E: ISSN No. 2349-9443 RNI No.UPENG/2012/42622 VOL.-8, ISSUE-1,January (Part-1) 2019
Asian Resonance

New Design for Generation of Power using Wind Tree Systen

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Abstract

Power industry is the major part for many industries for supplying necessary power to the production. Electricity is essential for commercial and domestic purpose. The wind tree consists of many aero leaves which are a leaf shaped blade which itself acts as a turbine. The leaf shaped turbine produces electricity when the air rotates the leaf setup. The concept of vertical axis wind turbine is used here. The leaves are designed in such a way that the wind flow in any direction rotates the turbine. A single setup will act as a handy / portable generator for producing required amount of electricity. All the leaves of the tree are connected to the battery and when the wind flows, the turbine rotates and the electricity is generated according to the wind flow rate.

Keywords: Add some keywords, Aim of the Study in your paper.

Introduction

The usage of renewable source of energy for power production is necessary since the non-renewable resources are very few to handle the requirements. Among the renewable source of energy, wind energy can be used as it is readily available. The major part is that it reduces environmental problems such as global warming when compared to the other source of energy to produce power. Wind energy will also reduce cost and there is no need in search of major part of the energy source.

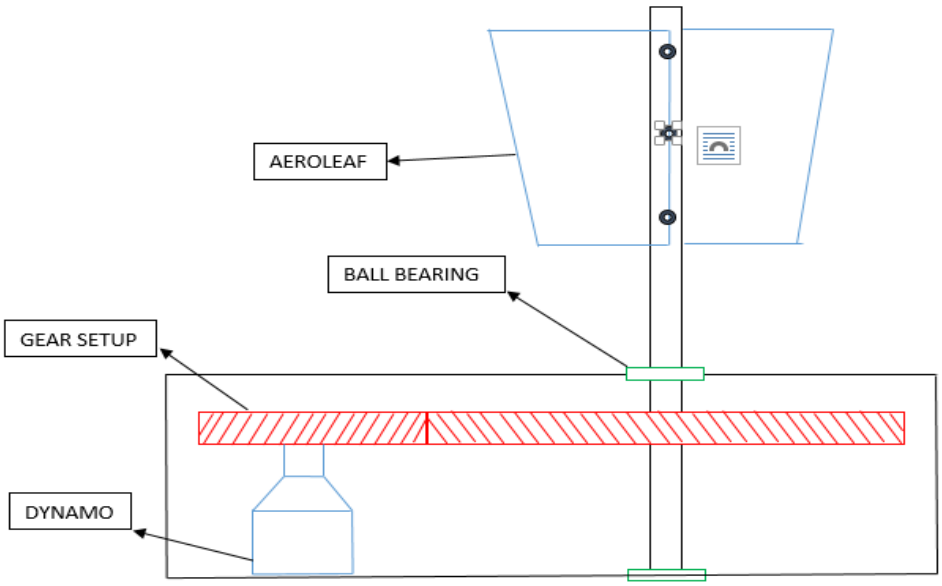
Review of Literature

The concept of wind tree is used in which wind energy acts as the driving power. In wind tree the turbines are implemented in the form of artificial tree's leaf. The main aim of these leaves is to utilize the low wind flow that is circulating around the human habitat (1-5). There are two types of wind turbines available namely, Horizontal Axis Wind Turbine (HAWT) and Vertical Axis Wind Turbine (VAWT). The leaf acts as vertical axis wind turbine i.e. it works based on the drag force. The wind blowing in any direction can be used to generate power. The gear setup is also implemented to enhance the production of power in a better manner. Here the energy conversion takes place in such a manner that the kinetic energy is first converted into mechanical energy and then the mechanical energy is converted into electrical energy. The advantage of wind tree is that they are compact and portable. It is also sound free, economical and nature dependent. It can rotate in both wind flow direction of our climatic changes like North-East monsoon and South-West monsoon (6-10).

Experimental Setup

Schematic diagram of the wind tree system is shown in fig.1.The concept used here is the wind energy (air) is used to generate the electricity with the help of the blades fixed in the stem of our turbine. The total is made with the different setup and material here the blades are made up of High Density Polyethylene (HDPE) which is a easily available material in the market and low cost material. Here we are using the dynamo as a generator which is used to generate electricity when the leaf rotated by wind (11-12). The dynamo (generator) works on the principle of Faraday's law of electromagnetic induction, which states that "Whenever a conductor is placed in a varying magnetic field (Or conductor is moved in a magnetic field) an EMF gets induced in the conductor". When the wind blades or aero leaves started to rotate due to the wind flow which is coupled with the shaft in one end and with the gear setup in the other end to increase the rpm of the pinion gear fixed in the head of the dynamo.

Fig 1.Schematic Diagram of the Wind Tree System



Result and Discussion

The blade are shaped by considering the aero foil design, a curved scoops are given to experience low drag force against wind when rotating in the wind. We have fixed a dynamo of capacity 12V for the generation of the electricity. The wind energy or kinetic energy is converted into rotational energy using vertical axis wind turbine and further coupled with the gear on the head of dynamo. Further the rotational energy from the turbine is converted to electrical energy by means of dynamo fixed in it. The output of the dynamo (generator) will be varying frequently according to the wind because the wind speed is not constant. The energy can be stored in the battery for the constant supply to light LED based street light, emergency light etc.

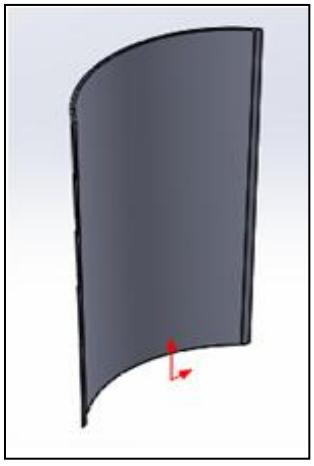
However, the simple wind turbine, manufacturing is very easy. The leaf (blades) is made up of normal household plastics for the cost effective product. In drag based wind turbines, the wind force pushes against a surface. The drag force of the open, or concave, face of the cylinder is greater than the drag force on the closed or convex section.

Design of Aero Leaf (Blade)

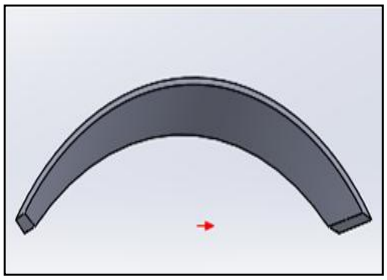
The design that have been designed for our wind tree is shown different views in the following-

Front View

Isometric View



Top View



The dimensions of the blades are also listed in the following:

1. Height of the blade = 250 mm.
2. Width at top = 150 mm.
3. Width at Bottom = 130 mm.
4. Concavity at Top = 37.5 mm
5. Concavity at Bottom = 32.5 mm.

Torque Calculation

Torque from Air to Blade

Torque = Force × Radius

Force can be calculated as

Force = Mass flow rate × Velocity

Where

Mass flow rate = Density × Discharge

Discharge = Velocity × Area
= 4.38 × 0.035
= 0.1533 m^3/s
Mass flow rate = Density × Discharge
= 0.1533 × 1.225
= 0.18779 kg/s
Force = Mass flow rate × Velocity
= 0.18779 × 4.38
= 0.8225 N
Radius = $\frac{150 + 130}{2}$ = 140 mm.

Torque = Force × Radius
= 0.8225 × 140
= 155 N - mm

Torque need to rotate the gear initially at 62.07 N – mm [Gear calculation]

The gear torque is less than the torque of air produced. So that gear will rotate easily in the air when the air flows at the required velocity.

Power Output Calculation

Dynamo Output = 6W 12V
Practical Calculation:
For 2 to 3 rotations per second equal 120-240 rpm.
[Take 200 rpm]
The output will be 1.0 – 2.4 V
[Take 2V or ~1W in power]
Therefore Power ≅ 1W.

Theoretical Calculation:

$$P = \frac{2 \times \pi \times N \times T}{60}$$

$$P = \frac{2 \times \pi \times 200 \times 62.07}{60}$$

P = 1.299 W ≅ 1W

Kinetic Energy of Air

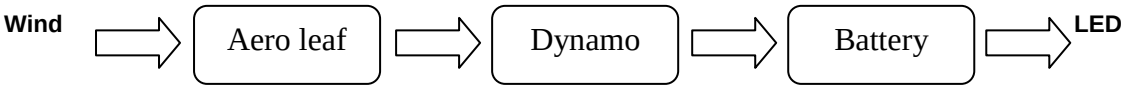
Theoretical Calculation

Power = ½ $m \times v^2$
= ½ (ρ × A × v) × v^2
Where ρ = 1.225 kg/m^3 [Density of air]
A = 0.035 m^2 [Aero-leaf cross section]
v = 4.38 m/s [Velocity]
Therefore Power = ½ (1.225 × 0.035 × 4.38) × 4.38^2
Power = 1.8 W

Both the theoretical and practical calculations are approximately equal.

Block Diagram

The block diagram will show how the setup has been constructed:



Conclusion

From this project we would like to conclude that the power obtained from the wind tree will be more sufficient for providing electricity for street lights, house hold appliances. Hence it will save amount of electricity by generating power rather than drawing power from electric cable lines. Also we would strongly recommend installing these types of wind tree in all type of areas where it can give an aesthetic look and also will generate its own power. The can even more generated if the number of blades and height of the tree gets increased.

Endnotes

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