INNOVATIVE LIGHTING SYSTEM DESIGN WITH MAGNETIC LEVITATION PRINCIPLE

WONG KIAN LOON

B050910054

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2013

B050910054 BACHELOR OF MANUFACTURING ENGINEERING (ROBOTICS AND AUTOMATION) (HONS.) 2013 UTeM

UNVERSITY TEKNIKAL MALAYSIA MELAKA

INNOVATIVE LIGHTING SYSTEM DESIGN WITH MAGNETIC LEVITATION PRINCIPLE

This report submitted in accordance with requirement of the University Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotics and Automation) (Hons.)

by

WONG KIAN LOON

B050910054

891123085887

FACULTY OF MANUFACTURING ENGINEERING

2013

DECLARATION

I hereby, declared this report entitled “Innovative Lighting System Design with Magnetic Levitation Principle” is the results of my own research except as cited in references.

Signature	:	…….....
Author’s Name	:	WONG KIAN LOON
Date	:	…….

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Cachelor of Manufacturing Engieering (Robotics and Automation) (Hons.). The member of the supervisory committee is as follow:

…….

(Mohd Najib bin Ali Mokhtar)

Abstrak

Isu-isu peningkatan kos tenaga dan masalah rumah hijau kian di bincangkan telah meningkat penumpuan penciptaan teknologi hijau oleh kebanyakan saintis dan jurutera pada masa kini. Tenaga angin merupakan salah satu sumber tenaga yang boleh diperbaharui dan kurang menyebabkan pencemaran alam sekitar. Ia telah banyak digunakan oleh pelbagai Negara terutamanya Negara berdingin tinggi. Report ini merupakan pembelajaran berkait dengan inovasi system lampu dengan aplikasi daya apungan magnet. Generasi tenaga kuasa oleh VAWT merupakan titik berat dalam projek ini. Oleh itu, penciptaan sistem lampu dengan menggunakan kuasa elektrik daripada sumber angin telah dihasilkan. VAWT telah dipilih dalam projek ini dengan sebab-seba tertentu, terutamanya sebab kebolehan ia mampu berputar walaupun angin dating daripada pelbagai arah. Malah, masalah untuk memulakan pemutaran VAWT adalah to tork pemutarannya. Daya apungan yang disebabkan oleh magnet merupakan salah satu cara yang digunakan untuk menyelesaikan masalah tersebut. Medan magnet yang mampu menhasilkan arus elektrik dengan menlalui penggulungan dawai. Kaedah ini telah dibuktikan oleh saintis Michael Faraday. Jumlah voltan telah dihasilkan oleh dijanakan oleh sistem tersebut. Kecekapan projek disasarkan untuk meningkat walaupun pada keadaan angin yang rendah.

ABSTRACT

In the midst of energy escalating costs and the risk of global warming, benefit of green technology is being focused by most of the scientist and engineer. Wind energy becomes a reliable energy source in most of the country. Wind energy categorizes as renewable energy which is an environment free. The focus of this project was designing a lighting system with magnetic levitation principle. Power generation was the main point of the project as an innovative lighting system should able to produce power for lighting system operates. VAWT was chosen as turbine to receive wind sources with appropriate reason on especially its ability to receive wind sources from different directions. However, VAWT has a problem with its starting torque, thus it was solved by application of magnetic levitation principle. The magnetic repulsive force used as a levitation force to reduce the VAWT weight. Coil wounded around a core that induced voltage was created magnetic field. It was proven by Michael Faraday on his contribution. An amount of voltage was able to generate by the system. Higher efficiencies in term of voltage generated and rotation speed able to achieve under lower wind speed conditions targeted at the better improvement of the system.

ACKNOWLEDGEMENT

First of all, I would like to take the golden opportunity to thanks my supervisor Mr. Mohd Najib bin Ali Mokhtar for his guidance, advice and inspiration. The knowledge and encouragement given has lend me a big hand in completing the project.

Secondly, I would like to appreciate the moral support given by my beloved family. They might not understand the project and knowledge behind, but they are willing encourage me and support me. Problem may occurred everyday and solutions are needed. My father and mother whom showing me the right path to success based on their experience. It is very useful advice when I am facing problem. Thank you.

Thirdly, I would like to grateful to others lecturers and friend that I am unable to mentioned all. There advicing me, giving me idea and support me during my project. Sometime I might lost my word, but it was unintentionally.

Lastly, apologize to all that I have cause inconvenience and discomfort.

Thank you.

DEDICATION

For my beloved family

For my dearest lecturers

For those who support me and bring me laughter

Sincerely and genuinely from

Kian Loon, Wong

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS & NOMENCLATURE

VAWT	-	Vertical Axis Wind Turbine
HAWT	-	Horizontal Axis Wind Turbine
PMB	-	Permanent Magnet Bearing
CFL	-	Compact Fluorescents Lamp
HID	-	High Intensity Discharge
PSM	-	Project Sarjana Muda
CO_2	-	Carbon dioxide
Nd	-	Neodynium
DXF	-	Drawing Exchange Format
N_1	-	Number of turns
n	-	Number of layers
$ø_c$	-	Diamet of winding
$ø_T$	-	Total diameter of coil
DC	-	Direct Current
AC	-	Alternatif Current
d	-	Diameter of blade
e	-	Gap between two blade
e'	-	Shaft diameter
r_{pi}	-	Internal recovery ratio
A_T	-	Swept Area
H_T	-	Blade height
D	-	Total diameter of wind turbine
AR	-	Aspect ratio
P_{max}	-	Maximum power generated
RPM	-	Rotation per minutes
$ø$	-	Magnetic flux

B	-	Magnetic field
A	-	Surface area of magnet
dt	-	Time of change
v	-	rotor rotation speed
r	-	coil radius
V	-	Voltage
N	-	Number of turns

CHAPTER 1

INTRODUCTION

Lighting system occurred in every corner of the world where human living. It is a must in human daily life. Earth completes one revolution of rotation in 24 hours and creates day and night hours. During night hours, lighting system plays a very important role in lighting up every corner to let human activity to continue. Therefore, lightning system consumes a certain amount of electricity used in every sector. A data set measured by Lester R. Brown on lighting energy consumption in the world on year 2005, the results show there were 19% energy deplete in the lighting system of total electricity consumption of 17,982TWh (Lester Brown, 2005). Lighting system has become a primary power consuming of human. However, it lighting system has caused global warming to the earth. It main issues of global warming are not about the lighting system, it is caused by the power generator which keep a generating power supply human needs. Therefore, the ever-changing technology is now trending to an environment free, recyclable and green technology. There are different designs to current light bulbs which can reduce power consumption occurred in the market.

Figure 1.1: Example power saving light bulbs

(Sources: < http://www.abbarquitectura.com/the-light-on-energy-saving-light-bulbs/> 20/11/2012)

In order to reduce pollution to environments, natural sources like solar power and wind power are considered for power generation. Both are renewable energy which is available in the earth and free of charge viewed at <http://www.planetarysystems.com/designRenew.php>. Focused on the wind turbine power generator, typical wind turbine set up at high air flowing location either onshore or offshore. High air flow will cause the designed turbine to rotate and generate power. Continuous improvement of wind turbine has created various designs which can generate power although around is a low wind environment. A low wind environment is in low air flowing conditions. Turbine is hard to be drive by low air flowing conditions. China is one of the countries which stay under low wind environment (Huachun Wu, 2010). Desire of China to produce wind turbine under low wind conditions was developed with present of magnetic levitation concept. Magnetic levitation reduced the friction typically faced by a wind turbine which requires higher driving torque to rotate the turbine. Principle of magnetic levitation applied in the project on designing a lighting system which power generation comes from vertical axis wind turbine. In other word, this project is focused on designing a vertical axis wind turbine (VAWT) combined with magnetic levitation to generate power for a light bulb. The concept is to reduce power usage of a resident in lighting system from a country power generation station by generating own energy.

Figure 1.2: Vertical Axis Wind Turbine (VAWT)

(Sources: http://www.turbosquid.com/FullPreview/Index.cfm/ID/543054 20/11/2012)

1.1 Problem Statements

In every house or in every building, electricity consumed for lighting system would be about 20 to 50% of the total electricity consumed in everyday. Consequently, the electricity cost of lighting system would hold about 20 to 50% of electricity monthly bills. Researcher make predictions on electrical consumption on lighting system from the year 2006 to 2020, the result shows the demand for electricity for lighting system will continuously increase (Lester R.Brown *et al*, 2005). Results proved that more and more energy power must provide to the world in order to fulfil the demand of electricity. Nuclear power plant, hydro power generation and oil and gas power generation plant which brought to environment pollution and ecological unbalance continuous appeared in every corner of the world. It is because the mentioned power plant is the only able to provide huge energy power to our human being.

However, there are many renewable energy power generator is continued developed by many engineer. In this project, a smaller scale power generator is designing for lighting system. Proposed for energy power generator sources is

VAWT. Various designs available in market, the problems here is how to make sure the designed VAWT able to rotate as the direction of air flow in a city was not constant. Furthermore, permanent magnetic power generator must include with magnetic levitation for the rotor.

1.2 Objective

In the line with problem statements, objectives of the project are drawing up. First of all, the intention of the project is to design a lighting system with principle of magnetic levitation. It is a lighting system which electricity is provided by a self power generation system. Magnetic levitation is combining with VAWT which mechanically operate by air flow. Thus, the project is aiming to study, analyze and interface VAWT with magnetic levitation. There are different VAWT design created by many Engineer, this project is mainly focusing on Savonius VAWT. The next objective is to study and design a suitable VAWT which able to rotate in irregular air flowing environment.

1.3 Scopes

There are many different researches and developers have designed VAWT with the application of magnetic levitation principle. However, most of the VAWT were designed for large power generation applications. It is used as one of the main power supply for a city or town in a country. Throughout the available results, this project is focusing on the following scopes: -

- Review existing structure of VAWT and design accordingly with smaller scale for lighting system.
- To study principle of magnetic levitation and apply into VAWT power generator.
- To study and apply principle of magnetic power generation.

- To design a VAWT which able to rotate although air flowed from different horizontal direction.
- To analyze Savonius vertical axis wind turbine and applied in project design.

CHAPTER 2

LITERATURE REVIEW

2.0 Light

Light is a simplification of visible light which is a type of electromagnetic radiation. It is visible to the human eye. Electromagnetic radiation is terminology used to describe kinds of energy released by Sun. Electromagnetic radiation includes radio waves, TV waves, radar waves heat, light, ultraviolet light, X-rays, short waves, microwaves and gamma rays. Every electromagnetic radiation is classified according to intensity or frequency. Light researched to having a wavelength of between 380nm to 750nm (Pavel Borodulin *at al*, 2002).

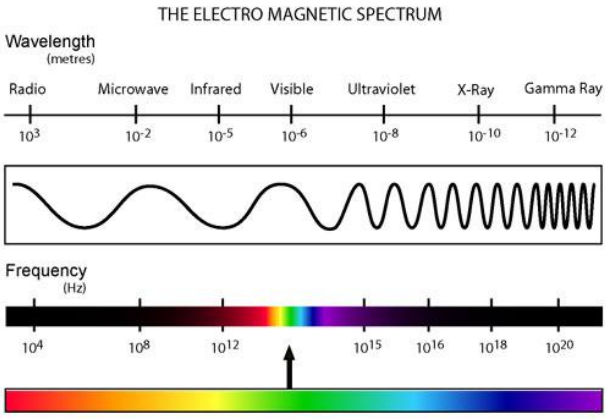

Figure 2.1: Electromagnetic Radiation wavelength

(Source: http://hypertextbook.com/facts/2002/PavelBorodulin.shtml 30/092012)

There are many types of light sources. The common light sources experiences everyday would be thermal light sources which are emission of light from a red-hot object. An example of thermal light sources would be the Sun light (Mark Csele, 2004). Due to the concept of thermal light source of the sunlight, our great scientist *Thomas Alva Edison* invented light bulb which allows electric current flow through thin tungsten until its glowing light. Light bulb invention illuminates every corner of the world during the night hour.

2.1 Lighting System

Lighting is major electric consuming in human daily life. Lighting is kind of illumination using light to achieve an aesthetic effect. In daily using, lighting used to light up the interior of a building. Due to energy saving purpose, there are different types of lighting are invented. The most common types of lighting found in everyday purpose are fluorescent lighting. Other types of lighting include incandescent, tungsten halogen, compact fluorescent lamps, tubular fluorescent fixtures, and high intensity discharge. Both of the lighting is classified according to in power consumption and levels of usage.

2.1.1 Incandescent

Incandescent light bulb is kind of electric light which produce light with filament wire heated to a high temperature by electric current until its' glowing. Manufacturer produced different voltage ratings of incandescent light bulb from 1.5V to 300V. Typically, incandescent light bulb consumed 15 percent of energy as lighting. The rest of the power is emitted as heat. Light bulb efficiency is measured according to the number of lumens' which measurement of light output over wattage of light bulb. As a result, the efficacy is used as represent the efficiency of a light bulb. On the other hand, incandescent light bulb produces 10 to 17 lumens per watt (Jay Leone *et al*, 2012). Besides, it has relatively short lives about 1000 to 200 hours for uses.