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Design and Analysis of Vertical Axis Wind Turbine with Multi-Stage Generator

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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. The horizontal axis wind turbine cannot be used for household purpose. So, Savonius vertical axis wind turbine can be better option as it operate in low wind condition also.The choice for this model is to showcase its efficiency in varying wind conditions as compared to the traditional horizontal axis wind turbine and contribute to its steady growing popularity for the purpose of mass utilization in the near future as a reliable source of power generation.*

KeyWords:Renewableenergy,VAWT,Savonius,Multi stage generator,Household,Handmade PM generator

1. INTRODUCTION

The use of wind turbines has risen rapidly in recent years because of the potential that they offer for carbon free power generation. Winds are usually unsteady with high levels of turbulence for significant proportions of the time, resulting in air flows characterized by rapid changes in speed and direction. It has been pointed out several times in the literature that vertical axis wind turbines (VAWTs) may be more appropriate for urban applications because of a number of distinct advantages it presents over the conventional horizontal axis wind turbines (HAWTs). 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. 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 known as multi stage generator has been specifically designed for household installation. The S-rotor has been designed using an analytical method and confirmed by natural wind testing.

Increasing demand in energy facilitated the need of clean energy such as wind energy. Residences, buildings and commercial sites needs more power, but also continuous power. Important facilities such as wireless or radio sets requires small amount of energy, but with a continuous supply. This study was done to investigate the design and development of the vertical axis wind turbines.

1.1. Present 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. Bio fuels 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. Achieving the goal to cut off global energy- related CO_2 emissions by 2050, requires a doubling (from today's levels) of renewable generation by 2020.

1.2. Classification of wind turbines

With the intention of using this abundant source of wind energy, various designs have been proposed till date. Depending on their axis of rotation wind turbines are mainly two types: horizontal axis wind turbine (HAWT) and vertical axis wind turbine (VAWT).

Table 1. Comparison of VAWT and HAWT

	Vertical Axis Wind Turbine (VAWT)	Horizontal Axis Wind Turbine (HAWT)
Tower sway	Small	Large
Yaw mechanism	No	Yes
Self-starting	No	Yes
Overall formation	Simple	Complex
Generator location	On ground	Not On ground
Height from ground	Small	Large
Blade's operation space	Small	Large
Noise produced	Less	Relatively high
Wind direction	Independent	Dependent
Obstruction for birds	Less	High
Ideal efficiency	More than 70%	50–60%

II- CONSTRUCTION

To make a design effective one should keep in mind that for which application it is designing. Small scale power generation unit needs a more compact design with the right calculations. The main parts of this wind turbine are the rotor and the generator.

2.1. Savonius rotor

The key feature of this rotor is its simpler design. 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. This shape is akin to "S" when viewed from top as shown in Fig. 1. 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 avertical shaft.

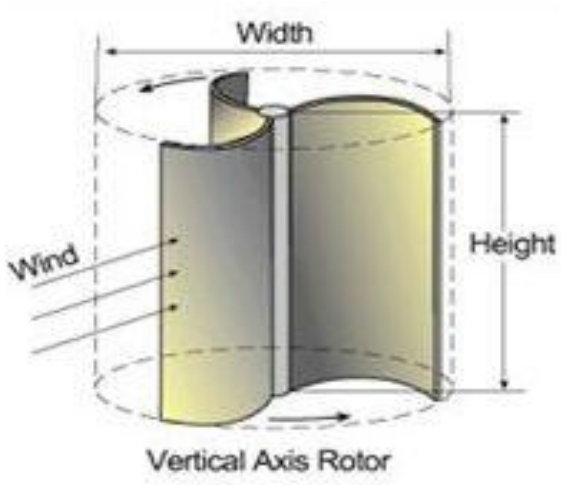


Fig1: Diagram of Savonius rotor

2.2. PM 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.2 shows the three phase connection of the 9 coils. It is designed when there is a special requirement of power or space.

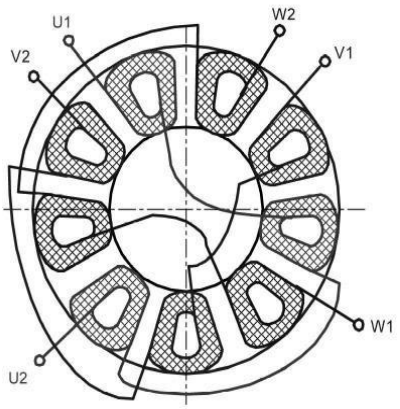
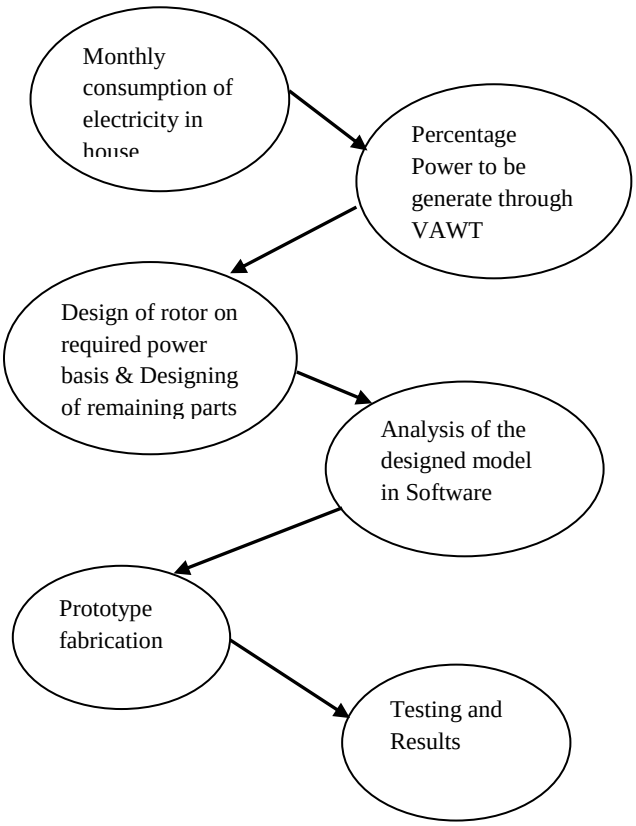


Fig.2: Handmade 3-phase connection of coils with block diagram of generator

2.3. Battery

It is very difficult to get the consistent supply of power through wind turbine. Hence, to utilize its generated power, the heavy duty battery will prefer to store that charge.

3. METHODOLOGY ROUTE



IV- 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 for design and analysis purpose.

4.1. Creo

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

4.2. Ansys

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

V- OBJECTIVE

- Understanding of wind power generation and basics of wind power conversion system
- Effect of obstacles on wind flow and optimal position of wind turbines on building and landscape
- Understanding effects of wind turbine on environment such as noise or vibrations
- Suggesting convenient impellers and generators for wind turbine
- Designing and testing of wind turbine for suggesting further development

5. CONCLUSION

The integration of wind energy converters into buildings, and here in particular into high-rise buildings, is a challenging problem which is still largely unsolved. Vertical axis wind turbine offer economically viable energy solution for remote areas away from the integrated grid systems. Instead of alternator, handmade generator can be helpful which can designed accordingly power requirement and space available. The multi stage generator can give double amount of power with the same size of rotor design. The designed model should be capable of giving 10% of electricity consume per hour. This can be act as an alternative to the inverters in the houses with the use of free wind energy.

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