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Design and Analysis of Household Wind Turbine With Multi stage Generator

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Abstract— Renewable energy generation in the urban environment has been receiving an increased attention o zver recent years due to the proximity with the point of use. Building integrated wind turbines are an interesting option in this respect. This paper focuses on how efficiently a household wind turbine can be made to utilize the power of free wind for electrical energy generation. This project produces an exploration of a Savonius rotor (S-rotor) wind turbine adapted for household/domestic electricity generation. The design and justification of the new machine will be described.
Keywords— VAWT, Savonius, Multi stage generator, Household, Wind Turbine

I. INTRODUCTION

This project produces an investigational exploration of a Savonius rotor wind turbine adapted for household electricity generation. The innovative technology turbine collects wind energy and converts it into electricity, which in turn produces a output which is used to charge one heavy duty battery. As a result, the home is served simultaneously by the wind turbine and the utility. In this study, a small electricity generator has been specifically designed for household installation. The generator (alternator) is driven by a modified Savonius rotor. This type of rotor (which is of the vertical axis variety) is chosen instead of a horizontal axis machine due to its simplicity and reliability. The concept is to let homeowners generate their own clean power, thereby reducing Carbon Dioxide emissions. In addition, by putting the wind to work, the household electricity bill should be decreased. The Savonius turbine has been overlooked in the past for small household applications. However, this paper indicates that the design could be very useful for reducing fossil fuel energy consumption within the home.

A. Energy Scenario

Coal has been the fastest-growing global source of energy, meeting 47% of new electricity demand. People are interested for introducing carbon capture and storage (CCS) technology to meet the climate change goals by 2020, which hardly seems feasible. That is why, in recent years more emphasis has been given on the clean energy. Biofuels have shown a steady growth; however, only represent 3% of global road transport fuel consumption. Solar and wind power are the fast growing sectors in the renewable energy field. Wind power has experienced dramatic growth over the last decade. The global installed capacity of wind energy at the end of 2010 was around 194 GW, a 17 GW increase from the year 2000.

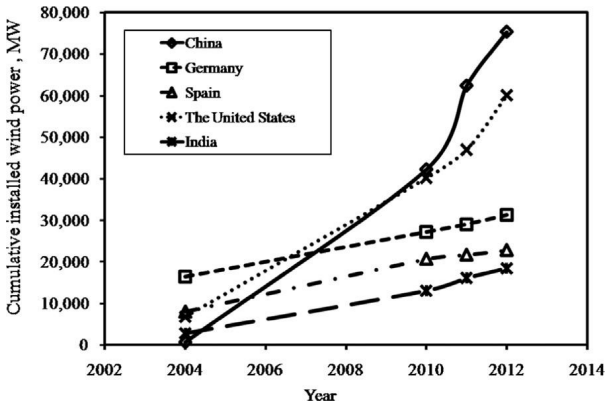


Fig. 1. Total installed wind power for several countries in the world.

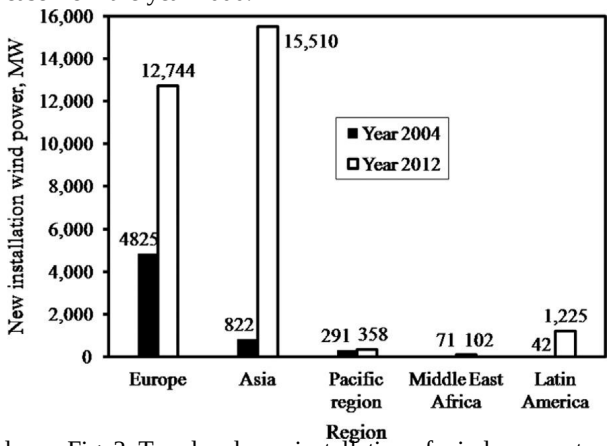


Fig. 2. Trend and new installation of wind power at several regions in the world.

B. Orientation of Wind Turbine

Turbines can be categorized into two overarching classes based on the orientation of the rotor. Horizontal axis wind turbine and vertical axis wind turbine. Horizontal axis wind turbine is mostly use for large scale production.

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Fig.3 Vertical Axis (VAWT)



Fig.4 Horizontal Axis (HAWT)

II. HOUSEHOLD MODEL

A. *Turbine Rotor*

In vertical axis wind turbine (VAWT), various types of rotor are used. The mainly used are Darrius type and Savonius type.

1) The darrius type blades have low solidity and aerofoil shape but more efficient than savonius rotor. But, their construction is complicated.
2) On the other hand, the savonius blades have high solidity, cup shapes are push by wind. Construction of savonius blade is very simple and reliable. Hence, this rotor is preferable. A Finish engineer Savonius introduced the Savonius rotor in 1920s. He has reformed the design of Flettener's rotor by dividing a cylinder into half, along its central axis and relocating the two semi-cylindrical surfaces sideways. These type of rotors may be of two, three or higher bladed systems and can be used in single- or multi-staged arrangements. The working principle is based on the difference of the drag force between the convex and the concave parts of the rotor blades when they rotate around a vertical shaft.

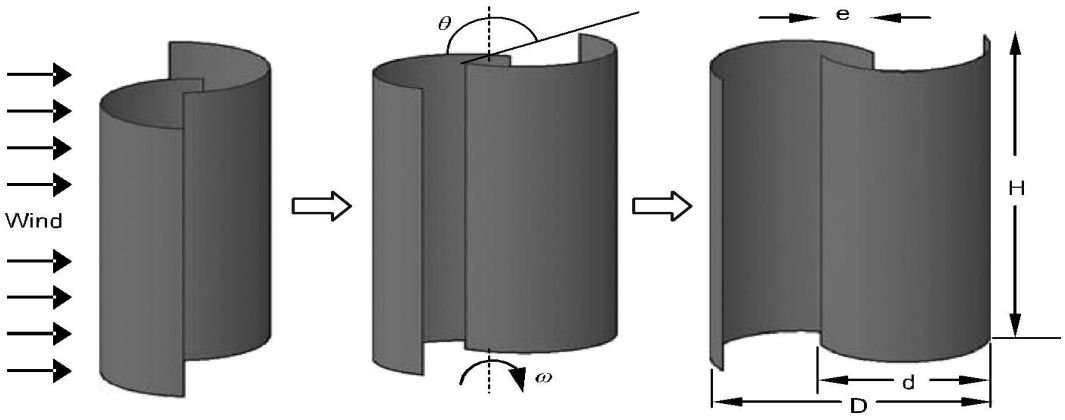


Fig.5. Rotor at different angular Schematic diagram of a two-bladed Savonius positions.

B. *Multi stage Generator*

1) *Alternator:* Motorcycles have an RFPM machine which is the alternator, to convert motor power into electricity to supply its lights and electronic parts such as displays. For VAWT it is always better to use a light generator because of the fact that it needs to be rotate totally. Increasing weight increases the necessary wind speed required to self start, due to higher inertia. Motorcycle alternators are built with a very strong structure designed for the occurrence of high vibrations

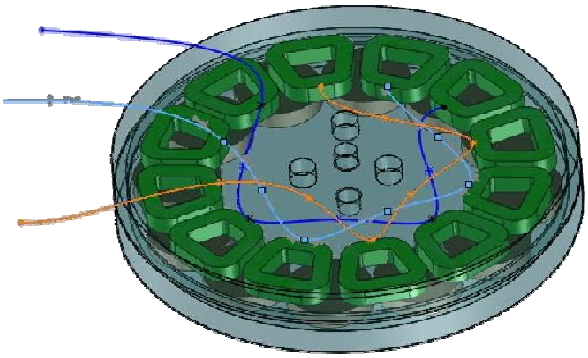
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and dynamic forces of the motorcycles.

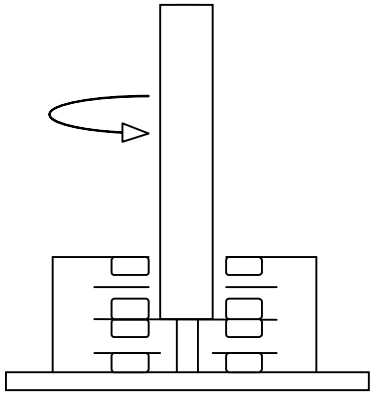


Fig. 6 ROYAL Enfield 3 wire - 6 volts Alternator

2) *Permanent magnet generator:* Based on the faradays law of electricity generation. The concept of multi stage generator is incorporating in this project. The permanent magnet generator, which is the handmade generator with the use of magnets, coils and connection wires of the required specification and numbers.Fig.7 shows the three phase connection of the 12 coils. It is designed when there is a special requirement of power or space. If this arrangement gets doubled then it will produce nearly twice power with same size of rotor.



3 phase handmade connection



Block diagram of multi stage generator

Fig.7 Generator arrangement

III.SOFTWARE TOOLS

As in market nowadays top CAD tools are available like Proe, Creo, Solid works, Solid edge, Catia.etc And analysis software like ansys, hypermesh, nastran etc. Implementing two of this is use for design and analysis purpose.Instead of going directly to the manufacturing it is better to use available sources.

A. Design

Latest CAD software Creo is use for designing the parts and making its assembly. This gives the mistake proof and errorless design.

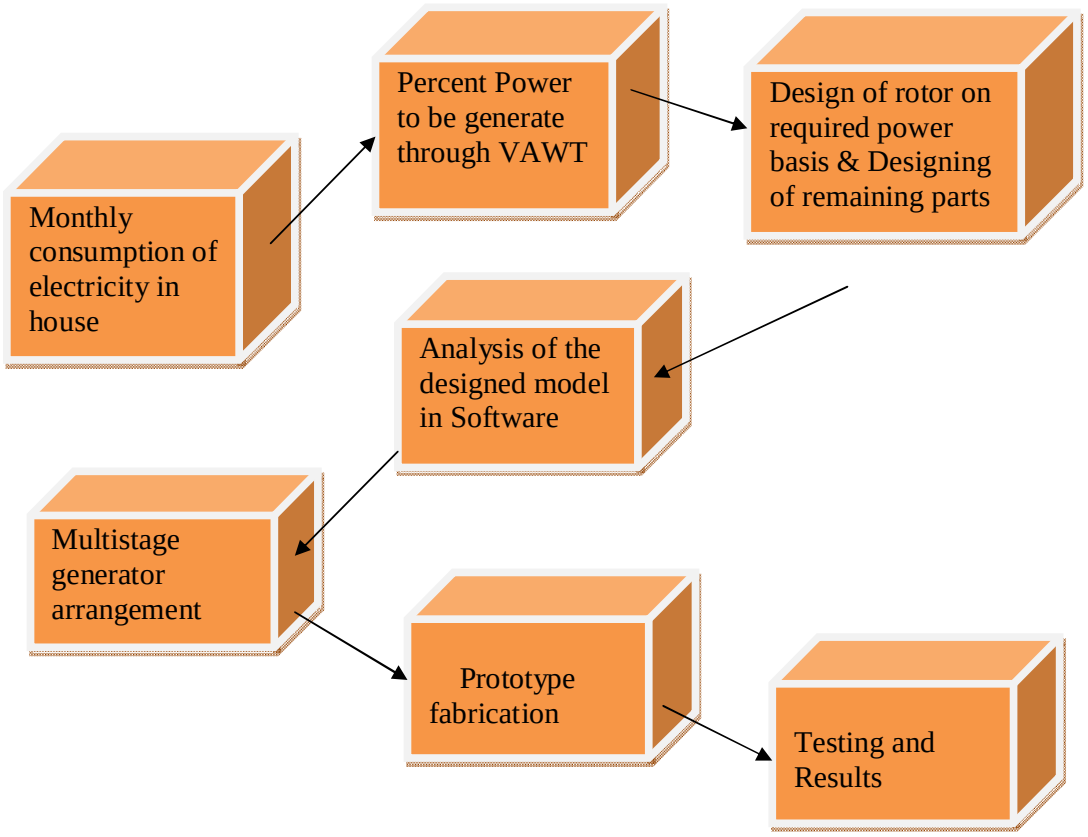
B. Analysis

Ansys is the analysis software.Various type of analysis such as stress,strain,bending etc. are accurately done with this tool.

IV.METHEDOLOGY

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V. CONCLUSION

Vertical axis wind turbine offer economically viable energy solution for remote areas away from the integrated grid systems. In order to spread the use of VAWT, the problems associated with various configurations, i.e. poor self-starting and low initial torque, low coefficient of power, poor building integration should be over-come. Furthermore, following conclusions can be drawn from the present review:

1) Efficient design of turbine set up can beastly utilize the ample wind energy potential available in the world.
2) At least 10 percent of power requirement of the consumer should be fulfilling by this.
3) The concept of multi stage generator can give nearly double power with same size of rotor.
4) It can be Alternative to the invertors which use the electric source to charge themselves.
5) Gear arrangement can be beneficial in case of low rpm, Due to varying wind conditions

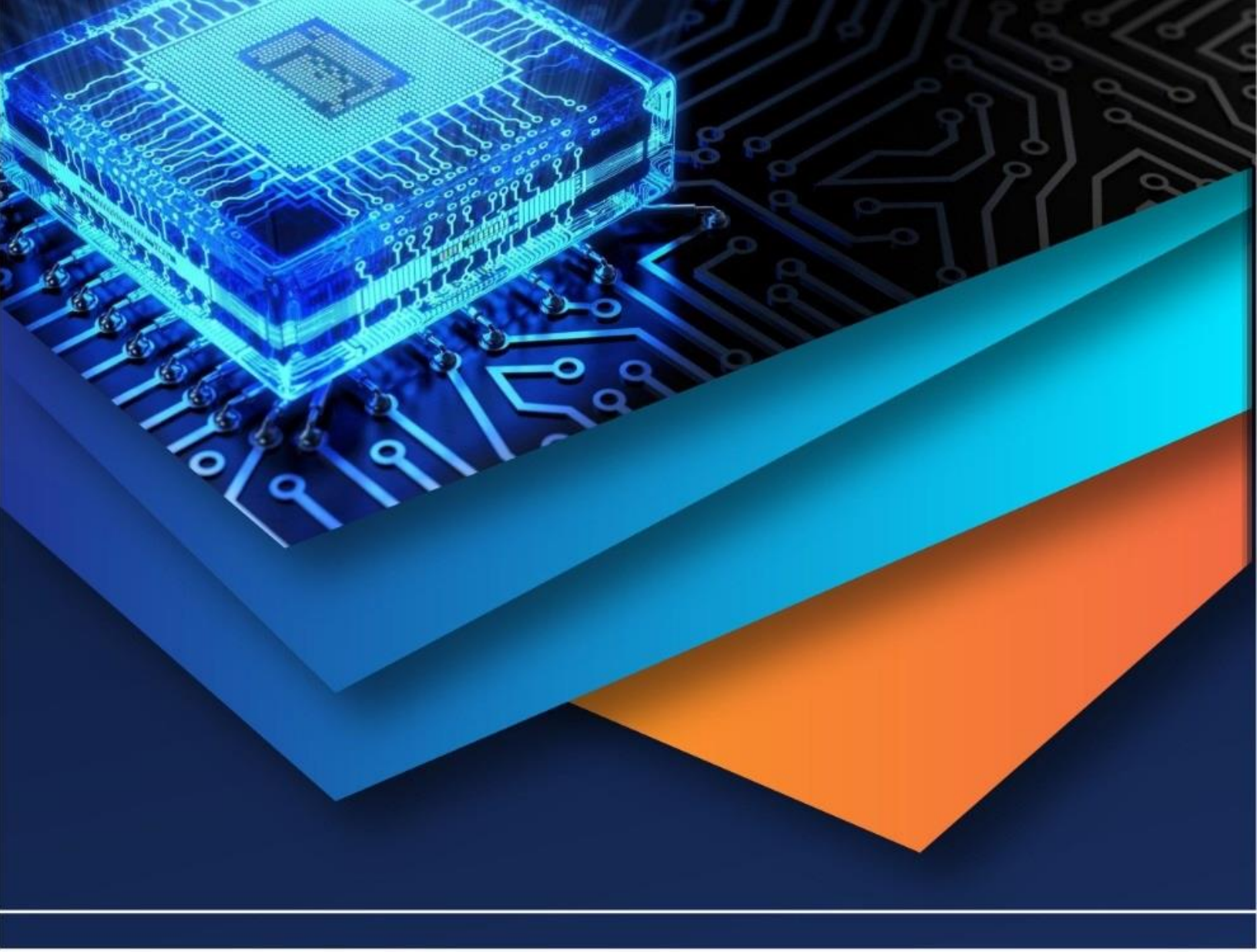
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