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Vertical Axis Wind Turbine and Its Applications for Highways

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ABSTRACT

Since the demand of power is increasing day by day and due to the depleting natural resources of fuel such as coal and petroleum there is need to find an alternative . Wind energy is a emerging sector in renewable energy resources since India has a high potential for the wind energy sector we can use the potential to generate energy and reducing our dependency on non renewable energy resources . The project focuses on harnessing the wind energy produced along the roadside due the movement of the vehicles on a roads and highways. For this we are using a vertical axis wind turbine since these turbine uses less space and can be installed along the roadside. The vertical axis wind turbines can produce energy even for low speed which makes it suitable for using it along the roadside. The energy produced by the turbine will be used for streetlighting making the streetlighting self sustaining by cutting their dependence on the grid.

Keywords: harnessing, grid

INTRODUCTION

Background Study

Energy is a hot topic in the news today increased consumption, increased cost, depleted natural resources, our dependence on foreign sources, and the impact on the environment and the danger of global warming.

Wind energy has great potential to lessen our dependence on traditional resources like oil, gas and coal without much damage to the environment.

India has a vast network of road and highways along with the street lights which consumes a lot of power for its operation, we can cut those consumption by generating power through wind energy.

By harnessing the wind energy produced by the movement of vehicles on the roads by using vertical axis wind turbine along the divider section and use it for street lighting and other use.

We can also generate some revenue by using the produced energy for running advertisement by using led bill boards

the most commonly used design of vertical axis wind turbine are classified into to types they are as follows

- darrieus wind turbine
- savonius wind turbine.

Although wind has been harnessed for centuries, it has only emerged as a major part of our energy solution quite recently. Before the 21st century, wind was primarily used to pump water from wells and to grind grain, but over the last twenty years the cost of wind energy has dropped by more than 80 percent, turning it into the most affordable form of clean energy. Recent advances have allowed for sophisticated wind technologies, which previously sat in the mind of thoughtful engineers and inventers, to be developed into cost-effective, reliable solutions.

For a small wind turbine to be effective, it must produce energy across a wide range of wind speeds. It must be able to generate energy from winds that are switching directions and gusting. It must also be very quiet, so that it will not disturb people living nearby, and it certainly helps if it is pleasing to the eye as well.

Wind power harnesses the power of the wind to propel the blades of wind turbines. These turbines cause the rotation of magnets, which creates electricity. Wind towers are usually built together on wind farms.

Objective

The main objective of the project is to develop a vertical axis wind turbine which can harness the wind energy and convert it into electrical energy. The electrical energy produced can be used for street lighting purpose which can lessen the dependence on grid, moreover the power generated is eco friendly which is much better for the environment as compared to the conventional source of energy such as coal and petroleum.

Nomenclature

VAWT- vertical axis wind turbine

2 Literature Survey

turbines operate on a simple principle. The energy in the wind turns two or three propeller-like blades around a rotor. The rotor Wind is connected to the main shaft, which spins a generator to create electricity.

Simply stated, a wind turbine works the opposite of a fan. Instead of using electricity to make wind, like a fan, wind turbines use wind to make electricity. The wind turns the blades, which spin a shaft, which is connected to a generator that produce electricity. Wind turbines are classified in to two groups. They are Vertical Axis Wind Turbine (VAWT) and Horizontal Axis Wind Turbine (HAWT).

A vertical-axis wind turbine (VAWT) is a type of wind turbine where the main rotor shaft is set transverse to the wind (but not necessarily vertically) while the main components are located at the base of the turbine. This arrangement allows the generator and gearbox to be located close to the ground, facilitating service and repair. VAWTs do not need to be pointed into the wind, which removes the need for wind-sensing and orientation mechanisms. (VAWT) are not widespread, but their simplicity and better performance in disturbed flow-fields, compared to small horizontal-axis wind turbines (HAWT) make them a good alternative for distributed generation devices in urban environment they are further classified into,

- Darrieus Wind Turbine Darrieus Wind Turbine are commonly known as an “Eggbeater” turbine. It was invented by Georges Darrieus in 1931. A Darrieus is a high speed, low torque machine suitable for generating alternating current (AC) electricity. Darrieus generally require manual push therefore some external power source to start turning as the starting torque is very low. Darrieus has two vertically oriented blades revolving around a vertical shaft.
- Savonius Wind Turbine: - Savonius vertical-axis wind turbine is a slow rotating, high torque machine with two or more scoops and are used in high-reliability low-efficiency power turbines. Most wind turbines use lift generated by air foil-shaped blades to drive a rotor, the Savonius uses drag and therefore cannot rotate faster than the approaching wind speed**.**

2.1 India’s Market Overview of Wind Energy

India has a vast supply of renewable energy resources. India has one of the world’s largest programs for deployment of renewable energy products and systems 3,700 MW from renewable energy sources installed. The data obtained from metallurgical department of India shows the potential power of wind energy distributed in different states of India.

States with strong potential	Potential MW	Installed MW
Andhra Pradesh	8285	93
Gujarat	9675	173
Karnataka	6620	124
Madhya Pradesh	5500	23
Maharashtra	3650	401
Orissa	1700	1
Rajasthan	5400	61
Tamil Nadu	3050	990
West Bengal	450	1

FIG 3 – potential wind energy in Ind

METHODOLOGY: -

Fabrication of vertical axis wind turbine consists of different parts which are needed to be fabricated as parts of main assembly these are: -

BASE:- Some base is stronger than others. Base is important in the construction of the windmill because not only do they have to support the windmill, but they must also be subject to their own weight and the drag of the wind. If a weak tower is subject to these elements, then it will surely collapse. Therefore, the base must be identical so as to insure a fair comparison.

FRAME:- it is the structure which attaches the alternator and rotating shaft of the turbine .

BLADES:- This is important because the length of the blade is directly proportional to the swept area. Larger blades have a greater swept area and thus catch more wind with each revolution. Because of this, they may also have more torque. we intend to use light aluminium material for blades.

ROTATING SHAFT:- this shaft helps to connect the rotors of the alternator and the wind turbine of the blades for the purpose of transferring the mechanical energy to the alternator.

GENERATOR:- An alternator is an electromechanical device that converts mechanical energy to electrical energy in the form of alternating current. Most alternators use a rotating magnetic field but linear alternators are occasionally used. In principle, any AC electrical generator can be called an alternator, but usually the word refers to small rotating machines driven by automotive and other internal combustion engines. Alternators in power stations driven by steam turbines are called turbo-alternator

WIND POWER CALCULATIONS: -

The wind mill works on the principle of converting kinetic energy of the wind to mechanical energy. The kinetic energy of any particle is equal to one half its mass times the square of its velocity, or ½ mv^2.

$$K.E = \frac{1}{2} mv^2 \quad \text{…………………….. (1)}$$

K.E = kinetic energy

m = mass

v = velocity,

M is equal to its Volume multiplied by its density ρ of air

$$M = \rho AV \quad \text{…………………….. (2)}$$

Substituting equ(2) in equ(1)

We get,.

$$K E = \frac{1}{2} \rho \, AV.V^2$$

$$K E = \frac{1}{2} \rho AV^3 \quad \text{watts}$$

ρ = density of air (1.225 kg/m^3)

$$A = \pi D^2/4 \quad (\text{Sq. m})$$

D = diameter of the blade

$$A = \pi*(1.22)^2/4$$

$$A = 1.16 \text{Sq.m}$$

Available wind power $Pa = (\frac{1}{2} \rho \, \pi D^2 V^3)/4$

$$P = 1/8 \rho \, \pi D^2 V^3 \quad \text{watt}$$

4. RESULTS

After the fabrication process, next step was testing the turbine performances, according to the testing results, we can get conclusion about its performance. In order to do that the height of the legs of the turbine were increased to make easier the RPM measuring and also to enhance the stability of the turbine. Initially the motor the wind was not quite enough but later the turbine started to rotate and speed gradually increased with time and wind flow .we connected the multimeter and put it in dc voltage configuration and checked the output voltage along with the rpm of the wind turbine. we took test for different time period the results are recorded and displayed

The results recorded during the testing of the turbine are given below in the table the values measured are output voltage and rpm of the turbine given below in the tabular column

SL.NO.	**SPEED OF THE TURBINE IN RPM**	**DC VOLTAGE OUTPUT MEASURED (volts)**
1	19	1.45 v
2	33	3.1 v
3	47	5.3 v
4	59	9.1 v
5	78	11.2 v
6	95	12.3 v

Conclusion

Our work and the results obtained so far are very encouraging and reinforces 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. We obtained a output dc voltage of 10-12v which is sufficient for charging a battery It is hoped that they may be constructed used high-strength, low- weight materials for deployment in more developed nations and settings or with very low tech local materials and local skills in less developed countries.

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