Analysis of Vertical Axis Wind Solar Hybrid Power System

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Abstract-Energy is essential for the growth and development of any country. The quality of life is closely related to energy consumption, which has continuously increased over the last few decades in developing countries. The design fundamentals of the hybrid electric power generation system utilizing both wind and solar energy for remote area is today's need. Wind power is the conversion of wind power into a useful form of energy. Wind power, as an alternative to fossil fuels, is plentiful, renewable, widely distributed, clean, produces no greenhouse gas emissions during operation and uses little land. The effects on the environment are generally less problematic than those from other power source. The solar energy is available throughout year and it is free and clean sources of energy. The solar PV cells absorb the radiation of sun and converting it into the electrical power. The wind mill is capable to extracted energy in day and night time while the solar PV cell is capable to extracted the power only during day hours. The combination of this hybrid system will be beneficial in future aspects.

Keyword-*Hybrid Renewable Energy;Solar Energy;Vertical Axis Wind Turbine.*

I. INTRODUCTION

Renewable energy researches, particularly wind and solar have been gaining popularity and recognized as potential sources for clean, inexhaustible and free energies. The concept of on-site renewable energy generation is to extract energy from renewable sources close to the populated area where energy is required. In the modern era, on-site energy extraction from renewable energy sources in urban settings is regarded as the next step in the process of reducing dependencies on the usage of conventional power generation using fossil fuels. A hybrid system consisting of wind and solar renewable energy sources is more beneficial than a system that only depends on one source of energy. Also, the power supply from a hybrid system is more stable and reliable. In addition, optimization of hybrid renewable energy system is crucial for researchers to maximize the energy output from the system with the lowest cost and highest reliability.

1.1 Principles of Savonius Rotor Wind Turbine

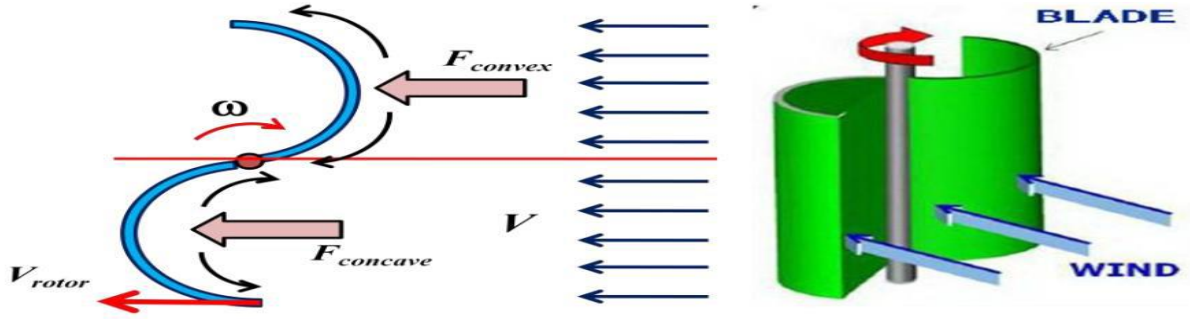


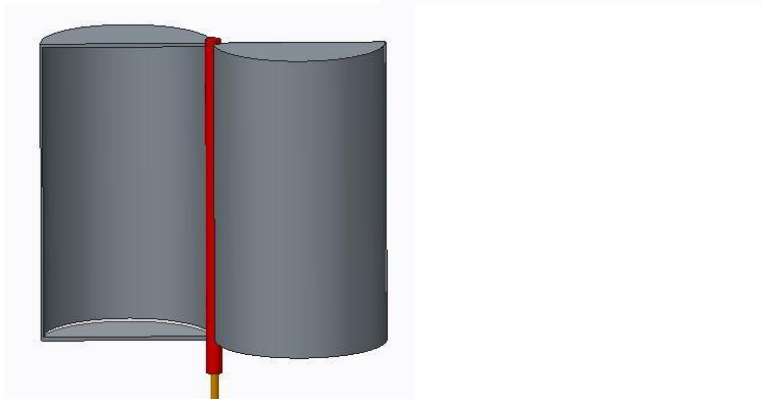
Fig.1.1 Schematic drawing showing the drag forces exert on two blade Savonius.

II. METHODOLOGY

2.1 CAD Design of Savonius Rotor Blade

Table 2.1:Turbine Specification

Blade Type	S- Type (Savonius)
Number of Blade	2
Blade Height	80 cm
Blade Diameter	40 cm
Blade Material	Aluminium Sheet
Thickness of Blade	0.5 mm



Figu 2.1 3D Model of Savonius Rotor Blade

Above fig 2.1 shows us 3D model of savonius rotor blade made in creo 2.0. The blades are designed in such a way that maximum surface area is in contact with the flowing air in order to increase the swept area by turbine. The design of blade is such that drag causes the blade to rotate more the wind speed more will be the current produced by the VAWT and the specification of the rotor blade is as shown in the table2.1

2.2 Experimental Setup

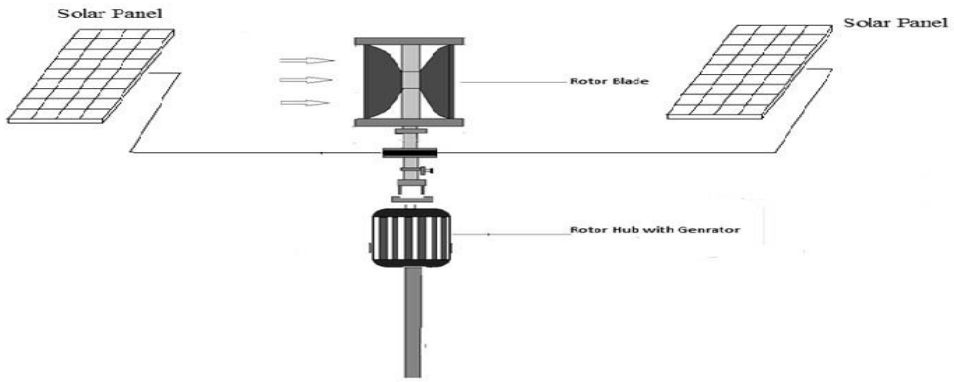


Fig.2.2: Set up of Hybrid System

The experimentation is carried out at different times in order to record the output. The output from the wind system and solar system recored separately and combinely. The temeperature of the surrounding is recorded with help of temperature data logger devices.The gobal intensity at particular region is recordred with solar meter.For wind rotor the wind is continuously made flow with different speed in order to recorded the output.

III. OBSERVATIONS

A model has been developed to design, analyze solar photovoltaic-wind hybrid system with due consideration given to various parameters required for designing both standalone wind/solar and hybrid system (wind + PV) with battery backup.

Day Time	Solar radiation (W/m^2)	Voltage (V)	Current (A)
9 A.M	530	4.33	0.8
10 A.M	740	6.02	1.23
11 A.M	880	8.22	1.8
12 A.M	930	9.95	2.33
1 P.M	1012	10.37	3.1
2 P.M	980	9.98	2.37
3 P.M	890	8.28	1.83
4 P.M	785	6.35	1.28
5 P.M	620	4.72	0.87

Table 3.1 Stand alone Solar PV

Time	Wind speed (m/s)	Voltage (V)	Current (A)
9 A.M	4	4.3	1.25
10 A.M	3	3.2	0.78
11 A.M	6	6.02	1.9
12 A.M	5	5.5	1.63
1 P.M	6	5.89	1.82
2 P.M	3	3.08	0.66
3 P.M	7	6.66	2
4 P.M	5	5.32	2.53
5 P.M	6	6	1.87

Table 3.2 Stand alone Wind System

Time	Solar and Wind Hybrid System	
	Voltage (V)	Current (A)
9:00 AM	8.5	2.05
10:00 AM	9.1	2.01
11:00 AM	14.1	3.7
12:00 PM	15.2	3.96
1:00 PM	16.09	4.92
2:00 PM	13.06	3.03
3:00 PM	14.66	3.83
4:00 PM	11.37	3.81
5:00 PM	10.52	2.74

Table 3 Hybrid System

IV. RESULT & DISCUSSION

In this chapter detailed result of observation made in previous chapter is carried and discussion is made using graphical tools. Various plots are made with respect to operating condition and variable parameter. The system is analysed according to the graphs and discussion is made

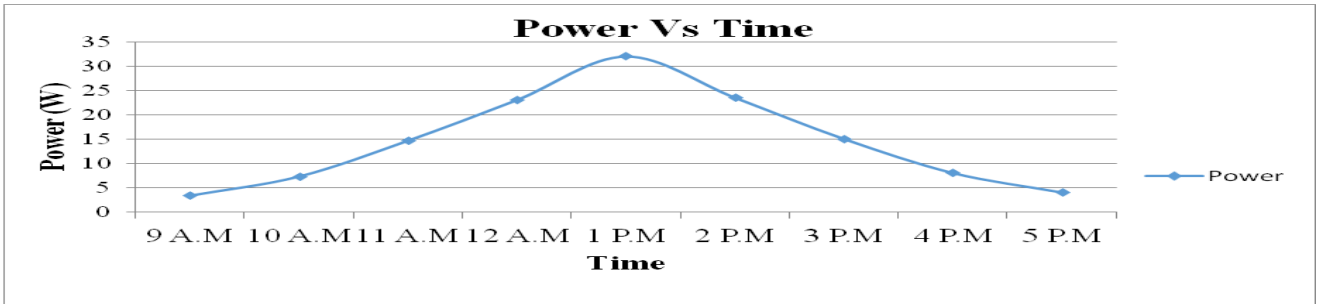


Fig.4.1: Power variation with respect to Time

Fig4.1 shows the variation of power output from the solar system alone. The nature of graph is dome shape which shows the peak at time of 1 A.M this because of the large amount of solar intensity incident on earth surface as the intensity of solar radition is less in the morning are the power output is less and same is the case afternoon

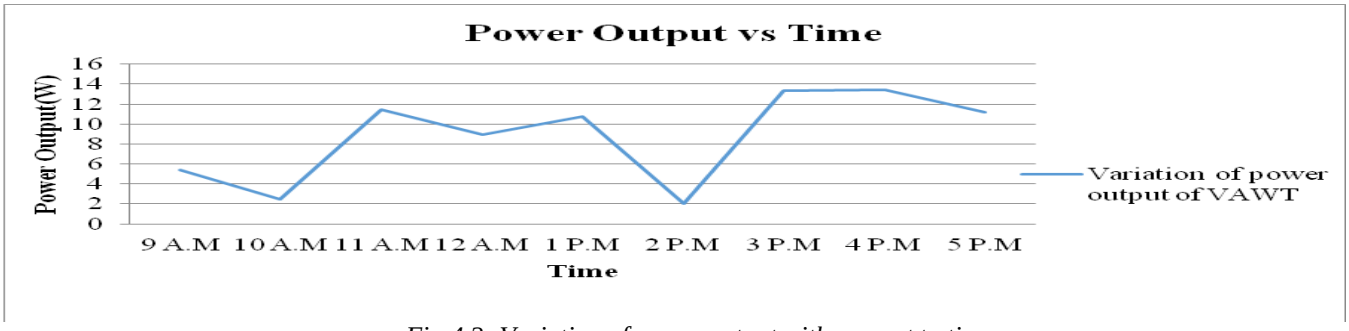


Fig.4.2: Variation of power output with respect to time

Figure 4.2 shows the variation of daily solar radiation. The nature of graph is zig-zag which shows the peak at time of 3 A.M, this because of the large designed speed of wind turbine rotor was noted at that time. At other time as there is various in wind speed the pattern of graph is not uniform is zig-zag.

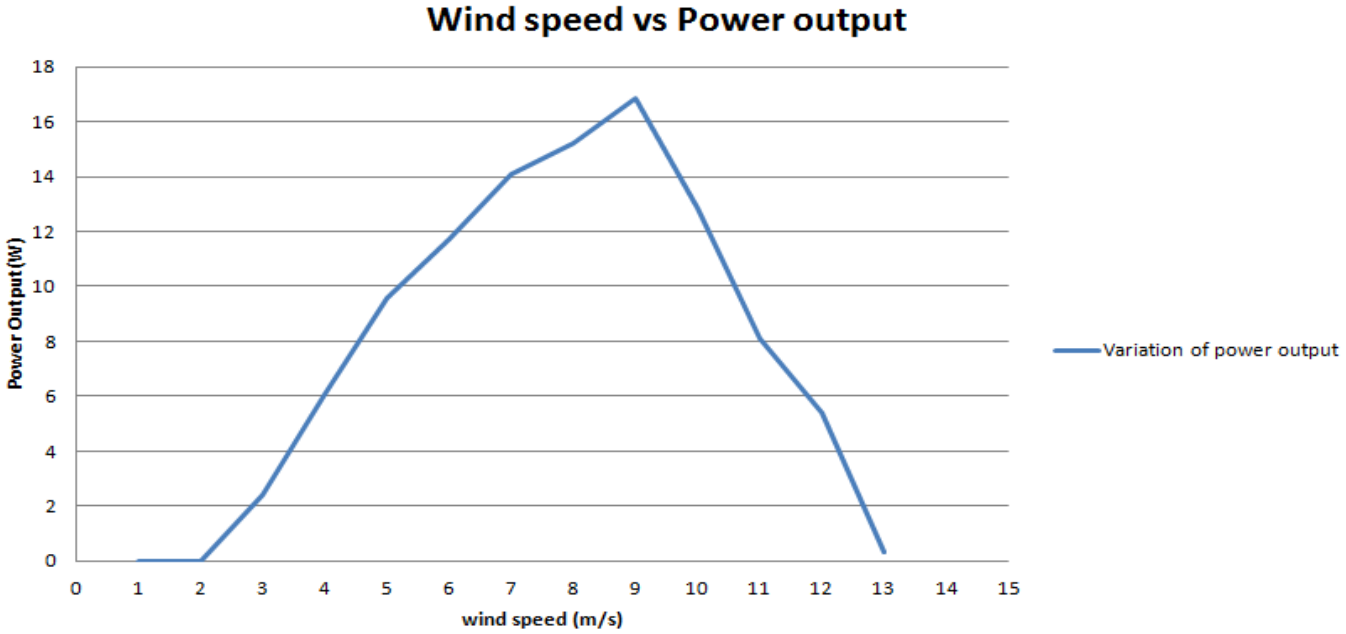


Fig.4.3 Wind speed Vs Power output

Fig.4.3 shows the variation of power developed by turbine rotor at variable wind speed. The nature of graph is dome shape as the particular value the power developed is at the peak this speed is the designed speed of the turbine and after that speed the power developed reduces as there is miss balancing of the turbine rotor and rated power cannot be developed thereafter.

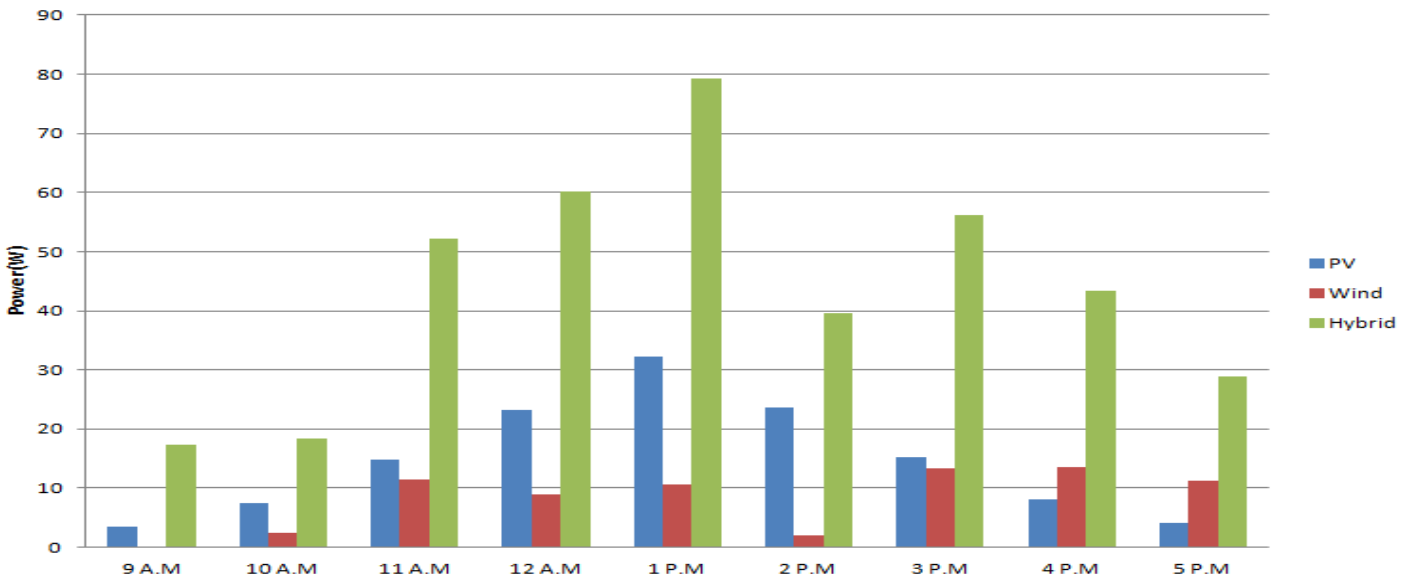


Fig.4.4:Comparison of Power output for Hybrid and Individual systems

Above graph 4.4 shows the variation of power output produced by single pv, single wind turbine and Hybrid system, the bar chart shows that the power output produced by the hybrid system at every time is more than the both individually hence the hybrid system is more efficient than the stand alone system of them individually.

V. CONCLUSIONS

The main idea of combining the two types of systems together was to try to archive a constant power production, which would be available most of the time. Our hybrid system is capable of producing.maximum power output of 79.16W However, the purpose of this system was not to power a house or any large system, our main goal was to provide a power solution for remote areas that are not fitted with an electric distribution system. These types of systems are known today as remote area power supply (RAPS) which can be very useful in many locations around the globe. The capacity to generate this much power can be lifesaving in many situations. Our final product turned out to be a successes and the greatest feature of our design is the portability of the system. All the components can easily be disassembled into small pieces, facilitating transportation, and reassembly just as easily in any location where there is some wind/sun. This process of reassembling the unit is not only fairly easy, but it also does not require advanced technical knowledge. According to our calculations and testing results, this hybrid system is fully functional, safe and efficient.

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