Design and Testing of Bladeless Wind Turbine

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Abstract - *Bladeless wind turbines use vortex shedding to harvest wind energy. A bladeless wind turbine converts wind energy into mechanical energy, which is then turned into electrical energy using piezoelectric sensors. In the creation of bladeless wind turbines, we first assessed the necessity to transition to renewable energy sources. This helped us outline the project's goals and objectives. Based on this research, an analysis was undertaken to collect important data, which was then used to create the CAD model. The bladeless wind turbine was then produced and tested, with different design made to boost output and efficiency. The output of the bladeless wind turbine increased with increase in quantity and size, increase in the outer diameter of the dome, and change in the material of the circular disc.*

Key Words: Renewable energy, Wind energy, Vortex Shedding, Wind turbine.

1.INTRODUCTION

Renewable energy refers to sources of energy that are replenished naturally and can be continuously utilized without depleting finite resources. Renewable energy is also referred to as clean energy as it doesn't produce harmful pollutants or emissions that are harmful to the environment. Solar energy is the most abundant renewable energy source, obtained from the sun's radiation, and it can be harnessed through the use of photovoltaic panels. Another renewable energy source that uses wind turbine power is wind energy.

Energy from wind has been utilised for thousands of years because it is abundant, clean, and dependable. Reducing greenhouse gas emissions, air pollution, and reliance on foreign oil is achieved by the usage of this sustainable substitute for fossil fuels. Recently, as nations all over the world have been trying to take themselves away from fossil fuels and move towards greener energy sources, wind energy has become more popular. India is currently at the forefront of developing countries in terms of economic growth and development. Therefore, as India continues to grow and develop economically, its energy demand is expected to increase significantly in the upcoming decades.

However, its relatively low energy concentration per unit area can make it expensive to produce compared to other energy sources. Therefore wind energy is the best choice because it has numerous advantages, including its clean and sustainable nature and its ability to provide a stable and long-term energy supply. It is also cost effective as wind is freely available in abundant quantities.

Wind turbines come in a variety of designs, such as vertical- and horizontal-axis models. The sort of turbines that rotate along a horizontal axis are called horizontal-axis turbines, and they are the most often used. In contrast, a rotor having blades that rotate along a vertical axis is observed in vertical-axis turbines. However, there are several drawbacks to wind energy as well, such as the requirement for steady wind speeds and the possible influence on animals and the natural environment.

Bladeless wind turbines are a relatively new technology that aims to provide an alternative to traditional wind turbines. As they have cone shape mast instead of blade they do not have any rotating blades that could harm wildlife and reduced noise pollution.

1.1 BLADELESS WIND TURBINE

Bladeless wind turbine is to generate clean and sustainable energy while minimizing the negative impacts on the environment and wildlife. Unlike traditional wind turbines with rotating blades, bladeless wind turbines utilize a different mechanism, such as the vortex shedding effect, to capture wind energy. This design eliminates many of the issues associated with traditional wind turbines, such as noise pollution, bird strikes, and the need for expensive maintenance.

1.2 PROBLEM STATEMENT

1. To create unconventional wind turbine that are more efficient, compact and have fewer components.
2. Designing of conventional windmill is complicated.
3. The cost of the various component of conventional windmill is high.
4. The production cost and transportation cost of heavy parts of windmill is high.
5. They emit low frequency sound that is harmful for human health.

2. OBJECTIVES

1. Analysed the need for transitioning to renewable energy sources.
2. Worked on a detailed CAD model.
3. Developed a prototype of the bladeless wind turbine.
4. Verified that the design is cost-effective, requires less maintenance, and is easy to setup.
5. Promoted the environmental benefits and safety, advantages of bladeless wind turbines over traditional models.

3. COMPONENTS USED

1. **Mast /Dome:** Mast is a cone structure of the turbine. The mast have to move and vibrate when air with high velocity strikes to it. So the material used for mast should be light in weight and have higher strength therefore we have used PVC foam sheet for mast.
2. **Piezoelectric sensor:** We have used piezoelectric sensor to convert mechanical energy into electrical energy. We have used 35mm sensors to increase output of turbine.
3. **Connecting rod:** Connecting rod works as a connector between mast, stand and circular disc. Also vibrations are transferred through this rod from mast to striker. So it should have higher flexibility and strength, Therefore we have used threaded rod made up of mild steel.
4. **Spring:** We have used spring to stabilize the structure and promote the vibrations through its elastic properties. This spring will go under high pressures so, we used cast iron spring which can bear high pressure and these springs are easily available in the market.
5. **Striker (Circular Disc):** Striker is a cylindrical part which actually strikes with sensors. Striker is connected at the bottom of the connecting rod so it should not heavy. If it is heavy in weight it will resist motion of mast and efficiency of turbine is reduced. So we used light weight high density polyethylene which is solid and light weight material.
6. **Stand/tripod:** It is a structure on which whole system is assembled. It should be heavy and strong such that it can bear forces due to high velocity air and should not change its position. So to keep it heavy we have used rectangular iron rods for manufacturing of stand

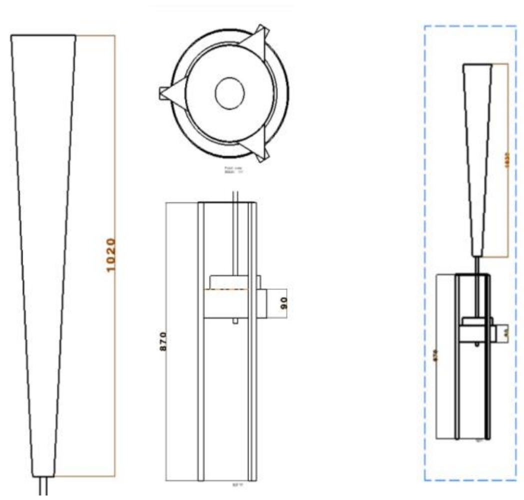

Fig -1: 2D Drafting of 3D Model

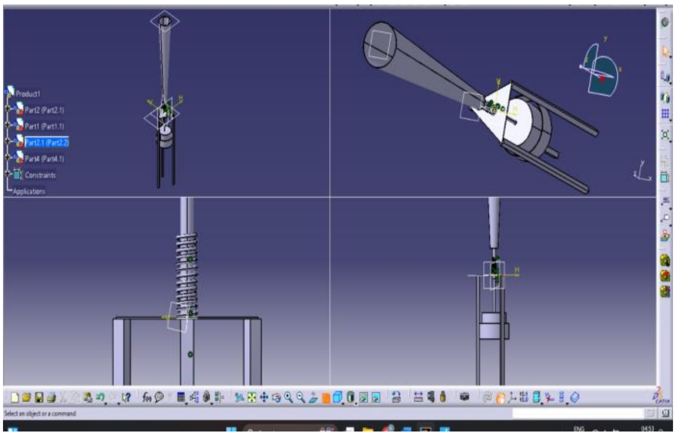

Fig -2: 3D CAD Model

4. WORKING METHODOLOGY

Bladeless wind turbine consists of cone shaped mast that oscillates due to vortex effect around the mast structure. As mast is attached to the striker with the help of spring so that it should oscillate. Due to oscillation the striker exerts pressure on piezoelectric cell membrane. Piezoelectric cell converts mechanical vibration into electrical potential. Then the electrical impulses are observed with the help of Digital multi-meter. The output is measured in terms of voltage deflection.

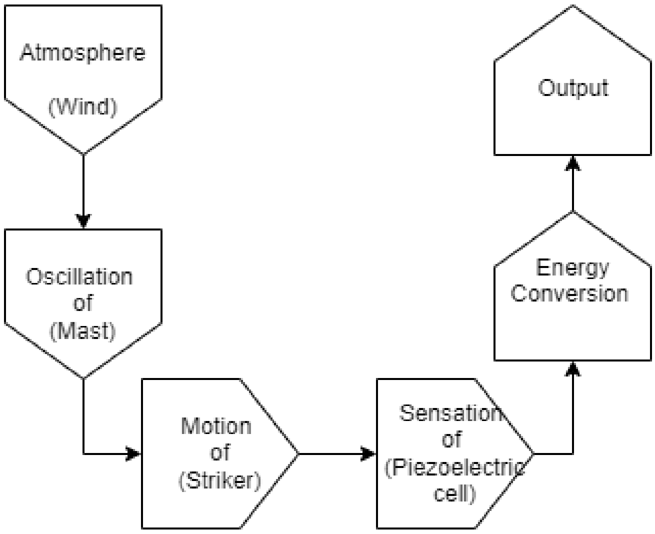

Fig -3: Working Process

Fig -4: Experimental Setup

5. RESULTS

It was observed that the dome/mast made up of PVC sheet connected with piezoelectric sensors in experimental setup had constant current output. But the voltage was dependent on the velocity of air.

As the wind velocity increases, the vortex-induced vibrations (VIV) also increase. Due to vibrations the frequency and amplitude of mast are captured by piezoelectric sensors.

Wind velocity and Voltage:

1. At low wind velocity (1-4 m/s) the output voltage is minimal.
2. At moderate wind velocity (4-7 m/s) the output voltage is noticeable.
3. At high wind velocity (8 m/s and above) the output voltage is significantly optimal for energy conversion.

6. CONCLUSIONS

1. The voltage output of the wind turbine increased when the quantity and size of sensors was increased.
2. The voltage output also increased when polyethylene circular disc was used instead of steel circular disc.
3. With the increase in wind velocity, the voltage also increased.
4. The voltage output increased when the outer diameter of the dome was increased.

REFERENCES

[1] Sandeep Kumar, Akash Gupta, Upinder Kumar, Himanshu Kumar Yadav , Design and Fabrication of Vortex Bladeless Windmill, Vol-22-Issue-17-September-2019

[2] Davang Shubham S., Manade Sunil K., Patil Ganeshkumar S., Patil Pavan S., Bladeless Wind Turbine, Volume 5, Issue 4, Apr-2018

[3] Dr. Ravindra. M. Moharil1, Animesh Khairkar2 , Ambika Kulkarni2, Niharika Yedekar2 , Shubham Badure2 , Shubham Bawaskar2 , Bladeless Wind Turbine, Vol. 4, No.7, 2019 www.ijies.net

[4] Sumit Upadhyaya1, Radhika Agrawal2, Nishant Baish3, Adarsh Shivhare4, Subash Chand Pal5, PIEZOELECTRIC BLADELESS WIND TURBINE, Volume: 07 Issue: 05 | May 2020

[5] 1Suryaprakash S, 2Mohanraj M, 3Mr.B.Elamvazhudi, WIND ENERGY INTEGRATION BY BLADELESS WINDMILL, JETIR December 2021, Volume 8, Issue 12

[6] Mr. Satish Raghuwanshi, Amol Sonanis, Ayush Pandey, Akriti Shrivastava, Mayank banwariya, Chandrashekhar singh Mourya , DESIGN AND FABRICATION OF VORTEX BLADELESS TURBINE,

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