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Wind Tree Turbine Energy Conversion System

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***Abstract* – Wind energy is the fastest growing source of clean energy worldwide. Wind energy plays a vital role to generate the electricity. Likewise these sources are decreasing sooner rather than later.In this project wind energy is used to generate electricity by using aero leaves. Many aero leaves are placed in the form of tree shape, called wind tree. Vertical axis wind turbine is used to generate electricity. The PVC pipes or GI sheet are used for turbines and its look like a normal leaf but it placed in a vertical manner. These aero leaves are able to generate power from breezes .They are also silent, so they could theoretically be installed along buildings, streets, or even in people's backyards. The aero leaves should rotate depend on wind direction. The vertical axis wind turbines will catch wind from all wind directions. When the wind blows, the aero leaves rotate and produce the energy. Power is generated with the help of generators and it is stored in battery. It concludes that, generating energy is good for the environment and also it can provide power to remote locations.**

***Keywords* – Wind turbine, vertical axis wind turbine, aero leaves.**

I. INTRODUCTION

Wind energy is considered as the fastest growing clean energy source which is available. This natural resource renews itself and creates no pollution. It is also reliable, efficient and at low lifecycle costs. Right now add to additionally diminishing the expenses of vitality generation from wind later on. The aero leaves captured energy from wind speeds of less than five mph. there are two energy sources, that can be used to generate the electricity. They are renewable and non-renewable energy sources. Non renewable energy sources are limitedly available but renewable energy sources are available on all human time scale. The usage of wind tree turbines has risen rapidly in recent years because of the potential that they offer for carbon free power generation and environment friendly. In thios project we considered wind as a renewable source of electricity .wind energy that transforms the kinetic energy of the wind into electrical energy that can be used for practical use. Wind turbines covert the kinetic energy in wind into mechanical power that runs a generator to produce clean electricity. The breeze turns the sharp edges, which turn a pole associated with a generator or the generator's rotor, which makes power.Wind tree is designed as same as tree and it works quietly. This wind tree turbine consists of of many aero leaves that have tiny blades which produce electricity even in the light wind speed. The interesting device, inspired naturally to supply renewable energy, has been designed at Iowa State University. The innovation comprises of little pieces of bespoke plastic fitted inside the leaf stalks. These fittings release an electrical charge once they are folded or bent by moving air. The science behind this is called the 'piezoelectric effect' (or biomimetic technology). The piezoelectricity is that the ability of certain materials to get an electrical charge in response to applied mechanical stress.

II. OBJECTIVES

The primary destinations of this task is to create and approve inventive answers for little and medium size breeze tree turbines to improve their intensity, empowering and encouraging the organization into urban and semi-urban territories.

III. TYPES OF WIND TURBINES

1. Horizontal-Axis Wind Turbines:
(HAWT) get their name from the very fact that their axis of rotation is horizontal. They have the most rotor head and electrical generator at the highest of a tower, and are pointed into the wind. The variability of wind distribution and speed brings up the need of a gear system connected to the rotor and therefore the generator. The gear system enables a continuing speed of rotation to the generator thus enabling constant frequency generation. Turbine blades are made stiff so as to stop the blades from being pushed into the tower by high winds. Downwind machines have also been built, as they not require a yaw mechanism to stay them facing the wind, and furthermore in light of the fact that in high breezes the cutting edges can turn out of the breeze in this way expanding drag and grinding to a halt.Most of the HAWTs are upwind as downwind systems cause regular turbulence which can cause fatigue.

2. Vertical Axis Wind Turbines:

Vertical-axis wind turbines (or VAWTs) have the main rotor shaft arranged vertically as the plane of rotation is vertical. Blades are also vertical in this arrangement. The biggest advantage of VAWTs is they don't require a yaw control mechanism to be pointed into the wind. Thus these are useful in sites where wind direction is random or there is presence of large obstacles like trees, houses etc. Also VAWTs don't require a tower structure and can be placed nearby a ground enabling access to electrical components. Some drawbacks are the low efficiency of wind production and the fact that large drag is created for rotating the blades in a vertical axis.

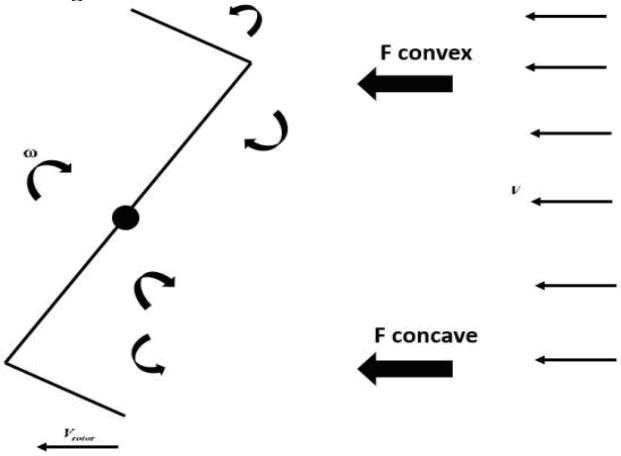

Fig 1.Schematic sketch of vertical axis turbine working.

The Savonius turbine is probably the most straightforward turbine. Efficiently, it is a drag-type gadget, comprising of a few scoops. Looking down on the rotor from over, a two-scoop machine would resemble a "S" shape in cross segment. As a result of the bend, the scoops experience less drag while moving against the breeze than while moving with the breeze. The differential drag makes the Savonius turbine turn. Since they are drag-type gadgets, Savonius turbines separate substantially less of the breeze's capacity than other comparably estimated lift-type turbines. A great part of the cleared territory of a Savonius rotor might be close to the ground, on the off chance that it has a little mount without an all-encompassing post, making the general vitality extraction less compelling because of the lower wind speeds found at lower statures.

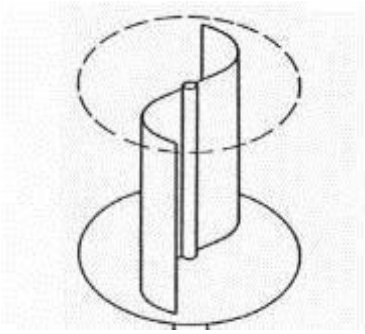

Fig.2. Savonius turbine.

IV. BLOCK DIAGRAM

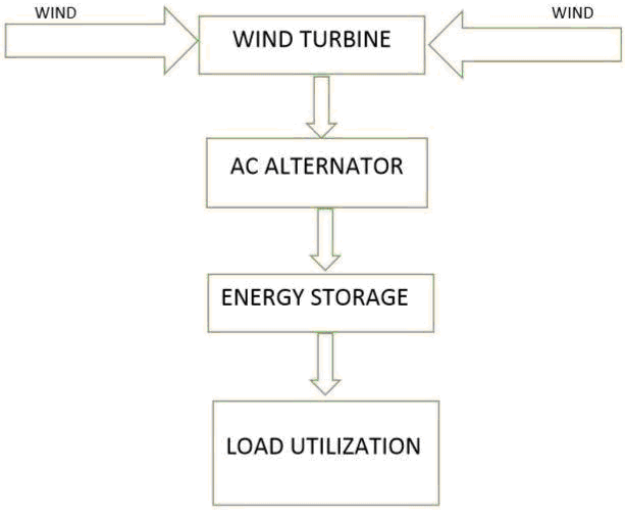

Fig. 3.Block diagram.

V. LITERATURE SURVEY

The figure, graph, chart can be written as per given below schedule

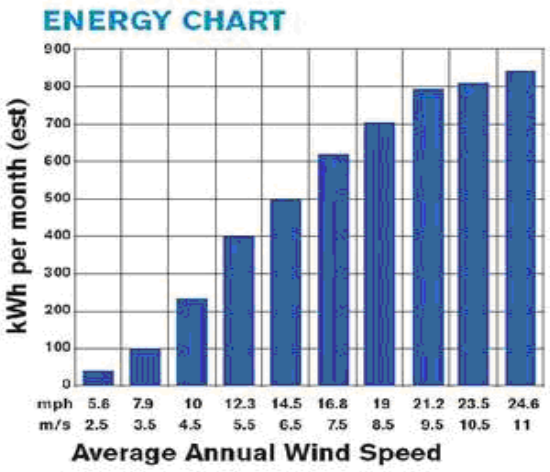

Fig 4. Average annual wind speed with power.

To get a preliminary estimate of the performance of a particular wind turbine, use the formula below.

$$AEO = 0.01328D^2V^3$$

Where,

AEO = Annual energy output, Kwh/year

D = Rotor diameter,feet

V = Annual average wind speed,mph[23]

VI. COMPONENTS REQUIRED

The components required for fabricating the wind tree power generation is listed below,

- wind turbine blades
- shaft

- frames
- DC generator
- battery
- led bulb

1. Batteries

Stand – alone frameworks expect batteries to store overabundance power produced for use when the breeze is quiet. They likewise need a charge controller to shield the batteries from cheating. Profound cycle batteries, for example, those utilized for golf carts,can release and revive 80% of their ability many occasions, which makes them a decent alternative for sustainable power source frameworks. Car batteries aqre shallow-cycle batteries and ought not be utilized in sustainable power source frameworks on account of their short life in profound cycling tasks.

Small wind turbines generate direct current electricity. In very small systems, DC appliances operate directly off the batteries. If you want to use standard appliances that use conventional household alternating current, you must install an inverter to convert DC electricity from the batteries to AC. Although the inverter slightly lowers the overall efficiency of the system, it allows the home to be wired for AC, a definite plus with lenders, electrical code officials, and future homebuyers.

For safety, batteries should be isolated from living areas and electronics because they contain corrosive and explosive substances. Lead-acid batteries also require protection from temperature extremes.

2. DC Generator

Fig.5. DC generator.

Specifications: Type: Coreless
Rated Output Voltage: 3V- 48V DC.
Maximum Speed: 5000 rpm.
Rated Torque: 2.1 N-m.
I. NOISELESS.

Different generator designs produce either alternating current (AC) or direct current (DC), and they are available in a large range of output power ratings. The generator's rating, or size, is dependent on the length of the wind turbine's blades because more energy is captured by longer blades. It is important to select the right type of generator to match your intended use. Most home and office appliances operate on 120 volt (or 240 volt), 50 cycle AC. Some appliances can operate on either AC or DC, such as light bulbs and resistance heaters, and many others can be adapted to run on DC. Storage systems using batteries store DC and usually are configured at voltages of between 12 volts and 120 volts. Generators that produce AC are generally equipped with features to produce the correct voltage (120 or 240 V) and constant frequency (60 cycles) of electricity, even when the wind speed is fluctuating. DC generators are normally used in battery charging applications and for operating DC appliances and machinery. They also can be used to produce AC electricity with the use of an inverter, which converts DC to AC.

VII. EXPERIMENTAL WORK

Experiment is conducted to validate the model designed. We created the experimental set-ups required to test the prototypes and structures. In order to determine the effectiveness of the products that were manufactured, we performed tests to evaluate them. We also tested the power output of the turbine blades and evaluated how the vibrations from the turbine affect the stress on the tree structure. Two experiments have been conducted based on the wind speed value. The procedure of calculating the power is counting the voltage and the current that feeding the battery. The power gained can be calculated using the below equation.

$$P=I\times V$$

where I: the current in Ampere and V is the voltage.

VIII. EQUATIONS

The formula for calculating the power from a wind turbine is:

$$\text{Power} = Cp\,½p\,A\,V^3$$

Where,

P = power output,watts

Cp = maximum power coefficient, ranging from 0.25 to 0.45, dimension less (theoretical maximum= 0.59)

p = Air density,kg/m³

A = Rotor swept area, m² or ∏D² /4 (D is the rotor diameter in m, ∏ = 3.1416)

V = Wind speed, mps[23]

IX. SYSTEM WORKING

The design of wind tree is capable of extracting maximum kinetic energy from the wind owing to the structured blade design.

Fig.6. Design of savonius turbine.

A gearbox is attached between the blade and generator in order to increase the number of rotations and enables the system to work smoothly. A buck boost converter is connected to the DC generator which helps in providing a DC output voltage. A battery is used to store the generated power. A charge controller is connected to the battery in order to protect it from charging. A suitable load is attached to the battery in case of overcharging.

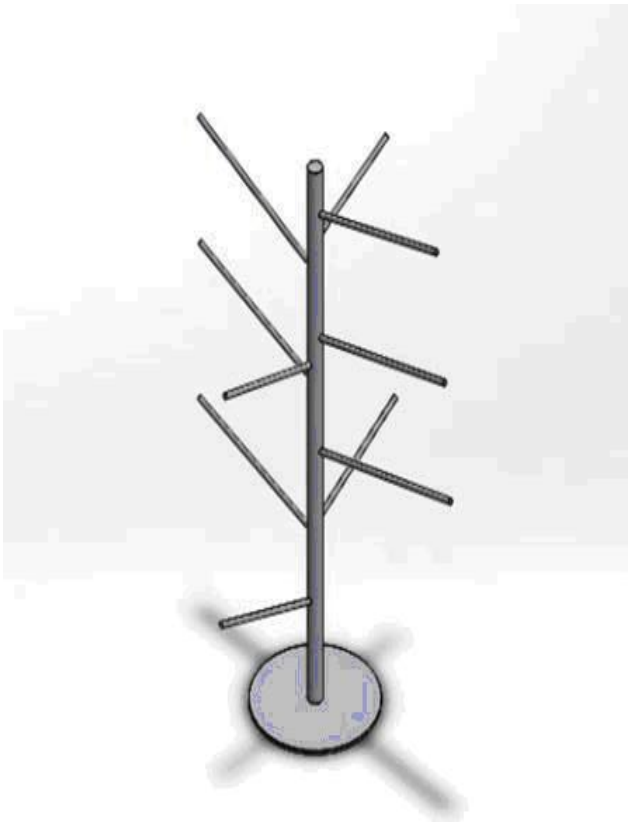

Fig.7. Tree with branches.

Each aeroleaves along with generators are connected in series, so the generated voltage will get added. This resulted output is given to the battery and it is stored by battery. It will be given to drive the load.

X. POWER CURVE

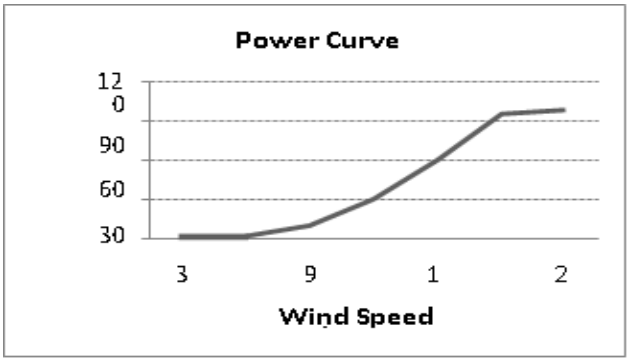

Fig.8. Power curve graph.

This power curve indicates the power per aeroleaf depends on wind velocity. If the wind speed increases the generation will also increase. It can rotate at both the directions.

XI. ASSUMPTIONS FOR CALCULATING POWER

1. All the turbines are expected to create same force yield.
2. The effectiveness of the considerable number of turbines are thought to be same.
3. Effect of pivot of one turbine on the another is dismissed.
4. The mechanical misfortunes of the considerable number of turbines are viewed as same.
5. The weight misfortunes at the sharp edges of the considerable number of turbines are equivalent.
6. Coefficient of execution for all the turbines is thought to be same. The force determined for single turbine with wind speed of 5m/s is KWh.

XII. ADVANTAGES

1. They can produce electricity.
2. They can be installing in urban areas.
3. No emission of greenhouse gases.
4. Easy installation as compare to horizontal axis wind turbine.

XIII. FUTURE SCOPE

In the future we all hopes to develop a perfect tree that has leaves with natural fibers, roots that could generate geothermal energy and ‘bark’ covered with photosensitive cells.

XIV. CONCLUSION

From this project our conclusion is that wind tree works silently with less noise. With better design and increasing the number of turbines along with some advanced technology it is possible to implement this project on a large scale. Wind turbines are a start for society to lessen the damage done by the earth by not using energy sources that produces pollution. Hopefully the project could propel research and testing on VAWT frameworks and give knowledge for different gatherings to finish additional testing and enhance productivity and implement of vertical axis wind turbines.

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