UNIVERSITI TEKNIKAL MALAYSIA MELAKA

A DEVELOPMENT OF WIND TURBINE GENERATOR USING WASTE ENERGY FOR DOMESTIC USER.

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

by

NORLIYANA BINTI KHAIRIL ANWAR
B071310856
920207-14-6018

FACULTY OF ENGINEERING TECHNOLOGY

2016

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: A development of wind turbine generator using wasted energy for domestic user.

SESI PENGAJIAN: 2016/17 Semester 1

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I hereby, declared this report entitled "A development of wind turbine generator using waste energy for domestic user" is the results of my own research except as cited in references.

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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:

……

ENCIK MOHD YUNOS BIN ALI

(Project Supervisor)

ABSTRAK

Turbin angin adalah alat penjanaan kuasa yang digerakkan oleh tenaga kinetik angin. Tenaga kinetik akan ditukar kepada tenaga mekanikal dengan memutar aci penjana dan menjana elektrik. Turbin angin adalah penjana yang mempunyai kos permulaan yang rendah berbanding dengan penjana kuasa lain. Projek ini akan memperkenalkan teori operasi penjana turbin angin yang jarang digunakan di Malaysia. Selain itu, kajian ini menjalankan eksperimen pembinaan yang mudah untuk turbin angin. Selain menjana elektrik daripada turbin angin, kertas ini membawa kemungkinan baru untuk membangunkan turbin angin menggunakan tenaga terbuang dari udara berlebihan dikeluarkan dari unit luar penghawa dingin. Untuk proses ini, 60% daripada bahan-bahan yang digunakan untuk membina turbin angin ini adalah paip PVC bermula dari menara sehingga asas dan 20% daripada bahan CPVC yang digunakan untuk pembinaan bilah. Selebihnya terdiri daripada pengunaan motor dan komponen elektronik yang digunakan untuk menstabilkan dan menapis voltan keluaran daripada penjana. Prestasi kelajuan angin berlebihan, voltan dan output semasa telah direkodkan untuk menganalisa prestasi data. Oleh itu untuk memastikan bahawa semua objektif bagi Projek Sarjana Muda dicapai, eksperimen yang dibuat mestilah dilakukan dengan betul dengan merujuk skop projek.

ABSTRACT

A wind turbine is a power generating device that is driven by the kinetic energy of the wind. The kinetic energy will converted into mechanical energy by rotating the generator shaft and generated the electricity. Wind turbine generator is a generator that has a low initial cost compared to other power generators. This project will introduce the theoretical operation of wind turbine generators which are rarely used in Malaysia. Moreover, this study presents an experiment by running a simple construction of wind turbines. Besides generating electricity from a wind turbine, this paper brings a new possibility to develop a wind turbines using wasted energy from the excess air released from outdoor unit of air-conditioner. For this process, 60% of the materials used to build this wind turbine is a PVC pipe started from tower to the foundation and 20% from the CPVC material used for blade construction. The rest consist of the used of motor and electronic components that are used to stabilize and filter the output voltage of the generator. The performance of the wind speed of excess air release, voltage and current output were recorded in order to analyze data performance. Therefore to make sure that all the objectives for the Bachelor Degree Project is achieved, the experiment and procedure must be done properly by referring the scope of the project.

DEDICATION

This project is dedicated to my father, who taught me that the best kind of knowledge to have is that which is learned for its own sake. It is also dedicated to my mother, who taught me that even the largest task can be accomplished if it is done one step at a time. Last but not least, I sincerely thanks to my project supervisor and all my friends for being my great pillars of support throughout my journey of education.

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ACKNOLEDGEMENT

I wish to acknowledge and express my gratitude and appreciation to my supervisor, Mr. Mohd Yunos Bin Ali has been the ideal project supervisor. His sage advice, insightful criticisms, and patient encouragement aided the writing of this report in innumerable ways. I would also like to thank my beloved parents, Khairil Anwar Bin Ibrahim and Suzana Binti Samion, my sister and my brother whose steadfast support of this project was greatly needed and deeply appreciated.

Last but not least, to all my friends and for those who directly or indirectly contribute in this project, thank you.

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LISTS OF SYMBOLS AND ABBREVIATIONS

DC	- Direct current
AC	- Alternating current
rpm	- Revolutions per minute
m/s	- Metre per second
HAWT	- Horizontal Axis Wind Turbine
VAWT	- Vertical Axis Wind Turbine
kW	- kilo watt
V	- volt
A	- ampere
mA	-mili ampere
mAh	- milliamp hour
PVC	- Polyvinyl chloride
CPVC	- Chlorinated polyvinyl chloride
UTeM	- Universiti Teknikal Malaysia Melaka

CHAPTER 1
INTRODUCTION

1.0 Introduction.

This chapter focus more about the background and problem statement. Then followed by objective and scope have been identified. Finally, the proposed solution for this project are briefly discussed.

1.1 Background of Project.

Energy sources are classified as non-renewable and renewable energy. Renewable energy defined as the energy collected naturally where the energy source is not reduced or can be replenished within a human lifetime. This energy gained worldwide attention as the price of raw material for non-renewable energy soaring. Furthermore, renewable energy are considered to be important in control of fuel consumption which is cannot be renew and reducing the emissions of greenhouse gases. Reduction of greenhouse gas emissions will helps to protect the Earth from pollution. Examples of renewable resources can be seen daily around the world such as wind, solar, hydropower, geothermal and biomass.

Wind is air in motion due to the irregular energy of solar radiation to the surface of the earth. Today, people taking advantage of this wind natural energy to generate electricity. Impact than the use of this energy source can help minimize fuel consumption and air pollution control. Wind has played a long and important role in the history of human civilization. This power energy has been used for pumping water,

milling grain and driving other mechanical devices start from thousand years ago. These wind flow can be harvested using wind turbines and used to make electricity. Nowadays wind farm commonly employs groups of wind turbine, located either on land, near-shore and off-shore. A wind turbine is a device that is equipped with a blade, working to convert the kinetic energy into rotational motion to turn the electrical generator and produces electricity.

Wasted energy from wind resources available a cooling tower, air ventilation system, humidification plant or any system that produces strong and consistent winds. (Chong et al., 2014). A cooling tower is a semi-enclosed device commonly used to dissipate heat from power generation units, water-cooled refrigeration, air conditioning and industrial processes. The cooling tower will cools the hot water that can reduce product output at greater energy input. Therefore, generating plants, chemical processes and refrigeration loops, which use the cooling system can save most of the money if understand well the process of cooling system. (Burger, 1996). The study on the energy-saving benefit and economic evaluation analysis shows the results indicate that cooling tower with flue gas injection is more economical than the conventional cooling tower compare to conventional cooling tower under the same condition. (Han et al. 2009). A blower also one of the cooling system used in Malaysia industrial. Blower is a machines to provide a large flow of air by rotating a blades which connected to a hub and the shaft, driven by a motor to various processes in industries.

1.2 Problem Statement

Wind energy gained attention in European countries which have high average wind speeds since it is free in terms of energy resources and free from the environmental pollution. However, the limitless of natural resources in Malaysia becomes a major problem when dealing with renewable electricity generation. Malaysia has two main seasons weather southwest monsoon in May / June to September and the northeast monsoon from November to March. Overall, the mean

daily wind speed in Malaysia is about 1.8 m / s. (Basil, 2013). Figure 1.1 will shows the mean daily speed in Malaysia. Most of wind turbine generator need high wind speed in order to generate high power output. High wind speed acquired at higher altitudes where there is less friction slowing the velocity of the wind down. Therefore, HAWTs usually have high cost for the construction and the maintenance because it must be mounted on a long towers to maximize the power efficiency. (Dang, 2009).

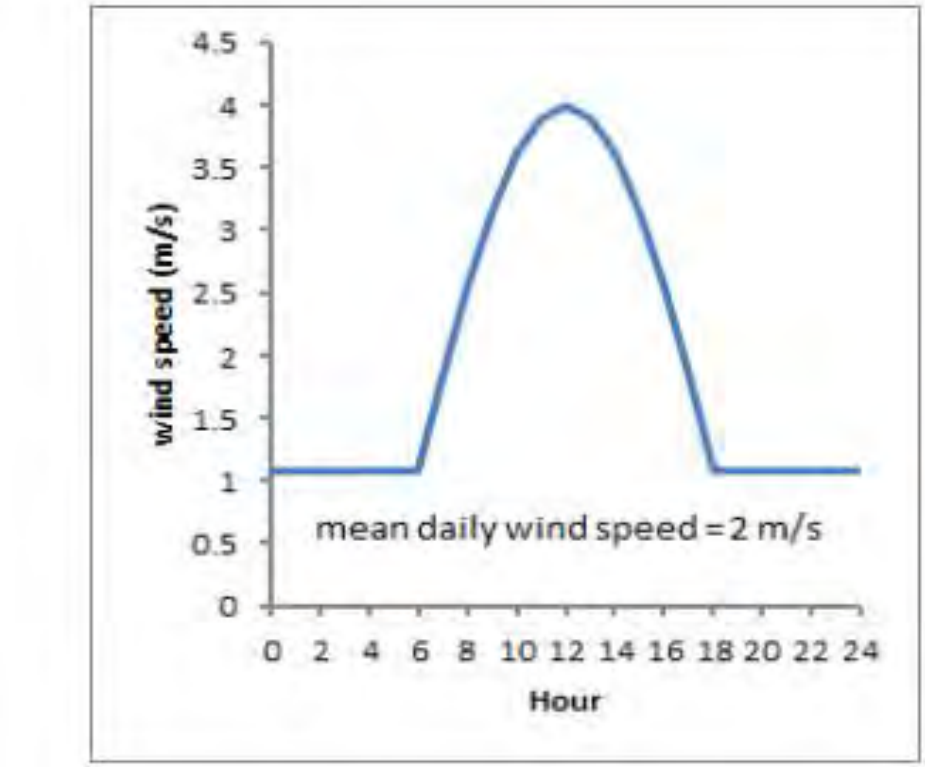

Figure 1.1 Daily wind speed in Malaysia.(Basil, 2013).

1.3 Objective

The objectives of this project are to:

i. To develop a model of wind turbine generator by reuse wasted energy from a cooling system.

ii. To produce electricity from wind speeds released by the cooling fan system.

1.4 Scope

Scope of the project is to design a wind generator by using wasted energy from excess air produced by a cooling system for domestic purposes. Afterwards, this project will used a three blade wind turbine which are a type of horizontal-axis wind turbine (HAWT) in order to convert the kinetic energy to mechanical energy. An example of three blades horizontal wind turbine illustrated in the Figure 1.2.

Figure 1.2 A horizontal with three blades wind turbines. (T. Al-Shemmeri, 2010).

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter relates to the reading material of the literature review that will discuss about the history and the different types of wind turbine. Besides that, in this chapter we also able to discuss the components used and the operation of wind turbines. The information obtained from this literature will be used to assist the implementation of the next process.

2.1 Wind Turbine

History of the emergence of a wind turbine system starting from application of driving a sailboats and sailing ships. Then the use of natural energy is growing over time, evolving from movement of ships to operating irrigation pumps to finally generating electricity for general use. Wind power get the world focus today because its fuel costs is free in comparison with the use of oil and coal for energy sources non-renewable. Constraints of this energy source, they will run out eventually and become exhausted, since it cannot be replenished in a short period of time. (Dang, 2009).

Anderson P.D. has conduct two studies about the historical and modern utilization of wind power. Wind part of renewable energy sources which do not have fuel costs. Power output from wind generators can be categorized into two parts through the use of mechanical shaft power directly (a gearing ratio) or by allowing the wind turbine power generators, and the electrical power generated as power. Current wind generator technology has revealed many modern applications such as hybrid

energy, water pumping and battery charging and heating. This non-conventional energy sources widely accepted among consumers.

Wind energy has very low external and social costs, also it is clean and safe. In Europe and America, both had been investigated about the environmental impact of wind energy. Noise emission is one of the environmental impact that has been discussed, especially in the late 1980's noise became a crucial issue. Other important issue is sun's reflection in the fiberglass blades but it has been solved in the early year. Also, to design and construct a wind turbine the important thing to be considered is it must fit into the landscape. (Anderson, 2007).

2.2 Types of Wind Turbine.

The wind turbine fall into two type namely vertical and horizontal axis wind turbines. Concept and function is the same, which distinguish the two wind turbines are in terms of efficiency, noise factor, axis rotation of rotor shafts and the cost of construction.

2.2.1 Horizontal Axis Wind Turbines (HAWT).

A HAWT has main rotor shaft which is the rotating axis of wind turbine and an electric generator placed on the tower and the rotor position must be towards to the wind. Blades of HAWT spin horizontally as shown in Figure 2.1. HAWT has a variable blade pitch to allow the turbine to adjust the blades and it receives power from the entire blade rotation. This will enhance the efficiency of wind turbines power for the season and circumstances. HAWT requires fast wind speeds to start producing sufficient power, usually this types of wind speeds are generally acquired at higher altitudes. Thus, the HAWTs have to be mounted on high towers where there is not much friction slowing the velocity of the wind down to maximize the power efficiency. A sensor are used to detect the direction of wind is blowing from to maximize HAWT

power output. The HAWT frequently used by the commercial energy to provide power to customers compare to VAWT. (Dang, 2009).

Nevertheless, a study was done provided in Northern Shaanxi, China shows two inland of Yulin and Yan'an convenient with VAWT type wind turbine. This is because of, the average wind speed is only about 4 m/s in rural areas in China. HAWT operate at wind speeds of 8 to 10 m/s and it is difficult to work when the average wind less than 3-4 m/s. HAWT will lose the power output in time to adjust to the wind direction. As a result, the output power by HAWT are lower than the use of VAWT. (Cheng et al. 2012).

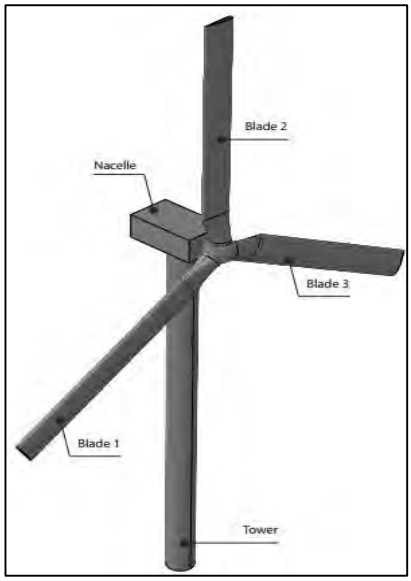

Figure 2.1 Horizontal axis wind turbine prototype design.(Ben Hassena et al., 2015).

2.2.2 Vertical Axis Wind Turbines (VAWT).

The main rotor shaft for a VAWT is stands vertical or perpendicular to the land. Figure 2.2 shows types of VAWT. Furthermore, VAWT can start generate power at lower speed and its does not have to be mounted high in the sky. The VAWT also spins quieter and do not have to change directions to catch the wind compare to the HAWT. VAWTs usually not been adopted for commercial power because it provide less power

and have less efficiency than HAWTs. (Dang, 2009). However VAWT has attracted most attention of researchers because of the good performance on the starting-torque and low starting wind speed and VAWT don't need faced towards the wind compared with the HAWT. (Cheng et al. 2012). In contrast, due to the absence of low starting torque, extra components or external electricity feed-in are needed particularly when in urban areas. This do not give good returns regarding to the investment returning. (Batista et al. 2015).

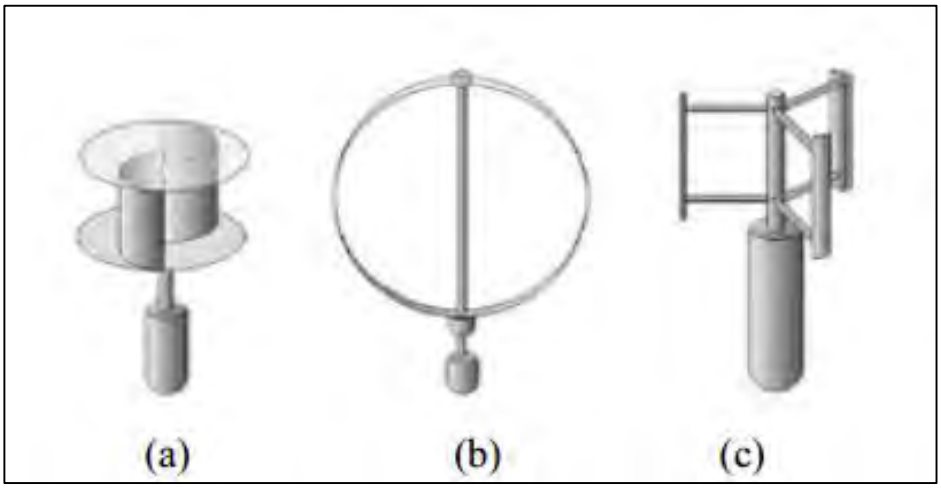

Figure 2.2 Type of VAWT turbines: (a) Savonius rotor; (b) Darrieus rotor; (c) H-Darrieus roor. (Sunyoto et al., 2013).

2.3 Components of Wind Energy Systems.

Wind generation requires several components that are important in energy production. Main components of wind turbine consists of six parts which is the rotor, the gearbox, the generator, the control and protection system, the tower and the foundation. Figure 2.3 shows the main components of wind turbines.

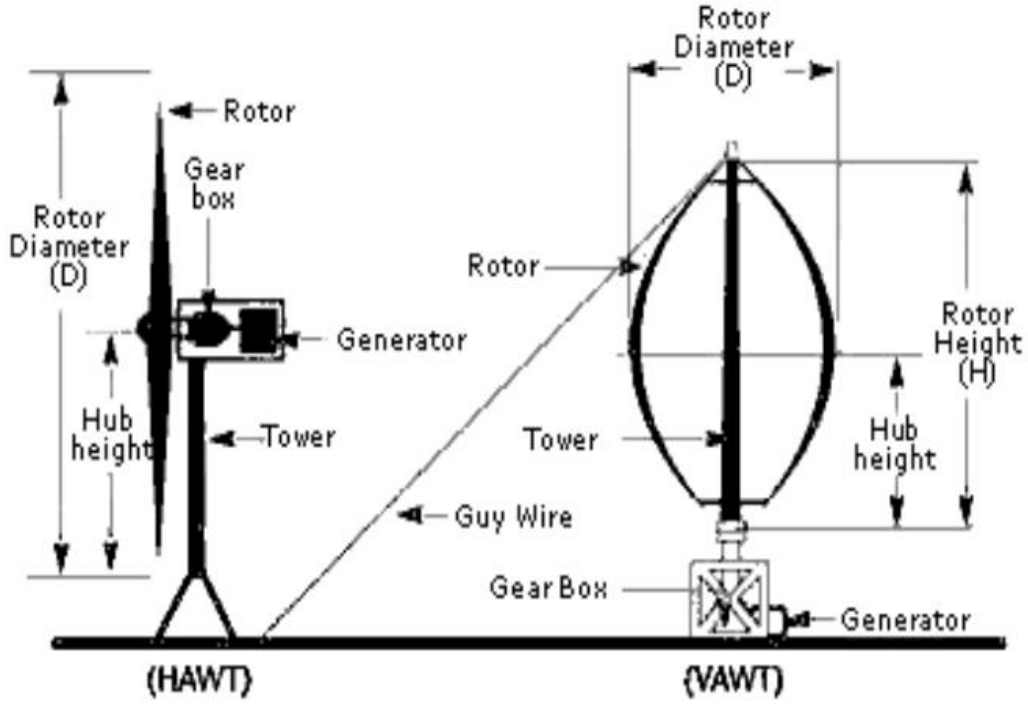

Figure 2.3 Wind turbine components. (T. Al-Shemmeri, 2010).

2.3.1 Rotor

Rotor is define as a rotating part of an electrical or mechanical device which is the heart of wind turbines. Rotor consist several of rotor blades that connected to hub. Blades catch the wind to start rotating and create rotational shaft energy. It basically converts kinetic energy into mechanical energy then converted to electrical energy by other parts in the wind turbine. Output power generated by the wind turbine can be adjusted by changing the size of the rotor diameter. Amount of the energy output against the rotor size available in Table 2.1. (Dang, 2009).