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Portable Wind Turbine

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Abstract: Awareness about the important of renewable energy such as solar, wind and geothermal as a primary alternative to non-renewable energy sources has been increase among the world society. Many countries like United Kingdom, Spain, United State of America and Japan has started to develop a renewable technology especially wind energy in order to supply electricity to their citizen. In Malaysia the wind energy is not widely used for power generation as the average wind speed which is about 3-6 m/s (East Coast region) make it not very efficient for large scale of power production. However, a small scale of wind turbine can be used to generate an electricity from a low wind speed. The portable wind turbine can also be utilized at rural area where there is no electrical supply to power up a small device. This project is to design and develop a portable vertical wind turbine for small capacity electrical generation purpose. The design research begins with the study about the type of wind turbine, characteristic of wind turbine, review on wind speed in Malaysia and current trend of portable wind turbine. Then, vertical wind turbine was chosen because it is most suitable way to build a portable type of wind turbine. Moreover, Savonius and Darrieus wind turbine was choose as the wind blade.

Keywords: Portable Vertical Wind Turbine, Savanius and Darrieus.

1. Introduction

Renewable energy has becoming an important type of energy that needs to be developing at present. Since there are a lot of issue regarding the pollution and world climate, the implementation of renewable energy is becoming crucial especially for future planning. There are a several type of renewable energy sources which are solar, wind and hydro. The wind turbine technology is one of the most popular types of renewable energy source around the world. It harvests the wind through the blade and the rotation of the blade due to the wind blow will produce an electricity power. The main reason why the wind energy is widely used in many countries to generate electricity is because of the cost require to develop a wind turbine is relatively low than cost require to develop a solar station or a hydroelectric station. Other than that, besides being recognized as a green energy, wind energy also practically can operate in any time with the present of wind unlike the solar energy which can only produce electricity during a day light. In Malaysia, the implementation of wind turbine as a power grid energy sources are not used widely. This is due to the average wind speed in Malaysia especially at east peninsular is only about 3 to 5 m/s

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[1]. However, an electricity still can be generated at that speed of wind depend on the design of a wind turbine itself.

2. Materials and Methods

2.1 Materials

The materials needed and used in this project are very simple which are:

- DC Motor Generator 3 V – 12 V
- Shaft
- Aluminums for Rotor blades (Savanious and Darrieus designed blades)
- DC Motor Generator Holder
- Coupling
- Wires for output
- Multimeter
- Fan

The Project block diagram is shown in Figure 1. The selection of the type of wind turbine, both Savonius and Darrieus were selected to form a hybrid wind turbine design. Generally, there are two type of wind turbine which is horizontal axis wind turbine (HAWT) and vertical axis wind turbine (VAWT) [2]. Savonius rotor gave a high self- starting rotation value and the Darrieus rotor contributed to a higher efficiency to the wind turbine. The selection of VAWT was made to adapt the design requirement which need the turbine to be small, portable and easy to be install. They do not require as much wind to generate power, thus allowing them to be closer to the ground where wind speed is lower. By being closer to the ground they are easily maintained and can be installed on chimneys and similar tall structures [3].3 number of blades was selected as the even number of blades are avoided due to vibration effect and other than that due to the economical reason. The design consists of two blade which are Savonius blade and Darrieus blade. The combination of these two types of blades increased the performance of the wind turbine as they are neglecting each weakness and provide support to each other by their strength. Aluminium with less thickness were used to design the Savanious and also Darrieus blades. The efficiency of vertical axis wind turbine can be increases by modifying the size and shape of the blade [4]. Aluminium is selected as a material for the drive shaft. Special standard part which is coupling are used to connect motor shaft and also another aluminumshaft which is fixed with blades 2.2 Equations

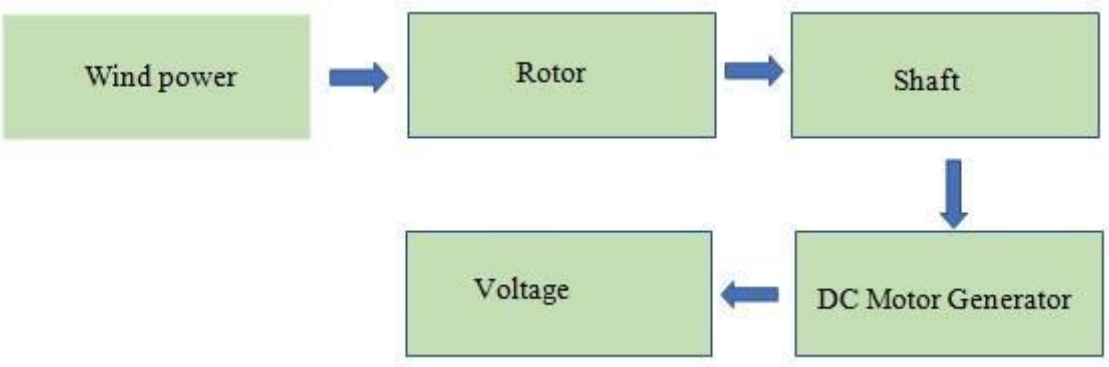

Figure 1: Project block diagram

2.3 Equations

The most important formula used in the experiment is to calculate Power. The formula to calculate Power is Voltage times with current:

$$P = IV$$

Voltage and current values were tested and recorded from output of the portable wind turbine using multimeter, then power were calculated using this formula.

3. Results and Discussion

This part will discuss and analyze result of the experiment that have been conducted to obtain output (Voltage, Current and Power), based on distance from fan to the portable wind turbine. The distance was measured in "FEET" which were suitable for this experiment. Current and voltage were measured using multimeter for this experiment. Then, Power were calculated using the formula (P = IV), where the current and voltage values were taken from the reading in the result. Other than that, the prototype of this project also have been shown which is portable wind turbine. The image of the prototype was taken in front view and also top view as shown in Figure 2 and Figure 3.

3.1 Results

3.1.1 Portable wind turbine

Figure 2: Front view of portable wind turbine

Figure 3: Top view of portable wind turbine

3.1.2 Output values of the Portable wind turbine

Table 1: The output value for Voltage, Current and Power

Distance (Ft)	Voltage (V)	Current (mA)	Power (mW) P = IV
0.5	**2.030**	**31.58**	**64.110**
1	**1.720**	**25.70**	**44.204**
1.5	**1.507**	**20.43**	**30.788**
2	**1.058**	**15.24**	**16.120**

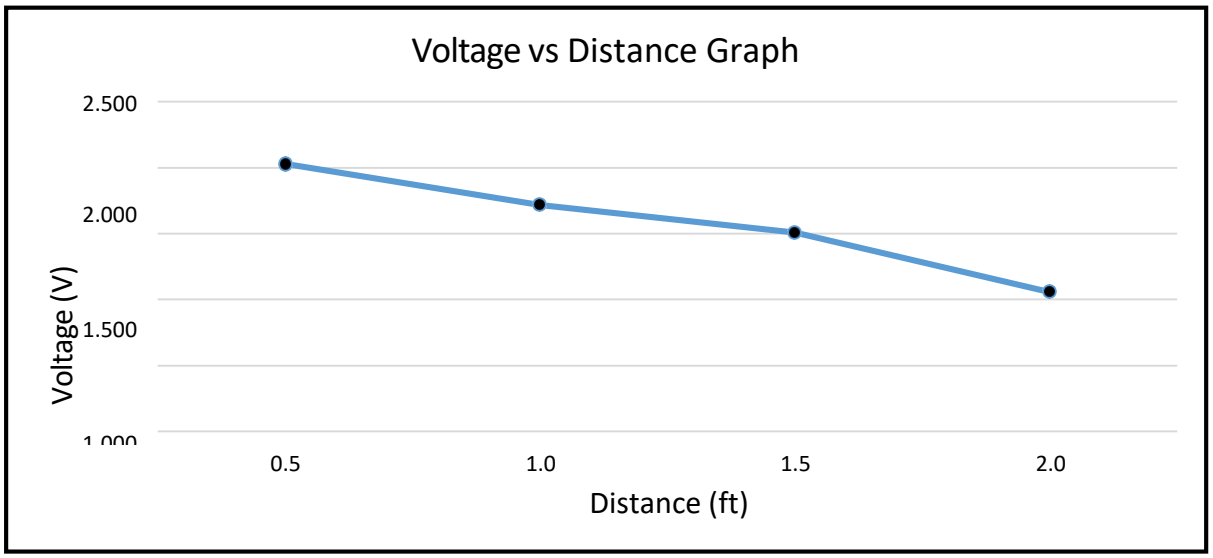

Figure 4: Graph of voltage against distance

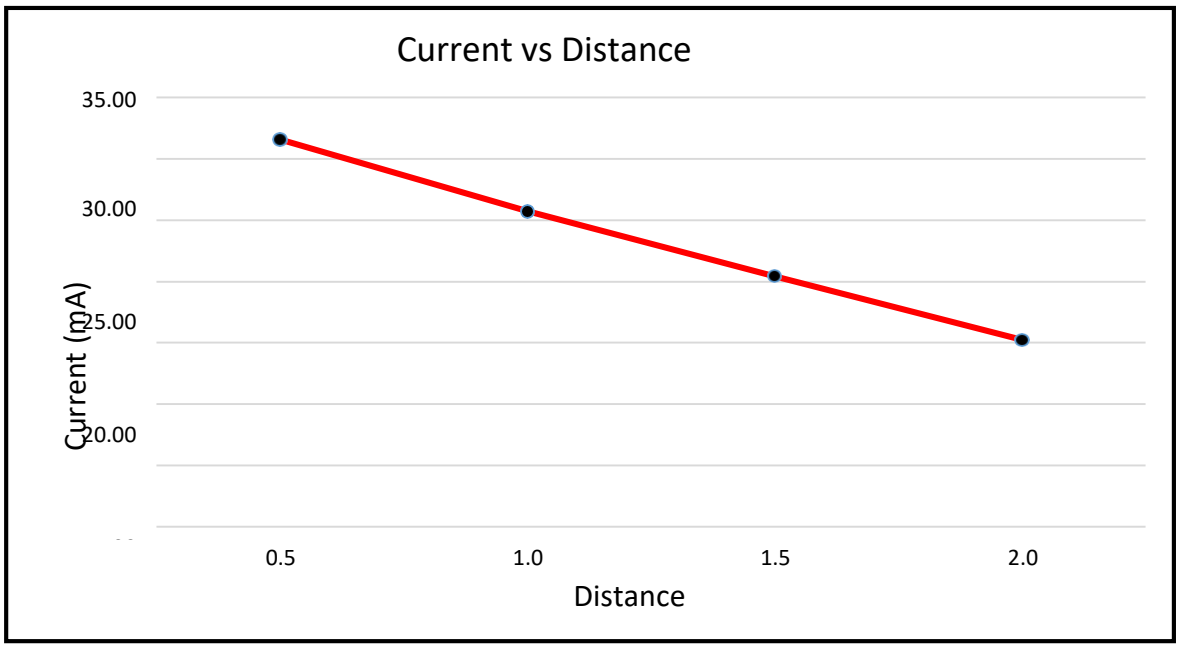

Figure 5: Graph of Current against Distance

From the graph in Figure 4, it shows that when the fan was placed in 0.5 FEET distance from the Portable wind turbine, the voltage measured were 2.030 V. Whereas, when the fan placed 1 FEET away from the portable wind turbine, the outputs voltage was 1.720 V. Moreover, when the fan is placed more far away from the portable wind turbine which is 1.5FEET and 2FEET, the outputs voltage measured were 1.507 V and 1.058 respectively.

From the graph Figure 5 above of Current against distance, it shows that when the fan is placed 0.5 FEET away from the portable wind turbine which is considered nearer, the Current reading is 31.58 mA. Whereas, when the fan is moved a bit far behind which is about 1 FEET then the Current reading were decreased to 25.70. Moreover, the fan also was placed in distance of 1.5 FEET and also 2 FEET away from the turbine, where the current value decreased more which is 20.43 mA and 15.24 mA respectively.

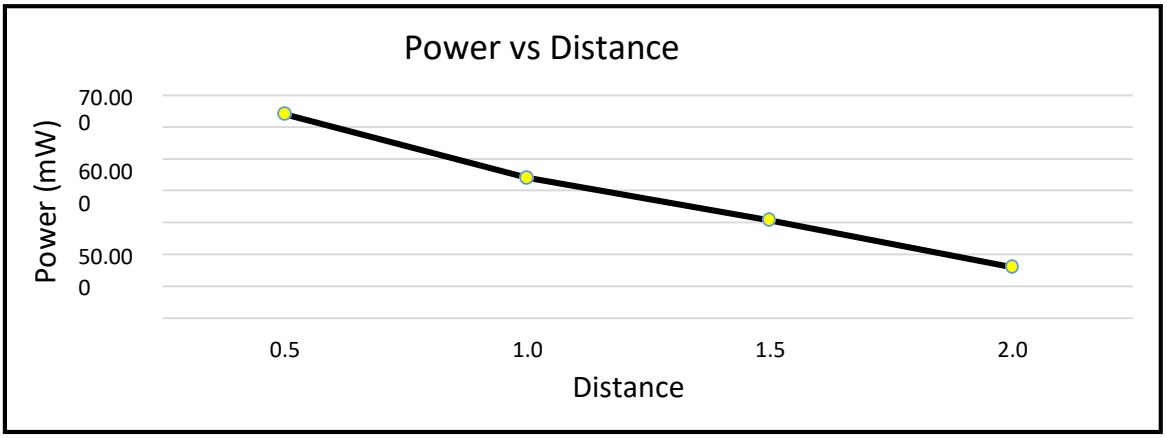

Figure 6: Graph of Power against Distance

Figure 6 shows the value of the power is decreasing when the distance from the fan to the portable wind turbine is increasing. Power is calculated based on the readings in voltage and current, where the formula is P = IV. First, when the distance is 0.5 FEET away from the turbine, the turbine was rotating in high speed which the power is 64.110 mW. Then the fan was moved a bit far which is 1 FEET away from the turbine, the power calculated is 44.204 mW. Moreover, when the fan is moved back even far from the turbine which is 1.5 FEET and 2 FEET, the power value decreased even more with 30.788 mW and 16.120 Mw respectively.

4 Conclusion

This experiment was conducted by designing a portable vertical axis wind turbine. Savanious and Darrieus blade type of design were combined to create the portable wind turbine where it is surely occupied less space compared to horizontal axis wind turbine. Moreover, this portable wind turbine is transportable from one place to another because it's small in size. Other than that, from the reading of outputs above, this portable wind turbine can be produce electricity even in low wind speed.

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