solar panels. Hydro energy is converted into electricity using a hydro generator. Both domestic and business uses are possible for this electrical power. This paper demonstrates how we have integrated three renewable energy sources to produce electricity constantly at a reduced cost, with less maintenance, and without causing harm to the environment.

These days, a lot of scholars are paying attention to the importance of sustainable energy. This is mostly because it has been seen that fossil fuels are more expensive and have a more detrimental effect on the environment. Non-renewable energy sources are finite and cannot be recycled, such as coal, natural gas, fossil fuels, and nuclear power.

Both humans and other species are severely harmed by these energy sources. Energy that can be replenished by natural processes is derived from renewable sources. They can be used again because they are renewable and difficult to deplete. Nonconventional energy sources are a promising way to meet the world's growing demand for electricity. Numerous renewable energy sources exist, including geothermal, hydro, wind, sun, and tidal energy.

II. LITERATURE REVIEW

The design of a solar tracker system and their implementation dedicated to the PV conversion panels. In this study of tilt angle is a major point. The net gain of 15% -35% from tracking PV modules in fixed position toward the sun. The most popular single axis system is used for tracking the sun position by tilting angle. The multi-agent system is beneficial and it is used for tracking the sun in the photovoltaic plant. This system is beneficial, easy installation and low cost so it is also a preferable for the solar power production. This system consumes less power. It has a problem of generating the tracking trajectories for PV tracking systems is computational complex. Assuming this for a year is time-consuming. The exact value of this improvement depends on the installation. (Khadidja et al, 2014).

The amount of energy delivered to the battery through the solar and wind energy combination is controlled by the hybrid controller. It is directly associated to the relay which designed a distinctive household load with wind solar hybrid system with the charge controller to charge a battery. The wind solar hybrid system mainly consists of the wind turbine and solar panel. The energy produced from the two with a combination is used for household purpose. As per requirement the energy form the battery is use given to the load. Controller had an electronic component such as microcontroller ATMEGA8535, LCD display (+5 V (16X2)) and An IC ULN2803. An IC ULN2803 is used for over current prevention process if occurs. At that time, it gives an indication alarm. The estimated Total Cost of wind and solar hybrid power =Rs. 1,00,213 and had a payback period is 1 year. So, Wind and Solar Hybrid System is more resourceful for rural area where electricity is not easily accessible. (Vadirajacharya et al, 2012).

The Savonius type wind turbine model is used. In this model experiment is carried out on 2, 3 and 4 blades of the wind turbine. The effect of blades non-performance calculated. This shows the tip speed ratio, torque and power coefficient according to wind speed. Pressure distribution of wind turbine shown in ANSYS 13.0 software. This model had optimum performance when used with 3 blades at their high tip ratio. The highest tip ratio is achieved in Savonius model is 0.555 at a wind speed 7 m/s (Wenehenubun et.al, 2015).

Design of hybrid system is a process of selecting the reliable components and its sizing to provide cheap, efficient, reliable and cost effective renewable energy. This system is also utilized for irrigation purpose. The submersible pump consumes 204 units per day on an average to irrigate the 1.5 acres for mango crop. The cost calculation of the wind-solar hybrid system is done in that. This data will be useful for small scale wind-solar hybrid system manufacturers. The major advantage of wind – solar hybrid energy system is that when used together, reduces the cost of the system. This analysis gives the guideline of engineers to develop the hybrid system to meet the energy demand with optimum cost. In rural area cannot reach electricity with limited cost or do not access the convection commercial fuel. So it beneficial to design hybrid system for irrigation purpose in the rural area (Shivrath et al, 2012)

The wind turbine is designed in such way that the optimum tip speed ratio extracts maximum power with available wind speed when turbine rotor passes through air it leaves the turbulence wake in the path of the stream. If next blade of revolving rotor comes in the region of the wake when the air is still turbulent it will not able to remove power from the wind turbine resourcefully. And it comes into high vibration. If rotor blade rotates slowly then the air striking each rotor blade would no longer be in turbulence. This is another way to select the tip speed ratio so that rotor blade does not pass through turbulent air (Ragheb et at,).

III. PROBLEM STATEMENT

One primary issue facing modern power generation systems is the reliance on a single source. A serious deficit of electricity may result from the limited or nonexistent availability of this one source of energy. This was the issue that was examined during the project's research.

IV. OBJECTIVES

- This project's primary goal is to offer a backup power source for isolated areas, like small towns and research sites.
- Additionally, the system can be employed in areas hit by natural disasters as a temporary power source. The product needs to be inexpensive and simple to produce in order to meet these goals.
- Alternating current (AC) diesel generators, loads, renewable energy sources, energy storage, power converters, rotary converters, coupled diesel systems, dump loads, load management options, or a supervisory

control system are all possible components of a hybrid system.

V. SYSTEM DESIGN

- Several energy sources together provide hybrid energy. The best combination out of all the combinations is the combination of solar and wind power with a hydro generator. Hydroelectric crystals may drive dc loads and that tiny voltage that is held in a lead acid battery by converting force applied to them into electrical energy.
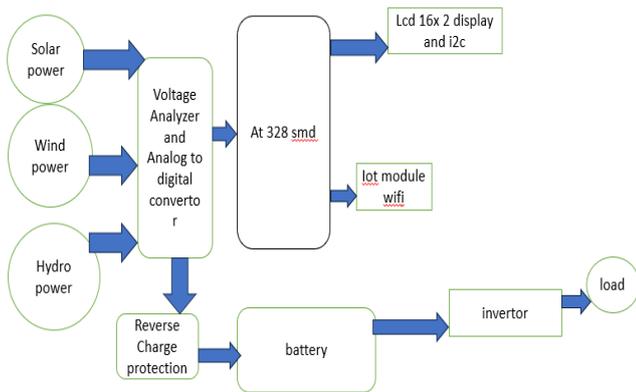- The inverter is linked to the battery. The 12-volt D.C. is converted to 230-volt A.C. using this inverter.

Figure 1: Block Diagram

- To turn on the loads, 230 volts of AC voltage are applied. Conventional battery charging units are also utilized to deliver power to the circuitry.
- Here, the voltage and current status are displayed by an LED display that is controlled by an ATMega 328p controller.
- When wind is available, a wind turbine can be utilized in this system to generate electricity, and when solar radiation is accessible, solar energy panels can be employed.
- It is also possible for both portions to generate power simultaneously. The purpose of batteries is to supply power continuously.
- With the aid of a driver circuit, the microcontroller in the system regulates the switching between the converters.
- A charge controller/converter is employed to regulate the solar panels' power supply.
- Through the use of a wifi module IOT and a web-based application, the actual generated voltage and current that is stored in the battery will be displayed graphically and accessible to anyone, anywhere.

VI. RESULT AND DISCUSSIONS

After the implementation of the hardware model, the load receives the output. Direct feeding of the DC output from the

solar panel to the battery is done at a 30° angle. After being dipped down or stepped up to a high enough voltage to charge the battery, the wind turbine produces DC output power. A 230V AC supply is produced for the load by the inverter using the battery's DC output. Water conservation and rainwater harvesting are being implemented by covering a water reservoir with a solar panel. Table 1 displays the measured values of the parts utilized in the solar wind hybrid power generation prototype model.

Table 1: Hybrid Power Generation

Components	Input Voltage	Output Voltage	Output Current	Output Power
Solar Panel	-	18V	0.46A	8.28W
Wind Generator	-	3.4V	0.6A	2.04W
Total Power (Theoretical)				10.32W
Total Power at Load (Practical)				6.2W
Total Output Voltage				230V

The Following figure shows the hardware setup of the proposed system:

Figure 2: Result of Hardware

VII. CONCLUSION

The idea of producing hybrid power through the use of wind, solar, and hydropower is working well. This hybrid power generation system outperforms other systems in terms of output and capacity when compared to single or dual power generation systems. As an alternative to traditional energy sources, it is a good and efficient way to generate power. This system's proximity to the load will lower transmission losses and associated costs. When the wind and water are moving at high speeds, the efficiency of the system is enhanced. The system's efficiency peaks when there is an abundance of solar

radiation. Individuals ought to inspire and achieve by employing these unconventional energy sources. It is environmentally beneficial and produces no toxic waste, unlike traditional energy. It is a good, dependable, and reasonably priced way to generate electricity.

REFERENCES

[1] B. Khadidja, K Dris, A.Boubeker. and Noureddine S, (2014) Optimisation of a Solar Tracker System for Photovoltaic Power Plants in Saharian region, Example of Ouargla. Energy Procedia.

[2] Vadirajacharya, P.Katti, (2012) Rural Electrification Through Solar and Wind Hybrid System: A Self Sustained Grid Free Electric Power Source, Energy Procedia 14 2081 – 2087.

[3] F. Wenehenubun, (2015) An experimental study on the performance of Savonius wind turbines related with the number of blades, Energy Procedia 68 297 – 304.

[4] Y. Shivrath et. al,(2012) Design & Integration of Wind-Solar Hybrid Energy System for Drip Irrigation Pumping Application, Vol.2, Issue.4, July-Aug 2012 pp-2947-2950.

[5] Ragheb and A. Ragheb Wind Turbines Theory - The Betz Equation and Optimal Rotor Tip Speed Ratio.

[6] T.Tudorache and L. Kreindler, , (2010) Design of a SolarTracker System for PV Power Plants, Vol. 7, No. 1.

[7] A.Mathias, (2013) Which Solar Panel Type is Best? Mono- vs. Polycrystalline vs. Thin Film. A.T.

[8] Tudorache, L. Kreindler, (2010) Design of a Solar Tracker System for PV Power Plants, Vol. 7, No. 1.

[9] Kumar, S. Ram, (2014) Development of Small Hydro Power in India, IJSRD Vol. 2, Issue 09.

[10] V. Khare, S. Nema, and P. Baredar, (2013) Status of solar wind renewable energy in India, Renewable and Sustainable Energy Reviews 27 1–10.

[11] K.Gaiser, P. Erickson, (2016) An experimental investigation of design parameters for pico-hydro Turgo turbines using a response surface methodology, Renewable Energy 85 406-418.

[12] S.Williamson, B.Stark, (2013) Performance of a low-head pico-hydro Turgo turbine, Applied Energy 102 1114–1126.

[13] J. Chukwuneke, C. Achebe,(2014) Experimental Investigation on Effect of Head and Bucket Splitter Angle on the Power Output of A Pelton Turbine, Vol.4, No.10.

[14] J.Ujam J. Chukwuneke, (2014) Modelling The Effect of Head and Bucket Splitter Angle on The Power Output of A Pelton Turbine ,Aug.. Vol. 5. No. 03.

[15] B. Nasir., (2013) Design Of High Efficiency Pelton Turbine For Micro hydropower Plant Volume 4, Issue 1, January-February pp. 171-183.

[16] O. Paish (2002) Micro-hydropower: status and prospects. Proc Inst Mec Eng – Part A: J Power Energy; 216:31–40.

AUTHORS BIOGRAPHY

Om Patil,
Student, E&TC Engineering, NBN Sinhgad Technical Institute Campus, Ambegaon Bk, Pune, Maharashtra, India.

Tejas Patil,
Student, E&TC Engineering, NBN Sinhgad Technical Institute Campus, Ambegaon Bk, Pune, Maharashtra, India.

Prof. Sunita Deshmukh,
Asst. Professor, E&TC Engineering, NBN Sinhgad Technical Institute Campus, Ambegaon Bk, Pune, Maharashtra, India.

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