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Highway Wind Turbine

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Abstract This our project focuses 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 air tangentially strikes on the blade of the vertical axis wind turbine and its makes a rotation of the turbine in only one direction. The solar system is used to generate electrical energy and also installed in a way that it diverts the vehicle air towards the turbine. 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 and the solar system is stored in a battery.

Index Terms – introduction, working, types, objective, problem statement, material, electronic components, block diagram, advantages and disadvantages, faq's, result, conclusion, reference, project photo.

INTRODUCTION

In a day to day life, the demand for the electricity is much higher than the production of electrical energy. One of the major problems ever since the natural resources are going to finish one day. The fossil fuel major role in production global warming, a greenhouse gas, etc. currently 68 percent of the electrical energy produced by the thermal power plant and remaining 22 percent included hydropower plant, nuclear power plant, gas power plant and as we realized the fossil fuel is finished in one day. Solar and wind both are renewable energy sources. Solar energy available begins of day and the wind energy is maximum on the highway due to the speed of the vehicle. The motivation of this project contributes the global trend toward clean energy.

The main motive behind this project is to design a vertical axis wind turbine which effectively uses the wind energy generated by the vehicle speed on the highway. So the maximum wind energy can be extracted by the vertical axis wind turbine as compared to the horizontal axis wind turbine. We have designed modified savonius vertical axis wind

turbine which is more efficient than old savonius design. in modified vertical axis turbine we twisted the blade of the turbine to gain maximum spin on low pressure of the wind, we also try to achieve less vibration at gear moment .This turbine works under all the environmental condition and cyclone also. This design of the blade enables the turbine to rotate in clockwise and anticlockwise directions. The arrangement of solar plats is in such a way that they divert the vehicle air towards turbine for effective use of vehicle air.

WHAT IS HIGHWAY WIND TURBINE OR VAWT?

The Vertical Axis Wind Turbine is a type of wind turbine and it is most frequently used for residential purposes to provide a renewable energy source to the home. This turbine includes the rotor shaft and two or three blades where the rotor shaft moves vertically. So, this turbine movement is related to the spinning of coins on the edge. In this turbine, the generator is placed at the bottom of the tower whereas the blades are covered around the shaft.

The **vertical axis wind turbine working principle** is that, the rotors in the turbine revolve around a vertical shaft by using vertically oriented blades. So they generate electricity by using wind power. The wind operates the rotor which is connected to the generator, so the generator converts the energy from mechanical to electrical. **Vertical axis wind turbine components** are blade, shaft, bearing, frame & blade support.

WORKING OF HIGHWAY WIND TURBINE

This turbine works once the wind turns the turbine. Here, the savory VAWT is used in this lighting system. Once this turbine rotates, then the generator will get it as mechanical input & generate the output as electrical energy.

This turbine is arranged on the dividers of the highway roads. The shape of turbine wings is curved to get the wind for revolution from the 2-way road

where the vehicle speed will make this turbine turn. Here, wind speed is used in different ways based on our requirements.

A vertical axis wind turbine is connected to the Gearbox which includes gears. This gearbox is directly connected to the electric generator shaft. This turbine will revolve once the wind blows & the gearbox in this system will enhance the turbine rotations internally & send these rotations to the generator like a mechanical input. So the generator will generate the output as the electrical energy by using this input so that this output will be stored within the rechargeable battery.

In this way, electricity is generated and stored in the battery using the vehicle's speed with the help of a turbine.

TYPES OF HIGHWAY WIND TURBINE OR VAWT

In this discussion, we will explore the characteristics of Darrieus designs and Savonius designs, two prominent types of vertical axis wind turbines (VAWTs).

Darrieus designs are known for their slender, vertical blades that resemble an eggbeater, while Savonius designs feature a cylindrical shape with curved blades that resemble an S-shape.

Additionally, we will delve into the concept of successful drag-based VAWTs, including the use of cup anemometers for measuring wind speeds and the prevalence of Darrieus VAWTs compared to Savonius VAWTs in the current market.



1. Darrieus Designs and Their Characteristics

You'll notice that Darrieus designs have unique characteristics compared to other vertical axis wind turbines. These designs are characterized by their vertical orientation and a curved shape that resembles aerofoils or airplane wings.

The curved blades are connected to a vertical shaft, which is then connected to a generator. This design allows the turbine to capture wind energy from any direction, making it more efficient and versatile than other designs.

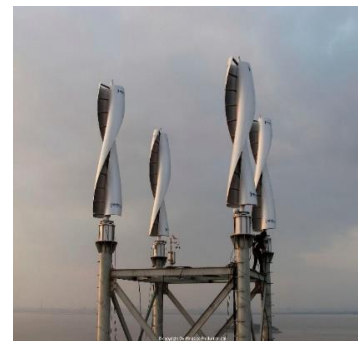
If you're interested in building or making a vertical axis wind turbine, it's important to consider the specific requirements and challenges associated with Darrieus designs. These include the need for a sturdy supporting structure, proper blade design, and efficient power conversion.



2. Savonius Designs and Their Characteristics

The Savonius design is known for its simplicity and durability. It features two or three curved blades that are arranged in an S-shape. This design is often used for small-scale applications and is particularly suitable for low wind speeds.

The curved blades allow the turbine to capture wind from any direction, making it highly efficient in turbulent wind conditions. The Savonius design also has the advantage of being self-starting, meaning it can begin generating electricity with minimal wind speed.



OBJECTIVE OF THIS PROJECT

The main objective is to harvest and recapture the maximum amount of wind energy from the automobiles running on the highways. The unused and considerable amount of wind is used to drive the vertical wind turbine, which will use the kinetic energy of the wind to produce the electrical energy. Increased turbulence levels yield greater fluctuations in wind speed and direction. Unlike traditional horizontal axis wind turbine (HAWT), vertical axis wind turbine effectively captures turbulent winds which are typical in urban settings. Our aim is to design the turbine which will capture the maximum of wind in any direction by placing it at optimum place and height by considering both the cost and safety of the system. This system can be used in huge number to generate the huge amount of useful electrical energy. This energy can be stored and transferred to nearest rural places where we can fulfill the demand of electricity. The thought of design directs us to look into the various aspects such as manufacturing, noise, cost which leads us to our additional aim of analyzing the system to overcome

the usual technical glitches. The project brief involves the design of a small scale wind turbine that can be easily mass produced and fitted on every highway medians to aid electricity consumption.

PROBLEM STATEMENT

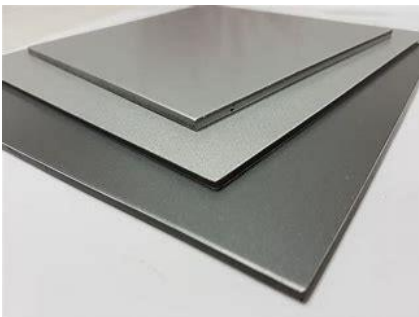
A major hindrance in the growth of wind energy is fluctuation in the sources of wind. Highways appear to be a sufficient source of potential wind energy. An in-depth analysis of fluid flow due to traffic on highways must be performed to acquire boundary limits for the wind turbine design. The turbine must be able to store energy for use when there is low traffic, bumper to bumper or stop and go traffic. The design must be sustainable and environmentally friendly.

MOTIVATION AND OBJECTIVE

The motivation for designing a highway wind turbine is to contribute towards the global trend in wind energy production in a feasible way. Wind turbines are traditionally employed in rural areas, the goal of this project is to design a wind turbine that can be used in cities. In particular, the turbines will use the wind draft created by vehicles on the highway to generate electricity. The idea is to offset the amount of pollution created by burning fossil fuels by introducing a potential source of clean energy.

Materials used in this project

1)ALUMINUM COMPOSITE PANNEL :



Aluminum composite material and ACM panel manufacturing process made them suitable construction materials for various industrial projects. Thanks to the current equipment and technology, manufacturers improved their characteristics.

2)STURDS :



Nuts and bolts are the smallest tools with the most incredible benefits. There would be no mechanical construction if these two tools were not there. They are very small in size, but they are the ones holding the whole machinery together.

3)BIRLA PVC-U PIPE :



Birla PVC-U (Polyvinyl Chloride Unplasticized) pipes are commonly used in plumbing, irrigation, and construction applications due to their strength, durability, and corrosion resistance. These pipes are made from rigid PVC material, which does not contain plasticizers, giving them a hard, non-flexible structure.

With the help of this pipe we made blades of our turbine.

For making blades we cut this pipe vertically in centre

4) SHAFT :

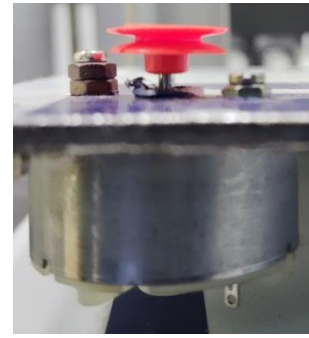
A shaft is a rotating machine element, generally of circular, which is used to transmit power from one place to another and to support the loads imposed by gears, pulleys, or sprockets. It is a crucial component in many machines.

5) ALUMINUM FOAM COMPOSITE SHEET :

Aluminum Foam Composite Panel combines foam with materials like marble, PVC, and wood, offering fireproof, waterproof, and high-strength properties. Its lightweight, multifunctional design is ideal for furniture, construction, and vehicle interiors.

6) Z809 BEARINGS :

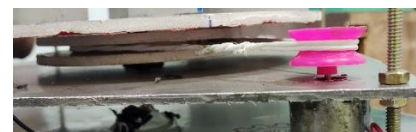
Industrial machines consist of small parts. In general, all types of machines have a supporting device for rotating shafts. This supporting device is called a bearing. The bearings are most widely used all over the world. They are installed to assist, guide, and limit the rotating parts of a vehicle. The bearings are static elements that carry the load. They reduce the friction between the moving parts.

7) 24 VOLT DC GEN. :

DC generator is an electromechanical energy conversion device that **converts mechanical power into DC electrical power** through the process of electromagnetic induction.

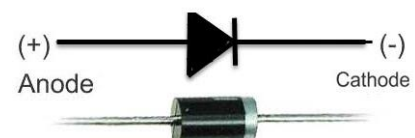
8) PULLY :

“A pulley is a mechanical component that helps transfer motion and power through a wheel turned by chain, rope, cord, or belt.”

9) V-BELT DRIVE SYSTEM :

A V-belt is a **flexible and efficient power transmission device**. It is used to transfer power from one shaft to another. The V-belt has a trapezoidal shape that wedges securely into the sheaves of a shaft. The V-shape design of the pulley allows for efficient power transmission.

ELECTRONIC CIRCUIT COMPONENTS AND THEIR FUNCTIONS

1) RECTIFIER :

A rectifier diode is a semiconductor device specifically designed for rectification, meaning it allows current flow in one direction while blocking it in the opposite direction. This unique property is essential in power conversion circuits, where AC (alternating current) is converted to DC (direct current).

2)VOLTAGE BOOSTER AND CHARGE CONTOLAR :



A boost converter or step-up converter is a DC-to-DC converter that **increases voltage**, while decreasing current, from its input (supply) to its output (load).

3) BATTERY BANK :



3.7V lithium batteries are rechargeable cells that **store electrical energy** using a chemical reaction between lithium ions and the battery's electrode materials.

4) LED :



An LED, or Light Emitting Diode, is defined as a semiconductor device that emits light when electrically energized through a process called electroluminescence.

5) CHARGING PORT :



The charging port, also known as a power or charging connector, is a crucial component of any device that requires battery charging. Whether it's a smartphone, tablet, or laptop, these ports are

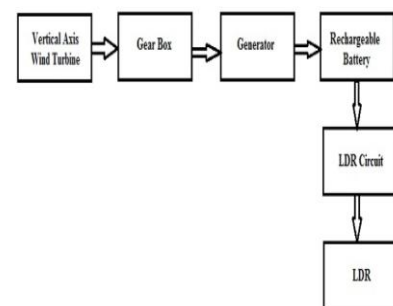
responsible for delivering electrical power to the device's battery.

6) CONNECTING WIRES :



Connecting wires are **flexible strands of metal that are used to establish electrical conductivity between two devices of an electrical circuit**. They are one of the most important components in an electrical circuit because they allow electricity to flow from one electrical component to another. Wires possess negligible resistance to the passage of current and are covered by an insulated coating of different colours.

BLOCK DIAGRAM OF HIGHWAY WIND TURBINE



ADVANTAGES OF HIGHWAY WIND TURBINE

- They can produce electricity in any wind direction
- Strong supporting tower is not needed because generator, gearbox and other components are placed on the ground
- Low production cost as compared to horizontal axis wind turbine
- As there is no need of pointing turbine in wind direction to be efficient so yaw drive and pitch mechanism is not needed
- Easy installation as compared to other wind turbine
- Easy to transport from one place to other
- Low maintenance cost
- They can be installed in urban area
- Low risk for human and birds because blades move at relatively low speed

DISADVANTAGES OF HIGHWAY WIND TURBINE

- As only one blade of wind turbine work at a time so efficiency is very low
- They need a initial push to start, this action use few of its own produce electricity
- When compared to horizontal axis wind turbine they are very less efficient with respect to them. this is because they have an additional drag when their blades rotates.
- They have relative high vibration because the air flow near the ground creates turbulent flow
- Because of vibration bearing wear increase which result in the increase of maintenance cost
- They create noise pollution
- Guy wires which hold up the machine, need some area to install.

Q. WHY HIGHWAY WIND TURBINE BLADES ARE PLACED VERTICALLY ?

Highway wind turbine blades are often placed vertically (in a vertical axis wind turbine or VAWT design) for several reasons, especially in the context of installation along highways or in areas with varying wind conditions:

1. **Space Efficiency:** Vertical-axis turbines are more compact and efficient in terms of space. Since highways are narrow areas, these turbines can be designed to fit without taking up too much room, especially in areas where horizontal-axis turbines (HAWTs) might not fit well.
2. **Omni-Directional Wind Capture:** VAWTs can capture wind from any direction without the need to be oriented towards the wind, unlike horizontal turbines, which must be pointed into the wind to operate optimally. This is particularly useful along highways, where the wind direction can change frequently due to the high-speed movement of vehicles and varying terrain.
3. **Lower Impact of Wind Shear:** At highway height, the wind can have turbulence or varying speeds due to the movement of vehicles. Vertical turbines tend to handle these variable wind speeds better because their design allows them to keep spinning efficiently, even in less consistent winds.
4. **Reduced Noise and Visual Impact:** VAWTs tend to be quieter than traditional horizontal-axis turbines, which is important in areas with a lot of traffic, like highways. Additionally, the design is often less visually intrusive and can blend better with the surrounding environment.
5. **Durability and Safety:** Vertical-axis wind turbines tend to have fewer moving parts at higher elevations, reducing the likelihood of damage due to debris (e.g., rocks, dirt) from the highway or the wind. They also reduce safety concerns related to high-speed traffic by keeping the turbines at a safer height.

These factors make vertical-axis wind turbines ideal for environments like highways where space, safety, and functionality are important.

RESULTS

In this project highway wind turbine i.e. vertical axis wind turbine using we generate electricity and generated electricity stored in battery.

CONCLUSION

Conclusively, extensive data is collected on wind patterns produced by vehicles on both sides of the highway. Using the collected data, a wind turbine is designed to be placed on the medians of the highway. Although one turbine may not provide adequate power generation, a collective of turbines on a long strip of highway has potential to generate a large amount of energy that can be used to power streetlights, other public amenities or even generate profits by selling the power back to the grid. This design concept is meant to be sustainable and environmentally friendly. Additionally, a wind turbine powered by artificial wind has a myriad of applications. Theoretically any moving vehicle can power the turbine such as an amusement park ride. The highway wind turbine can be used to provide power in any city around the globe where there is high vehicle traffic.

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Thank you !

PROJECT PHOTO

