UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF PORTABLE POWER GENERATION SYSTEM WITH LOW COST VERTICAL AXIS WIND TURBINE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours. The member of the supervisory is as follow:

……

(Ir Dr Mohd Farriz Bin Hj Md Basar)

ABSTRAK

Dengan peningkatan keperluan manusia, penggunaan tenaga juga meningkat dengan pesat dengan eksploitasi sumber semula jadi mineral yang membawa kepada kekurangan sumber tenaga pada masa akan datang. Untuk menyelesaikan masalah ini, salah satu penyelesaian adalah kuasa turbin angin. Projek ini melibatkan penggunaan bahan yang mudah bagi prototaip inovatif turbin angin paksi menegak yang berskala kecil untuk sistem bekalan kuasa. Prototaip turbin angin dibangunkan untuk kegunaan bekalan kuasa, yang merupakan contoh yang membawa kepada pertimbangan reka bentuk dan demonstrasi prestasi aplikasi sistem. Turbin paksi menegak lebih baik daripada paksi mendatar kerana ciri penerimaan angin dari semua arah. Bahan yang dipilih untuk projek ini adalah bahan yang mudah seperti kanvas sebagai bilah dan penjana elektrik AC. Turbin angin ini lebih baik daripada turbin angin biasa kerana ia dalam model mudah alih. Berdasarkan hasilnya, kecekapan turbin angin paksi menegak ini hanya 12% tetapi lampu limpah led masih boleh menyala. Eksperimen menunjukkan bahawa kelajuan angin minimum bagi turbin untuk berputar adalah 2.05m/s. Turbin angin mudah alih ini akan membawa perubahan dan evolusi dalam industri turbin angin dengan membawa kesedaran umum tentang tenaga bersih yang mampan dan meningkatkan keseluruhan kecekapan.

ABSTRACT

With the increasing needs of the human being, energy consumption is also increase tremendously with the exploitation of mineral natural resources, leading to deficiency of energy resources in future. In order to solving these problems, wind turbine power is one of the options. The purposes of this project involve a simple material of prototype innovatively a small scale portable vertical axis wind turbine for power supply system. A prototype of wind turbine is developed for application of power supply, which is as an example to address the design considerations and demonstration the performance application system. Vertical axis turbine is more preferable than horizontal axis due to its feature of being accepting wind from all direction. The material chosen for this project is a simple material such as canvas as a blade and AC electrical generator. This wind turbine is better than normal wind turbine as it in portable model. Based on the result, the efficiency of this vertical axis wind turbine is only 12% but the led spotlight still can light up. Experiment shows that the minimum wind speed for turbine to rotate is 2.05m/s. These portable wind turbines would bring change and evolution in wind turbine industry through bringing the general awareness regarding clean sustainable energy and increasing the overall efficiency.

DEDICATION

To my beloved parents Mr. Hasbullah Bin Yusoff and Mrs. Nik Nor Hayati Binti Yahya for their support and pray. A full appreciation to my supervisor Ir Dr Mohd Farriz Bin Hj Md Basar for advising and helping through this project.

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HAWT	-	Horizontal axis wind turbine
VAWT	-	Vertical axis wind turbine
MW	-	Megawatts
AC	-	Alternating Current
m/s	-	Meter per second
P	-	Power (watt)
A	-	Swept area
ρ	-	density of air
v	-	velocity of wind
PC	-	Personal computer
DC	-	Direct current
RPM	-	Revolution per Minute
ω	-	Angular
V	-	Voltage (Volt)
I	-	Current (Amp)
c_p	-	Power Coefficient
lx	-	Lux
LED	-	Light-Emitting Diodes

CHAPTER 1
INTRODUCTION

1.0 Introduction

In recent years, the world is growing as well as the world population is also increasing. With the increasing development, energy consumption has also increasing (Ahire 2015). In order to ensure the future for ourselves and future generations to follow, it is commonly accepted that we must act now to reduce energy consumption and greenhouse gases reduction, for example is carbon dioxide. To meet the energy crises, the new renewable and sustainable energy source technologies are being developed in the world. There are a few assets of renewable energy such as biomass, geothermal, solar, wave and wind.

Renewable energy is a clean, inexhaustible and increasingly competitive energy source. That are more reliable and potentially will become very cheap when technology and improved infrastructure. They include biomass, geothermal, solar, wave, wind, tidal energy and hydropower that are grown and harvested without fossil fuels. Non-renewable energy such as coal and petroleum, required costly for exploration and dangerous because required mining and drilling and that will be more expensive as demand increases and supply decreases.

Today, wind energy is one of the fastest growing sources in the new energy era on the world. Wind Power is a source of renewable energy that comes from the flow of air that flows on the surface of the earth. Wind turbines are power generation devices powered by wind kinetic energy. The kinetic energy of the wind will be converted into electricity to generate power supply.

There are usually had two type of wind turbine, horizontal axis wind turbine (HAWT) and vertical axis wind turbine (VAWT). HAWT has the main rotor shaft and an electrical generator on top of a tower. Although VAWT has a fixed structure and does not depend on the direction wind. Usually, VAWT gearbox and electrical generator are on the ground of the system.

In this project, the design of the system vertical axis wind turbine (VAWT) to take advantage of wind power have been proposed and implemented. This report will discuss the parameters to be considered in designing multi-direction wind turbines as portable power generators.

1.1 Wind Power

Harness the wind is one of the cleanest, the most sustainable way to generate electricity. Wind power harvests no heat-trapping emissions and no toxic emissions that leads to global warming. This and the fact that wind power is one of the most abundant and more competitive energy resources, making it an alternative to fossil fuels that endanger the health and environmental threats.

Wind Power is the fastest growing electricity source in the world. In 2012, a new capacity of nearly 45,000 megawatts (MW) is installed worldwide. This is an annual increase of 10 percent compared to 2011 (Anon 2012).

Wind power is the use of air flow through a wind turbine for generating mechanical power to electrical power. Wind power is an alternative to no burning fossil fuels, to a renewable energy, widely distributed, clean, produces no greenhouse gas emissions during operation, consumes no need water, and uses little space land. The amount of power available to a wind turbine depends on air density, wind speed and the swept area of the rotor. The net effect on the environment is far less problematic than with energy sources that are not renewable.

In Denmark, for example, at present, there are about 30 percent of wind power demands. Wind generation also accounts for about 17 percent of the country's energy needs in Portugal, 13 percent in Ireland, and 11 percent in Germany. It has been shown that, serious responsibility for the reduction of harmful global warming emissions, local development, and determination to prevent fuel imports being the main driver of European wind power development.

1.2 Wind Turbine

A wind turbine is an evolution of the classic windmills that can be seen in the more rural areas of the world. The purpose of wind turbine is to decrease dependence on fossil fuels for energy production and also to produce energy in a less wasteful manner. Wind turbine operates using the kinetic energy of the wind, which pushes the turbine blades and rotating motor that changes kinetic energy into electrical energy.

The wind turbine is a rotating machine that can be used directly for blending or can be used to produce electricity from kinetic power of wind. They provide clean and renewable energy for consumer use. The wind turbine is a good way to save money and make the environment clean and green.

This development has been improved to be used for a variety of applications and can be used by traffic signs, boats, or the whole community that usage wind farms to power. The development of wind turbines is a key step towards overhauling the way we harvest our energy.

Wind turbine commonly fall into one of two classes: horizontal-axis wind turbine (HAWT) and vertical-axis wind turbines (VAWT). HAWT are the most common type of wind turbines assembled across the world. VAWT is a type of wind turbine which basically two or three blades and in which the main rotor shaft runs vertically. The primary difference between the VAWT and HAWT is the position of their blades. In HAWT, blades are located on the top and rotating in the air.

The vertical axis wind turbine (VAWT) is the most typical of the turbine that persons are adding to make renewable energy source at their home. It is not usually used as the horizontal axis wind turbine, vertical axis wind turbine are great for placement at residential locations and more. While for VAWT, the generator is mounted at the base of the tower and blades are wrapped around the shaft.

The advantages of vertical axis wind turbine compared to horizontal axis wind turbines are able to catch wind from all directions with low wind speed without requiring in the wind direction. The blade airfoil cross-section and cutting the wind by push upwards due to the force difference between the two sides of the blade. When the air on the aerofoil-shaped, it moves faster than the blade of it underneath. This makes the air pressure underneath the bar higher than the above and due to the pressure of unequal blade having upward thrust.

The wind turbine efficiency depends on the rotor design parameters and airfoils selecting, twist angle correction and blade chord. Performances of aerodynamic show important roles in maximum efficiency of the rotor. In addition, aerodynamic also show an important role in a wind turbine. The force that responsible for the power yield, which produced by the turbine is identified as aerodynamic lift. This research will discuss the required parameter that to be considered in designing multi-directional wind turbine as a portable power generator.

1.3 Research Gap

This model project is focusing on the principle of portable and small scale wind turbine. So, vertical axis wind turbine (VAWT) has been chosen compare to horizontal axis wind turbine (HAWT). HAWT need are great for placement at residential. VAWT is the more advantage in operation and safety when it comes to their application with the urban environment and rural area.

Figure 1.1 shows the area of interest of wind turbine. Most of the wind turbine is focused on high cost and complex geometrical of wind turbine such as Darrieus

rotor, Helical Darrieus rotor and Horizontal axis wind turbine. H-Darrieus and savonius are classified in high cost and simple geometrical. It is expensive to construct and it is also difficult in terms of design and maintenance. This project of wind turbine is very simple in design, low cost and inexpensive to install.

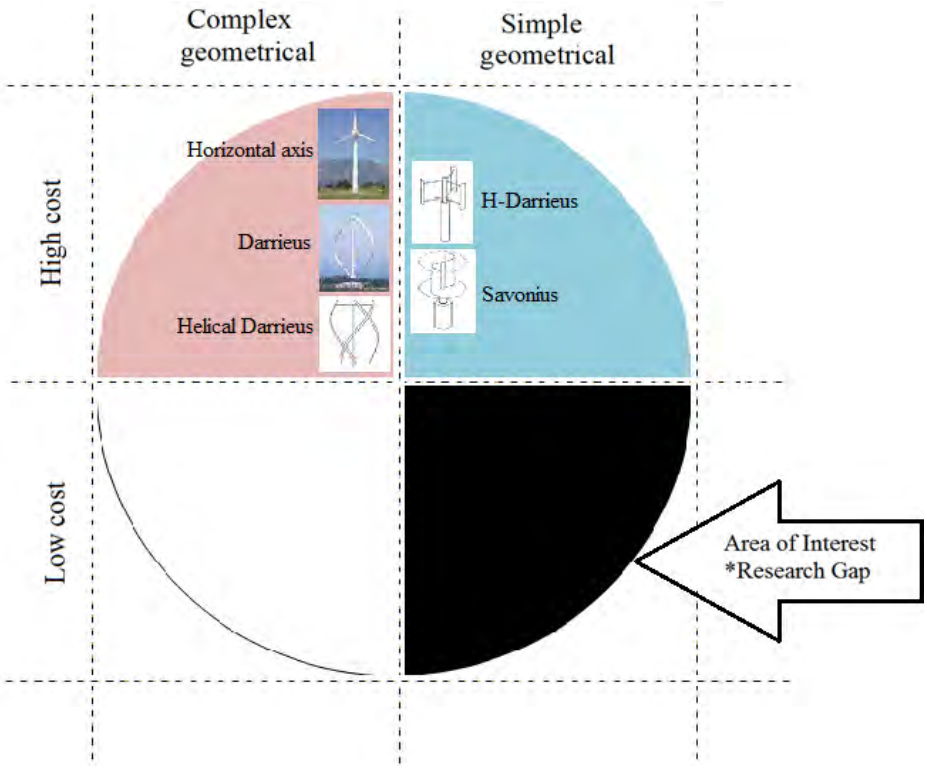

Figure 1.1 Area of interest

Hence, the objective of this project is to development a low cost portable power generation system with simple vertical axis wind turbine, it is suitable to be classified this project is low cost and simple. This project is portable generator, so it has advantage to move from one location to another location compare to other wind turbine in the market and other renewable energy. This wind turbine low cost because there are used simple material in there construction. It is light and easy to carry.

1.4 Problem Statement

Sources of natural resources such as gas, coal and oil will be reduced and will be exhausted if they are not used prudently. Because of this problem, demand for electricity is experiencing a strong growth. The renewable energy source technologies such as solar energy have been introduced to solve this problem. However, one of the biggest drawbacks of solar panel electricity is that it‟s available only during the day time and that too only when the sky is clear. Furthermore, the sun light being at its peak only during midday and not throughout the day makes its harnessing very inefficient. Contrary to this a windmill generator which depends on wind power appears to be much efficient because wind is available all through the day and does not rely on seasonal changes. However a wind turbine generator may work with greatest efficiency only if it‟s installed or positioned on specific regions such as on higher altitudes, near sea or river shores.

Normally to create wind turbine such as horizontal axis wind turbine (HAWT) and vertical axis wind turbine (VAWT) is need a high cost and hard to maintenance. There are permanent and hard to change from one location to another location. HAWT need a large area to install, but VAWT are great for placement at residential location and more small scale. So, to overcome this problem, this project to develop a VAWT with a portable, an expensive, and easy to assemble wind turbine system has been introduced and discussed. This project was constructed using mostly simple tools.

The most of the project or previous study are focused on small scale wind turbine, it used to charging mobile phone and power bank. From the research also shows the average of output voltage is just around 6V-8V, and there are need high speed of wind power to achieve that level. In Malaysia the average of wind speed is around 2.10 m/s – 5.20m/s, it is lower of wind power. So in this project is the system that can generate of electricity with a lower wind speed and high output generation.