POWER GENERATION ON HIGHWAY USING VERTICAL AXISWIND TURBINE

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ABSTRACT: -

Energy is an important aspect in our every day's life. The rapid growth of renewable energy generation is increasing to meet the demand for electricity. Wind is a renewable energy source. The wind energy is maximum on the highway due to the speed of the vehicle. This project works on use of air on highway divider with the help vertical axis wind turbine. When the vehicle passed on the highway it produces a considerable amount of air due to its speed. This kinetic energy ofwind tangentially strikes on the blade of the vertical axis wind turbine (VAWT) and it makes a rotation of the turbine inonly one direction. The generator with the gear mechanism is connected to the shaft of the vertical axis wind turbine to generate electricity. The electrical output of vertical axis turbine is stored in a battery. This stored energy which can be further used for street lighting.

Keywords: - Generator; Battery, Vertical Axis Wind Turbine.

I. INTRODUCTION: -

This paper deals with the design and fabrication of a wind turbine. In this turbine converts windenergy into electrical energy. The electrical energy produced here is used to drive the home appliances. A wind turbine is a type of engine. It uses the wind to make energy. To do this it uses vanes called sails or blades. The energy made by wind turbine can be used in manyways.

These include grinding grain or spices, pumping water and sawing wood. Modern wind power machines are used to create electricity. These are called wind turbines. Before modern times, windmills were most commonly used to grind grain into flour. The windmill has been in history formany years. A wind turbine is a device that converts the wind's kinetic energy into electricalenergy. Wind turbines are manufactured in a wide range of vertical and horizontal axis types. The smallest turbines are used for applications such as battery charging for auxiliary power for boats or caravans orto power traffic warning signs. Slightly larger turbines can be used for making contributions to a domestic power supply while selling unused power back to the utility supplier via the electrical grid. Arrays of large turbines, known as windfarms, are becoming an increasingly important source of intermittent renewable energy and are used by many countries as part of a strategy to reduce their reliance on fossil fuels. An electrical generator is a machine which converts mechanical energy into electrical energy. Induced EMF is produced in itaccording to Faraday's law of electro magnetic induction. This EMF causes a current to flow if the conductor circuit is closed. An inverter is an electronic device or circuitry that changes Direct Current (DC) to Alternating Current (AC). The input voltage, output voltage and frequency, and overall power handling depend on the design of the specificdevice or circuitry. The inverter does not produce any power; the power is provided by the DC source. It just converts direct current into alternating current.

ABOUT WIND ENERGY

Wind is caused by the uneven heating of the atmosphere by the sun, variations in the earth's surface, and rotation of the earth. Mountains, bodies of water, and vegetation all influence wind flow patterns. Wind Turbines convert the energy in wind to electricity by rotating propeller-like blades around a rotor. The rotor turns the drive shaft, which turns an electric generator. Three key factors affect the amount of energy a turbine can harness from the wind: wind speed, air density, and swept area

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.

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

LITERATURE SURVEY

D.A. Nikam : analyzed the on design and development of vertical axis wind turbine blade. This paper explains that the windmill such as vertical and horizontal windmill is widely used for energy production. The horizontal wind millis highly used for large scale applications which require more space and huge investment. Whereas the vertical windmill is suitable for domestic application at low cost. The generation of electricity is affected by the geometry and orientation ofthe blade in the wind turbine. To optimize this by setting the proper parameter for the blade design. The experimental result indicates that the blade plays critical role in the performance and energy production of the turbine. The optimized blade parameter and its specification can improve the generation of electricity.

Altab Hossain : investigated the design and development of A 1/3 scale vertical axis wind turbine for electrical power generation. In this paper the electricity is produce from the windmill by wind power and belt power transmission system.The blade and drag devices are designed in the ratio of 1:3 to the wind turbine. The experiment is conducted by different wind speed and the power produced by the windmill is calculated. The experimental result indicates that 567 W power produced at the speed of 20 m/s while 709 W power produced at the speed of 25 m/s. From this, the power production wills increases when the velocity is high.

M. Abid : analyzed the design, development and testing of a savonius and darrieus vertical axis wind turbine. This paper shows that vertical axis windmill is more efficient when compared to horizontal axis wind mill. The darrieus turbine consists of 3 blades which can start alone at low windspeed. When savonius turbine is attached on the top of existing windmill which provide the self-start at low wind speed. The result indicates that the darrieus vertical axis wind turbine acts as a self-starter during the testing. The function required the starting mechanism which can be provided bythe combination of NACA 0030 aero foil and savonius turbine. The high blade thickness of the NACA 0030 aerofoil will improves the self-starting capability of the turbine.

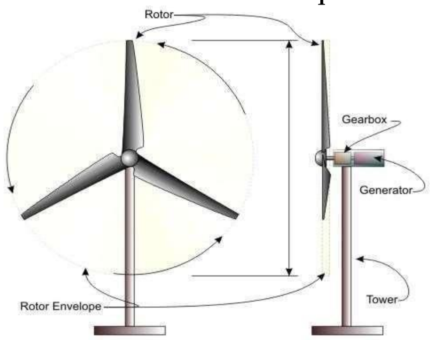
U.K.Saha, S.Thotla, D.Maity : Has conducted that, power coefficient Cp of Savonius rotor depends on number of stages. When number of stages increased from one to two, the rotor shows better performance characteristics, however the performance gets degraded when the number of stages become three. These may be increased in inertia of rotor. So, the optimum number of stages for Savonius rotor is two. It also concludes from the experimental evidence that a two- blade system gives optimum performance. For two blade two stage Cpis about 30%, V=6-8 m/s N.H. Mahmoud. Has conducted an experimental analysis by using, wind tunnel experimental setup, the experimental results show that -Three bladed Savonius rotors are more efficient than the three and four bladed Savonius rotors. The rotor with end plates gives higher efficiency than the without end plates. Blades having overlap ratios are better than the blades with without overlap ratios. By increasing Aspect Ratio Coefficient of performance (Cp) will also increase. T.Letcher : Has carried out experiment in three separate directions Computation Fluid Dynamics (CFD) modelling, generator design and materials manufacturing process. With the experimental data collected during this project, it was concluded that the power output of combined setup is higher than the single Savonius and Darrieus rotor.

METHODOLOGY:

Wind turbines are classified in to two groups. They are Vertical Axis Wind Turbine (VAWT) andHorizontal Axis Wind Turbine (HAWT).

HORIZONTAL AXIS WIND TURBINE (HAWT):

Horizontal axis wind turbines (HAWT) have the main rotor electrical generator the top of a tower, and must be pointed into the wind. Small turbines are pointed by a simple wind vane, while large turbines generally use a wind, sensor coupled with a servo motor. Most have a gearbox, which turns the slow rotation of the blades into a quicker rotation that is



more suitable to drive an electrical generator.

VERTICAL AXIS WIND TURBINE (VAWT):

They are quiet, Omni-directional, and they produce lower forces on the support structure. They do not require as much wind to generate power, thus allowing them to be closer to the ground where windspeed is lower. By being closer to the ground they areeasily maintained and can beinstalled on chimneys and similar tall structures.

The most popular types of VAWT are:

Darrieus Wind Turbine Savonius Wind Turbine **Darrieus Wind Turbine:** This 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 torqueis very low. Darrieus has two vertically oriented blades revolving arounda vertical shaft.

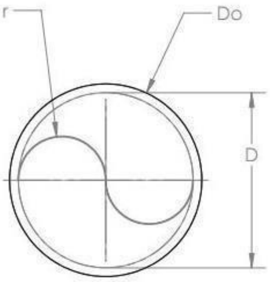
Savonius Wind Turbine:

This 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 airfoil-shaped blades to drive a rotor, the Savonius uses drag and therefore cannot rotate faster than the approaching wind speed. So, our task is to be increase the efficiency of the Savonius Vertical axis wind turbine with wind deflectors.

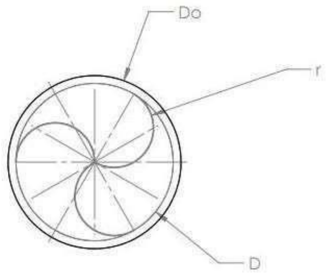
II. DESIGN

Many variables determine the shape of a Savonius barrel design. The ones we will be using are as follows: Do: outer diameter of the base of the rotor; D The distance between the two opposite blades; r the radius of the blades; and h the height of the rotor; we will be using a ratio D:h of 1:1. The ratio is the most common design feature of these turbines as they tend to be a square box shape, hence why the 1:1 ratio

Another ratio we will be using is the Do:D, which determines how far the base extends beyond the blade. We will be using a Do:D of 1.1:1, which is the ratio used in the design. The following figures show the design we built using SolidWorks and the measurements used for two, three,blades barrel Savonius wind turbine.



TWO BLADE ROTOR



THREE BLADE ROTOR

EXPERIMENTAL WORK:

The Savonius vertical-axis wind turbine uses cups, called scoops, instead of blades to capture wind power. When the wind blows, it creates a positive force in the scoop and a negative force on the back side of the scoop. This difference in force pushes the turbine around.

PARTS OF THE VERTICAL TURBINE

Blades:

For small wind turbines poly vinyl chloride material suitable and in strong winds the flexibility of pvc blades isuseful as it takes some of the energy out of the wind preventing the wind turbine generator from spinning too quickly and being damaged.

Ball Bearing: -

A ball bearing is a type of rolling-element bearing that uses balls to maintain the separation
between the bearing races

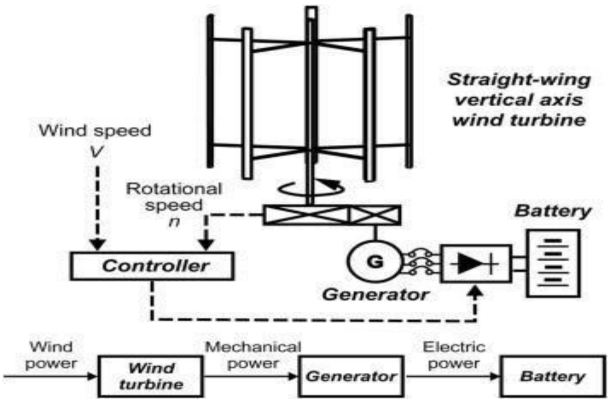
SHAFT: -

Any effective turbine will have 3 aerodynamically architecture blades. This makes it easier create a rotational movement every time the blades ate exposed to wind.

Dynamo: -

A dynamo is an electrical generator that produces direct current electric power with the use ofelectromagnetism.

BLOCK DIAGRAM: -



CALCULATIONS:

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

K. E=½ mv^2…………….. (1)

K.E = kinetic energym = mass
v = velocity,
M is equal to its Volume multiplied by its density r of air,M = r AV (2)
Substituting equation (2) in equation (1), We get,K E = ½ r AV.V^2
K E = ½ r AV^3 watts
r = density of air (1.225 kg/m^3 A = p D^2 /4(Sq.m) D = diameter of the blade A = p*$(1.22)^2$ /4A = 1. 16Sq.m
P = 1/8 r p D^2 V^3 watt
Available wind power Pa = (½ r p D^2 V^3)/4TRAIL 1: -
FOR VELOCITY 4.5m/s
Pa = (½ r p D2 V3)/4
Pa = (½*1.225*p*1.222 *4.53)/4
Pa = 65.21 wattsTRAIL 2: -
FOR VELOCITY 5.5m/s
Pa = (½ r p D2 V3)/4
Pa = (½*1.225*p*1.222 *5.53)/4
Pa = 119 watts

Time (Min)	Wind speed (m/sec)	Output voltage (Volts)
11:00-11:15	15.25	9.6
11:15-11:30	15.33	9.8
11:30-11:45	15.28	9.6
11:45-12:00	15.25	9.6
12:00-12:15	15.24	9.6
12:15-12:30	15.23	9.7
12:30-12:45	15.32	9.8
12:45-01:00	15.25	9.6
Average wind speed=15.2775 m/sec		

CONCLUSION:
The renewable energy sources such as solar and wind energy are used to generate the electricity. Therefore, the energy can be converted into electricity even from the moving vehicles on the highway. This project can also be developed by changing the number of blades and with the materials used. • This is applicable for the entire region, and the regional parameters also are taken in to account for the better results. This idea does not require any limitations and large space like nuclear or other types of power plants, it is possible to be built in any highway around the globe and produce more electricity. This type of power plant is the best solution for controlling the global warming.

FUTURE SCOPES:
By fixing solar panel in this vertical axis wind turbine will increase the efficiency. Fixing more in series or in parallel manner will give more efficiency.
The wind energy can be tapped to a full extend when the force acting on the blade of the turbine which is coming in the opposite direction of the wind is minimized. This can be achieved when there are some holes on the blade which are closed when the windis pushing the turbine and the holes are opened when the blade of the turbine is coming in the opposite direction of wind. “The experiment set up is placed at the base level and the same setup may be tested at a different places”

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