UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT WIND TURBINE GENERATOR BY USING ARDUINO

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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TAJUK: **Design and Development Wind Turbine Generator by Using Arduino**

SESI PENGAJIAN: **2017/18 Semester 2**

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I hereby, declared this report entitled “Design and Development Wind Turbine Generator by Using Arduino” 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:

……

(Project Supervisor)

ABSTRAK

Bahan api fosil digunakan secara meluas untuk menjana elektrik. Sungguhpun begitu, ia akan merosakkan alam sekitar dan akan menggunakan lebih banyak kos untuk menjana elektrik. Sebagai contoh, pencemaran angin adalah disebabkan oleh bahan api fosil. Oleh itu, tenaga baru untuk menjana elektrik tanpa merosakkan alam sekitar amatlah diperlukan. Angin merupakan salah satu sumber yang sangat diperlukan kerana ia merupakan tenaga bersih dan turbin angin pula digunakan secara meluas pada masa kini. Di samping itu, tenaga angin adalah sumber tenaga boleh diperbaharui dan boleh menjadi sumber tenaga yang tidak habis. Pelaksanaan projek ini ialah mengenai reka bentuk dan pembangunan penjana turbin angin dengan menggunakan arduino. Untuk kuasa angin, turbin angin akan dibekalkan dengan jumlah bilah dan kelajuan angin bilah kipas bersama-sama dengan penjana. Sistem kawalan elektronik digunakan untuk menyimpan tenaga elektrik yang dihasilkan oleh penjana dan disimpan ke dalam bateri. Selain itu, arduino akan digunakan untuk Revolusi Per Minute diukur (rpm) untuk penjana DC. Idea utama projek ini adalah untuk membangunkan prototaip yang menggunakan tenaga angin. Di samping itu, projek ini dijalankan dengan menggunakan perbezaan bilangan bilah untuk menghasilkan voltan yang akan dipaparkan melalui paparan voltmeter digital. Hasil daripada jangkaan projek ini, diharapkan dapat menghasilkan penjanaan elektrik menggunakan penjana turbin angin dan sistem ini akan berfungsi dengan baik.

ABSTRACT

Fossil fuels are widely used to generate electricity but it will damaging to the environment and will cause more cost to generate electricity. For example, wind pollution caused by fossil fuels. Therefore, new energy to generate electricity without harming the environment is required. The wind became a source of much needed because it is clean energy and wind turbines are widely used nowadays. In addition, wind energy is a renewable energy source and can be a source of inexhaustible energy. Implementation of this project is design and development wind turbine generator by using arduino. For wind power, wind turbines will be supplied with different number of blade and wind speed of the fan blades along with a generator. The electronic control system is used to store electrical energy generated by the generator and stored into the battery. Furthermore, the arduino that will use for measured Revolution Per Minute (rpm) for the dc generator. The main idea of this project is to develop a prototype that will use wind energy. In addition, the project uses a variety of blades to generate voltage that will be on display through digital voltmeter display. The result expectation for this project can generate electricity by using wind turbine generator and this system will work as it should.

DEDICATION

Thanks and appreciation a lot to my beloved dad, supervisor, family, and friends that help me in completing this final project.

ACKNOWLEDGEMENT

Alhamdulillah, praise and blessing of Allah Al-Mighty for his blessing upon us. It is with deepest sense who given me good health of body and mind, strength, patience and ability to complete this final project. I would like to say thank you to my supervisor, Dr Sahazati Binti Md Rozali and my co-supervisor Dr Aliza Binti Che Amran because they always give me direction and encouragement into this final project.

Besides, I would like to thank to my entire classmate, BETI because they give me a lot of information that I need to added into final project. They also give me a good communication to finish this project.

My family also help me by give a moral supportive that I need when I do this final project. Without them, I am sure that I could not finished this project as soon as possible. Lastly, thanks to everyone that help me to finished my project on time that given. Thank you.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

A	-	area
AC	-	Alternating Current
Cp	-	Coefficient of Power
DC	-	Direct Current
emf	-	Electromagnetic Field
F	-	Force
HAWT	-	horizontal axis wind turbine
I	-	Current
Km/h	-	Kilometer per hour
KW	-	Kilo Watt
LCD	-	Liquid Crystal Display
M	-	meter
MW	-	Mega Watt
P	-	Power
r	-	radius
rpm	-	revolution per minute
v	-	Velocity
V	-	Voltage
VAWT	-	vertical axis wind turbine
W	-	Watt
W	-	Work
τ	-	Torque

CHAPTER 1
INTRODUCTION

1.1 Introduction

Electricity is a form of energy that will provide power to load. Power supply can be generated by using solar panel, wind turbine, generator, ocean wave, nuclear, natural gas, hydroelectric, petroleum, geothermal source and so on. Difference country used variety of method in generating power supply depending on the resource. Malaysia uses a method like hydroelectric, coal, natural gas and petroleum. However, this source has their own limitation regarding to quantity and cost. It is good if there is a cheaper and easier way to generate power. Therefore, this project will propose power supply generation by using wind turbine generator.

1.2 Problem Statement (S)

Recently, the operating cost of generating electricity is rising due to increasing of the price of a non-renewable source (coal, petroleum and natural gas). A non-renewable resource is a natural resource that cannot be re-made or regrown at a scale comparable to its consumption. The effect of non-renewable source of energy production will affect the environment and human health, for example, global warming, acid rain, cancer, asthma, neurological toxins, and smog. It is possible that someday, most of the fuels will be exhausted, and will have to switch over to alternate energy. A renewable energy such as wind turbine is one of the options in

producing a green energy. The project will focus on wind turbine because this is one of renewable energy that can be proposed to be implemented in Malaysia. There are rooms for improvement in the design of wind turbine. Thus, this project will use the renewable source to generate energy and power for daily use.

1.3 Objectives

i. To design wind turbine generator system.
ii. To analyses the effect of number of blade on the wind turbine generator.

1.4 Scope of Project

i. Wind turbine generator will be developed based on different number of blade.
ii. The speed of blade will be measured by using arduino and it will be displayed on LCD.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

This subtopic reviews about the past research that relevance with this paper. The content is taken from various part reports, journal, and articles. The purpose of this project is to use a renewable energy as a source, reducing damage of nature and produce green technology. In this chapter, it consist all of the theory and implementation of the component regarding the project to achieve the project objective. All journal or article has been taken regarding generator by using wind turbine.

2.2 Background

Wind is just air in movement. It is carried on by the uneven warming of the Earth's surface by the sun. Since the Earth's surface is made of altogether different sorts of land and water, it assimilates the sun's warmth at various rates. One case of this uneven warming can be found in the everyday wind cycle. Among the day, the air over the land warms up more rapidly than the air over water. The warm air over the land extends and rises and the heavier, cooler air surges into have its spot, making wind. During the evening, the winds are switched in light of the fact that the air cools more quickly over land than over water. Similarly, the barometrical winds that circle the earth are made in light of the fact that the land close to the Earth's equator is warmed more by the sun than the land close to the North and South Pol.

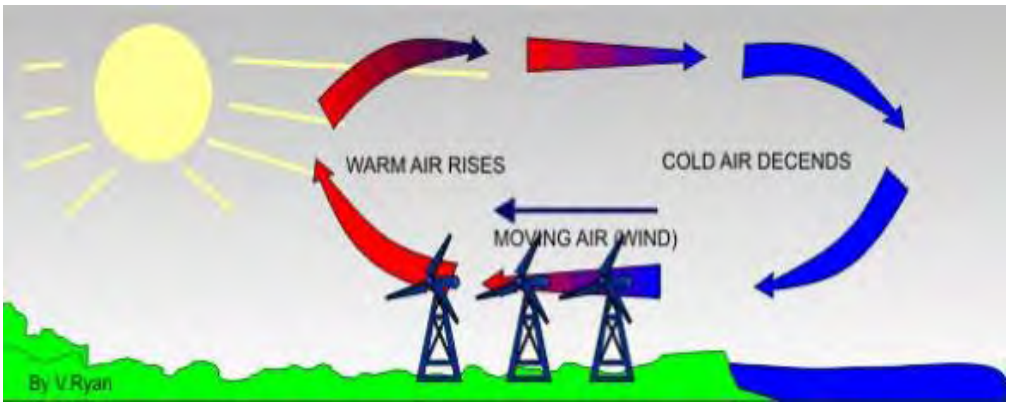

Figure 2.3: Wind Turbine Concept

2.3 Wind Turbine

The wind turbine is one of created object that been used to generate electricity. These object actually as a machine that will convert kinetic energy into mechanical energy. In order to operate these objects from mechanical energy to electrical energy, it will use wind turbine and wind generator to produce electricity. The wind turbine is one source of energy that can be gained easily in many places like the farm, village, clinic, school, single household, and others because it is a renewable energy. The uses of the wind turbine are one of the alternatives to help human life in gaining safe, friendly, renewal, and useful energy because of it is one of the solutions that can support human life wisely. The small wind turbine will produce less than 10kW by using permanent magnet generator but then, it has a big potential whereby it is flexible enough for general application and possible to mount almost everywhere. This is because; wind turbines on the market are often large, mounted on high towers and need plenty of space around them for safety and efficiency. Therefore, it is ways to specify flexible wind turbine which needs a small space, cheap, low risk to install and high efficiency. On the other hand, a wind turbine can be classified into two types which are horizontal axis and vertical axis.

2.3.1 Type of Wind Turbine

2.3.1.1 Horizontal axis wind turbine (HAWT)

Ricardo and Bruna (2016) argue that an aerodynamic optimization of horizontal-axis wind turbines, including drag effects, is based on Blade Element-Momentum theory. Which demonstrate that horizontal-axis wind turbines can never reach Betz limit, even in the absence of drag effects. In order to reach limit performance, all blade sections have to operate under highest lift-to-drag ration condition which confirmed by formulating the optimization problem as a nonlinear programming problem with equality and inequality constraints. This condition has been selected in the literature, but without a mathematical proof that is certainly true. The best distribution of axial and tangential induction factors are determined to select a difference approach from those found in the literature (Hasan & Muhammad, 2014). Usage of HAWT itself has various pros and cons for its user.

The pros are high efficiency, when the rotation of the blade moves concurrently to the wind so that it will receive the power through the spinning. Other than that, the tall tower will easily allow access for numerous winds to spin the blade. The variable number of blade pitch will give the turbine blade optimal angle of affect.

The cons are difficult to transport the tall tower and blade. In addition, to install tall HAWT is difficult because it will need very tall and expensive cranes and also skilled manpower. Furthermore, HAWT required an additional yaw control mechanism to turn the blades towards the wind. To support the gearbox, heavy blades and generator for the wind turbine are required in massive tour construction (Ingram, 2011).

2.3.1.2 Vertical axis wind turbine (VAWT)

According to Elfridus, Muhamad, and Nurhayati (2015), the vertical axis wind turbine is one type of wind turbine. It can capture the wind from any direction because of it has rotor shaft that is set vertically. Plus, the generator and transmission can be set at the ground level without need any stand to support it.

The advantage for a vertical turbine is it can place nearer the ground so that the blade will easily maintain by manpower. Next, it has lower wind startup speeds than HAWT and also has a lower noise signature.

The disadvantage is generally it produces energy only 50% of the efficiency of HAWT in large part and while VAWT's parts are located on the ground, they are also located under a weight of the structure above it (Hasan and Muhammad, 2014).

2.4 Type of Generator

2.4.1 Alternating current (AC) Generator

Electric rotating machine is family part of electrical generator (also called alternator). The direct current (dc) motor or generator, the induction motor or generator, and a number of derivatives of all these three are the other members of the family. The ordinary thing about all members of this family is that the basic physical process involved in their operation is the conversion of electromagnetic energy to mechanical energy, and vice versa.

2.4.1.1 Magnetism and Electromagnetism

Wiley and Sons (2004) asserted that certain resources found in nature exhibit a tendency to attract or abolish each other. These

resources, called magnets, are also called ferromagnetic because they include the element iron as one of their constituting elements. Magnets always have two poles: one called north; the other called south. Two north poles always push each other, as do two south poles. Still, north and south poles always attract each other. A magnetic field also known as a physical field established between two poles. The forces of attraction or repulsion existing between the two magnets determined through their intensity and direction. Thus, magnets can be found in all sorts of shapes and chemical components. In addition, typically magnets that been used in industry are unnaturally made. Magnets that endure their magnetism for long periods of time are denominated “permanent magnets”. A number of types of electric rotating machines, including synchronous machines these are broadly used. But then, due to mechanical, as well as operational reasons, limited to those with ratings much lower than large turbine-driven generators are permanent magnets in synchronous machines.

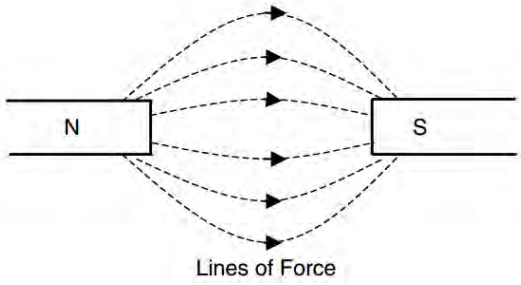

Figure 2.4.1.1a: Two magnetic poles of opposite polarity, and the magnetic field between them shown as “lines of force.”