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Design and Fabrication of Solar Windmill

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Abstract

In recent era, research and development activities in the field of renewable energy, especially wind and solar, have been considerably increased, due to the worldwide energy crisis and high global emission. Wind turbines & Solar are becoming popular in the renewable energy world. The design of hybrid electricity generation system by utilizing both solar and wind renewable energy to the domestic household in the remote area and for many applications like beside railway tracks, railway stations, highways for power generation, and for charging of electrical vehicle. The primary goal of the project is to design and create a compact wind turbine and solar panel to be used as an efficient way to generate electricity anywhere. It is not possible to operate a horizontal axis wind turbine for domestic use. Because it can function in low wind conditions as well, the Savonius vertical axis wind turbine may be a preferable option. According to tests, hybrid systems are the best option for supplying "high quality" power.

Keywords: Savonius vertical axis wind turbine, solar panel, hybrid power generation…

1. Introduction

Any nation's development depends greatly on its access to energy. It is a crucial component of a nation's economic development. Coal, oil, and natural gas are our main energy generators.

Energy is necessary for industrial, agricultural, commercial, and domestic purposes, as we all know. The need for energy in the world is rising daily. Energy can be produced from coal, fossil fuels, oil, and other gases in a variety of ways. However, since each of these sources is bad for the environment, there are restrictions on their use.

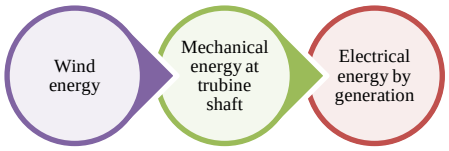
Then, we can choose among sources of sustainable energy like solar, wind, small hydro, biomass, and biofuel, among others. There is a great deal of potential for renewable energy to meet energy demand.

Because preserving natural resources is the fundamental goal, systems should be put in place to prevent global warming and carbon emissions. The nation will save money by generating electricity from renewable sources rather than coal or other fossil fuels. It is anticipated that using this renewable resource to produce energy will lower CO2 emissions.

There are several renewable energy sources, as was already mentioned, but wind and solar energy are the most common. because it is a well-known energy source and is frequently used everywhere.

1.1WIND ENERGY

Wind Energy is a renewable source of Energy. The extraction of power from wind is done with the help of modern turbines and energy conversion systems are used in converting the wind energy into electricity.
Energy chains of WIND ENERGY is as follows:



Classifications of windmills:
These are classified into 2 types according to the axis of rotation as.
1.Horizontal axis windmill
These horizontal axis windmills are further classified as follows.

- Multiblade type.
- Sail type
- Propeller type
- Dutch type

2.Vertical axis windmill
The vertical axis windmills are further classified as follows.

1. Savonius type
2. Dutch type

In this we are mainly focusing on Savonius type vertical axis windmill. And also, Savonius vertical axis wind turbine can be a better option as it operates in low wind condition also.

SAVONIUS TYPE VERTICAL AXIS WINDMILL:
TheSavonius wind consists essentially of a hollow circular cylinder sliced in half and halves are mounted on vertical axis. The blades of Savonius type windmill are in S shape.it forms S shape due to this Savonius type rotors are also called as S rotor and Savonius vertical axis wind turbine can be better option as it operates in low wind condition also.

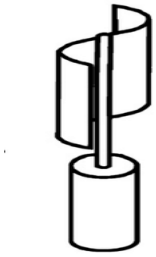


Fig-1.1: Savonius

1.2 SOLAR ENERGY

Solar energy is the energy that the sun provides to the earth's surface. One of the main sources of renewable energy, solar energy is used in a variety of devices and processes, including solar power generation, solar water heating, solar calculators, solar chargers, solar lamps, and more. Utilizing solar energy for the development of electric power has a number of benefits, including reduced pollution and affordable power generation. A solar power system is made up of three main components.

- Solar photovoltaic cells
- batteries for energy storage
- solar panels are all examples of renewable energy sources.

Solar-generated electricity (DC power) can be utilized to power AC loads through inverters, store it in batteries, or power DC loads directly.
The electric power generated by solar panels is measured in Watts or Kilowatts.
These photovoltaic cells are made with a variety of output ratings, including 5, 10, 20, and 100 watts. So, we may select a suitable solar panel based on the output power needed.

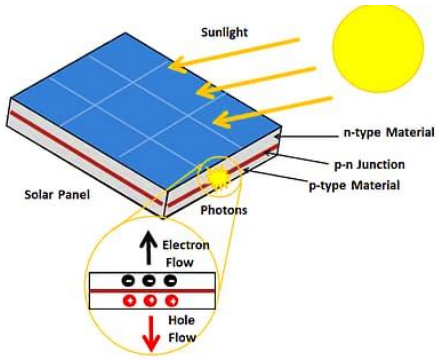


Fig-1.2: Solar Panel

For effective use, it is crucial to plan the placement of the solar panels on the roof, which are normally set up so that they face the East at a 45-degree angle.

2. DESIGN

The design process of solar windmill has been done using AUTO CAD software.

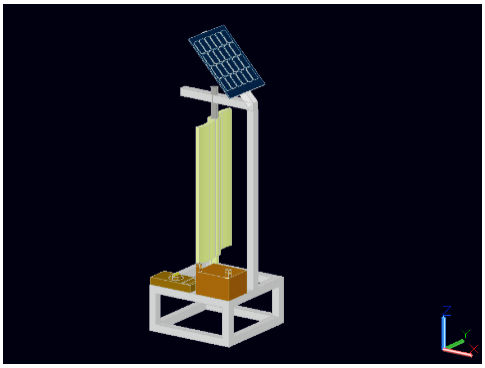


Fig-2.1: Overall Design

The following are the parts of solar wind mill.
LIST OF PARTS:

1. BASE

2. FRAME
3. BLADES
4. SOLAR PANEL
5. DYNAMO
6. MULTIMETER
7. BATTERY

1. BASE: The base is the bottom part in the assembly in which multimeter and battery are placed and it supports the complete assembly. It is of 60cm*60cm (dimension). This part is made of mild steels bars.

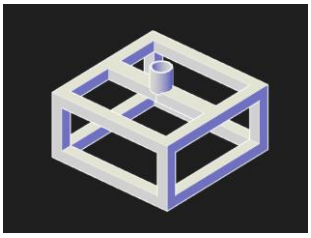


Fig-2.2: Base

2.FRAME:

The frame part is welded on the base. Which is of 143 cm height and 60 cm length. It is made up of mild steel bar. And also a 45 degrees inclined bar is welded on top of it in order to mount the solar panel on it which is of 30cm.

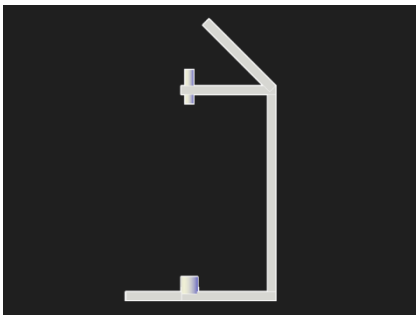


Fig-2.3: Frame

3.BLADE: This is a blade of savonius type. Which is made up of galvanised iron sheet. It is 3mm in thickness ,42 cm diameter, 88cm height. We have done brassing process on top and bottom of blade in order to hold the shaft.

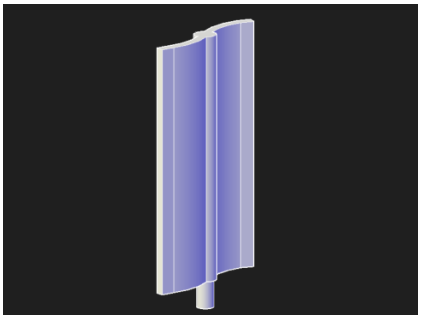


Fig-2.4: Blade

4. SOLAR PANEL: Solar panel is a device which is used to absorb the sun rays and convert it into electrical energy. It is actually a collection of photovoltaic cells. It screwed on the bar of 45 degrees. which is welded at top most part of the frame. The solar panel is of 12volts, and it's of 30×30cm ratio.

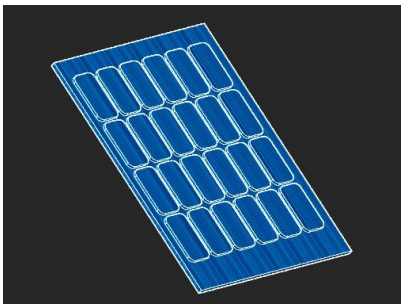


Fig-2.5: Solar Panel

5. DYNAMO: This is located at the bottom of the blade which is connected to the shaft which helps in power transmission. This is of 12v. The highlighted part consists of a small gear mechanism. This acts as a generator which helps in converting mechanical energy into electrical energy.

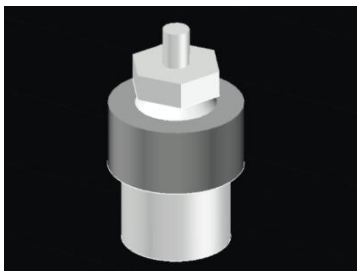


Fig-2.6: Dynamo

6. MULTIMETER Multimeter is device which is used to show voltage. It is located on the base.

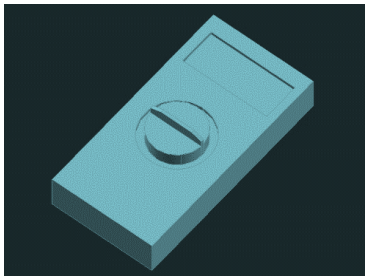


Fig-2.7: Multimeter

7. BATTERY:

Battery is a device which is used to store energy which is received from dynamo and solar panel. This is mounted on the base. It gets direct current (dc) and it is of 6v

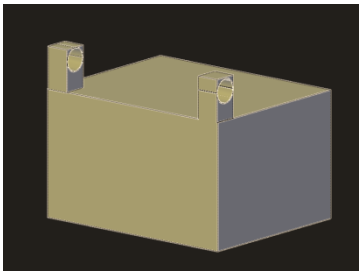


Fig2.8: Battery

3.CALCULATIONS AND RESULTS:

FORMULAS: FOR WINDMILL.

1. SWEPT AREA=DIAMETER×HEIGHT
    - Let diameter of the blade is 42cm.
    - Height of the blade is 88cm.
    - The thickness of the blade is 3mm.

Therefore, the area of the blade is =0.42×0.88m =0.3696m^2.

2. SPEED

The speed of a wind turbine can be calculated using the following formula:
Turbine speed (N) (in rpm) = (wind speed x 60) / (2 x π x blade length)

3.POWER PRODUCED

The power produced by a wind turbine can be calculated using the following formula:

Power (in watts) = 0.5 x rho x A x Cp x V^3
rho: air density in kilograms per cubic meter(kg/m^3)
A: area swept by the rotor blades in square meters(m^2)
Cp: is the power coefficient.
V: wind speed in meters per second (m/s)

S.NO	WIND SPEED	RPM	VOLTAGE
1	4.5	48	6.18
2	5	54	8.4
3	5.7	61	12.5
4	6	65	14.6
5	6.5	70	18.6
6	7	75	23.2

Table-3.1 For Wind Energy

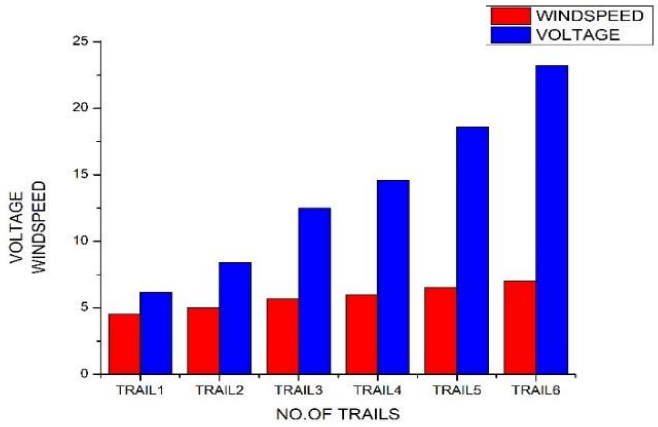


Chart-3.1

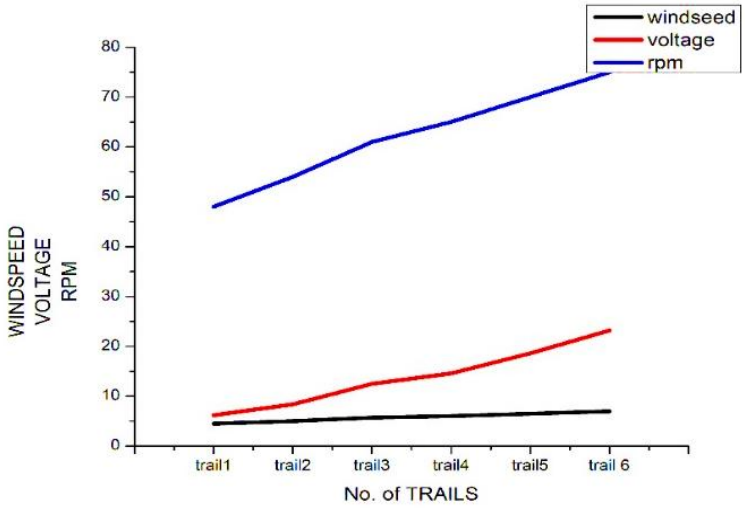


Chart-3.2

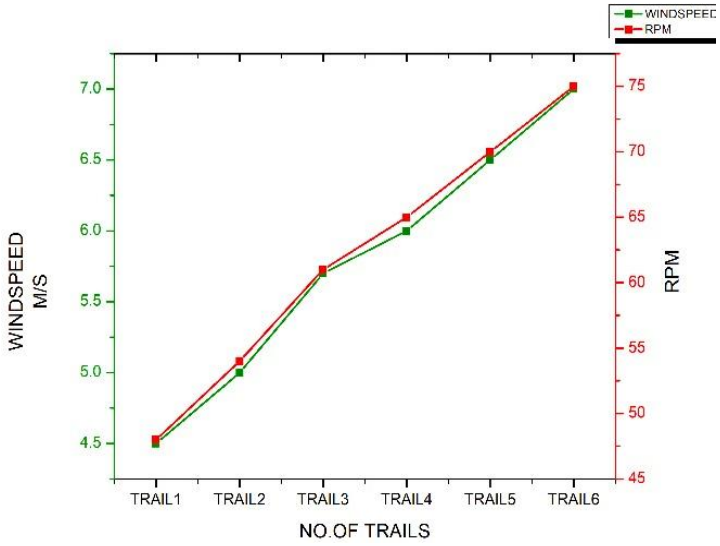


Chart-3.3

S.no	TIME	VOLTAGE
1	8:00 a.m.	10V
2	10:00 a.m.	15.46V
3	12:00 p.m.	19.65
4	14:00 p.m.	19.34V
5	17:00 p.m.	14.62V
6	20:00 p.m.	0.0V

Table-3.2 For Solar Energy

Fig-3.1 Complete Assembly

4. FUTURE SCOPE

In recent times, the existing sources of energy such as coal, oils, uranium (non-renewable energy sources) etc., may not be adequate to meet the increasing energy demand, due to the worldwide energy crisis and high global emission.

And they are getting exhausted day-by-day. As if there is a requirement, we are transporting them from various parts of the world, and they are expensive.

And they are increasing the pollution rate as well.

The design of hybrid electricity generation system (solar -wind mill) by utilizing both solar and wind renewable energy. Which are available all over the world that without causing or increasing the pollution rate will help in minimizing the utilization of such materials.

And useful to the present & future situation.

APPLICATIONS

- Railway stations
- Beside Railway tracks

- Highways
- Colleges
- For charging electrical vehicles etc....

5. CONCLUSION

In conclusion, hybrid power generation systems using solar and wind energy sources offer a reliable and efficient way to generate renewable energy. These systems combine the strengths of both solar and wind technologies to provide a stable source of electricity while addressing the intermittent nature of these energy sources through battery storage. The future scope of hybrid power generation systems looks promising, with potential advancements in technology leading to increased efficiency, improved energy storage, integration with smart grids, and reduced costs. As the demand for renewable energy continues to increase, hybrid power generation systems can play an important role in providing sustainable and reliable electricity for households, businesses, and communities around the world.

6. ACKNOWLEDGEMENT

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7. REFERENCES

1. R. Karthikeyan, S. Iniyan, and P. Goel, "A review of hybrid solar-wind power generation systems," Renewable and Sustainable Energy Reviews, vol. 11, no. 8, pp. 1417-1431, 2007.
2. J. R. Sharma and S. K. Singh, "A review on wind-solar hybrid power generation systems," Renewable and Sustainable Energy Reviews, vol. 58, pp. 180-188, 2016.
3. Gupta, A. Garg, and N. N. Sharma, "Review of hybrid solar-wind power generation system," Renewable and Sustainable Energy Reviews, vol. 38, pp. 460-470, 2014.
4. H. Wang, Y. Wang, Y. Yan, and M. Guo, "A review of hybrid solar-wind power generation systems for renewable energy utilization," Renewable and Sustainable Energy Reviews, vol. 82, pp. 2972-2985, 2018.
5. M. Kumar and R. Kumar, "A review on solar and wind energy for hybrid power generation system," International Journal of Emerging Technology and Advanced Engineering, vol. 3, no. 11, pp. 267-272, 2013.
6. Kumar and V. Pandey, "Hybrid power generation system using wind and solar energy: a review," Renewable and Sustainable Energy Reviews, vol. 58, pp. 23-33, 2016.
7. S. Singh and S. Pant, "A review of hybrid solar-wind power generation system," Renewable and Sustainable Energy Reviews, vol. 33, pp. 299-313, 2014.
8. R. K. Singh, M. Srivastava, and S. K. Singh, "Review on hybrid solar wind power generation system," International Journal of Engineering Research and Development, vol. 11, no. 11, pp. 42-49, 2015.
9. H. Y. Kuswanto, A. F. A. I. Dahlan, and F. F. Noor, "Hybrid solar-wind power generation: a review," Renewable and Sustainable Energy Reviews, vol. 45, pp. 431-446, 2015.

10. S. S. Mastino, L. H. P. Andrade, and M. P. Cerqueira-Neto, "A review on the development of hybrid wind-solar power generation systems," Renewable and Sustainable Energy Reviews, vol. 77, pp. 855-871, 2017.
11. H. Song and B. Y. Lee, "Review of recent trends in optimization techniques for solar-wind hybrid renewable energy systems," Applied Energy, vol. 179, pp. 1321-1333, 2016.
12. T. H. A. El-Fergany, "A review on the development of hybrid solar-wind power systems with energy storage systems for off-grid applications," Renewable and Sustainable Energy Reviews, vol. 80, pp. 1030-1048, 2017.
13. J. Wu, B. Zhang, Y. Gao, and F. Wang, "Review of solar-wind hybrid power generation system technology and its application prospect," Journal of Cleaner Production, vol. 208, pp. 1181-1191, 2019.
14. O. Raji, I. O. Ibrahim, and A. A. Yusuf, "Design and performance analysis of a hybrid solar-wind power generation system: a review," International Journal of Energy and Environmental Engineering, vol. 11, no. 3, pp. 319-338, 2020.
15. V. Sharma, S. S. Rathore, and S. Kumar, "A review on solar-wind hybrid power generation system with converter topologies," Journal of Renewable Energy, vol. 2019, Article ID 3852037, 25 pages, 2019.