



**Faculty of Electrical and Electronic Engineering Technology**



**INVESTIGATION OF HORIZONTAL AXIS WIND TURBINE  
CHARACTERISTIC FOR ONSHORE APPLICATION**

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**Bachelor of Electrical Engineering Technology (Industrial Power) with Honours**

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**INVESTIGATION OF HORIZONTAL AXIS WIND TURBINE  
CHARACTERISTIC FOR ONSHORE APPLICATION**

**MUHAMMAD HAFIZUL ADDIN BIN LAMREK**

**A project report submitted  
in partial fulfillment of the requirements for the degree of  
Bachelor of Electronics Engineering Technology with Honours**



**Faculty of Electrical and Electronic Engineering Technology**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

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I declare that this project report entitled “Investigation of Horizontal Axis Wind Turbine Characteristics For Onshore Application” is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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## APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electrical Engineering Technology (Industrial Power) with Honours.

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Date :

.....  
.....

## DEDICATION

*Alhamdulillah Thank you Allah for allowing me to complete this FYP II Final Year assignment. I would not have been able to accomplish this feat without the help of people who were close to me. First and foremost, I want to express my gratitude to my parents, Lamrek Bin Mat and Noriah Binti Mat Sharip, as well as my family, for their unwavering support during my study during the last seven semesters. Many thanks to my supervisor, Nurbahirah Binti Norddin, for all of her assistance and advice, which enabled me to complete all of my goals today. Thank you also to all of my friends for continually coming up with new ideas and assisting me in solving problems that I encountered while working on this final year project. Throughout my final year project trip, I learned a lot of new facts and gained a lot of new expertise. It also affects my skills and character in terms of how to approach the challenge in the most innovative way possible.*



## ABSTRACT

Wind energy is a renewable energy source that is both natural and non-polluting to the environment. Due to the rising expense of fossil fuels, wind turbines are one of the few options for generating electricity without using fossil fuels and without emitting greenhouse emissions. The goal of this research is to create a wind turbine prototype that can supply enough electricity to power the load. In addition, this research develops a wind turbine rotation system that produces 5V DC output. The horizontal axis wind turbine (HAWT) design was used for this project. As a result of this research, the wind turbine can generate enough electricity to power the required load. This project entails designing and fabricating the blades of a small DIY wind turbine that generates 5V DC. Because a wind turbine generates power using clean energy, this project will demonstrate how to make use of the renewable energy available to us in order to benefit society and the environment. The material used to build this project is primarily made of a light substance that is easy to transport. As a result, in order to ensure that this project met all of its objectives, the experimental results are acquired and examined precisely utilising the scope as a guide.

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## **ABSTRAK**

*Tenaga angin adalah tenaga yang diperbaharui yang boleh digunakan kerana ia semula jadi dan tidak mencemarkan alam sekitar. Kerana kenaikan kos ekonomi bahan bakar fosil, turbin angin adalah salah satu penyelesaian yang dapat menjana tenaga tanpa menggunakan bahan bakar fosil dan mengelakkan daripada menghasilkan gas rumah hijau. Tujuan kajian ini adalah untuk membina prototaip untuk turbin angin untuk membekalkan output elektrik untuk beban yang diperlukan. Selain itu, kajian ini juga mengembangkan sistem putaran untuk turbin angin sehingga akan menghasilkan output untuk 5V DC. Reka bentuk turbin angin paksi mendatar (HAWT) dipilih dalam projek ini. Hasil kajian ini ialah turbin angin dapat menjana elektrik yang dapat membekalkan beban yang diperlukan. Projek ini melibatkan reka bentuk dan membuat bilah turbin angin buatan sendiri yang menghasilkan output DC 5V. Oleh kerana turbin angin menggunakan tenaga bersih untuk menghasilkan elektrik, projek ini akan menunjukkan bagaimana penggunaan tenaga boleh diperbaharui di sekitar kita sehingga dapat bermanfaat bagi masyarakat dan persekitaran. Bahan yang digunakan untuk membangunkan projek ini pada dasarnya adalah dari bahan ringan sehingga mudah dibawa. Oleh itu, untuk memastikan bahawa projek ini mencapai semua objektif, hasil eksperimen diperoleh dan dianalisis dengan cara yang tepat dengan menggunakan skop sebagai rujukan.*



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First and foremost, I want to express my gratitude to my parents and family for their unwavering support throughout my schooling over the last six semesters.

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## LIST OF SYMBOLS

$\delta$	-	Voltage angle
	-	
	-	
	-	
	-	
	-	
	-	
	-	



## LIST OF ABBREVIATIONS

V	-	Voltage
A	-	Ampere
	-	
	-	
	-	
	-	
	-	
	-	





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# CHAPTER 1

## INTRODUCTION

### 1.1 Background

Electricity is a type of energy that is utilized to keep electronics running. Electrical was not more than a natural element in this planet before modernity, and it was not until the late 19th century that a scientist discovered how to harness electricity energy sources. When the electrons that surround an atom's nucleus are excited, electricity is produced. Because the electron is made up of energy, whatever movement it makes causes the energy to scatter. Benjamin Franklin and William Watson are the first to document how electricity is created. Franklin's most famous experiment with electricity occurred when he was flying a kite when lightning struck the kite, resulting in the invention of the Lightning Rod. Franklin is also credited with discovering the positive and negative potentials in electricity. Michael Faraday, Alessandro Volta, Luigi Galvani, Andre-Marie Ampere, and George Simon Ohm all contributed to the study of electricity. This entire group of scientists is responsible for developing the fundamentals of electric measurement, which also marked the beginning of the modern era of electrical technology.

Nowadays, electricity is one of the most essential kinds of energy that is used all over the world to help each country flourish. In order to meet the need for electricity, each country began to mass generate it, also known as a power plant. Non-renewable and renewable energy sources are divided into two categories. Non-renewable energy has a finite supply, meaning it will run out or not be renewed after a thousand years. Fossil fuels make up the majority of renewable energy sources (coal, petroleum, and natural gas). Renewable energy

is obtained from a source that replenishes itself at a rate that is equal to or faster than the rate at which it is consumed. Renewable energy is also defined as energy collected in a natural manner, such as wind, solar, hydro, and geothermal energy.

Wind is one of the most widely used renewable energy sources nowadays. The source of wind is the sun, which heats the earth's surface unevenly, resulting in hot and cold regions. When the earth's temperature drops from a high to a low temperature, wind is produced. As a result, as the sun heats the earth, the temperature rises, the molecule number decreases, and the molecule at a low temperature goes to a lower pressure area. Wind is a renewable resource that is clean, free, and readily available. Every day, all of the world's wind turbines capture the wind's energy and transform it into electricity. A wind turbine that is occupied with the blades that is lift and rotates when hit by wind leading the rotor to spin and a generator to make the power is highly effective in other to produce electricity and at the same time to comprehend the global warming.

## 1.2 Problem Statement

Individual living standards have risen as a result of social and economic progress, and everyone today requires technology to function in their daily lives. The use of technology has gradually become more important in daily life, with practically all technologies relying on the use of energy. This is how critical electricity is for the social and economic growth to continue. However, the use of electricity, particularly in non-renewable energy sources, has resulted in global warming, and practically every country in the world is now focusing on the use of renewable energy in order to avoid the global warming that has been occurring for over a century.

A wind turbine is a renewable energy source that obtains its power from the wind. Wind turbines are environmentally friendly since they use clean energy. In comparison to the European countries, onshore wind energy investment and expansion is modest in Norway. (Dugstad, 2020)

This research focused on creating a portable horizontal wind turbine that can charge electronic devices such as cell phones, power banks, and other similar devices. This product is ideal for someone who enjoys outdoor activities and enjoys visiting natural areas where there is no access to electricity.

### **1.3 Project Objective**

The main aim of this project:

1. To develop a portable Horizontal axis wind turbine.
2. To analyze wind speed, voltage and current using measurement tools.
3. To successful charge the electronic gadget.

### **1.4 Scope of Project**

The goal of this project is to create a portable horizontal axis wind turbine that uses a DC motor to generate 5V that may be used to charge or store a battery. Three or five blades will capture the wind and cause the rotor of a DC motor to rotate in this project. Furthermore, because the blades are composed of plastic or aluminums, they cannot hurt the user, particularly a child. The following is an illustration of a five-blade horizontal axis wind turbine:



Figure 1.1 Example five blade of Horizontal axis wind turbine



## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

The literature reviews pertinent to this topic will be presented in this chapter. It contains material from prior research as well as a completed project. This chapter will go into the theory of various components such as capacitors, DC motors, and so on. This chapter also goes through the project's history and what it can do for the power industry, particularly in terms of supplying electricity from clean sources.

#### 2.2 Energy Sources

Fuad M. Noman's research, "Comprehensive Review of Wind Energy in Malaysia: Past, Present, and Future Research Trends,". Malaysia has recognized the necessity of renewable energy in addition to traditional sources of electricity generation as a result of rising global energy demand. Malaysia has implemented a number of energy policies that have helped the country become a regional leader in energy production. In 1979, the first National Energy Policy was passed, and the Renewable Energy Act was passed in 2011. One of the policy framework's goals is to precisely assess energy demands, conserve resources and the environment, and promote low-income development carbon technologies. (Fuad M. Noman, 2020)

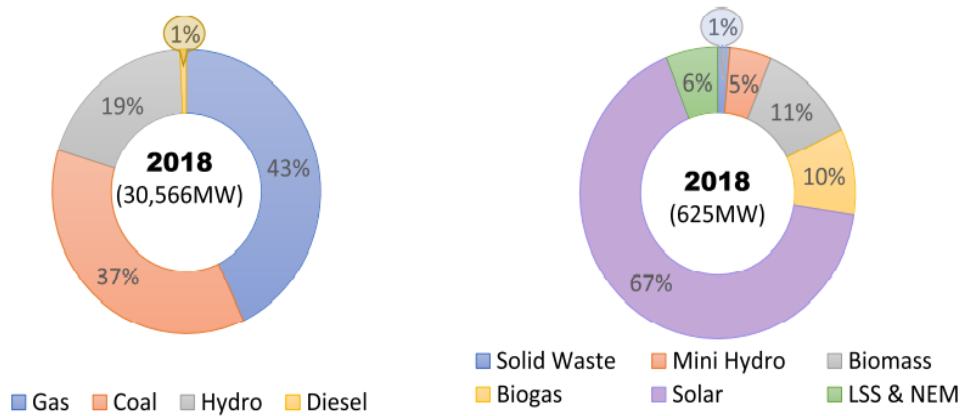


Figure 2.1: Installed energy capacity in Malaysia by plant type (end of 2018). (a) non-renewable sources. (b) renewable sources. LSS: large scale isolar, NEM: net energy metering

### 2.3 Wind Turbine

“Comprehensive Review of Wind Energy in Malaysia: Past, Present, and Future Research Trends,” by Fuad M Noman. Malaysia has developed several wind turbines farms, mostly for scientific purposes, with some of them allegedly giving electricity to isolated places. However, there have been inconsistent reports on the success or failure of these projects, raising serious worries about the new wind projects that will be erected in the future. Table 2.1 shows the well-known wind farms that have been built in Malaysia. (Fuad M. Noman, 2020)

Table 2.1: Wind Power Plant in Malaysia

Project	Year	Location	Sponsor
150 kW	1995	Terumbu Layang-Layang (Sabah)	TNB
Two × 100 kW	2007	Perhentian Island (Terengganu)	TNB UKM
3.3–25 kW	2009– 2013	Kudat, Kuching, Kuala Perlis, and Kuala Terengganu	SIRIM
3.3 kW	2014	Setiu (Terengganu)	UMT

The research “On Critical Aeroelastic Modes of a Tri-rotor Wind Turbine” by Oliver Tierdad Filsoof was published in the International Journal of Mechanical Science. Offshore or onshore wind turbines are a frequent way to transfer kinetic energy from the wind into electricity, but there are alternative options. Due to higher stability features than two-bladed rotors, a wind turbine typically consists of a single-tower with a horizontally aligned three-bladed rotor attached to the top, as shown in Figure 2.2. Vertical axis wind turbines are another wind turbine concept. Increased rotor size has been used for years to reduce costs and increase efficiency, but this has its drawbacks. Large rotor blades are difficult to fabricate and ship a shore, increasing the danger of composite failure modes. New wind turbine concepts are attempting to address these issues, with one of them being the creation of a multi-rotor wind turbine (MRWT) (Oliver Tierdad Filsoof, 2021)

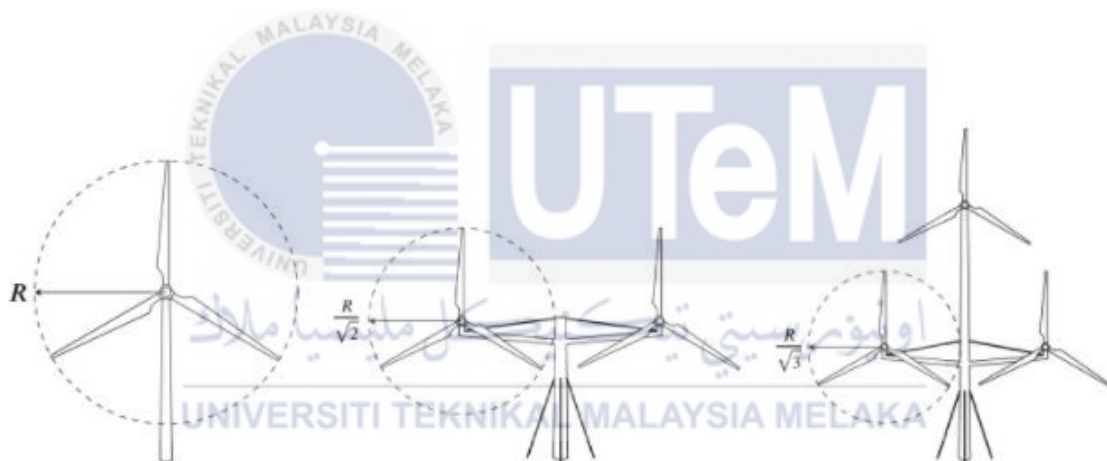


Figure 2.2: Illustration of how the rotor radius,  $R$ , on a wind turbine scales with  $R/n$  for constant power output where  $n$  is the number of rotors.

## 2.4 Type of Wind Turbine

Horizontal Axis Wind Turbines and Vertical Axis Wind Turbines are the two main types of wind turbines. Both types of wind turbines have the same goal of producing electricity by harnessing the wind, but there are differences in how the blades rotate. Identifying the axis around which the blades rotated is one way to classify a wind turbine.