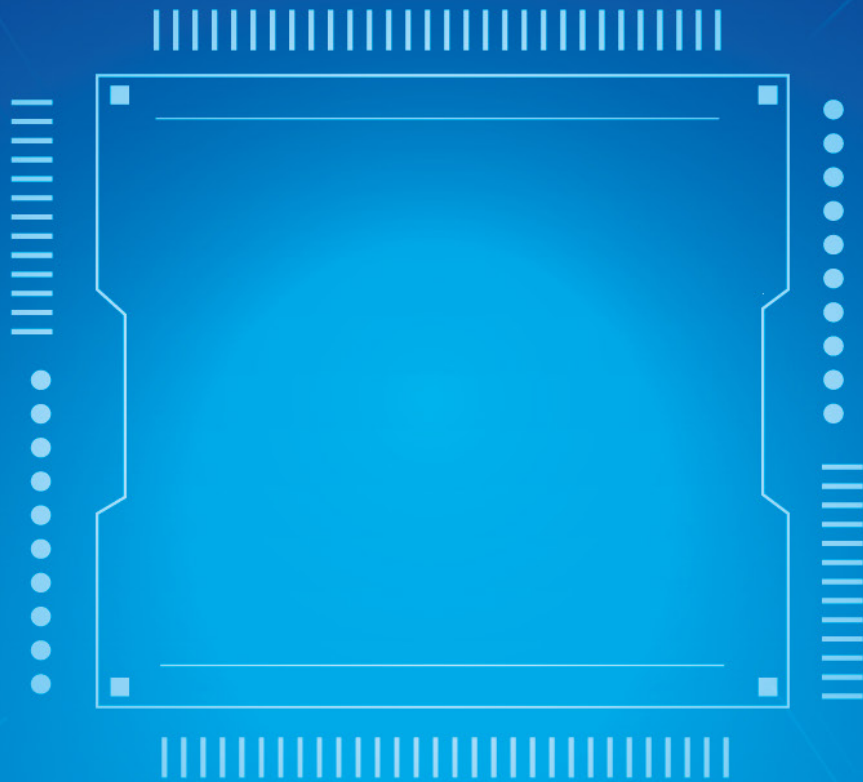




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## Pinwheel: An Innovative Wind-Driven Power Source for Tricycles

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### ABSTRACT

Reduced dependency on fossil fuels can be achieved using wind energy, a native renewable energy source. Energy research is a very sensitive and vital topic since it directly affects our lives and how it is used. The global supply of fossil fuels is running out, endangering the long-term viability of the global economy. Wind energy provides a flexible, environmentally friendly option that also contributes to national energy security. This study focuses on evolving the traditional pinwheel into a helpful power source that is wind propelled and can be connected to any place as long as the wind is present to allow it to revolve. A dynamo replaced the traditional wind turbine to act as the main engine of the wind-driven power source. The pinwheel may be fastened to any surface in the tricycle. The pinwheel's propeller revolves while the vehicle is in motion. The dynamo will produce a magnetic field and electricity while the propeller revolves. The current will be stored in a power bank using a circuit to control it. The pinwheel's maximum and quickest charging time for a 6-volt battery is 2 hours and 52 minutes, with an output of 0.035 volts at a speed of 50 kph.

### INTRODUCTION

Growing economies and developing nations around the world have struggled for years to fulfill rising energy demands for their social and economic growth with inadequate energy supply infrastructure. In the era of modernization and industrialization, new technologies invaded how people live. As a result of the growing percentage of innovation in technology, world problem arises from the utilization of power and electricity. However, some inventions aim to decrease the rate of this growing dilemma yet the world needs more. For gaining a variety of useful benefits, managing renewable energy is substantial to the world. One of the known main and native renewable energy sources is wind energy. This type of energy is one of the cleanest types of energy and it is quite valuable to manage and monitor it correctly. Data-supported study of the harvesting of wind energy technologies provides essential guidance for energy management. Patent data are frequently used to monitor technology developments and identify fascinating trends (Atluntas & Gok, 2023). Since fossil fuel supplies have been running out and energy demand has increased internationally, interest in wind energy, which has several advantages including being omnipresent, renewable, clean, and having a limitless energy capacity, has increased (Roga, Bardhan, Kumar, and Dubey, 2022). Both societal and economic progress requires energy. Byproducts of natural resources, such as renewable energy sources, can help reduce the need for non-renewable resources. More and more people are turning to renewable energy sources, with the wind being one of the most widely used, as the effects of climate change intensify. It provides a dependable, sustainable, and environmentally friendly choice that contributes to national energy security at a time when non-renewable resource sources are running

out throughout the world (Son *et al.*, 2022). The need for employing clean and sustainable energy sources is critical given the worldwide issue with fossil fuels and the climate impact of carbon emissions. Wind energy has recently grown to constitute a sizable portion the global green energy due to its qualities of being abundant, widely dispersed, and environmentally beneficial. The estimated capacity of the world's wind resources for power production is 1010 kW/a, and since 1980, installed wind capacity has increased at an average annual growth rate of 25% (Dai *et al.*, 2022).

### Statement of The Problem

1. What is the level of acceptability of the wind-driven power source for tricycle drivers in Valenzuela City as perceived by the respondents in terms of appearance, functionality, safety, and portability?

2. How long does the wind-driven power source for tricycles in Valenzuela City take to charge a 6-volt battery at the following speed?

- 20kph
- 30kph
- 40kph
- 50kph

3. How long does the wind-driven power source for tricycles in Valenzuela City take to charge a cellphone battery at the following speed?

- 20kph
- 30kph
- 40kph
- 50kph

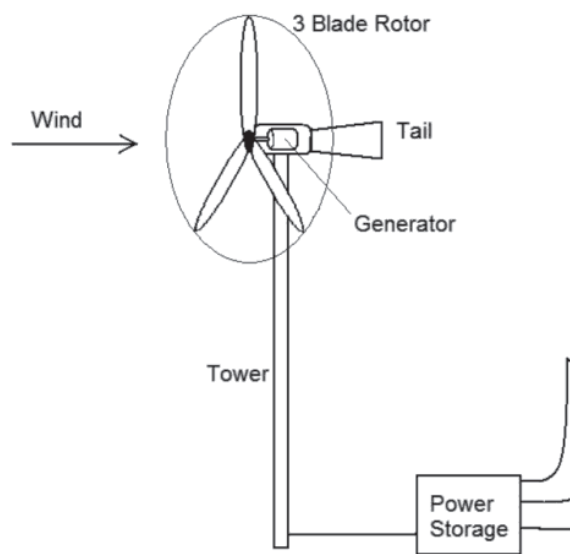
### LITERATURE REVIEW

The need to minimize the extreme reliance on conventional fossil fuels has become more pressing. Wang (2015)

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showed in his study that the increasing public awareness of environmental issues has accelerated the development of a number of green and clean energy harvesting techniques and tactics. For the past few decades, windmills based on the electromagnetic induction principle have been widely used to convert wind energy into electricity (Yang *et al.*, 2021). Wind turbines are examples of renewable green energy producers. Energy is necessary for both social and economic advancement. Natural resources like renewable energy can help lessen reliance on non-renewable resources. The usage of renewable energy sources has increased as a result of the effects of climate change, with the wind being one of the primary ones. In the current era of diminishing non-renewable resource supplies globally, it offers a dependable, sustainable, and ecologically friendly alternative that improves national energy security (Roga, Bardhan, Kumar, and Dubey, 2022). Alternative non-renewable energy sources like fossil fuel reserves may be more cost-effectively replaced by renewable energy sources like wind, sun, hydropower, geothermal, and biomass. In terms of technology, renewable energy sources are preferable to non-renewable energy sources for providing clean energy and preventing their depletion (Sharmila, 2022).



**Figure 1:** Pinwheel Construction Diagram

A pair of cables fastened to the inner ends of opposing windmill airfoil blades that each freely contacts via the opposite ends of a cross member fastened to the hub connects them to the central hub. Each airfoil blade is then supported by a triangle formed by these wires as they continue to an attached reel on the hub. Depending on the tension in the cables, which is detected by a sensor, which in turn activates the electric motor, the reel's tiny reversible electric motor stretches and retracts the cables and, therefore, the blades. The wires extend as the wind velocity rises, and vice versa (Dzunda, Kotianova, Pulis, Kis, and Hurna, 2016).

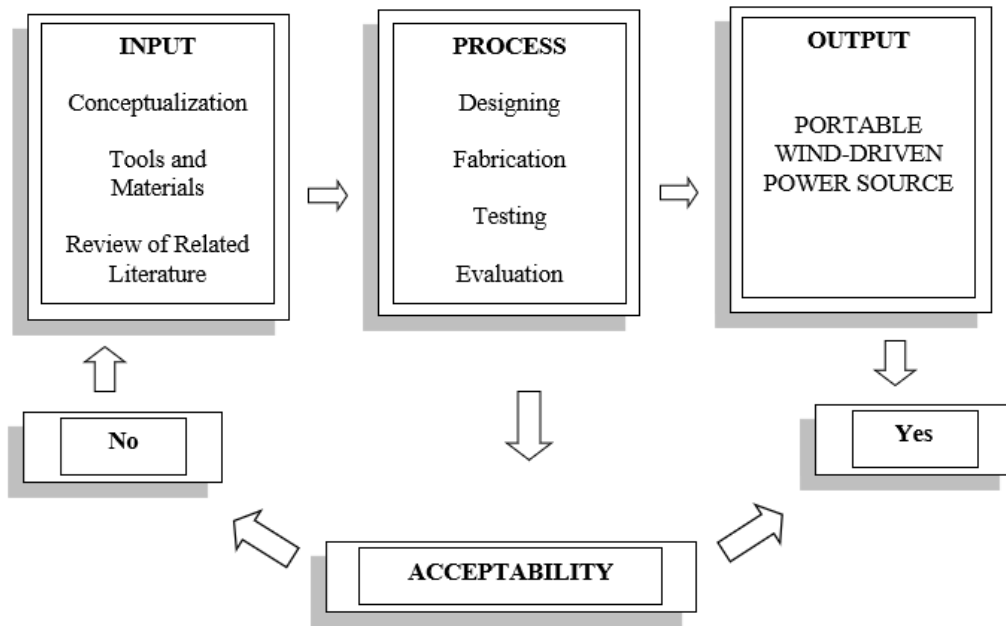
As the guide vanes or control tail wings are fixed during manufacturing, they extend from next to each airfoil blade's inner ends and automatically present the proper angle of attack to the wind. Due to the centrifugal force that causes the cables to be stiff, it is possible for the assembly to rotate while driving a generator thanks to the shaft that extends from the hub. To keep the blades facing the proper direction in relation to the wind direction, conventional yaw control mechanisms are offered.

According to Agarwal, Verma, and Gaurh (2016), the International Energy Agency (IEA) has recognized wind energy as a crucial component in reducing reliance on fossil fuels and as a useful instrument in the fight against global warming. The basic idea behind harvesting wind energy is to use a wind turbine to capture the kinetic energy of the wind and a generator to further transform it into electrical energy. In recent decades, there has been a lot of interest in wind energy conversion systems that try to transform the mechanical energy of air flow into electrical energy. The wind energy conversion system may be separated into land-based and offshore wind energy conversion (OWEC) systems depending on where it is installed. Despite having a later start than land-based wind energy, OWEC has garnered greater attention due to its major benefits in terms of abundant wind energy, minimal wind shear, high power output, and low land occupation rate. A comparison is made between the benefits and drawbacks of various offshore wind energy devices (OWEDs), including horizontal-axis, vertical-axis, and cross-axis OWEDs. Following that, various significant obstacles to offshore wind conversion technologies are described and in-depth examined, including the complicated maritime environment, deep-sea power transmission, and high installation costs. Finally, the development trend of offshore wind power is projected based on the summary and analysis of various upcoming technologies and the existing use of offshore wind energy. Future energy generation from offshore wind power systems is predicted to be smooth because of multi-energy complementary, critical component optimization, and intelligent control methods (Li, Wang, Yang, Chong, and Xiang, 2020)

### Scope and Delimitation

The research focuses on the development of a wind-driven power source for tricycles in Valenzuela City. The respondents of the research are tricycle drivers in Valenzuela City, Philippines, who go through Barangay Dalandanan, Barangay Mapulang Lupa, and Barangay Bagbaguin. The survey seeks respondents' perceptions of the functionality, safety, portability, and appearance of the wind-driven power source for tricycle drivers in Valenzuela City. It can only hold a maximum of 12 volts and can only be used to charge USB-enabled devices and power banks. It does not cover electronic gadgets that require high voltage, and it is not a replacement for a car battery.

**METHODS**



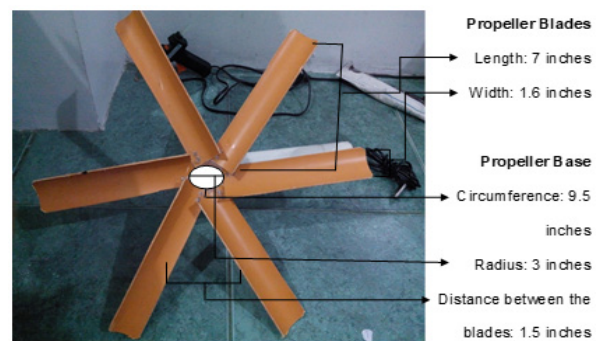
**Figure 2:** Conceptual Framework

**The Conceptual Framework of the Study**

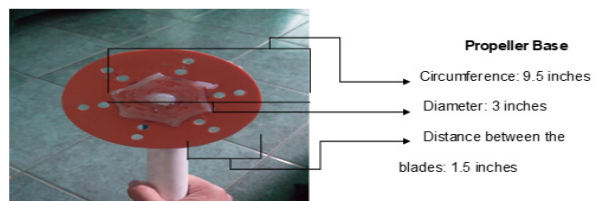
The study’s methodology is demonstrated through the conceptual framework. The conception of a product prototype for the wind-driven power source for tricycles in Valenzuela City that will be used to capture wind energy is where the research process starts. The product will be built with specific tools and materials, and the study’s findings will be supported by connecting it to relevant literature and research. Based on the requirements, the portable wind-driven power source will be designed and built using the study’s input. Drivers of public utility vehicles will put the portable wind-powered generator to the test and analyze it to determine whether or not the product is acceptable. The data that will be gathered will be tabulated, analyzed, and interpreted by the researchers.

**MATERIALS AND METHODS**

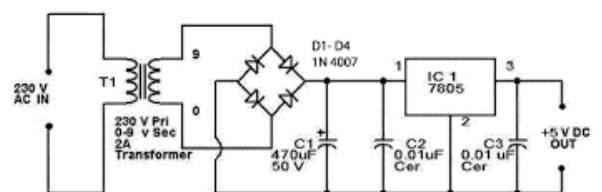
The researchers drew out a schematic design of the circuit that connects the battery and DC motor. Draw the diagram’s layout first, then transfer it to the printed circuit board. The ferric chloride is then ready to be used to melt copper with a minor design and pass it through a PCB. Make careful to wash the PCB after adding the extra copper to the circuit to prevent chemical poisoning and create patterns for where the electronic component will go. Prepare a hole for soldering or fastening. Using recyclable plastic components, create a DC motor propeller. Measure at least six recycled fan blades that are 1.6 inches wide and 7 inches long, and then build one piece of base that is 9.5 inches in circumference and 3 inches in radius.



**Figure 3:** The propeller of the Portable Wind-Driven Power source



**Figure 4:** The base of the Portable Wind-Driven Power source



**Figure 5:** The schematic diagram of a 5-volt regulated power supply

**Statistical Analysis**

The researcher utilized a researcher-made survey questionnaire to gather data and evaluate the level of acceptability of the innovative wind-driven power source for tricycles. The researcher employed a random sampling technique to gather data from randomly selected respondents from each of the selected barangay. The results on the level of acceptability of the portable wind-driven power source were analyzed using a 5-point Likert scale. The percentage was used to compute and tabulate the profile of the respondents while Weighted Mean was used to compute and evaluate the perception of the respondents on the level of acceptability of wind-driven power sources for tricycles in Valenzuela City.

**RESULT AND DISCUSSION**

Table 1 shows the level of acceptability of the innovative wind-driven power source for tricycles in Valenzuela City as perceived by the respondents in terms of appearance, functionality, safety, and portability. Based on the data gathered, tabulated, and summarized, the average mean of appearance, usefulness, safety, and portability is 4.73, 4.7, 4.53, and 4.9 respectively. The overall mean of the level of acceptability of the Portable Wind-Driven Power Source as perceived by the respondents in terms of appearance, functionality, safety, and portability is 4.72 which means that it is highly acceptable. The respondents believed that the wind-driven power source for tricycles is extremely functional and usable. The

**Table 1:** The Level of Acceptability of Innovative Wind-Driven Power Source for Tricycles

Indicator	Weighted Mean	Interpretation
Appearance	4.73	Highly Acceptable
Functionality	4.7	Highly Acceptable
Safety	4.53	Highly Acceptable
Portability	4.9	Highly Acceptable
Grand Mean	4.72	Highly Acceptable

survey results demonstrate that the wind-driven power source for tricycles is also safe to utilize and the wind-driven power source may easily be moved anywhere, and the invention appears greatly constructed and designed.

The table demonstrates that a portable wind-drive power source may fully charge a 6-volt battery in 7 hours and 10 minutes at a speed of 20kph with an output voltage of 0.014 volts. It can also completely charge a 6-volt battery in 4 hours and 46 minutes with an output voltage of 0.021 volts at a speed of 30 kph. It can fully charge the 6-volt battery in 3 hours and 35 minutes at a speed of 40 kph giving output at a voltage of 0.047 volts. The portable wind-driven mobile power source can charge the 6-volt battery within 2 hours and 52 minutes at a speed of

**The Speed of Charging of a 6v battery using the Innovative Wind-Driven Power Source for Tricycles**

Table 2 displays how long it takes the innovative wind-driven power source for tricycles in Valenzuela City to charge a 6-volt battery.

**Table 2:** The Speed of Charging of a 6v battery using the Innovative Wind-Driven Power Source for Tricycles

Speed	Voltage	Duration	Fully Charge
50kph	0.035volts	1 minute	2hrs and 52minutes
40kph	0.028volts	1 minute	3hrs and 35minutes
30kph	0.021volts	1 minute	4hrs and 46minutes
20kph	0.014volts	1 minute	7hrs and 10minutes

50kph giving an output voltage of 0.035 volts. According to the study of Safe, Kashem, Moniruzzaman and Islam (2014), The speed of the revolution per minute (rpm) of the DC motor and the rise in voltage output have a direct proportional connection. The induction of electricity inside the motor rises when the dynamo or DC motor spins quicker as the wind blows stronger, resulting in an increase in its voltage output. In relation to this study, the results of testing of the wind-driven power source for tricycles demonstrate that the voltage out increases as the speed of the tricycles increases.

**The Speed of Charging of a 6v battery using the Innovative Wind-Driven Power Source for Tricycles**

Table 3 shows that the innovative wind-driven power source for tricycles in Valenzuela City can fully charge the cellphone battery within 4 hours and 10 minutes with an output voltage of 0.014 volts at the speed of 20kph; it can also fully charge the battery within 2 hours and 42 minutes with an output voltage of 0.021 volts in the speed of 30kph; it can also fully charge the battery within 2 hours and 5 minutes giving an output voltage of 0.028v at the speed of 40kph; And within 50kph speed, it can

**Table 3:** The Speed of Charging of a 6v battery using the Innovative Wind-Driven Power Source for Tricycles

Speed	Percent of Charge	Volts	Duration	Fully Charge
50kph	1%	.035v	1minute	1hr and 40 minutes
40kph	.8%	.028v	1 minute	2hrs and 5 minutes
30kph	.6%	.021v	1 minute	2hrs and 42 minutes
20kph	.4%	0.014v	1 minute	4hrs and 10 minutes

fully charge the battery within 1 hour and 40 minutes with an output voltage of 0.035 volts.

### CONCLUSIONS

The researcher was able to arrive at and draw conclusions based on the findings and results of the study. During the process of evaluation, the researchers concluded that the respondents who evaluated the innovative wind-driven power source for tricycles perceived it as highly acceptable in terms of appearance, functionality, safety, and portability. The outcome of the research indicated a result of quicker charging of a 6v battery at speed of 50kph with an output voltage of 0.035 volts. The outcome indicates tremendous performance in harnessing renewable energy, which might be advantageous in reducing power usage. Wind energy produces no carbon emissions and can be helpful in reducing carbon emissions by substituting electricity provided by other sources such as fossil fuel power plants.

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