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Design and Fabrication of Solar Wind Turbine

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Abstract

Our nation's rising energy needs result in a regular power outage in rural areas. This is a result of both factories' high-power usage and the limited supply of non-renewable energy sources. Therefore, it is well known that the adoption of a hybrid renewable energy system to produce electricity can provide a quick, dependable, and cost-effective solution for rural households. In remote locations, this solar-wind energy combination can significantly reduce our need for electricity. However, the wind speed varies day and night, affecting how much electricity the horizontal axis wind turbine produces. To overcome this, issue the vertical axis Wind Turbine with C Type blade has been introduced for producing power at low wind speed by integrating both C type blade Wind Turbine and solar photo-voltaic, the hybrid design has been built.

Keywords: Design, fabrication, solar wind turbine, hybrid renewable energy.

1. Introduction

Making an aero leaf wind turbine that uses Vertical Axis Wind Turbines (VAWT) to transform wind into usable electricity. According to Arab news, Saudi Arabia now has very high energy demands compared to the global norm; Saudis use three times as much electricity as the typical person worldwide. This significant demand should direct attention toward considering various sources of energy. Renewable energy sources like the sun, wind, and rivers are among the best energy sources that may use the idea of sustainability. The advantage of wind energy is that, unlike solar energy, which can only be used in sunlight, wind turbines may be used throughout the year, 24 hours a day. The efficient and environmentally friendly use of this renewable energy is another idea related to sustainability. This, in turn will eliminate the environment threat and improve Saudi Arabia communities' health and life style. Being the major energy consumers, streets, parks, schools, and other public buildings should occasionally be exposed to wind. The idea of this project is to convert this wind by using Vertical Axis Wind Turbines (VAWT) to a useful energy by using it as a power source that can serve these consumers.

1.1 Wind Turbine

A fixed-ratio gearbox connects the wind turbine's rotor to the generator shaft. This turbine must be operated essentially at constant speed at all times. While variable generator rotor resistance can also be employed, modern high-power wind turbines in the 2–10 MW range are mostly based on variable speed operation with blade pitch angle adjustment acquired

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primarily by power electronic equipment. These wind turbines can primarily be developed using either a doubly-fed induction generator (DFIG) system, which consists of a DFIG with a partial-scale power converter connected to the rotor windings, or a direct-in-line system, which is built with a direct-driven (without a gearbox) PMSG connected to the grid via a full-scale power converter. The most often used wind turbine designs can be divided into four categories based on these concepts, which are discussed below. This topology, which is shown in Fig.1.1, corresponds to a wind turbine with a constant or fixed speed control and an asynchronous squirrel cage induction generator (SCIG) that is directly connected to the electrical grid via a step-up power transformer.

This idea needs a reactive power compensator, like a capacitor bank, since the squirrel cage induction generator always draws reactive power from the AC network. By doing so, the demand for reactive power from these turbine generators to the grid can be decreased or even completely eliminated. Usually, this is done by continuously swapping capacitor banks (5–25 steps) in accordance with the amount of active power produced. By using a soft starter, the grid connection is made more smoothly. In a fixed speed machine, wind variations are turned into mechanical fluctuations, which are then converted into electrical power fluctuations, regardless of the power control technique. When the network is poor, they can result in voltage fluctuations at the wind turbine's point of common coupling (PCC) with the electrical grid. In the absence of a capacitor bank, these voltage fluctuations allow the fixed speed wind turbine to require variable reactive power from the utility grid, which raises both the voltage fluctuations and line losses.

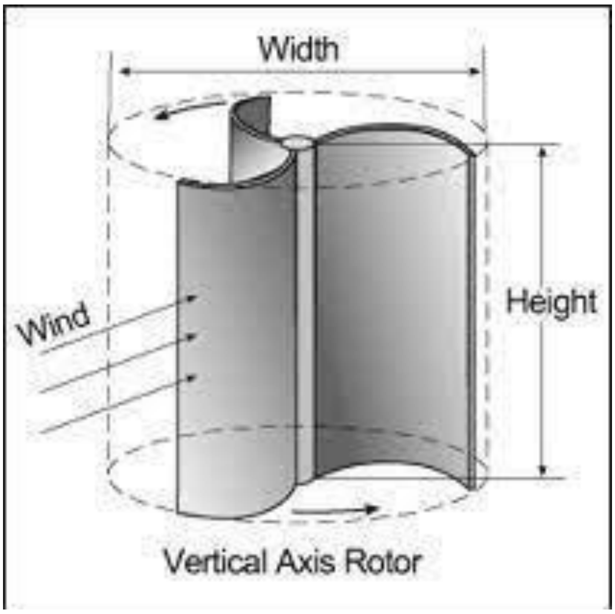

Figure. 1 Wind turbine

1.2 Solar Panel

A solar panel is a collection of electrically connected solar photovoltaic modules that are installed on a base. A bundled, connected assembly of solar cells is known as a photovoltaic module. The solar panel can produce and supply power for use in home and commercial applications as part of a larger photovoltaic system. Each module's rating, which normally runs from 100 to 320 watts, is based on its DC output power under standard test conditions (STC). The size of a module with the same rated output depends on its efficiency; for example, a 16% efficient 230 watts module has twice the area of an 8% efficient 230 watts module.

There are limits to how much power one solar module can generate, so most setups use many modules. A panel or array of solar modules, an inverter, and occasionally a battery, a solar tracker, and connector cables make up a photovoltaic system.

Figure. 2 Solar Panel

2. Literature Review

2.1 Experimental design and fabrication of portable hybrid wind and solar energy system

A 5 KW freestanding wind and solar power combining system is created, produced, and ground tested for this study. This portable apparatus is 8 feet, 5 inches wide, 8 feet, 4 inches deep, and 38 feet tall. Four 120 watts solar panels, a 1.5 KW wind turbine, a solar charge controller, remote power storage, a battery, and battery control make up this gadget. This hybrid device can be utilized in a variety of applications without the need for a grid. This device's description and characterisation, as well as the photovoltaic data that was gathered in April (Mangalore), are given. This gadget can be used to boost the efficiency of solar panel technology even more. The hybrid energy tower's construction strategy is straightforward. The hybrid energy tower combines solar panels and vertical wind turbines to produce energy from both sources. The tower is positioned on the roadway between the barrier and the car, which, due to its speed, generates a substantial amount of air. The solar panel is in a way that directs air from the car to the turbine. The gear systems and generator are fastened to the wind turbines' shafts to produce electricity. Hence, a portable remedy for energy problems is possible [1].

2.2 Design and fabrication of wind and solar hybrid power plant

Since wind turbines are only 59% efficient (Ref: Betz, law) and because huge rotors and large wake formations require very high separations between turbines, the usual way of generating wind power must be rethought with a new strategy. One such idea is the VAWT with vortex turbine, which enhances the performance of the turbine by adding a second vortex using a pair of vortex generators. The project work will involve developing a vortex chamber using Unigraphics, creating a scaled functioning model using three-dimensional modeling to demonstrate energy generation, and testing the model to see how wind speed affects the turbine's speed, voltage, current, and power output [2].

2.3 Design and fabrication of transportable hybrid solar and wind energy system

Design, construction, and field testing have all been completed for a 7 KW freestanding solar and wind hybrid power system. This transportable system has a folded size of 7 feet, 3 inches by 7 feet, 3 inches by 34 feet. The components of this system include sixteen 280 watts solar panels, a 2.4 KW wind turbine, a charge controller, an inverter, remote power management, control, and monitoring capabilities, and 72 kWh of batteries. Without a grid, this hybrid system can be employed in space applications as well as other remote locations. Photovoltaic data collected on February 7th, 2015 is presented together with a description and details of this system. The adoption of this technique is helping to increase the effectiveness of solar panel technology [3].

2.4 Design and fabrication of a hybrid solar & micro wind power generator

The construction of a micro hybrid system that uses both solar and wind energy concurrently is the subject of this essay. Today, electricity is a facility that every human being needs. The availability of all traditional energy sources is steadily declining. Thus, we must switch from using conventional to non-traditional energy sources. In this study work, two energy sources namely, solar and wind energy are combined. The design and construction of the hybrid solar and micro wind turbine are described in the study. Micro wind turbines and solar PV cells both have a lot of promise. We have covered the design and construction of such a system in our research paper on hybrid systems. Because there is no gear box in the turbine, the hybrid system produces electricity effectively, is simple to install, and requires little maintenance. A hybrid system is intended to generate up to 40 W of power. The fabrication of 10 3.2 W solar PV cells with 24 horizontal axis wind turbines in a vertical plane (Max Power). In this study, the designing parameter is assessed and discussed. Many factors that affect the effectiveness of both solar PV cells and micro wind turbines are discussed.

2.5 Design and fabrication of maglev wind turbine

Maglev turbines are the perfect alternative to conventional wind turbines because they don't require the tall towers that are required to accommodate their large blades. In the latter part of the 21st century, renewable sources may make up 20% to 50% of total energy consumption, according to estimates. Maglev wind turbines are superior to conventional wind turbines in a number of ways. They may employ winds, for instance, that are capable of commencing at 1.5 meters per second (m/s). Moreover, they could function in gusts of more than 40 m/s. The largest conventional wind turbines in the world right now only have a 5 MW power output. But a big maglev wind turbine might produce 1 GW of renewable energy, which is enough to power 750,000 houses. The goal of the study is to conduct a methodical examination of the design and fabrication processes in order to determine the optimal output from the Vertical Axis Maglev Wind Turbine and by using solar panels for harnessing solar energy.

3. Problem Identification

The primary disadvantage of wind turbines with horizontal plates is that they consume less energy due to their moderate speed. In order to use more wind energy, the horizontal plate is revolving.

- When used alone, solar energy has a low output.
- For the majority of gadgets, the energy output from reputable energy sources is not compactable.
- The majority of devices use more energy than is generated by wind and solar energy.

4. Objectives

- Less wind means easier power generation and emergency off-grid power for any community.
- Enables homeowners to save money and benefit from reliable power.
- Easy to install and Easy to wire.
- The adaptable tower top interface fits a range of towers.

5. Proposed Model

A digital mockup (DMU) created based on the dimensions and market availability of basic parts, we can assess the best package usage on the basis of a digital mock up (DMU). We ensure that every component is perfectly positioned because we are experts in production-ready development, and this includes the capacity to adapt components in terms of geometry and actually setting them in place. to guarantee a smooth start to production. This is excellent industry approach to design any machine utilizing 3D software's.

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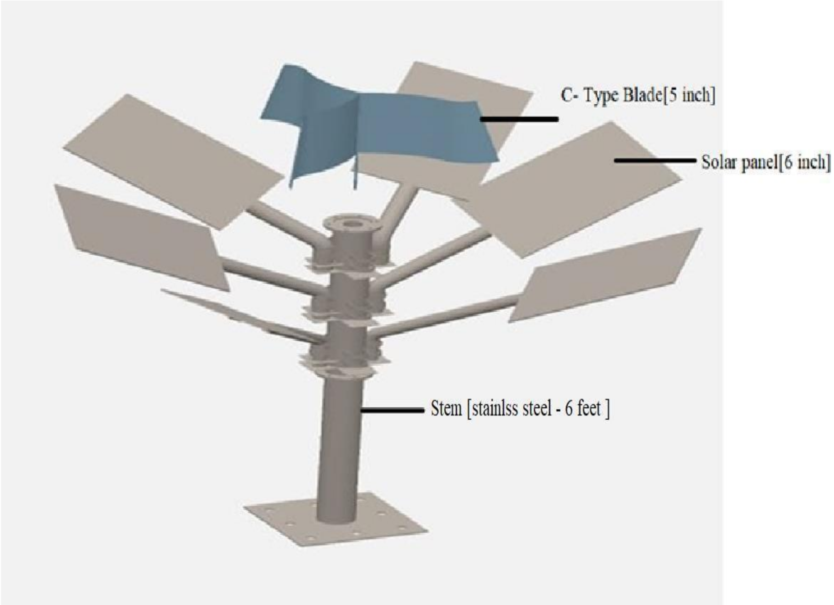

Figure. 3 Design of a solar wind turbine

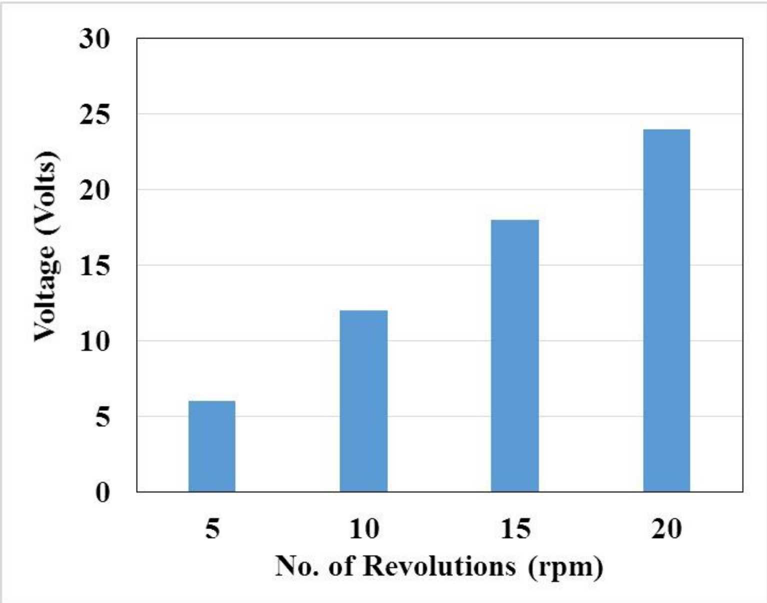

Figure. 4 Turbine revolution graph

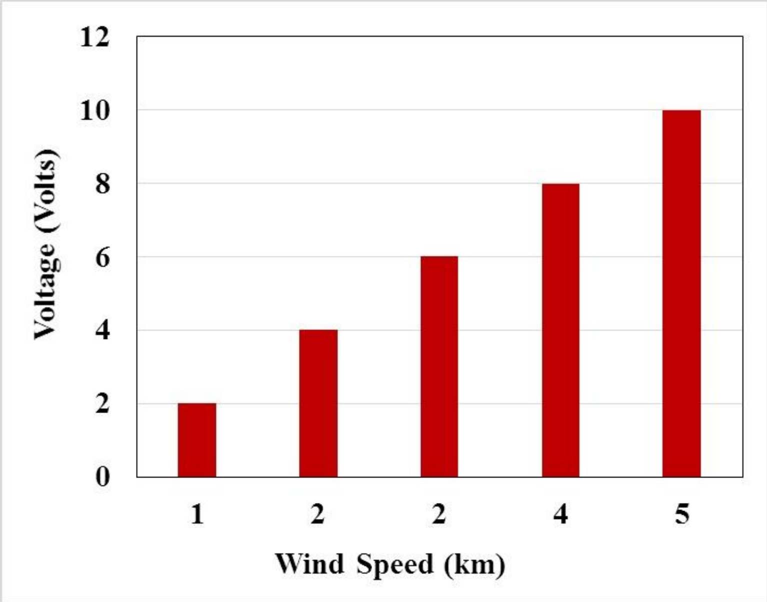

Figure. 5 Wind speed graph

6. Conclusion

We were able to reach a number of significant conclusions and recommendations that will aid in the future development of standalone vertical pivot wind turbines. When compared to earlier projects, we could design a Vertical Axis Wind Turbine framework that increased power yield. Using our data, we were able to offer new design aspects to improve the system and efficiency. A minimum wind speed of 12 m/s is necessary to have an acceptable output power, taking into account a 31–35% efficiency difference between theoretical and experimental findings. Inefficient wind speed had a significant impact on producing the required amount of power. Even though we were able to create this design for a vertical axis wind turbine with a solar panel, there is constantly room for improvement. By not using energy sources that cause pollution, society can begin to decrease the harm done to the planet by installing wind turbines. It is hoped that the project would advance research and testing on vertical pivot wind turbines (VAWT) equipped with solar panel systems and provide information for other groups to complete more testing and improve the productivity and operation of these wind turbines.

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