Vertical Axis Wind Turbine with Charging System

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Abstract - The Fast growing renewable energy sector in India is Wind Energy which is vital for economic growth of the country and since independence India has worked on their resources on increasing its energy capacity. Keeping this point of view the project studied the feasibility for installing the vertical axis wind turbine (VAWT) system especially at roof top. The project is designed with several types of blades for getting the efficiency and checking the potential of the design at ground level. The Model made was of Savonius type and DC motor was used inversely with Savonius input connected to motor shaft and electrical output was taken from the terminals of the motor. The efficiency is quite low but it can be usable power generated from nothing and have therefore advantage over Horizontal axis wind turbine (HAWT) plus on the contrary this can work on low heights thus these turbines can be installed on individual houses for particular use. The energy produced makes the model a reliable source of continuous energy. This is a low-cost Vertical Axis turbine which is basically a test keeping development in view and the paper aimed to refine the design features and the fabrication techniques aim to make the device suitable for the household use. The paper content focuses on current India Scenario and potential of VAWT in India, advantages over HAWT keeping Indian Wind Energy industry, discussing its development and our project focus on harnessing this wind energy using a small axis wind turbine capable of working at low wind speed at low heights and has also checked the potential with 3 blade and 2 blade wind turbine with difference between them. The project considered the major drawback of wind generated power that is inconsistent power production caused by variability in wind conditions and low conversion efficiency and has therefore worked with the variability as the design has been found feasible and yielding continuous energy at different wind speed. The paper analysis with the research shown in this paper about combating the drawbacks to wind generated power. Further recommendations are made for further designs of VAWTs with test to be done.

1. INTRODUCTION

If the efficiency of a wind turbine is increased, then more power can be generated thus decreasing the need for expensive power generators that cause pollution. This would also reduce the cost of power for the common people. The wind is literally there for the taking and doesn't cost any money. Power can be generated and stored by a wind turbine with little or no pollution. If the efficiency of the common wind turbine is improved and widespread, the common people can cut back on their power costs immensely.

Ever since the Seventh Century people have been utilizing the wind to make their lives easier. The whole concept of windmills originated in Persia. The Persians originally used the wind to irrigate farm land, crush grain and milling. This is probably where the term windmill came from.

The recent surge in fossil fuels prices, demands for cleaner energy sources, and government funding incentives, wind turbines are becoming a more viable technology for electrical power generation. Fortunately there is an abundance of wind energy to be harnessed. Currently, horizontal axis wind turbines (HAWT) dominate commercially over vertical axis wind turbines (VAWT). However, VAWT do have some advantages over HAWT. The main objective of our work is to improve the output of the wind power generation produce electric power using vertical axis wind turbine, Currently, horizontal axis wind turbines (HAWT) dominate the wind Energy market due to their large size and high power generation characteristics. However, vertical axis wind turbines (VAWT) are capable of producing a lot of power. The mechanical power generation equipment can be located at ground level, which makes for easy maintenance.

Most modern windmills have 5-6 blades while past windmills have had 4~8 blades. Past windmill also had to be manually directed into the wind, while modern windmills can be automatically turned into the wind. The sail design and materials used to create them have also changed over the years.

In most cases the altitude of the rotor is directly proportional to its efficiency. As a matter of fact, a modern wind turbine should be at least twenty feet above and three hundred feet away from an obstruction, though it is even more ideal for it to be thirty feet above and five hundred feet away from any obstruction.

2. SYSTEM MODEL

3. PROPOSED METHODOLOGY

*** Experiment set up and working**

Table 2.1 Specifications of the wind turbine

Blade Dimensions	Shaft Dimensions	Turbine Dimensions
Height - 20 inch	Diameter – 1.18 inch	Diameter – 25 inch
Diameter- 4 inch	Length – 22.83 inch	Height – 30 inch
Thickness - 0.08 inches		Pulley Diameter- 2.5 inch
Angle between blades – 51.42°		Wheel Diameter – 20 inch

➢ **Design of Assembly**

The components of the full-scale VAWT are Base, Blades, Shaft, Bearings, Pulley and Rope, Dynamo and Battery.

➢ **Design of Base**

In this project there is a base which is made up of wooden material and can withstand large force of wind. The base & its height are related to cost and transmission system incorporated. So the height of base is 18mm & breadth is 14 inch & length is 14 inch.

➢ **Design of Blade**

Wind turbine blades have curved shaped cross-section design. While designing the size of blade it is must to know the weight and cost of blades in the project. Seven blades with vertical shaft are used; it has a height & diameter of 20 inch &2.5 inches respectively. The angle between two blades is 51.42°. So if one Blade moves then other blade comes in the position of first blade, so the speed increases.

➢ **Shaft Designing**

The shaft should be perfectly fitted with the wheels and blades. The shaft should be as less as possible in thickness & light in weight, to avoid problem of slipping & fraction created. Length of shaft & diameter are22.83 inch & 1.18inch respectively. The Shaft is made up of Galvanized Iron (G.I).

➢ **Design of Bearing**

Design of Bearing For the smooth operation of Shaft, bearing

Mechanism is used. To have very less friction loss the two ends of shaft are pivoted into the same dimension bearing. The Bearing has diameter of 1.377inches. Bearing are generally provided for supporting the shaft and smooth operation of shaft. Grease is used for bearing maintenance.

➢ **Designing of pulley**

Designing of Pulley the speed ratio between two pulleys is 0.125, i.e., in one revolution of rim/wheel, the pulley completes 8 revolutions, so the speed can increase considerably. Also the pulley should have light in weight, so no consumption of power will take place in revolving. For the project, the dimension of rim/wheel is 20 inch and for pulley required is 2.5inch. So in one revolution of rim/wheel, the pulley completes 8 revolutions. It is made up of mild steel. It should be properly attached to the shaft of blades. So no friction will take place. The thickness of pulley is 1.25 cm. For the driving purpose, rope is used, which is placed in these two pulleys.

- **Dynamo Specifications**

A dynamo is an electrical generator that produces direct current with the use of a commutator. A machine for converting mechanical energy into electrical energy, typically by means of rotating coils of copper wire in a magnetic field. Dynamos still have some uses in low power applications, particularly where low voltage DC is required, since an alternator with a semiconductor rectifier can be inefficient in these applications.

Hand cranked dynamos are used in clockwork radios, hand powered flashlights, mobile phone rechargers, and other human powered equipment to recharge batteries.

Dynamo used in this project is 12 Volts 1 Ampere, which runs at 500rpm.

- **Energy storage / battery**

The output of generator is given to the battery for electric energy storage purpose. We used the series combination of two 6 volt batteries with 5 ampere current so total capacity of the battery is up to 12 Volts 5 Amperes. Generally this battery is lead acid type battery and also restorable. The supply of generator is given to the battery through a diode.

Battery Power = 12x5= 60 Watts

Battery Charging time = Battery Power/Dynamo Power

= 60/12 => 5 hours (Ideal Condition)

Battery Discharging Time = Battery Power/Output Power

= 60/5 => 12 Hours (Ideal Condition)

- **Working of vertical axis wind turbine**

Vertical axis wind turbine (VAWT) has seven blades, in which the main rotor shaft runs vertically. These blades are wrapped around the wheel and are curved in shaped and the Dynamo is mounted on the base of the tower which is connected to the charging station. The charging station consists of 6v x2 series connected batteries, PCB (printed circuit board) and a switch. Dynamo coils rotate and convert mechanical energy into electrical energy which is send to charging port which includes resistor which ensures not more than 3V passes through it. When the switch is ON the charging system start working and batteries are inactive. When the switch is OFF, dynamo sends this electric power directly to batteries and hence batteries get charged. Battery is also connected to charging port which is fitted with diode. Diode ensures that the current only move from dynamo to the battery and not vice-versa. The charging board is made up of Medium Density Fiber (MDF). The output power generated by wind generator is measured by using multi-meter.

4. SIMULATION/EXPERIMENTAL RESULTS

The average natural wind speed to be 6 m/s. Density of air is 1.204 kg/m3.Turbine 0.635 m in diameter and 0.762 m in height, the power of the wind is given by,

Pw= ½ ρ A u3

Where,

Pw - power of the wind (W)

ρ - Air density (kg/m3)

A - Area of a segment of the wind being considered (m

U - Undisturbed wind speed (m/s)

A= D lb

Where,

A- Swept area (m2)

D-diameter of the turbine (m)

Lb- length of the turbine Blades (m)

Table-1: Observation Table

S. NO.	Speed (rpm)	Voltage (Volts)	Current (Ampere)	Power (Watts)
1.	30	4.39	1.86	8.16
2.	39	4.64	2.28	10.61
3.	48	5.73	2.28	13.06
4.	70	6.14	2.98	17.78
5.	97	7.16	3.64	26.39

5. CONCLUSION

Our work and the results obtained so far are very encouraging and reinforce the conviction that vertical axis wind energy conversion systems are practical and potentially very contributive to the production of clean renewable electricity from the wind even under less than ideal sitting conditions this project will be helpful in rural areas where the electricity supply is scarce. Also in most cities, bridges are a faster route for everyday commute and in need of constant lighting makes this an efficient way to produce energy.

6. FUTURE SCOPES

The efficiency can be increased by precise fabrication of prototype and also by designing the Blades of the turbine more aerodynamically and use simulation software like Solid works. The development of effective alternators and dynamos can be used to harness wind energy from relatively small winds.The use of materials like Acrylic Plastic Sheets can be used to develop low cost VAWT.

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