



DEVELOPMENT OF ENERGY REGENERATIVE SYSTEM FROM AIR CONDITIONER WASTE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia
Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering
(Robotics & Automation) with Honours

By

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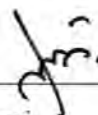
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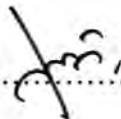
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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotic & Automation) with Honours.

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ABSTRAK

Pada masa kini, penggunaan tenaga di peringkat global meningkat dengan pesat terutamanya di negara-negara yang sedang pesat membangun. Ini adalah kerana kadar peningkatan penduduk dan pertumbuhan ekonomi yang membawa kepada permintaan sumber tenaga yang tinggi dan boleh membuat ia dalam keadaan kritikal. Oleh itu, ia perlu dipelihara dengan cara yang baik supaya sumber-sumber tenaga yang tidak boleh diperbaharui tidak akan habis pada masa hadapan. Idea untuk menggunakan teknologi tenaga boleh diperbaharui semakin meningkat untuk beberapa tahun kebelakangan ini bagi memenuhi keperluan permintaan tenaga. Tenaga boleh diperbaharui mempunyai potensi yang sangat menarik, dan sumber yang sangat berguna dalam pengurangan kos-kos semulajadi yang disambungkan kepada sistem bekalan tenaga untuk menjadikan ia sebagai sumber pilihan tenaga, yang akan digunakan di masa hadapan. Oleh itu, tujuan projek ini adalah untuk membangunkan sistem penjanaan semula tenaga daripada sisa angin penghawa dingin. Ini boleh mengurangkan udara yang sia-sia telah dilepaskan secara bebas kepada persekitaran tanpa tindakan lanjut. Mekanisme turbin angin telah digunakan sepanjang projek ini. Oleh itu objektif projek ini adalah untuk mereka bentuk dan membangunkan prototaip Waste Kinetic Recovery Sistem Tenaga (WKERS) untuk menjana elektrik daripada penghawa dingin pemeluwap dan juga menganalisis prestasi prototaip Waste Kinetic Sistem Pemulihan Tenaga (WKERS) dengan ujian eksperimen. Terdapat tiga jenis bilah yang digunakan iaitu NREL, Swept dan Elliptical. Ujian setiap bilah direkodkan di dalam table dan juga graph. Untuk konklusinya, purata voltage yang dikeluarkan dan pusingan turbin (rpm) disebabkan jarak antara mekanisme turbin dengan permukaan penghawa dingin.

ABSTRACT

Nowadays, the global energy consumption is increased rapidly especially in the developing countries. This is due to the high of the population and economic growth that lead to higher demands of the energy that only can make it in a critical situation. Thus, it has to be conserved in good ways so that these non-renewable energy sources would not be depleted in the future. The idea of using the renewable energy technology is steadily increased for the past few years in order to meet the requirement of the energy demands. The renewable energy has a very impressive potential of resources that is very useful in cost reduction of natural costs that connected to the customary energy supply system to make it as the option energy source, later on, to be used. Thus, the aim of this project is to develop the energy regenerative system from air conditioner waste. This can decrease the wasted air that been discharged freely to environment without further action. The wind turbine mechanism is been applied throughout this project. Hence the objective of this project is to design and develop a prototype of Waste Kinetic Energy Recovery System (WKERS) for generating the electricity from air conditioner condenser and also analyze the performance of the Waste Kinetic Energy Recovery System (WKERS) prototype with the experimental test. There are three types of blade that been used such as NREL, Swept and Elliptical. Then, the result of the performance for each blades is tabulated in the table and graph. As a conclusion, the average voltage output and turbine rotation (rpm) are affected by the distance of the wind turbine from the condenser.

DEDICATION

For my beloved, cherished and happy parents and family, supervisor, lecturers, and companions that dependably have faith in me to finish this project and report.

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LIST OF ABBREVIATIONS

WKERS	-	Waste Kinetic Energy Recovery System
CFL	-	Compact Fluorescent Lamp
3D	-	Three Dimensional
NREL	-	National Renewable Energy Laboratory
BOM	-	Bill of Material
MMGS	-	Millimeter, Gram and Second
ABS	-	Acrylonitrile Butadiene Styrene
PMDC	-	Permanent magnet direct current
PC	-	Personal Computer
CO ₂	-	Carbon Dioxide
VAWT	-	Vertical Axis Wind Turbine
HAWT	-	Horizontal Axis Wind Turbine

LIST OF SYMBOLS

%	-	Percentage
kW	-	Kilo Watt
AC	-	Alternating Current
DC	-	Direct Current
HP	-	Horse Power
V	-	Voltage
F	-	Farad
Cp	-	Coefficient of force
ρ	-	Density of air
A	-	Area
V	-	Velocity
λ	-	Tip speed ratio
R	-	Radius
MW	-	Megawatt

CHAPTER 1

INTRODUCTION

In this Chapter 1, it consists of background, motivation, related problem statements, objectives and the scopes of the study. Hence, for the background of the study, there will be focused on the usage of energy consumption neither non-renewable nor renewable energy sources. While for the problem statements, there will be focused on the wasted air that been discharged freely without any action from the air conditioner condenser system to the atmosphere. Next, the objectives of this study are to design and develop a prototype of waste kinetic energy recovery system (WKERS) for generating the electricity from air conditioner condenser and analyze the performance of (WKERS) prototype. Lastly, for the scopes or limitation, will enlarge on the project scope and the limitation of the study.

1.1 Background

A process of regenerate or recover the waste air into wind energy is known as Waste Kinematic Energy Recovery System (WKERS). Therefore, the wind turbine is needed as a mechanism to regenerate or recover the discharged air to the environment. Nowadays, the global energy consumption is increased rapidly especially in the developing countries. This is due to the high of the population and economic growth that lead to higher demands of the

energy that only can make it in a critical situation. Thus, it has to be conserved in good ways so that these non-renewable energy sources would not be depleted in the future. The idea of using the renewable energy technology is steadily increased for the past few years in order to meet the requirement of the energy demands.

The renewable energy has a very impressive potential of resources that is very useful in cost reduction of natural costs that connected to the customary energy supply system to make it as the option energy source, later on, to be used. The usage of this energy sources is better in performance and economic aspect. Furthermore, it is not limited but is highly depend on the geographical conditions. The places that the most energy is needed are in the urban areas such as in industrial and residential sectors. This is because of the electricity usage of that equipment such as a lamp, fans, air conditioner, freezer and etc, is very high. However, in this project, in order to generate the electricity from the alternatives wind resources, is by using the wind turbine systems. Hence, the main idea of this project is to design and develop a prototype of waste kinetic energy recovery system (WKERS) wind turbines by installing at the condenser of the air conditioner system. This function is to create power from the wasted air that been released to the atmosphere. Besides that, the turbines are encompassed by fenced in areas to enhance the performance as well as the wind stream of the ventilation system. The electricity that been generated from this system can be utilized to power up the power consumption of the small appliances such as LED lamps

1.2 Motivation of the Study

In this modern era, the higher usage of the non-renewable energies such as fossil fuels, natural gas and others lead the energy to decrease rapidly due to the high demand of population especially in the city and industrial areas. Thus to avoid the energies continue to decrease dramatically, the alternative method is by using the renewable energy such as solar, the wind, bio and also geothermal energy. This research has been done by many researchers before, in order to find another source which can be used as the energy to produce electricity. Therefore,

one of the sources that could be considered is the wasted discharged air from the condenser of air conditioning system. Previously, this wasted air is only being discharged to the atmosphere without further process intake. Hence, just like using the concept of the wind energy, the waste air can be valued in the form of energy, and can be reused as energy to generate and producing the electricity. Rather than being removed as waste to the atmosphere, reused this energy to form the wind energy is another method to produce energy. This alternatives method is able to reduce the electricity usage of the household and also save the budget of the electricity. Besides that, what more that motivate to the study is the application that uses the wind energy or kinetic energy as their source.

According to historical, many people that used and apply the concept of the wind turbine to refrigerate new fish for conveyance to adjacent markets. In addition, the wind turbine has also been used for pumping of water. The applications for small wind turbines are constrained just by the creative thinking and ability of the person. Moreover, what is attracted and motivated in doing the study is using the SolidWorks software to design the prototype.

Then, there also have the mechanical and electrical part that need to be done in this project in order to obtain the desired performance of the prototype. The mechanical part is that needs to fabricate the prototype by using the 3D printer. Hence, got to gain knowledge on how to used and conduct the printer is such a good experience. Meanwhile, for the electrical part that needs to build the simple electric circuit in order to connect the prototype. Lastly, the motivation of the study is to develop the application that used the energy from the wasted air from the air conditioner system This application can save nature and reduced from unnecessary gas that been released without further action mostly in the industrial sector and city areas.

1.3 Problem Statement

The aim of this project is the development of the energy regenerative system from air conditioner waste to become electrical energy. The idea of recovering the wasted air from the air conditioner condenser has been completed by many researchers. However, various issues are confronted during the research. Hence, for examples, due to many building that used the air conditioning system, the wasted air has been discharged from the condenser system of the air conditioner. The wasted air is been discharged freely to the atmosphere without further action be taken. As what can be seen, the wasted air which is known as kinetic energy or wind energy can be regenerate or reuse back in the form of electrical energy.

In addition, the usage of the air conditioning system can increase the monthly electricity expenses for the household unit. This can be seen, when a house that used air conditioning system regularly or keeps using in a prolonged period of time, the power consumption that needs to operate in the electrical devices may lead to high energy usage that drags the reading of electric tariff. Thus, the monthly expenses of the household will be increased. Hence, this situation should be improved in order to reduce the electricity expenses.

Next, the vibration may occurred on the wind turbine when it was working. The occurrence of this vibration was because of the structure of the wind turbine was insufficient to withstand the wind energy from the fan and this prompt to the harm of the machine. Also, the removal of tidy for the fan must be done after each experimental test. The tidy of dust was gathered on the blades once it was working and this influenced the performance of the fan and analyzed the result.

However, the distance between the wind turbine and the surface of the condenser may affected the performance of the blade to be rotate and experiments result. And, the performance of the wind turbine was affected when the center of the fan did not parallel to the origin of the wind turbine. Thus, another method needs to be taken in order to solve the problems, by choosing a good material for the prototype, and used the design of the blades from the previous research. Therefore, this project is designed to regenerate the wasted energy from air conditioner by convert the wind energy to electrical energy.

1.4 Objectives

The objective of the project are as follows:

- I. To design and develop a prototype of Waste Kinetic Energy Recovery System (WKERS) for generating the electricity from air conditioner condenser.
- II. To analyze the performance of the Waste Kinetic Energy Recovery System (WKERS) prototype

1.5 Scope of the study

The scope and limitation of this project are:

- I. SOLIDWORKS software is used to sketch and draw the design of the blades.
- II. The design of the blade is based on previous researched on the performance analysis of different blade design for waste kinematic energy recovery system (WKERS)
- III. The blades is fabricated by using 3D printer machine
- IV. Developed a prototype to model the regenerative energy harvesting and measured for performance of the blade from the wasted wind energy exhausted from the air condenser

1.6 Summary of the chapter

The introduction of this project is discussed in Chapter 1. Then followed by a background of the project, motivation of the study, problem statements related to the study, objectives, and scopes of the study.

For Chapter 2, the Literature Review part will concentrate on the historical of a wind turbine, and the renewable energy harvesting. This part will also concentrate on the type of a wind turbine, the application that uses the wind turbine as the source of energy, the blade type with the previous achievement and lastly the advantaged of using the wind turbine.

Next, in Chapter 3, Methodology part will list out the ways of completing this project. Gantt chart of the project planning will be provided. Project flow will also be shown in the form of flow chart involves for every part that needs to completing this project. Besides that, the experimental test been expressed clearly in the term of a flowchart with the assistance of the diagram and all the significance figures, for the setup and procedure of test appropriately are been stated.

Chapter 4 will focus on the design and development of performance of the waste kinetic energy recovery system (WKERS) from air conditioner condenser based on blades design basically in finding the wind speed, the voltage output from the wind turbine and the effect of distance on the performance of wind turbine and so on.

Lastly, in Chapter 5, the data and result is been tabulated and describe in detailed from an experimental test based on the performance analysis and several criteria. Last but not least, future work of this study can be made such as adding whale inspired on these blade designs in order to perform better.